San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101

Draft Environmental Impact Report – April 2019

PREPARED FOR:
San Francisquito Creek Joint Powers Authority
615 B Menlo Avenue, Menlo Park, CA 94025
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SAN FRANCISQUITO CREEK
JOINT POWERS AUTHORITY
SFCJPA.ORG

April 22, 2019

Dear Members of the Public and Interested Agencies:

Welcome to the Draft Environmental Impact Report of the proposed San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101.

The San Francisquito Creek Joint Powers Authority (SFCJPA) and our partners – the cities of Palo Alto, East Palo Alto, Menlo Park, and the Santa Clara Valley Water District and San Mateo County Flood Control District – are excited to move forward with this effort, made possible by our recent completion of a flood protection, ecosystem restoration, and recreation project from San Francisco Bay to Highway 101.

This Draft EIR was developed with substantial public input in 2017, gathered through four community meetings, two stakeholder workshops, and a public tour of potential project sites. This document, like the proposed project and the challenges it seeks to address, is large and complex. We encourage you to begin your review with the first two chapters, which describe the SFCJPA's regional vision of connected major capital projects, how the project proposed here fits into that broad plan, what this project entails and a summary of its potential impacts, and why we prefer it over the other 16 alternatives we examined.

Like many large water-related projects around the country, this project has involved a long-term partnership with the U.S. Army Corps of Engineers. We look forward to continuing this collaboration for as long as it enhances our ability to quickly complete a project preferred by our communities.

To solicit your comments on this Draft EIR, the SFCJPA will hold a public hearing in each city, as listed on the following page. Additionally, written comments can be submitted by June 19, 2019, to the address below or via email to: comments@sfcjpa.org. Then, based on your comments, we will improve the document and the SFCJPA Board of Directors will consider a Final EIR.

Our communities are weary of the threat of flooding each winter, and are concerned that this risk is growing due to climate change. Thus, our primary goal in this effort is to provide a meaningful level of flood protection that can be achieved in the near term and enables additional protection later. In the context of many constraints, we believe our proposed project represents the best way to accomplish that goal and provide other benefits. Please read the pages that follow and let us know if you agree. Sincerely,

Gary Kremen Chair, Board of Directors	Len Materman Executive Director

650-324-1972 * jpa@sfcjpa.org * 615 B Menlo Avenue * Menlo Park, CA 94025

San Francisquito Creek

Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101

Draft Environmental Impact Report

Public Hearings

Thursday, May 23, 2019
7:00-8:30 p.m.
Laurel School Upper Campus Atrium
275 Elliott Drive
Menlo Park, CA

Wednesday, May 29, 2019
7:00-8:30 p.m.
East Palo Alto City Hall Community Room
2415 University Avenue
East Palo Alto, CA

Wednesday, June 5, 2019
7:00-8:30 p.m.
Palo Alto Art Center Auditorium
1313 Newell Road
Palo Alto, CA

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April 2019

ICF. 2019. *San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101*. Draft EIR. April. (ICF 00712.12.) San Jose, CA. Prepared for San Francisquito Creek JPA, Menlo Park, CA.

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Acronyms and Abbreviations

°F	Fahrenheit
μg/m^3	microgram per cubic meter
AB	Assembly Bill
ABAG	Association of Bay Area Governments
AC Transit	Alameda-Contra Costa County Transit District
ADT	average daily traffic
AIA	airport influence area
AMP	Archaeological Monitoring Plan
APE	Area of Potential Effects
ATP	Archaeological Testing Plan
BA	biological assessment
BAAQMD	Bay Area Air Quality Management District
BART	Bay Area Rapid Transit
bgs	below ground surface
BMP	best management practice
BO	biological opinion
C/CAG	City/County Association of Governments of San Mateo County
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
cal BP	calibrated years before present
CAL FIRE	California Department of Forestry and Fire Protection
Cal Water	California Water Service Company
Cal/OSHA	California Division of Occupational Safety and Health
CalEEMod	California Emissions Estimator Model
CalEPA	California Environmental Protection Agency
Caltrans	California Department of Transportation
CAP	Climate Action Plan
CARB	California Air Resources Board
Carl Moyer Program	Carl Moyer Memorial Air Quality Standards Attainment Program
CBSC	California Building Standards Code
CCAP	Climate Change Action Plan
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
CHP	California Highway Patrol

CLUP	Comprehensive Land Use Plan
CMP	Congestion Management Program
CNDDB	California Natural Diversity Database
CNEL	Community Noise Equivalent Level
CNPS	California Native Plant Society
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
Corps	U.S. Army Corps of Engineers
CPUC	California Public Utilities Commission
CRHR	California Register of Historical Resources
CWA	Clean Water Act
cy	cubic yard
dB	decibel
dBA	A-weighted decibel
dbh	diameter at breast height
DEIR	Draft Environmental Impact Report
DOT	Department of Transportation
DPM	diesel particulate matter
DPR	Department of Parks and Recreation
DTSC	Department of Toxic Substances Control
EFH	essential fish habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EO	executive order
EPA	U.S. Environmental Protection Agency
EPAPD	East Palo Alto Police Department
EPASD	East Palo Alto Sanitary District
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FCR	fire cracked rock
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
g/bhp-hr	grams per brake horsepower-hour
GHG	greenhouse gas
GWMP	Groundwater Management Plan
GWP	global warming potential
HCP	Habitat Conservation Plan
HFCs	hydroflourocarbons
HMP	Hydromodification Management Plan
HMTA	Hazardous Materials Transportation Act
“Hot Spots” Act	Air Toxics “Hot Spots” Information and Assessment Act of 1987
HWCA	Hazardous Waste Control Act

I-	Interstate
in/sec	inches per second
JPA	Joint Powers Authority
LCFS	Low Carbon Fuel Standard
Ldn	day-night level
LEDPA	Least Environmentally Damaging Practicable Alternative
Leq	equivalent sound level
LID	low-impact development
Lmax	maximum sound levels
LOS	Level of Service
LUFT	Leaking Underground Fuel Tank
LUST	leaking underground storage tank
MBTA	Migratory Bird Treaty Act
MCE	maximum credible earthquake
MGD	million gallons daily
MHWL	Mean High Water Line
MM-	Mitigation Measure
MMP	Mitigation Monitoring Plan
MOU	memorandum of understanding
MPCSD	Menlo Park City School District
MPFPD	Menlo Park Fire Protection District
MPMWD	Menlo Park Municipal Water District
MPO	Metropolitan Planning Organization
MPPD	Menlo Park Police Department
MRP	Municipal Regional Stormwater NPDES Permit
MS4	municipal separate storm sewer system
MSL	mean sea level
MT	metric ton
MTC	Metropolitan Transportation Commission
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAHC	Native American Heritage Commission
NED	National Economic Development
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO	nitric oxide
NO_2	nitrogen dioxide
NOC	Notice of Completion
NOP	Notice of Preparation
NO_X	nitrogen oxides
NPDES	National Pollution Discharge Elimination System
NRHP	National Register of Historic Places

NSR	New Source Review
NTU	nephelometric turbidity unit
OHWM	ordinary high water mark
PAFD	Palo Alto Fire Department
PAUSD	Palo Alto Unified School District
PCBs	polychlorinated biphenyls
PFCs	perfluorocarbons
PG&E	Pacific Gas and Electric Company
PM	particulate matter
PM10	particulate matter less than or equal to 10 microns in diameter
PM2.5	particulate matter less than or equal to 2.5 microns in diameter
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
PPV	peak particle velocity
PRC	Public Resources Code
project	San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101
Quaternary	San Francisquito Creek, only younger
RCRA	Resource Conservation and Recovery Act
RCSD	Ravenswood City School District
Regional Water Board	Regional Water Quality Control Board
RMS	root mean square
ROG	reactive organic gas
RPS	Renewables Portfolio Standard
RSP	rock slope protection
RTP/SCS	Regional Transportation Plan/Sustainable Communities Strategy
RWQCP	Regional Water Quality Control Plant
RWS	Regional Water System
S/CAP	Sustainability and Climate Action Plan
SamTrans	San Mateo County Transit District
SARA	Superfund Amendments and Reauthorization Act
SB	Senate Bill
SCCVCD	Santa Clara County Vector Control District
SCS	sustainable communities strategy
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SEL	sound exposure level
SF_6	sulfur hexafluoride
SFBAAB	San Francisco Bay Area Air Basin
SFCJPA	San Francisquito Creek Joint Powers Authority
SFC MAC	San Francisquito Creek Multi-agency Coordination
SFPUC	San Francisco Public Utilities Commission
SGSCA	Stanford Grounds Services Certified Arborist
SIP	State Implementation Plan

SLAC	Stanford Linear Accelerator Center
SLE	St. Louis encephalitis virus
SLF	Sacred Lands File
SLR	sea level rise
SMCFCD	San Mateo County Flood Control District
SMCL	San Mateo County Library
SMCMVCD	San Mateo County Mosquito and Vector Control District
SM-STOPPP	San Mateo Countywide Stormwater Pollution Prevention Program
SO_2	sulfur dioxide
South Bay	South San Francisco Bay
SPCC	Spill Prevention, Control, and Countermeasure
SPL	sound pressure level
Standard Guidelines	Impact Mitigation Guidelines Revisions Committee of the SVP Standard Guidelines
State Water Board	State Water Resources Control Board
SUHSD	Sequoia Union High School District
SVCW	Silicon Valley Clean Water
SVP	Society of Vertebrate Paleontology
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board's
TAC	toxic air contaminant
Tanner Act	Toxic Air Contaminant Identification and Control Act
TMDL	Total Maximum Daily Load
TPZ	Traffic Pattern Zone
TSCA	Toxic Substance Control Act
UCMP	University of California Museum of Paleontology
UDP	Unanticipated Discovery Protocol
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency's
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
UST	underground storage tank
UWMP	Urban Water Management Plan
V/C	volume-to-capacity ratio
Valley Water	Santa Clara Valley Water District
VdB	vibration decibel level
VMT	vehicle miles traveled
VTA	Santa Clara Valley Transportation Authority
WBSD	West Bay Sanitary District
WDR	waste discharge requirement
WEE	western equine encephalomyelitis virus
WNV	West Nile Virus

Chapter 1
Introduction and Summary

This document is the public Draft Environmental Impact Report (EIR) of the San Francisquito Creek Joint Powers Authority's (SFCJPA) proposed San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101 (project). This Draft EIR analyzes the environmental effects of the project in the context of the benefits and impacts of other projects within the watershed and floodplain, and is being circulated for public review and comments from April 22, 2019 through June 19, 2019.

This Draft EIR has been prepared in compliance with the California Environmental Quality Act (CEQA) to provide an objective analysis to be used by the Lead Agency responsible for compliance under CEQA, as well as other agencies and the public, in their considerations regarding the implementation, rejection, or modification of the project as proposed. This Draft EIR identifies, evaluates, and discloses possible environmental impacts of feasible project alternatives, and presents strategies to avoid, reduce, or compensate for any significant impacts. SFCJPA is the Lead Agency for environmental review of the proposed project, and is the project proponent. If the project is approved, SFCJPA will be responsible for the implementation, monitoring, and reporting of applicable mitigation measures to ensure these measures are properly completed. Where appropriate, SFCJPA may delegate to another public agency or to a private entity responsibilities and tasks associated with implementing the project.

This report does not determine whether the project will be implemented; it serves only as an informational document in the local planning and decision-making process. Following public review of the Draft EIR, SFCJPA may develop a Final EIR that the SFCJPA Board of Directors would consider for certification. Local government agencies may use the information in this Draft EIR in deciding whether to allow the project to construct facilities on lands within their jurisdictions, and environmental regulatory agencies may use the Final EIR in assessing whether to grant the permits necessary for the project to proceed. Additionally, using information contained within this Draft EIR and other information it has generated, the U.S. Army Corps of Engineers (Corps) will evaluate this project's compliance with the federal National Environmental Policy Act.

1.1 Background

SFCJPA is a regional government agency formed in 1999 by the cities of East Palo Alto, Menlo Park, and Palo Alto, the San Mateo County Flood Control District, and the Santa Clara Valley Water District. The jurisdictions are divided by San Francisquito Creek, which forms a portion of the county line between San Mateo and Santa Clara Counties, and they are united by this shared natural physical feature. SFCJPA plans, designs, and implements projects that are comprehensive in both geography and function. Its projects cross jurisdictional boundaries and protect communities against, and alert them of the potential for, flooding, including flooding from storms and sea level rise; enhance and restore ecosystems; and connect neighborhoods by improving access to trails.

Flooding from the creek is a relatively common occurrence, including twice within the past decade. The largest flow recorded since record keeping began in 1930 occurred in February 1998, when the creek overtopped its banks in several areas, damaging approximately 1,700 properties. That event is now considered by SFCJPA and the Corps to have been approximately a 70-year flood, relative to the commonly referenced standard of a 100-year flood event.[1]

In all of its major capital work, including upstream of U.S. Highway 101, SFCJPA seeks to sustainably and adaptively manage the watershed system and to increase the conveyance and/or detention of water in order to protect people and property from creek flows of at least the 100-year-event level—now and in a future with climate change. This Draft EIR analyzes alternatives that meet this objective at a programmatic level, and conducts a more detailed project level analysis to enable the implementation of the first phase of work to protect the communities from flows up to the 1998 flood event level. By evaluating and recommending that project, which is achievable in the near term, this Draft EIR is meaningful to the local communities. Importantly, the project also advances local priorities of enhancing creek habitat and recreational opportunities.

1.2 Protecting People and Property along all of San Francisquito Creek

The project is proposed within the San Francisquito Creek watershed (Figure 1-1). For the purpose of this Draft EIR, Francisquito Creek is considered to have three major and distinct segments or "reaches" (Figure 1-2). Reach 1 includes the length of the creek between San Francisco Bay and the upstream side of the bridge at West Bayshore Road, a frontage road to U.S. Highway 101. Immediately upstream (west) of Reach 1 is the section of the creek labeled Reach 2, which extends from the upstream side of West Bayshore Road to the area immediately upstream of the Pope-Chaucer Bridge. It is within the Reach 2 section of the creek that work is proposed to occur in the near future as a result of this Draft EIR. Upstream of Reach 2 lies Reach 3, where potential future projects discussed in this Draft EIR would complement the objectives of the work proposed in Reach 2.

Following is a brief description of capital projects within the three reaches of San Francisquito Creek, including projects recently completed by SFCJPA or by other entities that support SFCJPA objectives, as well as projects that SFCJPA or others may implement in the future.

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[1] The 100-year flood is considered to have a 1 percent chance of occurring in any given year.

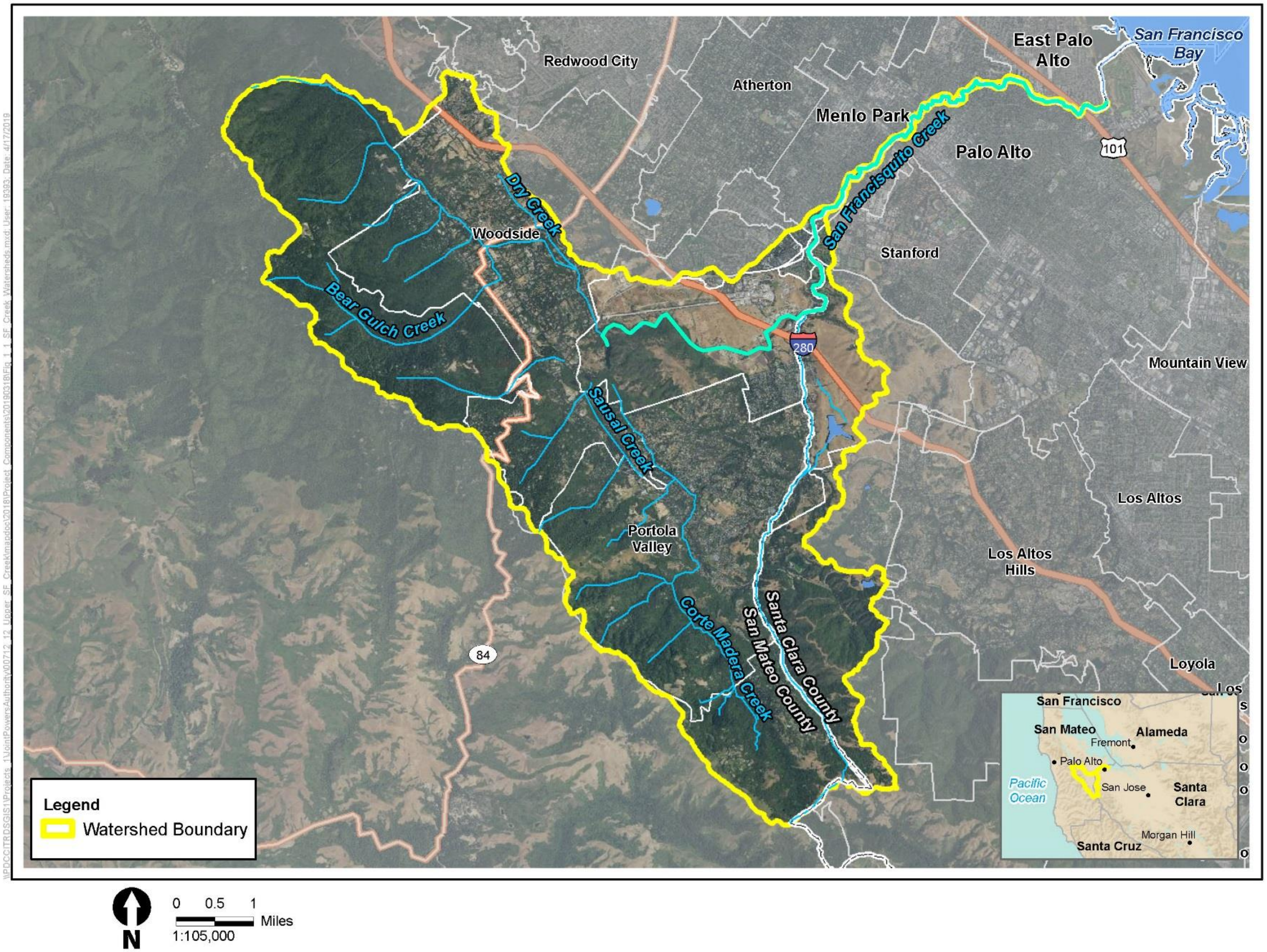

Figure 1-1. San Francisquito Creek Watershed

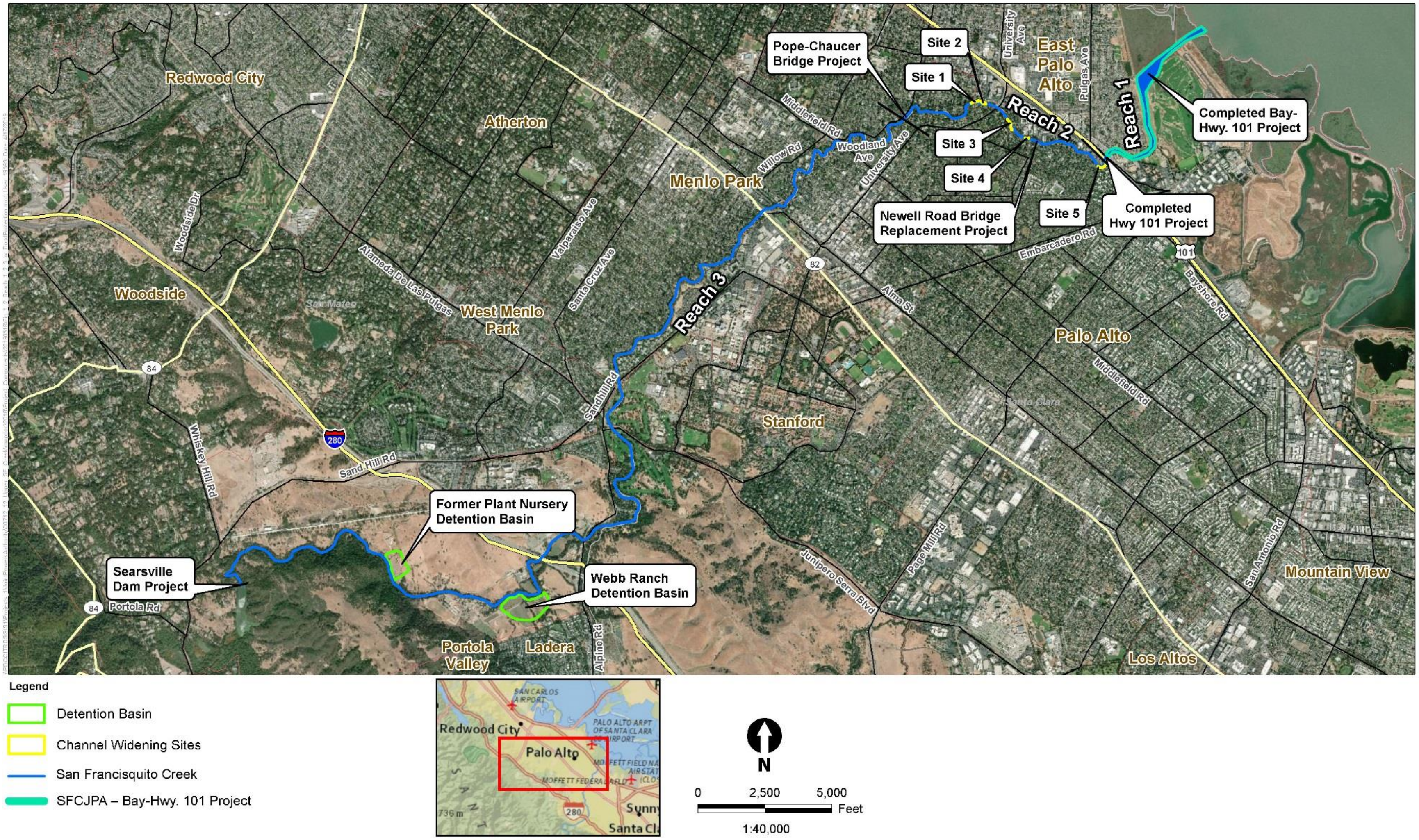

Figure 1-2. Project Reaches

1.2.1 Reach 1 – San Francisco Bay to West Bayshore Road

In the primary portion of the creek influenced by San Francisco Bay tides (Reach 1), SFCJPA and partners have completed construction of the downstream-most portion of the San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project, from San Francisco Bay to Highway 101, which eliminated the threat of creek-induced flooding to that area. That project removed the floodplain from areas adjacent to the creek by creating a new marsh floodplain *within* a widened channel and the bayside portion of an adjacent marsh, and by building new levees and floodwalls. The Final EIR for the Bay to Highway 101 Project was certified by the SFCJPA Board in November 2012. Additionally, to align the bridges over the creek at U.S. Highway 101 and its frontage roads (East Bayshore Road and West Bayshore Road) with SFCJPA's flood protection objectives and projects, the California Department of Transportation recently rebuilt those bridges.

This completed work from the Bay through the highway and West Bayshore Road will keep the largest possible creek flows within Reach 1 from exiting the channel, even after sea level rises 10 feet above today's mean high tide. That project is connected to, and forms the centerpiece of, the next two major SFCJPA efforts: (1) upstream of this reach along the creek, which is the subject of this Draft EIR; and (2) the SAFER Bay project extending north and south along 11 miles of shoreline in both counties to remove properties from the floodplain of San Francisco Bay, including when sea level rises to the same level.

1.2.2 Reach 2 – Upstream Side of West Bayshore Road to Upstream Side of Pope-Chaucer Bridge

The area evaluated in the greatest detail within this Draft EIR is within Reach 2, the creek's most densely populated region and the one that is now the most likely to flood. All alternatives considered for this reach would modify the channel or nearby areas in order to allow a larger flow to pass through Reach 2 without causing flooding. These alternatives must be contemplated in the context of many considerations, such as existing land uses, properties, species, and aesthetics.

The two Reach 2 alternatives analyzed in the most detail would increase creek flow at the location of least capacity, the Pope-Chaucer Bridge, by replacing the existing bridge with a new bridge of greater flow capacity, and would increase flow capacity between the new bridge and Reach 1. Thus, these project alternatives would enable the maximum flow that could enter Reach 2 from upstream to be contained within the channel throughout Reach 2. Because Reach 1 already has greater capacity, these high flows would safely reach San Francisco Bay.

Of the two Reach 2 alternatives that underwent a detailed analysis in this document, SFCJPA has selected as its preferred alternative the alternative that is less-impactful on the environment because it largely restores the creek to its natural capacity by removing and replacing aging concrete structures within the channel with smaller structures or natural bank. It is anticipated that this widening will require small or underground permanent easements from between five and ten property owners on the Palo Alto side of the creek, and, if SFCJPA pursues the construction of creekside parks, from one property owner on the East Palo Alto side. This preferred project also proposes to include habitat enhancements in the stream and recreational improvements along the top of bank. Also within Reach 2, the City of Palo Alto plans a separate project to replace the Newell

Road Bridge over San Francisquito Creek, and therefore this Draft EIR evaluates the cumulative impacts of SFCJPA's and the City of Palo Alto's proposed projects.

These proposed projects would increase channel flow capacity within all of Reach 2 to at least 7,500 cubic feet per second (cfs)—enough to accommodate the peak flow recorded during the 1998 flood of record. While a 100-year event would be expected to result in a flow of 8,150 cfs at the Pope-Chaucer Bridge, the maximum flow that could actually reach that bridge is 7,500 cfs due to a capacity constriction upstream in Reach 3 at the Middlefield Road Bridge. Rather than replace the Middlefield Road Bridge and construct floodwalls in, or channelize, much of Reach 2 to protect against a 100-year event, SFCJPA or its partners will supplement a project in Reach 2 with a new facility farther upstream within Reach 3 to detain a high flow before it can cause downstream flooding in Reach 2.

1.2.3 Reach 3 – Upstream of Reach 2 to the Searsville Reservoir

In Reach 3, which includes areas of the watershed upstream of the Pope-Chaucer Bridge, there are opportunities to improve habitat and to protect against flows that exceed the capacity of the creek channel in Reach 2, now and after the proposed project is implemented.

SFCJPA analysis has concluded that all potential locations of effective detention basins are within Reach 3, on property owned by Stanford University, the largest landowner within the watershed. Stanford University is currently exploring a project to modify the Searsville Dam and Reservoir (Stanford University 2015) by creating an opening at the base of the dam and then using creek flows to send reservoir sediment downstream (known as "flushing") in order to create a new channel upstream of a new dam opening. During normal flows, the opening at the base of the dam would allow fish to migrate through that location. During high flows, water that exceeds the capacity of the opening would be temporarily detained behind the dam, thus reducing peak flows downstream. Stanford University has calculated that during a 100-year storm event such a project could reduce peak flows in downstream flood prone areas by 800–1,000 cfs beyond the flood attenuation benefit currently provided by the reservoir.

While SFCJPA is working with Stanford University to enable the implementation of a Stanford project at Searsville and this Draft EIR discusses the cumulative impacts of constructing both that project and SFCJPA's preferred project in Reach 2, the implementation of any project at Searsville would require the University to prepare separate environmental documents and permit applications. Stanford University has studied potential projects at Searsville Dam and Reservoir for many years. Should Stanford University decide not to pursue the project at Searsville by the time SFCJPA implements its project in Reach 2, SFCJPA may pursue the implementation of one or more detention basins in other locations on University property. Similar to Stanford-operated stormwater detention basins on its main campus, the potential locations of floodwater detention basins identified by SFCJPA could capture and store floodwaters during major storms on one to two occasions each century, and continue their current uses at all other times. This Draft EIR analyzes at a program level the environmental impacts associated with the construction and infrequent operation of potential basins west of Interstate Highway 280 on portions of the Webb Ranch U-Pick field and parking lot and on the former site of the Boething plant nursery.

Though complicated to construct, detention basins at Searsville, Webb Ranch, and the former plant nursery represent potentially feasible alternatives that would, as a stand-alone project, provide real flood protection. However, the approximately 1,000 cfs of water detention from site(s) within Reach

3 represents less protection, likely achievable at a later date, than the preferred project alternative in Reach 2.

Thus, this Draft EIR also discusses a project in Reach 3 that complements the preferred alternative by increasing the level of flood protection afforded solely by the Reach 2 project from 7,500 cfs to almost 8,500 cfs. This increase of protection from a 70-year event to greater than a 100-year event could significantly reduce the flood threat from extreme weather events that are becoming more common due to climate change. Furthermore, this increased level of flood protection could reduce the need for thousands of property owners to purchase flood insurance.

While more difficult to achieve in the near term than a Reach 2 project, a project in the upstream areas of Reach 3 that results in the temporary detention of extreme flows is a critical piece of SFCJPA's overall strategy to reduce risk and costs in our communities. Thus, also included in this Draft EIR is a program-level analysis of the opportunity to achieve flood protection upstream following the implementation of SFCJPA's preferred project. Should either Stanford or SFCJPA pursue such a project in Reach 3, a more detailed project-level environmental analysis would be required.

1.3 Lead, Responsible, and Trustee Agencies for this EIR

SFCJPA is the Lead Agency for CEQA compliance for the project. The following public agencies have been identified as responsible agencies (i.e., additional public agencies that have discretionary approval authority over the project, per State CEQA Guidelines Section 15381) and/or trustee agencies (i.e., those that have jurisdiction by law over natural resources affected by a project and held in trust for the people of California, per State CEQA Guidelines Section 15386).

- California Department of Fish and Wildlife (responsible and trustee)
- San Francisco Bay Regional Water Quality Control Board (responsible)
- County of Santa Clara (responsible)
- County of San Mateo (responsible)
- City of Menlo Park (responsible)
- City of Palo Alto (responsible)
- City of East Palo Alto (responsible)
- Santa Clara Valley Water District (responsible) and may manage construction of the project on behalf of SFCJPA
- San Mateo County Flood Control District (responsible)

While agencies of the federal government are not defined as public agencies under CEQA (per State CEQA Guidelines Section 15379), the following federal agencies have discretionary approval power over the project.

- U.S. Army Corps of Engineers
- National Marine Fisheries Service

- U.S. Fish and Wildlife Service

1.4 Required Permits and Approvals

The project would be subject to federal, state, and local regulations that protect various aspects of environmental quality. Table 1-1 presents a summary of permit requirements, organized by agency with jurisdiction.

Table 1-1. Permit Requirements Potentially Applicable to the Project

Agency with Jurisdiction	Regulation(s)	Required Authorization
San Francisco Bay Regional Water Quality Control Board	Federal Clean Water Act, Sections 401 and 402 California Porter-Cologne Water Quality Control Act	401 Water Quality Certification or Waste Discharge Requirements, National Pollutant Discharge Elimination System (NPDES) general permit for discharge of stormwater from construction sites
Bay Area Air Quality Management District (BAAQMD)	Authority to Construct/ Permit to Operate	An “Authority to Construct” is issued after BAAQMD engineers review a proposed project and determine if it is capable of complying with air quality laws; and a “Permit to Operate” is issued after the project is built and compliance is demonstrated.
U.S. Army Corps of Engineers	Federal Clean Water Act, Section 404, 33 U.S.C. 408 National Environmental Policy Act (NEPA)	Permits for dredge and fill activities below ordinary high-water mark in waters of the United States; federal action requires NEPA compliance
U.S. Fish and Wildlife Service (USFWS)	Federal Endangered Species Act (ESA)	Potential need for “take” authorization of terrestrial species under ESA Section 7 will be determined through Corps consultation with USFWS
National Marine Fisheries Service (NMFS)	ESA	Potential need for “take” authorization of steelhead under ESA Section 7 will be determined through Corps consultation with NMFS
California Department of Fish and Wildlife	California Endangered Species Act California Fish and Game Code Section 1602	Streambed Alteration Agreement for activities affecting bed/banks of a jurisdictional stream
State Office of Historic Preservation	National Historic Preservation Act State Office of Historic Preservation requirements California Public Resources Code	Authorization under Section 106 of the National Historic Preservation Act
City of Palo Alto	Local plans and regulations	Permitting entity for work on City land or public right-of-way.
City of East Palo Alto	Local plans and regulations	Permitting entity for work on City land or public right-of-way.
City of Menlo Park	Local plans and regulations	Permitting entity for work on City land or public right-of-way.

1.5 Public and Agency Involvement in EIR Process

1.5.1 Scoping Comment Period

Scoping refers to the public outreach process used under CEQA to determine the coverage and content of an EIR. Scoping is initiated when the Lead Agency issues a formal Notice of Preparation (NOP) announcing the beginning of the EIR process. SFCJPA filed the NOP with both San Mateo County and Santa Clara County on December 21, 2016, and the NOP received a project number from the State Clearinghouse on February 17, 2017. As required by State CEQA Guidelines Section 15082, the NOP provided information on the background, goals, and objectives of the project; announced preparation of and requested public and agency comment on the EIR; and provided information on the public scoping meetings to be held in support of the EIR's development.

Four public scoping meetings were held in 2017 (January 18, January 26, January 31, and February 1). Additionally, three workshops were held later in 2017 to obtain further public input (October 4, October 14, and October 25).

1.5.2 Public and Agency Review of Draft EIR

CEQA requires that the Lead Agency notify agencies and the public that a Draft EIR is complete and available for review. The official notification, referred to as a Notice of Completion (NOC), is sent to the State Clearinghouse. CEQA also requires that the Lead Agency provide written notice of the draft document's availability to the County Clerk's office for posting, and to any other parties who have requested it. The NOC must also be published in a general-circulation newspaper, posted on and off the project site, or mailed to residents of properties adjacent to the project site. Issuance of the NOC initiates a public review period during which the Lead Agency receives and collates public and agency comments on the project and the document.

SFCJPA is now circulating the Draft EIR for public review and comments between April 22, 2019, and June 19, 2019. The purpose of public circulation and the public hearing is to provide agencies and interested individuals opportunities to comment on or express opinions regarding the contents of the Draft EIR. SFCJPA plans to present a summary of the Draft EIR at Regular City Council meetings within the three cities benefitting from the project: Palo Alto, East Palo Alto, and Menlo Park. In addition to these public meetings, SFCJPA will conduct public hearings in these three cities to solicit public and agency comments on the Draft EIR. The dates, times, and locations of the public hearings are listed in this proposed project's Notice of Availability, which can be viewed at SFCJPA.org and through the local agencies listed in Section 1.3 above.

Written comments regarding this Draft EIR should be submitted by **June 19, 2019** to:

Kevin Murray
Senior Project Manager
San Francisquito Creek Joint Powers Authority
615-B Menlo Avenue
Menlo Park, California 94025
email: comments@sfcjpa.org
phone: 650-324-1972

1.5.3 Preparation of the Final EIR

Before the Lead Agency can approve a project, it must prepare a Final EIR that addresses the comments received on the draft document. The Final EIR will include a list of all individuals, organizations, and agencies that provided comments and it will contain copies of the comments received during the public review period, along with the lead agency's responses. The public comments and responses within the Final EIR, as well as that document's findings and conclusions and separate information regarding the proposed project's costs and technical and logistical feasibility, will all be taken into account by the SFCJPA Board and others in deciding whether and how to proceed with this project.

1.5.4 Summary of Potential Impacts and Mitigation

Table 1-2 summarizes the project's potential for significant impacts on the environment, along with the mitigation measures identified to reduce the level of impacts. For a complete description of potential impacts and recommended mitigation measures, refer to the specific discussions in Chapter 3.

Table 1-2. Potential Impacts, Mitigation and Levels of Significance of the Proposed Project (Channel Widening Alternative)

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Aesthetics		
Impact AES-1—Cause substantial degradation of the visual character or quality of the project site and its surroundings, including scenic vistas	**None**	**LTS**
Impact AES-2—Cause substantial damage to scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway	**None**	**LTS**
Impact AES-3—Create a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area	**MM-AES.1:** Control Nighttime Lighting	**LTS**

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Air Quality		
Impact AQ-1—Conflict with or obstruct implementation of an applicable air quality plan	**MM-AQ-1:** Utilize clean diesel-powered equipment during construction to control construction-related NO_X emissions for all Alternatives and operations-related NO_X emissions for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative **MM-AQ-2:** Use on-road haul trucks with model year 2010 and newer engines during construction for all Alternatives and operations for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative **MM-AQ-3:** Reduce construction emissions for all Alternatives and operations emissions for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative to below BAAQMD NO_X thresholds **MM-AQ-4**: Implement BAAQMD's Basic Construction Mitigation Measures for all Alternatives and operations for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	**LTSM**
Impact AQ-2— Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard	**MM-AQ-1, MM-AQ-2, MM-AQ-3,** and **MM-AQ-4**	**LTSM**
Impact AQ-3—Expose sensitive receptors to substantial pollutant concentrations	**MM-AQ-1, MM-AQ-2, MM-AQ-3,** and **MM-AQ-4**	**Project: LTSM** **Cumulative: SU**
Impact AQ-4— Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people	**None**	**LTS**

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Biological Resources		
Impact BIO-1—Result in the disturbance or loss of special-status plant populations	**MM-BIO-1:** Restrict construction access to previously disturbed areas **MM-BIO-2:** Revegetate disturbed areas with local ecotypes of native plants **MM-BIO-3:** Conduct botanical surveys **MM-BIO-4**: Confine construction disturbance and protect special-status plants during construction **MM-BIO-5**: Compensate for loss of special-status plants	**LTSM**
Impact BIO-2—Result in disturbance or loss of riparian habitat	**MM-BIO-6:** Develop and implement worker awareness training **MM-BIO-7:** Identify and protect sensitive habitats **MM-BIO-8:** Restore riparian habitat	**LTSM**
Impact BIO-3—Result in disturbance or loss of State- or Federally protected wetlands	**MM-BIO-9:** Avoid and protect jurisdictional wetlands during construction **MM-BIO-10:** Compensate for loss of wetland habitat **MM-BIO-11**: Conduct a wetland delineation	**LTSM**
Impact BIO-4—Result in temporary and permanent changes to waters of the US (intermittent drainage)	**MM-HWR-1:** Prepare an adaptive management plan	**LTSM**
Impact BIO-5—Result in disturbance or loss of locally protected trees	**MM-BIO-12:** Compensate for loss of trees, consistent with applicable tree protection regulations **MM-BIO-13:** Project trees from construction impacts	**LTSM**
Impact BIO-6—Result in effects on steelhead trout and suitable habitat	**MM-BIO-6** **MM-BIO-14:** Limit in-channel and stream bank construction to the dry season **MM-BIO-15:** Reduce pile-driving noise for protection of fish **MM-BIO-16:** Implement avoidance measures for aquatic vertebrates prior to construction activities **MM-BIO-17**: Implement fish relocation activities prior to construction	**LTSM**

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Impact BIO-7—Result in effects on California red-legged frog and habitat	**MM-BIO-6** and **MM-BIO-16** **MM-BIO-18:** Implement survey and avoidance measures for California red-legged frog prior to construction activities **MM-BIO-19:** Prevent California red-legged frog and other amphibians and reptiles from entering the detention basin	**LTSM**
Impact BIO-8—Result in effects on western pond turtle and habitat	**MM-BIO-6** **MM-BIO-20:** Conduct preconstruction surveys for western pond turtles; relocate if needed	**LTSM**
Impact BIO-9—Result in effects on bats (pallid bat, hoary bat, and Townsend's big-eared bat)	**MM-BIO-4** and **MM-BIO-17** **MM-BIO-21:** Implement preconstruction survey for pallid and hoary bats	**LTSM**
Impact BIO-10—Result in effects on nesting migratory birds and raptors	**MM-BIO-6** **MM-BIO-22:** Install nesting exclusion devices **MM-BIO-23:** Conduct preconstruction nesting bird surveys **MM-BIO-24:** Establish buffer zones for nesting raptors and migratory birds	**LSTM**
Impact BIO-11—Result in effects on bay checkerspot butterfly	**None**	**NI**
Impact BIO-12—Result in effects on California tiger salamander and habitat	**MM-BIO-25:** Implement survey and avoidance measures for California tiger salamander prior to construction activities	**LTSM**
Impact BIO-13—Result in effects on Santa Cruz black salamander and California giant salamander and habitat	**MM-BIO-19** (see Impact BIO-7)	**LTSM**
Impact BIO-14—Result in effects on San Francisco dusky-footed woodrat	**MM-BIO-26:** Conduct preconstruction surveys for dusky-footed woodrats **MM-BIO-27:** Relocate woodrats and middens prior to construction activity	**LTSM**
Impact BIO-15—Result in effects on western burrowing owls and habitat	**MM-BIO-6** **MM-BIO-28:** Implement survey and avoidance measures for western burrowing owls prior to construction activities	**LTSM**

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Cultural and Paleontological Resources		
I**mpact CULT-1—**Cause a substantial adverse change in the significance of a historical or architectural resource as defined in State CEQA Guidelines Section 15064.5	**None**	**NI**
Impact CULT-2—Cause a substantial adverse change in the significance of a tribal cultural or archaeological resource as defined in State CEQA Guidelines Section 15064.5 and PRC Section 21084.3	**MM-CULT-1:** Stop work if archaeological deposits are encountered during ground-disturbing activities **MM-CULT-2:** Develop and implement a Tribal Cultural and Archaeological Testing Plan **MM-CULT-3:** Develop and implement a Tribal Cultural and Archaeological Monitoring Plan	**LTSM**
Impact CULT-3—Disturb any human remains, including those interred outside of formal cemeteries	**MM-CULT-1, MM-CULT-2,** and **MM-CULT-3**	**LTSM**
Geology and Soils		
Impact GEO-1— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving fault rupture	**None**	**LTS**
Impact GEO-2— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismic ground shaking Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismic ground shaking	**None**	**LTS**
Impact GEO-3— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismically induced ground failure, including liquefaction	**None**	**LTS**
Impact GEO-4— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving landslides	**None**	**NI**

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Impact GEO-5— Result in substantially accelerated soil erosion or loss of topsoil	**MM-HWR-1:** Prepare an Adaptive Management Plan	**LTSM**
Impact GEO-6—Locate structures on a geologic unit or soil that is unstable or that would become unstable as a result of construction, increasing the risk of onsite or offsite landslide or slope failure	**None**	**LTS**
Impact GEO-7—Involve construction on expansive soil, creating substantial risks to life or property	**None**	**LTS**
Impact PALEO-1—Result in the destruction or loss of a unique paleontological resource or site	**MM-PALEO-1:** Conduct a preconstruction paleontological resources field survey and paleontological resources inventory and evaluation **MM-PALEO-2:** Conduct worker awareness training for paleontological resources prior to construction **MM-PALEO-3:** Stop work immediately if paleontological resources are discovered inadvertently	**LTSM**
Greenhouse Gas Emissions and Climate Change		
Impact GHG-1—Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment	**MM-AQ-2** (see Air Quality, above) **MM-GHG-1:** Implement BAAQMD's best management practices to reduce GHG emissions from construction	**LTSM**
Impact GHG-2—Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing emissions of greenhouse gases	**None**	**LTS**
Hazardous Materials and Public Health		
Impact HAZ-1—Substantially increase hazards to the public or the environment due to the routine transport, use, or disposal of hazardous materials	**MM-HAZ-1:** Prepare and implement a Spill Prevention, Control, and Countermeasure Plan **MM-HAZ-2:** Require proper storage and handling of potential pollutants and hazardous materials	**LTSM**
Impact HAZ-2—Expose workers or the public to existing hazardous materials contamination	**MM-HAZ-1** **MM-HAZ-3:** Stop work and implement hazardous materials investigations and remediation in the event that unknown hazardous materials are encountered	**LTSM**

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Impact HAZ-3—Generate hazardous emissions or handle hazardous or acutely hazardous materials, substances, or wastes within 0.25 mile of an existing or proposed school	**MM-HAZ-1**	**LTSM**
Impact HAZ-4—Be located on a site that is included on a list of hazardous materials sites	**None**	**LTS**
Impact HAZ-5—Create a safety hazard for people in the project area due to the proximity to an airport	**None**	**LTS**
Impact HAZ-6—Interfere with an emergency response or evacuation plan	**MM-TT-1:** Require a site-specific Traffic Control Plan	**LTSM**
Impact HAZ-7— Expose people or structures, either directly or indirectly, to risk of wildland fires	**None**	**NI**
Impact HAZ-8—Increase breeding or harborage of disease vector organisms	**MM-HAZ-4:** Prevent mosquito breeding during project construction	**LTSM**
Hydrology and Water Resources		
Impact HWR-1— Increase flood risks	**None**	**LTS**
Impact HWR-2— Deplete groundwater resources or interfere with groundwater recharge or supply	**None**	**LTS**
Impact HWR-3—Degrade water quality	**MM-HWR-1:** Prepare an Adaptive Management Plan	**LSTM**
Impact HWR-4—Affect designated beneficial uses	**None**	**LTS**
Land Use and Planning		
Impact LU-1—Physically divide an established community	**None**	**NI**
Impact LU-2—Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect	**None**	**LTS**

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Impact LU-3—Conflict with any applicable habitat conservation plan or natural community conservation plan	**None**	**NI**
Impact AG-1— Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use	**None**	**LTS**
Impact AG-2—Conflict with existing zoning for agricultural use, or a Williamson Act contract	**None**	**NI**
Impact AG-3— Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))	**None**	**NI**
Impact AG-4—Result in the loss of forest land or conversion of forest land to non-forest use	**None**	**NI**
Impact AG-5— Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use	**None**	**LTS**
Noise and Vibration		
Impact NV-1— Generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies	**MM-NV-1:** Provide advance notification of construction and operations schedule and 24-hour hotline to residents **MM-NV-2:** Designate a noise disturbance coordinator to address resident concerns **MM-NV-3:** Install temporary noise barriers	**SU**
Impact NV-2—Expose persons to or generate excessive ground-borne vibration or ground-borne noise levels	**MM-NV-4:** Conduct construction vibration monitoring and implement control approach(es)	**LTSM**

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Impact NV-3— Expose people residing or working in the project area to excessive noise levels	**None**	**LTS**
Public Services		
Impact PS-1—Adversely affect fire protection services or require the provision of new or physically altered fire protection facilities	**None**	**LTS**
Impact PS-2—Adversely affect police services or require the provision of new or physically altered police facilities	**None**	**LTS**
Impact PS-3—Adversely affect schools or require the provision of new or physically altered school facilities	**None**	**NI**
Impact PS-4—Adversely affect other public facilities or require the provision of new or physically altered governmental facilities	**None**	**NI**
Recreation		
Impact REC-1—Result in the need for development of new parks or recreational facilities, the need for expansion of existing facilities, or increased use of existing parks or other recreational facilities, thereby resulting in substantial physical deterioration	**None**	**LTS**
Impact REC-2—Substantially reduced access to existing recreational facilities and substantially reduced availability of existing recreational facilities or uses	**MM-REC-1:** Maintain access to Jasper Ridge Biological Preserve Former Nursery Detention Basin Alternative **MM-REC-2:** Maintain access to Jasper Ridge Biological Preserve Webb Ranch Detention Basin Alternative	**LTSM**
Traffic and Transportation		
Impact TT-1—Potential to conflict with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system	**MM-TT-1:** Require a temporary traffic signal at Middlefield Road/Woodland Avenue-Palo Alto Avenue	**LTSM**
Impact TT-2— Potential to Conflict with an applicable congestion management program	**None**	**LTS**

Impact	Proposed Mitigation Measures	Level of Significance After Mitigation[a]
Legend: NI = No impact; LTS = Less than significant; LTSM = Less than significant with mitigation; SU = Significant and unavoidable with mitigation		
Impact TT-3—Potential to create traffic safety hazards	**MM-TT-2:** Require a site-specific traffic control plan	**LTSM**
Impact TT-4—Potential to obstruct emergency access	**MM-TT-1** and **MM-TT-2**	**LTSM**
Impact TT-5—Potential to conflict with alternative transportation	**MM-TT-2**	**LTSM**
Utilities and Service Systems		
Impact UT-1—Adversely affect water supply, water treatment facilities, wastewater treatment facilities, and storm drainage facilities	**None**	**LTS**
Impact UT-2—Adversely affect landfill capacities and not comply with federal, state, and local statutes and regulations related to solid waste.	**None**	**LTS**
Energy		
Impact EN-1—Consume energy resources in a wasteful, inefficient, or unnecessary manner	**None**	**LTS**
Impact EN-2—Conflict with or obstruct a state or local plan for renewable energy or energy efficiency.	**None**	**LTS**

[a] Impact Levels: NI = No Impact; LTS = Less-than-Significant Impact; LTSM = Less-than-Significant Impact with Mitigation; SU = Significant and Unavoidable Impact

1.5.5 Significant and Unavoidable Impacts

As discussed in Section 3.2 (*Air Quality*), the cumulative effect of background sources of health risk and particulate matter 2.5 microns or less in diameter (PM2.5) concentrations combined with construction-related risks and concentrations could potentially exceed Bay Area Air Quality Management District (BAAQMD) cumulative thresholds. Although the contribution of increased cancer risk and PM2.5 concentration from construction activities associated with the project is anticipated to be relatively small, there are likely sensitive receptors in the project area that are exposed to elevated health risks and pollutant concentrations from the existing major roadway sources in the area, particularly U.S. Highway 101. As such, it is possible that the cumulative BAAQMD health risk thresholds would be exceeded or that an existing exceedance would be worsened due to the contribution of increased health risks and PM2.5 concentration from construction activities associated with the project. Implementation of MM-AQ-1 and MM-AQ-2 would reduce the likelihood of cumulative impacts; however, it would still be possible for even a small additional contribution to cause a new or worsen an existing exceedance of the BAAQMD cumulative thresholds. Therefore, cumulative impacts would be significant and unavoidable.

As discussed in Section 3.10, *Noise and Vibration,* noise control practices are expected to reduce modeled noise levels; however, it is possible that construction noise could still result in a substantial increase at some residences. Implementation of MM-NV-1, MM-NV-2, and MM-NV-3 would be required to attempt to further reduce noise. These mitigation measures would provide advance notice to nearby residences, designate a disturbance coordinator to handle resident complaints, and install noise barriers to further attenuate noise. However, even with implementation of these measures, it is unlikely that construction would be able to comply with the noise ordinance limits in the Cities of East Palo Alto and Menlo Park. Consequently, this impact is significant and unavoidable.

1.5.6 Potential Areas of Controversy

During the EIR scoping process, the following areas of concern were raised:

- Maintaining a "natural" looking creek
- Achieving a high enough level of flood protection (e.g., protection against a 100-year flood event)
- Coordinating flood protection efforts throughout the watershed

1.5.7 Issues to be Resolved

Prior to implementation of the proposed project, SFCJPA will need to obtain easements and permits from the Cities of Palo Alto, East Palo Alto, and Menlo Park, and the Counties of Santa Clara and San Mateo, as well as easements from several private properties. Until project approval, SFCJPA will also continue to work with stakeholders to refine proposed mitigation measures or develop suitable alternative measures to address identified potential significant impacts, while meeting the project's objectives.

1.6 References

Stanford University. 2015. Searsville Alternatives Study Steering Committee Recommendations. Available: https://news.stanford.edu/searsville/Searsville_Steering_Committee_Recommendations_April_2015.pdf. Accessed April 18, 2019.

Chapter 2
Program Description

2.1 Document Structure and Program Objectives

This Program Environmental Impact Report (EIR) has been prepared to assess proposed flood protection, environmental, and recreational enhancement actions in the San Francisquito Creek watershed. Program EIRs are used to document a series of actions that can be characterized as a single large project. Such actions are related by one or more of the following criteria:

- Geography;
- As logical parts in a chain of contemplated actions;
- In connection with the issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program; or
- As individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects, which can be mitigated in similar ways.[1]

The actions proposed by the San Francisquito Creek Joint Powers Authority (SFCJPA) meet all of these criteria. Program EIRs typically contain less detail than Project EIRs, and further California Environmental Quality Act (CEQA) documentation is often required for actions that are analyzed at a broad level in a Program EIR. However, within the program that is assessed by this Program EIR, there are specific actions that are analyzed at a higher level of detail (a "project level") than other actions. Analysis at a project level will help ensure that CEQA documentation is complete and enable the implementation of these actions.

The objectives of the actions analyzed by this Program EIR are to:

- Protect life, property, and infrastructure from floodwaters exiting the creek during flows up to 7,500 cubic feet per second (cfs), while minimizing impacts of the project on adjacent communities and the environment;
- Enhance habitat within the project area, particularly interconnected habitat for threatened and endangered species;
- Create new recreational opportunities and connect to existing bike and pedestrian corridors;
- Minimize operational and maintenance requirements; and
- Not preclude future actions to bring cumulative flood protection up to a 100-year flow event.

2.2 Setting

San Francisquito Creek originates in the eastern foothills of the Santa Cruz Mountains and drains a watershed that is approximately 45 square miles in size, from Skyline Boulevard to San Francisco Bay. The watershed contains three reservoirs (Searsville, Lagunita, and Felt) and several tributary

[1] State CEQA Guidelines Section 15168.

creeks, including Los Trancos, West Union, Alambique, Bear, and Corte Madera Creek as well as many smaller tributaries that drain into the creeks. San Francisquito Creek begins at the confluence of Corte Madera Creek and Bear Creek, just downstream of Searsville Dam, and flows through Stanford University and the communities of Menlo Park, Palo Alto, and East Palo Alto to San Francisco Bay. San Francisquito Creek represents the boundary between Santa Clara and San Mateo Counties and the cities of Menlo Park, Palo Alto, and East Palo Alto. The watershed's 5-square-mile floodplain is located primarily within these cities. Land uses adjacent to San Francisquito Creek are predominantly institutional (Stanford University), residential, roadway, and open space. Further details regarding the setting are included with analysis of the individual environmental resource categories in Chapter 3 of this EIR.

2.3 Project Reaches

For this Program EIR, San Francisquito Creek is described in three reaches (Figure 1-2). Reach 1 extends from San Francisco Bay to the upstream side of U.S. Highway 101. SFCJPA has completed construction of improvements in Reach 1 following the completion of CEQA documentation in 2012. This Program EIR does not include proposed actions in Reach 1, though the upstream end of Reach 1 may be traversed for construction access to a channel-widening site within Reach 2 (Site 5). Reach 2 extends from the upstream side of the frontage road to U.S. Highway 101 (West Bayshore Road) to the upstream side of the Pope-Chaucer Bridge. Reach 3 begins on the upstream side of the Pope-Chaucer Bridge and extends throughout the upper watershed.

2.4 Selection of Alternatives to Consider

Seventeen alternatives, including a No-Project Alternative, were considered for environmental analysis in this DEIR based on stakeholder input received in 2017 and 2018. Following is a summary of these potential alternatives and the screening of each, based on its ability to meet the project's objectives (Table 2-1). Those alternatives that meet project objectives are then screened for financial, logistical, and technical feasibility (Table 2-2). The alternatives that remain following this screening are further described in Chapter 2 and analyzed in Chapter 3 of this DEIR.

2.4.1 CEQA Requirements

CEQA requires that an EIR evaluate a "reasonable range" of feasible alternatives to a proposed project. An EIR is not required to consider every conceivable alternative to a project; rather, consideration should focus on alternatives that appear to be feasible, attain most of the project objectives, and avoid or substantially lessen the proposed project's significant environmental effects. In addition, although the No-Project Alternative is not the baseline for determining whether impacts related to the proposed activities would be significant, an EIR must evaluate the No-Project Alternative to allow decision-makers to compare the impacts of approving the project to the impacts of not approving it.

CEQA requires that an EIR include a description of the physical environmental conditions in the vicinity of the project as they exist at the time the Notice of Preparation is published. The environmental setting will normally constitute the baseline conditions against which the lead agency will evaluate the alternatives and determine if an impact is significant. However, in some cases the existing physical environmental conditions do not provide a reasonable baseline for determining the significance of the impacts for some resource topics. In this draft EIR, two baseline conditions were used in order to fully disclose the impacts of the project alternatives in comparison to both existing and projected future conditions for the *Hydrology and Water Resources* section. This approach is consistent with the opinion issued by California Supreme Court in *Neighbors for Smart Rail v. Exposition Metro Line Construction Authority* (2013) 57 Cal.4th 439. Other sections consider only existing conditions as the baseline.

EIRs are required to include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed project or program (State CEQA Guidelines Section 15126.6(a), (d), (f)). This requirement enables the lead agency to identify the environmentally superior alternative—that is, the alternative that would least affect the environment while still accomplishing the project objectives. If the No-Project Alternative is identified as environmentally superior but would not meet project objectives, the lead agency must also identify the environmentally superior alternative that would meet project objectives (CEQA Guidelines Section 15126.6(e)).

2.4.2 Least Environmentally Damaging Practicable Alternative

An additional evaluation to determine the Least Environmentally Damaging Practicable Alternative (LEDPA) consistent with Section 404(b) of the federal Clean Water Act and appropriate sections of laws and regulations of the State of California is required in order to secure construction permits from the U.S. Army Corps of Engineers and Regional Water Quality Control Board. While the descriptions and analyses of the alternatives presented in this Draft EIR are intended to satisfy CEQA, these analyses also serve to inform the relative environmental impacts of all alternatives and the degree to which each is capable of being done after taking into consideration cost, existing technology, and logistics in light of the project's overall purposes, i.e. the "practicable" part of LEDPA. This analysis, described in Sections 2.6, 2.7, and 2.8 below, and Tables 2-1 and 2-2, determined that the proposed project is the most feasible and least environmentally damaging alternative that meets the project objectives.

2.5 Alternatives Considered

For the past two decades, members of the public, local agency staff members, and the U.S. Army Corps of Engineers have been analyzing the capital improvements necessary to protect communities within the flood-prone Reach 2 of San Francisquito Creek, upstream of U.S. Highway 101. The three fundamental approaches to providing flood protection—contain, detain, or bypass—with the specific alternatives proposed for analysis, include:

- Enable the creek to contain higher flows during storms by removing constrictions or raising the height of the creek bank in the floodplain area (Alternatives 2, 5, 6, 7, 8, 10, 11, 12, and 17),
- Temporarily detain or store portions of high flows during storms through one or more floodwater detention facilities in Reach 3 (Alternatives 3, 9, 13, and 16), and/or
- Remove a portion of the high flows immediately upstream of Reach 2, route that portion of the flow through the flood-prone area in an underground bypass channel, and deposit this water at a location in the creek that can safely convey it to San Francisco Bay (Alternatives 4, 14, and 15).

While CEQA requires that an EIR consider a reasonable range of alternatives and not every conceivable alternative, in 2017 SFCJPA conducted four public meetings and three public workshops in the three cities benefiting from and affected by this project to define the scope of this Draft EIR. As a result of this effort to engage the public and stakeholders, and through written comments received since then, SFCJPA expanded to 17 the number of potential alternatives; all 17 alternatives considered in this analysis are described below.

2.5.1 Alternative 1: No Action

As required by CEQA, through the EIR, SFCJPA will analyze the impact of not taking action and compare it to the alternatives that are selected through the screening process described below. The No-Action Alternative assumes that existing conditions will remain as is and no actions will be implemented; thus, it forms the project's baseline conditions. Because consideration of this alternative is required, it is not included in the alternatives screening process below.

2.5.2 Alternative 2: Replace the Pope-Chaucer Bridge and Widen Channel Downstream

This alternative would provide flood protection for Reach 2 upstream of U.S. Highway 101, with creek flows approximately equal to 7,500 cfs at the Pope-Chaucer Bridge and downstream. The bridge that connects Pope and Chaucer Streets would be replaced with a structure that would not cause flooding at flows up to this level. Were the Pope-Chaucer Bridge to be replaced in this way, five channel "bottlenecks" near the West Bayshore Road Bridge and between the Newell Road Bridge and Euclid Avenue would cause creek flows to back up and rise; this alternative would widen those areas, increase channel conveyance, and accommodate the increased flow underneath the Pope-Chaucer Bridge.

Directly upstream of University Avenue, an existing temporary 1- to 3-foot wall, which is an extension of the University Avenue Bridge parapet, would be replaced with a permanent concrete or hydrostatic parapet extension of similar length and height. Immediately upstream of the parapet extension, a 273-foot-long concrete in-channel structure and wall on the East Palo Alto side would be removed. In place of that concrete structure, the bank elevation would be restored and planted to restore riparian habitat, and a small creekside park would be established. Across from the location where the bridge parapet extension and restored bank meet, in the back of two Palo Alto properties, between 1 and 4 feet of creek bank elevation would be added to 225 linear feet of creek bank through sacked concrete atop the existing sacked concrete wall (125 feet) and through a concrete retaining wall that largely replaces an existing wooden retaining wall (100 feet).

Upstream of that area, on the Palo Alto side, the aging sacked concrete bank would be replaced with an architecturally treated soil nail wall. The replacement of aging sacked concrete with soil nail walls would also occur in two locations between the Newell Road Bridge and University Avenue bridge, and immediately upstream of West Bayshore Road, either a soil nail or sheet pile wall would replace sacked concrete. Additionally, pools and habitat structure would be added to the channel to create low-velocity refuge habitat for migrating steelhead at the Pope-Chaucer Bridge and widening sites.

2.5.3 Alternative 3: Construct One or More Detention Basins

This alternative would provide flood protection upstream of U.S. Highway 101 by modifying or building facilities in upstream areas of the San Francisquito Creek watershed west of Interstate 280 to detain and temporarily store water and reduce peak flows during large storm events. All feasible locations for such basins are on land owned by Stanford University.

Over the past several years, Stanford University has extensively studied a potential project for its Searsville Dam and Reservoir that could enable fish passage and provide flood protection for communities downstream. The University's preferred project would create an opening at the base of Searsville Dam and excavate sediment built up in the reservoir behind the dam to create a channel through the reservoir basin to areas upstream. Very high flows that exceed the capacity of the new opening would back up behind the dam, thereby providing temporary floodwater detention.

To understand the hydraulic and sediment issues associated with a potential project at Searsville Dam and Reservoir, Stanford University and its consultants have conducted studies in consultation with SFCJPA as well as staff at the state and federal regulatory agencies. This analysis supports the University's preferred approach to modifying the dam, indicating that, with infrequent and adaptive sediment management downstream near U.S. Highway 101, Stanford's preferred project is currently expected to reduce peak flow by 800–1,000 cfs during a 100-year event. Furthermore, Stanford's preferred project, in concert with SFCJPA's preferred project (Alternative 2 above), is expected to reduce overtopping in flood-prone areas during high flows up to the 100-year event. SFCJPA expects to begin construction on its preferred project as soon as possible and complete construction prior to changes at Searsville. If Stanford moves forward with a project at Searsville Dam and Reservoir, the University would analyze it in a separate CEQA document.

Should Stanford University not move forward with a project at Searsville that serves to temporarily detain floodwaters, two potential floodwater detention basins along the creek between that dam and Interstate 280 could provide protection to flood-prone communities downstream. Similar to Stanford-operated stormwater detention basins on its main campus, the potential locations of floodwater detention basins identified by SFCJPA could capture and store floodwaters during and immediately after major storms on up to three occasions each century, and continue their current uses at all other times.

These potential basins were considered for analysis in this Program EIR. One potential site is at Webb Ranch, where a basin could be constructed approximately 0.5 mile upstream of Interstate 280, along the southern side of San Francisquito Creek. During a major storm event, the basin could accept high creek flows into an area of approximately 27.4 acres to a depth of 13 feet to temporarily store approximately 440 acre-feet of water. This would hold back approximately 1,000 cfs during a peak flow, and the water would be released after the peak flow subsided downstream. A second potential site for a floodwater detention basin is the previous site of Boething plant nursery ("Former Nursery Detention Basin"), approximately 1.5 miles upstream of Interstate 280, along the northeastern side of San Francisquito Creek. The basin, which would cover approximately 12.4 acres, would detain approximately 180 acre-feet of water and hold back approximately 500 cfs during a peak flow.

2.5.4 Alternative 4: Construct an Underground Bypass Culvert

This alternative would provide flood protection upstream of U.S. Highway 101 against a storm event resulting in a flow of approximately 7,500 cfs by constructing a new creek bank structure that would divert 1,800 cfs during high flows into a culvert beneath city streets. The underground flow would bypass the floodplain area and be deposited back into the creek downstream at U.S. Highway 101, where capacity is higher, or directly into San Francisco Bay. SFCJPA has considered three potential alignments for a bypass culvert: Willow Road through Menlo Park, Woodland Avenue through East Palo Alto, and Seneca/Hamilton Avenue through Palo Alto.

2.5.5 Alternative 5: Replace the Pope-Chaucer Bridge and Construct Floodwalls

This alternative would provide flood protection upstream of U.S. Highway 101 for creek flows approximately equal to 7,500 cfs at the Pope-Chaucer Bridge and downstream. The Pope-Chaucer Bridge would be replaced with a structure that would not obstruct flows of 7,500 cfs or less. Also, this alternative would provide flood protection upstream of U.S. Highway 101 by modifying or constructing approximately 4,300 feet of new floodwalls between Newell Road Bridge and Maple Street in Palo Alto. The floodwalls would have a height of 1 to 2 feet on both sides of the creek, allowing a minimum of 7,500 cfs to be contained within the channel.

2.5.6 Alternative 6: Install a Culvert through the Pope-Chaucer Bridge and Increase Capacity Downstream

This alternative would construct a culvert through the existing Pope-Chaucer Bridge foundation. The culvert, which would be in addition to the existing culvert under the bridge, would transport flows of approximately 1,800 cfs from the creek. To meet project objectives, this alternative would also require flood protection downstream of the Pope-Chaucer Bridge, such as channel widening or floodwall construction, as discussed above under Alternatives 2 and 5.

2.5.7 Alternative 7: Develop a Bypass around the Pope-Chaucer Bridge and Increase Capacity Downstream

This alternative would include construction of a culvert for bypassing flows to one side of the existing Pope-Chaucer Bridge. The culvert would divert approximately 1,800 cfs of flow from the creek into the bypass and return it back into the creek immediately downstream of the Pope-Chaucer Bridge via a downstream outlet structure. This alternative would require fish exclusion screens and access for maintenance. To meet project objectives, this alternative would require additional flood protection downstream of the Pope-Chaucer Bridge, such as channel widening or floodwall construction, as described for Alternatives 2 and 5, above.

2.5.8 Alternative 8: Channel Deepening

This alternative would deepen the channel by excavating in areas where flow capacity needs to be increased.

2.5.9 Alternative 9: Develop Multiple Small-scale Detention Facilities

This alternative would involve construction of a series of small-scale water detention facilities. Locations are assumed to be on both sides of the creek and in the upper watershed, with property owners installing small detention facilities such as a bioretention basins or rain gardens. The goal would be to infiltrate rainfall at each property, thereby reducing runoff to the creek.

2.5.10 Alternative 10: Increase Debris and Nonnative Vegetation Removal

This alternative would increase the frequency and area for the removal of nonnative plants and debris from the creek (including dead vegetation). Reducing the amount of material in the creek would decrease channel roughness and increase water velocity, thereby reducing flood risk.

2.5.11 Alternative 11: Remove the Pope-Chaucer Bridge and Increase Capacity Downstream

This alternative would involve removing, not replacing, the Pope-Chaucer Bridge to increase flow capacity at the site. The bridge creates a constriction; if removed, at least 7,500 cfs of flow would be able to move past that location and downstream. To meet project objectives, this alternative would require additional flood protection downstream of the Pope-Chaucer Bridge, such as channel widening or floodwall construction, as described above for Alternatives 2 and 5.

2.5.12 Alternative 12: Replace the Pope-Chaucer Bridge with a Bike-/ Pedestrian-only Bridge and Increase Capacity Downstream

This alternative would involve replacing the Pope-Chaucer Bridge with a bridge that would allow for greater flow capacity (i.e., 7,500 cfs) and accommodate only pedestrians and bicyclists, not motorized vehicles. To meet project objectives, this alternative would require additional flood protection downstream of the Pope-Chaucer Bridge, such as channel widening or floodwall construction, as described above for Alternatives 2 and 5.

2.5.13 Alternative 13: Increase Incentives or Requirements for Low-impact Development

This alternative would involve creating incentives or requirements for the implementation of low-impact development (LID) that would increase the amount of permeable surfaces in the watershed. This alternative assumes that any remaining open space along or near the creek would be developed in a low-impact manner.

2.5.14 Alternative 14: Use Overland Floodways

This alternative would involve directing flood flows over local roadways to bypass the constrained creek channel within the floodplain area. These flows would then be deposited back into the creek downstream at U.S. Highway 101, where capacity is higher, or directly into San Francisco Bay. The only roadways adjacent to the creek in the floodplain area are residential streets.

2.5.15 Alternative 15: Build and Operate a New Pump Station

This alternative would involve construction and operation of a new pump station to pump water from upstream of the flood-prone area during flood events, and deposit these flows back into the creek downstream at U.S. Highway 101, where capacity is higher, or directly into San Francisco Bay.

To provide protection during flows of 7,500 cfs, the capacity of the pump station would have to be approximately 1,800 cfs.

2.5.16 Alternative 16: Build and Operate a Ladera Dam

The Ladera Dam concept was initially described in the *Reconnaissance Investigation Report of San Francisquito Creek* (San Francisquito Creek Coordinated Resource Management Planning 1997). The dam was conceptualized as an on-stream (in-line) earthen dam that straddles San Francisquito Creek near Webb Ranch. A dam in this area would allow normal creek flows through a channel in the base of the dam. High-flow events that would exceed the capacity of the base channel would be temporarily detained behind the dam.

2.5.17 Alternative 17: U.S. Army Corps of Engineers Plan

This alternative, developed by the U.S. Army Corps of Engineers but not selected by the Corps as its preferred alternative, includes features similar to Alternative 2: replace the Pope-Chaucer Bridge and widen the channel to increase conveyance and provide freeboard. This alternative includes widening in four locations, all on the Palo Alto creek bank. Some areas of widening would replace sacked concrete with a soil nail wall, and during widening, temporary access roads would be needed. Non-structural measures, such as development of a floodplain management plan and an early-warning system, are also considered part of the alternative.

2.6 Alternatives Screening

Alternatives 2 through 17 were evaluated using a two-round approach. In Round 1 (Table 2-1), alternatives were evaluated for their ability to meet the project objectives. None of the alternatives would preclude future actions to bring cumulative flood protection up to a 100-year flood event and therefore this objective was not evaluated. Alternatives that could not achieve project objectives were excluded from further consideration (i.e., screened out). The alternatives that could potentially meet project objectives were subject to feasibility evaluation in Round 2 (Table 2-2). The results of this screening are summarized below.

Table 2-1. Screening of Alternatives, Based on each Alternative's Ability to Meet Project Objectives

Project Objective	Replace the Pope-Chaucer Bridge and Widen Channel Downstream	Construct One or More Detention Basins	Construct an Underground Bypass Culvert	Replace the Pope-Chaucer Bridge and Construct Floodwalls	Install a Culvert through the Pope-Chaucer Bridge and Increase Capacity Downstream	Develop a Bypass around the Pope-Chaucer Bridge and Increase Capacity Downstream	Channel Deepening	Develop Multiple Small-scale Detention Facilities	Increase Debris and Nonnative Vegetation Removal	Remove the Pope-Chaucer Bridge and Increase Capacity Downstream	Replace the Pope-Chaucer Bridge with a Bike-/ Pedestrian-only Bridge and Increase Capacity Downstream	Increase Incentives or Requirements for Low-Impact Development	Use Overland Floodways	Build and Operate a New Pump Station	Build and Operate a Ladera Dam	U.S. Army Corps of Engineers Alternative (not selected by the Corps)
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9	Alt 10	Alt 11	Alt 12	Alt 13	Alt 14	Alt 15	Alt 16	Alt 17
NOTE: ● = Meets Criteria Easily; ◒ = Meets Criteria with Difficulty; X = Does Not Meet Criteria																
a. Protect life, property, and infrastructure from floodwaters exiting the creek.	Yes. Could increase creek capacity by 1,800 cfs, to a total of 7,500 cfs, before water would overtop the channel.	Yes. One basin could reduce peak flow through the floodplain area by at least 800–1,000 cfs. Multiple basins could reduce peak flow by 1,800 cfs, which would eliminate overtopping during a flow event up to 7,500 cfs.	Yes. Culvert could convey 1,800 cfs around the floodplain area, thereby eliminating overtopping during a flow event up to 7,500 cfs.	Yes. Could increase creek capacity by 1,800 cfs, to a total of 7,500 cfs, before water would overtop the channel.	Yes. Could increase cumulative capacity in the creek and new culvert by 1,800 cfs, to a total of 7,500 cfs, before water would overtop the channel.	Yes. Could increase cumulative capacity in the creek and new culvert by 1,800 cfs, to a total of 7,500 cfs, before water would overtop the channel.	No. Sediment would be re-deposited in floodplain area, reducing capacity.	No. Beneficial for environment, but would not meet project's objective for meaningful flood protection.	No. Beneficial, but would not meet project's objective for meaningful flood protection.	Yes. Could increase creek capacity by 1,800 cfs, to a total of 7,500 cfs, before water would overtop the channel.	Yes. Could increase creek capacity by 1,800 cfs, to a total of 7,500 cfs, before water would overtop the channel.	No. Floodplain area is mostly developed, and upper watershed has mostly pervious surfaces; therefore, limited opportunities for LID projects, and would not meet project's objective for meaningful flood protection.	No. Flooding overland in the developed floodplain area would pose a risk to people and property, and not meet project's objectives for meaningful flood protection.	Yes. Could convey 1,800 cfs around the floodplain area, thereby eliminating overtopping during a flow event up to 7,500 cfs.	Yes. Could reduce peak flow through the floodplain area by 1,800 cfs, thereby eliminating overtopping during a flow event up to 7,500 cfs.	No. Would result in overtopping during a 7,500 cfs flow event.
Rating	●	◒	●	●	●	●	X	X	X	●	●	X	X	◒	●	X
b. Minimize impacts on the adjacent community.	Yes. Impacts would include noise and car, bike and pedestrian traffic during construction. Loss of mature trees, which would be mitigated.	Yes. Infrequent impacts on agricultural/ commercial lands. During construction, noise and traffic impacts from trucks off-hauling sediment.	No. During construction, major traffic, utility, and noise impacts, and temporary relocation of adjacent residents. New easements required.	Yes. Aesthetic impacts, noise and traffic during construction, and loss of mature trees, which would be mitigated.	Yes. Impacts would include noise and traffic during construction, loss of several mature trees, which would be mitigated.	Yes. Impacts would include noise and traffic during construction, loss of several mature trees, which would be mitigated.	Yes. Recurring noise and traffic impacts during initial construction as well as periodic maintenance to deepen the channel.	Yes. Noise and traffic impacts during construction. Could displace other land uses.	Yes. Minimal community impacts, if any.	No. Permanent and temporary construction impacts on traffic. Loss of mature trees, which would be mitigated.	No. Permanent impact on car traffic; loss of mature trees, which would be mitigated. During construction, impacts of noise and car, bike and pedestrian traffic.	Yes. Minimal impact during construction. if any.	No. Major impacts on transporta-tion during, and immediately after flood events.	Yes. Construction noise and traffic impacts. Potential noise impacts during operation of pump station.	Yes. During construction, noise and traffic impacts from trucks.	Yes. Impacts would include noise and traffic during construction, and the loss of mature trees, which would be mitigated.
Rating	◒	◒	X	◒	◒	◒	◒	◒	●	X	X	●	X	◒	◒	◒

Project Objective	Replace the Pope-Chaucer Bridge and Widen Channel Downstream Alt 2	Construct One or More Detention Basins Alt 3	Construct an Underground Bypass Culvert Alt 4	Replace the Pope-Chaucer Bridge and Construct Floodwalls Alt 5	Install a Culvert through the Pope-Chaucer Bridge and Increase Capacity Downstream Alt 6	Develop a Bypass around the Pope-Chaucer Bridge and Increase Capacity Downstream Alt 7	Channel Deepening Alt 8	Develop Multiple Small-scale Detention Facilities Alt 9
c. Minimize impacts on/ enhance the environment.	Yes. Impacts on riparian vegetation along banks. Improvement of aquatic habitat where channel is widened and concrete is removed.	Yes. Approximately 1–3 times per century, inundation of habitat within basin. Impacts during construction.	No. At water inlet and outlet, impacts on creek bank vegetation and potential impact from trapping aquatic species.	Yes. Impacts on riparian vegetation along banks. Impacts during construction.	No. Creates a less natural channel and flow condition at bridge. Potential trapping of aquatic species and impacts on riparian vegetation. Impacts during construction.	No. Creates a less natural channel and flow condition at bridge. Potential trapping of aquatic species and impacts on riparian vegetation. Impacts during construction.	No. During construction and ongoing impacts on benthic habitat at deepening sites.	Yes. Noise and other impacts during construction.
Rating	◒	◒	X	◒	X	X	X	◒
d. Minimize operational and maintenance requirements.	Yes. Would not change long-term operation and maintenance.	Yes. Increased operational and maintenance needs for new inlet and outlet structures and detention basins.	Yes. Increased maintenance at water inlet and outlet structures and within culvert.	Yes. Would not change long-term operation and maintenance.	Yes. Increased maintenance of culvert.	Yes. Increased maintenance of culvert.	No. Requires ongoing, channel deepening.	Yes. Maintenance of new detention basins, including water inlets and outlets, and removal of accumulated sediment.
Rating	●	◒	◒	◒	◒	◒	X	◒
Advance for feasibility screening?	**Yes**. Meets project objectives.	**Yes**. Meets project objectives.	No. Substantial impacts on community during construction. Environmental impacts without the environmental benefits of improving creek habitats.	**Yes**. Meets project objectives, though potentially substantial impacts on aesthetics and trees on top of bank.	No. Installing a culvert through the bridge's concrete structure would not improve the creek's hydraulic function and would be inconsistent with the project's objective to enhance habitats.	No. Diverting water around the existing bridge would not improve the creek's hydraulic function and would be inconsistent with the project's objective to enhance habitats.	No. High ongoing maintenance costs and benthic habitat impacts make this inconsistent with project goals to minimize environmental impacts and maintenance requirements.	No. Although beneficial, it would not meet project's objective for meaningful flood protection.

Project Objective	Increase Debris and Nonnative Vegetation Removal Alt 10	Remove the Pope-Chaucer Bridge and Increase Capacity Downstream Alt 11	Replace the Pope-Chaucer Bridge with a Bike-/ Pedestrian-only Bridge and Increase Capacity Downstream Alt 12	Increase Incentives or Requirements for Low-Impact Development Alt 13	Use Overland Floodways Alt 14	Build and Operate a New Pump Station Alt 15	Build and Operate a Ladera Dam Alt 16	U.S. Army Corps of Engineers Alternative (not selected by the Corps) Alt 17
c. Minimize impacts on/ enhance the environment.	Yes. Could remove vegetation and natural debris that provides aquatic habitat.	Yes. Impacts on riparian vegetation along banks. Minor impacts during construction.	Yes. Impacts on riparian vegetation along banks. Minor impacts during construction.	Yes. Minimal impacts. Benefits to water quality.	No. Flood waters on roads would pick up petroleum products and debris, which may be delivered to creek and San Francisco Bay.	Yes. Potential impacts on aquatic species at water inlet.	No. Loss of riparian and other habitats, and fish passage would be impeded.	Yes. Impacts on riparian vegetation along banks. Improvement of aquatic habitat where channel is widened and concrete is removed.
Rating	◒	◒	◒	●	◒	◒	X	X
d. Minimize operational and maintenance requirements.	No. Requires ongoing, potentially annual, removal.	Yes. Would likely not change long-term operation and maintenance.	Yes. Would likely not change long-term operation and maintenance.	Yes. LID facilities require maintenance, such as vegetation management.	No. Structures to divert and keep water on specific floodways would require mainten-ance.	Yes. Pump station and related facilities would require mainten-ance.	No. New requirements to maintain dam and remove sediment.	Yes. Would likely not change long-term operation and maintenance.
Rating	X	●	●	◒	◒	◒	◒	●
Advance for feasibility screening?	No. Although beneficial, it would not meet project's objective for meaningful flood protection. SFCJPA is involved in a separate annual effort related to this alternative.	No. Traffic impacts of bridge removal would not be consistent with the project's objective to minimize community impacts.	No. Traffic impacts of bridge removal would not be consistent with the project's objective to minimize community impacts.	No. Limited opportunities for LID projects; would not meet project's objective for meaningful flood protection.	No. Roadway flooding would be inconsistent with the project objective of meaningful flood protection and make evacuation and emergency response during floods difficult.	**Yes.** Meets project objectives.	No. Would not meet project objectives to minimize impacts on environment and minimize maintenance.	No. Would be inconsistent with the project objective of meaningful flood protection because overtopping would occur during a 7,500 cfs flow event.

Based on the analysis in Table 2-1, Alternatives 2, 3, 5, and 15 have the potential to meet project objectives. The feasibility of implementing these alternatives is assessed in Table 2-2.

Table 2-2. Screening of Alternatives: Feasibility of the San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project: Upstream of U.S. Highway 101

Conceptual Alternatives	Replace the Pope-Chaucer Bridge and Widen Channel Downstream	Construct One or More Detention Basins	Replace the Pope-Chaucer Bridge and Construct Floodwalls	Build and Operate a New Pump Station
	Alt 2	Alt 3	Alt 5	Alt 15
NOTE: ● = Meets Criteria Easily; ◒ = Meets Criteria with Difficulty; X = Does Not Meet Criteria				
Relative Cost Estimate (low, medium, high, very high)	Medium	High	Medium	Very High
Rating	◒	○	◒	X
Logistical Feasibility and Site Control	SFCJPA and its partners have control over many sites and would require easements at some properties.	Sites are controlled by Stanford University; SFCJPA would need easements.	SFCJPA and its partners have control over many sites and would require easements at some properties.	Member cities would need to agree to implement this alternative. At present, no locations or discharge areas exist.
Rating	◒	◒	◒	X
Technical Feasibility	Feasible	Feasible	Feasible	To achieve flood protection objective, both pump station and culvert would need to be very large.
Rating[c]	●	●	●	◒
Advance for Full Analysis?	**Yes**	**Yes**	**Yes**	No, high costs for construction and operation. Uncertain feasibility.

2.7 Summary of Results

The previous screening process examined how well each of the 17 alternatives met the project objectives, and then the cost, and logistical and technical feasibility, of the remaining alternatives. The following alternatives advanced through this screening process:

- Alternative 2: Replace the Pope-Chaucer Bridge and Widen Channel Downstream
- Alternative 3: Construct One or More Detention Basins

- Alternative 5: Replace the Pope-Chaucer Bridge and Construct Floodwalls Downstream

As described below, these alternatives were grouped according to the reaches in which they primarily occur, then re-organized and renamed.

2.7.1 Reach 2 Alternatives

Within Reach 2, Alternatives 2 and 5 advanced for full analysis in the EIR. Alternative 2 was renamed the Channel Widening Alternative, and Alternative 5 was renamed the Floodwalls Alternative. Both alternatives include replacing the Pope-Chaucer Bridge and widening the channel immediately upstream of U.S. Highway 101 (Site 5) to align the channel with the recently completed modifications to the bridge at the highway's West Bayshore frontage road. Where Alternatives 2 and 5 differ is in how they achieve flood protection between those two locations. The Channel Widening Alternative would involve primarily creek channel widening, replacing decades-old sacked concrete walls with more vertical, architecturally treated soil nail walls. The Floodwalls Alternative would involve construction of floodwalls at the top of the creek's banks. Finally, both alternatives would include construction of creekside parks and aquatic habitat enhancements (Figures 2-1 and 2-2). Table 2-3 shows the different elements of the Channel Widening and Floodwalls Alternatives.

Table 2-3. Reach 2 Alternatives

Channel Widening Alternative (Preferred Project)	Floodwalls Alternative
Widen Channel at Sites 1 through 4, University Avenue Bridge Parapet Extension	Construct Floodwalls
Replace Pope-Chaucer Bridge	Replace Pope-Chaucer Bridge
Widen Channel at Site 5	Widen Channel at Site 5
Construct Creekside Parks where feasible	Construct Creekside Parks where feasible
Enhance Aquatic Habitat	Enhance Aquatic Habitat

As described above in Section 2.1, this document is a Program EIR with a "project-level component." Specifically, Reach 2 alternatives are analyzed at a project level. This was possible because there is currently adequate information for project-level analysis of these alternatives, and the alternatives may be implementable in the near term.

2.7.2 Reach 3 Alternatives

Within Reach 3, Alternative 3 advanced for full analysis in the Program EIR. Alternative 3 was split into two alternatives, each representing one of the two potential detention basin sites. The potential detention basin at the previous site of Boething plant nursery is called the Former Nursery Detention Basin Alternative and the potential detention basin at Webb Ranch is called the Webb Ranch Detention Basin Alternative.

Reach 3 alternatives are analyzed at a program level because, although these alternatives may be important components of SFCJPA's overall flood protection program, there is not sufficient information available for analysis at a project level. In addition, the need for these projects may be obviated by a Stanford University project at Searsville Dam and Reservoir.

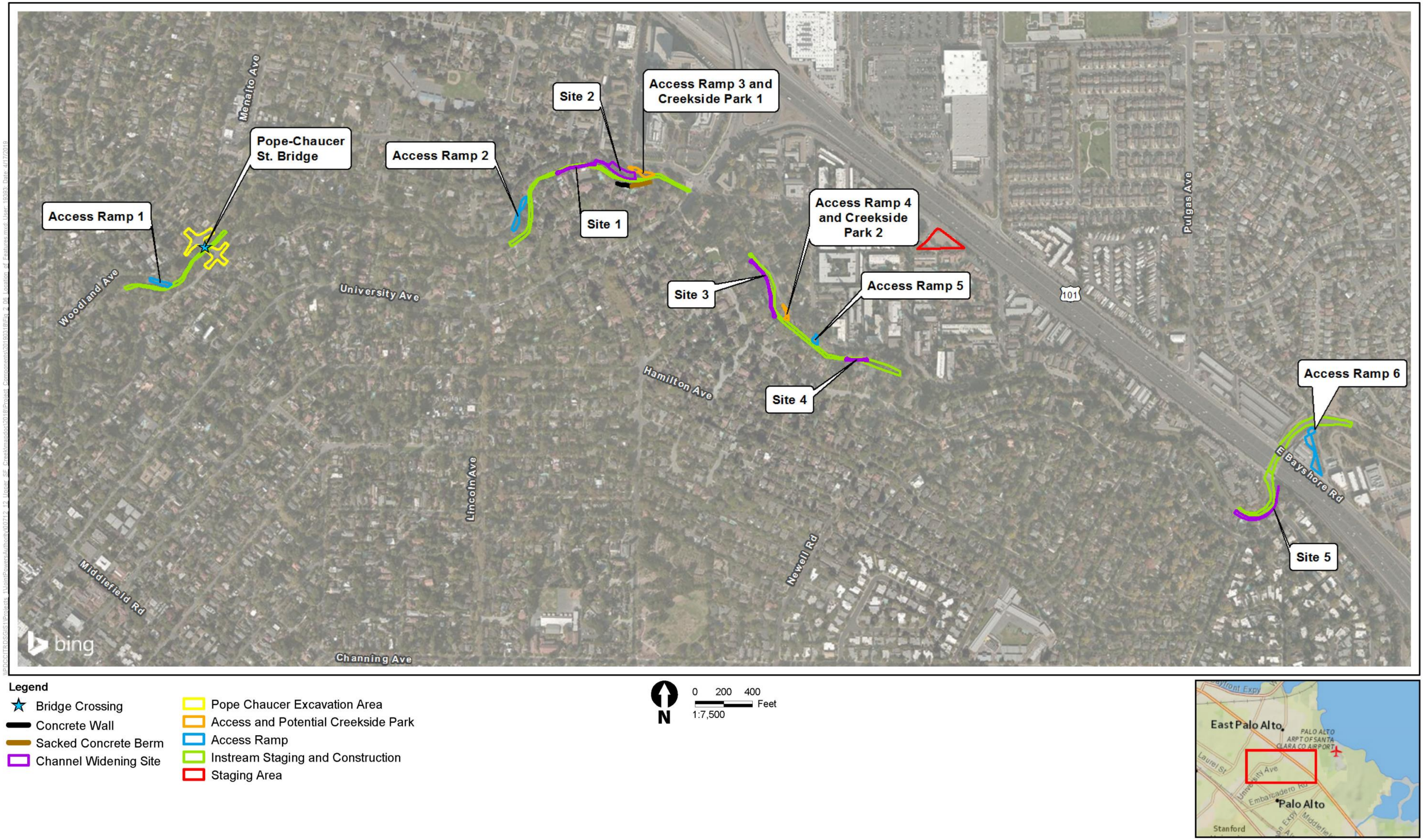

Figure 2-1. Channel Widening Alternative Components

Figure 2-2. Floodwall Alternative Components

2.8 Description of Alternatives

2.8.1 No-Project Alternative

Under the No-Project Alternative, the proposed flood protection, habitat enhancement, and recreational opportunities would not occur. SFCJPA and member agencies would continue ongoing activities to maintain existing flood protection facilities; flood protection and other activities that are not part of the proposed project would continue.

2.8.2 Channel Widening Alternative (Preferred Project)

The Channel Widening Alternative (Figures 2-3 through 2-6) is the preferred project for Reach 2. Under the Channel Widening Alternative, flood protection would be achieved by replacing the Pope-Chaucer Bridge with a bridge that accommodates an increased flow. Downstream of the bridge, flood protection would occur by modifying the channel only in areas necessary to accommodate that greater flow, widening the waterway by removing instream concrete structures at five sites and by replacing the University Avenue Bridge upstream parapet extension. Aquatic habitat restoration, which would benefit steelhead and other species, would be achieved by adding permanent woody debris, boulders, and/or features to the channel at the widening sites and the Pope-Chaucer Bridge. The creation of recreational opportunities would involve constructing two small creekside parks and connecting new features to existing trails where possible.

Because the window to work in the creek is limited by restrictions protecting native steelhead migration during spawning season, the construction of this alternative will occur during at least two different years.

SFCJPA is working to enable the construction of the preferred project to begin by the early summer of 2020. However, SFCJPA must first complete the certification of this EIR and secure the permits, easements, and additional funding necessary to begin construction. Given the complexities and uncertainties related to securing these items for a multi-jurisdictional project with substantial constraints, construction may not begin until 2021.

The construction methods and equipment anticipated for this alternative are considered typical for projects of this type, and are described further below.

Replace Pope-Chaucer Bridge

The existing Pope-Chaucer Bridge, which includes a concrete culvert and deck below a roadway and open space on the downstream side, would be completely removed in order to increase flow to approximately the capacity of the channel at that location (7,500 cfs). The new bridge would be supported by two piers alongside features that support fish migration, while the road width would remain the same; on each side of road is a sidewalk, two small areas for creek overlook, and either one or two street lamps. Replacement of the Pope-Chaucer Bridge would require closure of the existing bridge roadway for approximately 9 months. Construction would begin in the spring, with work starting within the stream channel on June 15. Approximately 1,000 cubic yards (cy) of material would be removed below the ordinary high-water mark, and approximately 5,000 cy would be removed between the ordinary high-water mark and the top of the bank. Streambed vegetation, from 250 feet downstream of the bridge to 250 feet upstream, would be removed as needed to accommodate construction equipment.

Construction Methods for Pope-Chaucer Bridge Replacement

It is anticipated that demolishing the existing bridge and building the new bridge will take approximately 9 months, during which time vehicular, bike, and pedestrian traffic across San Francisquito Creek at this location would be interrupted. Following bridge closure in the spring, removal of the existing channel culvert and earth embankment would begin on June 15. After completion of instream staging and construction of the new bridge, construction of the approaches to the bridge along Palo Alto Avenue, Woodland Avenue, Pope Street, and Chaucer Street would be accomplished concurrently with final placement of rock slope protection (RSP) along the newly graded stream banks.

Construction Equipment

The equipment anticipated to be used during construction includes front-end loaders, backhoes, graders, dump trucks, cranes pile drivers, fork lifts, trailer-mounted portable generators, pickup trucks, light hand tools, pumps, drilling machines, and compaction equipment of various sizes. This is further described in this Draft EIR's *Air Quality* section.

Construction

The culvert would be removed by breaking up the culvert and surrounding fill material with a jack hammer and removing it with an excavator and trucks. The channel area under and adjacent to the new bridge would then be graded to the approximate dimensions of the newly expanded channel's cross section using heavy equipment. Any channel flows in San Francisquito Creek would be kept separate from construction activities using temporary flow diversion procedures within or adjacent to the remaining portions of the culvert. To protect the active stream, the contractor would employ one of the following best management practices (BMPs), depending, in part, on the amount of streamflow: install piping between upstream and downstream cofferdams (filled with cleaned gravel) to allow upstream flow to bypass the work site, use a temporary low-flow channel with sandbag levees, or use the existing culvert while it remains in place.

Once streamflows are protected, bridge construction would begin. Heavy equipment (excavators, backhoes, etc.) would be used to first excavate the channel to the new cross section, then remove the old culvert, the two abutment foundations at the top of the bank, and the two pier foundations in the stream channel at the toe of each slope. Cofferdams would be installed using driven sheet piling to maintain dry areas for excavation, pile driving, and the placement of concrete around the piles. Excavation would continue to the bottom elevation of the pier footing. Approximately 78 steel-pipe piles (five or six per day) would be hammer driven into the ground with the use of diesel pile-driving machines. Once the piles are installed, concrete foundations would be formed using both steel and timber forms. Dewatering may be necessary to install the foundation and pier walls under dry conditions. If necessary, dewatering outflows would be directed downstream and outside of the construction footprint using settling tanks and pumps.

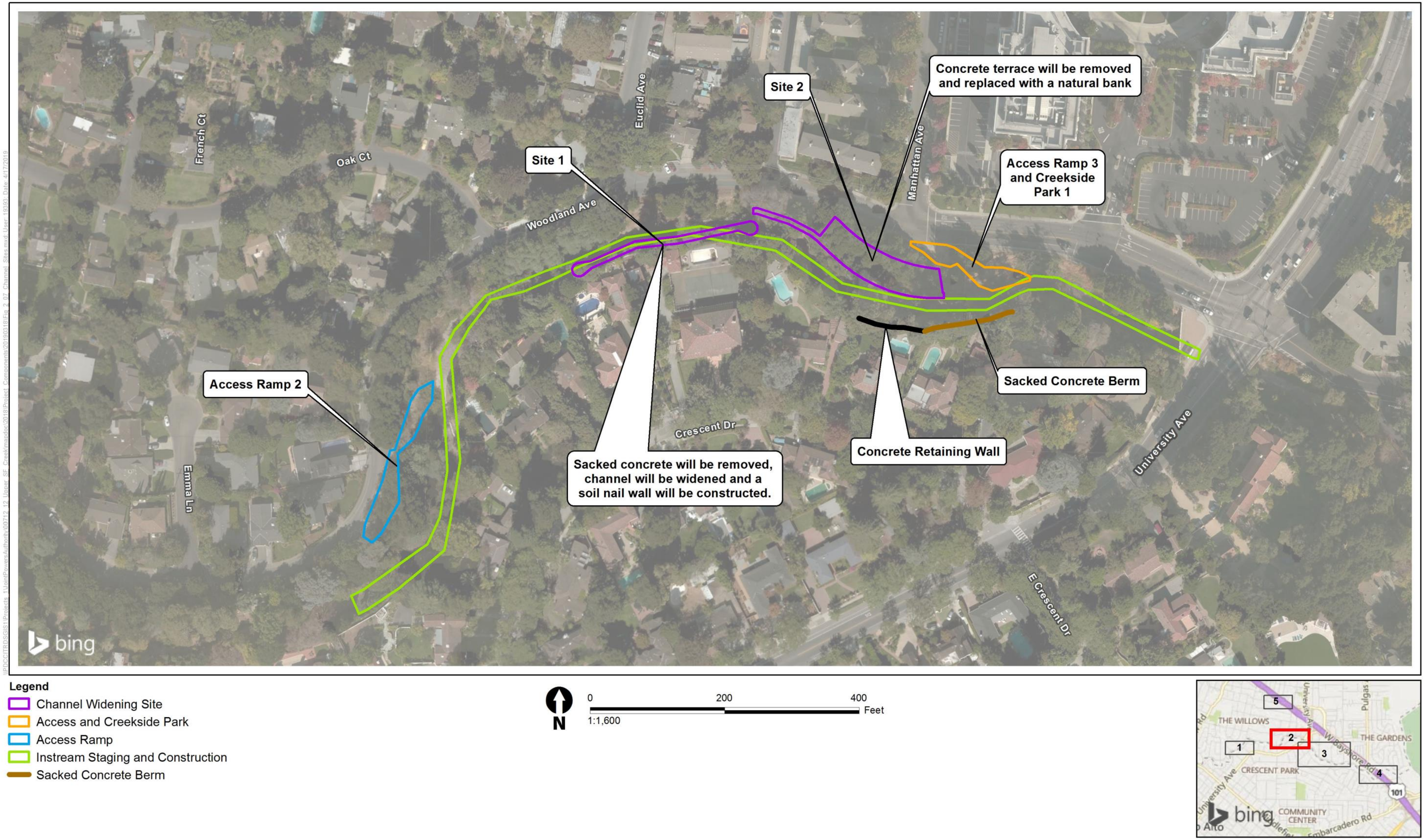

Figure 2-3. Channel Widening Alternative, Sites 1 and 2

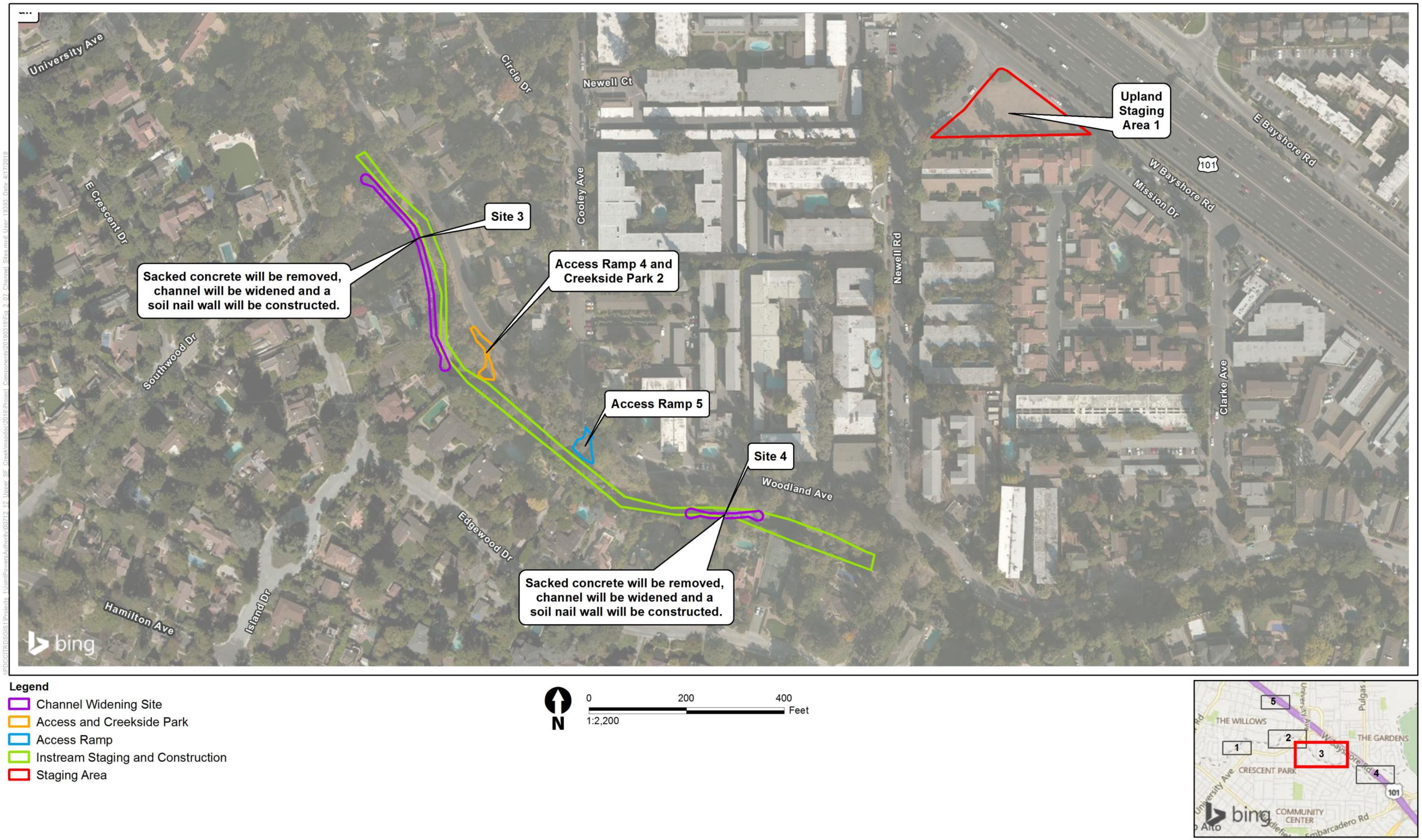

Figure 2-4. Channel Widening Alternative, Sites 3 and 4

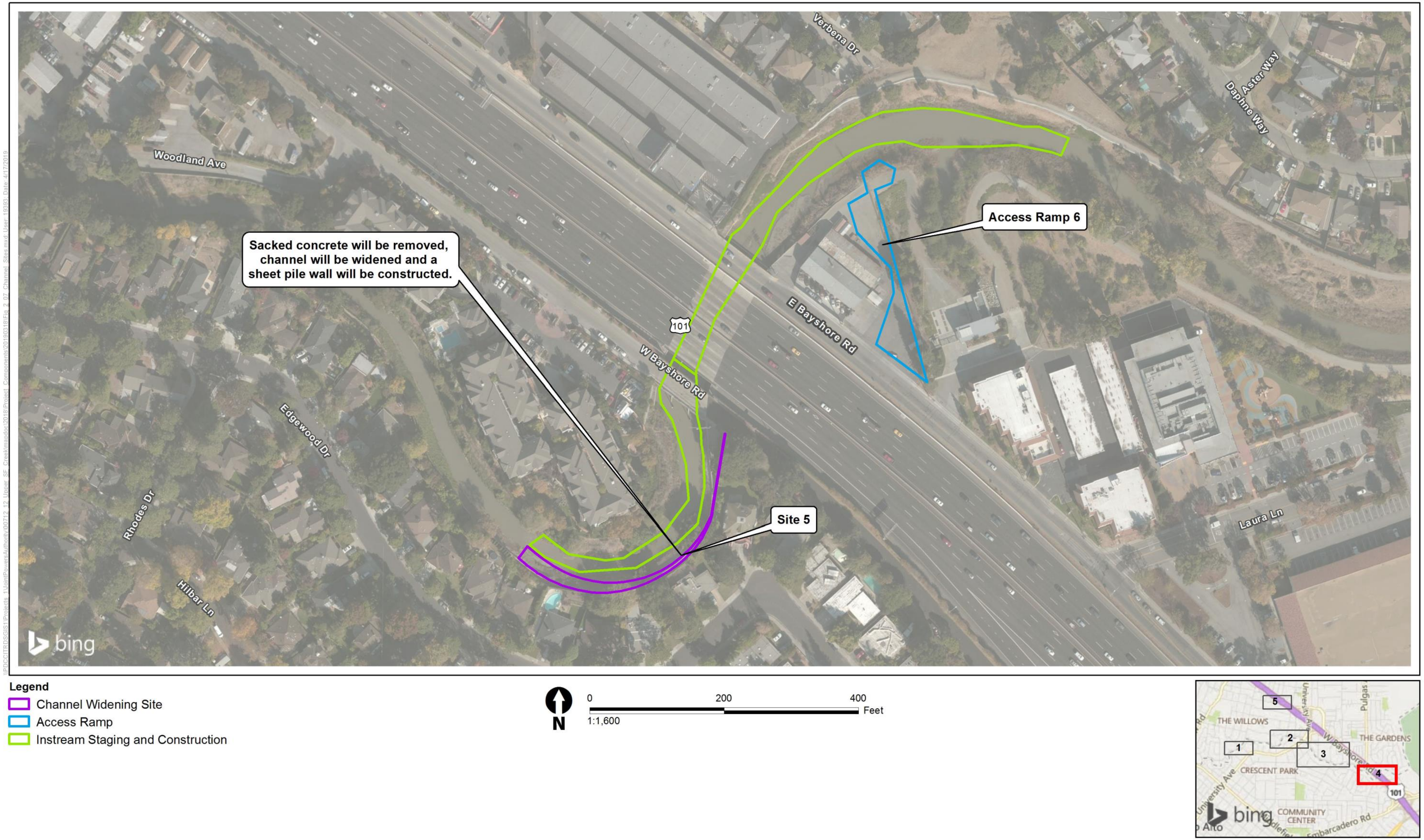

Figure 2-5. Channel Widening Alternative, Site 5

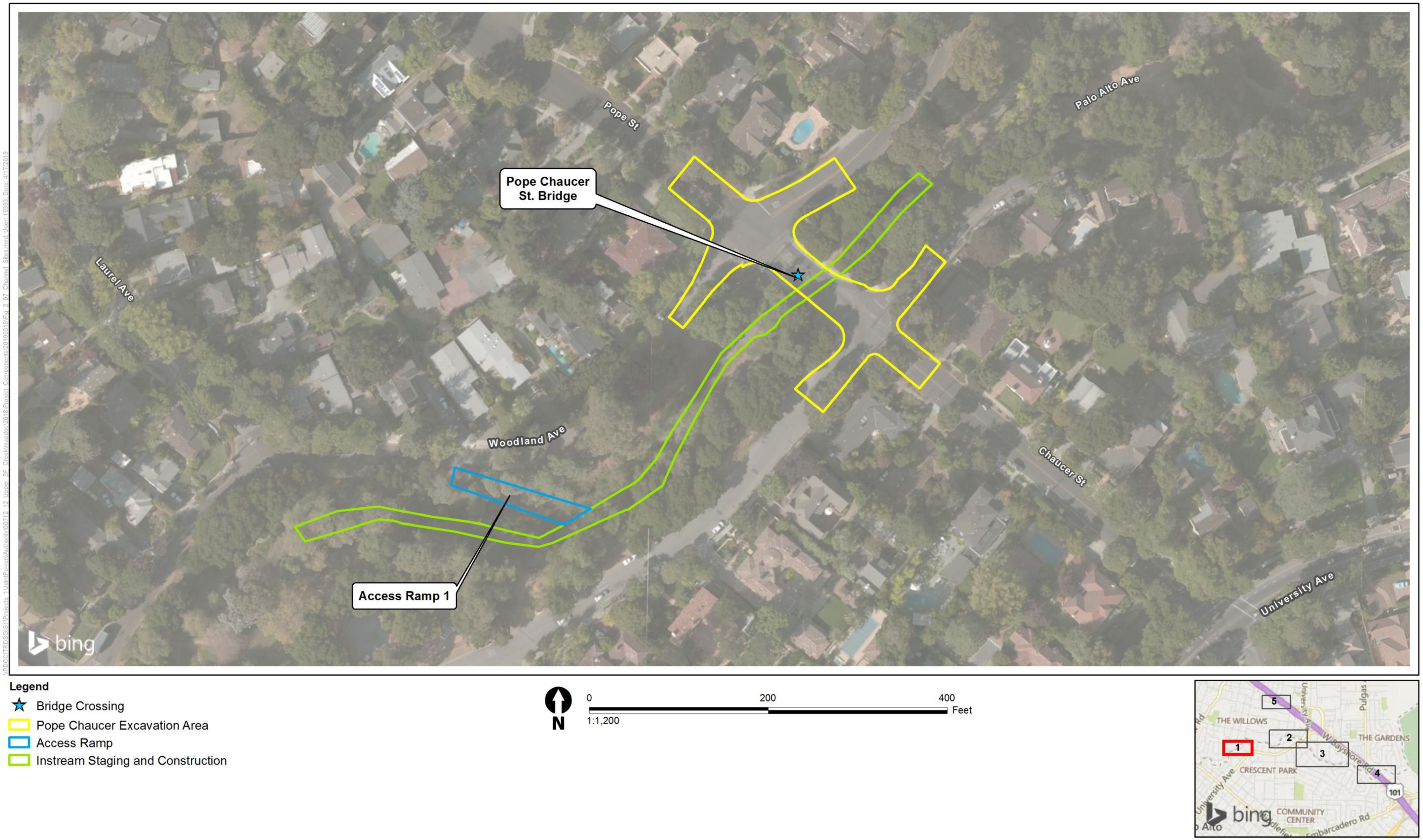

Figure 2-6. Pope-Chaucer Bridge
Included in the Channel Widening Alternative and Floodwall Alternative

Pile-supporting foundations, piers, and abutments with wing walls would be formed with the use of reinforced concrete. Abutments and pier footings would be installed below the final grade of the streambed. The steel piles in the abutments would remain below the surface; however, 23 piles on each pier footing (a total of 46 piles) would be exposed within the creek. Water from the curing concrete would be retained within forms with the aid of curing compounds. Once cured, temporary falsework and forms would be constructed in the channel to support the deck concrete on the superstructure while curing. The deck concrete would be poured onto reinforcing steel within the superstructure and retained by watertight forms and equipment that would prevent the concrete from falling into the channel. Following curing, all falsework and forms would be removed from the channel. The bridge approach would be surfaced concurrently to allow local traffic to pass over the new bridge. The entire channel in the area where earth removal occurred would then be graded to the approximate dimensions of the expanded channel's cross section using heavy construction equipment. The remaining portion of the existing culvert would be removed.

Just as this project minimizes the areas of creek channel to be widened to accommodate an increased flow under a replaced Pope-Chaucer Bridge, it calls for RSP only in the areas necessary to protect the channel, banks, and infrastructure during high creek flows. RSP with a 1.5 to 1 side slope would be placed in the newly graded channel. From the upstream face of the bridge, RSP would be about halfway up the bank for approximately 150 feet and then at the toe of the bank for another 100 feet, and from the downstream face of the bridge, RSP would be about halfway up the bank for approximately 125 feet and then at the toe of the bank for another 125 feet. RSP would also be placed along the channel bottom but only in the area directly under the bridge in order to protect the piers from scour. In total, it is anticipated that 4,800 square feet of RSP would be placed below the bridge, 13,000 square feet would be placed upstream, and 11,000 square feet would be placed downstream. As part of the project, fish habitat (large woody debris, boulders, pools, and bed material over in-channel RSP) would be constructed in the channel beneath, and immediately upstream and downstream, of the bridge.

Channel Widening at Sites 1 through 4

From the Pope-Chaucer Bridge to U.S. Highway 101, the creek is heavily constrained on both sides by residential property, public roadways, and utility infrastructure. Through most of this reach, the capacity of the channel is equal to or greater than 7,500 cfs, which is the maximum flow that would be conveyed from upstream areas once the Pope-Chaucer Bridge is replaced. Areas of the channel that cannot accommodate this level of flow are constrained by concrete structures, and thus this project alternative increases capacity by widening bank areas covered with hardened material. This project would replace those creek bank areas with:

1. a natural slope where there is sufficient space between the top of bank and existing homes and roads, or
2. an almost vertical, architecturally treated wall where no such space exists at the top of bank.

At Site 1 (Figure 2-3), approximately 288 linear feet of existing sacked concrete as well as bank soil material behind that concrete would be removed from the bank on the Palo Alto side of the creek ("Palo Alto Bank") with use of an excavator. Excavated and removed materials would include approximately 2,321 cy of bank soil and 173 cy of sacked concrete (total of 2,495 cy). The bank would be set back approximately 5 to 20 feet (mean of 12 feet) along the reach, and to stabilize the bank, the project would construct a soil nail wall, which would include an architectural treatment to better blend in with surrounding geology or natural features.

At Site 2 (Figures 2-3), approximately 320 linear feet of concrete terracing and bank material would be removed from the bank on the East Palo Alto side of the creek ("East Palo Alto Bank") with an excavator. Excavated and removed materials would include approximately 4,819 cy of bank soil and 318 cy of concrete terracing (total of 5,137 cy). The bank would be set back approximately 1 to 15 feet (mean of 10 feet) along the reach and vegetated with native plant species. Also, on the East Palo Alto Bank at Site 2, a 1- to 3-foot-high wooden extension of the University Avenue Bridge parapet stretches approximately 400 feet upstream. This would be replaced with a permanent parapet extension of the same size (maximum of 3 feet) that is either a fixed concrete structure or a hydrostatic one that raises only during high flows. Across from the location where the bridge parapet extension and restored bank meet, in the back of two Palo Alto properties, between 1 and 4 feet of creek bank elevation would be added to 225 linear feet of creek bank through sacked concrete atop the existing sacked concrete wall (125 feet) and through a concrete retaining wall that largely replaces an existing wooden retaining wall (100 feet).

At Site 3 (Figure 2-4), approximately 456 linear feet of existing sacked concrete and bank material along the Palo Alto Bank would be removed with an excavator. Excavated and removed materials would include approximately 2,806 cy of bank soil and 508 cy of sacked concrete (totaling 3,314 cy). The bank would be set back approximately 4 to 24 feet (mean of 9 feet), and to stabilize the bank, an architecturally treated soil nail wall would be constructed.

At Site 4 (Figure 2-4), approximately 160 linear feet of existing sacked concrete and bank material along the Palo Alto Bank would be removed with an excavator. Excavated and removed materials would include approximately 478 cy of bank soil and 122 cy of sacked concrete material (totaling 600 cy). The bank would be set back approximately 4 to 18 feet (mean of 9 feet), and to stabilize the bank, an architecturally treated soil nail wall would be constructed.

In total, approximately 10,424 cy of bank soil, 804 cy of sacked concrete, and 318 cy of concrete terracing would be removed by widening these four channel sites (total of 11,546 cy).

Channel Widening at Site 5

At Site 5 (Figure 2-5), the Palo Alto Bank is currently stabilized with a warped sacked concrete wall. Widening would allow the Palo Alto Bank to "tie in" to the U.S. Highway 101 bridge, which was recently reconstructed and widened immediately downstream. Currently, the width of the upstream channel does not match the width of the bridge. To conform the channel to the bridge design widening at Site 5 is included in both of the Reach 2 alternatives. Approximately 400 linear feet of sacked concrete and bank material would be removed with an excavator. Excavated and removed materials would include approximately 6,111 cy of bank soil and concrete material. The bank would be set back approximately 12 to 21 feet (mean of 15 feet), and to stabilize the bank, a sheet pile wall would be constructed.

Construction Methods for Channel Widening

Channel widening would occur over two construction seasons, each lasting between June 15 and October 15 due to restrictions protecting native steelhead migration. Detailed information regarding the construction approach is provided below, including the differences among Sites 1 through 5.

Construction Equipment

The construction equipment anticipated to be needed at each site as well as the specifications for the equipment are provided in the tables below. When not in use, equipment will be stored within the instream or upland staging areas.

Table 2-4. Construction Equipment List

Equipment	Site 1	Site 2	Site 3	Site 4	Site 5	Total
Backhoe	1	1	1	1	1	5
Cement Truck with Boom	1	1	1	1	1	5
Pump Truck	1	1	1	1	1	5
Excavator	1	1	1	1	1	5
Track-mounted Dump Truck	1	1	1	1	1	5
Man Lift	1	1	1	1	1	5
Fork Lift	1	1	1	1	1	5
Pickup Truck	4	4	4	4	4	20
Drill Rig	0	0	0	0	1	1
Vibrahammer	0	0	0	0	1	1

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Table 2-5. Equipment Specifications

			Grams per Horsepower-Hour per Equipment											
Equipment Name	Horsepower	Load Factor	ROG	NO_X	CO	SO_2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5	CO_2	Total GHGs (CO_2e)
Backhoe	75	0.55	0.835	5.394	3.908	0.006		0.474	0.474		0.474	0.474	568.300	573.495
Concrete Truck (T7 SC)			1.14E-03	2.81E-02	5.15E-03	3.67E-05	2.15E-04	8.05E-04	1.02E-03	7.81E-05	7.41E-04	8.19E-04	3.84	3.88
Pump Truck (T7 SC)			1.14E-03	2.81E-02	5.15E-03	3.67E-05	2.15E-04	8.05E-04	1.02E-03	7.81E-05	7.41E-04	8.19E-04	3.84	3.88
Excavator	157	0.57	0.652	4.868	3.381	0.006		0.288	0.288		0.288	0.288	568.299	573.494
Track-mounted Dump Truck (T7 SC)			1.14E-03	2.81E-02	5.15E-03	3.67E-05	2.15E-04	8.05E-04	1.02E-03	7.81E-05	7.41E-04	8.19E-04	3.84	3.88
Man Lift (T7 SC)			1.14E-03	2.81E-02	5.15E-03	3.67E-05	2.15E-04	8.05E-04	1.02E-03	7.81E-05	7.41E-04	8.19E-04	3.84	3.88
Fork Lift (T7 SC)			1.14E-03	2.81E-02	5.15E-03	3.67E-05	2.15E-04	8.05E-04	1.02E-03	7.81E-05	7.41E-04	8.19E-04	3.84	3.88
Pickup Truck (LDT1)			3.41E-04	9.88E-04	9.53E-03	8.54E-06	9.86E-05	1.26E-05	1.11E-04	3.91E-05	1.14E-05	5.05E-05	0.84	0.88
Drill Rig	2000	0.42	1.12	14.061	3.03	0.93		0.998	0.998		0.998	0.998	505.755	510.379
Vibrahammer	350	0.62	0.339	3.704	1.212	0.005		0.121	0.121		0.121	0.121	568.299	573.494

Notes: ROG = reactive organic gas; NO_X = oxides of nitrogen; CO = carbon monoxide; SO_2 = sulfur dioxide; PM2.5 = particulate matter 2.5 microns in diameter or less; PM10 = particulate matter 10 microns in diameter or less; CO_2 = carbon dioxide; GHG = greenhouse gas; CO_2e = carbon dioxide equivalent

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Access Ramps

There is evidence that access ramps were previously constructed at the sites, but the ramps are now vegetated. These access ramps would be re-established through vegetation removal and grading to allow vehicles to enter the channel. The access ramps would be approximately 12 feet wide and 20 feet long and revegetated after use with appropriate native plant species.

A transmission box at Access Ramp 2 (Figure 2-3) would be moved a short distance within the footprint of the reconstructed access ramp. Access Ramps 3 and 4 (Figures 2-3 and 2-4) have poles and overhead wires that would be relocated a short distance to a previously disturbed unvegetated area. At Access Ramp 5 (Figure 2-4), a transmission box would be relocated a short distance to a previously disturbed and unvegetated area.

Upland Staging Area

Construction vehicles, equipment, and materials for channel widening and wall construction would be staged in East Palo Alto at 375 Donohoe Street and/or at the corner of West Bayshore Road and Newell Road, as shown on Figures 2-1 and 2-8, pending the securing of a temporary easement.

Instream Staging and Construction Areas

There is limited upland area available for staging. Hence, the areas shown in Figures 2-3 through 2-6 as *instream staging* and *construction areas* would serve for the movement of equipment and vehicles as well as the staging of materials for the walls that would be constructed at each site. As necessary, any existing vegetation at the bottom of the channel would be removed within these areas to accommodate construction activities.

Process for Removing Sacked Concrete and Bank Material

Sacked concrete and bank material would be removed 5 feet at a time, starting at the top of the bank, using an excavator. After each 5-foot section of sacked concrete and bank material is removed, an architecturally treated soil nail wall would be built within that section, as described below. At Site 5, a sheet pile wall would be built rather than a soil nail wall.

Soil Nail Wall Construction

For this type of bank stabilization, non-tensioned steel bars (nails) are inserted into the stream bank face to anchor the wall into the ground below the surface using top to bottom construction (Figure 2-7). A soil nail wall is considered environmentally superior to other retaining wall types and construction methods because it minimizes the amount of soil excavated, has much less ground disturbance compared to a retaining wall with a substantial footing, and typically has a shorter construction period.

Construction of the soil nail wall would begin with widening the creek by removing the existing sacked concrete and soil behind it in lifts. A lift is a specified height of soil to be excavated at any given time to allow a single soil nail to be inserted and the bank stability layer to be constructed. The bank stability layer is a thin layer of shotcrete, reinforced with welded wire, which is applied to the exposed slope around the soil nail. Working from top to bottom, once all the soil nails in the first lift are inserted and the bank stability layer constructed, then work would begin on the second lift below and continue downward until all the soil nails have been inserted. The installation of the soil nails involves drilling a hole, inserting a steel bar, and grouting the drilled hole. A steel bearing plate is then installed on the end of the soil nail and tightened down onto the shotcrete bank stability layer. Once all the lifts have been constructed, a second layer of shotcrete or concrete is then applied on top of the bank stability layer, which would encase the bearing plate and soil nail assembly. The exterior of this layer would include an architectural treatment to better blend in with surrounding geology or natural features.

To minimize scour at the bottom of the soil nail wall and to prevent future bank instability, bank toe protection would be added at the base of the wall. The toe protection constitutes placing specially sized rocks along the length of the wall and around the corners and embedding them approximately 2 feet into the natural creek bottom. At the face of the wall, it would be approximately 4 feet above the existing creek bottom and would slope downward away from the wall until it conforms with the creek bottom. The top of the toe protection is dictated by the water level for the relatively common 2-year storm event.

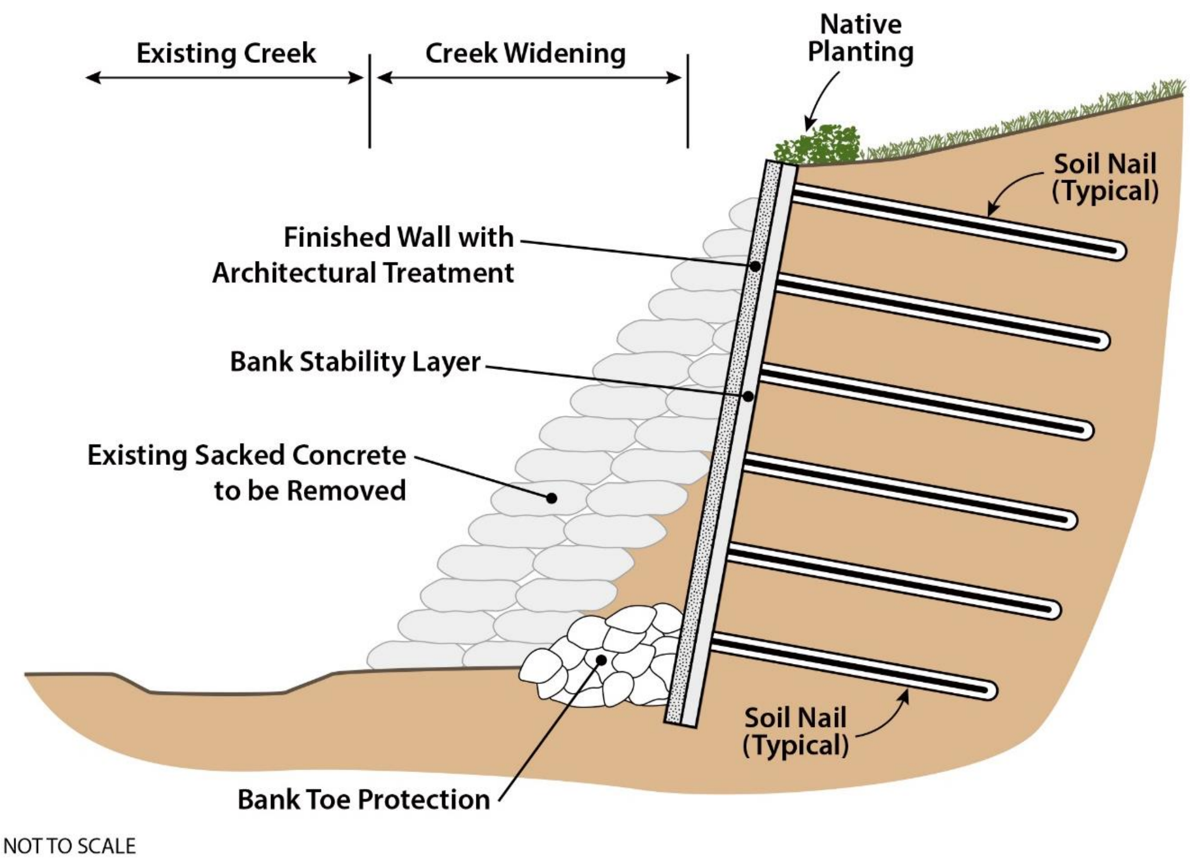

Figure 2-7. Typical Soil Nail Wall Construction

Legend

Staging Area

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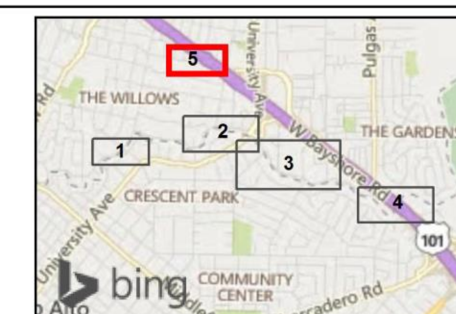

Figure 2-8. Upland Staging Area 2

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Sheet Pile Wall Construction

Sheet piles are proposed for one widening area by West Bayshore Road. Sheet pile walls are constructed from prefabricated, interlocking pile sections and driven into the ground. Steel piles offer modest corrosion resistance and reusability; reinforced concrete is also used in some situations. Steel sheet piles are most commonly used in deep temporary excavations that are free of subsurface boulders or rocks that could prevent driving to desired depths. The area that is proposed for sheet pile installation has limited access and would therefore be accessed via an existing ramp downstream of U.S. Highway 101. This access would minimize impacts on residents on either side of the creek.

Sheet pile walls are constructed by first establishing the wall location on the ground with use of a guide frame or guide beam. Next, a piling rig lifts the first sheet pile and vibrationally drives it to the desired depth. The piling rig then drives the second sheet pile adjacent to the first but overlapping so that the two piles lock together. Steps 2 and 3 are then repeated until the wall's perimeter is completed.

If the sheet piles are not long enough to reach the required depth in the ground, extension sheet piles are required. To extend sheet piles, the bottom of a second sheet pile is welded to the one in the ground; the new combined unit is vibrationally driven into the ground as described above.

Rock Slope Protection

At the toe of all widened areas, the base of the wall or bank would be excavated down to a depth of 2 feet and boulders would be placed (Figure 2-7). RSP located in the channel bottom would be covered with native bed material to improve creek habitat and aesthetics. Willow stakes would be installed along the bottom of much of the RSP and near the low-flow channel, as well as at the top of the RSP.

Factors that would be considered when determining whether to plant vegetation include the following:

1. Would the vegetation conflict with flow capacity goals?
2. Are water velocities too high to maintain vegetation?
3. Is the underlying soil substrate appropriate?
4. Would the vegetation affect access to the creek?

Concrete Truck Operation

A concrete truck would operate from Woodland Avenue, with a boom extended to (or across) the channel to access the areas where each wall would be built. Trees along Woodland Avenue and San Francisquito Creek would be pruned to accommodate the truck and boom.

Traffic Management

At each access ramp, there would be temporary traffic stops with flaggers for loading/off-loading equipment and materials and vehicle ingress/egress to the site. In addition, traffic would move one way on Woodland Avenue when a concrete truck is operating from the road. Traffic would not be stopped for more than approximately 30 minutes at any site.

Dewatering

Depending on conditions during the year of construction, dewatering may or may not need to occur at any of the sites either concurrently or sequentially.

Sites 1 through 4: The instream staging/construction areas (Figures 2-3 and 2-4) would be sealed off with clean gravel bags and plastic sheeting such as Visqueen or the equivalent. Cofferdams would be built to prevent/reduce any downstream influence or upstream freshwater influence. Within these areas, a gas generator-driven pump would be used to pump water from a shallow groundwater well with corrugated piping inserted, through a pipeline to a discharge location downstream of the site. An energy dissipater would be built to prevent discharged water from causing scour in the channel.

Site 5: The instream staging/construction area (Figures 2-5) would be dewatered during construction. Dewatering is expected to require the installation of about eight groundwater wells, each approximately 12 to 20 feet deep; continuous pumping would produce about 130,000 gallons per day and effectively dewater the area. Water would be routed around construction areas back to the creek. A hollow stem auger drilling rig would be used to install the wells. Cofferdams would be built to prevent/reduce any downstream tidal influence or upstream freshwater influence. Downstream of the dewatered area, a sheet pile coffer dam would be built. Native fish would be relocated to creek areas outside of construction impacts prior to dewatering. Upstream of the dewatered area, gravel bags would be used. Water from upstream would be gravity fed through a pipe around the site or pumped, if needed.

Extension of the University Avenue Bridge Parapet and Concrete Removal

Directly upstream of University Avenue, a temporary 2- to 3-foot wall, which is an extension of the University Avenue Bridge parapet, would be replaced with a permanent structure of similar length and height. Immediately upstream of the parapet extension, a 273-foot-long concrete in-channel structure and wall on the East Palo Alto side would be removed to increase flow capacity, and in its place the project will restore a natural bank with native plants, restore the natural bank elevation, and create a small creekside park.

Construction of Small Creekside Parks

Consistent with the project objective of creating new recreational opportunities and connecting to existing bike and pedestrian corridors, two small creekside parks may be constructed in the City of East Palo Alto at the locations shown in Figures 2-3 and 2-4. The parks would be sited where construction access ramps were previously built and used. The parks would consist of landscaping and benches. The design would use gravel so as to maintain existing pervious surfaces. The total area of each creekside park would be a maximum of 400 square feet.

Aquatic Habitat Restoration

Consistent with the project objective of enhancing ecosystem habitat within the project area, particularly interconnected habitat for threatened and endangered species, this project would restore habitat through several actions. In this alternative, it would remove concrete and nonnative vegetation within the channel and, where possible, create a natural set back bank with native vegetation, and reduce water velocities and create a high-flow-velocity refuge for steelhead to migrate through within Reach 2. This would be achieved by adding hydraulic control structures such as J-weirs, root wads, boulders, and/or other features at the toe of newly constructed bank walls.

Operations and Maintenance

Project elements would require maintenance to continue functioning effectively, similar to existing maintenance. Constructed features will be inspected annually for structural integrity, and debris, substantial sediment deposition, and potentially hazardous vegetation will be adaptively managed and potentially removed from the channel before the rainy season, or during or immediately following a major storm event. In addition, the monitoring and maintenance of new vegetation would occur, at a minimum, for 3 years following completion of the project. This activity would consist of removing invasive plant species, inspecting newly planted vegetation, and replanting as needed. All of these activities will be conducted in accordance with a new Operations and Maintenance Plan for the project. Creekside parks would require trash pickup and disposal as well as routine maintenance of benches and landscaping.

2.8.3 Floodwalls Alternative

Flood protection under the Floodwalls Alternative would be achieved by constructing floodwalls (Figure 2-2 and Figure 2-9), as described below. It would also include the following elements, which are described in the Channel Widening Alternative description above: replace the Pope-Chaucer Bridge, widen the channel at Site 5, and perform environmental and recreational enhancements.

A total of 7,260 linear feet of floodwalls would be constructed. The floodwalls would be constructed of concrete, with a maximum height of 2 feet from the top of the bank. For floodwall installation, all access would be from Woodland Avenue. Access ramps and the upland staging areas shown for the Channel Widening Alternative in Figures 2-3 through 2-6 and Figure 2-8 would be used for this alternative. Installation of the floodwalls would be preceded by excavation and compaction to prepare the foundation. An excavator and dump trucks would be in the channel to remove excavated soil and bring in the formwork and rebar. In-stream work would be necessary to access many of the sites, given the proximity of private property and physical barriers such as trees and fences. Concrete would be pumped across the channel from Woodland Avenue using a concrete truck with an articulating boom. Traffic would be controlled (flagged) where the concrete truck is operating; trees would need to be pruned in those areas. Vegetation at the bottom of the channel would be cleared as needed to allow for vehicle movement and construction. Pieces of the floodwalls would be brought to the project site by tractor trailer. Installation of the floodwalls would require approximately 3 months (i.e., 72 days for installation of the floodwall panels and 10 days for miscellaneous construction activities and contingencies).

Operations and Maintenance

For the floodwalls, operations and maintenance would be guided by a future agreement among SFCJPA partner agencies on both sides of the creek and consist primarily of vegetation management to enable visual inspections to detect damaged concrete or exposed reinforcing bar. If found, the damaged concrete would be repaired in accordance with American Concrete Institute Bulletins. Visual inspections would also look for undermining. If found, backfilling or grouting would be implemented.

Figure 2-9. Example Sheet Pile Floodwall

2.8.4 Detention Basin Alternatives

The Reach 3 alternatives would occur upstream of the Pope-Chaucer Bridge on Stanford University property (Figure 2-10). This reach is analyzed at a program level in this EIR.

Former Nursery Detention Basin Alternative Construction

This alternative would involve the construction of an approximately 12.4-acre detention basin at the previous Boething Nursery site, roughly 1.5 miles upstream of Interstate 280 on the northeastern side of San Francisquito Creek and south of the Stanford Linear Accelerator Center's linear accelerator building. The 14-foot-deep detention basin would store approximately 180 acre-feet of water, hold back approximately 500 cfs during a peak flow, and have a cut of 1,310,000 cy. The detention basin would be dug using excavators. The excavated material would be loaded onto trucks for hauling to an off-site location for reuse or disposal. The detention basin would not be lined. A weir would be constructed along the San Francisquito Creek channel adjacent to the detention basin. A notch (spillway) would be cut into the weir to allow water to flow into the detention basin during high flows. Because of the depth of the channel relative to the surrounding ground level, a hydraulic backwater achieved by the installation of wing walls within the channel may be required to bring the water surface level within the creek up to the desired weir elevation. Construction of the detention basin is estimated to require approximately 6 months. A fish exclusion device would be installed to prevent fish stranding, using National Marine Fisheries Service guidelines (National Marine Fisheries Service 1997). Road re-alignments may be necessary for site access. The weir would require regular maintenance to ensure it will function as needed during flood events. This alternative could be implemented as a stand-alone project with no downstream improvements, or as a complementary project after downstream improvements are made.

As a stand-alone project, during storm events resulting in creek flows greater than the current capacity of the Pope-Chaucer Bridge (about 5,800 cfs), water would flow over the notch from San Francisquito Creek to the detention basin and be temporarily detained to reduce peak flows downstream. Hydraulic models estimate that this would occur about once every 22 years.

As a future project that would complement SFCJPA's preferred project in Reach 2, the weir would be designed such that the basin begins to fill during storms that result in a flow greater than the new capacity of Pope-Chaucer Bridge (about 7,500 cfs). Hydraulic models estimate that this would occur about one to two times every century.

Sediment that accumulates within the basin during flood events would need periodic removal and transport to an appropriate location. The land that the basin is constructed on would function as it does currently for the majority of the time; it is anticipated that it would function as a floodwater detention facility one or two times per century on average. Construction would maximize potential for local infiltration. The general site access, staging, and basin locations are shown on Figure 2-10.

Webb Ranch Detention Basin Alternative Construction

This alternative would consist of the construction of an approximately 27.4-acre detention basin at the Webb Ranch site, approximately 0.5 mile upstream of Interstate 280 on the southern side of San Francisquito Creek. The detention area encompasses a portion of a U-Pick field and parking area. The 13-foot-deep basin would store approximately 440 acre-feet of water, hold back approximately 1,000 cfs during a peak flow, and have a cut of approximately 1,040,000 cy. The land that the basin is constructed on would continue to function as it does currently for the majority of the time, allowing for multiple land use (parking/farming). It is anticipated that it would function as a floodwater detention facility one or two times per century on average.

Similar to the Former Nursery Detention Basin Alternative described above, the Webb Ranch Detention Basin Alternative could be implemented as a stand-alone project with no downstream improvements, or as a complementary project after downstream improvements are made. Both potential basins would begin operating during storms of similar size (during a 22-year storm event as a stand-alone project, or during an event equal to the 1998 flood as a project complementing SFCJPA's preferred project).

The general design and construction methods of these two basins would also be similar. A notch (spillway) would be cut into the weir to allow water to flow into the detention basin during high flows. Because the channel adjacent to this location is not as deep as it is at the Former Detention Basin site, there would likely not be a need to create a hydraulic backwater to divert flows in to the basin. Construction of the detention basin is expected to take approximately 6 months. A fish exclusion device would be installed to prevent fish stranding, using National Marine Fisheries Service guidelines (National Marine Fisheries Service 1997). Sediment that would accumulate within the basin would need to be periodically removed and to maintain capacity. Some road re-alignment may be necessary. The general site access, staging, and basin locations are shown on Figure 2-10. Road re-alignments may be necessary for site access during construction. The weir would require regular maintenance to ensure it will function as needed during flood events.

2.9 Environmental Commitments

All project alternatives would incorporate the environmental commitments listed below for all elements of the project. The project's BMPs and other commitments will be included in construction plans and specifications and the Mitigation Monitoring and Reporting Program.

2.9.1 General Construction Site Housekeeping

1. The work sites, areas adjacent to the work sites, and access roads will be maintained in an orderly condition, free and clear from debris and discarded materials. Personnel will not sweep, grade, or flush surplus materials, rubbish, debris, or dust into storm drains or waterways. Upon completion of work, all building materials, debris, unused materials, concrete forms, and other construction-related materials will be removed from the work site (Santa Clara Valley Water District Water Quality BMP 18).
2. To prevent mosquito breeding on construction sites, SFCJPA will require the construction contractor to ensure that standing water is gone within 4 days (96 hours). All work sites will be examined, and unnecessary water that may stand longer than 96 hours will be drained. Construction personnel will properly dispose of unwanted or unused artificial containers and tires. If possible, any container or object that holds standing water that must remain outdoors will be covered, inverted, or have drainage holes drilled (California Department of Public Health 2008).
3. The following general construction site housekeeping measures will be implemented as necessary within staging areas:
    a. Staging areas that are not already paved or covered with compacted aggregate base that are used for parking vehicles, trailers, workshops, maintenance, equipment, piping, formwork, rebar, storing masonry on pallets, or metal product storage will be graded as required and surfaced with a minimum of 3 inches of compacted aggregate base rock over a high-modulus, woven soil separation geo-textile. Areas for storing aggregate base or other rock products will also be placed on this same geo-textile. The objective is to maintain separation between native soils and construction materials. Areas storing soils and sand are not required to be surfaced with an aggregate base course.
    b. Aggregate base will be removed from all staging areas prior to project completion, and the surfaces will be regraded to their original grades or matching surrounding conditions as directed by the engineer.
    c. Any soils contaminated with petroleum product or other hazardous materials by the contractor will be removed by the contractor and disposed of in accordance with local, state, and federal laws.
    d. Contractor is responsible for weed control in staging areas and material storage areas.
4. The spread of invasive nonnative plant species and plant pathogens will be avoided or minimized by implementing the following measures:
    a. Construction equipment will arrive at work sites clean and free of soil, seed, and plant parts to reduce the likelihood of introducing new weed species.

Figure 2-10. Detention Basins

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b. Any imported fill material, soil amendments, gravel, etc., required for construction and/or restoration activities that will be placed within the upper 12 inches of the ground surface will be free of vegetation and plant material.

c. Certified weed-free erosion control materials (or rice straw in upland areas) will be used exclusively.

d. To reduce the movement of invasive weeds into uninfested areas, the contractor will stockpile topsoil removed during excavation as appropriate and subsequently reuse the stockpiled soil for re-establishment of disturbed project areas.

2.9.2 Water Quality Protection

1. The following measures will be implemented as necessary to reduce and minimize stormwater pollution during ground-disturbing maintenance and construction activities:

    a. Soils exposed because of construction or maintenance activities will be seeded and stabilized using hydroseeding, mulching, and/or erosion control fabric. These measures will be implemented such that the site is stabilized and water quality protected prior to the first rainfall event that results in a creek flow of 100 cfs, or November 1, whichever comes first.

    b. The preference for erosion-control fabrics will be natural fibers.

    c. Appropriate measures include, but are not limited to, the following:

        - Silt fences
        - Straw bale barriers
        - Brush or rock filters
        - Storm drain inlet protection
        - Sediment traps
        - Sediment basins
        - Erosion-control blankets and mats
        - Soil stabilization (i.e., tackified straw with seed, jute, geotextile blankets)
        - Wood chips

    d. All temporary construction-related erosion control methods will be removed at the completion of the project (e.g., silt fences) (Santa Clara Valley Water District Water Quality BMP 41).

2. Sediments will be stored and transported in a manner that minimizes water quality impacts.

    a. Wet sediments may be stockpiled outside of a live stream or within a dewatered stream so water can drain or evaporate before removal.

    b. This measure applies to saturated, not damp, sediments and depends upon the availability of a stockpile site.

    c. For those stockpiles located outside the channel, water draining from them will not be allowed to flow back into the creek or into local storm drains that enter the creek, unless water quality protection measures recommended by the Regional Water Quality Control Board are implemented.

d. Trucks may be lined with an impervious material (e.g., plastic) or have their tailgates blocked with dry dirt or hay bales, for example. Trucks may drain excess water by slightly tilting their loads and allowing the water to drain out.

e. Water will not drain directly into channels (outside of the work area) or onto public streets without providing water quality control measures.

f. Streets and affected public parking lots will be cleared of mud and/or dirt by street sweeping (with a vacuum-powered street sweeper), as necessary, and not by hosing down the street (Santa Clara Valley Water District Water Quality BMP 4).

3. Oily, greasy, or sediment-laden substances or other material that originate from project operations and may degrade the quality of surface water or adversely affect aquatic life, fish, or wildlife will not be allowed to enter, or be placed where they may later enter, any waterway.

4. The project will not increase the turbidity of any watercourse flowing past the construction site by taking all necessary precautions to limit any increase in turbidity as follows:

   a. Where natural turbidity is between 0 and 50 nephelometric turbidity units (NTUs), increases will not exceed 5 percent.

   b. Where natural turbidity is greater than 50 NTUs, increases will not exceed 10 percent.

   c. Where the receiving water body is a dry creekbed or storm drain, waters in excess of 50 NTUs will not be discharged from the project site.

   d. Water turbidity changes will be monitored. The discharge water measurements will be made at the point where the discharge water exits the water control system for tidal sites and 100 feet downstream of the discharge point for non-tidal sites. Natural watercourse turbidity measurements will be made in the receiving water 100 feet upstream of the discharge site. Natural watercourse turbidity measurements will be made prior to initiation of project discharges, preferably at least 2 days prior to commencement of operations (Santa Clara Valley Water District Water Quality BMP 40).

5. Vehicles will be washed and maintained only in approved areas. No washing of vehicles will occur at work sites (Santa Clara Valley Water District Hazards and Hazardous Materials BMP 9).

6. No fueling will be done in a waterway or immediate floodplain, unless equipment stationed in these locations is not readily relocated (i.e., pumps, generators).

   a. For stationary equipment that must be fueled on the site, containment will be provided in such a manner that any accidental spill of fuel will not be able to enter the water or contaminate sediments that may come in contact with water.

   b. Any equipment that is readily moved out of the waterway will not be fueled in the waterway or immediate floodplain.

   c. All fueling done at the job site will provide containment to the degree that any spill will be unable to enter any waterway or damage riparian vegetation (Santa Clara Valley Water District Hazards and Hazardous Materials BMP 10).

7. No equipment servicing will be done in a stream channel or immediate floodplain, unless equipment stationed in these locations cannot be readily relocated (i.e., pumps, generators).

a. Any equipment that can be readily moved out of the channel will not be serviced in the channel or immediate floodplain.

b. All servicing of equipment done at the job site will provide containment to the degree that any spill will be unable to enter any channel or damage stream vegetation.

c. If emergency repairs are required in the field, only those repairs necessary to move equipment to a more secure location will be done in a channel or floodplain.

d. If emergency repairs are required, containment will be provided equivalent to that done for fueling or servicing (Santa Clara Valley Water District Hazards and Hazardous Materials BMP 11).

8. Measures will be implemented to ensure that hazardous materials are properly handled and the quality of water resources is protected by all reasonable means.

   a. Prior to entering the work site, all field personnel will be trained to know how to respond when toxic materials are discovered.

   b. The discharge of any hazardous or nonhazardous waste, as defined in Division 2, Subdivision 1, Chapter 2, of the California Code of Regulations (CCR) will be conducted in accordance with applicable state and federal regulations.

   c. In the event of any hazardous material emergencies or spills, personnel will call the Chemical Emergencies/Spills Hotline at 1 800 510-5151 (Santa Clara Valley Water District Hazards and Hazardous Materials BMP 12) and relevant city hotline.

9. Accidental release of chemicals, fuels, lubricants, and non-storm drainage water will be prevented.

   a. Field personnel will be appropriately trained in spill prevention, hazardous material control, and cleanup of accidental spills.

   b. No fueling, repair, cleaning, maintenance, or vehicle washing will be performed in a creek channel or in areas at the top of a channel bank that may flow into a creek channel (Santa Clara Valley Water District Hazards and Hazardous Materials BMP 13).

10. Spill prevention kits appropriate to the hazard will always be in proximity when using hazardous materials (e.g., crew trucks and other logical locations).

   a. Prior to entering the work site, all field personnel will know the location of spill kits on crew trucks or other locations.

   b. All field personnel will be advised of these locations and trained in their appropriate use (Santa Clara Valley Water District Hazards and Hazardous Materials BMP 14).

11. Runoff from soil stockpiles will be avoided. If soil is to be stockpiled, no runoff will be allowed to flow to a creek.

12. Cofferdams will be used for tidal work areas. For tidal areas, a downstream cofferdam will be constructed to prevent the work area from being inundated by tidal flows. By isolating the work area from tidal flows, water quality impacts will be minimized. Downstream flows continue through the work area and through pipes within the cofferdam.

   a. Installation of coffer dams will begin at low tide.

b. Waters discharged through tidal cofferdam bypass pipes will not exceed 50 NTUs over the background levels of the tidal waters into which they are discharged.

c. Cofferdams in tidal areas may be made from earthen material. If earth is used, the downstream and upstream faces will be covered by a protected covering (e.g., plastic or fabric) if needed to minimize erosion. Sheet piles or gravel bags may alternatively be used.

13. Groundwater will be managed at work sites. If high levels of groundwater in a work area are encountered, the water will be pumped out of the work site. If necessary to protect water quality, the water will be directed into specifically constructed infiltration basins, into holding ponds, or onto areas with vegetation to remove sediment prior to the water re-entering a receiving water body. Water pumped into vegetated areas will be pumped in a manner that will not create erosion around vegetation. The relevant city will be consulted.

14. Sanitary/septic waste will be managed. Temporary sanitary facilities will be located on jobs that last multiple days, in compliance with California Division of Occupational Safety and Health Regulation 8, CCR 1526. All temporary sanitary facilities will be placed outside of the creek channel and floodplain and removed when no longer necessary. In addition, as part of the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) and the San Mateo Countywide Stormwater Pollution Prevention Program (SM-STOPPP), as required under waste discharge requirements and the National Pollutant Discharge Elimination System (NPDES) permit for the discharge of stormwater runoff from the municipal separate storm sewer systems overseen by the San Francisco Bay Regional Water Quality Control Board, all construction sites are required to have site-specific and seasonally and phase-appropriate effective BMPs (San Francisco Bay Regional Water Quality Control Board 2009). SFCJPA will be responsible for ensuring compliance with these stormwater requirements and programs, and will consult with appropriate staff at local jurisdictions. Based on the project components, it will require that the project construction contractor employ a qualified Stormwater Pollution Prevention Plan (SWPPP) practitioner to implement and document the pollution prevention measures outlined in the SWPPP prepared for the project. The project will implement measures to accomplish the objectives specified in SFCJPA's San Francisquito Creek Watershed Analysis and Sediment Reduction Plan, which fulfills the NPDES permit provisions that require the co-permittees of the SCVURPPP and SM-STOPPP within the creek watershed to assess and implement sediment management measures in the watershed (San Francisquito Creek Joint Powers Authority 2004).

2.9.3 Safe Use of Herbicides and Pesticides

1. Pesticides products are to be used only after SFCJPA has made an assessment regarding the environmental, economical, and public health aspects of each of the alternatives.

2. All herbicide use will be consistent with approved product specifications. Applications will be made by, or under the direct supervision of, state-certified applicators who are under the direction of a licensed pest control advisor (Santa Clara Valley Water District Hazards and Hazardous Materials BMP 1).

3. Only herbicides and surfactants that are registered for aquatic use will be applied within the banks of channels within 20 feet of any water that may be present. Aquatic herbicide use will be limited to July 1 through October 15. If rain is forecast, then the application of aquatic herbicide will be rescheduled (Santa Clara Valley Water District Hazards and Hazardous Materials BMP 8).

2.9.4 Construction Dust Control

1. Dust control measures for all construction sites:
   a. Bay Area Air Quality Management District (BAAQMD) basic control measures for construction emissions of PM10 will be implemented at all construction sites. Current measures stipulated by the BAAQMD CEQA Air Quality Guidelines include the following (Bay Area Air Quality Management District 2010):
      - All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, unpaved access roads) will be watered two times per day.
      - All haul trucks transporting soil, sand, or other loose material off the site will be covered.
      - All visible mud or dirt track-out onto adjacent public roads will be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
      - All vehicle speeds on unpaved roads will be limited to 15 miles per hour.
      - All roadways, driveways, and sidewalks to be paved will be completed as soon as possible. Building pads will be laid as soon as possible after grading, unless seeding or soil binders are used.
      - Idling times will be minimized, either by shutting equipment off when not in use or reducing the maximum idling time allowed by the California Airborne Toxics Control Measure (Title 13, CCR Section 2485). Clear signage will be provided for construction workers at all access points.
      - All construction equipment will be maintained and properly tuned in accordance with manufacturer's specifications. All equipment will be checked by a certified mechanic and determined to be running in proper condition prior to operation.

   b. A publicly visible sign will be posted, with the telephone number and person to contact at the lead agency regarding dust complaints. This person will respond and take corrective action within 48 hours. The air district's phone number will also be visible to ensure compliance with applicable regulations (Santa Clara Valley Water District Air Quality BMP 1).

2.9.5 Construction Noise Control

1. SFCJPA will implement practices that minimize disturbances to residential neighborhoods surrounding work sites.
   a. Work will be conducted during normal working hours and as required by the cities of Palo Alto, East Palo Alto, and Menlo Park.
   b. Internal combustion engines will be equipped with adequate mufflers.
   c. Except as provided by law, idling of heavy-duty diesel trucks with gross vehicular weight ratings of greater than 10,000 pounds shall be no more than 5 minutes.
   d. The arrival and departure of trucks hauling material will be limited to the hours of construction.

e. The use of Jacobs compression release brakes (commonly known as "Jake brakes") is prohibited in residential areas (Santa Clara Valley Water District Noise BMP 2).

2.9.6 Aesthetics Resources Protection

1. To buffer the effects of construction activities and staging on aesthetic values, SFCJPA will require contractors to provide visual screening for the active construction site, including the construction staging and laydown area. Screening will consist of an 8-foot-high chain link fence covered with fabric or an equivalent. It will be put in place during the first week of construction and remain until construction is complete and equipment is demobilized.

2.9.7 Biological Resources Protection

1. Existing access ramps and roads to waterways will be used where possible. If temporary access points are necessary, they will be constructed in a manner that minimizes impacts on waterways:
   a. Temporary project access points will be created as close to the work area as possible to minimize running equipment in waterways and will be constructed so as to minimize adverse impacts.
   b. Any temporary fill used for access will be removed upon completion of the project. Site topography and geometry will be restored to pre-project conditions to the extent possible (Santa Clara Valley Water District Biological Resources BMP 4).
2. Pre-construction biological surveys will be performed prior to any project-related activity. These surveys will work to identify effects on migratory birds and other sensitive wildlife in the work area. No birds, perennial nests, nests with eggs, or nests with hatchlings will be disturbed (Santa Clara Valley Water District Biological Resources BMP 8).
3. Nesting exclusion devices may be installed to prevent potential establishment or occurrence of nests in areas where construction activities would occur. All nesting exclusion devices will be maintained throughout the nesting season or until completion of work in an area makes the devices unnecessary. All exclusion devices will be removed and disposed of when work in the area is complete (Santa Clara Valley Water District Biological Resources BMP 10).
4. Impacts on native aquatic vertebrates (fish, amphibians, and reptiles) will be avoided or minimized. Native aquatic vertebrates may or may not be able to rapidly recolonize a stream reach if the population is eliminated from that stream reach. If native aquatic vertebrates are present when cofferdams, water bypass structures, and silt barriers are to be installed, an evaluation of the stream and the native aquatic vertebrates will be conducted by a qualified biologist. The qualified biologist will consider:
   a. Native aquatic species present at the site.
   b. The ability of the species to naturally recolonize the stream reach.
   c. The life stages of the native aquatic vertebrates present.
   d. The flow, depth, topography, substrate, chemistry, and temperature of the stream reach.
   e. The feasibility of relocating the aquatic species present.
   f. The likelihood the stream reach will naturally dry up during the work season.

Based on consideration of these factors, the qualified biologist may decide to relocate native aquatic vertebrates during construction. The qualified biologist will document in writing the reasons to relocate native aquatic species, or not to relocate native aquatic species, prior to installation of cofferdams, water bypass structures, or silt barriers.

If the decision is made to relocate the native aquatic species, then the operation will be based on the Santa Clara Valley Water District's Fish Relocation Guidelines.

5. Local ecotypes of native plants will be planted and appropriate erosion-control seed mixes will be chosen. The following steps will be taken by a qualified biologist or vegetation specialist:
    a. Evaluate whether the plant species currently grows wild in Santa Clara County.
    b. If the plant species currently grows wild in Santa Clara County, the qualified biologist or vegetation specialist will determine whether the plant installation must include local natives (i.e., grown from propagules collected in the same or adjacent watershed and as close to the project site as feasible).

       A qualified biologist or vegetation specialist will be consulted to determine which seeding option is ecologically appropriate and effective. The following guidelines will inform the biologist or vegetation specialist's determination.
    c. For areas that are disturbed, an erosion-control seed mix may be used, consistent with the Santa Clara Valley Water District Guidelines and Standards for Land Use near Streams, Design Guide 5, Temporary Erosion Control Options.
    d. In areas with remnant native plants, the qualified biologist or vegetation specialist may choose an abiotic application instead, such as an erosion control blanket or seedless hydro-mulch and tackifier, to facilitate passive revegetation of native species.
    e. Temporary earthen access roads may be seeded when site and horticultural conditions are suitable.
    f. If a gravel or wood mulch has been used to prevent soil compaction, per BI-11, this material may be left in place (if ecologically appropriate) instead of seeding.
    g. Seed selection will be ecologically appropriate, as determined by a qualified biologist, per Guidelines and Standards for Land Use near Streams, Design Guide 2, Use of Local Native Species, and the Supplemental Landscaping\Revegetation Guidelines.
6. Animal entry and entrapment will be avoided.
    a. All pipes, hoses, or similar structures less than 12 inches diameter will be closed or covered to prevent animal entry. All construction pipes, culverts, or similar structures greater than 2 inches diameter stored at a construction site overnight will be inspected thoroughly for wildlife by a qualified biologist or properly trained construction personnel before the pipe is buried, capped, used, or moved.
    b. If inspection indicates the presence of sensitive or state- or federally listed species inside stored materials or equipment, work on those materials will cease until a qualified biologist determines the appropriate course of action.
    c. To prevent entrapment of animals, all excavations, steep-walled holes, or trenches more than 6 inches deep will be secured against animal entry at the close of each day. Any of the

following measures may be employed, depending on the size of the hole and method feasibility:

- Holes will be securely covered (no gaps) with plywood or similar materials at the close of each working day or any time the opening will be left unattended for more than 1 hour.
- In the absence of covers, the excavation will be provided with escape ramps constructed of earth or untreated wood, sloped no steeper than 2:1, and located no farther than 15 feet apart.
- In situations where escape ramps are infeasible, the hole or trench will be surrounded by filter fabric fencing or a similar barrier, with the bottom edge buried to prevent entry.

2.9.8 Tribal Cultural Resources Protection

1. SFCJPA has consulted with two tribes on the project and determined that the area is sensitive for potential tribal cultural resources. SFCJPA is planning to follow the recommendation of the tribes to have a Native American, as well as an archaeologist be on site to monitor during earthwork/ground disturbance activities. More information on tribal cultural and historical/architectural resources is provided in Section 3.4.

2.9.9 Geology and Soils Commitments

1. All new construction designs will be based on recommendations from geotechnical analyses of the project site.
2. The contractor(s) retained for construction and revegetation of the proposed project will be required to stockpile excavated topsoil, as appropriate, so it can be reused for revegetation on the project site, as needed. To ensure maximum topsoil recovery, topsoil will be stockpiled separately from other excavated materials.

2.9.10 Land Use Commitments

1. The project design will be consistent with guidelines presented in the San Francisco Bay Conservation and Development Commission's *Shoreline Spaces: Public Access Design Guidelines for the San Francisco Bay* (2005) and *Public Access and Wildlife Compatibility* (2001).

2.9.11 Transportation/Traffic

1. Suitable public safety measures will be used. Fences, barriers, lights, flagging, guards, and signs will be installed, as determined appropriate by the public agency having jurisdiction, to give adequate warning to the public of the construction and of any dangerous condition to be encountered as a result thereof.

2.10 References

Bay Area Quality Management District. 2010. *Source Inventory of Bay Area Greenhouse Gas Emissions: Base Year 2007*. Last Revised: February 2010. Bay Air Quality Management District, 375 Beale Street, San Francisco, CA 94105.

National Marine Fisheries Service, Southwest Region. 1997. *Fish Screening Criteria for Anadromous Salmonids*. January. Available: http://www.westcoast.fisheries.noaa.gov/publications/hydropower/southwest_region_1997_fish_screen_design_criteria.pdf.

San Francisco Bay Conservation and Development Commission. 2001. *Public Access and Wildlife Compatibility*. San Francisco Bay Conservation and Development Commission, 455 Golden Gate Avenue, San Francisco, CA 94102

San Francisco Bay Conservation and Development Commission. 2005. *Shoreline Spaces: Public Access Design Guidelines for the San Francisco Bay*. San Francisco Bay Conservation and Development Commission, 455 Golden Gate Avenue, San Francisco, CA 94102

San Francisquito Creek Coordinated Resource Management Planning. 1997. *Reconnaissance investigation report of San Francisquito Creek*. San Francisquito Creek Coordinated Resource Management and Planning.

San Francisquito Creek Joint Powers Authority. 2004. *The San Francisquito Creek Watershed Analysis and Sediment Reduction Plan. Final Report*. Prepared by Northwest Hydraulic Consultants and Jones & Stokes.

San Francisco Regional Water Quality Control Board. 2009. *Staff Report: Evaluation of Water Quality Condition for San Francisco Bay, Proposed Revisions to Section 303(d) List*. San Francisco Regional Water Quality Control Board, 1515 Clay Street #1400, Oakland, CA 94612.

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Chapter 3
Environmental Analysis

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3.1 Aesthetics

This section provides environmental analysis of the project's impacts on aesthetics. The section summarizes the regulatory environment and discusses the environmental setting, provides the criteria used for determining impacts, discusses the impact mechanism and level of impact resulting from project construction and implementation, and describes mitigation to minimize the level of impact.

3.1.1 Regulatory Setting

The proposed project would be implemented in a manner that protects public health, safety, and the environment through compliance with all applicable federal, state, and local laws, regulations, orders, and other requirements or policies. Local laws, regulations, orders, and plans applicable to aesthetics and visual quality within the project area are presented in Table 3.1-1.

Table 3.1-1. County and City Policies Relevant to Aesthetics

Document	Policy
Santa Clara County General Plan (1994)	**C-RC 57:** The scenic and aesthetic qualities of both the natural and built environments should be preserved and enhanced for their importance to the overall quality of life for Santa Clara County. **C-RC 58:** The general approach to scenic resource preservation on a countywide basis should include the following strategies: a. conserving scenic natural resources through long range, inter-jurisdictional growth management and open space planning; b. minimize development impacts on highly significant scenic resources; and c. maintaining and enhancing scenic urban settings, such as parks and open space, civic places, and major public commons areas. **C-RC 62:** Urban parks and open spaces, civic places, and public commons areas should be designed, developed and maintained such that the aesthetic qualities of urban settings are preserved and urban livability is enhanced. Natural resource features and functions within the urban environment should also be enhanced. **C-GD 4:** Development activity should minimize degradation of the natural environment and avoid diminishment of heritage resources.
San Mateo County General Plan (1986)	**Conservation, Open Space, Parks & Recreation** **Goal 4:** Expand the aesthetic and functional contributions made to the urban environment by public open spaces, trail systems, scenic roadways, and street trees and plantings. **C/OS 9.1: Development Requirements.** Require new developments to protect and enhance the character of scenic roadways and trails designated on Figure C/OS-4, including but not limited to treatment of signs and screening, land uses, and preservation of view corridors.

Document	Policy
City of Palo Alto Comprehensive Plan 2030 (2017)	**Views** **Policy L-6.5**: Guide development to respect views of the foothills and East Bay hills along public street corridors in the developed potions of the City. **Map L-4**. Community Design Features. This map identifies major view corridors within the Baylands. **Scenic Routes and Gateways** **Program L-9.1**: Recognize Sand Hill Road, University Avenue between Middlefield Road and San Francisquito Creek, Embarcadero Road, Page Mill Road, Oregon Expressway, Interstate 280, Arastradero Road (west of Foothill Expressway), Junipero Serra Boulevard/Foothill Expressway and Skyline Boulevard as scenic routes and preserve their scenic qualities. **Program L10.4.1**: Continue to provide a bicycle/pedestrian path adjacent to Embarcadero Road, consistent with the Baylands Master Plan and open space character of the baylands subject to federal and State airport regulations. **Map L-4**. Community Design Features. This map identifies Embarcadero Road east to Harbor Road as a scenic route and identifies Embarcadero Road at East Bayshore Road as a gateway.
City of Palo Alto Baylands Master Plan (2008)	The Baylands Master Plan observed that the essential character of the Baylands (open, spacious, horizontal, with little or nothing between the planes of ground and water and the sky) was established by the tideland marsh areas. The following is a list of applicable policies: **Overall Environmental Quality Policy No. 10.** Allow access to the Flood Basin only in certain seasons to protect the waterfowl and shorebird refuge area. **Flood Protection Policy No. 2.** Do not allow new levee construction to intrude on any marsh or wetlands without appropriate mitigation. **Flood Protection Policy No. 3.** Continue to monitor the status of the South San Francisco Bay Shoreline Study and the South Bay Salt Pond Restoration Project. Take no position on potential modifications to the Bayfront levees until the South San Francisco Bay Shoreline Study is completed. Any levee modifications should be built to prevent flooding with as low a profile as is possible so that their visual and ecological effects will be reduced. (Note: This policy was written for a specific project proposed in the 1970s that was dropped and is no longer relevant. However, this adapted version may be appropriate for the current Shoreline Study.)

Document	Policy
Vista 2035 East Palo Alto General Plan (2017)	**Land Use and Urban Design Element** **Goal LU-1:** Maintain an urban form and land use pattern that enhances the quality of life and meets the community's vision for its future. **Policy 1.4 Unique neighborhoods, districts and corridors.** Enhance the unique character and identity of the City's neighborhoods, districts and corridors through land use and design decisions. Allow policies and programs to be focused on each unique area of the City. **Goal LU-5:** Preserve the character of existing single-family neighborhoods. **Policy 5.8 Streetscape beautification.** Proactively beautify existing streetscapes with pedestrian-scaled lighting, and drought-tolerant street trees and landscaping. **Goal LU-9:** Provide an urban environment that is tailored to the pedestrian. **Policy 9.3 Landscaping.** Require development projects to incorporate drought tolerant, native species landscaping in order to extend and enhance the green space network of the City. **Policy 9.9 Tree Planting.** Encourage the planting and maintenance of appropriate tree species that shade the sidewalk, improve the pedestrian experience throughout the City, and enhance flood protection. Street trees should be selected that do not damage sidewalks, or block views of commercial buildings. **Policy 9.10 Streetscape.** Enhance the pedestrian experience through streetscape improvements that could include new street lighting, tree planting, undergrounding of utilities, and easement dedications to increase the size of the sidewalks and pedestrian amenities. **Parks, Open Space and Conservation Element** **Goal POC-2:** Improve and enhance existing parks and trails. **Policy 2.5 Park Improvements.** Maintain, improve, and renovate existing parks with new equipment and features (especially drinking fountains, lighting, fitness equipment, and restrooms) to ensure continued use, accessibility and quality facilities.

City of Menlo Park General Plan (2016, 2013)	**<u>Land Use Element</u>** **Figure 3 Community Features.** Includes View Corridor/Scenic Vista features. **<u>Neighborhood Preservation</u>** **Goal LU-2:** Maintain and enhance the character, variety and stability of Menlo Park's residential neighborhoods. **Policy LU-2.2 Open Space**. Require accessible, attractive open space that is well maintained and uses sustainable practices and materials in all new multiple dwelling and mixed-use development. **<u>Open Space</u>** **Goal LU-6:** Preserve open-space lands for recreation; protect natural resources and air and water quality; and protect and enhance scenic qualities. **Policy LU-6.7 Habitat Preservation.** Collaborate with neighboring jurisdictions to preserve and enhance the Bay, shoreline, San Francisquito Creek, and other wildlife habitat and ecologically fragile areas to the maximum extent possible. **<u>Open Space/Conservation, Noise and Safety Elements</u>** **<u>Open Space/Conservation Element</u>** **Goal OSC1:** Maintain, Protect and Enhance Open Space and Natural Resources. Protect, conserve and enhance valuable natural resources, open areas and designated open space lands rich in scenic value, wildlife or of a fragile ecological nature through conservation and restoration efforts. **Policy OSC1.1 Natural Resources Integration with Other Uses.** Protect Menlo Park's natural environment and integrate creeks, utility corridors, and other significant natural and scenic features into development plans. **Policy OSC1.3 Sensitive Habitats.** Require new development on or near sensitive habitats to provide baseline assessments prepared by qualified biologists, and specify requirements relative to the baseline assessments. **Policy OSC1.7 San Francisquito Creek Joint Powers Authority.** Continue efforts through San Francisquito Creek Joint Powers Authority to enhance the value of the creek as a community amenity for trails and open space, conservation and educational opportunities. **Policy OSC1.15 Heritage Trees.** Protect Heritage Trees, including during construction activities through enforcement of the Heritage Tree Ordinance (Chapter 13.24of the Municipal Code). **<u>Safety Element</u>** **Goal S1:** Assure a Safe Community. Minimize risk to life and damage to the environment and property from natural and human-caused hazards, and assure community emergency preparedness and a high level of public safety services and facilities. **Policy S1.2 Location of Public Improvements.** Avoid locating public improvements and utilities in areas with identified flood, geologic and/or soil hazards to avoid any extraordinary maintenance and operating expenses. When the location of public improvements and utilities in such areas cannot be avoided, assure that effective mitigation measures will be implemented. **Policy S1.13 Geotechnical Studies.** Continue to require site-specific geologic and geotechnical studies for land development or construction in areas of potential land instability as shown on the State and/or local geologic hazard maps or identified through other means.

Document	Policy
	Policy S1.25 Creeks and Drainage-ways. Seek to retain San Francisquito and Atherton creeks/channels in their natural state in order to prevent undue erosion of creek banks. Protect creek-side habitat and provide maintenance access along creeks where appropriate. **Policy S1.26 Erosion and Sediment Control.** Continue to require the use of best management practices for erosion and sediment control measures with proposed development in compliance with applicable regional regulations.
Sources: County of Santa Clara 1994, County of San Mateo 1986, City of Palo Alto 2017, City of East Palo Alto 2017, City of Menlo Park 2013, 2016.	

3.1.2 Environmental Setting

Study Area

The study area for this aesthetics analysis takes into account the potential visual impacts of proposed project improvements and operations in relation to the existing visual quality and character, scenic resources, and types of viewers in the immediate vicinity of the proposed project areas(s). A number of smaller, individual project sites comprise the larger proposed project and its alternatives. These locations are mapped on Figures 2-2 through 2-8 in Chapter 2, *Program Description*. In defining the study area, distance zones are largely determined by the extent to which the sites associated with the project would be visible, depending on the position and angle of the viewer and the available lines of sight. For direct effects on aesthetics and visual quality in urban environments, the study area is at least the centerline of the creek bed or outer edge of the project element site boundary plus 0.25 mile, depending on the visibility of project components, taking into account the area's landform (topography), land cover (vegetation and structures), and atmospheric conditions (dust, fog, precipitation), which can limit human sight.

Considering the anticipated scale of the proposed project and the residential/urban environment of the immediate vicinity, the zone of highest visual concern is not generally expected to extend beyond a foreground distance of 0.25 mile from the proposed project. Due to the presence of existing structures and tall/dense vegetation, the proposed project would have a limited visual presence beyond a foreground viewing distances of 0.25 mile.

However, intervening development may limit visibility in complex, highly site-specific ways. Although vegetation, homes, and buildings would largely block views outside of 0.25 mile from the proposed project, views of the project area(s) may be visible at a greater distance through specific "view corridors" along major arterials, channels or rivers, freeways, railways, or other transportation corridors. These are addressed as appropriate throughout this section.

Although there are instances in which visual impacts may be experienced outside of the 0.25-mile study area, the study area distance is appropriate because tall vegetation, buildings, and other intervening development would largely block views outside of 0.25 mile from the centerline.

Existing Conditions

Regional Visual Character

The aesthetic character in the greater project area(s) varies from rural to urban. Urban area visual elements include industrial, commercial, and residential developments and associated infrastructure. Also, numerous creeks, sloughs, and rivers drain into the South San Francisco Bay (South Bay), adding a distinctive element to the region's aesthetic character.

Each city within the study area includes substantial urban and rural visual aspects. Urban areas have been extensively developed and display a variety of modern multi-story buildings in the city centers, with urban landscaped communities and residential areas skirting downtown districts.

Aesthetic aspects in the Reach 3 Alternatives areas of the study area are all on Stanford Land, and the detention basins are proposed on a portion of Webb Ranch, and the previous location of a tree and plant nursery, currently used for cattle grazing, that is adjacent to a closed Primate Research Center, Jaspar Ridge Biological Reserve, and Stanford Linear Accelerator Center (SLAC) National Accelerator Facility. The study area also includes a variety of colorful vistas and topographically varied lands such as views of the riparian area along San Francisquito Creek, open space grasslands, and the foothills to the west. Scenic highways (Interstate [I-] 280) in the area provide picturesque views of the rolling foothills, mountains, creeks, coastline, forests, and open spaces.

The creeks within the study area add varied visual aspects to the views through the seasons. The area provides significant riparian habitat for vegetation, wildlife, and aquatic resources, with resulting aesthetic viewing opportunities. The following creeks run through urban and rural areas, creating alternating scenic views: San Francisquito Creek, Dry Creek, Bear Creek, Los Trancos Creek, Sausal Creek, and Corte Madera Creek.

As mentioned, the proposed detention basins are on Stanford land, which has a wide variety of land uses, including residential, farming, commercial, research, open space, grazing land, and a biological preserve. It is also home to diverse socioeconomic groups and new development, and is known for its scenic beauty. Ultimately, the visual character and quality of any given viewshed will depend on the position, speed, and angle of the viewer, the level of obstruction/intervening development, and individual viewer preferences.

Project Vicinity and Visual Character

San Francisquito Creek starts at the confluence of Corte Madera Creek and Bear Creek on Stanford University land, and flows into the South Bay about 2.5 miles south of the Dumbarton Bridge. San Francisquito Creek and its tributaries flow through five municipalities (Palo Alto, East Palo Alto, Menlo Park, Portola Valley, and Woodside) and form the boundary between two counties (Santa Clara and San Mateo). Stanford University is the largest landowner in the watershed and spans both counties and is approximately 0.9 mile southeast of where the San Francisquito Creek meets El Camino Real.

Visual resources are components of the natural, cultural, or project environment and include any site, object, or feature of the landscape that can be seen in the landscape. Natural visual resources include land, water, vegetation, and animals that compose the natural environment. Cultural visual resources include buildings, structures, and artifacts that compose the cultural environment. Visual resources of the project environment include geometrics, structures, and fixtures that compose the project. Visual resources can also be legally protected or locally valued and include state-designated scenic routes, scenic vista views, and views toward and within natural areas, parks, and urban areas that have been identified as having historical or cultural importance or that include buildings of similar historical or cultural importance or notable landmark status.

The study area has a wide variety of land uses and natural habitats, including residential areas, a major university (Stanford), commercial centers, open space preserves, grazing land, and a biological preserve. I-280, an Officially Designated State Scenic Highway in San Mateo County (eligible state scenic highway in Santa Clara County), traverses the project site and passes through the study area for visual impacts approximately 2 miles east of the Searsville Dam (Caltrans 2017). No other state-, county-, or city-designated scenic routes that are protected within the study area have been identified.

The November 2017 historic and cultural resources records search revealed 55 previously recorded resources, with one located within the project-level Area of Potential Effects (APE), two within the program-level APE, and 52 within a 0.5-mile radius of both the project- and program-level APEs. The majority of these resources were positioned along San Francisquito Creek and largely dated to the prehistoric period. No built structures that serve as historic resources or cultural landmarks have been identified. Cultural resources are described in detail in Section 3.4.

The study area has several mature street trees, mature riparian vegetation along creek corridors, mature residential landscaping, and other areas of dense, vegetated land cover in open space areas contributing to the natural environment, which is known for its scenic beauty. These elements contribute to recreational land uses located between the U.S. 101 and El Camino Real transportation corridors. The study area is also home to diverse socioeconomic groups and a mix of established and newer development that help to define the cultural environment. Between U.S. 101 and El Camino Real, land uses are primarily residential, with clustered commercial and retail outlets just south of El Camino Real, and several commercial business offices, restaurants, and a hotel just south of U.S. 101. Noteworthy visual resources within the study area include the following.

- **San Francisquito Creek** – Nearly hidden among a kaleidoscopic community of some four million Californians, San Francisquito Creek has managed to remain a remarkably undeveloped riparian oasis beneath scattered oak and redwood. The small stream has managed to escape urbanization as the boundary between the cities of Palo Alto, East Palo Alto, and Menlo Park. Fueled by winter rains and year-round springs, the creek's 45 square mile watershed gathers dozens of small tributaries draining the Eastern Slope of the Santa Cruz Mountains. The short San Francisquito main stem, formed at the confluence of Bear Creek and Corte Madera Creek, flows for 12 miles east through Stanford University before meeting the southern portion of San Francisco Bay, the largest estuary on the West Coast (American Rivers 2017).
- **Johnson Park** – Johnson Park is located between Waverley and Kipling Streets and Everett and Hawthorne Avenues, approximately 0.13 mile southeast of San Francisquito Creek. It is a 2.5-acre neighborhood park that provides a children's playground, basketball hoop, picnic tables, benches, volleyball sand pit, community garden plots, and pathways.
- **El Palo Alto Park** – El Palo Alto Park spans over the project site and is located between Alma Street, the Caltrain tracks, and El Camino Real. The 0.5-acre park includes a lighted bicycle/pedestrian pathway that connects Palo Alto and Menlo Park. In addition to the path and

the bridge that spans over the creek, the park includes six interpretive plaques that provide a history of the area and environmental information pertaining to the San Francisquito Creek Watershed. The park also features El Palo Alto, which is a redwood tree that is over a thousand years old and has been designated as California Heritage Landmark #2. In addition to El Palo Alto Park, another bicycle/pedestrian bridge links Palo Alto and Menlo Park in the vicinity of Waverley Street. Via this bridge, Willow Road (in Menlo Park) and Palo Alto Avenue (in Palo Alto) are connected; however, no designated trails are located in this area. The San Francisquito Creek Trail is part of a larger trail system that, when complete, will extend from the Stanford campus to the west to the Bay margin to the east, generally following the creek. In the vicinity of the project site, however, this trail is limited, and only a small segment exists in El Palo Alto Park before crossing west over the Caltrain tracks and El Camino Real.

- **El Camino Park** – El Camino Park is the City of Palo Alto's oldest park. The park first opened in 1914 and has been open for sports and other recreational activities ever since. The park is located on the corner of El Camino Real and Alma Street, across from the Stanford Shopping Center. It is approximately 200 feet south of San Francisquito Creek. The park includes a soccer field and softball field with bleachers, lights, and a parking lot.
- **Hopkins Creekside Park –** Hopkins Creekside Park is adjacent to the project site and north of Palo Alto Avenue from Emerson Street to Marlowe Street. The park consists of approximately 12.4 acres of mostly undeveloped land along the banks of the creek. In general, the park is about 1.5 miles long and 200 feet wide at its widest point. Two locations provide open areas that consist of amenities such as maintained lawns, benches, picnic tables, and trash receptacles.
- **Stanford Golf Course** – Stanford Golf Course is an 18-hole golf course on Stanford University property. San Francisquito Creek flows through the course. Because this resource is privately owned and not freely open to the public, it is not considered further in this analysis.
- **Lagunita Reservoir** – Lagunita Reservoir is a small, offstream reservoir fed by water diverted from San Francisquito Creek. It is located on Stanford University property. Popular walking and jogging trails follow the perimeter of the lake.
- **Jasper Ridge Biological Preserve** – Jasper Ridge Biological Preserve is a 1,189-acre area that provides a natural laboratory for researchers, educational experiences to students and docent-led visitors, and refuge to native plants and animals. It is owned and managed by Stanford University. The preserve is not open to the general public; however, docent-led tours are available by appointment.
- **Searsville Dam and Reservoir –** is a small reservoir located on Corte Madera Creek, on Stanford University property. The dam was built in 1892 by the for-profit Spring Valley Water Company and acquired by Stanford in 1919. The reservoir created by the dam was once a popular swimming location, but has been closed to the general public since its incorporation into the Jasper Ridge Biological Preserve in 1975 (Stanford School of Humanities & Sciences 2019).

Visual Character of the Project Sites

For this Program EIR, San Francisquito Creek is described in three reaches (Figure 2-1). Reach 1 extends from San Francisco Bay to the upstream side of U.S. 101. The San Francisquito Creek Joint Powers Authority (SFCJPA) and partners have completed flood protection actions in Reach 1; this Program EIR does not include proposed actions in Reach 1. Therefore, this Program EIR assesses proposed project activities within Reaches 2 and 3. Reach 2 extends from the upstream side of U.S. 101 to the upstream side of Pope-Chaucer Bridge. Reach 3 extends from the upstream side of Pope-Chaucer Bridge to Searsville Dam. As described above under *Study Area*, the proposed project and its alternatives are made up of a number of smaller, individual project sites within each reach where the various project elements would be implemented (refer to Figures 2-2 through 2-8). The visual character of these individual sites are described below, by Reach.

The Reach 2 sites are the Pope-Chaucer Bridge Site, Channel Widening Sites 1–5, Aquatic Habitat Enhancement Sites, Creekside Park Sites, and the Floodwall Development Sites. Some of the channel widening sites are adjacent to one another, so share the same general location. Therefore, the visual character of these sites is discussed together.

- **Pope-Chaucer Bridge Site –** Pope-Chaucer Bridge spans the creek in a single-family residential area that is well-maintained and where homes have well-kept, mature landscaping. Mature street trees are also prominent. The homes are separated from the creek corridor by Palo Alto and Woodland Avenue, which parallel the creek. The creek corridor is densely vegetated with riparian vegetation and ornamental trees lining the upper banks, along the roadways. The existing bridge is low-profile and appears to be a regular roadway corridor with sidewalks, and the bridge is not obvious because surrounding vegetation screens views of the bridge structure and most views of the creek. In the 1990s the City of Menlo Park implemented measures to reduce right-turn traffic from the bridge by vegetating a portion of the concrete culvert of the bridge. This vegetation flourished and created a small park-like area over the culvert. This vegetation would need to be removed as part of bridge replacement.


Pope-Chaucer Bridge looking downstream

- **Channel Widening Sites 1 and 2 –** Multi-family residences and an office/business complex are located to the north of Sites 1 and 2, separated from the creek by Woodland Avenue. Single-family homes directly abut and are located to the south of the creek. Walls built at the tops of the banks along both sides of creek, a red wooden fence at the top of the bank along Woodland Avenue between Manhattan and University Avenue, and dense riparian vegetation block most views of the creek at Sites 1 and 2. Private pedestrian bridges have been built over the creek that allow more direct visual access and to cross the creek. There are no scenic vista views associated with these sites.


Channel widening at Site 1

- **Channel Widening Sites 3 and 4 –** Sites 3 and 4 are similar to Sites 1 and 2. Single-family residences and multi-family residences are located to the north of Sites 3 and 4, separated from the creek by Woodland Avenue. Single-family residences directly abut and/or are located to the south of the creek. Walls have been built at the tops of the banks along both sides of the creek and dense riparian vegetation block most views of the creek and Sites 3 and 4. There are no scenic vista views associated with these sites.
- **Channel Widening Site 5 –** Multi-family residences are located to the north of and abut Site 5. Single-family residences directly abut Site 5 and are located to the south of the creek. West Bayshore Road and U.S. 101 also cross over the creek to the north. Vegetation along this portion of the creek is not very dense, and views of Site 5 are available from the building on West Bayshore Road, and between gaps in the soundwalls along U.S. 101. However, fencing and landscaping block most views from the residences. There are no scenic vista views associated with this site.


Channel widening at Site 5

- **Aquatic Habitat Enhancement Sites –** The aquatic habitat enhancement sites share the same locations as Pope-Chaucer Bridge and Channel Widening Sites 1–5. See the descriptions for those sites. There are no scenic vista views associated with these sites.
- **Creekside Park Sites –** As described earlier, two parks are planned if agreeable to land owners. If constructed, Pocket Park 1 shares the same location as Channel Widening Site 2, and Pocket Park 2 shares the same location as Channel Widening Site 3. See the descriptions for those sites. There are no scenic vista views associated with these sites.

- **Floodwall Development Sites –** The floodwall development sites share similar locations as Channel Widening Sites 1–4 (see the descriptions for those sites). However, floodwalls would be installed along a greater creek length, including the portion of the creek west of Site 1 to Maple Street. The visual conditions along this segment of creek are similar to the other sites. There are no walls at the tops of the banks; however, dense riparian vegetation blocks most views of the creek from Woodland Avenue. Residents on the other side of the creek have varying degrees of visual access based on landscaping and fencing. However, a private pedestrian bridge has been constructed over the creek with gate access to Woodland Avenue, which would provide more direct visual access to the creek for that resident. There are no scenic vista views associated with these sites.

The visual character of the Reach 3 sites is as follows:

- **Former Tree and Plant Nursery Site –** The previous location of Boething Nursery was on Stanford land adjacent to the closed Primate Research Center, and is currently used for cattle grazing. The proposed detention basin is near the eastern base of Jasper Ridge, which is densely vegetated with mature trees and shrubs, on gently rolling terrain that is predominantly grasslands dotted with mature oaks. The site is west of I-280, which does not have views of the site due to terrain and berms along the freeway that prevent views toward the site. The site is also located south of the Stanford Linear Accelerator, which is a long linear structure, which along with terrain and mature trees and shrubs in the landscape, obscures views of the site from Sand Hill Road to the north. Therefore, most views toward the site are only available to viewers on the private property. There are scenic vista views towards the site, but the site is not visible within these views. In addition, scenic vista views are available from the site but are only available to those located on the private property.
- **Webb Ranch Site –** The proposed detention basin would occupy a portion of Webb Ranch, specifically a U-Pick field and parking area. The site is also located on Stanford land just east of Jasper Ridge, within an area of gently rolling terrain but on land that has been graded flat for vineyard and row crop production. The creek, which is lined with dense riparian vegetation, borders the site to the north and a small, densely vegetated drainage way located between Andeta Way and the creek transects the middle of the site. The site is southwest of I-280, which does not have views of the site due to terrain and berms along the freeway that prevent views toward the site. Also, the site cannot be seen from Alpine Road to the east because terrain along the roadway and mature trees and shrubs prevent views. However, partial views of the site are available from residential areas and the Ladera Recreation District located to the south of the site. Terrain and mature trees and shrubs in the landscape partially obscure views of the site from these areas, but other areas have direct, unobstructed scenic vista views. Views toward the site are also only available to viewers on the private property where the basin would be located. Scenic vista views are also available from the site but are only available to those located on the private property.

Sensitive Viewers

Viewers within the study area represent people such as residents, recreationists, travelers, and commercial viewers. Viewers can be further subdivided into categories that help to establish viewer preferences and their sensitivity to changes in visual resources. Viewer preferences are determined as part of the visual inventory phase of the analysis, in which visual resources are identified, and viewer sensitivity is determined later.

Viewer preference and sensitivity varies among viewer types. Viewer sensitivity is the degree to which viewers are sensitive to changes in the visual character of visual resources. It is the consequence of two factors, viewer exposure and viewer awareness. Viewer exposure is a measure of proximity (the distance between viewer and the visual resource being viewed), extent (the number of viewers viewing), and duration (how long the visual resources are viewed). The greater the exposure, the more viewers will be concerned about visual impacts. Viewer awareness is a measure of attention (level of observation, based on routine and familiarity), focus (level of concentration), and protection (legal and social constraints on the use of visual resources). The greater the attention, the more viewers will be concerned about visual impacts.

Low viewer sensitivity exists when few viewers experience a defined view or viewers are not particularly concerned about the view, such as commuters on a freeway. High viewer sensitivity exists when many viewers experience a view frequently or for a long duration or the viewers (many or few), such as those in a residential neighborhood, are likely to be very aware of and concerned about the view. Generally, residents and recreationists are highly sensitive viewers, and local business employees and commuters are less sensitive viewers, although viewer sensitivity in established downtown areas can be high. In these areas, particularly in parks or along sidewalks, viewers are likely to have expectations of a built environment that is particular to an identifiable urban core, including specific structures; expectations related to such views lead to higher viewer sensitivity.

The approach to analyzing visual quality and potential changes to visual quality recognizes that most views are seen by a variety of viewer types, with different sensitivities to changes in the viewed landscape. As such, the approach uses the most sensitive viewer type as the basis for determining the potential impact of a proposed project on viewers.

For this project, the primary viewer groups are considered to be residents who neighbor the project elements and recreationists who are adjacent to and traverse the project elements, particularly in the case of Channel Widening at Sites 1–5, as well as at Pope-Chaucer Bridge. Other viewer groups include travelers on roadways adjacent to and traversing the project corridor. Residential viewers are owners or renters who have extended viewing times. Residential viewers generally have a desire to maintain the existing landscape as-is because how their neighborhood looks is a contributing factor for residents choosing to live in a certain location. Therefore, residential viewers tend to be uninterested in change unless that change is beneficial, or they have been able to participate in defining the change. As such, viewer sensitivity for residential viewers is considered to be high. Recreational viewers provide or participate in active and passive recreational uses such as organized sporting events, indoor and outdoor leisure activities, and cultural events. Recreational viewers are often focused on their recreational activity, and although they tend to be unsupportive of visual changes that would negatively affect the recreational setting, they tend to be supportive of visual improvements that enhance their recreational experience. Recreational services provided for visitors can be permanent, while the individual visitors are more transitory. Viewer sensitivity for recreational viewers is considered to be moderately high. Travelers can include pedestrians, cyclists, motorists, and road users that use various modes of transportation for commuting, touring, and shipping. These viewers are transitory and have shorter viewing times as they approach and then pass by a fixed location. Pedestrians use only their feet (or a wheelchair or other device), most often on a sidewalk or trail. Cyclists use bicycles at greater speeds than pedestrian travel, and may use trails, traffic lanes, and sidewalks. Motorists use vehicles with engines (e.g., cars, trucks, buses, motorcycles, mopeds, or any other technology that is not self-propelled, regardless of fuel source).

Motorists move at higher speeds than other groups. By necessity, the driver of a motor vehicle focuses less on the view outside the vehicle. Passengers within vehicles and rail cars move at high rates of speed and may be focused on views outside of the vehicle or rail car or on activities within the vehicle or rail car such as talking, reading, working, eating, people watching, or napping. Overall, viewer sensitivity for traveling viewer groups is considered to be low.

3.1.3 Impact Analysis

Methods and Significance Criteria

Two alternatives are analyzed for Reach 2. These alternatives differ in terms of their primary flood control strategy. Specifically, the Channel Widening Alternative involves removing human-made constrictions and creek channel widening, and the Floodwall Alternative involves construction of flood walls at the top of the creek's banks. Table 2-1 shows the different elements of the Channel Widening Alternative and Floodwall Alternative. Both alternatives include the replacement of Pope-Chaucer Bridge, channel widening at Site 5, and aquatic habitat enhancement. Potential construction of creekside parks is also common to both alternatives, but is dependent on private land access and agreements.

The alternatives for Reach 3 represent different potential future actions of the overall flood protection program. The Reach 3 alternatives would occur upstream of Pope-Chaucer Bridge on Stanford University property. The first alternative would involve the construction of an approximately 12.4-acre detention basin at the previous location of a tree and plant nursery (Former Plant Nursery Detention Basin) located near Stanford's closed semicircular Primate Research Center, roughly 1.5 miles upstream from I-280 near the northeastern side of San Francisquito Creek. The second alternative (Webb Ranch Detention Basin) would consist of the construction of an approximately 27.4-acre detention basin at a portion of the current Webb Ranch site, using a U-Pick field and associated parking area, located approximately 0.5 mile upstream from I-280 along the southern side of San Francisquito Creek.

Impacts on aesthetics, including visual character, visual quality, scenic vistas, scenic resources, as well as light and glare, that would occur as a result of the proposed project were determined by identifying if temporary or permanent obstructions or changes to the overall visual quality and character would be introduced during its construction and/or operation. Construction and operational impacts are discussed separately below by impact area for each project Element.

The project's potential impacts on aesthetic resources were assessed qualitatively, based on existing visual quality and the proposed project-related changes proposed.

For the purposes of this analysis, an impact was considered to be significant and require mitigation if it would result in any of the following:

- Substantial degradation of the visual character or quality of the project site and its surroundings, including scenic vistas.
- Substantial damage to scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway.
- Creation of a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area.

Each impact discussion includes a summary table identifying the level of impact associated with the individual project elements, followed by text analysis.

Impacts and Mitigation Measures

Impact AES-1—Cause substantial degradation of the visual character or quality of the project site and its surroundings, including scenic vistas

Summary by Project Element: Impact AES-1—Cause substantial degradation of the visual character or quality of the project site and its surroundings, including scenic vistas		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative:		
Replace Pope-Chaucer Bridge	Less than Significant	Less than Significant
Channel Widening at Sites 1 through 4	Less than Significant	Less than Significant
Channel Widening at Site 5	Less than Significant	Less than Significant
Extension of University Avenue Bridge	Less than Significant	Less than Significant
Parapet and Concrete Removal	Less than Significant	Less than Significant
Aquatic Habitat Enhancement		
Construction of Creekside Parks	Less than Significant	Less than Significant
Floodwall Alternative: Floodwalls	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative: Former Nursery Site Detention Basin Construction	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative: Webb Ranch Site Detention Basin Construction	Less than Significant	Less than Significant

Preferred Alternative

The Preferred Alternative (Figures 2-3 through 2-6) is assessed in this Program EIR at a higher level of detail (i.e., to a "project level") than other alternatives. Flood protection under this alternative would be achieved by replacing Pope-Chaucer Bridge, widening the channel at five sites, and extending the University Avenue Bridge parapet upstream. Aquatic habitat restoration would consist of increasing channel roughness at the channel widening sites to reduce water velocities. This would be achieved by adding pools, woody debris, boulders, and other structural elements to the channel. Recreational opportunity creation would involve the construction of two small creekside parks (if access and agreements are achieved) and connections to existing trails where possible. These project elements are discussed further below.

Construction

Section 2.4, *Selection of Alternatives to Consider*, outlines the Environmental Commitments that would be incorporated for all elements of the project. All project alternatives and elements would implement the following best practices related to the visual and aesthetic environment:

- Generally, the work site(s), areas adjacent to the work site(s), and access roads will be maintained in an orderly condition, free and clear from debris and discarded materials. Upon completion of work, all building materials, debris, unused materials, concrete forms, and other construction-related materials will be removed from the work site.

- To buffer the effects of construction activities and staging on aesthetic values, SFCJPA will require contractors to provide visual screening for the active construction site, including the construction staging and laydown area. Screening will consist of 8-foot-high chain-link fence covered with fabric or an equivalent. It will be put in place during the first week of construction and will remain until construction is complete and equipment is demobilized.

The presence of construction materials, equipment, onsite workers, and other associated improvements would alter the existing visual environment. Construction activities would introduce heavy equipment and associated vehicles into the views of all viewer groups, especially residents. Temporary visual changes would also result from the erection of support structures, such as falsework platforms and the approach structures necessary to facilitate project construction.

Construction activities would include earthwork, bridge construction, associated truck hauling and other major material and equipment movement and storage, any of which could cause visual intrusions in any given area because these activities would be fairly visible to adjacent residential areas. Soil movement, such as during grading or excavation, could involve the release of dust, which could affect visibility. The proposed project would, in accordance with the Environmental Commitments presented in Chapter 2, water all exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) two times per day to prevent, reduce, or mitigate fugitive dust emissions.

Construction staging areas could introduce visual changes to their immediate surroundings, with unsightly aggregations of stored material and equipment that would be visible to adjacent residents, roadway users, and recreationists. Because there is limited upland area available for staging, the areas shown in Figures 2-3 through 2-6 as instream staging and construction areas would serve for the movement of equipment and vehicles, as well as the staging of materials for walls that would be constructed at each site. Vegetation at the bottom of the channel would be removed within these areas as needed. Visual disruptions associated with staging areas would be mostly localized at these sites and one upland site.

As mentioned, contractors would use best management practices to further reduce or avoid visual impacts during construction. Site managers would conduct regular site inspections to ensure that staging areas are clean and orderly, to the extent practicable, and that construction debris is removed from public rights-of-way and adjacent properties/roadways.

Because of the nature of the proposed construction activities and duration of the construction period, visual changes would occur near these higher-sensitivity receptors, such as recreationists or residents. However, once construction is complete, construction equipment would be removed, and construction staging areas and temporary structures would be dismantled. The areas disturbed by construction would be remediated and revegetated, as necessary, after completion.

Construction activities associated with individual project elements and their potential visual impacts are provided in greater detail below.

Replace Pope-Chaucer Bridge

In general, fairly substantial construction work would be required to accommodate the Pope-Chaucer Street Bridge replacement. Consequently, visual disturbance associated with project construction would occur, but would be temporary (limited to the approximate construction period of 9 months). Replacing the Pope-Chaucer Bridge would require that trees growing on top of and adjacent to the concrete culvert bridge at Pope and Chaucer Streets be removed. In addition, some vegetation along the creek would be removed to accommodate construction of the channel and some placement of rock slope protection. This would open up views toward the creek. However, upon project completion, street trees and other vegetation, including at the bottom and tops of banks, would be replanted with native species. Although shrubs and groundcovers would grow rather quickly, it will take several years before planted trees would be mature enough to provide the same type of aesthetic character as some of the trees that would be removed, which may be perceived negatively. However, the proposed landscaping plan would focus on a native planting palette and would provide greater habitat value, as well as a more varying visual variety than current conditions, which may be perceived as beneficial. As discussed above, primary viewer groups in the vicinity of the Pope-Chaucer Bridge are residents and recreationists using local roadways and sidewalks. Other primary viewer groups are motorists, commuters, and other travelers who use local roadways and thoroughfares that traverse the San Francisquito Creek corridor. Given the viewers' sensitivities, and the potential for higher viewer exposure due to residents' proximity to the proposed bridge replacement, viewer sensitivity is considered high. For this reason, SFCJPA and Cities reviewed the tree removal plan and requested additional trees be retained in order to minimize tree removals.

Although construction activities represent observable changes to visual character, these changes would be temporary because construction equipment, materials, and support structures would be installed at the beginning of the construction period and removed upon completion of the proposed project. In addition, revegetation efforts could improve project aesthetics resulting from vegetation removal, even though it may subtly differ from the existing visual character and take several years to mature. Therefore, proposed construction activities would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant. Permanent visual elements that would be introduced during the construction period and remain after the completion of construction are evaluated below under *Operations and Maintenance*.

Channel Widening at Sites 1–4

Channel widening would occur over one construction season between June 15 and October 15. Construction would occur between 8:00 a.m. and 6:00 p.m. At each of the sites, existing sacked concrete and bank material behind that concrete along the bank would be set back. A soil nail wall with native shrub vegetation planted on the top of the wall would be built to widen and stabilize the banks at Sites 1, 3, and 4. At Site 2, the bank would be vegetated with plant species shown in Table 2-4. Also, on the left bank at Site 2, there is a temporary wooden extension of the University Avenue Bridge parapet installed by the City of East Palo Alto in 2015 as an emergency measure, which would be replaced with a permanent cement structure of the same size (ranging from 1–3 feet).

Visual impacts at Channel Widening Sites 1–4 would be similar to one another. The existing but inactive access ramps to the sites would be re-established through vegetation removal and grading to allow vehicles to enter the channel. The access ramps would be approximately 12 feet wide and

20 feet long and would be revegetated after use. Reconstruction of the transmission box at Access Ramp 2 would not be noticeable because it would only be moved a short distance and be reconstructed. Relocation of the utility poles and overhead wires to construct access Ramps 3 and 4 would not be noticeable because this area was previously disturbed, is unvegetated, and the relocated lines would look the same as the existing lines. Construction traffic would be visible entering and existing the site and would temporarily disrupt views for residences while construction is in progress.

Instream staging and construction areas would require that some vegetation be removed from the bottom of the channel, and the cleared area would be used for the movement of equipment and vehicles and materials staging for walls that would be constructed at each site. In addition, vegetation would need to be removed from the upland staging site to accommodate construction vehicles, equipment and materials. Due to the density of the existing bankside vegetation and tree canopy as well as the relatively limited vegetation removal that is currently proposed, for most viewers, views would mostly be unchanged by the presence of instream staging and construction and associated vegetation removal. For views within the creek area and for those views with direct sightlines to the creek, the instream staging and construction would create a temporary visual disturbance, and the vegetation removal would open up views to provide a more expansive landscape of the habitat areas that comprise the creekbed and its surrounding areas.

Tree pruning would occur along Woodland Avenue and San Francisquito Creek to accommodate the concrete truck and boom that would operate from the roadway. The pruning would partially remove branches and/or reduce tree cover throughout the project areas; however, given the proposed extent of tree pruning, visual changes associated with tree pruning activities are expected to be negligible.

Removal of the sacked concrete would only affect a minor amount of vegetation growing among the sacked concrete. However, construction of the access ramps may require the removal of some mature riparian vegetation. Due to the density of the existing bankside vegetation and tree canopy as well as the relatively limited vegetation removal that is currently proposed, for most viewers, views would mostly be unchanged by the removal of mature riparian vegetation. For views within the creek area and for those views with direct sightlines to the creek, the removal of mature riparian vegetation would open up views to provide a more expansive landscape of the habitat areas that comprise the creekbed and its surrounding areas.

As mentioned, removing vegetation along the bank and laying the banks back would slightly alter the viewsheds that are available along the creekbed, depending on the speed (if the viewer is in an automobile or on a bicycle), position, and angle of a given viewer. These proposed visual changes associated with vegetation removal would be visible during construction and the time period between construction and when replanting has occurred. Revegetation efforts would improve project aesthetics resulting from vegetation removal, even though it may subtly differ from the existing visual character and take several years to mature. Because of the meandering nature of the creek's corridor and the dense vegetation that lines both side of the creekbed, impacts associated with construction would be mostly localized at each of these sites.

Overall, given the residential viewers' sensitivities, which are similar to those presented at the channel widening sites, and the potential for higher viewer exposure due to residents' proximity to the proposed channel widenings, viewer sensitivity would be moderate-high.

Although construction activities potentially represent observable changes to visual character, these changes are considered to be temporary because construction equipment, materials, and support structures would be installed at the beginning of the construction period and removed upon completion of the proposed project. In addition, revegetation efforts would ensure that plants, trees, and vegetative cover that is removed to accommodate construction activities would be adequately replanted and repopulated in accordance with the Supplemental Landscaping\Revegetation Guidelines provided in Chapter 2 such that the overall land cover and riparian habitat closely resembles the visual environment that was observed before implementation of the proposed project. However, certain plant species may take several years to mature, which can lengthen the revegetation process. Regardless, proposed construction activities would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. Permanent visual elements that would be introduced during the construction period and remain after the completion of construction are evaluated below under *Operations and Maintenance*.

Channel Widening at Site 5

Channel widening would occur over one construction season between June 15 and October 15. Construction would occur between 7:00 a.m. and 5:00 p.m. At Site 5, the existing sacked concrete and bank material would be removed, the bank would be setback, and a sheet pile wall would be built to widen and stabilize the bank. Access Ramp 5 would also require vegetation removal and grading to re-establish the abandoned ramp, and a transmission box would be relocated a short distance to a previously disturbed unvegetated area. Construction traffic would also be visible entering and existing the site, disrupting views similar to Sites 1–4.

Instream staging and construction (and associated vegetation removal), tree pruning, and the removal of mature riparian vegetation (associated with construction of access ramps) would result in similar visual changes during construction as described above for Channel Widening at Sites 1–4. At Site 5, a sheet pile wall would be built rather than a soil nail wall. Visual impacts associated with the sheet pile wall would be similar to those associated with a soil nail wall. A sheet pile wall was selected for this area due to access considerations, which would occur downstream of U.S. Highway 101 to minimize construction impacts on residents on both sides of the creek in this area.

Overall, given the residential viewers' sensitivities, which are similar to those presented at this channel widening site, and the potential for higher viewer exposure due to residents' proximity to the proposed channel widening, viewer sensitivity would be moderate-high.

Although construction activities potentially represent observable changes to visual character, these changes are considered to be temporary because construction equipment, materials, and support structures would be installed at the beginning of the construction period and removed upon completion of the proposed project. In addition, revegetation efforts would ensure that plants, trees, and vegetative cover that is removed to accommodate construction activities would be adequately replanted and repopulated and protocols provided in Chapter 2 such that the overall land cover and riparian habitat closely resembles the visual environment that was observed before implementation of the proposed project. However, certain plant species may take several years to mature, which can lengthen the revegetation process. Regardless, proposed construction activities would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. Permanent visual elements that would be introduced during the construction period and remain after the completion of construction are evaluated below under *Operations and Maintenance*.

Aquatic Habitat Enhancement

Habitat restoration would add baffling at the toe of the slopes, anchoring large woody debris, placing large boulders or other structures in the channel to create refuge for steelhead trout. Aquatic habitat enhancement activities would take place in the creekbed, largely out of sight from viewers and vegetation removal would be minimal and limited to the immediate area where enhancements would occur. Furthermore, any observable changes in visual character are considered to be temporary because construction equipment, materials, and support structures would be installed at the beginning of the construction period and removed upon completion of the proposed project. Therefore, proposed construction activities would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant. Permanent visual elements that would be introduced during the construction period and remain after the completion of construction are evaluated below under *Operations and Maintenance.*

Construction of Creekside Parks

Two creekside parks are contemplated at the locations shown in Figures 2-3 through 2-5. The parks would consist of landscaping and benches and would be built based on landowner approval. The design would use gravel (not cement) so as to maintain impervious surfaces. The total area of each creekside park would be a maximum of 400 square feet.

Due to the size and nature of the creekside parks (one to be located just west of the intersection of Woodland Avenue and University Avenue; one to be located just west of the intersection of Woodland Avenue and Cooley Avenue), construction work would be less involved than the construction activities presented above in the replacement of Pope-Chaucer Bridge or at the channel widening sites analyzed herein. Therefore, though the parks would be constructed in residential areas where viewers have higher sensitivity, any observable changes in visual character are considered to be temporary because construction equipment, materials, and support structures would be installed at the beginning of the construction period and removed upon completion of the proposed project. Therefore, proposed construction activities would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant. I-280 crosses San Francisquito Creek approximately 4 miles southwest of the proposed park areas. Construction activities would not be visible from U.S. Highway 101. Permanent visual elements that would be introduced during the construction period and remain after the completion of construction are evaluated below under *Operations and Maintenance*.

Operations and Maintenance

The proposed project elements would require inspection and maintenance to continue to function effectively, similar to existing facilities. Maintenance for the new project elements would include activities such as routine inspections and debris removal, which typically occur prior to the rainy season, and more intensive debris removal after major flood events. Post-project maintenance would be generally similar to existing maintenance. Additionally, monitoring and maintenance of new vegetation would occur, at a minimum, for 3 years following completion of the project. This activity would consist of invasive plant removal, inspection of newly planted vegetation, and replanting as needed. Creekside parks would require trash pick-up and disposal as well as routine maintenance of benches and landscaping.

Replace Pope-Chaucer Bridge

Once built, the replacement bridge would occupy approximately the same area as the existing Pope-Chaucer Bridge. As such, though the proposed project would introduce visual changes into a residential area where viewers have a moderate-high sensitivity, because viewers are familiar with the existing bridge. The replacement structure would be consistent with respect to location, materials, color and elevation with the existing visual character and would not substantially alter the visual quality throughout the immediate project area. Trees have been planted on the current bridge concrete culvert, and although is not listed as a City of Menlo Park facility, residents like this feature, which was developed in the 1990s to remove a lane dedicated to making right turns. The new bridge design has retained the desire of the community and does not include a right-turn lane; however, there is the unavoidable loss of the trees planted over the current bridge's concrete culvert. Knowing the sensitivity of residents to tree removal, SFCJPA requested a review of trees to be removed, with many more trees being retained than initially proposed by bridge designers. Maintenance activities, such as debris and invasive plant removal, vegetation inspection, and replanting (as necessary) would serve to enhance the overall visual character and quality of the project site. Therefore, the proposed project would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. Images 3.1-1 and 3.1-2 below provide visual representations of the new bridge at Pope-Chaucer Streets.

Image 3.1-1. Pope-Chaucer Bridge Rendering Aerial View (1 to 2 years after construction)

Image 3.1-2. Pope-Chaucer Bridge Rendering Creek View (1 to 2 years after construction)

Channel Widening at Sites 1-4

Because of the meandering nature of the creek's corridor and the dense vegetation that lines both side of the creekbed, impacts associated with operation would be mostly localized at each of these sites. Sites 1 and 2 are located along the south side of Woodland Avenue just west of University Avenue. Sites 3 and 4 are located along the south side of Woodland Avenue just east of Southwood Drive.

Once built, the widened channel would occupy approximately the same area as the existing creekbed, albeit 9–12 feet wider (on average). As such, though the proposed project would introduce visual changes into a residential area where viewers have a moderate-high sensitivity, because viewers are familiar with the existing creek, and more so because views to the creek itself are largely obstructed by dense vegetation and trees, the widened channel would be consistent with the existing visual character and would not substantially alter the visual quality throughout the immediate project area. Structural components within the widened areas will replace existing structures and would not require large-scale vegetation removal. Generally, maintenance activities, such as debris and invasive plant removal, vegetation inspection, and replanting (as necessary) would serve to enhance the overall visual character and quality of the project site. Therefore, the proposed project would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant. I-280 crosses the San Francisquito Creek approximately 4 miles southwest of the proposed Channel Widening at Site 5. It would not be visible from I-280.

Channel Widening at Site 5

Once built, the widened channel at Site 5 would occupy approximately the same area as the existing creekbed, albeit approximately 15 feet wider (on average). As such, though the proposed project would introduce visual changes into a residential area where viewers have a moderate-high sensitivity, because viewers are familiar with the existing creek, and more so because views to the creek itself are largely obstructed by dense vegetation and trees, the widened channel would be consistent with the existing visual character, and would not substantially alter the visual quality throughout the immediate project area. Generally, maintenance activities, such as debris and invasive plant removal, vegetation inspection, and replanting (as necessary) would serve to enhance the overall visual character and quality of the project site. Therefore, the proposed project would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant. I-280 crosses San Francisquito Creek approximately 4 miles southwest of the proposed Channel Widening at Site 5. It would not be visible from I-280.

Aquatic Habitat Enhancement

Aquatic habitat enhancement activities would take place in the creek bed, largely out of sight from viewers (and view corridors). Aquatic enhancement efforts, invasive species removal, and replanting of native species would serve to compliment and beautify the adjacent riparian habitat, and would be viewed positively by recreational viewers (and residents), creating a net aesthetic benefit. Similarly, in general, maintenance activities, such as debris and invasive plant removal, vegetation inspection, and replanting (as necessary) would serve to enhance the overall visual character and quality of the project site. Therefore, the proposed project would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant.

Construction of Creekside Parks

If owner access and agreement are obtained, both of the approximately 400-square-foot creekside parks, which would consist of landscaping and benches, would introduce visual changes into a residential area where viewers have a moderate-high sensitivity. However, the creekside parks are expected to complement and enhance the adjacent riparian habitat, and would be viewed positively by residential viewers and recreationists, creating a net aesthetic benefit. Similarly, in general, maintenance activities, such as debris and invasive plant removal, vegetation inspection, and replanting (as necessary) would serve to beautify the overall visual character and quality of the project site. Therefore, the proposed project would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant. I-280 crosses San Francisquito Creek approximately 4 miles southwest of the proposed creekside parks. They would not be visible from I-280.

Floodwall Alternative

Flood protection under the Floodwall Alternative would be achieved by constructing floodwalls as described below. It would also include the following elements, which are discussed under the Alternative R1-A1 description above: replace Pope-Chaucer Bridge; channel widening at Site 5; aquatic habitat restoration; and construction of creekside parks.

Construction

Replace Pope-Chaucer Bridge, Channel Widening at Site 5, Aquatic Habitat Enhancement, and Construction of Creekside Parks

Impacts would be the same as those presented above under the Channel Widening Alternative.

Floodwall Development

Figure 2-7 shows the locations where floodwalls would be constructed (along the south side of Woodland Avenue between Maple Street [on the west] and Newell Road [on the east]). The floodwalls would be constructed of concrete with a maximum height of 2 feet from the top of the bank. For floodwall installation, all access would be from Woodland Avenue. Access ramps and the upland staging area described for the Channel Widening Alternative would be used for this alternative. Installation of the floodwalls would be preceded by excavation and compaction to prepare the foundation. An excavator and dump trucks would be in the channel to remove excavated soil and bring in the form work and rebar. Concrete would be pumped across the channel from Woodland Avenue using a concrete truck with an articulating boom. Traffic would be controlled (flagged) where the concrete truck is operating, and trees would need to be pruned in those areas. Vegetation at the bottom of the channel would be cleared everywhere that the floodwalls would be built. Pieces of the floodwalls would be brought to the project site by tractor trailer. Installation of the floodwalls would require approximately 3 months: 72 days for installation of the floodwall panels and 10 days for miscellaneous construction activities and contingencies.

The presence of construction materials, equipment, onsite workers, and other associated improvements would alter the existing visual environment. Construction activities would introduce equipment and associated vehicles into the views of all viewer groups, especially residents. Construction activities would include earthwork, excavation and compaction, associated truck hauling and other major material and equipment movement and storage, vegetation pruning, and clearing, any of which could cause visual intrusions in any given area because these activities would be fairly visible to adjacent residential areas. Construction staging areas could also introduce visual changes to their immediate surroundings, with unsightly, visually chaotic aggregations of stored material and equipment. As mentioned, contractors would use best management practices to further reduce or avoid visual impacts during construction.

Overall, given the residential viewers' sensitivities, which are similar to those presented at the Pope-Chaucer Bridge replacement site under the Channel Widening Alternative, and the potential for higher viewer exposure due to residents' proximity to the proposed floodwall locations, viewer sensitivity would be moderate-high.

Although construction activities potentially represent observable changes to visual character, these changes are considered temporary because construction equipment, materials, and support structures would be installed at the beginning of the construction period and removed upon completion of the proposed project. Therefore, proposed construction activities would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant. Permanent visual elements that would be introduced during the construction period and remain after the completion of construction are evaluated below under *Operations and Maintenance*.

Operations and Maintenance

Replace Pope-Chaucer Bridge, Channel Widening at Site 5, Aquatic Habitat Enhancement, and Construction of Creekside Parks

Impacts would be the same as those presented above under the Channel Widening Alternative.

Floodwall Development

Once built, the proposed floodwalls would occupy an approximately 0.7-mile stretch along the south side of Woodland Avenue. As mentioned, the floodwalls would not exceed 2 feet from the top of the bank. Though this built element would be introduced into areas that have viewers with higher sensitivity (residents), the visual changes would be minimal, considering the amount of current bank armoring, the size of the proposed floodwalls (relative to the existing channel height), and because the dense vegetation and trees would mostly screen available views to this feature. If vegetation and/or trees would need to be cleared and/or removed, those areas would be revegetated and replanted, as necessary. Therefore, the proposed project would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant.

Former Nursery Detention Basin Alternative

Construction

This alternative would involve the construction of an approximately 12.4-acre detention basin that is 14 feet deep at the previous location of a tree and plant nursery, located adjacent to Stanford's inactive semicircular Primate Research Center, SLAC Accelerator, and Jasper Ridge, roughly 1.5 miles upstream from I-280 near the northeastern side of San Francisquito Creek. Construction of a detention basin is expected to require approximately 6 months. The general site access and staging areas, located adjacent to the basin, are shown in Figure 2-8.

The presence of construction materials, equipment, onsite workers, and other associated improvements would alter the existing visual environment. Construction activities would introduce equipment and associated vehicles into the viewsheds in the immediate vicinity; however, these viewsheds are private, as the project is on Stanford lands that are closed to the public. Views from public roadways are limited, including those from I-280 in which elevated grading and light vegetation on the south side of the freeway obstruct views into the preserve. As a result, viewer groups are largely absent from this area. Relevant viewers include Stanford employees, visiting researchers, docents, and occasional visitors.

Construction activities would include earthwork, excavation and compaction, potential truck hauling (onsite soil storage may be a possibility, as was done for significant deeper excavations that occurred both at SLAC and for the Primate Research Facility), and for other material and equipment movement and storage, any of which could cause temporary visual intrusions. Construction staging areas could also introduce visual changes to their immediate surroundings. However, public views are largely absent from this area. Furthermore, as mentioned, contractors would use best management practices to further reduce or avoid visual impacts during construction.

Although construction activities potentially represent observable changes to visual character, these changes are considered to be temporary because construction equipment, materials, and support structures would be installed at the beginning of the construction period and removed upon completion of the proposed project. Furthermore, public views are largely absent from this area. Therefore, proposed construction activities would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As mentioned, construction activities would be difficult to detect from I-280 because of the topography and intervening development. As such, impacts would be less than significant. Permanent visual elements that would be introduced during the construction period and remain after the completion of construction are evaluated below under *Operations and Maintenance*.

Operations and Maintenance

Once built, the detention basin would occupy an approximately 12.4-acre site. After large storm events, sediment that accumulates within the basin may need periodic removal. Besides this, the basin would receive little maintenance. The basin itself would be revegetated with no change to function similar to Stanford's other numerous detention facilities, and would be consistent with the existing visual character at the site. This built element would be situated in an area that has limited public views, which are mostly screened by elevated roadway grading, intervening vegetation, and undulating topography. Therefore, the proposed project would not contribute to a substantial degradation of the visual character or quality of the project site and its surroundings. As such, impacts would be less than significant.

Webb Ranch Detention Basin Alternative

This alternative would consist of the construction of an approximately 27.4-acre detention basin within a portion of Webb Ranch, specifically a U-Pick field and associated parking area. Webb Ranch is located approximately 0.5 mile upstream from I-280 along the southern side of San Francisquito Creek. The 13-foot-deep basin would store approximately 440 acre-feet of water and hold back approximately 1,000 cubic feet per second during a peak flow and have a cut of approximately 1,040,000 cubic yards. The general design and construction of the Webb Ranch detention basin would be the same as described above for the former tree and plant nursery detention basin. The Webb Ranch basin would be multipurpose, and would be able to be used again for both parking and annual organic crops with saved topsoil from excavation. After large storm events, sediment that would accumulate within the basin may need to be periodically removed to maintain capacity.

The general site access, staging areas, and basin locations are shown in Figure 2-8.

Construction and Operations and Maintenance

The detention basin proposed at Webb Ranch would be approximately 0.9 mile southeast of the proposed detention basin at the former nursery site. Both of these sites would be consistent with the existing visual character. This built element would serve multipurpose functions as a detention facility for large storm events as well as maintaining current land uses. Both basins are situated in areas with limited public views that are mostly screened by elevated roadway grading, intervening vegetation, and undulating topography. However, the size of the basins is different, based on site specific topographical constraints—the Webb Ranch detention basin would be 15 acres larger than the former Nursery Detention Basin but 1 foot shallower. However, anticipated impacts would be similar.

Impact AES-2—Cause substantial damage to scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway

Summary by Project Element: Impact AES-2—Cause damage to scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwall Alternative All Project Elements	No Impact	No Impact
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Preferred Alternative

Construction and Operations and Maintenance

Replace Pope-Chaucer Bridge, Channel Widening at Sites 1–4, Channel Widening at Site 5, Aquatic Habitat Enhancement, and Construction of Creekside Parks

San Francisquito Creek and the Pope-Chaucer Bridge, channel widening, aquatic habitat enhancement, and creekside park sites are approximately 4 miles northeast of I-280, and construction activities would not be visible from I-280. Therefore, proposed construction and operations and maintenance activities associated with replacing the Pope-Chaucer Bridge, widening the channel at five sites, and extending the University Avenue Bridge parapet upstream would not cause substantial damage to scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway, and there would be no impact.

Floodwall Alternative

Construction and Operations and Maintenance

Replace Pope-Chaucer Bridge, Channel Widening at Site 5, Aquatic Habitat Enhancement, and Construction of Creekside Parks

Impacts would be the same for these project elements as those presented above under the Preferred Alternative.

Floodwall Development

San Francisquito Creek and the floodwall development sites are approximately 4 miles northeast of I-280, and construction activities would not be visible. Therefore, proposed construction and operations and maintenance activities associated with the floodwalls would not cause substantial damage to scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway and there would be no impact. However, the local community has stated that they do not want to see floodwalls, so personal vistas could be affected.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

The presence of construction materials, equipment, onsite workers, and other associated improvements would alter the existing visual environment. Construction activities would introduce equipment and associated vehicles into the viewsheds in the immediate vicinity; however, these viewsheds are private land owned by Stanford University. Views from public roadways are extremely limited, including those from I-280 in which elevated grading and light vegetation on the south side of the freeway obstruct views into the preserve.

Construction activities would include earthwork, excavation, associated truck hauling and other major material and equipment movement and storage, any of which could cause visual intrusions. Construction staging areas could also introduce visual changes to their immediate surroundings. However, public views are largely absent from this area. Furthermore, as mentioned, contractors would use best management practices to further reduce or avoid visual impacts during construction.

Although construction activities potentially represent observable changes to visual character, these changes are considered to be temporary because construction equipment, materials, and support structures would be installed at the beginning of the construction period and removed upon completion of the proposed project. Furthermore, public views are largely absent from this area. Construction activities would not affect the visual resources discussed above under *Project Vicinity and Visual Character*. As mentioned, construction activities would be difficult to detect from I-280 because of the topography and intervening development. Therefore, proposed construction activities would not cause substantial damage to scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway. As such, impacts would be less than significant. Permanent visual elements that would be introduced during the construction period and remain after the completion of construction are evaluated below under *Operations and Maintenance.*

Operations and Maintenance

Once built, the detention basin would occupy a portion of either Webb Ranch or land that was previously used as a tree and plant nursery. The land, similar to Stanford's other numerous detention facilities, would be multipurpose, and could continue current uses, including parking and organic farming, that would be temporarily flooded during large storm events. These built elements would be situated in areas that have limited public views, are mostly screened by elevated roadway grading, intervening vegetation, and undulating topography. The detention basin would not affect the visual resources discussed above under *Project Vicinity and Visual Character*, including the San Francisquito Creek itself. Therefore, the proposed project would not cause substantial damage to scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway. As such, impacts would be less than significant.

Impact AES-3—Create a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area

Summary by Project Element: Impact AES-3— Creation of a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwall Alternative All Project Elements	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Preferred Alternative

Construction

Replace Pope-Chaucer Bridge, Channel Widening at Sites 1–4, Channel Widening at Site 5, and Aquatic Habitat Enhancement

Construction activities are expected to occur during daylight hours, consistent with County and City regulations and are, therefore, unlikely to substantially alter ambient illumination light levels, or result in significant spill light impacts on surrounding land uses. The project is proposed in a residential setting in which there are numerous existing sources of light and glare, including light/glare emitted from existing homes and cars, lampposts, and headlights along local residential thoroughfares such as Woodland Avenue. In addition, there is also little potential for construction activities to produce substantial glare. The net contribution of project construction activities associated with the project sites, when considered in addition to existing sources of light and glare, would not be substantial, and any impacts associated with additional illumination, such as limited lighting potentially between the hours of 4:00 p.m. and 5:00 p.m. during the winter, would be temporary in nature. The proposed project would not create a new source of substantial light or glare that would adversely affect day or nighttime views in the area. Impacts would be less than significant.

Mitigation Measure MM-AES-1 would ensure that if nighttime lighting at the construction site is required, lighting would be directed downward/on site, away from sensitive receptors (residences), and spillover light would be minimized to the greatest extent practicable. Though nighttime construction lighting may be somewhat visible to sensitive receptors, it would not be a significant nuisance for nearby residents due its directional orientation, which would minimize spill effects. With implementation of MM-AES-1 and because any nighttime construction lighting would be limited to the construction period, impacts would be less than significant.

Operations and Maintenance

Replace Pope-Chaucer Bridge

Built elements (i.e., lampposts) associated with the replacement of the Pope-Chaucer Bridge would not significantly alter ambient illumination light levels, or result in significant spill light impacts on surrounding land uses. As mentioned, the project is proposed in a setting in which there are numerous existing sources of light and glare, including light/glare emitted from existing homes and cars, lampposts, and headlights along local residential thoroughfares such as Woodland Avenue. Moreover, because of the density and height of mature trees and other vegetation, intervening landforms, and overall development, built elements associated with the bridge would go largely unnoticed by nearby residents and motorists. Viewer groups primarily affected by the replacement of Pope-Chaucer Bridge would be residents. All project lighting features would be installed in accordance with applicable regulations designed to avoid spill light and glare. In addition, project elements would be designed to be compatible with the design character of the setting in which they are being proposed, and would receive non-highly reflective finishes and colors. Therefore, it is not expected that the project would produce significant light or glare impacts. The project's net contribution, when considered in addition to existing sources of light and glare, would not be substantial. The proposed project would not create a new source of substantial light or glare that would adversely affect day or nighttime views in the area. Impacts would be less than significant.

Channel Widening at Sites 1–4, Channel Widening at Site 5, and Aquatic Habitat Enhancement

No built elements associated with the Channel Widenings at Sites 1–5 and aquatic habitat enhancement sites would introduce new sources of light that could increase ambient illumination light levels, or result in significant spill light impacts on surrounding land uses. The concrete channels associated with the channel widening sites would receive finishes and colors that are not highly reflective, and no new sources of illumination are proposed. Woody debris and boulders associated with the aquatic habitat enhancement sites would blend into the existing habitat and visual environment. Therefore, it is not expected that the project would produce significant light or glare impacts associated with Channel Widenings at Sites 1–5 or the aquatic habitat enhancement sites. The project's net contribution, when considered in addition to existing sources of light and glare, would be negligible. Impacts would be less than significant.

Construction of Creekside Parks

As shown in Figure 2-1, any creekside parks would include a small park area, seating areas, and a walkway to connect to nearby sidewalks. These parks would not be lit at night and, therefore, would not introduce any new sources of light that could increase ambient illumination light levels or result in significant spill light impacts on surrounding land uses. Park features would receive finishes and colors that are not highly reflective. Therefore, it is not expected that the project would produce substantial light or glare impacts. The net contribution of any changes proposed at creekside parks, when considered in addition to existing sources of light and glare, would be negligible. Impacts would be less than significant.

Floodwall Alternative

Construction

Replace Pope-Chaucer Bridge, Channel Widening at Site 5, and Aquatic Habitat Enhancement

Impacts would be the same as those presented above for the Preferred Alternative, because they are common elements.

Floodwall Development

Construction activities are expected to occur during daylight hours, consistent with County and City regulations and are, therefore, unlikely to substantially alter ambient illumination light levels, or result in significant spill light impacts on surrounding land uses. The project is proposed in a residential setting in which there are numerous existing sources of light and glare, including light/glare emitted from existing homes and cars, lampposts, and headlights along local residential thoroughfares such as Woodland Avenue. In addition, there is also little potential for construction activities to produce substantial glare. The net contribution of project construction activities associated with the floodwall development, when considered in addition to existing sources of light and glare, would not be substantial, and any impacts associated with additional illumination would be temporary in nature. The proposed project would not create a new source of substantial light or glare that would adversely affect day or nighttime views in the area. Impacts would be less than significant.

If nighttime lighting at the construction site is required, lighting would be directed downward/on site, away from sensitive receptors (residences), and spillover light would be minimized to the greatest extent practicable. Though nighttime construction lighting may be somewhat visible to sensitive receptors, it would not be a significant nuisance for nearby residents due its directional orientation, which would minimize spill effects. As such, and since any nighttime construction lighting would be limited to the construction period, impacts would be less than significant.

Operations and Maintenance

Replace Pope-Chaucer Bridge, Channel Widening at Site 5, Aquatic Habitat Enhancement, and Construction of Creekside Parks

Impacts would be the same for these project elements because they are the same as those presented above under the Preferred Alternative.

Floodwall Development

No built elements associated with the floodwall development would introduce new sources of light that could increase ambient illumination light levels, or result in significant spill light impacts on surrounding land uses. The concrete floodwalls themselves would receive finishes and colors that are not highly reflective, and no new sources of illumination are proposed as a part of this project element. Therefore, it is not expected that the project would produce significant light or glare impacts. The project's net contribution, when considered in addition to existing sources of light and glare, would not be substantial. The proposed project would not create a new source of substantial light or glare that would adversely affect day or nighttime views in the area. Impacts would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Construction activities are expected to occur during daylight hours, consistent with County and City regulations and are, therefore, unlikely to substantially alter ambient illumination light levels or result in significant spill light impacts on surrounding land uses. The proposed detention basins are within Stanford lands that are either privately operated (Webb Ranch) or restricted access (former

Nursery Site) in which limited light and glare is currently emitted from existing facilities. Views from public roadways are extremely limited, including those from I-280 in which elevated grading and light vegetation on the south side of the freeway obstruct views into the preserve. The glare from the proposed detention basins would not be appreciably different than current conditions. In addition, there is also little potential for construction activities to produce substantial glare. The net contribution of project construction activities associated with the detention basin construction, when considered in addition to existing sources of light and glare, would not be substantial, and any impacts associated with additional illumination would be temporary in nature. The proposed project would not create a new source of substantial light or glare that would adversely affect day or nighttime views in the area. Impacts would be less than significant.

If any nighttime lighting at the construction site is required, lighting would be directed downward/on site, away from sensitive receptors, and spillover light would be minimized to the greatest extent practicable. As such, and since any nighttime construction lighting would be limited to the construction period, impacts would be less than significant.

Operations and Maintenance

No built elements associated with the detention basin construction would introduce new sources of light that could increase ambient illumination light levels, or result in significant spill light impacts on surrounding land uses. The basins would be multipurpose, and would serve as temporary detention for high creek flows, but most of the time would continue to be used in a manner similar to their current purposes. No new sources of illumination are proposed. Therefore, it is not expected that the project would produce significant light or glare impacts. The proposed project would not create a new source of substantial light or glare that would adversely affect day or nighttime views in the area. Impacts would be less than significant.

MM-AES.1: Control Nighttime Lighting

The SFCJPA will ensure that if nighttime lighting at the construction site is required, lighting will be directed downward/on site, away from sensitive receptors (i.e., residences), and spillover light will be minimized to the greatest extent practicable.

3.1.4 Cumulative Impacts

The study area for the cumulative impacts analysis is limited to locations that have clear sightlines to the built elements proposed as part of the project, which extends approximately 0.25 mile from the project perimeter. There are no other known future projects in the study area; therefore, the proposed project would not result in long-term visual impacts to the surrounding area. Overall, impacts associated with the proposed project elements would be less than significant, and, once operational, visible, built elements introduced by the proposed project would primarily include replacement of the Pope Chaucer Bridge (negligible change over existing conditions), Channel Widening at Sites 1–5, and installation of walls for bank protection. In a fairly developed residential/suburban community that is dense with vegetation and trees that line both sides of San Francisquito Creek, these visual changes would be minimal, if at all visible. Other project elements, such as aquatic habitat enhancements, would serve to beautify the project site(s) and surrounding areas. These features are expected to be viewed positively by the neighboring residents/community and would create an overall net benefit in terms of aesthetics. Therefore, the proposed project would not degrade the overall visual quality, damage any scenic resources, or introduce new sources of light and glare. As with the proposed project, related projects would be required to undergo environmental clearance prior to development that would identify potential aesthetics or visual resources impacts and project-specific mitigation measures, as necessary. Therefore, aesthetics or visual resources impacts would not occur as a result of the proposed project, and impacts related to aesthetics and visual resources are not cumulatively considerable.

3.1.5 References

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3.2 Air Quality

This section provides environmental analysis of the proposed project's impacts on air quality. The section summarizes the regulatory environment and discusses the environmental setting, provides the criteria used for determining impacts, discusses the impact mechanism and level of impact resulting from construction and operation of the proposed project, and describes mitigation to minimize the level of impact.

3.2.1 Regulatory Setting

The agencies of direct importance to the project for air quality are the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and the Bay Area Air Quality Management District (BAAQMD). EPA has established federal air quality standards for which CARB and BAAQMD have primary implementation responsibility. CARB and BAAQMD are also responsible for ensuring that state air quality standards are met.

Federal

Clean Air Act and National Ambient Air Quality Standards

The Clean Air Act (CAA) was first enacted in 1963 and amended numerous times in subsequent years (1965, 1967, 1970, 1977, and 1990). The CAA establishes federal air quality standards, known as National Ambient Air Quality Standards (NAAQS), and specifies future dates for achieving compliance. The CAA also mandates that the state submit and implement a State Implementation Plan (SIP) for local areas that fail to meet the standards. The plans must include pollution control measures that demonstrate how the standards will be met.

The 1990 amendments to the CAA identify specific emission-reduction goals for areas that fail to meet the NAAQS. These amendments require both a demonstration of reasonable further progress toward attainment and incorporation of additional sanctions for failure to attain or meet interim milestones. The sections of the CAA that would most substantially affect development of the project include Title I (Nonattainment Provisions) and Title II (Mobile-Source Provisions).

Table 3.2-1 shows the NAAQS currently in effect for each criteria pollutant. The California Ambient Air Quality Standards (CAAQS) (discussed below) are also provided for reference.

Table 3.2-1. National and State Ambient Air Quality Standards

Criteria Pollutant	Average Time	California Standards	National Standards[a]	
			Primary	Secondary
Ozone	1 hour	0.09 ppm	None[b]	None[b]
	8 hours	0.070 ppm	0.070 ppm	0.070 ppm
Particulate Matter (PM10)	24 hours	50 μg/m³	150 μg/m³	150 μg/m³
	Annual mean	20 μg/m³	None	None
Fine Particulate Matter (PM2.5)	24 hours	None	35 μg/m³	35 μg/m³
	Annual mean	12 μg/m³	12.0 μg/m³	15.0 μg/m³

Criteria Pollutant	Average Time	California Standards	National Standards[a]	
			Primary	Secondary
Carbon Monoxide	8 hours	9.0 ppm	9 ppm	None
	1 hour	20 ppm	35 ppm	None
Nitrogen Dioxide	Annual mean	0.030 ppm	0.053 ppm	0.053 ppm
	1 hour	0.18 ppm	0.100 ppm	None
Sulfur Dioxide[c]	Annual mean	None	0.030 ppm	None
	24 hours	0.04 ppm	0.14 ppm	None
	3 hours	None	None	0.5 ppm
	1 hour	0.25 ppm	0.075 ppm	None
Lead	30-day average	1.5 μg/m^3	None	None
	Calendar quarter	None	1.5 μg/m^3	1.5 μg/m^3
	3-month average	None	0.15 μg/m^3	0.15 μg/m^3
Sulfates	24 hours	25 μg/m^3	None	None
Visibility Reducing Particles	8 hours	—[d]	None	None
Hydrogen Sulfide	1 hour	0.03 ppm	None	None
Vinyl Chloride	24 hours	0.01 ppm	None	None

Source: CARB 2016.

a. National standards are divided into primary and secondary standards. Primary standards are intended to protect public health, whereas secondary standards are intended to protect public welfare and the environment.

b. The federal 1-hour standard of 12 parts per hundred million was in effect from 1979 through June 15, 2005. The revoked standard is referenced because it was employed for such a long period and is a benchmark for SIPs.

c. The annual and 24-hour NAAQS for sulfur dioxide apply for only 1 year after designation of the new 1-hour standard in areas that were previously nonattainment areas for the 24-hour and annual NAAQS.

d. The CAAQS for visibility-reducing particles is defined by an extinction coefficient of 0.23 per kilometer (visibility of 10 miles or more due to particles when relative humidity is less than 70%).

PM10 = particulate matter less than or equal to 10 microns in diameter
PM2.5 = particulate matter less than or equal to 2.5 microns in diameter
μg/m^3 = micrograms per cubic meter
ppm = parts per million

Non-Road Diesel Rule

EPA has established a series of increasingly strict emissions standards for new off-road diesel equipment, on-road diesel trucks, and locomotives. New construction equipment used for the project, including heavy-duty trucks and off-road construction equipment, would be required to comply with the emissions standards.

State

California Clean Air Act and California Ambient Air Quality Standards

In 1988, the state legislature adopted the California CAA, which established a statewide air pollution control program. The California CAA requires all air districts in the state to endeavor to meet the CAAQS by the earliest practical date. Unlike the Federal CAA, the California CAA does not set precise attainment deadlines. Instead, the California CAA establishes increasingly stringent requirements for areas that require more time to achieve the standards. The CAAQS are generally more stringent than the NAAQS and incorporate additional standards for sulfates, hydrogen sulfide, visibility-reducing particles, and vinyl chloride. The CAAQS and NAAQS are listed together in Table 3.2-1.

CARB and local air districts bear responsibility for achieving California's air quality standards, which are to be achieved through district-level air quality management plans that are incorporated into the SIP. In California, EPA has delegated authority to prepare SIPs to CARB, which, in turn, has delegated that authority to individual air districts. CARB traditionally has established state air quality standards, maintaining oversight authority for air quality planning, developing programs for reducing emissions from motor vehicles, developing air emission inventories, collecting air quality and meteorological data, and approving SIPs.

The California CAA substantially adds to the authority and responsibilities of air districts. The California CAA designates air districts as lead air quality planning agencies, requires air districts to prepare air quality plans, and grants air districts authority to implement transportation control measures. The California CAA also emphasizes the control of "indirect and area-wide sources" of air pollutant emissions. The California CAA gives local air pollution control districts explicit authority to regulate indirect sources of air pollution and establish traffic control measures.

Statewide Truck and Bus Regulation

Originally adopted in 2005, the on-road truck and bus regulation requires heavy trucks to be retrofitted with particulate matter (PM) filters. The regulation applies to privately and federally owned diesel-fueled trucks with a gross vehicle weight rating greater than 14,000 pounds. Compliance with the regulation can be reached through one of two paths: (1) vehicle retrofits according to engine year or (2) a phase-in schedule. Compliance paths ensure that nearly all trucks and buses will have 2010 model year engines or newer by January 2023.

State Tailpipe Emission Standards

CARB established a series of increasingly strict emissions standards for new off-road diesel equipment, on-road diesel trucks, and harbor craft. New construction equipment used for the project, including heavy-duty trucks and off-road construction equipment, would be required to comply with the standards.

Carl Moyer Program

The Carl Moyer Memorial Air Quality Standards Attainment Program (Carl Moyer Program) is a voluntary program that offers grants to owners of heavy-duty vehicles and equipment. The program is a partnership between CARB and the local air districts throughout the state to reduce air pollution emissions from heavy-duty engines. Locally, the air districts administer the Carl Moyer Program.

Toxic Air Contaminant Regulation

California regulates toxic air contaminants (TACs) 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). In the early 1980s, CARB established a statewide comprehensive air toxics program to reduce exposure to air toxics. 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, CARB identified diesel particulate matter (DPM) from diesel-fueled engines as TACs. In September 2000, 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 (i.e., respirable particulate matter) emissions and the associated health risk by 75% in 2010 and 85% by 2020. The plan identifies 14 measures that CARB will implement over the next several years.

Local

Bay Area Air Quality Management District

BAAQMD has local air quality jurisdiction over projects in Santa Clara County and San Mateo County. Responsibilities of the air district include overseeing stationary-source emissions, approving permits, maintaining emissions inventories, maintaining air quality stations, overseeing agricultural burning permits, and reviewing air quality–related sections of environmental documents required by the California Environmental Quality Act (CEQA). BAAQMD is also responsible for establishing and enforcing local air quality rules and regulations that address the requirements of federal and state air quality laws and for ensuring that the NAAQS and CAAQS are met.

BAAQMD has adopted advisory emission thresholds to assist CEQA lead agencies in determining the level of significance of a project's emissions; the thresholds are outlined in BAAQMD's *CEQA Air Quality Guidelines* (BAAQMD 2017). BAAQMD has also adopted air quality plans to improve air quality, protect public health, and protect the climate. The Bay Area 2001 Ozone Attainment Plan was adopted to reduce ozone and achieve the NAAQS ozone standard; the 2017 Clean Air Plan was adopted to provide an integrated control strategy for ozone, PM, TACs, and greenhouse gas emissions.

The project will be subject to BAAQMD's rules and regulations, including those outlined below. This list may not be all encompassing because additional BAAQMD rules may apply to the project as specific components are identified.

- **Regulation 2, Rule 2 (New Source Review).** This regulation contains requirements for best available control technology and emissions 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 emissions limitations on certain odorous compounds.
- **Regulation 8, Rule 3 (Architectural Coatings)**. This regulation limits the quantity of reactive organic gas (ROG) in architectural coatings.
- **Regulation 9, Rule 6 (NO_X Emissions from Natural Gas–fired Boilers and Water Heaters)**. This regulation limits emissions of nitrogen oxides (NO_X) generated by natural gas–fired boilers.

- **Regulation 9, Rule 8 (Stationary Internal Combustion Engines).** This regulation limits emissions of NO_X and carbon monoxide (CO) from stationary internal combustion engines of more than 50 horsepower.
- **Regulation 11, Rule 2 (Asbestos Demolition, Renovation, and Manufacturing)**. This regulation controls emissions of asbestos to the atmosphere during demolition and renovation activities.

City of Menlo Park General Plan

The City of Menlo Park General Plan includes the following goals and policies associated with air quality:

Goal OSC5: Ensure Healthy Air Quality and Water Quality. Enhance and preserve air quality in accord with State and regional standards, and encourage the coordination of total water quality management including both supply and wastewater treatment.

Policy OSC5.1: Air and Water Quality Standards. Continue to apply standards and policies established by the Bay Area Air Quality Management District (BAAQMD), San Mateo Countywide Water Pollution Prevention Program (SMCWPPP), and City of Menlo Park Climate Action Plan through the California Environmental Quality Act (CEQA) process and other means as applicable.

City of Palo Alto Comprehensive Plan 2030

The City of Palo Alto Comprehensive Plan 2030 includes the following goals and policies associated with air quality:

Goal N-5: Clean, healthful air for Palo Alto and the San Francisco Bay Area.

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 toxic air contaminants 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 the 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.

Vista 2035 East Palo Alto General Plan

The Vista 2035 East Palo Alto General Plan includes the following goals and policies associated with air quality:

Goal HE-10: Improve respiratory health throughout the City and strive to reduce incidence of asthma and other respiratory illnesses.

3.2.2 Environmental Setting

This section provides a discussion of the existing conditions related to air quality in the study area. The information below is drawn from the relevant oversight agencies, which are BAAQMD, CARB, and EPA.

The project area is within the larger San Francisco Bay Area Air Basin (SFBAAB); the air basin comprises the study area for the project. Ambient air quality in the study area is affected by climatological conditions, topography, and the types and amounts of pollutants emitted. The following discussion describes relevant characteristics of the SFBAAB, describes key pollutants of concern, summarizes existing ambient pollutant concentrations, and identifies sensitive receptors.

Climate and Atmospheric Conditions

The SFBAAB contains all of Napa, Contra Costa, Alameda, Santa Clara, San Mateo, San Francisco, and Marin Counties as well as portions of Sonoma and Solano Counties (17 California Code of Regulations [CCR] Section 60101). The peninsula region of the SFBAAB extends from northwest of San José to the Golden Gate. 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 is able to flow easily across most of the city, making its 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 in the mid-60 degrees Fahrenheit, while in Redwood City the mean maximum summer temperatures are in the low 80s. Mean minimum temperatures during the winter months are in the high 30s to low 40s on the eastern side of the Peninsula and in the low 40s 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 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 seen from San Mateo to Redwood City.

Annual average wind speeds range from 5 to 10 miles per hour 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 shows a southwest wind pattern while Pillar Point in San Mateo County shows 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.

Air pollution potential is highest along the southeastern portion of the peninsula. This is the area most protected from the high winds and fog of the marine layer. Pollutant transport from upwind sites is common. In the southeastern portion of the peninsula, air pollutant emissions are relatively high due to motor vehicle traffic as well as stationary sources. At the northern end of the peninsula in San Francisco, pollutant emissions are high, especially from motor vehicle congestion. Localized pollutants, such as carbon monoxide, can build up in "urban canyons." Winds are generally fast enough to carry the pollutants away before they can accumulate.

Criteria and Other Air Pollutants of Concern

Criteria Pollutants

The federal and state governments have established ambient air quality standards (discussed below) for six criteria pollutants: ozone, lead, CO, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter (PM), which consists of PM less than or equal to 10 microns in diameter (PM10) and PM less than or equal to 2.5 microns in diameter (PM2.5). Ozone and NO_2 are considered regional pollutants because they (or their precursors) affect air quality on a regional scale. Pollutants such as CO, SO_2, and lead are considered local pollutants that tend to accumulate in the air locally. PM10 and PM2.5 are both regional and local pollutants.

The primary criteria pollutants of concern in the project area are ozone (including NO_X and ROGs), CO, and PM. The principal characteristics of these pollutants are discussed below.

Ozone, or smog, is a photochemical oxidant that is formed when ROGs and NO_X (both by-products of the internal combustion engine) react with sunlight. Ozone poses a health threat to those who already suffer from respiratory diseases as well as to healthy people. In addition, ozone has been tied to crop damage, typically in the form of stunted growth and premature death. Ozone can also act as a corrosive, resulting in property damage, such as the degradation of rubber products.

Reactive organic gases are compounds that are made up primarily of hydrogen and carbon atoms. Internal combustion associated with motor vehicle usage is the major source of hydrocarbons. Other sources of ROGs are the emissions associated with the use of paints and solvents, the application of asphalt paving, and the use of household consumer products, such as aerosols. Adverse effects on human health are not caused directly by ROGs but, rather, ROG reactions that form secondary pollutants, such as ozone.

Nitrogen oxides serve as integral participants in the process of photochemical smog production. The two major forms of NO_X are nitric oxide (NO) and NO_2. NO is a colorless, odorless gas that is formed from atmospheric nitrogen and oxygen when combustion takes place under high temperatures and/or high pressures. NO_2 is a reddish-brown gas that is formed by the combination of NO and oxygen. NO_X acts as an acute respiratory irritant and increases susceptibility to respiratory pathogens.

Carbon monoxide is a colorless, odorless, toxic gas that is produced by incomplete combustion of carbon substances, such as gasoline or diesel fuel. The primary adverse health effect associated with CO is interference with normal oxygen transfer to the blood, which may result in tissue oxygen deprivation.

Particulate matter consists of finely divided solids or liquids, such as soot, dust, aerosols, fumes, and mists. Two forms of fine particulates are now recognized—inhalable coarse particles, or PM10, and inhalable fine particles, or PM2.5. Particulate discharge into the atmosphere results primarily from industrial, agricultural, construction, and transportation activities. However, wind on arid landscapes also contributes substantially to local particulate loading. Both PM10 and PM2.5 may adversely affect the human respiratory system, especially in those people who are naturally sensitive or susceptible to breathing problems.

Toxic Air Contaminants

Although ambient air quality standards have been established for criteria pollutants, no ambient standards exist for TACs. Many pollutants are identified as TACs because of their potential to increase the risk of developing cancer or their acute or chronic health risks. For TACs that are known or suspected carcinogens, CARB has consistently found that there are no levels or thresholds below which exposure is risk free. Individual TACs vary greatly with respect to the risks they present. At a given level of exposure, one TAC may pose a hazard that is many times greater than another. TACs are identified and their toxicity studied by the California Office of Environmental Health Hazard Assessment.

Air toxics are generated by many sources, including *stationary sources*, such as dry cleaners, gas stations, auto body shops, and combustion sources; *mobile sources*, such as motor vehicles, diesel trucks, ships, and trains; and *area sources*, such as farms, landfills, and construction sites. The adverse health effects of TACs can be carcinogenic (cancer causing), short-term (acute) noncarcinogenic, and long-term (chronic) noncarcinogenic. Direct exposure to these pollutants has been shown to cause cancer, birth defects, damage to the brain and nervous system, and respiratory disorders.

The primary TACs of concern associated with the project are DPM and asbestos. DPM is generated by diesel-fueled engines and considered a carcinogen. DPM is typically composed of carbon particles ("soot", also called black carbon, or BC) and numerous organic compounds, including over 40 known cancer-causing organic substances. Examples of these chemicals include polycyclic aromatic hydrocarbons, benzene, formaldehyde, acetaldehyde, acrolein, and 1,3-butadiene. Asbestos is the name given to many naturally occurring fibrous silicate minerals. It has been mined for applications that require thermal insulation, chemical and thermal stability, and high tensile strength. It is also found in its natural state in rock or soil (known as naturally occurring asbestos). Mapping published by the U.S. Geological Survey and California Geological Survey indicates that the project site does not have any reported historic asbestos mines, historic asbestos prospects, asbestos-bearing talc deposits, fibrous amphiboles, or ultramafic rock outcrops.

Odors

Although offensive odors rarely cause physical harm, they can be unpleasant and lead to considerable distress among the public. This distress often generates citizen complaints to local governments and air districts. According to BAAQMD's *CEQA Air Quality Guidelines* and CARB's *Air Quality and Land Use Handbook*, land uses associated with odor complaints typically include wastewater treatment plants, landfills, confined animal facilities, composting stations, food manufacturing plants, refineries, chemical plants, petroleum refineries, auto body shops, coating operations, fiberglass manufacturing, foundries, rendering plants, and livestock operations. BAAQMD provides recommended screening distances for siting new receptors near existing odor sources; however, the project would not involve siting new receptors.

Air Quality Conditions

CARB collects ambient air quality data from a network of air monitoring stations throughout the state. In San Mateo and Santa Clara Counties combined, six stations record ozone levels, four stations record PM2.5, three stations record CO and NO_2, and two stations record PM10. The closest monitoring station is the Redwood City station, which is approximately 3.2 miles northwest of the Channel Widening Alternative and Floodwalls Alternative, 4.7 miles north of the Former Nursery Detention Basin Alternative, and 4.9 miles north of the Webb Ranch Detention Basin Alternative. The Redwood City station does not record PM10, so the San José–Jackson Street station PM10 data is shown in Table 3.2-2. Table 3.2-2 summarizes ozone, PM2.5, PM10, CO, and NO_2 levels for the last 3 years for which complete data are available (2015–2017). As shown in Table 3.2-2, the Redwood City and San José–Jackson Street stations have experienced violations of the ozone, PM10, and PM2.5 standards.

Table 3.2-2. Ambient Criteria Air Pollutant Monitoring Data (2015–2017)

Pollutant Standards	2015	2016	2017
Ozone (O_3) (Redwood City Station)			
Maximum 1-hour concentration (ppm)	0.086	0.075	0.115
Maximum 8-hour concentration (ppm)	0.071	0.060	0.086
Number of days standard exceeded[a]			
CAAQS 1-hour standard (> 0.09 ppm)	0	0	2
CAAQS 8-hour standard (> 0.070 ppm)	1	0	2
NAAQS 8-hour standard (> 0.070 ppm)	1	0	2
Carbon Monoxide (CO) (Redwood City Station)			
Maximum 8-hour concentration (ppm)	1.6	1.1	1.4
Maximum 1-hour concentration (ppm)	3.4	2.2	2.8
Number of days standard exceeded[a]			
NAAQS 8-hour standard (≥ 9 ppm)	0	0	0
CAAQS 8-hour standard (≥ 9.0 ppm)	0	0	0
NAAQS 1-hour standard (≥ 35 ppm)	0	0	0
CAAQS 1-hour standard (≥ 20 ppm)	0	0	0
Nitrogen Dioxide (NO_2) (Redwood City Station)			
State maximum 1-hour concentration (ppb)	47	45	67
State second-highest 1-hour concentration (ppb)	46	44	55
Annual average concentration (ppb)	10	9	10
Number of days standard exceeded			
CAAQS 1-hour standard (0.18 ppm)	0	0	0
Particulate Matter (PM10) (San José-Jackson Street Station)			
National[b] maximum 24-hour concentration ($\mu g/m^3$)	58.8	40.0	69.4
National[b] second-highest 24-hour concentration ($\mu g/m^3$)	47.2	35.2	67.3
State[c] maximum 24-hour concentration ($\mu g/m^3$)	58.0	41.0	69.8
State[c] second-highest 24-hour concentration ($\mu g/m^3$)	49.3	37.5	67.6
National annual average concentration ($\mu g/m^3$)	21.3	17.5	20.7

Pollutant Standards	2015	2016	2017
State annual average concentration (μg/m³)[d]	21.9	18.3	21.3
Number of days standard exceeded[e]			
NAAQS 24-hour standard (>150 μg/m³)	0	0	0
CAAQS 24-hour standard (>50 μg/m³)	3	0	19
Particulate Matter (PM2.5) (Redwood City Station)			
National[b] maximum 24-hour concentration (μg/m³)	34.6	19.5	60.8
National[b] second-highest 24-hour concentration (μg/m³)	25.6	18.4	57.7
State[c] maximum 24-hour concentration (μg/m³)	34.6	19.5	60.8
State[c] second-highest 24-hour concentration (μg/m³)	25.6	18.4	57.7
National annual average concentration (μg/m³)	5.7	8.3	9.0
State annual average concentration (μg/m³)[d]	5.7	*	9.1
Number of days standard exceeded[e]			
NAAQS 24-hour standard (> 35 μg/m³)	0	0	6

Sources: CARB 2018a; EPA, 2018a.
* = data not available
a. An exceedance is not necessarily a violation.
b. National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.
c. State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, state statistics are based on California-approved samplers.
d. State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.
e. 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.
Ppm = parts per million
NAAQS = National Ambient Air Quality Standards
CAAQS = California Ambient Air Quality Standards
μg/m³ = micrograms per cubic meter

Attainment Status

Local monitoring data (Table 3.2-2) are used to designate areas as *nonattainment*, *maintenance*, *attainment*, or *unclassified* for the NAAQS and CAAQS. The four designations are defined as follows:

- **Nonattainment** is assigned to areas where monitored pollutant concentrations consistently violate the standard in question.
- **Maintenance** is 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** is assigned to areas where pollutant concentrations meet the standard in question over a designated period of time.
- **Unclassified** is assigned to areas were data are insufficient for determining whether a pollutant is violating the standard in question.

Table 3.2-3 summarizes the attainment status of the project area with regard to the NAAQS and CAAQS.

Table 3.2-3. Federal and State Attainment Status for the Project Area

Criteria Pollutant	Federal Designation	State Designation
Ozone (O_3) (8-hour standard)	Marginal Nonattainment	Nonattainment
CO	Attainment	Attainment
PM10	Attainment	Nonattainment
PM2.5	Moderate Nonattainment (2006)	Nonattainment
NO_2	Attainment	Attainment
SO_2	Attainment	Attainment
Lead	Attainment (2008)	Attainment
Sulfates	(No Federal Standard)	Attainment
Hydrogen Sulfide	(No Federal Standard)	Unclassified
Visibility-Reducing Particles	(No Federal Standard)	Unclassified

Sources: CARB 2017, EPA 2018b.
O_3 = ozone
CO = carbon monoxide
PM10 = particulate matter less than or equal to 10 microns
PM2.5 = particulate matter less than or equal to 2.5 microns
NO_2 = nitrogen dioxide
SO_2 = sulfur dioxide

Sensitive Receptors in the Study Area

The NAAQS and CAAQS apply at publicly accessible areas, regardless of whether those areas are populated. BAAQMD generally defines a *sensitive receptor* as a facility or land use that houses or attracts members of the population who are particularly sensitive to the effects of air pollutants, such as children, the elderly, and people with illnesses. Examples of sensitive receptors include residential areas, schools, and hospitals. BAAQMD recommends that any proposed project that includes the siting of a new source or receptors assess associated impacts within 1,000 feet. Sensitive receptors within 1,000 feet of the project site are shown in Tables 3.2-4 through 3.2-6.

Table 3.2-4. Sensitive Receptors within 1,000 Feet of the Channel Widening Alternative and Floodwalls Alternative Project Area

Receptor	Distance of Nearest Receptor to Project Site
International School of the Peninsula	275 feet east
Laurel School Upper Campus	545 feet northwest
University Square Park	940 feet northeast
CEI Medical Group	150 feet north
Residences	Immediately adjacent [a]

[a] There are residences north, south, east, and west of the Pope-Chaucer Bridge and along the entirety of Reach 2. The closest residence is approximately 15 feet south of the site's property line.

Table 3.2-5. Sensitive Receptors within 1,000 Feet of the Former Nursery Detention Basin Alternative Project Area

Receptor	Distance of Nearest Receptor to Project Site
Residence	400 feet east

Table 3.2-6. Sensitive Receptors within 1,000 Feet of the Webb Ranch Detention Basin Alternative Project Area

Receptor	Distance of Nearest Receptor to Project Site
Ladera Recreation District	235 feet south
Residences	35-1,000 feet south[a]

[a] There are residences south of the entirety of the Webb Ranch Detention Basin Alternative project site. The closest residence is approximately 35 feet south of the site's property line.

3.2.3 Impact Analysis

Significance Criteria

Air quality impacts associated with construction and operation of the project were assessed and quantified using standard and accepted software tools, techniques, and emission factors. A summary of the methodology is provided below.

Construction Inventory

Construction of the project would generate emissions of ROG, NO_X, CO, PM10, and PM2.5 that would result in short-term impacts on ambient air quality in the study area. Emissions would originate from mobile and stationary construction equipment, employee vehicles, asphalt paving, and earth movement. It is expected that construction associated with the Channel Widening Alternative would occur over four phases between March 2019 and November 2019: Widen Channel at Sites 1-4, University Avenue Bridge Parapet Extension, Replace Pope-Chaucer Bridge, and Widen Channel at Site 5. It is expected that construction associated with the Floodwalls Alternative would occur over three phases between March 2019 and November 2019: Construct Floodwalls, Replace Pope-Chaucer Bridge, and Widen Channel at Site 5.

Criteria pollutant emissions from heavy-duty equipment, on-road vehicles, asphalt paving, and land disturbance were estimated for the Channel Widening Alternative and the Floodwalls Alternative using the California Emissions Estimator Model (CalEEMod), version 2016.3.2. CalEEMod was run with model default values for some construction parameters, such as equipment load factors. The construction schedule (i.e., start and end dates), the types and horsepower of construction equipment, the number of pieces of equipment, the amount of material imported and exported, and the number of acres to be graded and paved at the project sites were provided by the SFCJPA.

Construction-related emissions associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative were qualitatively evaluated because construction data were not available for these specific alternatives at the time of the analysis.

Operations Inventory

Operation of the project would generate emissions of ROG, NO_X, CO, PM10, and PM2.5 that could result in long-term impacts on ambient air quality. Criteria pollutant emissions from motor vehicles associated with development of the project were qualitatively evaluated.

The State CEQA Guidelines, Appendix G (14 CCR 15000 et seq.), identify significance criteria to be considered for determining whether a project could have significant impacts on existing air quality.

A project impact would be considered significant if construction or operation of the project would cause any of the following:

1. Conflict with or obstruct implementation of the applicable air quality plan.

   For the purposes of this analysis, "conflict with or obstruct implementation of" is defined as circumstances in which a project would worsen existing air quality violations or conflict with the 2017 Clean Air Plan.

2. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard.

   For the purposes of this analysis, a "cumulatively considerable net increase" is defined as circumstances in which construction or operational emissions exceed the pertinent BAAQMD thresholds, as described below under *Local Air District Thresholds*. The emissions thresholds presented in Table 3.2-7 represent the emissions that a project may generate before contributing to a cumulative impact on regional air quality. Therefore, exceedances of the project-level thresholds, as identified in Table 3.2-7, would be cumulatively considerable.

3. Expose sensitive receptors to substantial pollutant concentrations.

   For this analysis, schools, daycare facilities, places of assembly, medical facilities, parks, and residences are considered sensitive receptor locations. A "substantial pollutant concentration" is defined as a level that is more than the applicable BAAQMD threshold, as described below under *Local Air District Thresholds*.

4. Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people.

   For this analysis, an odor-producing facility, as defined by BAAQMD (2017), creates an "objectionable odor" if it receives five complaints per year averaged over 3 years.

Table 3.2-7. BAAQMD Significance Thresholds

Analysis	Threshold	
Regional Criteria Pollutants (Construction)	ROG:	54 pounds/day
	NO_X:	54 pounds/day
	PM10:	82 pounds/day (exhaust only)
	PM2.5:	54 pounds/day (exhaust only)
Regional Criteria Pollutants (Operations)	ROG:	Same as construction
	NO_X:	Same as construction
	PM10:	82 pounds/day (total)
	PM2.5:	54 pounds/day (total)

Analysis	Threshold
Localized Carbon Monoxide	Violation of CAAQS (per screening criteria)
Localized Particulate Matter	Failure to implement emissions control practices PM2.5 increase greater than 0.3 μg/m³ (project) PM2.5 increase greater than 0.8 μg/m³ (cumulative)
Localized Diesel Particulate Matter	Increased cancer risk of 10 in 1 million (project) Increased HI greater than 1.0 (project) Increased cancer risk of 100 in 1 million (cumulative) Increased HI greater than 10.0 (cumulative)
Asbestos	Failure to comply with Regulation 11, Rule 2

Source: BAAQMD 2017.
Notes:
ROG = reactive organic gas
NO_X = nitrogen oxide
PM10 = particulate matter less than or equal to 10 microns in diameter
PM2.5 = particulate matter less than or equal to 2.5 microns in diameter
CAAQS = California ambient air quality standards
$\mu g/m^3$ = micrograms per cubic meter
HI = hazard index

Local Air District Thresholds

The following section summarizes BAAQMD's thresholds and presents substantial evidence regarding the basis upon which they were developed. It also describes how the thresholds are used to determine whether project construction and operational emissions would result in either of the following:

- Interfere or impede with attainment of state or federal ambient air quality standards (CAAQS and NAAQS, respectively); or
- Increase risks to human health.

Regional Thresholds for Air Basin Attainment of State and Federal Ambient Air Quality Standards

BAAQMD has adopted thresholds for regional air pollutants (see Table 3.2-7) (as discussed above, ROG and NO_X are regional pollutants, whereas PM is both a regional and local pollutant) to assist lead agencies in determining the significance of environmental effects regarding local attainment of state and federal ambient air quality standards. The thresholds are based on emissions levels identified under the "New Source Review" (NSR) program, which is a permitting program established by Congress as part of the CAA Amendments of 1990 to ensure that air quality is not significantly degraded by new sources of emissions. The NSR program requires stationary sources to receive permits before construction and/or the use of equipment. By permitting large stationary sources, the NSR program ensures that new emissions would not slow regional progress toward attaining the NAAQS. BAAQMD has concluded that the stationary pollutants described under the NSR program are equally significant to those pollutants generated with land use projects. BAAQMD's regional thresholds identified in Table 3.2-7 were set as the total emission thresholds associated within the NSR program to help attain the NAAQS (BAAQMD 2017).

Health-Based Thresholds for Project-Generated Pollutants of Human Health Concern

In December 2018, the California Supreme Court issued its decision in *Sierra Club v. County of Fresno* (226 Cal.App.4th 704) (hereafter referred to as the Friant Ranch Decision). The case reviewed the long-term, regional air quality analysis contained in the EIR for the proposed Friant Ranch development. The Friant Ranch project is a 942-acre master-plan development in unincorporated Fresno County within the San Joaquin Valley Air Basin, an air basin currently in nonattainment for the ozone and PM2.5 NAAQS and CAAQS. The Court found that the air quality analysis was inadequate because it failed to provide enough detail "for the public to translate the bare [criteria pollutant emissions] numbers provided into adverse health impacts or to understand why such a translation is not possible at this time." The Court's decision clarifies that environmental documents must connect a project's air quality impacts to specific health effects or explain why it is not technically feasible to perform such an analysis.

As discussed in Section 3.2.2, *Criteria and Other Air Pollutants of Concern*, all criteria pollutants that would be generated by the proposed project are associated with some form of health risk (e.g., asthma). Criteria pollutants can be classified as either regional or localized pollutants. Regional pollutants can be transported over long distances and affect ambient air quality far from the emissions source. Localized pollutants affect ambient air quality near the emissions source. Ozone is considered a regional criteria pollutant, whereas CO, NO_2, SO_2, and lead (Pb) are localized pollutants. PM can be both a local and a regional pollutant, depending on its composition. As discussed above, the primary criteria pollutants of concern generated by the proposed project are ozone precursors (ROG and NO_X), CO, and PM (including DPM).

Regional Project-Generated Criteria Pollutants (Ozone Precursors and Regional PM)

Adverse health effects induced by regional criteria pollutant emissions generated by the proposed project (ozone precursors and PM) are highly dependent on a multitude of interconnected variables (e.g., cumulative concentrations, local meteorology and atmospheric conditions, the number and character of exposed individuals [e.g., age, gender]). For these reasons, ozone precursors (ROG and NO_X) contribute to the formation of ground-borne ozone on a regional scale, where emissions of ROG and NOx generated in one area may not equate to a specific ozone concentration in that same area. Similarly, some types of particulate pollutant may be transported over long-distances or formed through atmospheric reactions. As such, the magnitude and locations of specific health effects from exposure to increased ozone or regional PM concentrations are the product of emissions generated by numerous sources throughout a region, as opposed to a single individual project.

Models and tools have been developed to correlate regional criteria pollutant emissions to potential community health impacts. Appendix A summarizes many of these tools, identifies the analyzed pollutants, describes their intended application and resolution, and analyzes whether they could be used to reasonably correlate project-level emissions to specific health consequences. As described in Appendix A, while there are models capable of quantifying ozone and secondary PM formation and associated health effects, these tools were developed to support regional planning and policy analysis and have limited sensitivity to small changes in criteria pollutant concentrations induced by individual projects. Therefore, translating project-generated criteria pollutants to the locations where specific health effects could occur or the resultant number of additional days of nonattainment cannot be estimated with a high degree of accuracy.

Technical limitations of existing models to correlate project-level regional emissions to specific health consequences are recognized by air quality management districts throughout the state, including the San Joaquin Valley Air Pollution Control District (SJVAPCD) and South Coast Air Quality Management District (SCAQMD), who provided amici curiae briefs for the Friant Ranch legal proceedings. In its brief, SJVAPCD (2015) acknowledges that while health risk assessments for localized air toxics, such as DPM, are commonly prepared, "it is not feasible to conduct a similar analysis for criteria air pollutants because currently available computer modeling tools are not equipped for this task." The air district further notes that emissions solely from the Friant Ranch project (which equate to less than one-tenth of one percent of the total NOx and VOC in the Valley) is not likely to yield valid information," and that any such information should not be "accurate when applied at the local level." SCAQMD (2015) presents similar information in their brief, stating that "it takes a large amount of additional precursor emissions to cause a modeled increase in ambient ozone levels".[1]

As discussed above, air districts develop region-specific CEQA thresholds of significance in consideration of existing air quality concentrations and attainment or nonattainment designations under the NAAQS and CAAQS. The NAAQS and CAAQS are informed by a wide range of scientific evidence that demonstrates there are known safe concentrations of criteria pollutants. While recognizing that air quality is cumulative problem, air districts typically consider projects that generate criteria pollutant and ozone precursor emissions below these thresholds to be minor in nature and would not adversely affect air quality such that the NAAQS or CAAQS would be exceeded. Emissions generated by the project could increase photochemical reactions and the formation of tropospheric ozone and secondary PM, which at certain concentrations, could lead to increased incidence of specific health consequences. Although these health effects are associated with ozone and particulate pollution, the effects are a result of cumulative and regional emissions. As such, a project's incremental contribution cannot be traced to specific health outcomes on a regional scale, and a quantitative correlation of project-generated regional criteria pollutant emissions to specific human health impacts is not included in this analysis. It is foreseeable that unmitigated construction- and operational-generated emissions of ozone precursors and PM in excess of BAAQMD thresholds could contribute to cumulative and regional health impacts. In such cases, all feasible mitigation is applied, and emissions are reduced to the extent possible. Please refer to Impact AQ-2 for a discussion of project-generated emissions, cumulative impacts, and a description of feasible mitigation.

Localized Project-Generated Criteria Pollutants (PM and CO) and Air Toxics (DPM)

Localized pollutants generated by a project are deposited and potentially affect population near the emissions source. Because these pollutants dissipate with distance, emissions from individual projects can result in direct and material health impacts to adjacent sensitive receptors. Models and

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[1] For example, SCAQMD's analysis of their 2012 Air Quality Attainment Plan showed that modeled NOx and ROG reductions of 432 and 187 tons per day, respectively, only reduced ozone levels by 9 parts per billion. Analysis of SCAQMD's Rule 1315 showed that emissions of NOx and ROG of 6,620 and 89,180 pounds per day, respectively, contributed to 20 premature deaths per year and 89,947 school absences (South Coast Air Quality Management District 2015).

thresholds are readily available to quantify these potential health effects and evaluate their significance (California Air Pollution Control Officers Association 2009, Office of Environmental Health Hazard Assessment 2015, Bay Area Air Quality Management District 2017, California Air Resources Board 2000). Locally adopted thresholds and analysis procedures for the localized pollutants of concern associated with the proposed plan (CO, PM and DPM[2], and asbestos)[3] are identified below and summarized in Table 3.2-7.

Localized Carbon Monoxide Concentrations

Heavy traffic congestion can contribute to high levels of CO, and individuals exposed to such hot spots may have a greater likelihood of developing adverse health effects. BAAQMD has adopted screening criteria that provide a conservative indication of whether project-generated traffic would cause a potential CO hot spot. If the screening criteria are not 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 violations of the CAAQS for CO. Projects that do not generate CO concentrations in excess of the health-based CAAQS would not contribute a significant level of CO such that localized air quality and human health would be substantially degraded. BAAQMD's CO screening criteria are summarized below.

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

Localized Particulate Matter Concentrations

BAAQMD adopted an incremental PM2.5 concentration-based significance threshold in which a "substantial" contribution at the project level for an individual source is defined as total (i.e., exhaust and fugitive) PM2.5 concentrations exceeding 0.3 microgram per cubic meter ($\mu g/m^3$). This is the same threshold used to evaluate the placement of new receptors that would be exposed to individual PM2.5 emissions sources. In addition, BAAQMD considers projects to have a cumulatively considerable PM2.5 impact if sensitive receptors are exposed to PM2.5 concentrations from local sources within 1,000 feet, including existing sources, project-related sources, and reasonably foreseeable future sources, that exceed 0.8 $\mu g/m^3$.

BAAQMD has not established PM10 thresholds of significance. BAAQMD's PM2.5 thresholds apply to

[2] DPM is the primary TAC of concern—of all controlled TACs, emissions of DPM are estimated to be responsible for about 82% of the total ambient cancer risk in the BAAQMD (Bay Area Air Quality Management District 2017). Given the risks associated with DPM, tools and factors for evaluating human health impacts from project-generated DPM have been developed and are readily available. Conversely, tools and techniques for assessing project-specific health outcomes as a result of exposure to other TAC (e.g., benzene) remain limited. These limitations impede the ability to evaluate and precisely quantify potential public health risks posed by TAC exposure.

[3] Although SO_2 NO_2, and lead may also concentration locally, the project does not represent a significant source of these pollutants. Accordingly, they are not discussed or evaluated further.

both new receptors and new sources. However, BAAQMD considers fugitive PM10 from earthmoving activities to be less than significant with application of BAAQMD's Basic Construction Mitigation Measures.

Localized Diesel Particulate Matter Concentrations

DPM has been identified as a TAC and is particularly concerning because long-term exposure can lead to cancer, birth defects, and damage to the brain and nervous system. BAAQMD has adopted incremental cancer and hazard thresholds to evaluate receptor exposure to single sources of DPM emissions. The "substantial" DPM threshold defined by BAAQMD is exposure of a sensitive receptor to an individual emissions source, resulting in an excess cancer risk level of more than 10 in 1 million or a non-cancer (i.e., chronic or acute) hazard index (HI) greater than 1.0.

The air district considers projects to have a cumulatively considerable DPM impact if they contribute DPM emissions that, when combined with cumulative sources within 1,000 feet of sensitive receptors, result in excess cancer risk levels of more than 100 in 1 million or an HI greater than 10.0. BAAQMD considers a project to have a significant cumulative impact if it introduces new receptors at a location where the combined exposure to all cumulative sources within 1,000 feet is in excess of the cumulative thresholds.

Asbestos

BAAQMD considers a project to have a significant impact if it does not comply with the applicable regulatory requirements outlined in Regulation 11, Rule 2.

Impacts and Mitigation Measures

Impact AQ-1—Conflict with or obstruct implementation of an applicable air quality plan

Summary by Project Element: Impact AQ-1—Conflict with or obstruct implementation of an applicable air quality plan		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant

Channel Widening Alternative and Floodwalls Alternative

The project would be deemed inconsistent with the 2017 Clean Air Plan if it would result in regional population, employment, or vehicle miles traveled (VMT) growth that exceeds estimates used to develop applicable air quality plans. Projects that propose development that is consistent with the growth anticipated by the relevant land use plans would be consistent with the 2017 Clean Air Plan. Likewise, projects that propose development that is less dense than anticipated within a general plan (or other governing land use document) would be consistent with the air quality plans because emissions would be less than estimated for the region. The emission strategies in the Clean Air Plan were developed, in part, on regional population, housing, and employment projections prepared by the Association of Bay Area Governments.

The Channel Widening Alternative involves creek channel widening by replacing a decades-old sacked concrete wall with a more vertical, vegetated soil nail wall; replacement of Pope-Chaucer Bridge; channel widening immediately upstream of U.S. 101; and construction of creekside parks and aquatic habitat enhancements. The Floodwalls Alternative involves the construction and installation of floodwalls, replacement of Pope-Chaucer Bridge, channel widening immediately upstream of U.S. 101, and construction of creekside parks and aquatic habitat enhancements. As discussed in Section 3.13, *Traffic and Transportation*, the Channel Widening Alternative and Floodwalls Alternative would not add any additional capacity to existing roadways or permanently change traffic patterns in the area. Likewise, these alternatives would not conflict with or obstruct implementation of any applicable land use plan or contribute to regional employment or population growth, because the project would not construct any new land uses.

The Channel Widening Alternative and Floodwalls Alternative would also conflict with the 2017 Clean Air Plan if the criteria pollutant mass emissions associated with the alternatives would worsen existing air quality violations by exceeding BAAQMD's significance thresholds shown in Table 3.2-7. Implementation of Mitigation Measures (MM-) AQ-1 through MM-AQ-3 would reduce criteria pollutant emissions to less than BAAQMD's significance thresholds, as shown in Tables 3.2-9 and 2.3-1 and discussed further below.

Thus, the Channel Widening Alternative and Floodwalls Alternative would be consistent with population, employment, or VMT growth estimates that were used to develop the 2017 Clean Air Plan, and criteria pollutant mass emissions would not exceed BAAQMD's significance thresholds with implementation of MM-AQ-1 through MM-AQ-3. This impact would be less than significant with mitigation.

MM-AQ-1: Utilize clean diesel-powered equipment during construction to control construction-related NO_X emissions for all Alternatives and operations-related NO_X emissions for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The project applicant will ensure that all off-road diesel-powered equipment used during construction and operations is equipped with EPA Tier 4 Final engines.

MM-AQ-2: Use on-road haul trucks with model year 2010 and newer engines during construction for all Alternatives and operations for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The SFCJPA will ensure that all on-road heavy-duty diesel haul trucks with a gross vehicle weight rating of 19,500 pounds or greater used at the project sites comply with EPA 2007 on-road emission standards for PM10 and NO_X (0.01 grams per brake horsepower-hour [g/bhp-hr] and 0.20 g/bhp-hr, respectively).

MM-AQ-3: Reduce construction emissions for all Alternatives and operations emissions for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative to below BAAQMD NO_X thresholds

The SFCJPA will ensure construction- and operations-related emissions do not exceed BAAQMD's construction NO_X threshold of 54 pounds per day. In addition to implementing MM-AQ-1 and MM-AQ-2, the SFCJPA will coordinate with the BAAQMD to purchase NO_X credits to offset remaining NO_X construction and operations emissions exceeding BAAQMD thresholds.

The SFCJPA will track construction and operations activity, estimate emissions, and enter into a construction mitigation contract with BAAQMD to offset NO_X emissions that exceed BAAQMD NO_X maximum daily threshold of 54 pounds per day.

The maximum daily emissions will be calculated on a daily basis by determining total construction- and operations-related NO_X emissions for each calendar day. BAAQMD will use the mitigation fees provided by the SFCJPA to implement emissions reduction efforts that offset project NO_X emissions that exceed the BAAQMD threshold.

This mitigation includes the following specific requirements:

- The SFCJPA will require construction contractors to provide daily construction and operational activity monitoring data for all construction activities and operations activities associated with alternatives Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative to estimate actual construction and operational emissions, including the effect of equipment emissions reduction measures. The SFCJPA will submit the daily construction and operational activity monitoring data and an estimate of actual daily construction and operational emissions to SFCJPA and BAAQMD for review by the 15th day of each month for the prior construction month. The SFCJPA will examine the construction and operational activity monitoring to ensure it is representative, and BAAQMD will examine the emissions estimate to ensure it is calculated properly.
- After acceptance of the emissions estimates by BAAQMD for the prior month, the SFCJPA will submit mitigation fees to BAAQMD to fund offsets for the portion of daily emissions that exceed the maximum daily NO_X threshold. The mitigation fees will be based on the mitigation contract with BAAQMD (see discussion below) but will not exceed the emissions-reduction project cost-effectiveness limit set for the Carl Moyer Program for the year in which mitigation fees are paid. The current Carl Moyer Program cost-effectiveness limit is $30,000 per weighted ton of criteria pollutants (NO_X + ROG + [20*PM]). An administrative fee of 5% will be paid by the SFCJPA to BAAQMD to implement the program.
- The mitigation fees will be used by BAAQMD to fund projects that are eligible for funding under the Carl Moyer Program guidelines or other BAAQMD emissions-reduction incentive programs that meet the Carl Moyer Program cost-effectiveness threshold and are real, surplus, quantifiable, and enforceable.
- The SFCJPA will enter into a mitigation contract with BAAQMD for the emissions-reduction incentive program. The mitigation contract will include the following:
    - Identification of appropriate offsite mitigation fees required for the project.
    - Timing for submission of mitigation fees.

- Processing of mitigation fees paid by the SFCJPA.
- Verification of emissions estimates submitted by the SFCJPA.
- Verification that offsite fees are applied to appropriate mitigation programs within the SFBAAB.

The mitigation fees will be submitted within 4 weeks after BAAQMD accepts an emissions estimate provided by the SFCJPA showing that the maximum daily NO_X threshold was exceeded (when measured on an daily basis).

MM-AQ-4: Implement BAAQMD's Basic Construction Mitigation Measures for all Alternatives and operations for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The SFCJPA shall require all construction contractors to implement the basic construction mitigation measures recommended by BAAQMD. The emissions reduction measures shall include, at a minimum, the following:

- All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times a day.
- All haul trucks shall be covered when transporting soil, sand, or other loose material offsite.
- All visible mud or dirt track-out material on adjacent public roads shall be removed using wet-power vacuum-type street sweepers at least once a day. The use of dry-power sweeping is prohibited.
- All vehicle speeds shall be limited to 15 miles per hour on unpaved roads.
- All roadways, driveways, and sidewalks that are to be paved shall be paved as soon as possible. Building pads shall be laid as soon as possible after grading, unless seeding or soil binders are used.
- All construction equipment shall be maintained and properly tuned in accordance with manufacturers' specifications. All equipment shall be checked by a certified visible-emissions evaluator.
- Idling times shall be minimized, either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure).
- Publicly visible signs shall be posted with the telephone number and person to contact at the lead agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. BAAQMD's phone number shall also be visible to ensure compliance with applicable regulations.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The Former Nursery Detention Basin Alternative involves the construction of an approximately 12.4-acre detention basin at the Former Nursery site roughly 1.5 miles upstream from Interstate 280 (I-280) along the northeastern side of San Francisquito Creek. The Webb Ranch Detention Basin Alternative involves the construction of an approximately 27.4-acre detention basin at the Webb

Ranch site approximately 0.5 mile upstream from I-280 along the southern side of San Francisquito Creek. As discussed in Section 3.13, *Traffic and Transportation*, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would not add any additional capacity to existing roadways or permanently change traffic patterns in the area. Likewise, these alternatives would not conflict with or obstruct implementation of any applicable land use plan or contribute to regional employment or population growth, because the project would not construct any new land uses.

The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would also conflict with the 2017 Clean Air Plan if the criteria pollutant mass emissions associated with the alternatives would worsen existing air quality violations by exceeding BAAQMD's significance thresholds shown in Table 3.2-7. Implementation of MM-AQ-1 through MM-AQ-3 would reduce criteria pollutant emissions to less than BAAQMD's significance thresholds.

Thus, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would be consistent with population, employment, or VMT growth estimates that were used to develop the 2017 Clean Air Plan, and criteria pollutant mass emissions would not exceed BAAQMD's significance thresholds with implementation of MM-AQ-1 through MM-AQ-3. This impact would be less than significant with mitigation.

Impact AQ-2—Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard

Summary by Project Element: Impact AQ-2— Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation

Channel Widening Alternative

Construction

Criteria pollutant emissions generated by construction of the Channel Widening Alternative were quantified using CalEEMod. Estimated unmitigated construction emissions would be short-term and occur for approximately 8 months (March 2019 through November 2019). Table 3.2-8 summarizes the results of the emissions modeling.

Table 3.2-8. Unmitigated Criteria Pollutant Emissions from Channel Widening Alternative Construction in 2019 (pounds per day)

				PM10		PM2.5	
Construction Phase	**ROG**	**NO_X**	**CO**	**Dust**	**Exhaust**	**Dust**	**Exhaust**
Widen Channel at Sites 1–4	10	74	55	16	3	2	3
University Avenue Bridge Parapet Extension	1	7	4	2	<1	<1	<1
Replace Pope-Chaucer Bridge	5	44	23	5	2	1	2
Widen Channel at Site 5	6	85	37	5	2	1	2
Maximum Daily Emissions[a]	18	179	102	27	6	3	6
BAAQMD Threshold	*54*	*54*	--	*BMPs*	*82*	*BMPs*	*54*
Exceed Threshold?	*No*	*Yes*	--	--	*No*	--	*No*

Exceedances denoted as underline.
[a] Maximum daily emissions occur when partial overlap occurs for construction phases Widen Channel at Sites 1–4, Replace Pope-Chaucer Bridge, and Widen Channel at Site 5.
BAAQMD = Bay Area Air Quality Management District
BMPs = best management practices
CO = carbon monoxide
NO_X = nitrogen oxide
PM2.5 = particulate matter no more than 2.5 microns in diameter
PM10 = particulate matter no more than 10 microns in diameter
ROG = reactive organic gases

As shown in Table 3.2-8, construction of the Channel Widening Alternative would not generate ROG or PM exhaust in excess of BAAQMD's numeric thresholds. However, the Channel Widening Alternative would generate NO_X in excess of BAAQMD's significance threshold by a substantial amount, and this impact would be potentially significant. These emissions, if left unmitigated, could contribute to ozone ground-level formation in the SFBAAB, which at certain concentrations, can contribute to short- and long-term human health effects. Santa Clara and San Mateo Counties do not currently attain the ozone CAAQS and NAAQS (see Table 3.2-3). Certain individuals residing in areas that do not meet the ambient air quality standards, including Santa Clara and San Mateo Counties, could be exposed to pollutant concentrations that cause or aggravate acute and/or chronic health conditions (e.g., asthmas, lost work days, premature mortality). While construction of the Channel Widening Alternative would contribute to future NOx emissions, maximum daily construction-generated NOx emissions represent approximately 0.03 percent of total NOx in the SFBAAB (Bay Area Air Quality Management District 2017a)[4]. As previously discussed, the magnitude and locations of any potential changes in ambient air quality, and thus health consequences, from these additional emissions cannot be quantified with a high level of certainty due to the dynamic and complex nature of pollutant formation and distribution (e.g., meteorology, emissions sources, sunlight exposure). However, it is known that public health will continue to be affected in Santa Clara and San Mateo Counties so long as the region does not attain the CAAQS or NAAQS.

[4] SFBAAB 2015 NOx emissions reported in the Clean Air Plan were 300 tons per day (Bay Area Air Quality Management District 2017a). Maximum project-generated NOx emissions are 179 pounds per day, which equates to 0.0895 ton per day.

Because NO_X emissions would exceed the BAAQMD's threshold during construction, the implementation of mitigation measures would be necessary to reduce emissions to below the threshold. With implementation of MM-AQ-1 and MM-AQ-2, which require clean diesel-powered off-road equipment and engines in on-road trucks to be model year 2010 or newer, NO_X emissions would be reduced, but not to a less-than-significant level. However, implementation of MM-AQ-3, which requires the purchase of emissions offsets, would ensure that emissions do not exceed BAAQMD's NO_X threshold. Mitigated criteria pollutant emissions that incorporate the reductions that would be achieved with MM-AQ-1 through MM-AQ-3 are shown in Table 3.2-9.

Table 3.2-9. Mitigated Criteria Pollutant Emissions from Channel Widening Alternative Construction in 2019 (pounds per day)

				PM10		PM2.5	
Construction Year	**ROG**	**NO_X**	**CO**	**Dust**	**Exhaust**	**Dust**	**Exhaust**
Widen Channel at Sites 1–4	3	32	50	16	<1	2	<1
University Avenue Bridge Parapet Extension	<1	4	3	2	<1	<1	<1
Replace Pope-Chaucer Bridge	2	12	28	5	<1	1	<1
Widen Channel at Site 5	2	51	66	5	<1	1	<1
Maximum Daily Emissions including MMs AQ-1 and AQ-2[a]	7	<u>92</u>	124	27	1	3	1
Maximum Daily Emissions including MM-AQ-3	7	54	124	27	1	3	1
BAAQMD Threshold	*54*	*54*	*--*	*BMPs*	*82*	*BMPs*	*54*
Exceed Threshold?	*No*	*No*	*--*	*--*	*No*	*--*	*No*

Exceedances denoted as underline.

[a] Maximum daily emissions occur when partial overlap occurs for construction phases Widen Channel at Sites 1-4, Replace Pope-Chaucer Bridge, and Widen Channel at Site 5.

BAAQMD = Bay Area Air Quality Management District

BMPs = best management practices

CO = carbon monoxide

NO_X = nitrogen oxide

PM2.5 = particulate matter no more than 2.5 microns in diameter

PM10 = particulate matter no more than 10 microns in diameter

ROG = reactive organic gases

The Channel Widening Alternative would incorporate BAAQMD's Basic Construction Mitigation Measures as MM-AQ-4 in order to reduce construction-related fugitive dust impacts during all phases of construction. With implementation of the Basic Construction Mitigation Measures, impacts of construction-related fugitive dust emissions would be reduced to a less-than-significant level.

Because construction-related criteria pollutant emissions associated with the proposed project would be mitigated to below BAAQMD's significance thresholds, and dust emissions would be less than significant with implementation of BAAQMD's Basic Control Measures, criteria pollutant emission impacts would be less than significant with mitigation.

Operations and Maintenance

The Channel Widening Alternative would require maintenance activities that are similar to those currently being performed along the creek, including removing debris from channels, which could occur during any flood season, and more intensive post-flood clean-up that would be needed only after major flood events. Additionally, monitoring and maintenance of new vegetation would occur, at a minimum, for 3 years following completion of the Channel Widening Alternative. This activity would consist of invasive plant removal, inspection of newly planted vegetation, and replanting as needed. A Operations and Maintenance Manual will be created for all in-channel features after construction permits are obtained. Creekside parks would require trash pick-up and disposal as well as routine maintenance of benches and landscaping.

The operational activities described above would likely involve occasional light duty vehicle trips to transport personnel to the site and handheld landscaping equipment. Based on the types of vehicles and equipment and occasional nature of activities, operational emissions would be considered minor and less than significant. No mitigation is required.

Floodwalls Alternative

Construction

Estimated unmitigated construction emissions from the Floodwalls Alternative would be short-term and occur for approximately 8 months (March 2019 through November 2019). Table 3.2-10 summarizes the results of the emissions modeling.

Table 3.2-10. Unmitigated Criteria Pollutant Emissions from Floodwalls Alternative Construction in 2019 (pounds per day)

				PM10		PM2.5	
Construction Phase	**ROG**	**NO_X**	**CO**	**Dust**	**Exhaust**	**Dust**	**Exhaust**
Construct Floodwalls	2	14	6	2	<1	1	<1
Replace Pope-Chaucer Bridge	5	44	23	5	2	1	2
Widen Channel at Site 5	6	85	36	5	2	1	2
Maximum Daily Emissions[a]	10	<u>118</u>	52	12	3	2	3
BAAQMD Threshold	*54*	*54*	--	*BMPs*	*82*	*BMPs*	*54*
Exceed Threshold?	*No*	*Yes*	--	--	*No*	--	*No*

Exceedances denoted as <u>underline</u>.
[a] Maximum daily emissions occur when partial overlap occurs for construction phases Construct Floodwalls, Replace Pope-Chaucer Bridge, and Widen Channel at Site 5.
BAAQMD = Bay Area Air Quality Management District
BMPs = best management practices
CO = carbon monoxide
NO_X = nitrogen oxide
PM2.5 = particulate matter no more than 2.5 microns in diameter
PM10 = particulate matter no more than 10 microns in diameter
ROG = reactive organic gases.

As shown in Table 3.2-10, construction of the Floodwalls Alternative would not generate ROG or PM exhaust in excess of BAAQMD's numeric thresholds. However, the Floodwalls Alternative would generate NO_X in excess of BAAQMD's significance threshold. These results are consistent with the Channel Widening Alternative, although the amount of emissions is generally lower for this alternative. These emissions, if left unmitigated, could contribute to ozone ground-level formation in the SFBAAB, which at certain concentrations, can contribute to short- and long-term human health effects. Santa Clara and San Mateo Counties do not currently attain the ozone CAAQS and NAAQS (see Table 3.2-3). Certain individuals residing in areas that do not meet the ambient air quality standards, including Santa Clara and San Mateo Counties, could be exposed to pollutant concentrations that cause or aggravate acute and/or chronic health conditions (e.g., asthmas, lost work days, premature mortality). While construction of the Floodwalls Alternative would contribute to future NOx emissions, maximum daily construction-generated NOx emissions represent approximately 0.02 percent of total NOx in the SFBAAB (Bay Area Air Quality Management District 2017a)[5]. As previously discussed, the magnitude and locations of any potential changes in ambient air quality, and thus health consequences, from these additional emissions cannot be quantified with a high level of certainty due to the dynamic and complex nature of pollutant formation and distribution (e.g., meteorology, emissions sources, sunlight exposure). However, it is known that public health will continue to be affected in Santa Clara and San Mateo Counties so long as the region does not attain the CAAQS or NAAQS.

Similar to the Channel Widening Alternative, implementation of mitigation measures would be necessary to reduce NO_X emissions to below the threshold, and MM-AQ-1 and MM-AQ-2 would reduce direct emissions from the construction equipment, while MM-AQ-3 would reduce any remaining NO_X emissions over the threshold through the purchase of emissions offsets.

As shown in Table 3.2-11, implementation of MM-AQ-1 and MM-AQ-2 would reduce NO_X emissions associated with the Floodwalls Alternative, but not below BAAQMD's NO_X threshold. Therefore, the additional implementation of MM-AQ-3 would ensure emissions do not exceed BAAQMD's NO_X threshold, as shown in Table 3.2-11, through the purchase of emissions offsets. Additionally, the Floodwalls Alternative would incorporate BAAQMD's Basic Construction Mitigation Measures as MM-AQ-4, which would reduce construction-related fugitive dust emissions to less than significant.

[5] SFBAAB 2015 NOx emissions reported in the Clean Air Plan were 300 tons per day (Bay Area Air Quality Management District 2017a). Maximum project-generated NOx emissions are 118 pounds per day, which equates to 0.059 ton per day.

Table 3.2-11. Mitigated Criteria Pollutant Emissions from Floodwalls Alternative Construction in 2019 (pounds per day)

				PM10		PM2.5	
Construction Year	**ROG**	**NO_X**	**CO**	**Dust**	**Exhaust**	**Dust**	**Exhaust**
Construct Floodwalls	<1	6	3	2	<1	1	<1
Replace Pope-Chaucer Bridge	2	12	28	5	<1	1	<1
Widen Channel at Site 5	2	50	66	5	<1	1	<1
Maximum Daily Emissions including MMs AQ-1 and AQ-2[a]	4	<u>65</u>	78	12	1	2	1
Maximum Daily Emissions including MM-AQ-3	4	54	78	12	1	2	1
BAAQMD Threshold	*54*	*54*	--	*BMPs*	*82*	*BMPs*	*54*
Exceed Threshold?	*No*	*No*	--	--	*No*	--	*No*

Exceedances denoted as <u>underline</u>.

[a] Maximum daily emissions occur when partial overlap occurs for construction phases Construct Floodwalls, Replace Pope-Chaucer Bridge, and Widen Channel at Site 5.

BAAQMD = Bay Area Air Quality Management District

BMPs = best management practices

CO = carbon monoxide

NO_X = nitrogen oxide

PM2.5 = particulate matter no more than 2.5 microns in diameter

PM10 = particulate matter no more than 10 microns in diameter

ROG = reactive organic gases

Operations and Maintenance

The Floodwalls Alternative would require visual inspections for any damaged concrete or exposed reinforcing bar, and if found, repairing damaged concrete; it would also require visually inspecting for any undermining, and if found, backfilling or grouting. Additionally, monitoring and maintenance of new vegetation would occur, at a minimum, for 3 years following completion of the Floodwalls Alternative. This activity would consist of invasive plant removal, inspection of newly planted vegetation, and replanting as needed. Creekside parks would require trash pick-up and disposal as well as routine maintenance of benches and landscaping. Similar to the Channel Widening Alternative, the operational activities described above would likely involve occasional light duty vehicle trips to transport personnel to the site and handheld landscaping equipment. Such activities would be minor and result in less-than-significant levels of emissions. No mitigation is required.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Unmitigated criteria pollutant emissions generated by construction of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are conservatively assumed to exceed BAAQMD's NO_X threshold shown in Table 3.2-7. With implementation of MM-AQ-1 and AQ-2, NO_X emissions associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would be reduced, but would be conservatively assumed to remain above BAAQMD's NO_X threshold. Implementation of MM-AQ-3 would ensure emissions do not exceed BAAQMD's NO_X threshold.

The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would incorporate BAAQMD's Basic Construction Mitigation Measures as MM-AQ-4. Implementation of the Basic Construction Mitigation Measures during construction would reduce construction-related fugitive dust emissions to less than significant.

Because construction-related criteria pollutant emissions associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would be mitigated to below BAAQMD's significance thresholds with the implementation of MM-AQ-1 through AQ-3, and dust emissions would be less than significant with implementation of BAAQMD's Basic Construction Mitigation Measures, criteria pollutant emission impacts would be less than significant with mitigation.

Operations and Maintenance

The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would require sediment that accumulates within the basin during flood events to be removed and hauled by haul truck to an appropriate location once the basin empties out. Because equipment and vehicle assumptions associated with sediment removal activities were unable to be provided at the time of this analysis, sediment removal activities would be conservatively assumed to be intensive in nature and generate emissions in excess of BAAQMD's daily NO_X significance threshold shown in Table 3.2-7. Implementation of MM-AQ-1 and MM-AQ-2 would reduce direct NO_X emissions associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative, and implementation of MM-AQ-3 would ensure emissions do not exceed BAAQMD's NO_X threshold through the purchase of emissions offsets. As such, operational-related NO_X emissions would be less than significant with mitigation. Additionally, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would incorporate BAAQMD's Basic Construction Mitigation Measures as MM-AQ-4, which would reduce operations and maintenance-related fugitive dust emissions to less than significant.

Impact AQ-3—Expose sensitive receptors to substantial pollutant concentrations

Summary by Project Element: Impact AQ-3—Expose sensitive receptors to substantial pollutant concentrations		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation

Channel Widening Alternative

Construction

The primary pollutants of concern with regard to health risks to sensitive receptors from the Channel Widening Alternative construction are fugitive dust, asbestos, and DPM and PM2.5 exhaust. Each of these pollutants and its potential impact on nearby receptors is analyzed below.

Localized CO Impacts

Construction of the Channel Widening Alternative would involve the replacement of the Pope-Chaucer Bridge, which could temporarily change traffic patterns, but traffic volumes at intersections and on roadways in the vicinity of the Pope-Chaucer Bridge are low due to the residential nature of the surrounding land uses (TJKM 2018). Therefore, the Channel Widening Alternative would not contribute to or worsen localized CO concentrations within the project area from construction-related traffic, would not result in an exceedance of the BAAQMD screening criteria, and would not cause CO concentrations to exceed the CAAQS.

This impact would be less than significant.

Fugitive Dust

During grading and excavations activities, dust would be generated. The amount of dust generated is highly variable and dependent on the size of the disturbed area at any given time, the amount of activity, soil conditions, and meteorological conditions. BAAQMD's *CEQA Air Quality Guidelines* consider the dust impacts to be less than significant if BAAQMD's construction BMPs are employed to reduce these emissions. As BAAQMD's Basic Construction Mitigation Measures would be implemented as MM-AQ-4 of the project, construction-related fugitive dust emissions would be less than significant.

Naturally Occurring Asbestos

Depending on a project's size and geographic location, BAAQMD may enforce CARB's applicable air toxic control measures related to naturally occurring asbestos. Projects in areas that are known to contain naturally occurring asbestos or that may disturb asbestos in soil or building materials must comply with these measures. For projects that are not located in an area known to contain naturally occurring asbestos or that do not involve earth-disturbing activity, it can be assumed that the projects would not have the potential to expose people to airborne asbestos particles.

The project area is not located in an area that is known to contain naturally occurring asbestos (USGS 2011). Accordingly, the Channel Widening Alternative is not required to comply with CARB's notification requirements associated with the Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations. In addition, implementation of BAAQMD's Basic Construction Mitigation Measures would reduce and control dust emissions. Therefore, impacts associated with asbestos emissions would be less than significant.

DPM and PM2.5 Exhaust

Cancer health risks associated with exposure to DPM are typically related to chronic exposure (30-year exposure period). BAAQMD has determined that construction activities occurring at distances of greater than 1,000 feet from a sensitive receptor most likely do not pose a significant health risk.

As previously discussed, however, there are sensitive land uses (residences, a school, a park, and a medical facility) within 1,000 feet of the project site.

Residences are immediately adjacent to Sites 1–4, Site 5, the University Avenue Bridge Parapet Extension site, and the Pope-Chaucer Bridge site associated with the Channel Widening Alternative. However, construction activities would occur over a total of 5 months at Sites 1–4, with construction durations at each site occurring for a fraction of the 5-month period. In addition, construction activities would occur for 5 months at Site 5, 0.5 month at University Avenue Bridge Parapet Extension, and 8 months at the Pope-Chaucer Bridge. These construction durations are substantially lower than the 30-year exposure period typically associated with chronic cancer health risks. In addition, construction would occur in a generally linear fashion at each of the project sites. This method of construction would limit the exposure of any individual sensitive receptor located near one of the project sites to construction-related DPM and PM2.5 exhaust emissions.

Additionally, implementation of MM-AQ-1 and MM-AQ-2 would greatly reduce construction-related DPM and PM2.5 exhaust emissions by requiring the use of clean diesel-powered equipment.

In conclusion, the Channel Widening Alternative construction activities would not result in a significant increase in cancer risk at nearby sensitive receptors. Chronic HI and annual PM2.5 exhaust concentrations would also be below BAAQMD's project health risk thresholds. Therefore, impacts would be less than significant with mitigation.

Operations and Maintenance

The primary pollutants of concern with regard to health risks to sensitive receptors from the Channel Widening Alternative operation are DPM and PM2.5 exhaust, and locally concentrated CO. Each of these pollutants and their potential impact on nearby receptors is analyzed below.

DPM and PM2.5 Exhaust

The Channel Widening Alternative is not expected to represent a significant source of operational DPM, because project-related vehicle trips would be minor and are more likely to be composed of gasoline-fueled vehicles than diesel-fueled vehicles. Additionally, no diesel emergency back-up generators or any other major operations-related diesel-fueled equipment are included as part of the Channel Widening Alternative. Therefore, the Channel Widening Alternative would not result in any appreciable increases in health risks from DPM or PM2.5 exhaust during operation.

Localized CO Impacts

Implementation of the Channel Widening Alternative would not generate a significant number of new vehicle trips, because no new land use development would be constructed. During project operation and maintenance, the only trips to the project site would be occasional trips by employees to remove debris from the channel; these would occur during the flood season after major flood events. Creekside parks would require trash pickup and disposal as well as routine maintenance of benches and landscaping. In addition, new vegetation would be monitored and maintained, at a minimum, for 3 years following completion of the project. This would consist of removing invasive plants, inspecting newly planted vegetation, and replanting as needed. The number of trips would be minimal. Therefore, the Channel Widening Alternative would not contribute to or worsen localized CO concentrations within the project area from operations-related traffic, would not result in an exceedance of the BAAQMD screening criteria, and would not cause CO concentrations to exceed the CAAQS.

This impact would be less than significant.

Floodwalls Alternative

Please refer to *Channel Widening Alternative* for a detailed discussion regarding construction-related fugitive dust, naturally occurring asbestos, and localized CO for Impact AQ-4. The discussion below is unique to the Floodwalls Alternative.

Construction

DPM and PM2.5 Exhaust

Cancer health risks associated with exposure to DPM are typically related to chronic exposure (30-year exposure period). BAAQMD has determined that construction activities occurring at distances of greater than 1,000 feet from a sensitive receptor most likely do not pose a significant health risk. As previously discussed, there are sensitive land uses (residences, a school, a park, and a medical facility) located within 1,000 feet of the project site.

Residences are located adjacent to the Floodwall Development Sites, the Pope-Chaucer Bridge site, and Site 5 associated with the Floodwalls Alternative. However, construction activities would occur over 5 months each at the Floodwalls Construction site and Site 5, and 8 months at the Pope-Chaucer Bridge. These construction durations are substantially lower than the 30-year exposure period typically associated with chronic cancer health risks. In addition, construction would occur in a generally linear fashion at each of the project sites. This method of construction would limit the exposure of an individual sensitive receptor located near one of the project sites to construction-related DPM and PM2.5 exhaust emissions.

Additionally, implementation of MM-AQ-1 and MM-AQ-2 would greatly reduce construction-related DPM and PM2.5 exhaust emissions by requiring the use of clean diesel-powered equipment.

As with the Floodwalls Alternative, impacts would be less than significant with mitigation.

Operations and Maintenance

The discussion of cumulative operational impacts for the Channel Widening Alternative also applies to the Floodwalls Alternative, and impacts would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

The primary pollutants of concern with regard to health risks to sensitive receptors from the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative construction are fugitive dust, asbestos, and DPM and PM2.5 exhaust. Each of these pollutants and its potential impact on nearby receptors is analyzed below.

Fugitive Dust

During grading and excavations activities, dust would be generated. The amount of dust generated is highly variable and dependent on the size of the disturbed area at any given time, the amount of activity, soil conditions, and meteorological conditions. BAAQMD's *CEQA Air Quality Guidelines* consider the dust impacts to be less than significant if BAAQMD's construction BMPs are employed to reduce these emissions. Therefore, as BAAQMD's Basic Construction Mitigation Measures would be implemented as MM-AQ-4 of the project, construction-related fugitive dust emissions would be less than significant.

Naturally Occurring Asbestos

Depending on a project's size and geographic location, BAAQMD may enforce CARB's applicable air toxic control measures related to naturally occurring asbestos. Projects in areas that are known to contain naturally occurring asbestos or may disturb asbestos in soil or building materials must comply with these measures. For projects that are not located in an area known to contain naturally occurring asbestos or that do not involve earth-disturbing activity, it can be assumed that the projects would not have the potential to expose people to airborne asbestos particles.

The project sites are not located in an area that is known to contain naturally occurring asbestos (USGS 2011). Accordingly, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are not required to comply with CARB's notification requirements associated with the Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations. In addition, implementation of BAAQMD's Basic Construction Mitigation Measures would reduce and control dust emissions. Therefore, impacts associated with asbestos emissions would be less than significant.

DPM and PM2.5 Exhaust

Cancer health risks associated with exposure to DPM are typically related to chronic exposure (30-year exposure period). BAAQMD has determined that construction activities occurring at distances of greater than 1,000 feet from a sensitive receptor most likely do not pose a significant health risk.

There are sensitive land uses (a residence 400 feet east of the Former Nursery Detention Basin Alternative and residences to the south of the Webb Ranch Detention Basin Alternative) located within 1,000 feet of the project sites. The closest residence is approximately 35 feet south of the Webb Ranch Detention Basin Alternative. However, construction activities for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would occur over 6 months. This construction duration is significantly lower than the 30-year exposure period typically associated with chronic cancer health risks.

Also, implementation of MM-AQ-1 and MM-AQ-2 would greatly reduce construction-related DPM and PM2.5 exhaust emissions.

In conclusion, construction activities would not result in a significant increase in cancer risk at nearby sensitive receptors. Chronic HI and annual PM2.5 exhaust concentrations would also be below BAAQMD's project health risk thresholds. Therefore, impacts would be less than significant with mitigation.

Operations and Maintenance

The primary pollutants of concern with regard to health risks to sensitive receptors from operation of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are DPM and PM2.5 exhaust and locally concentrated CO. Each of these pollutants and its potential impact on nearby receptors is analyzed below.

DPM and PM2.5 Exhaust

The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would require sediment that accumulates within the basin during flood events to be removed and hauled by haul truck to an appropriate location once the basin empties out. Because equipment and vehicle assumptions associated with sediment removal activities were unable to be provided at the time of this analysis, sediment removal activities would be conservatively assumed to be intensive in nature and would represent a potentially significant source of operations and maintenance–related DPM. However, the duration of sediment removal activities would be significantly lower than the 30-year exposure period typically associated with chronic cancer health risks. Also, implementation of MM-AQ-1 and MM-AQ-2 would greatly reduce operations and maintenance–related DPM and PM2.5 exhaust emissions. Implementation of MM-AQ-3 would indirectly reduce operations and maintenance NO_X emissions; however, NO_X is considered a regional pollutant, and implementation of MM-AQ-3 would not reduce localized pollutants associated with operations and maintenance of the alternatives, such as DPM and PM2.5.

Additionally, no diesel emergency back-up generators or any other major operations-related diesel-fueled equipment are included as part of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative.

In conclusion, operations and maintenance activities would not result in a significant increase in cancer risk at nearby sensitive receptors. Chronic HI and annual PM2.5 exhaust concentrations would also be below BAAQMD's project health risk thresholds. Therefore, impacts would be less than significant with mitigation.

Localized CO Impacts

Implementation of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would not generate a significant number of new vehicle trips, because no new land use development would be constructed. Therefore, these alternatives would not contribute to or worsen localized CO concentrations within the project area from operations-related traffic. Thus, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would not result in an exceedance of the BAAQMD screening criteria, and CO concentrations would not exceed the CAAQS.

This impact would be less than significant.

Impact AQ-4—Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people

Summary by Project Element: Impact AQ-4—Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative and Floodwalls Alternative

While offensive odors rarely cause any physical harm, they can be unpleasant, leading to considerable distress among the public and often generate citizen complaints to local governments and air districts. According to CARB's *Air Quality and Land Use Handbook*, land uses associated with odor complaints typically include sewage treatment plants, landfills, recycling facilities, and manufacturing (CARB 2005). Odor impacts on residential areas and other sensitive receptors, such as hospitals, daycare centers, and schools, warrant the closest scrutiny, but consideration should also be given to other land uses where people may congregate, such as recreational facilities, work sites, and commercial areas.

Potential sources of odors during construction include diesel exhaust and asphalt paving, while potential sources of odors during operations would include exhaust from maintenance vehicle activity. Both construction- and operational-related activities near existing receptors would be temporary in nature and would not be expected to result in nuisance odors that would violate BAAQMD Regulation 7. During operational activities, odor impacts would be limited to the vehicle circulation routes associated with creekside park trash pickup and routine maintenance. Although such brief exhaust-related odors may be considered adverse, they would not affect a substantial number of people and would dissipate rapidly with distance from the source because exhaust-related odors are a highly localized effect. Because the Channel Widening Alternative Floodwalls Alternative are not anticipated to result in new substantial or long-term odors, this impact would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

While offensive odors rarely cause any physical harm, they can be unpleasant, leading to considerable distress among the public and often generate citizen complaints to local governments and air districts. According to CARB's *Air Quality and Land Use Handbook*, land uses associated with odor complaints typically include sewage treatment plants, landfills, recycling facilities, and manufacturing (CARB 2005). Odor impacts on residential areas and other sensitive receptors, such as hospitals, daycare centers, and schools, warrant the closest scrutiny, but consideration should also be given to other land uses where people may congregate, such as recreational facilities, work sites, and commercial areas.

Potential sources of odors during construction include diesel exhaust and asphalt paving, while potential sources of odors during operations would include exhaust from maintenance vehicle activity. Both construction- and operational-related activities near existing receptors would be temporary in nature and would not be expected to result in nuisance odors that would violate BAAQMD Regulation 7. During operational activities, odor impacts would be limited to the circulation routes associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative. Although such brief exhaust-related odors may be considered adverse, they would not affect a substantial number of people and would dissipate rapidly with distance from the source, because exhaust-related odors are a highly localized effect. Because the Channel Widening Alternative and Floodwalls Alternative are not anticipated to result in new substantial or long-term odors, this impact would be less than significant.

3.2.4 Cumulative Impacts

Potential cumulative air quality impacts include contributing to an exceedance of established standards for criteria pollutants, exposing sensitive receptors to DPM concentrations, or contributing to CO hot spots.

Criteria Pollutants

The BAAQMD has identified thresholds of significance that may be used to evaluate criteria pollutant impacts. Projects in excess of these significance thresholds would have a cumulatively considerable impact on air quality within the SFBAAB. As discussed in Impact AQ-3 for all alternatives, construction exhaust emissions would not exceed BAAQMD's quantitative thresholds with implementation of MM-AQ-1 through MM-AQ-3. In addition, construction-related dust emissions would be less than significant with implementation of BAAQMD's Basic Control Measures for fugitive dust. Operation of the Channel Widening Alternative and Floodwalls Alternative would not exceed any BAAQMD thresholds, and long-term mitigation is not required. Emissions associated with operation of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would be less than significant with implementation of MM-AQ-1 through MM-AQ-3. Therefore, the project would not result in a considerable contribution to this cumulative impact.

Diesel Particulate Matter

As shown in Tables 3.2-4 through 3.2-6, there are multiple sensitive receptors within 1,000 feet of the project sites.

Channel Widening Alternative and Floodwalls Alternative

For the Channel Widening Alternative and Floodwalls Alternative, the cumulative effect of background sources of health risk and PM2.5 concentrations combined with construction-related risks and concentrations could potentially exceed the BAAQMD cumulative thresholds. Although the contribution of increased cancer risk and PM2.5 concentration from construction activities associated with the project is anticipated to be relatively small, there are likely sensitive receptors in the project area that are exposed to elevated health risks and pollutant concentrations from the existing major roadway sources in the area, particularly U.S. 101. As such, it is possible that the cumulative BAAQMD health risk thresholds would be exceeded or that an existing exceedance would be worsened due to the contribution of increased health risks and PM2.5 concentration from construction activities associated with the Channel Widening Alternative and Floodwalls Alternative. Implementation of MM-AQ-1 and MM-AQ-2 would reduce the likelihood of cumulative impacts; however, it would still be possible for even a small additional contribution to cause a new or worsen an existing exceedance of the BAAQMD cumulative thresholds. Therefore, impacts would be significant and unavoidable.

The Channel Widening Alternative and Floodwalls Alternative are not expected to represent a significant source of operations and maintenance DPM because traffic to and from the site would consist of primarily light-duty vehicles, which are not substantial emitters of DPM. In addition, no diesel emergency back-up generators or any other major operations-related diesel-fueled pieces of equipment are included as part of the Channel Widening Alternative and Floodwalls Alternative. For the Channel Widening Alternative and Floodwalls Alternative, this impact is considered less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Existing cumulative cancer risks, HI, and PM2.5 concentrations in the vicinity of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are anticipated to be much lower than the existing risks and concentrations in the vicinity of the Channel Widening Alternative and Floodwalls Alternative project areas. While the Channel Widening Alternative and Floodwalls Alternative are located near U.S. 101, El Camino, and numerous stationary sources of pollutants, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are more than 1,000 feet from a major roadway (I-280) and in a less urbanized area with substantially fewer stationary emissions sources. As such, the background levels of risk and PM2.5 concentrations are not anticipated to be elevated at sensitive receptor locations near the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative. Consequently, the cumulative BAAQMD health risk thresholds would not be exceeded due to the minor contribution to health risks from construction activities associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative, and the relatively few background emissions sources in the area. Additionally, implementation of MM-AQ-1 and MM-AQ-2 would reduce DPM emissions from project-related sources. Therefore, impacts would be less than significant with mitigation.

Operations and maintenance activities for the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would generate DPM from diesel-powered construction equipment and vehicles, and could contribute to increased cumulative health risks. However, the duration of sediment removal activities would be significantly lower than the 30-year exposure period typically associated with chronic cancer health risks. Also, implementation of MM-AQ-1 and MM-AQ-2 would greatly reduce operations and maintenance-related DPM and PM2.5 exhaust emissions associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative. Consequently, the cumulative BAAQMD health risk thresholds would not be exceeded due to the minor contribution to health risks from construction activities associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative and the relatively few background emissions sources in the area near the project sites. For the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative, this impact is considered less than significant with mitigation.

Carbon Monoxide Hot-Spots

As discussed under Impact AQ-4 for all alternatives, traffic volumes at nearby intersections and roadways would not exceed BAAQMD's screening criteria as a result of the project. Therefore, this impact is considered less than significant.

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3.3 Biological Resources

This section provides environmental analysis of the project's impacts on biological resources. The section summarizes the regulatory environment and discusses the environmental setting, provides the criteria used for determining impacts, discusses the impact mechanism and level of impact resulting from project construction and implementation, and describes mitigation to minimize the level of impact.

3.3.1 Regulatory Setting

Federal

Federal Endangered Species Act

The federal Endangered Species Act (ESA) of 1973 requires federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) where a federal action may result in take of a species listed as threatened or endangered under ESA. *Take*, as defined by ESA, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." *Harm* is defined as "any act that kills or injures the species including significant habitat modification." Under federal regulations, take is further defined to include habitat modification or degradation that results, or is reasonably expected to result, in death or injury to wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

Pursuant to the requirements of ESA, an agency reviewing a proposed action within its jurisdiction must determine whether any federally listed species may be present on the project site and determine if the proposed action will result in a take of such species. Under ESA, habitat loss is considered to be an impact on a species. In addition, the agency is required to determine whether the proposed action is likely to jeopardize the continued existence of any species that is proposed for listing under ESA or to result in the destruction or negative modification of critical habitat proposed or designated for such species (16 United States Code [USC] 1536(3), (4)). Therefore, project impacts on these species or their habitats would be considered significant and would require mitigation.

Endangered Species Act Section 7 (Consultation Process)

The USFWS and NMFS maintain areas of critical habitat for federally regulated species to safeguard the continued existence of such species by restricting the type and extent of activities proposed under Section 7 of the ESA. Section 7 requires federal agencies to consult with the USFWS and/or NMFS for actions that may take a listed species or their habitat. Federal agency actions include activities that are on federal land, conducted by a federal agency, funded by a federal agency, or authorized by a federal agency (including issuance of federal permits and licenses).

Under Section 7, the federal agency conducting, funding, or permitting an action (the federal lead agency) must consult with USFWS and/or NMFS, as appropriate, to ensure that the proposed action will not jeopardize endangered or threatened species or destroy or adversely modify designated critical habitat. If a proposed action "may affect" a listed species or designated critical habitat, the lead agency is required to prepare a biological assessment (BA) evaluating the nature and severity of the expected effect. In response, USFWS and/or NMFS issues a biological opinion (BO), with a determination that the proposed action results in one of the following.

- Jeopardize the continued existence of one or more listed species (jeopardy finding) or result in the destruction or adverse modification of critical habitat (adverse modification finding), or
- Not jeopardize the continued existence of any listed species (no jeopardy finding) or result in adverse modification of critical habitat (no adverse modification finding).

The BO issued by USFWS and/or NMFS may stipulate discretionary "reasonable and prudent" conservation measures. If the proposed action would not jeopardize a listed species, USFWS and/or NMFS will issue an incidental take statement to authorize the proposed activity.

Endangered Species Act Section 9 (Prohibitions)

Section 9 of ESA prohibits the take of any fish or wildlife species listed under ESA as endangered. Take of threatened species is also prohibited under Section 9, unless otherwise authorized by federal regulations. In addition to the take definition described above, Section 9 prohibits removing, digging up, cutting, and maliciously damaging or destroying federally listed plants on sites under federal jurisdiction. Section 9 does not prohibit take of federally listed plants on sites not under federal jurisdiction.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) establishes a management system for national marine and estuarine fishery resources. This legislation requires that all federal agencies consult with NMFS regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect *essential fish habitat* (EFH), defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

The Magnuson-Stevens Act states that migratory routes to and from anadromous fish spawning grounds are considered EFH. The phrase *adversely affect* refers to any impact that reduces the quality or quantity of EFH. Federal activities that occur outside of EFH but that may have an impact on EFH must also be considered in the consultation process.

Clean Water Act: Sections 404 and 401

Waters of the US are protected under Section 404 of the Clean Water Act (CWA). *Waters of the US* are defined to include navigable waters of the nation; interstate waters; all other waters where their use, degradation, or destruction could affect interstate or foreign commerce; tributaries of any of these waters; and wetlands that meet any of these criteria or are adjacent to any of these waters or their tributaries. Waters of the US may include wetlands and non-wetland waters. Any activity that involves any discharge of dredged or fill material into waters of the US, including wetlands, is subject to regulation by the U.S. Army Corps of Engineers (USACE). Wetlands are defined under Section 404 as those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Jurisdictional wetlands must meet three wetland delineation criteria.

- They support hydrophytic vegetation (i.e., plants that grow in saturated soil).
- They have hydric soil types (i.e., soils that are wet or moist enough to develop anaerobic conditions).
- They have wetland hydrology (i.e., conditions of flooding, inundation, or saturation that support wetland communities).

The extent of USACE jurisdiction in inland situations extends to the ordinary high water mark (OHWM)—the line on the shore established by fluctuations of water and indicated by a clear, natural line impressed on the bank, shelving, changes in soil character, destruction of terrestrial vegetation, and/or the presence of litter and debris. In coastal situations, the USACE jurisdiction extends to the mean high water line (MHWL) based on elevation.

Activities requiring a Section 404 permit must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate pursuant to CWA Section 401. Either the State Water Resources Control Board (State Water Board) or the San Francisco Bay Regional Water Quality Control Board would have to issue such certification prior to the alteration of or discharge to waters of the US and the state (i.e., work involving bridge crossings of jurisdictional waters).

Clean Water Act Section 402

CWA Section 402 regulates construction-related stormwater discharges to surface waters through the National Pollutant Discharge Elimination System program, administered by the United States Environmental Protection Agency. CWA Section 402 is discussed in detail in Section 3.8, *Hydrology and Water Resources*, of this EIR.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 USC 661–667(e)) applies to any project with a federal component where any body of water is impounded, diverted, deepened, or otherwise modified. Project proponents are required to consult with USFWS and the appropriate state wildlife agency.

Executive Order 11990: Protection of Wetlands

Executive Order 11990 (May 24, 1997) directs federal agencies to refrain from assisting in or giving financial support to projects that encroach on publicly or privately owned wetlands. It further requires that federal agencies support a policy to minimize the destruction, loss, or degradation of wetlands. A project that encroaches on wetlands may not be undertaken unless the agency has determined that (1) there are no practicable alternatives to construction, (2) the project includes all practicable measures to minimize harm to wetlands affected, and (3) the impact will be minor.

Migratory Bird Treaty Act

The federal Migratory Bird Treaty Act (MBTA) (16 USC 703) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and the Soviet Union (now Russia) and authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. It establishes seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs (16 USC 703, 50 Code of Federal Regulations [CFR] 21, 50 CFR 10). Most actions that result in taking or in permanent or temporary possession of a protected species constitute violations of MBTA. Examples of permitted actions that do not violate MBTA are the possession of a hunting license to pursue specific gamebirds, legitimate research activities, display in zoological gardens, banding, and other similar activities. USFWS is responsible for overseeing compliance with MBTA, and the U.S. Department of Agriculture's Animal Damage Control Officer makes recommendations on related animal protection issues.

Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds

Executive Order 13186 (January 10, 2001) directs each federal agency taking actions having or likely to have a negative impact on migratory bird populations to work with USFWS to develop a memorandum of understanding (MOU) to promote the conservation of migratory bird populations. Protocols developed under the MOU must include the following agency responsibilities.

- Avoid and minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions.
- Restore and enhance habitat of migratory birds, as practicable.
- Prevent or abate the pollution or detrimental alteration of the environment for the benefit of migratory birds, as practicable.

The executive order is designed to assist federal agencies in their efforts to comply with MBTA, and does not constitute any legal authorization to take migratory birds.

Executive Order 13112: Invasive Species Prevention

Executive Order 13112 (February 3, 1999) directs all federal agencies to prevent and control the introduction and spread of invasive nonnative species in a cost-effective and environmentally sound manner to minimize their effects on economic, ecological, and human health.

State

California Endangered Species Act

The California Endangered Species Act (CESA) (California Fish and Game Code 2050–2116) states that all native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants and their habitats that are threatened with extinction and those experiencing a significant decline that, if not halted, would lead to a threatened or endangered designation will be protected or preserved.

California Native Plant Protection Act

The California Native Plant Protection Act of 1977 (California Fish and Game Code 1900–1913) prohibits take, possession, transportation, exportation, importation, or sale of rare and threatened plants, except as a result of agricultural practices, fire control measures, timber operations, mining, or actions of public agencies or private utilities. Private landowners are also exempt from the prohibition against removing rare and endangered plants, although they must provide 10-day notice to the California Department of Fish and Wildlife (CDFW) before removing the plants. This act has mostly been superseded by CESA.

California Fish and Game Code (1600, 2081, 3503, 3503.3, 3511, 4700, 5050, and 5515)

Section 1600 et seq. (Lake and Streambed Alteration)

Section 1600 et seq. requires notifying CDFW prior to any project activity undertaken in or near a river, stream, or lake that flows at least intermittently through a bed or channel. Should CDFW determine that the activity could have impacts on a State protected species or alter the hydrology or hydraulics of a system, a Lake or Streambed Alteration Agreement must be developed under the appropriate sub-section of Section 1600.

Section 2081 (Incidental Take Permit)

Under Section 2081, an Incidental Take Permit from CDFW is required for projects that could result in the take of a species that is state-listed as threatened, endangered, or identified as candidates for threatened/endangered under the CESA. *Take* is defined as an activity that would directly or indirectly kill an individual of a species. The definition does not include harm or harass, as does the definition of take under ESA. Additionally, habitat destruction is not included in the definition of take. Consequently, the threshold for take under CESA is higher than that under ESA. For example, habitat modification is not necessarily considered take under CESA. CDFW administers CESA and authorizes take through Section 2081 agreements (Incidental Take Permits), except for species designated as fully protected. Section 2081 also requires measure to avoid and minimize take of CESA-regulated species, and to fully mitigate the impact of take.

Sections 3503 and 3503.3 (Bird Nesting Protections)

Sections 3503 and 3503.3 state that it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by the code or any regulation made pursuant thereto.

Sections 3511, 4700, 5050, and 5515 (Fully Protected Species)

These sections list 37 fully protected species and prohibit take or possession at any time of the species listed, except for collecting these species for scientific research and relocation of bird species for the protection of livestock.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act of 1969 (California Water Code 13000 et. seq.) governs water quality in California. This act delegates responsibility to the State Water Board for water rights and water quality protection and directs the nine statewide Regional Water Quality Control Boards (Regional Water Boards) to develop and enforce water quality standards within their jurisdiction. The Porter-Cologne Act requires any entity discharging waste, or proposing to discharge waste, within any region that could affect the quality of the waters of the State to file a report of waste discharge with the appropriate Regional Water Board. *Waters of the State* are defined as "any surface water or groundwater, including saline waters, within the boundaries of the state" (California Water Code 13050(e)). The appropriate Regional Water Board then must issue a permit, referred to as a waste discharge requirement (WDR). WDRs implement water quality control plans and take into consideration the beneficial uses to be protected, the water quality objectives reasonably required for that purpose, other waste discharges, and the need to prevent nuisances (California Water Code 13263).

Local

City of Palo Alto Comprehensive Plan

The following policies and programs were taken from the Open Space chapter in the Palo Alto General Plan and protect special-status species and creek and riparian areas.

Policy N-1.4: Protect special-status species and plant communities, including those listed by State federal agencies and recognized organizations from the impacts of development and incompatible activities.

> Program N1.4.1. Periodically review California Environmental Quality Act (CEQA) thresholds of significance regarding special status species to identify changes in listed species recommended by professionally recognized scientific experts.

Policy N-1.5 Preserve and protect the Bay, marshlands, salt ponds, sloughs, creeks and other natural water or wetland areas as open space, functioning habitats, and elements of a large, interconnected wildlife corridor, consistent with the Baylands Master Plan, as periodically amended, which is incorporate by reference.

> Program N1.5.1 Maintain the value of local wetlands as habitats by ensuring adequate flow from the Bay and minimizing effluent.

Creek and Riparian Areas

Policy N-3.1 All creeks are valuable resources for natural habitats, connectivity, community design, and flood control, and need different conservation and enhancement strategies. Recognize the different characteristics along creeks in Palo Alto, including natural creek segments in the city's open space and rural areas, primarily west of Foothill Expressway; creek segments in developed areas that retain some natural characteristics; and creek segments that have been channelized. Pursue opportunities to enhance riparian setbacks along urban and rural creeks as properties are improved or redeveloped.

Policy N-3.2 Prevent the further channelization and degradation of Palo Alto's creeks.

Policy N-3.3 Protect the city's creeks from the impacts of future buildings, structures, impervious surfaces and ornamental landscaping and preserve their function as habitat connectivity corridors by establishing a range of setback requirements that account for existing creek conditions, land use characteristics, property ownership and flood control potential.

> Program N3.3.1 Update the Stream Corridor Protection Ordinance to explore 150 feet as the desired stream setback along natural creeks in open space and rural areas west of Foothill Expressway. This 150-foot setback would prohibit the siting of buildings and other structures, impervious surfaces, outdoor activity areas and ornamental landscaped areas within 150 feet of the top of a creek bank. Allow passive or intermittent outdoor activities and pedestrian,

equestrian and bicycle pathways along natural creeks where there are adequate setbacks to protect the natural riparian environment. Within the setback area, provide a border of native riparian vegetation at least 30 feet along the creek bank. The update to the Stream Protection Ordinance should establish:

- Design recommendations for development or redevelopment of sites within the setback, consistent with basic creek habitat objectives and significant net improvements in the condition of the creek.
- Conditions under which single-family property and existing development are exempt from the 150-foot setback.
- Appropriate setbacks and creek conservation measures for undeveloped parcels.

Program N3.3.2 Examine the development regulations of the Stream Corridor Protection Ordinance, with stakeholder involvement to establish appropriate setback requirements that reflect the varying natural and channelized conditions along creeks east of Foothill Expressway. Ensure that opportunities to provide an enhanced riparian setback along urban creeks as properties are redeveloped or improved are included in this evaluation.

Policy N-3.5 Preserve the ecological value of creek corridors by preserving native plants and replacing invasive, non-native plants with native plants.

Policy N-3.6 Discourage bank instability, erosion, downstream sedimentation, and flooding by minimizing site disturbance and nearby native vegetation removal on or near creeks and by reviewing grading and drainage plans for development near creeks and elsewhere in their watersheds.

Program N3.6.1 Review and update the Grading Ordinance to ensure that it adequately protects creeks from the erosion and sedimentation impacts of grading.

Policy N-3.7 Avoid fencing, piping and channelization of creeks when flood control and public safety can be achieved through measures that preserve the natural environment and habitat of the creek.

Policy N-3.8 Work with the SCVWD, San Francisquito Creek Joint Powers Authority (JPA) and other relevant regional and non-governmental agencies to enhance riparian corridors, provide compatible low-impact recreation and ensure adequate flood control.

Program N3.8.1 Work with the SCVWD to develop a maintenance, restoration and enhancement program that preserves flood protection while preserving riparian habitat, and identifies specific stretches of corridor to be restored or daylighted, standards to be achieved and sources of funding. Include provisions for tree and vegetation planting to enhance natural habitat and shade cover.

Program N3.8.2 Participate cooperatively in the JPA to achieve increased flood protection, habitat preservation, enhancement and improved recreational opportunities along San Francisquito Creek.

City of Palo Alto Tree Ordinance

Permits are required for any activity that affects trees growing on public property or in a City-owned street right-of-way. Protected tree species are coast live oak (*Quercus agrifolia*) more than 11.5 inches diameter at breast height (dbh) (approximately 4.5 feet above natural grade), valley oak (*Quercus lobata*) more than 11.5 inches dbh, and coast redwood (*Sequoia sempervirens*) more than 18 inches dbh. Heritage trees are designated by the Palo Alto City Council. Trees listed on landscape plans for commercial development are designated trees and require a permit from the Planning Department.

City of East Palo Alto General Plan

Goal POC-4. Protect and preserve the City's natural habitat and wildlife.

- 4.8 Inter-agency coordination. Coordinate with other public agencies such as the San Francisquito Creek Joint Powers Authority, Army Corps of Engineers, National Fish and Wildlife Service, and other similar entities on construction or development activity occurring within or adjacent to the City.
- 4.9 Riparian and flood buffer. Do not allow new development within a 100-foot buffer zone from the top of the San Francisquito Creek bank.

City of East Palo Alto Tree Regulations

The City of East Palo Alto Tree Regulation states that any tree—private or in the public right-of-way—with a trunk that measures greater than 40 inches in circumference (12.8 inches in diameter) measured 2 feet above the natural grade requires a Tree Removal Permit to remove.

- All trees with a diameter of 24 or more inches as measured at 40 inches above grade.
- Any tree within a public street or public right-of-way.
- Any tree that was preserved or planted as a condition of a development approval granted by the City.

City of Menlo Park General Plan

Goal OSC1 MAINTAIN, PROTECT AND ENHANCE OPEN SPACE AND NATURAL RESOURCES

Policy OSC1.1 Natural Resources Integration with Other Uses. Protect Menlo Park's natural environment and integrate creeks, utility corridors, and other significant natural and scenic features into development plans.

Policy OSC1.2 Habitat for Open Space and Conservation Purposes. Preserve, protect, maintain and enhance water, water-related areas, plant and wildlife habitat for open space and conservation purposes.

Policy OSC1.3 Sensitive Habitats. Require new development on or near sensitive habitats to provide baseline assessments prepared by qualified biologists and specify requirements relative to the baseline assessments.

Policy OSC1.4 Habitat Enhancement. Require new development to minimize the disturbance of natural habitats and vegetation and requires revegetation of disturbed natural habitat areas with native or non-invasive naturalized species.

Policy OSC1.5 Invasive, Non-Native Plant Species. Avoid the use of invasive, non-native species, as identified on the lists of invasive plants maintained at the California Invasive Plant Inventory and United States Department of Agriculture invasive and noxious weeds database, or other authoritative sources, in landscaping on public property.

Policy OSC1.7 San Francisquito Creek Joint Powers Authority. Continue efforts through San Francisquito Creek Joint Powers Authority to enhance the value of the creek as a community amenity for trails and open space, conservation and educational opportunities.

Policy OSC1.15 Heritage Trees. Protect Heritage Trees, including during construction activities through enforcement of the Heritage Tree Ordinance (Chapter 13.24of the Municipal Code).

Policy LU-6.7 states to collaborate with neighboring jurisdictions to preserve and enhance the Bay shoreline, San Francisquito Creek, and other wildlife habitat and ecologically fragile areas to the maximum extent possible.

City of Menlo Park Tree Regulations

The City of Menlo Park requires permits for removal or pruning (more than more than one-fourth of the canopy or roots) for trees that meet any of the following definitions:

- Any tree having a trunk with a circumference of 47.1 inches (diameter of 15 inches) or more measured at 54 inches above natural grade.
- Any oak tree native to California, with a circumference of 31.4 inches (diameter of 10 inches) or more measured at 54 inches above natural grade.
- Any tree or group of trees specifically designated by the City Council for protection because of its historical significance, special character or community benefit.
- Any tree with more than one trunk measured at the point where the trunks divide, with a circumference of 47.1 inches (diameter of 15 inches) or more, with the exception of trees that are under 12 feet in height, which are exempt from the ordinance.

Stanford University Regulations

According to the Stanford University Facilities Design Guidelines, Section 01 56 39, the following guidelines would be implemented if tree removal is necessary for the detention basins (Stanford University 2016).

- As a condition of project approval, all trees within the project limit including lay down or staging areas shall be inventoried and evaluated by the Landscape Architect and/or Stanford Grounds Services Certified Arborist (SGSCA) for saving in place, relocating to other areas, or demolition.
- All existing trees, shrubs and groundcovers to remain shall be indicated on the drawings. Removal of trees to be relocated shall be scheduled for completion before construction begins to avoid damage to trees, or trees shall be protected in place according to the following guidelines until transplanting is optimal.

- The project shall be responsible for the health of transplanted trees for at least a 90 day period after transplant, or for a longer period of time as decided during design development with input and approval from an SGSCA.
- Contractor to protect and insure welfare of all existing trees, shrubs and groundcover to remain or to be relocated, both within the contract limits, and within all adjacent areas used for access to construction site. Contractor to furnish and supply all equipment and personnel necessary for continued protection of tree and planting areas. Scope to include pruning, protection from physical damage including soil compaction in a tree's root zone, pest and disease control, and irrigation management during site work and construction.
- All tree, shrub and plant pruning and irrigation scheduling to be supervised by an SGSCA.
- Rare, threatened, endangered, or thought to be extinct California native vegetation as determined by Stanford University Campus Planning and Design Office and Grounds Services Department shall be retained and protected.
- Normally existing California native vegetation including native oaks shall be retained and protected or relocated where possible.

Water Resources Protection Ordinance (06-1)

The Water Resources Protection Ordinance was adopted by a Water Resources Protection Collaborative made up representatives from the Santa Clara Valley Water District (Valley Water), cities and towns within Santa Clara County, the Guadalupe-Coyote Resource Conservation District, the Regional Water Boards, and various community stakeholder interests. Its purpose is to protect the water resources managed by Valley Water by providing a set of model guidelines and standards for land use along stream corridors and regulating access to and use of Valley Water's facilities and easements. Construction and maintenance activities at project elements that are under the jurisdiction of Valley Water and subject to the Water Resources Protection Ordinance (within 100 feet of stream corridor) are required to be carried out in a manner consistent with the *Water Resources Protection Manual*, which specifies criteria for protecting existing riparian vegetation and revegetating riparian areas.

3.3.2 Environmental Setting

Study Area

The study area for the biological resources analysis is the San Francisquito Creek watershed (Figure 1-1). For the purpose of this EIR, the creek is described as having three reaches. Reach 1 extends from San Francisco Bay to the upstream side of West Bayshore Road. The San Francisquito Creek Joint Powers Authority (SFCJPA) is currently conducting flood protection actions in Reach 1, and this Program EIR does not include proposed actions in Reach 1, except for staging and access. Reach 2 extends from the upstream side of West Bayshore Road to the upstream side of Pope-Chaucer Bridge. Reach 3 extends from the upstream side of Pope-Chaucer Bridge to Searsville Dam. This Program EIR primarily assesses proposed actions within Reaches 2 and 3.

Existing Conditions

Existing conditions for biological resources were identified through a combination of literature research and site reconnaissance. Field visits by ICF biologists to evaluate habitats for wildlife and plant species were conducted in March 2010 and 2012 and April 2013 (ICF Jones & Stokes 2013). A wetland delineation was conducted on July 12 and 18, 2013 by ICF. Tree surveys were conducted by ICF in 2013, September and November 2017 and in December 2018. ICF Jones & Stokes prepared a *San Francisquito Creek Watershed Biological Baseline Report* in 2009, which was submitted to the USACE. This document was updated in 2011 and retitled the *San Francisquito Creek Feasibility Study* (USACE 2011). (See also, Appendix B.)

The project area is in the southwestern region of the San Francisco Bay area, which is characterized by warm, dry summers and mild, wet winters, with most of the rainfall occurring between November and April. Vegetation is adapted to this Mediterranean-type climate regime, and the landscape is a mosaic of drought-adapted tree, shrub, and grassland communities.

San Francisquito Creek is a perennial stream (in upstream reaches) that originates in the largely undeveloped eastern foothills of the Santa Cruz Mountains between Kings Mountain and Russian Ridge, running 13 linear miles from Searsville Dam downstream to the South San Francisco Bay. San Francisquito Creek flows through the southern portion of the town of Woodside, through the eastern portion of the City of Palo Alto, along the Menlo Park–Palo Alto boundary, and through the eastern portion of East Palo Alto prior to discharging into southern San Francisco Bay. The lowest 4.15 miles of San Francisquito Creek typically goes dry or supports only shallow water by late spring, with some isolated pools located in the channel. Major tributaries of San Francisquito Creek downstream of Searsville Dam include Los Trancos Creek and Bear Creek. The Los Trancos Creek watershed has an area of approximately 7.6 square miles and joins the mainstem of San Francisquito Creek about 0.5 mile east of Interstate (I-) 280. The Felt Lake Diversion, part of Stanford University's operations, is located on Los Trancos Creek at Arastradero Road. The Bear Creek watershed has an area of approximately 11.7 square miles and joins the mainstem of San Francisquito Creek about 0.3 mile below Searsville Dam.

Biological Communities in the Study Area

Eighteen habitat types occur in the study area/watershed: annual grassland, blue oak woodland, chamise chaparral, closed-cone pine-cypress, coastal oak woodland, coastal scrub, cropland, eucalyptus, freshwater emergent wetland, intermittent stream, lacustrine, montane hardwood conifer, montane riparian, redwood, saline emergent wetland, urban, valley oak riparian, and valley oak woodland (USACE 2011). Table 3.3-1 provides the acreage of each land cover in the watershed (Figure 3.3-1)

Table 3.3-1. Land Cover Acreages Within San Francisquito Creek Watershed

Land Cover Category	Acres
Annual Grassland	3,221
Blue Oak Woodland*	47
Chamise Chaparral*	682
Closed-Cone Pine-Cypress	6.7
Coastal Oak Woodland*	6,822

Land Cover Category	Acres
Coastal Scrub*	555
Cropland	365
Eucalyptus	44
Freshwater Emergent Wetland*	15
Lacustrine	84
Montane-Hardwood Conifer*	5,116
Montane Riparian*	21
Redwood*	2,119
Saline Emergent Wetland*	33
Urban	8,390
Valley Oak Riparian*	401
Valley Oak Woodland*	299
Intermittent Stream	10.3

Source: Cal Veg data. U.S. Forest Service (2018)
*Sensitive Natural Community

Following are descriptions of the 17 habitats that are at or near areas where the project will be implemented and therefore may be relevant for the effects analysis in this EIR.

Annual Grassland

This land cover type describes open grasslands composed primarily of nonnative annual plant species found predominantly in the middle of the watershed between the upper watershed foothills and the lower urbanized portion of the watershed. Many of these species also occur as understory plants in other land cover types (e.g., valley oak woodland, coastal oak woodland). Nonnative species dominating these areas include ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), Italian rye (*Lolium multifloum*), wild oat (*Avena fatua* and *A. barbata*), wall barley (*Hordeum murinum*), Italian thistle (*Carduus pycnocephalus*), filaree (*Erodium* spp.), bristly ox-tongue (*Helminthotheca echioides*), purple star thistle (*Centaurea calcitrapa*), yellow star thistle (*Centaurea solstitialis*), common groundsel (*Senecio vulgaris*), geranium (*Geranium* spp.), and milk thistle (*Silybum marianum*). Overall, as with other habitat types, grasslands adjacent to developed environments are more susceptible to invasive species and generally provide lower quality habitat than those grasslands adjacent to undisturbed habitat types (USACE 2011).

Several native grasses, most notably purple needlegrass (*Nassella pulchra*), are common in the watershed. Native forbs that commonly occur within this community include California man-root (*Marah fabacea*), California buttercup (*Ranunculus californicus*), blue-eyed grass (*Sisyrinchium bellum*), terrestrial brodiaea (*Brodiaea terrestris*), blue dicks (*Dichelostemma capitatum*), Ithuriel's spear (*Triteleia laxa*), suncup (*Taraxia ovata*), and mule's ears (*Wyethia* spp.). Occasional individual oak trees or small, open-canopied groupings of oaks occur within this community type. (USACE 2011)

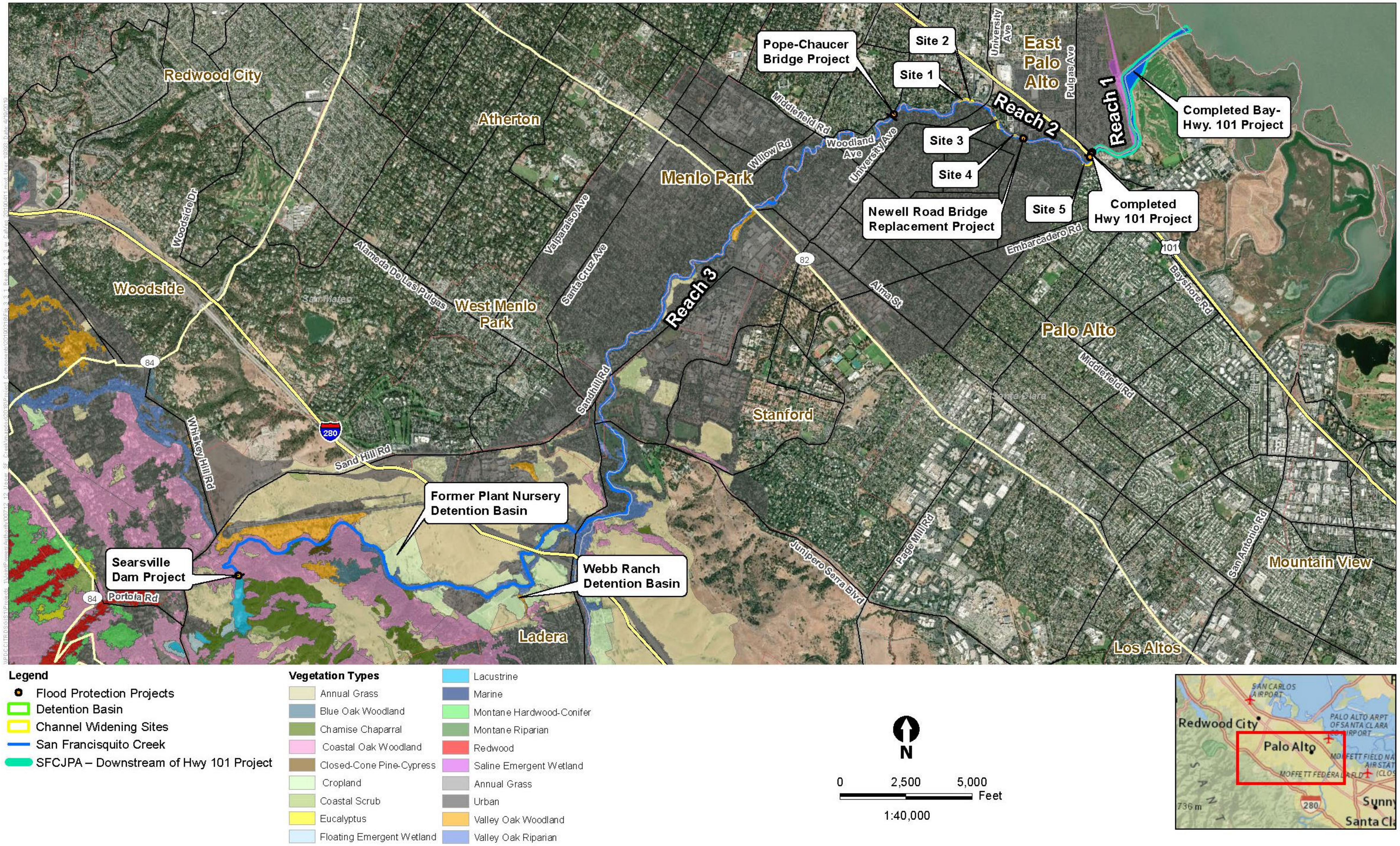

Figure 3.3-1Land Cover

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Annual grasslands provide habitat for a wide range of terrestrial wildlife. Amphibians include western toad (*Bufo boreas*), Sierran tree frog (*Pseudacris sierra*), and California tiger salamander (*Ambystoma californiense*). Reptiles include the western fence lizard (*Sceloporuss occidentalis*), gopher snake (*Pituophis catenifer catenifer*), and western yellow-bellied racer (*Coluber constrictor mormon*). (USACE 2011).

Small mammals that forage on the plants found in annual grasses include deer mice (*Peromyscus* spp.), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), California ground squirrel, and Botta's pocket gopher. Larger mammals, such as bobcat, coyote, opossum, raccoon, striped skunk, black-tailed jackrabbit (*Lepus californicus*), and black-tailed deer, also use annual grasslands, though other habitats are generally required for cover. American badgers (*Taxidea taxus*) are rarely sighted in the southern San Francisco Peninsula, but may be present within the upper areas of the watershed. Mountain lions (*Felis concolor*) are occasionally reported in the grasslands, riparian zones, and woodlands of the lower foothills region. (USACE 2011)

A variety of bird species are at least seasonally present in the watershed. Avian seed eaters, including western meadowlark (*Sturnella neglecta*), nest in grazed annual grasses, while other grassland species, such as red-winged blackbirds (*Agelaius phoeniceus*), are more likely to nest in taller, ungrazed vegetation. A variety of other species, including American goldfinch (*Carduelis tristis*), California towhee, loggerhead shrike (*Lanius ludovicianus*), and northern mockingbird (*Mimulus polyglottos*), nest in scattered shrubs throughout annual grasslands. Raptors, including white-tailed kite, red-tailed hawk, barn owl, and American kestrel, nest in nearby trees and forage in grasslands. Western burrowing owls (*Athene cunicularia hypugaea*) have not been observed nesting in the watershed, but may overwinter. Aerial foragers, including northern rough-winged swallow (*Stelgidopteryx serripennis*), tree swallow (*Tachycineta bicolor*), violet-green swallow (*Tachycineta thalassina*), cliff swallow (*Petrochelidon pyrrhonota*), barn swallow (*Hirundo rustica*), and white-throated swift (*Aeronautes saxatilis*), also may frequent annual grasslands. Great blue herons (*Ardea herodias*) and great egrets (*Ardea alba*) frequently are observed foraging in the grasslands near Stanford University. (USACE 2011)

Annual grasslands in the project area are found mostly in the lower to mid-elevations and west of I-280 in scattered patches, primarily adjacent to San Francisquito Creek in the western and southwestern portions of the project area. Large grassy areas next to residential properties were usually mapped as urban (see below) if they appeared to be lawns or composed primarily of planted species. (USACE 2011)

Blue Oak Woodland

Blue oak woodland is dominated by blue oak (*Quercus douglasii*), a highly drought-tolerant species adapted to growth on thin soils in the dry foothills. Blue oaks grow slowly in these soils and may take decades to reach maturity, forming open savanna-like woodlands. They generally occur on sites that are drier and have lower levels of nitrogen, phosphorus, and organic matter than those where valley oak (*Quercus lobata*), or coast live oak (*Quercus agrifolia*) are found (Griffin 1973, Baker et al. 1981). Although blue oaks can become established on south-facing slopes during wetter years or where mesic conditions are present, they are generally found on north-facing slopes throughout their range (Griffin 1971). However, in the Central California Coast Ranges, blue oak woodland is more common on south-facing slopes (Miles and Goudey 1997). California buckeye (*Aesculus californica*) and foothill pine are associate tree species in this community.

Wildlife species use of blue oak woodland are similar to the species listed below under *Coastal Oak Woodland*.

The understory varies from shrubby to open, with a composition similar to that of the adjacent California annual grassland. Understory species include California annual grasses, California coffeeberry, holly leaf cherry, and poison oak. Blue oak woodland is a sensitive natural community (California Department of Fish and Wildlife 2018).

Chamise Chaparral

This land cover type is single layered, generally lacking well-developed herbaceous ground cover and overstory trees. Shrub canopies frequently overlap, producing a nearly impenetrable canopy of interwoven branches. Total shrub cover frequently exceeds 80%, but may be considerably lower on very xeric sites with poor soils. There is a several-hundred-acre patch of chamise chaparral located in the Jasper Ridge Biological Preserve. This chamise chaparral includes dense stands of the dominant chamise (*Adenostoma fasciculatum*), buckbrush (*Ceanothus cuneatus*), yerba-santa (*Eriodictyon californicum*), toyon, scrub oak, poison oak, and black sage (*Salvia mellifera*)(USACE 2011).

This habitat supports wildlife similar to that found in scrub habitats and oak woodlands in the San Francisquito Creek watershed.

The majority of chamise chaparral in the San Francisquito Creek watershed occurs at higher elevations on xeric, south-facing slopes. Almost all of the chamise chaparral in the watershed is in the undisturbed portions of the upper watershed and is of high quality and value to resident species. This forest type is found mostly in the middle- to upper reaches of the San Francisquito Creek watershed (USACE 2011). Chamise chaparral is a sensitive natural community (California Department of Fish and Wildlife 2018a).

Closed-Cone Pine-Cypress

Closed-cone pine-cypress consists of an understory of chaparral species such as chamise and manzanita on well drained soils and a dense cover of shrubs and herbs on poorly drained soils. Stands of knobcone pine are found on serpentine soil. The overstory is dominated by a single species of one of the closed-cone pines or cypress. Pines which dominate closed-cone habitats are knobcone pine, Monterey pine, and several other species that would not occur in the project area.

Wildlife species that use this habitat include game species including tree squirrels and band-tailed pigeons. Non-game species use this habitat for feeding and cover. Great horned owls and red-tailed hawk may nest in closed-cone pine forests. This habitat type is found mostly in the middle- to upper reaches of the San Francisquito Creek watershed.

Coastal Oak Woodland

Coastal oak woodland is found mostly in the non-urbanized portions of the San Francisquito Creek watershed but does occur in the urban zone along the mainstem of San Francisquito Creek in small, isolated patches. The overstory of this land cover type consists primarily of deciduous and evergreen hardwoods (mostly oaks [*Quercus* spp.]), and occasionally scattered conifers) with a shrub or grassland understory. In mesic sites, the trees tend to be densely packed and form a closed canopy. In drier sites, the trees are widely spaced, forming an open woodland or savannah with an understory of grassland with scattered shrubs.

In the San Francisquito Creek watershed, coastal oak woodland is dominated by coast live oak (*Quercus agrifolia*). Common associates of coast live oak in the watershed are California bay (*Umbellularia californica*), madrone (*Arbutus menziesii*), and California buckeye (*Aesculus californica*). Typical understory plants are California blackberry, California rose, mugwort, poison oak, toyon (*Heteromeles arbutifolia*), and coyote brush (*Baccharis pilularis*).

Oak woodlands provide food and cover for many species of wildlife. Mature oak trees bear natural cavities, which are important resources for cavity-nesting birds and small mammals. Also, mature oak forests typically contain snags (standing dead trees), which are valuable resources for woodpeckers because they prefer dead trees and limbs for excavation of roost and nest sites. Snags receive high levels of use by secondary cavity-nesting birds (e.g., chickadees and wrens) and mammals. Snags also support wood-boring insects that provide food for bark-gleaning insectivorous birds. Oaks also provide acorns, which as a seasonal food are important for the survival of many species of wildlife in fall and winter. Birds that are dependent on acorns as a seasonal food include acorn woodpeckers (*Melanerpes formicivorus*), scrub-jays (*Aphelocoma* sp.), band-tailed pigeons (*Columba fasciata*), and California quail (*Callipepla californica*).

Characteristic wildlife species that can be found in all oak woodlands include amphibian species such as California red-legged frog (*Rana aurora draytonii*) and California tiger salamander (*Ambystoma californiense*) that use these habitat types for summer aestivation and movement when aquatic habitats are present; reptile species such as western pond turtle (*Clemmys marmorata*), gopher snake, and western fence lizard (*Sceloporus occidentalis*); bird species such as red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), barn owl (*Tyto alba*), great horned owl (*Bubo virginianus*), acorn woodpecker, Nuttall's woodpecker (*Picoides nuttallii*), northern flicker (*Colaptes auratus*), white-breasted nuthatch (*Sitta carolinensis*), California quail, spotted towhee, Bewick's wren (*Thryomanes bewickii*), and bushtit (*Psaltriparus minimus*); and mammal species such as deer mouse (*Peromyscus maniculatus*), western gray squirrel (*Sciurus griseus*), Townsend's western big-eared bat, mule deer (*Odocoileus hemionus*), and coyote (*Canis latrans*).

Coastal Scrub

Coastal scrub in the San Francisquito Creek watershed is characterized by a dense and continuous cover of two layers: an overstory of evergreen shrubs up to 7 feet tall and a perennial herb/subshrub understory up to 1 foot tall in openings. Bare zones about 3 feet wide may extend from stands into surrounding annual grasses. Coyote bush usually dominates the overstory. Coastal scrub communities are dominated by coyote brush, California sagebrush (*Artemisia californica*), scrub oak (*Quercus berberidifolia*), toyon, sticky monkeyflower (*Mimulus auranticus*), and California bee plant (*Scrophularia californica*). (USACE 2011)

Coastal scrub is primarily present in the upper portion (higher elevations) of the watershed. Because this habitat type occurs primarily in the upper, undeveloped areas of the watershed, habitat quality and value are both high for resident species (USACE 2011). Coastal scrub is sensitive natural community (California Department of Fish and Wildlife 2018a).

Cropland

Vegetation in this land cover type consists of planted crops found in limited extent along portions of Corte Madera and Los Trancos Creek. This land cover type occurs primarily in the mid-elevations of the San Francisquito Creek watershed, east of I-280. Adjacent buildings related to agricultural activities were usually labeled as urban if they surpassed the minimum mapping unit. These cropland areas are found in close proximity to the developed environment and thus have limited habitat value for native wildlife (USACE 2011).

Eucalyptus

Eucalyptus describes stands composed of one or more nonnative species of eucalyptus (*Eucalyptus* spp.), which are frequently planted in rows or in dense groves. Eucalyptus can also be found along waterways among riparian vegetation. Few native overstory or understory species are present within areas planted with gum trees, because eucalyptus demonstrates allelopathic properties, which usually prevents the establishment of other species. Where present, the understory is usually a mix of nonnative annual grasses and weedy species. This land cover type is probably under-mapped, which may be a result of its unclear signature, because it is found frequently throughout the San Francisquito Creek watershed. Eucalyptus has been historically planted by many parties and is common throughout the watershed and the region as a whole (USACE 2011).

Eucalyptus, while a nonnative plant, has a cultural link to the origins of Stanford University. As part of the original plans for Stanford University, Leland Stanford envisioned the arboretum as a “zoo for trees” with specimen trees of every type able to thrive at Stanford. Between 1888 and 1893, the year Stanford died, many hardy, fast-growing eucalyptus were planted as “nurse trees” to shade and aid in establishing the more tender varieties. Stanford's original intention was to remove the nurse trees once the others had stabilized. In the years that followed his death, however, the arboretum was neglected and while most specimen trees failed, the heartier eucalyptus flourished. Additionally, Mr. Stanford had thousands of eucalyptus planted throughout the campus to mark avenues and paths. Eucalyptus plantings are widespread throughout the Bay area and are found in many parts of the lower watershed beyond Stanford University (USACE 2011).

Characteristic species of this habitat include crows and ravens (*Corvus* spp.), barn owl, and red-tailed and red-shouldered hawks. Eucalyptus trees are important as roosts, perches, and nest sites for a number of bird species, particularly raptors. Those eucalyptus with stringy bark or a tendency for rapid deposition of litter, create microhabitats for a number of small vertebrate species, including northern alligator lizard, gopher snake, and woodrat. (USACE 2011)

Lacustrine

This land cover type includes permanently flooded lakes and reservoirs and intermittent lakes and ponds. Lacustrine features can vary greatly in size and depth. There are several lacustrine areas in the watershed, including Searsville Reservoir (USACE 2011).

Lacustrine wetlands provide habitat function for many groups of organisms or communities of organisms. Lakes are primarily habitat for fisheries, including invasive warm water fish such as striped bass (*Morone saxatilis*) and bluegill (*Lepomis macrochirus*). Migratory waterfowl and resident water-dependent birds are also considered typical of, and dependent on, lacustrine environments. At least 55 species of loons, grebes, cormorants, geese, ducks, rails, coots, plovers, avocets, gulls, terns, and kingfishers all use lacustrine wetlands in the San Francisquito Creek watershed, such as Searsville and Felt reservoirs. Freshwater mussels (likely *Anodonta californiensis* and *A. oregonensis*) are present in Felt Reservoir. Nonnative Chinese mystery snails (*Cipangopaludina chinensis*) and Louisiana red swamp crayfish (*Probambarus clarkia*) are also abundant in Felt Reservoir. While the quality of this habitat is good for bird species, the aquatic value of this habitat is low given that these lacustrine habitats are human-made and almost exclusively inhabited by invasive species. (USACE 2011)

Montane Hardwood-Conifer

This land cover type is characterized by a hardwood tree layer, a poorly developed and infrequent shrub layer, and a sparse shrub layer. In the San Francisquito Creek watershed, Douglas fir, California black oak (*Q. kelloggii*), Oregon white oak (*Q. garryana* var. *garryana*), tanoak (*Lithocarpus densiflorus*), madrone, and coast live oak are common associates. Associated shrubs include manzanita species, poison oak, and western leatherwood (USACE 2011).

The montane hardwood-conifer community is exclusively found in the middle- to high elevations of the San Francisquito Creek watershed and often intergrades with the redwood land cover type. These habitats are relatively undisturbed and have significant habitat value to resident species (USACE 2011). Montane hardwood is a sensitive natural community (California Department of Fish and Wildlife 2018a).

Wildlife species found within this habitat include western scrub jay, Steller's jay, acorn woodpecker, salt marsh common yellowthroat, western gray squirrel, California ground squirrel, dusky-footed woodrat, western fence lizard, and western rattlesnake. (USACE 2011)

Montane Riparian

This land cover type is dominated by bigleaf maple and California bay. Fremont cottonwood may also be present. This habitat is associated with streams, lakes, and ponds. The transition between this habitat and adjacent non-riparian vegetation is often abrupt and intergrades with montane hardwood. Amphibians, reptiles, bird sand mammals use this habitat type for food, cover and reproduction/ This habitat type is found mostly in the middle- to upper reaches of the San Francisquito Creek watershed. All riparian habitats are sensitive natural community (California Department of Fish and Wildlife 2018a).

Wildlife species use of montane riparian are similar to valley oak riparian.

Redwood

This land cover type is dominated by redwoods (*Sequoia sempervirens*) and is commonly divided into old growth and second growth forest. However, in the San Francisquito Creek watershed, the redwood land cover is all second growth, which is characterized by even-aged stands. Redwood forest in the watershed lies in a transition zone between the more marine-influenced areas of the northern peninsular and the less mesic climate of the Santa Clara Valley. Common associates in the San Francisquito Creek watershed are madrone (*Arbutus menziesii*), Douglas fir (*Pseudotsuga menziesii)*, and California buckeye. Understory vegetation, if present, may include deer fern (*Blechnum spicant*), California huckleberry (*Vaccinium ovatum*), California red huckleberry (*V. parviflorum*), coyote brush, tobacco brush (*Ceanothus velutinus* var. *velutinus*), and manzanita species (*Arctostaphylos* spp.). (USACE 2011)

The bulk of this land cover type is found in the middle- to high elevations of the San Francisquito Creek watershed and in protected open-space areas. Thus, redwood habitats in the watershed are relatively undisturbed and have significant habitat value. Within the developed portions of the watershed, redwood communities are sparsely found on reaches of San Francisquito Creek adjacent to Stanford University property near Sand Hill Road (USACE 2011). Redwood forests are sensitive natural community (California Department of Fish and Wildlife 2018a).

Wildlife often found within this habitat type includes California red-legged frog, California tiger salamander, peregrine falcon (*Falco peregrinus*), gray squirrel, Steller's jay, and deer mouse.

Urban

This land cover type refers to areas with primarily residential and commercial uses. Some of this type is unvegetated, but where vegetation occurs, it includes tree groves such as those found in city park and street strips, shade trees, lawns (including golf courses), and shrub cover. Vegetation consists of remnant native species, such as oaks, as well as nonnative trees (primarily eucalyptus), ruderal annual grasslands, and ornamental landscape plants. A large portion of the lower San Francisquito Creek watershed is urban. In rare instances, urban/suburban areas can provide habitat elements for native wildlife, including cover for nesting and roosting, and foraging sites. (USACE 2011)

Some native and introduced animals that are tolerant of human activities can be successful in urban landscapes. These species include western fence lizard, California alligator lizard, northern mockingbird, barn swallow, raccoon, striped skunk, European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), house finch (*Haemohous mexicanus*), eastern gray squirrel (*Sciurus caralinensis*), fox squirrel (*Sciurus niger*), house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), black rat (*Rattus rattus*), and opossum. (USACE 2011)

Valley Oak Riparian

Valley foothill riparian vegetation occurs along large stretches of San Francisquito Creek and its tributaries. It is composed of a canopy layer, an understory shrub layer, and a variable herbaceous layer. Most of the creeks in the developed portion of the watershed support discontinuous bands of riparian vegetation, generally ranging from less than 50 feet in width in the urbanized portion of the watershed to a 50- to 200-foot-wide band of dense riparian vegetation on the lands of Stanford University and in the upper watershed. The riparian zone in the lower watershed is currently limited in extent by land use and topography (USACE 2011). Valley oak riparian is a sensitive natural community (California Department of Fish and Wildlife 2018a).

Vegetation along the creeks consists of a mix of native and nonnative plants, which is indicative of the degraded condition of the habitat. Trees along the creek include various species such as acacia (*Acacia* spp.), eucalyptus (*Eucalyptus* spp.), oak (*Quercus* spp.), and cottonwood (*Populus* spp.), as well as English walnut (*Juglans regia*), California sycamore (*Platanus racemosa*), redwood, and Peruvian pepper (*Schinus molle*). Because the banks of the creek have been heavily armored, the valley oak riparian vegetation community is limited to narrow, patchy areas along the length of the creek in the project footprint. The understory vegetation along the banks of the creek is dominated by two nonnative species: Himalayan blackberry (*Rubus armeniacus*) and English ivy (*Hedera helix*). Small clumps of other native and nonnative forbs and grasses may also be present in the understory, such as ripgut brome, wild oat grass, horehound (*Marmbium vulgare*), poison hemlock (*Conium* *maculatum*), wild radish (*Raphanus sativus*), field mustard (*Brassica rapa*), milk thistle, and California mugwort (*Artemesia douglasiana*). The valley oak riparian vegetation associated with the Searsville Reservoir is dominated by willows, maples (*Acer* spp.), and dogwoods (*Cornus* spp.) (USACE 2011).

Wildlife species associated with riparian habitat include birds, mammals, amphibians, and reptiles. The wildlife species discussed mainly occur in the upper part of San Francisquito Creek due to the more natural and less disturbed nature of the habitat. Bird species that are characteristic of this habitat in the San Francisquito Creek watershed include California quail (*Callipepla californica*), mourning dove (*Zenaida macroura*), Nuttall's woodpecker (*Picoides nuttallii*), black-crowned night heron (*Nycticorax nycticorax*), and belted kingfisher (*Ceryle alcyon*). Many of these species nest or roost in riparian woodlands and feed in adjacent habitat areas, such as annual grasslands. Red-tailed hawk (*Buteo jamaicensis*), Cooper's hawk (*Accipiter cooperi*), red-shouldered hawk (*Buteo lineatus*), and sharp-shinned hawk (*Accipiter striatus*) are also found in riparian woodland habitat. Salt marsh common yellowthroat (*Geothlypis trichas sinuosa*) is relatively common at the margin of the riparian forest in the upper watershed, upstream from Searsville Reservoir. (USACE 2011)

Common mammals found within riparian woodland include deer (*Odocoileus sp.),* opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), deer mice, Botta's pocket gopher (*Thomomys bottae*), tree squirrels (*Scirus* spp.), San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*), California vole, coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), striped skunk (*Mephitis mephitis*), and the nonnative red fox (*Vulpes vulpes*).

A number of bat species have been recorded including Townsend's big-eared bat (*Corynorhinus townsendii*), red bat (*Lasiurus blossevillii*), hoary bat (*Lasiurus cinereus*), California myotis (*Myotis californicus*), Yuma myotis (*Myotis yumanensis*), long-ear myotis (*Myotis evotis*), fringed myotis (*Myotis thysanodes*), long-legged myotis (*Myotis volans*), big brown bat (*Eptesicus fuscus*), and western pipistrelle (*Pipistrellus hesperus*). (USACE 2011)

Amphibians and reptiles occur in riparian habitats in the San Francisquito Creek watershed. Amphibians include western toad, Sierran tree frog, California red-legged frog (*Rana draytonii*), California tiger salamander, arboreal salamander (*Aneides lugubris*), black salamander (*Aneides flavipunctatus*), California slender salamander (*Batrachoseps attenuatus*), California newt (*Taricha torosa*), rough-skinned newt (*Taricha granulosa*), and Santa Cruz ensatina (*Ensatina eschscholtzi*). Reptiles found in riparian habitats include California kingsnake (*Lampropeltis californiae*), Pacific gopher snake, California night snake (*Hypsiglena ochrorhyncha nuchalata*), western fence lizard, California alligator lizard (*Elgaria multicarinata multicarinata*), and western pond turtle (*Actinemys marmorata*). As with other species, riparian habitats in the undeveloped portions of the upper watershed are more suitable habitat and more likely to have amphibian and reptile species present. (USACE 2011)

Valley Oak Woodland

Valley oak woodland is dominated by valley oaks and ranges from savanna-like to more closed-canopy forest-like stands. It consists mostly of winter-deciduous, broad-leaved species. Denser stands often grow in valley soils along natural drainages. Tree density decreases with the transition from lowlands to the less fertile soils of drier uplands. Valley oak woodland often includes a shrub layer along natural drainages but this a relatively minor component in the uplands where stands tend to be more open. Common understory associates are poison oak, toyon, California blackberry, and coffeeberry (*Rhamnus californica*). This land cover type is best developed on deep, well-drained alluvial soils, usually in valley bottoms (USACE 2011). Valley oak woodland is a sensitive natural community (California Department of Fish and Wildlife 2018a).

Valley oak woodland is relatively scarce in the San Francisquito Creek watershed; small areas were mapped along San Francisquito Creek and its tributaries. (USACE 2011)

Wildlife species associated with valley oak woodland are the same as discussed for coastal oak woodland.

Wetlands

Freshwater Emergent Wetland

Freshwater emergent wetlands are characterized by frequent flooding and the ability for the roots of erect, herbaceous hydrophytes to prosper in an anaerobic environment. Dominant vegetation is usually perennial monocots. The vegetation along the San Francisquito Creek watershed consists primarily of cattails, broadfruit bur-reed (*Sparganium eurycarpum*), water smartweed (*Persicaria amphibia*), watercress (*Nasturtium officinale*), tall flatsedge (*Cyperus eragrostis*), perennial pepperweed, floating primrose-willow (*Ludwigia peploides*), water mint (*Mentha aquatic*), stinging nettle (*Urtica dioica*), knotgrass (*Paspalum distichum*), and spreading bentgrass (*Agrostis stolonifera*). In San Francisquito Creek, freshwater emergent wetlands will change locations according to storm events and sediment deposition/mobilization. Freshwater emergent wetland is a sensitive natural community (California Department of Fish and Wildlife 2018a).

Freshwater emergent wetlands are among the most productive wildlife habitats in California. They provide food, cover, and water for more than 160 species of birds, and numerous mammals, reptiles, and amphibians. Many species rely on freshwater wetlands for their entire life cycle. However, many freshwater wetlands in the San Francisquito Creek watershed are impaired and provide habitat for invasive bullfrogs (*Rana catesbeiana*) and other nonnative species. Given the proximity of this habitat to the developed environment throughout the watershed, habitat value within the watershed is low. The presence of invasive bullfrogs further lowers the value of this habitat type to native amphibians. Skunks and raccoons also are commonly encountered in the wetlands in the lower watershed. (USACE 2011)

Saline Emergent Wetland

Saline emergent wetlands are characterized as salt or brackish marshes consisting mostly of perennial graminoids and forbs, along with algal mats on moist soils and at the base of vascular plant stems. Characteristic plant species are cordgrass (*Spartina* spp.), pickleweed (*Salicornia virginica*), and other species that occur in or on the margins of the marsh. These include saltwort (*Batis maritima*), jaumea (*Jaumea carnosa*), alkali heath (*Frankenia salina*), and marsh gumplant (*Grindelia stricta* var. *angustifolia*). (USACE 2011)

In the San Francisquito Creek watershed, this land cover type occurs only in the marshy area where the creek enters the South Bay and a short distance upstream along the creek, but supports species such as salt marsh harvest mouse (*Reithrodontomys raviventri*), Ridgway's rail (*Rallus obsoletus obsoletus*), and other native birds. These wetlands, given their location close to the developed environment, also make them susceptible to invasive species recruitment (USACE 2011). Saline emergent wetland is a sensitive natural community (California Department of Fish and Wildlife 2018a). Some of this habitat is being replaced by the project in Reach 1, which has increased the extent of this habitat along San Francisquito Creek.

Non-Wetland Waters

Intermittent Stream

Approximately 10.3 acres of non-wetland waters of the US were mapped and characterized along the Creek in July of 2013. The majority of the tidally influenced section of the creek contained standing water, and where standing water was absent, the ground was saturated. In non-tidal areas, the creek bed was dry, except for occasional isolated ponds, and characterized by barren, unconsolidated beds of sand, gravel, cobble, or rocky substrates.

Special-Status Species

Special-status species include the following categories of plants and animals.

- Plants or animals that are listed, candidates, or proposed for listing as threatened or endangered under ESA or CESA.
- Plants listed as rare under the California Native Plant Protection Act.
- Plants that meet the CEQA definition of rare or endangered, including those considered by the California Native Plant Society (CNPS) to be "rare, threatened, or endangered in California" (California Rare Plant Rank [CRPR] Lists 1 and 2).
- Sensitive natural communities identified by CDFW (CDFW 2018).
- Animals fully protected under the California Fish and Game Code.
- Animal species of special concern to CDFW.
- Bats identified as medium or high priority on the Western Bat Working Group regional priority species matrix[1].

Searches of the California Natural Diversity Database (CNDDB), CNPS database, USFWS database, and NMFS database were conducted to identify all special-status plant and wildlife species that could occur in the project area. Results of the CNDDB search within 2 miles of the project area are shown in Figures 3.3-2a, -2b and 3.3-3a, -3b.

Additionally, the USACE *Environmental Setting Report* (2011) and the *Stanford Habitat Conservation Plan* (HCP) (2013) was used to identify species that occur in the Stanford University area. The potential for each species to occur at each of the proposed project element sites was then assessed in more detail based on the species' known distribution (i.e., the locations and recency of recorded occurrences) and the types and quality of habitat present at each project element site. The following tables describe special-status plant and wildlife species evaluated as having the potential to be present at one or more of the project element sites (Tables 3.3-2 and 3.3-3).

Special-Status Plants

A search of the CNDDB (California Department of Fish and Wildlife 2019) and the CNPS database (California Native Plant Society 2019) identified 37 special-status plant species that may occur in the project region. Based on the habitats present at each of the proposed project element sites, and the locations and dates of the occurrences for the 37 documented species, 26 of the 37 species were identified as having the potential to be present at one or more of the proposed project element sites. The project *footprint* is defined as areas that would be temporarily and permanently impacted by construction and operation activities.

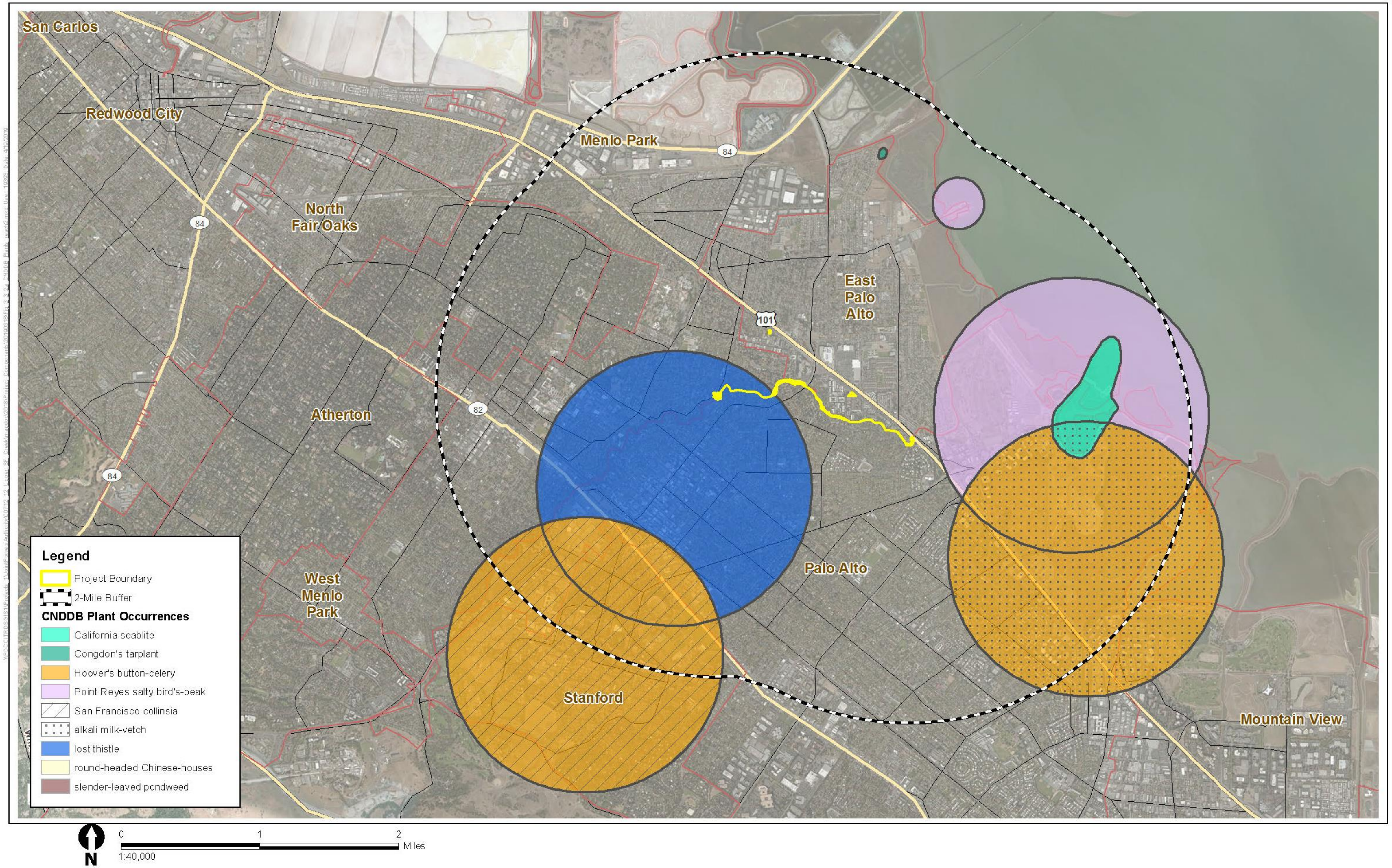

Figure 3.3-2a California Natural Diversity Database Plant Species Results

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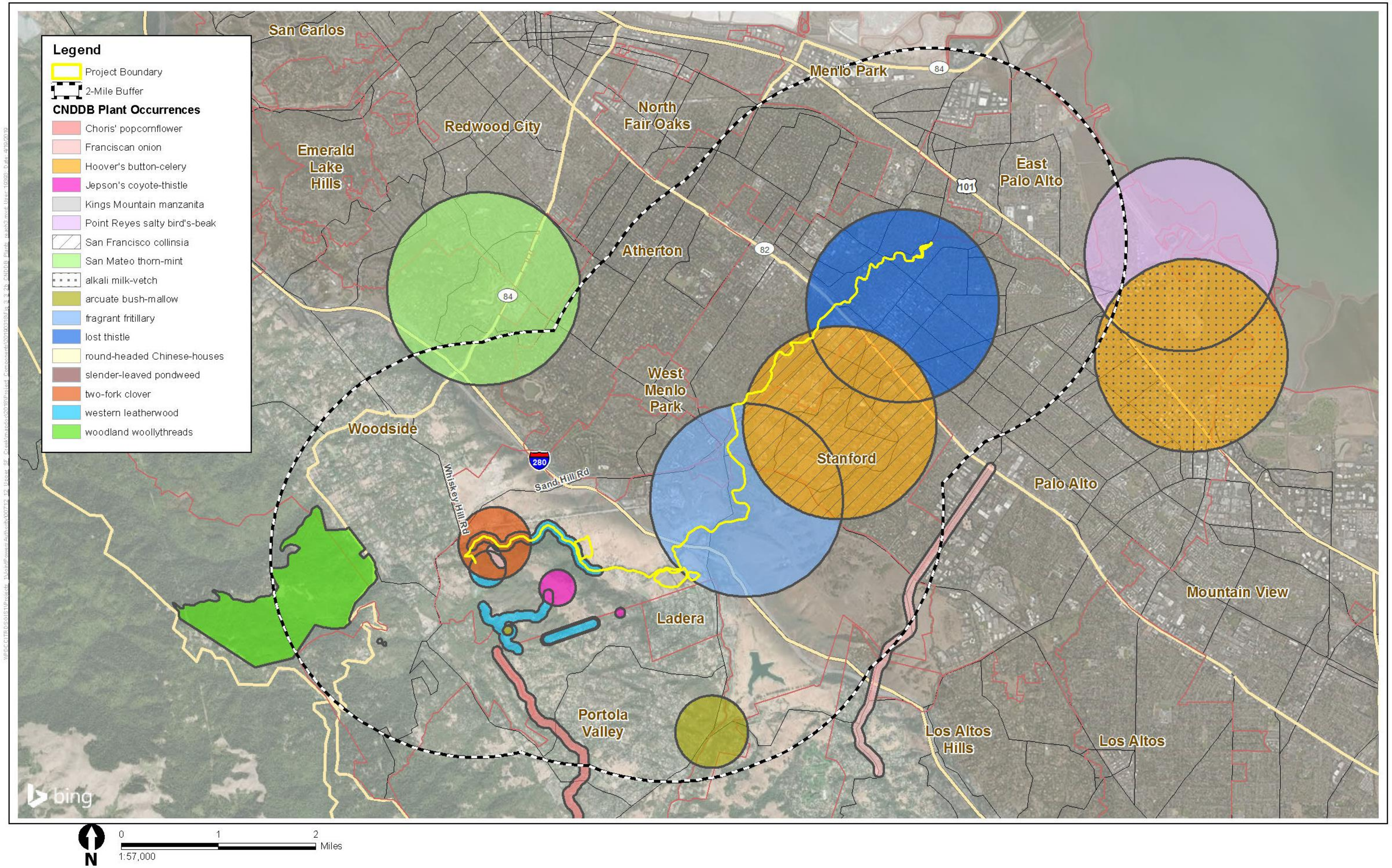

Figure 3.3-2b California Natural Diversity Database Plant Species Results (Continued)

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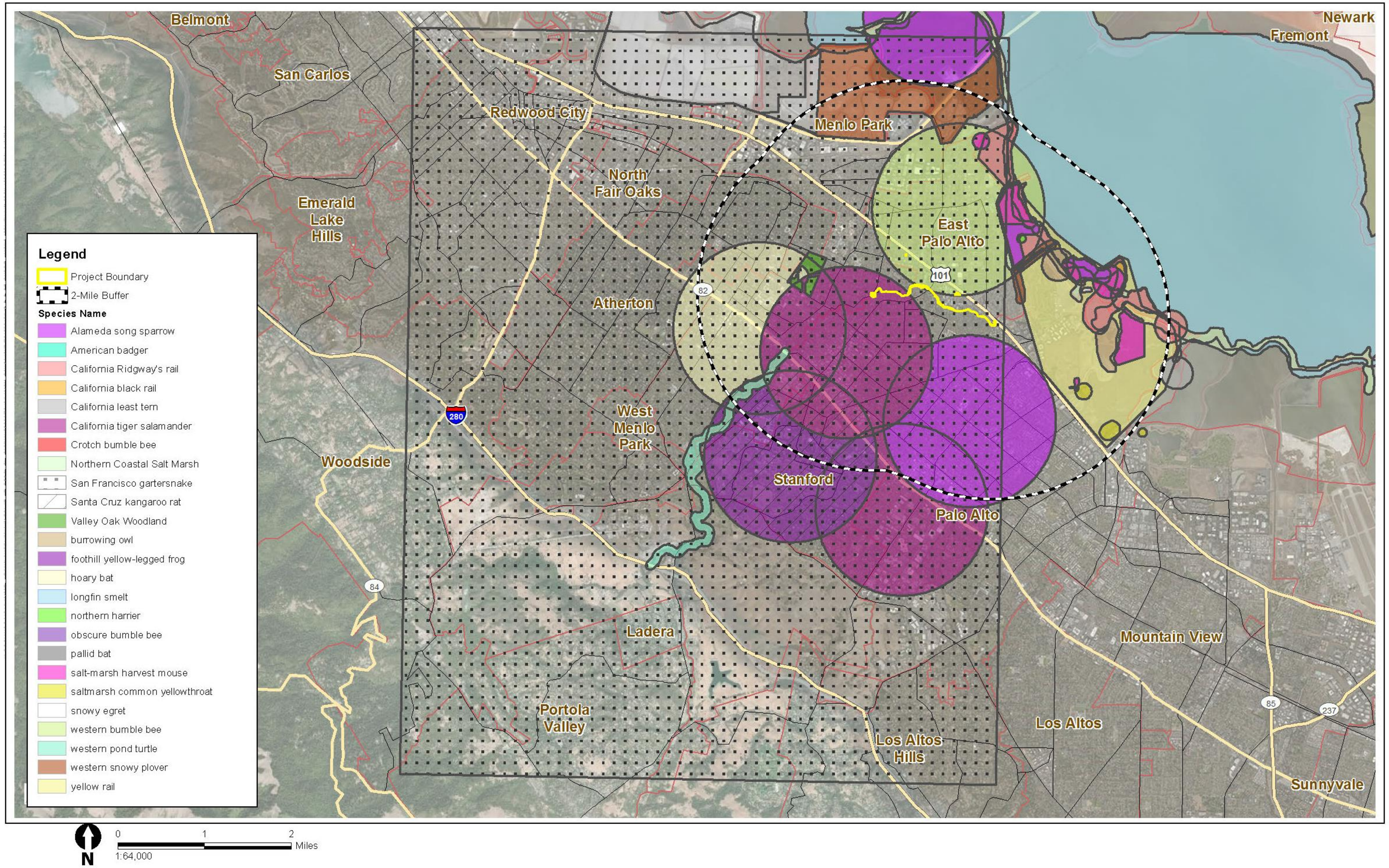

Figure 3.3-3a California Natural Diversity Database Animal Species Results

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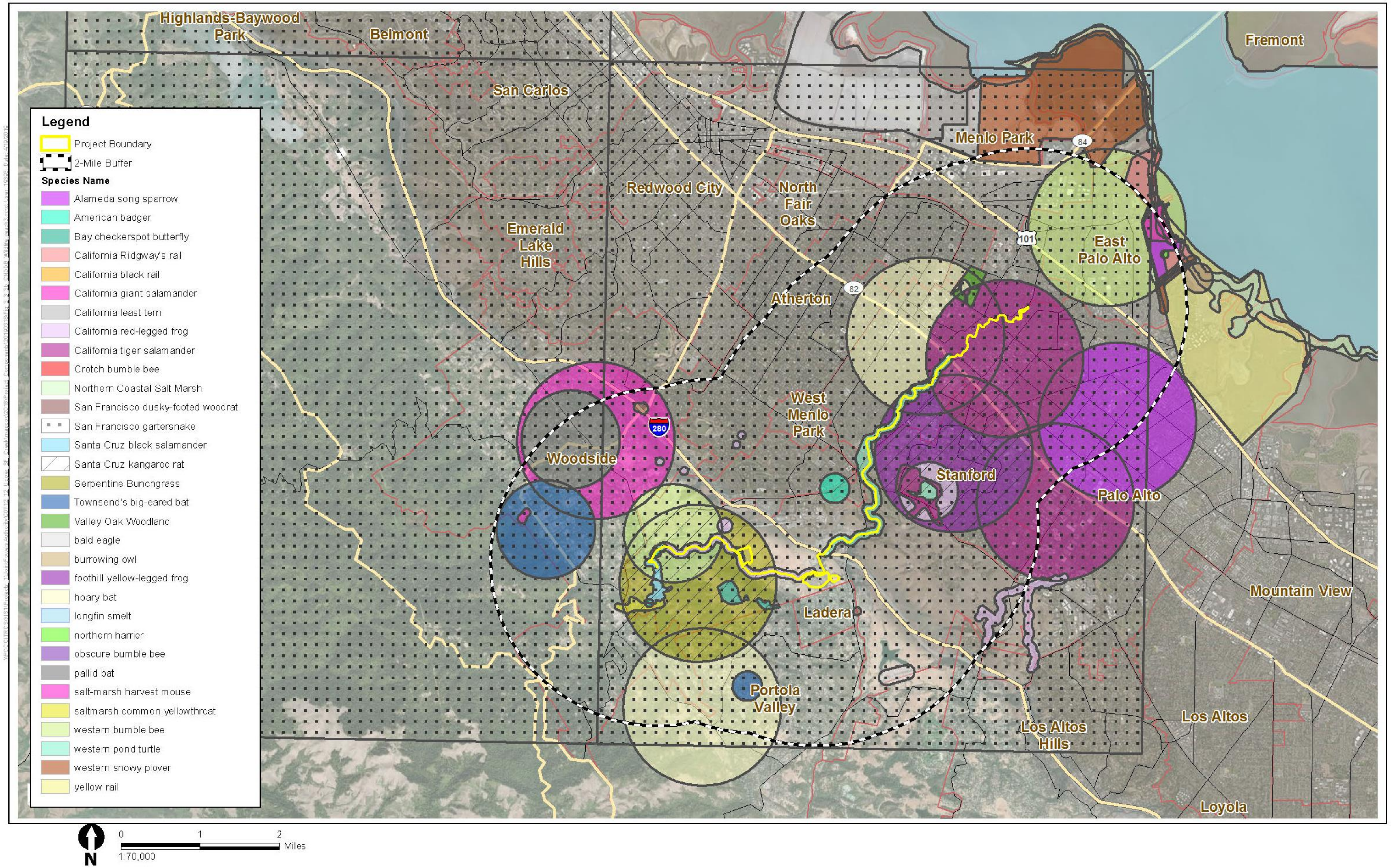

Figure 3.3-3b California Natural Diversity Database Animal Species Results (Continued)

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Table 3.3-2. Special-Status Plant Species with Potential to Occur in the Project Footprint

Common and Scientific Name	Status Federal/ State/ CRPR	Geographic Distribution	Habitat Requirements	Rationale
Alkali milk-vetch *Astragalus tener* var. *tener*	–/–/1B.2	Southern Sacramento Valley, northern San Joaquin Valley, east San Francisco Bay area	Grassy flats and vernal pool margins, on alkali soils, below 200 feet above mean sea level (MSL)	**Suitable habitat –** One extirpated occurrence in Mayfield Slough in Palo Alto approximately 1.3 miles east of the project footprint along margin of salt marsh (CDFW 2019); marginal habitat in salt marsh in the Faber and Laumeister Tracts. The only part of the project that would support this species habitat requirements is Reach 1, and the part of Reach 1 that may be used for access. This species was not found for the Reach 1 project and the floodplain was completely regarded. This species is not likely to be present.
Anderson's manzanita *Arctostaphylos andersonii*	–/–/1B.2	Santa Cruz mountains	Broad-leafed upland forest, chaparral, north coast coniferous forest, 60–760 meters MSL	**Suitable habitat –** Suitable broad-leafed upland forest, chaparral, and north coast coniferous forest in the project footprint. One historic occurrence from 1968 approximately 1.8 miles west of the project footprint. Occurrence was not identified during survey in 2013 (CDFW 2019).
Arcuate bush mallow *Malacothamnus arcuatus*	–/–/1B.2	San Mateo, Santa Clara, and Santa Cruz Counties	Found in chaparral and cismontane woodland, especially in gravelly alluvium, from 50 to 1,165 feet above MSL	**Suitable habitat –** Chaparral and cismontane woodland habitat are present in the project footprint. Two occurrences of arcuate bush mallow within 2-miles of the project footprint

Common and Scientific Name	Status Federal/ State/ CRPR	Geographic Distribution	Habitat Requirements	Rationale
				(CDFW 2019): one in the Jasper Ridge Biological Preserve just above Searsville Reservoir and one from a location along Los Trancos Creek, 2 miles behind Stanford University near the historic site of Schenkel's Picnic Park
Bent-flowered fiddleneck *Amsinckia lunaris*	–/–/1B.2	Alameda, Contra Costa, Colusa, Lake, Marin, San Benito, Santa Clara, Santa Cruz, San Mateo, Sonoma, Sutter, and Yolo Counties.	Cismontane woodland, valley and foothill grassland, coastal bluff scrub	**Suitable habitat –** Suitable grassland and cismontane woodland habitat are present. No occurrences within 2 miles of the project footprint.
California seablite *Suaeda californica*	E/–/1B.1	Morro Bay, San Luis Obispo County; historically found in the south San Francisco Bay	Margins of tidal salt marsh	**Suitable habitat –** Marginal habitat in salt marsh in the Faber and Laumeister Tracts. The only part of the project that would support this habitat is Reach 1, and the part of Reach 1 that may be used for access. This species was not found for the Reach 1 project and the floodplain was completely regarded. This species is not likely to be present.
Chaparral ragwort *Senecio aphanactis*	–/–/2B.2	Coastal California and Baja	Chaparral, cismontane woodland, coastal scrub on drying alkaline flats 20–855 meters	**No suitable habitat –** Alkaline flats are not present within the project footprint. No occurrences within 2 miles of the project footprint.
Choris' popcornflower *Plagiobothrys chorisanus* var. *chorisanus*	–/–/1B.2	Coastal Central California	Coastal prairie, chaparral, northern coastal scrub and wetland-riparian	**Suitable habitat –** Suitable chaparral, northern coastal scrub and wetland-riparian habitat are present, One historic occurrence from 1898

Common and Scientific Name	Status Federal/ State/ CRPR	Geographic Distribution	Habitat Requirements	Rationale
				located approximately 1 mile south of the project footprint.
Coastal marsh milk-vetch *Astragalus pyncostachyus* var. *pyncostachyus*	–/–/1B.2	Humboldt, Marin, San Luis Obispo and San Mateo Counties	Coastal dunes, coastal scrub, and wetland-riparian	**Suitable habitat –** Suitable coastal scrub and wetland riparian habitat are present. No occurrences within 2 miles of the project footprint.
Congdon's tarplant *Centromadia parryi* ssp. *Congdonii*	–/–/1B.1	East San Francisco Bay Area, Salinas Valley, Los Osos Valley	Annual grassland, on lower slopes, flats, and swales, sometimes on alkaline or saline soils, below 700 feet above MSL	**Suitable habitat –** Small areas of marginal habitat adjacent to salt marsh/brackish marsh in the Faber and Laumeister Tracts. One occurrence approximately 1.7 miles west of the project footprint.
Crystal Springs fountain thistle *Cirsium fontinale* var. *fontinale*	E/E/1B.1	San Mateo and Santa Clara Counties	Valley and foothill grassland, chaparral, cismontane woodland, meadows and seeps; serpentine seeps and grassland	**Suitable habitat –** Serpentine soils are present at the southern end of the project footprint. No occurrences within 2 miles of the project footprint
Crystal Springs lessingia *arachnoidea*	–/–/1B.2	Sonoma, San Francisco, San Mateo, Santa Clara, and Riverside Counties	Valley grassland, foothill woodland, northern coastal scrub, serpentine soil	**Suitable habitat –** Serpentine soils are present at the southern end of the project footprint. No occurrences within 2 miles of the project footprint
Dudley's lousewort *Pedicularis dudleyi*	–/R/1B.2	Monterey, Santa Cruz, San Luis Obispo, San Mateo Counties	Chaparral, cismontane woodland, north coast coniferous forest, valley and foothill grassland. Deep shady woods of older coast redwood forests; maritime chaparral	**Suitable habitat –** Suitable chaparral, redwood, cismontane woodland, and grassland habitat present. No occurrences within 2 miles of the project footprint.
Fragrant fritillary *Fritillaria liliacea*	–/–/1B.2	Alameda, San Benito, Solano, Contra Costa, Santa Clara,	Coastal prairie, valley grassland, northern coastal	**Suitable habitat –** Suitable grassland, coastal scrub and wetland-

Common and Scientific Name	Status Federal/ State/ CRPR	Geographic Distribution	Habitat Requirements	Rationale
		Sonoma, Monterey, San Francisco, Marin, San Mateo Counties.	scrub, wetland-riparian, sometimes serpentine soil	riparian habitat present. One historic occurrence from 1894 overlaps the project footprint but is mapped as "best guess" from historic records (CDFW 2019).
Franciscan onion *Allium peninsulare* var. *franciscanum*	–/–/1B.2	Fresno, Santa Clara, Sonoma, Mendocino, San Joaquin, Monterey, San Mateo, Napa, Solano Counties	Cismontane woodland, valley and foothill grassland with clary, volcanic, often serpentinite soils	**Suitable habitat –** Suitable grassland and cismontane woodland habitat are present. One occurrence from 2013 overlaps the project footprint on serpentine soils near Searsville Lake (CDFW 2019). The occurrence is identified as occurring on Jasper Ridge.
Hoover's button-celery *Eryngium aristulatum* var. *hooveri*	–/–/1B.1	Alameda, Santa Clara, Fresno Monterey, San Benito, San Luis Obispo Counties	Vernal pools	**No suitable habitat –** Vernal pools are not present within the project footprint. One historic occurrence with 1 mile accuracy overlaps the project footprint; this occurrence is considered possibly extirpated (CDFW 2019).
Jepson's coyote-thistle *Eryngium jepsonii*	–/–/1B.2	Inner North Coast Ranges, Sacramento Valley, San Joaquin Valley, San Francisco Bay Area	Occurs in vernal pool	**No suitable habitat –** Vernal pools are not present within the project footprint. Two occurrences mapped near the Jasper Ridge Biological Preserve at Stanford University approximately 0.75 mile from the project footprint, the most recent of which was observed in 2014 (CDFW 2019).
Kings Mountain manzanita	–/–/1B.2	San Mateo and Santa Cruz Counties	Broadleaved upland forest, chaparral, and north coast	**No suitable habitat –** Granitic and sandstone substrates are not present

Common and Scientific Name	Status Federal/ State/ CRPR	Geographic Distribution	Habitat Requirements	Rationale
Arctostaphylos regismontana			coniferous forest, on granitic or sandstone substrates, from 1,000–2,400 feet above MSL	in the project footprint. One occurrence approximately 1.3 miles of the project footprint on Mid-Peninsula Open Space District Property (CDFW 2019).
Legenere *limosa*	–/–/1B.1	Alameda, Lake, Monterey, Napa, Placer, Sacramento, Santa Clara, Shasta, San Joaquin, San Mateo, Solano, Sonoma, Stanislaus, Tehama, Yuba Counties	Vernal pools 1–1,005 meters.	**No suitable habitat –** Vernal pools are not present in the project footprint. No occurrences are documented within 2-miles of the project footprint (CDFW 2019).
Lost thistle *Cirsium praeteriens*	–/–/1A	Santa Clara County	Unknown	**No suitable habitat –** Identified in two collections from Palo Alto in 1901. This species is presumed to be extirpated (CDFW 2019).
Marin western flax *Hesperolinon congestum*	T/T/1B.1	Alameda, San Mateo, Colusa, Marin, San Francisco Counties	Chaparral, valley grassland. Serpentine soil	**No suitable habitat –** There are no occurrences of this species within 2 miles of the project footprint (CDFW 2019).
Methuselah's beard lichen *Usnea longissima*	–/–/4.2	Humboldt County, with additional occurrences in Del Norte, Mendocino, Sonoma, Santa Cruz, and San Mateo Counties;	North Coast coniferous forest, broadleafed upland forest; grows on a variety of trees in the “redwood zone,” including big leaf maple, oaks, ash, Douglas-fir, and bay	**Suitable habitat –** Suitable montane riparian habitat, Douglas fir forest, and redwood forest. There are no occurrences of this species within 2 miles of the project footprint (CDFW 2019).
Minute pocket moss *Fissidens pauperculus*	–/–/1B.2	Butte, Del Norte, Humboldt, Mendocino, Marin, Santa Cruz, San Mateo, Sonoma Counties.	North coast coniferous forest (damp coastal soil)	**Suitable habitat –** Suitable montane riparian habitat, Douglas fir forest, and redwood forest. There are no occurrences of this species within 2 miles of the project footprint (CDFW 2019).

Common and Scientific Name	Status Federal/ State/ CRPR	Geographic Distribution	Habitat Requirements	Rationale
Point Reyes bird's-beak *Chloropyron maritimum* ssp. *palustre* [*Cordylanthus maritimus* ssp. *palustris*]	–/–/1B.2	Coastal northern California from Humboldt to Santa Clara Counties; Oregon	Coastal salt marsh, below 35 feet above MSL	**Suitable habitat –** Marginal habitat in salt marsh in the Faber and Laumeister Tracts. One occurrence from 1955 overlaps the project footprint with a 1-mile accuracy and is considered possibly extirpated (CDFW 2019). The only part of the project that would support this species habitat requirements is Reach 1, and the part of Reach 1 that may be used for access. This species was not found for the Reach 1 project and the floodplain was completely regarded. This species is not likely to be present.
Round-headed Chinese houses *Collinsia corymbosa*	–/–/1B.2	Fresno, Humboldt, Mendocino, Marin, Santa Clara, San Francisco, San Joaquin, Solano Counties	Coastal dunes 0–30 meters above MSL	**No suitable habitat –** Coastal dunes are not present in the project footprint. One historic occurrence overlaps the project footprint but is considered extirpated in CNDDB (CDFW 2019).
Saline clover *Trifolium hydrophilum* (*T. depauperatum* var. *hydrophilum*)	–/–/1B.2	Sacramento Valley, central western California	Salt marsh, mesic alkaline areas in grasslands, vernal pools	**Suitable habitat –** Marginal habitat in salt marsh in Faber and Laumeister Tracts. No occurrences within 2 miles of the project footprint. The only part of the project that would support this species habitat requirements is Reach 1, and the part of Reach 1 that may be used for access. This species was not found for the Reach 1 project and the floodplain was completely regarded.

Common and Scientific Name	Status Federal/ State/ CRPR	Geographic Distribution	Habitat Requirements	Rationale
				This species is not likely to be present.
San Francisco campion *Silene verecunda* ssp. *verecunda*	–/–/1B.2	Inyo, San Mateo, San Bernardino, Santa Cruz, San Francisco Counties	Coastal scrub, valley and foothill grassland, coastal bluff scrub, chaparral, coast prairie; often on mudstone or shale	**Suitable habitat –** Mudstone and shale soils are not present in the project footprint. No occurrences within 2 miles of the project footprint.
San Francisco collinsia *Collinsia multicolor*	–/–/1B.2	Monterey, Marin, Santa Clara, Santa Cruz, San Francisco, San Luis Obispo, San Mateo Counties	Northern coastal scrub, closed-cone pine forest	**Suitable habitat –** Coastal scrub and closed-cone pine forest are present. One historic collection from 1903 overlaps the project footprint.
San Mateo thornmint *Acanthomintha obovata* ssp. *duttonii*	E/E/1B.1	San Mateo County	Chaparral, valley grassland. Serpentine soil	**Suitable habitat –** Chaparral and grassland habitat are present. One occurrence is located approximately 2 miles west of the project footprint.
San Mateo woolly sunflower *Eriophyllum latilobum*	E/E/1B.1	Los Angeles, Mariposa, Napa, riverside, San Benito, Santa Clara, San Mateo Counties	Foothill woodland with serpentine soil	**Potentially suitable habitat present –** Foothill woodlands are present. No occurrences are located within 2 miles of the project footprint.
Santa Clara red ribbons *Clarkia concinna* ssp. *automixa*	–/–/4.3	Alameda, Santa Clara, Santa Cruz Counties	Cismontane woodland, chaparral	**Suitable habitat –** Suitable cismontane woodland and chaparral habitat are present. No occurrences within 2 miles of the project footprint.
Santa Cruz clover *Trifolium buckwestiorum*	–/–/1B.1	Mendocino, Monterey, Santa Clara, Santa Cruz, San Mateo, Sonoma Counties	Coastal prairie, mixed evergreen forest	**No suitable habitat –** Coastal prairie and mixed evergreen forest are not present in the project footprint. No occurrences within 2 miles of the project footprint.

Common and Scientific Name	Status Federal/ State/ CRPR	Geographic Distribution	Habitat Requirements	Rationale
Slender-leaved pondweed *Stuckenia filiformis*	–/–/2B.2	Scattered locations in California: Contra Costa, El Dorado, Lassen, Merced, Mono, Modoc, Mariposa, Placer, Santa Clara*, San Mateo, and Sierra Counties; Arizona, Nevada, Oregon, Washington	Freshwater marsh, shallow emergent wetlands and freshwater lakes, drainage channels; 300–2,150 meters	**No suitable habitat –** Marshes and swamps with permanent standing water are not present in the project footprint. One historic occurrence mapped as Palo Alto in 1899 overlaps the project footprint (CDFW 2019).
Two-fork clover *Trifolium amoenum*	E/–/1B.1	Alameda, Marin, Napa, Santa Clara, San Mateo, Solano, Sonoma Counties	Coastal bluff scrub, valley and foothill grassland (sometimes serpentine)	**Suitable habitat –** Valley and foothill grassland are not present. One occurrence from 1950 overlaps the project footprint on San Francisquito Creek near Searsville Lake (CDFW 2019).
Western leatherwood *Dirca occidentalis*	–/–/1B.2	Alameda, Contra Costa, Marin, Santa Clara, San Mateo, and Sonoma Counties.	Brushy slopes in moist areas in broadleaved upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, north coast coniferous forest, riparian forest, and riparian woodland, from 164 to 1,300 feet in elevation	**Suitable habitat –** Suitable cismontane, closed-cone-coniferous forest, and riparian forest are present in the project footprint. One occurrence from 2011 mapped along San Francisquito Creek near Searsville Lake in the project footprint.
White-flowered rein orchid *Piperia candida*	–/–/1B.2	Del Norte, Humboldt, Mendocino, Santa Cruz, Siskiyou, San Mateo, Sonoma, Trinity Counties.	Yellow pine forest and north coastal coniferous forest. Sometimes serpentine	**Suitable habitat –** North coastal coniferous forest is present in the project footprint. No occurrences are located within 2 miles of the project footprint.
White-rayed pentachaeta *bellidiflora*	E/E/1B.1	Monterey, Marin, San Bernardino, Santa Cruz, San Mateo Counties	Valley and foothill grassland, cismontane woodland; open rocky slopes and grassy areas, often on serpentine	**Suitable habitat –** Grassland cismontane woodland are present in the project footprint. No occurrences are located within 2 miles of the project footprint.

Common and Scientific Name	Status Federal/ State/ CRPR	Geographic Distribution	Habitat Requirements	Rationale
Woodland woollythreads *Monolopia gracilens*	–/–/1B.2	Alameda, Contra Costa, Kern, Monterey, Santa Clara, Santa Cruz, San Luis Obispo, San Mateo Counties	Mixed evergreen forest, redwood forest, chaparral, often on serpentine	**No suitable habitat –** No serpentine habitat within the project footprint. One occurrence of this species is located at the Jasper Ridge Biological Preserve at Stanford University approximately 1.2 miles west of the project footprint (CDFW 2019).

[a] Status
E = listed as endangered
T = listed as threatened
R = listed as rare
– = no listing.
California Rare Plant Rank (CRPR) (California Native Plant Society 2018). Available http://www.cnps.org/cnps/rareplants/ranking.php
1A = plants presumed extirpated in California and either rare or extinct elsewhere.
1B = plants rare, threatened or endangered in California and elsewhere.
2B = plants rare, threatened, or endangered in California but more common elsewhere.
4 = watch list: plants of limited distribution.
0.1 - seriously threatened in California (over 80% of occurrences threatened/high degree and immediacy of threat)
0.2 - moderately threatened in California (20-80% of occurrences threatened/moderate degree of immediacy of threat)

Special-Status Fish and Wildlife

Fisheries

Several special-status fish species are present in San Francisquito Creek or in the Bay where the creek meets the Bay. Longfin smelt (*Spirinchus thaleichthys*) and green sturgeon (*Acipenser medirostris*) could occur in the Bay and possibly up into the tidally influenced section of San Francisquito Creek, although unlikely given that the size of San Francisquito Creek is very small.

The Central California Coast distinct population segment of steelhead (*Oncorhynchus mykiss*) is the only special-status fish species known to have been historically present in Peninsula watersheds, including San Francisquito Creek. There are most likely two types of *O. mykiss* in the watershed; anadromous steelhead (*O. mykiss* that migrate to the ocean and return to freshwater) and resident rainbow trout (*O. mykiss* that live in fresh water and do not travel out to the ocean). While the present-day hydrology of the San Francisquito Creek watershed has been highly altered, the creek still supports an anadromous run of steelhead up to Searsville Dam and in the tributaries with confluence below Searsville Dam.

The run of steelhead in San Francisquito Creek has been classified as an essential population in the 2016 *Final Coastal Multispecies Recovery Plan* (NMFS 2016). Within the watershed, steelhead have been documented in San Francisquito Creek, Bear Creek and its tributaries, Corte Madera Creek and its tributaries, and Los Trancos Creek since as early as 1905 (Leidy 2007) to present day.

The long-term, consistent finding of juveniles and evidence of spawning imply a persisting steelhead/rainbow trout population. However, there exists very little escapement information or data on returning adults and minimal information on the timing of outmigration and returning adults (although this information can be assumed from juvenile presence studies and spawning data).

The studies that best represent the occurrence and extent of steelhead in the watershed are the following.

- Vogel 2002. An extensive snorkel survey of juvenile *O. mykiss* in Los Trancos Creek, funded by Stanford University. The survey covered 2.3 miles of channel downstream and 1.6 miles upstream of the Felt Lake Diversion Dam in the spring of 2002. Fry and yearling trout were identified upstream and downstream of the diversion dam.
- Launer and Holtgreive 2000. A Stanford University study, in the summers of 1998 and 1999, of all fish populations in San Francisquito Creek and Los Trancos Creek. The survey started at the confluence of San Francisquito and Los Trancos creeks, continued upstream to Searsville Dam on San Francisquito Creek, and terminated at the Felt Lake Diversion fish ladder on Los Trancos Creek. A small portion of Bear Creek was also surveyed in 1998. The study found that nonnative fishes supported by Searsville Lake were not expanding their range into the rest of the watershed and that “moderate to high” densities (i.e., encounter rates of greater than 0.61 individuals per minute) of steelhead/trout, including yearlings, were prevalent in the surveyed reaches.
- California Department of Fish and Game conducted summer electrofishing surveys of Bear, Los Trancos, and San Francisquito Creeks in 1976 and in 1992–1993. The effort was more extensive in 1992–1993, but steelhead were found in all streams during both surveys. However, more

young of year *O. mykiss* were found upstream of the Felt Lake Diversion. Because the survey was conducted before the installation of a fish ladder in 1995, this suggests a self-sustaining resident rainbow trout population upstream of the diversion. However, it does not confirm a resident rainbow trout population because the diversion barrier was not a complete barrier to movement.

The creek reach that extends from San Francisco Bay to Junipero Serra Boulevard is used as a migration corridor for spawning adult steelhead and an emigration corridor for juvenile fish (NMFS 2008). Steelhead have not been observed spawning in this portion of San Francisquito Creek and overwintering and summer rearing habitats are limited due to a low density of habitat features such as woody material, root wads, boulder and cobble aggregations, and off-channel habitats (Jones and Stokes 2004, NMFS 2008). As noted above, the lower reach of San Francisquito Creek typically goes dry or supports only shallow water by late spring, blocking juvenile emigration in some years (NHC 2001) (AECOM 2017) and precluding summer rearing.

The creek reach that extends from Junipero Serra Boulevard to the confluence with Bear Creek contains spawning and rearing habitat for steelhead (NHC et al. 2001). Approximately 1.5 miles of remaining streambed is composed of bedrock with little spawning gravel. Pools are common in this reach, and the channel gradient is relatively flat, averaging about 0.5%. The flat gradient and numerous pools have led to high levels of silt in the streambed. However, the pools provide summer rearing and overwintering habitat. (AECOM 2017)

Threats to steelhead habitat in San Francisquito Creek include channel modification from flood water conveyance, which includes bank protection measures, residential and commercial development close to the Creek, roads and railroads, and water diversions and impoundments including Searsville Dam. Critical habitat for Central California Coast steelhead is designated in San Francisquito Creek in the project reaches (70 *Federal Register* 52570). Essential fish habitat is also designated in San Francisquito Creek for Pacific salmon and groundfish species such as starry flounder.

Wildlife

A search of the CNDDB and the USFWS databases identified 55 special-status wildlife species with potential to occur in the project area (see below). Additionally, the Stanford HCP and USACE *Environmental Setting Report* (2011) were used to identify species that occur in the San Francisquito watershed. Of the 55 species, 32 species (including steelhead trout discussed above) could use portions of the project footprint. The project footprint is defined as areas that will be temporarily and permanently impacted by construction and operation activities. Table 3.3-3 provides an overview of these wildlife species.

Table 3.3-3. Special-Status Fish and Wildlife Species with Potential to Occur in the Project Footprint

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
Invertebrates					
Callophrys mossii bayensis San Bruno elfin butterfly	E/--	San Bruno Mountain, Montara Mountains, and northern end of Santa Cruz Mountains, San Mateo County; San Francisco Bay area, Contra Costa County, Marin County	North-facing slopes and ridges facing Pacific Ocean from 600 to 1,100 feet; rocky outcrops and cliffs in coastal shrub	Absent	**No suitable habitat –** Project footprint is below 600 feet and there are no slopes or ridges near the Pacific Ocean
Euphydryas editha bayensis Bay checkerspot butterfly	T/–	Disjunct occurrences in San Mateo and Santa Clara Counties	Associated with specific host plants that typically grow on serpentine soils	Present	**Suitable habitat –** There is one CNDDB occurrence of this species within Reach 3 at Jasper Ridge Preserve
Fish					
Acipenser medirostris Green sturgeon	T/SSC	From Mexico to Alaska in marine waters. Bays and estuaries along the west coast of North America, from British Columbia south to San Luis Obispo	Ocean water, bays, and estuaries while not spawning; spawn in the mainstem of freshwater rivers with connection to marine habitat and suitable deep pools	Absent	**No suitable habitat –** San Francisquito Creek is relatively shallow and lacks deep freshwater pools
Hypomesus transpacificus Delta smelt	T/T	Primarily in the Sacramento–San Joaquin Estuary, but has been found as far upstream as the mouth of the American River on the Sacramento River and Mossdale on the San Joaquin River; range extends downstream to San Pablo Bay	Occurs in estuary habitat in the Delta where fresh and brackish water mix in the salinity range of 2–7 parts per thousand (Moyle 2002)	Absent	**No suitable habitat –** Project footprint outside of known range
Oncorhynchus mykiss Central California coast steelhead	T, CH/–	Coastal drainages along the central California coast	Cold, clear water with clean gravel of appropriate size for spawning; most spawning occurs in headwater streams; steelhead migrate to the ocean to feed and grow until sexually mature; occurs in well-oxygenated, cool, riverine habitat with water temperatures from 7.8 to 18°C	Present	**Suitable habitat –** Steelhead known to use project area as a migratory connection to upstream spawning habitat

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
			(Moyle 2002); habitat types are riffles, runs, and pools		
Oncorhynchus kisutch Central California coast coho salmon	E (central coast)/ –	Pacific Ocean and rivers and creeks from Punta Gorda to the San Lorenzo River	Occur in coastal streams with water temperatures < 15°C; need cool, clear water with instream cover; spawn in tributaries to large rivers or streams directly connected to the ocean (Moyle 2002)	Absent	**No suitable habitat –** No coho salmon runs are known to persist in San Francisquito Creek and coho salmon have been extirpated from tributaries to San Francisco Bay (NMFS 2005)
Spirinchus thaleichthys Longfin smelt	C/T/–	Occurs San Francisco Estuary and the Sacramento/San Joaquin Delta (Bay-Delta), Humboldt Bay, and the estuaries of the Eel River and Klamath River offshore	Occurs in nearshore waters, to estuaries and lower portions of freshwater streams, requires cooler water temperatures lower than 63–73°F (Moyle 2002)	Absent	**No suitable habitat –** Adults occur in the South Bay in brackish water, but would not occur in San Francisquito Creek in the project area
Entosphenus tridentatus Pacific lamprey	--/SSC	Sacramento, San Joaquin, and tributaries of San Francisco Bay, Delta (Moyle 2002)	Ammocoetes live in freshwater for 5–7 years and then move towards the ocean. Feed on fish including salmon and flatfish. Adults return to freshwater to spawn and then die. (University of California 2018)	Absent	**No suitable habitat –** Pacific lamprey do not occur historically or currently in San Francisquito Creek. Lack of flows during summer months and large sediment loads are thought to adversely affect habitat (Goodman and Reid 2017)
Amphibians					
Ambystoma californiense California tiger salamander	T/T	Central Valley, including Sierra Nevada foothills, up to approximately 1,000 feet, and coastal region from Sonoma County south to Santa Barbara County	Small ponds, lakes, or vernal pools in grasslands and oak woodlands for larvae; rodent burrows, rock crevices, or fallen logs for cover for adults and for summer dormancy	Present	**Suitable habitat –** Occurs within the project footprint (Reach 3); there are several CNDDB records in Lake Lagunita and surrounding areas of Stanford University
Aneides flavipunctatus niger Santa Cruz black salamander	–/SSC	Santa Cruz, San Mateo, and Santa Clara Counties	Live in damp environments on land; mixed deciduous and coniferous woodlands and coastal grasslands; found under	Present	**Suitable habitat –** One individual collected near Searsville Lake and along San Francisquito Creek in 1978 (CDFW 2019)

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
			rocks, talus, and damp woody debris		
Dicamptodon ensatus California giant salamander	–/SSC	Mendocino, Lake, Glenn, Sonoma, Marin, San Mateo, and Santa Cruz Counties	Occurs in wet coastal forests in or near clear, cold permanent or semi-permanent streams and seeps	Present	**Suitable habitat –** Species identified several kilometers from Stanford, upstream in San Francisquito Creek system (Stanford University 2011)
Rana boylii Foothill yellow-legged frog	--/C	Occurs in the Klamath, Cascade, north Coast, south Coast, Transverse, and Sierra Nevada Ranges up to approximately 6,000 feet	Creeks or rivers in woodland, forest, mixed chaparral, and wet meadow habitats with rock and gravel substrate and low overhanging vegetation along the edge; usually found near riffles with rocks and sunny banks nearby	Absent	**No suitable habitat** – Several CNDDB records within 2 miles of project site, but all are historical (1940 and older) and assumed extirpated from the locations
Rana draytonii California red-legged frog	T/SSC	Found along the coast and coastal mountain ranges of California from Mendocino County to San Diego County and in the Sierra Nevada from Butte County to Stanislaus County	Permanent and semi-permanent aquatic habitats, such as creeks and cold-water ponds, with emergent and submergent vegetation; may aestivate in rodent burrows or cracks during dry periods	Present	**Suitable habitat –** Three CNDDB records of this species; one record is located within the Jasper Ridge Preserve (Reach 3), another is located just north of the western portion of the project area, and the third is located southeast of the project footprint outside of the San Francisquito watershed
Taricha rivularis Red-bellied newt	–/SSC	Found in coastal drainages from Humboldt County south to Sonoma County; isolated population of uncertain origin in Santa Clara County	Lives in stream or river habitat; found in coastal woodlands and redwood forest along the coast Larvae go into vegetation and under stones during the day	Absent	**No suitable habitat –** Outside of known range; one disjunct population in Stevens Creek watershed

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
Reptiles					
Actinemys (=*Emys*) *marmorata* Western pond turtle	–/SSC	The western pond turtle is uncommon to common in suitable aquatic habitat throughout California, west of the Sierra-Cascade crest and absent from desert regions, except in the Mojave Desert along the Mojave River and its tributaries	Occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation in woodlands, grasslands, and open forests; nests are typically constructed in upland habitat within 0.25 mile of aquatic habitat	Present	**Suitable habitat –** Three CNDDB records of this species; one record is located within the Jasper Ridge Preserve (western project footprint), another is located just north of the western portion of the project area, and the third is located southeast of the project footprint outside of the San Francisquito watershed
Chelonia mydas Green sea turtle	T/–	Pacific Ocean along coast of California	Pacific Ocean	Absent	**No suitable habitat –** Outside of known range.
Thamnophis sirtalis tetrataenia San Francisco garter snake	E/E, FP	Northern San Mateo County southward along the coast and the eastern slope of the Santa Cruz Mountains to the Santa Clara County line	Favors ponds, lakes, and slow moving streams and marshy areas containing abundant vegetation, which it uses for cover; nearby upland habitat is important during fall and winter.	Absent	**No suitable habitat –** There is no suitable habitat within the portion of San Francisquito Creek within the project area; additionally, the project area is situated entirely in an intergrade zone of snakes that are genetic hybrids of San Francisco garter snake and red-sided garter snake; these intergrades are not considered to belong to either species and are not protected as such; there is one CNDDB record within 5 miles of the study area (specific location suppressed)

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
Mammals					
Antrozonous pallidus Pallid bat	–/SSC	Widespread throughout California	Roosts in fissures in caves, tunnels, mines, hollow trees, and locations with stable temperatures	Present	**Suitable habitat –** Two CNDDB records, one of which is located near Stanford University, within the project vicinity
Bassariscus astutus Ringtail	–/FP	Widely distributed in California, particularly in the foothills of the Coast Ranges and Sierra Nevada, ringtails are relatively uncommon	Occurs in brushy or wooded habitats, primarily in riparian areas not usually more than 0.5 mile from permanent water	Present	**Suitable habitat –** Abundance of prey species occurs within the project footprint near Stanford, but there are no CNDDB records within 2 miles of the project site
Corynorhinus townsendii Townsend's big-eared bat	–/SSC	Widespread throughout California, from low desert to mid-elevation montane habitats	Roosts in caves, tunnels, mines, buildings, and other cave-like spaces; will night roost in more open settings, including under bridges	Present	**Suitable habitat –** This species has been detected on Stanford property (Stanford University 2011)
Dipodomys venustus venustus Santa Cruz kangaroo rat	–/–	Central coast of California	Well-drained, deep soils often on slopes with chaparral or mixed chaparral and sometimes abandoned farm fields	Absent	**No suitable habitat –** Outside of known habitat; two historical CNDDB records from 1938 and 1941
Lasiurus cinereus Hoary bat	–/–	Widespread throughout California	Roosts in trees, typically within forests	Present	**Suitable habitat –** Six CNDDB records, one of which is located near Stanford University, within the project vicinity
Neotoma fuscipes annectens San Francisco dusky-footed woodrat	–/SSC	West side of Mount Diablo to coast and San Francisco Bay	Present in chaparral habitat and in forest habitats with a moderate understory	Present	**Suitable habitat –** One CNDDB record within the Jasper Ridge Preserve (western project footprint), located less than 1 mile from the project footprint

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
Reithrodontomys raviventris Salt marsh harvest mouse	E/E	The San Francisco Bay Estuary and Suisun Marsh	Saline to brackish salt marsh habitat	Absent	**No suitable habitat –** No suitable habitat within the project footprint
Sorex vagrans halicoetes Salt-marsh wandering shrew	-/SSC	Southern arm of the San Francisco Bay in San Mateo, Santa Clara, Alameda, and Contra Costa Counties	Salt marshes from 6–9 feet above mean sea level	Absent	**No suitable habitat –** No suitable habitat in the project footprint
Taxidea taxus American badger	–/SSC	Throughout California, except the northern corner of the north coast area	Typically, open areas of drier scrub, forest, and herbaceous habitats with friable soils	Present	**Suitable habitat** – Two CNDDB records within the Jasper Ridge Preserve (western project footprint), located less than 1 mile from the project footprint
Birds					
Accipiter cooperii Cooper's hawk	–/SSC	Year-round resident throughout much of California, except in the high Sierra Nevada	Cooper's hawks nest in riparian, deciduous, conifer, and mixed woodlands and forage along forest edges and in broken habitats	Present	**Suitable habitat –** This species has been observed near Stanford University lands (USACE 2010)
Accipiter striatus Sharp-shinned hawk	–/SSC	Migrant and winter resident throughout most of California	Nest in ponderosa pine, black oak, riparian deciduous, mixed conifer, and Jeffrey pine habitats	Present	**Suitable habitat –** This species has been observed near Stanford University lands (USACE 2010)
Aquila chrysaetos Golden eagle	–/FP/SSC	Throughout California	Occur in rolling foothills, mountain areas, sagebrush-juniper flats, and desert	Present	**Suitable habitat –** Golden eagles have been observed in the San Francisquito Creek watershed, although nesting would occur only near large, open, hilly expanses of land; there are no CNDDB (CDFW 2019) records of golden eagle nesting in the watershed

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
Ardea herodias Great blue heron (rookery)	–/–	Nests in suitable habitat throughout California except at higher elevations in Sierra Nevada and Cascade mountain ranges	Widely distributed in freshwater and calm-water intertidal habitats	Present	**Suitable habitat –** Great blue heron have the potential to nest in vegetation adjacent to lake and wetland habitat within the western project footprint, and there have been numerous observations of this species in the project vicinity
Asio flammeus Short-eared owl	–/SSC	Found throughout the United States; in California, populations are non-breeding	Large open areas with low vegetation, including coastal grasslands, marshes, and agricultural areas	Present	**Suitable habitat –** No observations of long-eared owls are in the project footprint; the CNDDB record indicates adults and fledglings seen at Stevens Creek in 1987 (CDFW 2019)
Asio otus Long-eared owl	–/SSC	Found throughout the United States; in California, populations are non-breeding	Riparian vegetation with tall willows and cottonwoods; also stands of live oak paralleling streams; requires adjacent open land with mice	Present	**Suitable habitat –** No observations of long-eared owls are in the project footprint; the CNDDB record indicates nesting birds at Bair Island in San Francisco Bay (CDFW 2019)
Athene cunicularia Burrowing owl	–/SSC	Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas; rare along south coast	Level, open, dry, heavily grazed or low stature grassland or desert vegetation with available burrows	Present	**Suitable habitat –** Suitable habitat in Reach 3 near Stanford University
Brachyramphus marmoratus Marbled murrelet	T/E	From Alaska to the central coast of California	Pacific Ocean, but nesting occurs in old growth forest	Absent	**No suitable habitat –** No old growth redwoods for nesting
Charadrius alexandrines nivosus Western snowy plover	T/SSC	Twenty breeding sites are known in California from Del Norte to San Diego County	Coastal beaches above the normal high tide limit in flat, open areas with sandy or saline substrates; vegetation and	Absent	**No suitable habitat** – No open coastal beach habitat or open salt plains in the project area

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
			driftwood are usually sparse or absent		
Coccyzus americanus Yellow-billed cuckoo	E/E	Nests along the upper Sacramento, lower Feather, south fork of the Kern, Amargosa, Santa Ana, and Colorado Rivers	Requires wide, dense riparian forests/woodlands with a thick understory of willows for nesting; sites with a dominant cottonwood overstory are preferred for foraging; may avoid valley-oak riparian habitats where scrub jays are abundant; utilizes orchards adjacent to streams	Absent	**No suitable habitat –** No dense riparian forests/woodlands in the project site; no CNDDB records
Circus cyaneus Northern harrier	–/SSC	Occurs throughout lowland California; has been recorded in fall at high elevations	Grasslands, meadows, marshes, and seasonal and agricultural wetlands	Present	**Suitable habitat –** Both forage and nesting habitat in the grasslands within the western project footprint; three CNDDB records are documented along the South Bay, but this species is known to be more prevalent and extends its range into the foothills west of Menlo Park
Coturnicops noveboracensis Yellow rail	–/SSC	Historical records of nests in Mono County east of the Sierra Nevada and formerly Marin County on the coast; winter records also on the coast from Humboldt County to Orange County, where the Central Valley merges with the San Francisco Bay estuary	Freshwater marshes, brackish marshes, coastal salt marshes with moist soil or low standing water, and grassy meadows; prefers densely vegetated marshes	Absent	**No suitable habitat –** Most CNDDB records are from the early 1900s; one was captured near the Palo Alto Baylands in 1988, which is outside of the project footprint (CDFW 2019)
Dendroica petechia Brewster Yellow warbler	–/SSC	Breeding distribution includes most of California except the Central Valley, the Mojave Desert region, and high altitudes and the eastern side of the Sierra Nevada	Nests in dense riparian habitats dominated by willows and other riparian species, including alders, cottonwoods, and sycamores	Present	**Suitable habitat –** Yellow warblers have been identified on or near the Stanford University campus; there is some potential for this species to nest within

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
					the riparian corridors of the San Francisquito Creek watershed, although no records of nesting could be found (USACE 2010)
Egretta thula Snowy egret (rookery)	–/–	Occurs in coastal lowlands and other lowland areas throughout California	Shores of coastal estuaries, fresh and saline emergent wetlands, ponds, slow-moving rivers, irrigation ditches, and wet fields; nests in dense marshes or at low heights in trees	Present	**Suitable habitat –** Forage habitat in the grasslands within the western project footprint and nesting habitat in the adjacent vegetation; there are numerous observations of the species within the vicinity of the project footprint
Elanus leucurus White-tailed kite	–/FP	Lowland areas west of Sierra Nevada from the head of the Sacramento Valley south, including coastal valleys and foothills to western San Diego County at the Mexico border	Low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands for foraging	Present	**Suitable habitat –** Both forage and nesting habitat in the grasslands within the western project footprint; two CNDDB records are documented along the South Bay, but this species is known to be more prevalent and extends its range into the foothills west of Menlo Park
Falco peregrinus anatum American peregrine falcon	–/FP	Entire United States; year-round residents in California	Open landscapes with cliffs or large buildings; rivers, coastlines, and cities where rock pigeon populations are present but will prey on most birds	Present	**Suitable habitat –** Peregrine falcons are observed on the Stanford Campus (Stanford University 2018)
Geothlypis trichas sinuosa Saltmarsh common yellowthroat	–/SSC	Found only in the San Francisco Bay Area in Marin, Napa, Sonoma, Solano, San Francisco, San Mateo, Santa Clara, and Alameda Counties	Freshwater marshes in summer and salt or brackish marshes in fall and winter; requires tall grasses, tules, and willow thickets for nesting and cover	Present	**Suitable habitat –** Three CNDDB records of this species in the project vicinity east, west, and southeast of the project footprint

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
Haliaeetus leucocephalus Bald eagle	–/E, FP	Entire United States	Habitat is ocean shore, lake margins, and rivers for nesting and wintering; most nests within 1 mile of water	Present	**Suitable habitat –** CNDDB record of nesting pair with 2 young on the south side of Felt Reservoir in 2016
Lanius ludovicianus Loggerhead shrike	–/SSC	Lowlands and foothills of California	Open habitats with shrubs, fences, utility line poles, or other perches	Present	**Suitable habitat –** Loggerhead shrikes have been observed near Stanford University lands (USACE 2010)
Laterallus jamaicensis conturniculus California black rail	–/T, FP	Permanent resident in the San Francisco Bay and east-ward through the Delta into Sacramento and San Joaquin Counties; small populations in Marin, Santa Cruz, San Luis Obispo, Orange, Riverside, and Imperial Counties	Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations	Absent	**No suitable habitat –** No suitable habitat in the project area
Melospiza melodia pusillula Alameda song sparrow	–/SSC	Found only in marshes along the southern portion of the San Francisco Bay	Brackish marshes associated with pickleweed; may nest in tall vegetation or among the pickleweed	Present	**Suitable habitat –** The project footprint includes only marginal habitat for this species; however, there are numerous records of this species in the project vicinity
Nycticorax nycticorax Black-crowned night heron (rookery)	--/--	Found along the coast of California	Found/breeds in fresh and saltwater wetlands, swamps, lakes, wooded streams, lakes, shorelines, and agricultural areas; nest on platforms of sticks in a group of trees or on protected ground	Present	**Suitable habitat –** Foraging habitat in the grasslands within the western project footprint and suitable nesting habitat occurs throughout the project footprint; there is one CNDDB record of this species within the project vicinity

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale
Pelecanus occidentalis californicus California brown pelican	D/E	The Pacific coast from Canada through Mexico	Coastal areas; nests on islands; occasionally along Arizona's lakes and rivers	Absent	**No suitable habitat –** No records of this species within the project vicinity
Phalacrocorax auritus Double-crested cormorant /(rookery)	–/–	Winters along the entire California coast and inland over the Coast Ranges into the Central Valley from Tehama County to Fresno County; a permanent resident along the coast from Monterey County to San Diego County, along the Colorado River, Imperial, Riverside, Kern and King Counties, and the islands off San Francisco; breeds in Siskiyou, Modoc, Lassen Counties	Rocky coastlines, beaches, inland ponds, and lakes; needs open water for foraging, and nests in riparian forests or on protected islands, usually in snags	Present	**Suitable habitat –** Foraging habitat in the grasslands within the western project footprint and suitable nesting habitat occurs throughout the project footprint; there are no CNDDB records of this species within the project vicinity, but there have been several recent observations of this species in the Jasper Ridge Preserve (western project footprint) and other portions of the project footprint
Rallus obsoletus obsoletus California Ridgway's rail	E/E	Found along the Pacific Coast in Monterey and San Luis Obispo Counties	From tidal mudflats to tidal sloughs	Absent	**No suitable habitat –** No suitable habitat in the project area
Rynchops niger Black skimmer	--/SSC	Common summer resident at the Salton Sea and coastal southern California; largest breeding population at Salton Sea, coastal Orange County, and south San Diego Bay	Nests on gravel bars and sandy beaches; forages in shallow, calm waters or on mud flats in estuaries; requires large areas of bare beach sufficiently isolated from terrestrial predators and other disturbances	Absent	**No suitable habitat –** Highly urbanized area near Bay
Sternula antillarum browni California least tern	E/E	Found along the Pacific Coast of California from San Francisco to Baja California	Nest on open beaches or tidal marsh kept free of vegetation by natural scouring from tidal action	Absent	**No suitable habitat –** No open beach areas at project site

Scientific and Common Names	Status Fed/State	Geographic Distribution	Habitat Requirements	Habitat Present/Absent	Rationale

[1] Status explanations:

Federal

E = listed as endangered under the federal Endangered Species Act (ESA).

T = listed as threatened under the ESA.

CH = critical habitat in project footprint

PT = proposed for federal listing as threatened under the ESA.

C = species for which USFWS has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposed rule to list, but issuance of the proposed rule is precluded.

D = delisted.

– = no listing.

State

E = listed as endangered under the California Endangered Species Act (CESA).

T = listed as threatened under CESA.

FP = fully protected under the California Fish and Game Code.

SSC = species of special concern in California.

D = delisted.

– = no listing.

3.3.3 Impact Analysis

Methods and Significance Criteria

Impacts on vegetation and wildlife were analyzed based on existing biological conditions and resources present at each project element site and a review of the design for the proposed project elements.

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would result in any of the following:

- Adverse effects, either directly or indirectly through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies or regulation, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service.
- Adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service.
- Adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means).
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impeded the use of native wildlife nursery sites.
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

Two Habitat Conservation Plans, Stanford University's HCP (2013) and the Santa Clara County HCP, have plan areas near the project site, but they do not overlap with the project site. Hence, the proposed project would not result in such conflicts, and this issue is not addressed further.

Table 3.3-4 summarizes which wildlife species may be affected in each reach. The Channel Widening Alternative and Floodwalls Alternative are mostly in Reach 2, except there is access to the project through Reach 1. The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are in Reach 3.

Table 3.3-4. Wildlife Species Potentially Affected Organized by Project Reach

Wildlife Species	Reach 1	Reach 2	Reach 3
Bay checkerspot butterfly			X
Central California coast steelhead	X	X	X
California tiger salamander			X
Santa Cruz black salamander			X
California giant salamander			X
California red-legged frog		X	X
Western pond turtle		X	X
Pallid Bat	X	X	X
Ringtail			X
Townsend's big-eared bat			X
Hoary bat		X	X
San Francisco dusky-footed woodrat			X
American badger			X
Cooper's hawk, sharp-shinned hawk, golden eagle, short-eared owl, long-eared owl, yellow warbler, American peregrine falcon, bald eagle, loggerhead shrike			X
Northern harrier, snowy egret, white-tailed kite, saltmarsh common yellowthroat, Alameda song sparrow	X		X
Great blue heron rookery, black-crowned night heron rookery, double-crested cormorant rookery	X	X	X
Burrowing owl			X

Impacts and Mitigation Measures

Impact BIO-1—Result in the disturbance or loss of special-status plant populations

Summary by Project Element: Impact BIO-1—Result in the disturbance or loss of special-status plant populations		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	No Impact

Channel Widening Alternative and Floodwalls Alternative

Construction

Twenty-six special-status plant species have the potential to occur in the project area (Table 3.3-2). If present, individual plants of these special-status species along San Francisquito Creek and in adjacent areas could be damaged or removed by construction. Substantial loss of individual plants as a result of construction disturbance (earthwork, staging activities, foot traffic, vehicle traffic, etc.) or destruction of suitable habitat adjacent to an existing population could result in a significant impact on the species.

Implementation of Mitigation Measure (MM-) BIO-1, MM-BIO-2, MM-BIO-3, MM- BIO-4 and MM-BIO-5 will reduce impacts on special-status plants. These include minimizing new temporary access points and removing temporary fill used for access after construction is complete, planting local ecotypes of native plants and using appropriate erosion-control seed mixes as needed, encouraging passive revegetation, conducting preconstruction surveys, fencing areas to keep out construction equipment, and compensating for any loss of special-status plant species. With these mitigation measures in place, impacts would be less than significant.

MM-BIO-1: Restrict construction access to previously disturbed areas

Existing access ramps and roads to waterways will be used where possible. If temporary access points are necessary, they will be constructed in a manner that minimizes impacts on waterways:

- Temporary project access points will be created as close to the work area as possible to minimize running equipment in waterways and will be constructed to minimize adverse impacts.
- Any temporary fill used for access will be removed upon completion of the project. Site topography and geometry will be restored to pre-project conditions to the extent possible (Santa Clara Valley Water District Biological Resources BMP 4).

MM-BIO-2: Revegetate disturbed areas with local ecotypes of native plants

Local ecotypes of native plants will be planted, and appropriate erosion-control seed mixes will be chosen. The following steps will be taken by a qualified biologist or vegetation specialist:

- Evaluate whether the plant species currently grows wild in Santa Clara County.
- If the plant species currently grows wild in Santa Clara County, the qualified biologist or vegetation specialist will determine whether the plant installation must include local natives (i.e., grown from propagules collected in the same or adjacent watershed and as close to the project site as feasible).
- A qualified biologist or vegetation specialist will be consulted to determine which seeding option is ecologically appropriate and effective. The following guidelines will inform the biologist or vegetation specialist's determination.
  - For areas that are disturbed, an erosion-control seed mix may be used, consistent with the Santa Clara Valley Water District Guidelines and Standards for Land Use near Streams, Design Guide 5, Temporary Erosion Control Options.
  - In areas with remnant native plants, the qualified biologist or vegetation specialist may choose an abiotic application instead, such as an erosion control blanket or seedless hydro-mulch and tackifier, to facilitate passive revegetation of native species.

- Temporary earthen access roads may be seeded when site and horticultural conditions are suitable.
- If a gravel or wood mulch has been used to prevent soil compaction, this material may be left in place (if ecologically appropriate) instead of seeding.
- Seed selection will be ecologically appropriate, as determined by a qualified biologist, per Guidelines and Standards for Land Use near Streams, Design Guide 2, Use of Local Native Species, and the Supplemental Landscaping\Revegetation Guidelines.

MM-BIO-3: Conduct botanical surveys

SFCJPA will retain a qualified botanist to survey suitable habitat in the project area for special-status plants. Surveys will be conducted prior to site preparation or construction, during the appropriate blooming periods for each species as indicated in Table 3.3-5.

Table 3.3-5. Timing of Surveys for Special-Status Plants

Species	Blooming Period
Alkali milkvetch (*Astragalus tener* var. *tener*)	Mar–Jun
Anderson's manzanita (*Arctostaphylos andersonii)*	Nov-May
Arcuate bush mallow (*Malacothamnus arcuatus*)	Apr-Sep
Bent-flowered fiddleneck (*Amsinckia lunaris*)	Mar-Jun
California seablite (*Suaeda californica*)	Jul–Oct
Choris' popcornflower (*Plagiobothrys chorisianus var. chorisianus*)	Mar-Jun
Coastal marsh milk-vetch (*Astragalus pycnostachyus var. pycnostachyus*)	Apr-Oct
Congdon's tarplant (*Centromadia parryi* ssp. *congdonii*)	Jun–Nov
Crystal Springs fountain thistle (*Cirsium fontinale var. fontinale*)	Apr-Oct
Crystal Springs lessingia (*Lessingia arachnoidea*)	Jul-Oct
Dudley's lousewort (*Pedicularis dudleyi*)	Apr-Jun
Fragrant fritillary (*Fritillaria liliacea*)	Feb-Apr
Franciscan onion (*Allium peninsulare* var. *franciscanum*)	Apr-Jun
Methuselah's beard lichen (*Usnea longissimi*)	N/A
Minute pocket moss (*Fissidens pauperculus*)	N/A
Point Reyes bird's-beak (*Chloropyron maritimum* ssp. *palustre* [*Cordylanthus maritimus* ssp. *palustris*])	Jun–Oct
Saline clover (*Trifolium depauperatum* var. *hydrophilum*)	Apr–Jun
San Francisco campion (*Silene verecunda ssp. verecunda*)	Mar-Jun
San Francisco collinsia (*Collinsia multicolor)*	Feb-May
San Mateo thornmint (*Acanthomintha obovata* ssp. *duttonii*)	Apr-Jun
San Mateo woolly sunflower (*Eriophyllum latilobum*)	May-Jun
Santa Clara red ribbons (*Clarkia concinna* ssp. *automixa*)	Apr-Jul
Two-fork clover (*Trifolium amoenum*)	Apr-Jun
Western leatherwood (*Dirca occidentalis*)	Jan-Mar
White-flowered rein orchid (*Piperia candida)*	Mar-Sep
White-rayed pentachaeta (*Pentachaeta bellidiflora*)	Mar-May

Surveys will follow the *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed, and Candidate Species* (U.S. Fish and Wildlife Service 1996), *General Plant Survey Guidelines* (U.S. Fish and Wildlife Service 2002), and *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities* (CDFW 2018b). Special-status plants identified during the surveys will be mapped using a handheld global positioning system unit and documented as part of the public record. A report of occurrences will be submitted to SFCJPA and the CNDDB.

Surveys will be completed before ground-disturbing activities begin; survey timing will allow for follow-up mitigation, if needed. If the qualified biologist determines that individuals of identified special-status plant species could be affected by construction traffic or activities, MM-BIO-4 and, if necessary, MM-BIO-5, will be implemented.

MM-BIO-4: Confine construction disturbance and protect special-status plants during construction

Construction disturbance will be confined to the minimum area necessary to complete the work and will avoid encroachment on adjacent habitat. If special-status plants are found, a setback buffer will be established around individual plants or the area occupied by the population, based on the judgment of a qualified botanist. The plants, as well as a species-appropriate buffer area determined in consultation with agency staff (CDFW and USFWS), will be protected from encroachment and damage during construction by installing temporary construction fencing. Fencing will be brightly colored and highly visible. Fencing will be installed under the supervision of a qualified botanist to ensure proper location and prevent damage to plants during installation. Fencing will be installed before site preparation or construction work begins and will remain in place for the duration of construction. Construction personnel will be prohibited from entering these areas (the exclusion zone) for the duration of project construction. Fencing installation will be coordinated with fence installation required by other mitigation measures protecting wetlands, riparian habitat, and mature trees.

MM-BIO-5: Compensate for loss of special-status plants

If any individual special-status plants are present and cannot be effectively avoided through implementation of MM-BIO-4, SFCJPA will develop and implement a compensation plan so that there is no net loss of special-status plants. The compensation plan will be developed by a qualified botanist in coordination with and approval of CDFW or USFWS, depending on whether the plant has state or federal status, respectively, or both. The compensation plan will preserve an offsite area containing individuals of the affected species.

The offsite compensation area will contain a population and/or acreage equal to or greater than that lost as a result of project implementation and will include adjacent areas as needed to preserve the special-status plant population in perpetuity. Compensation of the affected population will occur in an amount equal to or greater than the amount lost as a result of the project to ensure that genetic diversity is preserved and no net loss of the number of individuals occurs. The quality of the population preserved will also be equal to or greater than that of the affected population, as determined by a qualified botanist retained by the SFCJPA. The SFCJPA will be responsible for ensuring that the compensation area is acquired in fee or in conservation easement, maintained for the benefit of the special-status plant population in perpetuity, and funded through the establishment of an endowment.

If an offsite population is not located or is not available for preservation, SFCJPA will employ a qualified nursery to collect and propagate the affected species, collected at the appropriate time of year, prior to population disturbance at the affected areas of the project. Transplantation will also be implemented if practicable for the species affected, including mature native plants to the extent feasible.

A monitoring and adaptive management plan will be developed for each compensation area, subject to CDFW and USFWS approval. This plan will establish success criteria for the site and will include protocols for annual monitoring of the site. The goal of monitoring will be to assess whether the compensation plan has successfully mitigated project impacts; monitoring will be designed to ensure that the required number of plants and/or plant acreage is being sustained through site maintenance. Factors to be monitored shall include, at a minimum, density, population size, natural recruitment, and plant health and vigor. If monitoring indicates that special-status plant populations are not maintaining themselves, adaptive management techniques will be implemented. Such techniques could include reseeding/replanting, nonnative species removal, and other management tools. The site will be evaluated at the end of the monitoring period by a qualified biologist to determine whether the mitigation has met the goal of this mitigation measure to preserve a population the same size and of equal or greater quality as that lost as a result of project activities at the site. Criteria by which this determination will be made will be established in the monitoring plan. The monitoring plan will also address adaptive management strategies to be adopted if the evaluation determines that the site does not meet the success criteria. In that case, a monitoring plan will stay in place until the success criteria are met.

Operations and Maintenance

For the Channel Widening Alternative, the project would require similar maintenance activities as those currently conducted along the creek. Maintenance of the project elements includes removing debris from the channel during the flood season and after major flood events. New activities consist of monitoring and maintenance of newly planted vegetation for 3 years. This activity would consist of invasive plant removal, inspection of newly planted vegetation, and replanting as needed. Creekside parks would require trash pick-up and disposal as well as maintenance of benches and landscaping. These activities would not result in new impacts on special-status plants. The overall impact would be less than significant.

For the Floodwalls Alternative, in addition to the activities discussed for the Channel Widening Alternative, maintenance of the floodwalls would consist of visual inspections for any damaged concrete or exposed reinforcing bar, and if found, repairing the damaged concrete. Undermining would also be visually inspected and if found, backfilling or grouting would be done. No impacts on special-status plant species are expected from this maintenance activity since all work will occur on existing walls. The overall impact would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

For the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative, special-status plant species would be protected during construction by implementation of MM-BIO-1, MM-BIO-2, MM-BIO-3, MM- BIO-4 and MM-BIO-5. These include minimizing new temporary access points and removing temporary fill used for access after construction is complete, planting local ecotypes of native plants and using appropriate erosion-control seed mixes as needed, and encouraging passive revegetation as appropriate. These mitigation measures will ensure that impacts are avoided, reduced if they cannot be avoided, and compensated as appropriate. With these mitigation measures in place, impacts would be less than significant.

Operations and Maintenance

Operations and maintenance of the detention basins would include excavation of sediment. However, because the area of the new detention basin will be completely graded and excavated during construction, special-status plants are not expected to be present during future operations and maintenance activities; therefore, no impacts on special-status plant species are expected from operations and maintenance.

Impact BIO-2—Result in disturbance or loss of sensitive natural communities, including riparian habitat

Summary by Project Element: Impact BIO-2—Result in disturbance or loss of riparian habitat		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than significant with mitigation	No Impact

Channel Widening Alternative

Construction

There are a total of 13 sensitive natural communities in the project area, which includes two wetland communities and two riparian communities. The wetland communities are addressed below under Impact BIO-3. Habitat along San Francisquito Creek and in adjacent areas could be impacted by the project. Substantial loss of sensitive natural communities and riparian habitat as a result of construction disturbance (earthwork, staging activities, foot traffic, vehicle traffic, etc.) could result in a significant impact on the species.

Riparian vegetation (valley oak riparian habitat) is found along the banks of San Francisquito Creek in Reaches 2 and 3 except where sack concrete walls or other bank armoring are currently found. There is some riparian vegetation (willows) in the channel as well. A temporary impact of 0.61 acre is expected due to vegetation removal in the channel and minor grading of the access ramps. This area will be revegetated. Additional tree impacts will occur at the Pope-Chaucer Bridge site and Site 2. These impacts are discussed below under Impact BIO-5.

Sensitive natural communities and riparian habitat will be protected to the maximum extent practicable during construction by implementation of MM-BIO-6, which would educate construction workers on sensitive habitat types, MM-BIO-7 would limit impacts on sensitive vegetation by fencing off sensitive habitat that is not within the project footprint, and MM-BIO-8 would restore any riparian habitat temporarily impacted. Revegetation of impacted areas could improve the quality and extent of riparian habitat in the project area by expanding areas of riparian growth, increasing the proportion of native species, and planting selected under- and over-story species to provide improved vertical structure and habitat complexity. A qualified restoration ecologist will develop a Habitat Management and Monitoring Plan (HMMP) in the context of the federal and state permitting processes under the Clean Water Act and California Fish and Game Code and would include success criteria as specified by the permitting agencies. With these mitigation measures the impact would be less than significant.

MM-BIO-6: Develop and implement worker awareness training

Prior to construction, a qualified biologist will conduct a Worker Awareness Training to inform construction project workers of their responsibilities regarding sensitive environmental resources. The training will include environmental education about the aquatic and terrestrial special-status species (steelhead trout, California red-legged frog, western pond turtle, pallid bat, hoary bat, Townsend's big-eared bat, nesting migratory birds and raptors, Bay checkerspot butterfly, California tiger salamander, Santa Cruz black salamander, California giant salamander, San Francisco dusky-footed woodrat, and western burrowing owl), as well as sensitive habitat (e.g., in-stream habitat, riparian habitat, wetlands, serpentine). The training will include visual aids to assist in identification of regulated biological resources, actions to take should protected wildlife be observed within the project area, and possible legal repercussions of impacting such regulated resources.

MM-BIO-7: Identify and protect sensitive habitats

To avoid unnecessary damage to or removal of sensitive habitat, the SFCJPA will retain a qualified biologist or ecologist to survey and demarcate sensitive habitat on or adjacent to the proposed areas of construction in San Francisquito Creek. Sensitive habitat not slated for trimming or removal to accommodate project construction will be protected from encroachment and damage during construction by installing temporary construction fencing to create a no-activity exclusion zone. Fencing will be brightly colored and highly visible and installed under the supervision of a qualified biologist to prevent damage to sensitive habitat during installation. The fencing will protect all potentially affected riparian habitat consistent with International Society of Arboriculture tree protection zone recommendations, to the extent possible, and any additional requirements of the resource agencies with jurisdiction over the project. Fencing will be installed before any site preparation or construction work begins and will remain in place for the duration of construction. Any sensitive vegetation will be trimmed with the approval of an International Society of Arboriculture certified arborist who will develop an approach to minimize stress and potential damage to trees and shrubs. Construction personnel will be prohibited from entering the exclusion zone for the duration of project construction. Access and surface-disturbing activities will be prohibited within the exclusion zone.

MM-BIO-8: Restore riparian habitat

The SFCJPA will restore any permanently affected riparian habitat at a mitigation-to-impact ratio of 2:1, and restoring temporarily affected habitat at a minimum impact-to-mitigation ratio of 1:1 to ensure no net loss of riparian habitat in the affected stream reaches. SFCJPA will carry out additional plantings outside of the construction areas above Pope Chaucer Bridge, from University Avenue west to the Stanford Shopping Center, and will carry out invasive plant removal downstream of University Avenue and upstream to Stanford Shopping Center (See Figure 3.3-4). The SFCJPA will develop an HMMP to ensure that all permanently affected or removed habitat is replaced “in kind” with the appropriate native overstory and understory species to maintain structural complexity and habitat value. The MMP will be developed in the context of the federal and state permitting processes under the CWA and the California Fish and Game Code and will include success criteria as specified by the permitting agencies. The HMMP will also include adaptive management guidelines for actions to be taken if the success criteria are not met. The initial annual monitoring will assess progress of the plantings according to predetermined success criteria. If progress is not satisfactory, adaptive management actions (including replanting, nonnative species removal, etc.) could be implemented. The HMMP will remain in force until the success criteria are met.

Operations and Maintenance

The project would create minimal maintenance needs which are similar to existing conditions. Vegetation monitoring and removal of invasive weeds for 3 years is not expected to result in new impacts on sensitive habitats. Further, ongoing maintenance will be performed through adherence to project mitigation measures and environmental commitments. Trash removal and maintenance of benches and landscaping in creekside parks would not affect sensitive vegetation. The impact would be less than significant.

Floodwalls Alternative

Construction

There are a total of 10 sensitive natural communities in the project area, which includes two wetland communities and two riparian communities. The wetland communities are addressed below under Impact BIO-3. Habitat along San Francisquito Creek and in adjacent areas could be impacted by the project. Substantial loss of sensitive natural communities and riparian habitat as a result of construction disturbance (earthwork, staging activities, foot traffic, vehicle traffic, etc.) could result in a significant impact on the habitat.

Construction of the floodwalls could temporarily impact 1.61 acres of riparian habitat (for excavation to build the walls) and permanently impact 0.167 acres (the footprint of the walls). Floodwalls would be constructed instead of channel widening (Channel Widening Alternative). Implementation of MM-BIO-6 would educate construction workers on sensitive habitat types, MM-BIO-7 would limit impacts to riparian vegetation by fencing off riparian habitat that is not within the project footprint, and MM-BIO-8 will restore any riparian habitat permanently impacted. With implementation of these mitigation measures the impact would be less than significant.

Operations and Maintenance

In addition to the operations and maintenance activities discussed under the Channel Widening Alternative, maintenance of the floodwalls would consist of visual inspections for any damaged concrete or exposed reinforcing bar, and if found, repairing the damaged concrete. Undermining would also be visually inspected and if found, backfilling or grouting would be done. The impact of these operations and maintenance activities would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

There are a total of 10 sensitive natural communities in the project area, which includes two wetland communities and two riparian communities that could be affected by the project. The wetland communities are addressed below under Impact BIO-3. Habitat along San Francisquito Creek and in adjacent areas could be impacted by the project. Substantial loss of wetlands and riparian habitat as a result of construction disturbance (earthwork, staging activities, foot traffic, vehicle traffic, etc.) could result in a significant impact on the communities.

The riparian impacts of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would be less than for the Channel Widening Alternative and Floodwalls Alternative, because the detention basin constructed under the Former Nursery Detention Basin Alternative or Webb Ranch Detention Basin Alternative would be excavated in annual grassland habitat. Riparian habitat is present at the Former Nursery site and the Webb Ranch site along San Francisquito Creek. A wetland delineation would be performed to determine if wetlands are present in or near the detention basins (see MM-BIO-11). The construction of the weir in San Francisquito Creek could affect riparian habitat. Implementation of MM-BIO-6 would inform construction workers on sensitive habitat types, MM-BIO-7 would reduce impacts to riparian vegetation by fencing off riparian habitat that is not within the project footprint, and MM-BIO-8 would restore any riparian habitat permanently impacted. With implementation of these mitigation measures the impact would be less than significant.

Operations and Maintenance

Operations and maintenance of the detention basin would include excavation of sediment when necessary and removal of instream vegetation near the weir. These activities are not expected to result in effects on sensitive vegetation. There would be no impact.

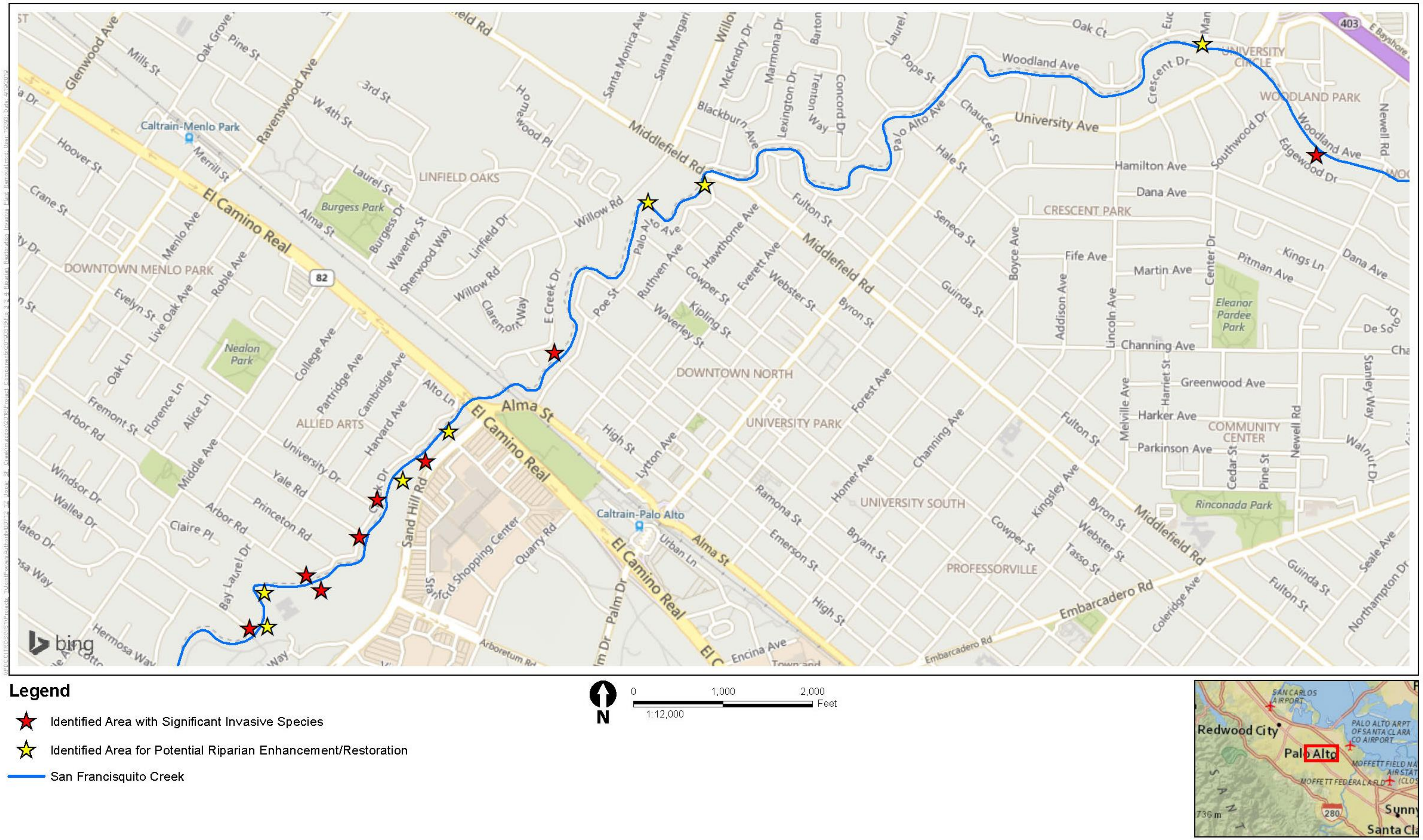

Figure 3.3-4 **Potential Habitat Restoration Sites**

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Impact BIO-3—Result in disturbance or loss of State- or Federally protected wetlands

Summary by Project Element: Impact BIO-3—Result in the disturbance or loss of State- or Federally protected wetlands		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	No Impact
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	No Impact

Channel Widening Alternative

Construction

All construction would occur within the channel of San Francisquito Creek or on the creek's banks. As discussed above, freshwater wetlands in the San Francisquito Creek occur sporadically and ephemerally as they change locations according to storm events and sediment deposition/mobilization. However, any wetlands present would be fenced and excluded before site preparation and construction activities begin, as discussed in MM-BIO-9. It is possible that heavy equipment (e.g., an excavator) working in the channel would not be able to completely avoid wetland habitats. The SFJPA will compensate for any wetlands impacted by project construction, as discussed in MM-BIO-10. The effect would be less than significant with implementation of MM-BIO-9 and MM-BIO-10.

MM-BIO-9: Avoid and protect jurisdictional wetlands during construction

The SFCJPA will ensure that a qualified resource specialist (biologist, ecologist, or soil scientist) clearly identifies wetland areas outside of the direct impact footprint with temporary orange construction fencing, before site preparation and construction activities begin at each site, or the qualified resources specialist will implement another suitable low-impact measure The resource specialist will use the wetland delineation mapping prepared for the proposed project and will confirm or modify the location of wetland boundaries based on existing conditions at the time of the survey. Exclusion fencing will be installed before construction activities are initiated, and the fencing will be maintained throughout the construction period. No construction activity, traffic, equipment, or materials will be permitted in fenced wetland areas.

MM-BIO-10: Compensate for loss of wetland habitat

If wetlands are affected by the construction activities, compensation will be at a 2:1 ratio for permanent impacts and at 1:1 ratio for temporary impacts. Restoration, creation, or enhancement of wetlands will either be off site or on site and will be detailed in the HMMP.

Operations and Maintenance

The project would have minimal in-channel maintenance needs. The primary maintenance activity would be debris removal after flooding events, which is similar to existing conditions. Vegetation monitoring and removal of invasive weeds in accordance with the MMP is not expected to result in impacts on wetland habitat. Further, ongoing maintenance would be performed through adherence to project environmental commitments. Trash removal and maintenance of benches and landscaping in creekside parks would not affect wetlands. Emergency maintenance may need to be performed during the life of the project but is not reasonably foreseeable and would be subject to separate approval. Operations and maintenance activities would have no impact on wetlands.

Floodwalls Alternative

Construction

Similar to the Channel Widening Alternative, wetlands would be fenced and avoided, as discussed in MM-BIO-9, and effects would be less than significant. However, due to the linear nature of the floodwalls, it may not be possible to avoid all wetlands. If wetlands are impacted then impacts would be reduced to less than significant with implementation of MM-BIO-10.

Operations and Maintenance

As described above for the Channel Widening Alternative, operations and maintenance activities would not impact wetland habitat.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

It is unknown if there would be wetland impacts from development of either one of the detention basins or the installation of a weir in San Francisquito Creek. A wetland delineation has not been conducted in these areas. A wetland delineation would be conducted prior to construction, as detailed in MM-BIO-11. If there are wetland impacts, **MM-BIO-10** would be implemented to compensate for loss of wetland habitat, reducing the impact to less than significant.

MM-BIO-11: Conduct a wetland delineation

A wetland delineation will be conducted for the project elements that were not included in the previous delineation of the project. The delineation will be conducted by a qualified wetland biologist according to the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (U.S. Army Corps of Engineers 2008). The results will be amended to the previous wetland delineation for verification by the USACE.

Operations and Maintenance

Operations and maintenance of the detention basins and weirs would not result in impacts to wetlands. Any wetlands at the detention basins would have already been impacted, and weir maintenance would not involve ground disturbance.

Impact BIO-4—Result in temporary or permanent changes to non-wetland waters of the US (intermittent drainage)

Summary by Project Element: Impact BIO-4—Result in temporary or permanent changes to waters of the US (intermittent drainage)		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant	No Impact

Channel Widening Alternative and Floodwalls Alternative

Construction

Heavy equipment working and being stored in the channel would impact the channel bottom by compacting the substrate. Additionally, in-channel vegetation may be removed to allow access for heavy equipment. Approximately 5.2 acres or 6,385 linear feet of intermittent drainage that are non-wetland waters of the US could be temporarily disturbed. It is expected that compacted areas would recover during flood events, disturbed areas would naturally revegetate, and the effect would be less than significant.

There would be a permanent impact on approximately 3,000 square feet of waters of the US due to rock slope protection placement and pile installation at the channel under and near the Pope-Chaucer Bridge. There would also be a decrease of channel shading due to demolition of Pope-Chaucer Bridge and an increase in channel width. There would be an additional 16,500 square feet of daylighted channel, including 143 linear feet of restored creek channel. An estimated 12,100 square feet of restored riparian will also be in the Pope Chaucer Bridge area under the Channel Widening Alternative.

As discussed in Impact HWR-3 in Section 3.8, *Hydrology and Water Resources*, construction-related disturbance from channel widening at Sites 1 through 5 and replacing Pope-Chaucer Bridge could result in increased delivery of sediment into surface waters depending on the location of the work. Increased sediment delivery could also occur as a result of erosion due to increased water velocity downstream of sites where flow capacity is increased (see Section 3.8).

These disturbances have potential to degrade habitat immediately in and adjacent to the project work sites. Sediment input could also degrade downstream habitat. The areas of principal concern are those that support habitat for native fish and amphibians.

However, as identified in Chapter 2, Section 2.8, implementation of MM-HWR-1 would involve development and implementation of an adaptive management plan to minimize erosion. Additionally, environmental commitments, general construction site housekeeping, water quality protection, and biological resources protection commitments would be implemented to protect water quality and biological resources during construction. Project construction work would also require development and implementation of a Storm Water Pollution Prevention Plan (SWPPP), providing further protection of habitats. These measures have been adopted as environmental commitments for the proposed project and are described in detail in Chapter 2. These commitments include measures that would:

- Minimize stormwater pollution through implementation of erosion control measures.
- Minimize entry of new sediment into the stream channel through proper stockpiling of sediments and otherwise preventing escape of sediments from street surfaces, truck loads, and other sediment sources.
- Remove material that could affect water quality that results from project operations from any location where it could reenter any waterway.
- Monitor turbidity and avoid increasing turbidity beyond stated thresholds.
- Ensure that all equipment maintenance (i.e., vehicle washing, refueling, equipment servicing) is done either offsite or outside the stream channel, unless equipment stationed in these locations cannot be readily relocated. If emergency repairs are required, containment would be provided.
- Prevent the accidental release of hazardous materials, chemicals, fuels, lubricants, and non-storm drainage water.
- Isolate work areas from surface flow through use of cofferdams.
- Manage groundwater, if high levels of groundwater are encountered at a project site.
- Avoid introduction of sanitary and septic waste into waterways.

With adherence to these environmental commitments and MM-HWR-1, the impact of construction on waters of the US would be less than significant.

Operations and Maintenance

As discussed in Impact HWR-3 in Section 3.8, channel widening and the new Pope Chaucer Bridge would increase downstream flows and likely increase velocities in Reach 2 and potentially increase erosion in areas that are already showing signs of erosion. This could increase sedimentation into San Francisquito Creek. However, with implementation of MM-HWR-1 (discussed in Section 3.8), which would require preparation of an Adaptive Management Plan to monitor creek flows for signs of increased erosion at 13 sites and identify and implement additional erosion control as needed, these effects would be minimized and reduced to less-than-significant. This adaptive management approach provides a framework for understanding the cause-and-effect linkages between project components and the erosion response of the system. The Adaptive Management Plan would identify management triggers that indicate when erosion control responses are required. Ongoing monitoring would determine the effectiveness of the adaptive management action.

Maintenance-related activities such as removing debris from the active channel during flood events could result in increased delivery of sediment into San Francisquito Creek depending on the location of the work. This disturbance has the potential to degrade habitat immediately adjacent to the maintenance site, which receives direct sediment input and could also degrade downstream habitat to the extent that fine sediment is carried downstream. This maintenance activity is presently taking place on San Francisquito Creek. Vegetation monitoring and removal of invasive weeds for 3 years is not expected to result in new impacts on instream habitat. Trash removal and maintenance of benches and landscaping in creekside parks would not affect instream habitat. Emergency maintenance may need to be performed during the life of the project but is not reasonably foreseeable and would be subject to separate approval. Further, ongoing maintenance would be performed through adherence to project environmental commitments.

With implementation of environmental commitments described above to protect water quality and MM-HWR-1, the impact would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Construction of the detention basins under these alternatives would be near San Francisquito Creek and a weir would be built in San Francisquito Creek to direct high flows into the detention basins. During construction of the weir there may be temporary and minor impacts to the waters of the US. However, the environmental commitments discussed above would be implemented to protect water quality and biological resources during construction. As such, these impacts would be less than significant.

Operations and Maintenance

Flows in the creek would be less during storm events if the weir is overtopped. This would result in a permanent change in flow downstream of the weir, but only during high flow events. Maintenance activities are not expected to result in impacts to non-wetland Waters of the US.

Impact BIO-5—Result in disturbance or loss of locally protected trees

Summary by Project Element: Impact BIO-5—Result in the disturbance or loss of locally protected trees		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	No Impact
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	No Impact

Channel Widening Alternative

Construction

The project site occurs within the jurisdiction of the City of Menlo Park's Heritage Tree Ordinance (Chapter 13.24, Menlo Park Municipal Code), the City of East Palo Alto's Development Code (Section 18.28.40) and the City of Palo Alto's Tree Preservation and Management Regulations (Title 8, Palo Alto Municipal Code).

Table 3.3-6 shows the trees that are expected to be removed at Site 2 (due to removal of the concrete structure and channel widening) and the Pope Chaucer Bridge site (due to excavation of fill material).

Table 3.3-6. Tree Impacts by Site and City

Site 2 (East Palo Alto)		Pope Chaucer Bridge Site (Palo Alto)		Pope Chaucer Bridge Site (Menlo Park)	
Species	**dbh (inches)**	**Species**	**dbh (inches)**	**Species**	**dbh (inches)**
Bay	60 (multi-stem)				
Buckeye	70 (multi-stem)				
Cedar	15				
Hackberry	14 (multi-stem)	Coast live oak	20	Red horse chestnut	12
Coast live oak	12	Coast live oak	18	Red horse chestnut	1
Coast live oak (3 trees)	15				
Coast live oak (2 trees)	24				
Coast live oak	32				
Coast live oak	16				
Coast live oak	17				
Coast live oak	30 (multi-stem)				
Madrone	12			Ginkgo	2
Oak (unknown spp.)	6	Red horse chestnut	4	Ginkgo	2
Redwood	14	Red horse chestnut	4	Magnolia	12
				Magnolia	6
				Magnolia	6
				Magnolia	6
				English Hawthorn	6

Creek widening and construction of Pope Chaucer Bridge will impact trees listed in the table above. Implementation of MM-BIO-12 will compensate for any tree removal by planting new trees in accordance with City tree ordinances. This will reduce the impact to less than significant.

Creekside parks and access ramps would occur in areas that were previously graded and do not contain mature trees. If protected trees are impacted during these construction activities, then implementation of MM-BIO-12 would reduce the impacts to less than significant through replacement.

At Sites 1, 3, 4, and 5, trees at the top of the bank in Palo Alto might need to be removed post-construction due to damage from soil nails and/or root damage caused by removing the sakrete and widening the bank adjacent to the trees. Fifteen large trees could possibly be affected by the widening. Eight blue gum trees (36 to 112 dbh), four coast live oaks (13 to 34 dbh), and three coast redwoods (35 to 48 dbh) will need to be monitored during construction activities to determine if roots will be damaged. Removal would be evaluated on a case-by-case basis to determine whether root damage can be avoided during construction (see MM-BIO-13). This is described in more detail in an arborist report that was prepared for the project (HortScience/Bartlett Consulting 2018). Implementation of MM-BIO-12 (compensate for removal of trees) and MM-BIO-13 would reduce impacts on protected trees to a less-than-significant level.

The use of heavy equipment and vehicles and stockpiling of excavated materials could inadvertently damage protected trees by directly cutting or injuring roots, compacting soil and reducing the tree's ability to take up water, or compromising the tree's structural integrity. Injuries to limbs or trunk can alter a tree's ability to transport water and nutrients. All of these effects can decrease a tree's chances of survival and could be significant. Implementation of MM-BIO-12 would reduce impacts on protected trees to a less-than-significant level through replacement.

MM-BIO-12: Compensate for loss of trees, consistent with applicable tree protection regulations

The cities of Palo Alto, East Palo Alto and Menlo Park do not permit removal of protected trees until a construction permit has been issued that ensures that tree loss would not conflict with tree ordinances/regulations. Each of these cities has its own specifications for calculating mitigation for tree impacts. A written permit is required to remove a protected tree. The project will compensate for permanent construction-related losses (removal or damage) of protected trees by replanting trees after completion of the construction activities. The compensatory ratios and planting locations will be confirmed through coordination with the SFCJPA and each City's regulations for the proposed project. The areas shown in Figure 3.3-4 have been identified as having potential for planting.

MM-BIO-13: Protect Trees from Construction Impacts

On the Palo Alto side of the creek in Sites 1, 3, 4 and 5, the following steps will be taken to reduce impacts on trees and maintain their health and vitality:

1. A licensed arborist selected by a panel of SFCJPA member agency representatives will be secured prior to construction. The Project Arborist will submit a tree protection plan for review prior to mobilization.
2. Construction superintendents will meet with the Project Arborist before beginning work to review all work procedures, access routes, storage areas, and tree protection measures.
3. The Project Arborist will monitor excavation and removal of sacked concrete as well as drilling for soil nails within 25 feet of trees.

4. If roots 2 inches and greater in diameter are encountered during site work and must be cut to complete the construction, the Project Arborist must be consulted to evaluate effects on the health and stability of the tree and recommend treatment.
5. Sacked concrete within 25 feet of trees will be removed with equipment that will minimize damage to trees above and below ground, and that can be operated from outside the dripline of the trees.
6. If injury should occur to any tree during construction, the tree will be evaluated as soon as possible by the Project Arborist so that appropriate treatments can be applied. Additional compensation in the form of mitigation planting will be considered if treatments cannot fully mitigate damages to protected trees.
7. No excess soil, chemicals, debris, equipment or other materials will be dumped or stored within the dripline of any trees.
8. Any additional tree pruning needed for clearance during construction must be performed by a Certified Arborist and not by construction personnel.

The Project Arborist may conclude that a tree(s) should be removed because it could be damaged to an extent that would pose a safety hazard to people or nearby structures. If a tree is removed, its removal will be mitigated as provided by MM-BIO-12.

Operations and Maintenance

The project would create minimal in-channel maintenance needs, with debris removal after flooding events the primary maintenance activity, which is similar to existing conditions. Vegetation monitoring and removal of invasive weeds for 3 years is not expected to result in new impacts on trees. Further, ongoing maintenance would be performed through adherence to project environmental commitments. Trash removal and maintenance of benches and landscaping in creekside parks would not affect trees. There would be no impact on protected trees during operation or maintenance.

Floodwalls Alternative

Construction

Construction of the floodwalls could impact approximately 80 protected trees. The linear nature of floodwalls at the top of the bank would make it difficult and in some cases impossible to avoid tree impacts. Implementation of MM-BIO-12 would replace any protected trees that are lost or damaged and MM-BIO-13 would require a certified arborist to be present during construction of the floodwalls to assess damage to trees. With implementation of these mitigation measures, the impact would be less than significant.

Operations and Maintenance

Disturbance or loss of protected trees would not occur during operations and maintenance. No protected trees are expected to be disturbed from these activities and there would be no impact.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Construction of the detention basin would not require removal of trees. However, construction of the weir on San Francisquito Creek may require tree removal. Implementation of MM-BIO-12 would replace any lost or damaged trees and reduce the impact to less than significant. If trees are close to construction of the weir and may be impacted indirectly by construction, MM-BIO-13 will be implemented to assess tree damage during construction.

Operations and Maintenance

No loss of or damage to protected trees is expected from operations and maintenance of the detention basin or weir. There would be no impact.

Impact BIO-6—Result in effects on steelhead trout and suitable habitat

Summary by Project Element: Impact BIO-6—Result in effects on steelhead trout and suitable habitat		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant

Central California Coast steelhead was listed as threatened by NOAA Fisheries Service on August 18, 1997 (62 *Federal Register* [FR] 43938). There is no state status. Central California Coast steelhead includes populations from the Russian River to Aptos Creek and the drainages of San Francisco and San Pablo Bays eastward to the Napa River. Passage barriers, water diversions, and overall habitat degradation have reduced steelhead populations not only in Santa Clara Basin streams, but also throughout California and the West. Reproducing populations are known to exist in Coyote Creek, Guadalupe River, Stevens Creek, and San Francisquito Creek.

Steelhead is the only special-status fish species known to have been historically present in Peninsula watersheds, including San Francisquito Creek. While the present-day hydrology of the San Francisquito Creek watershed has been highly altered, the creek still supports an anadromous run of steelhead up to Searsville Dam, which is the only complete migration barrier in the watershed.

Additionally, critical habitat was designated for Central California Coast steelhead by NMFS (70 FR 52570, September 2, 2005) in the project area. San Francisquito Creek is included in the Santa Clara Hydrologic Unit. The value of the section of the San Francisquito Creek in the project area is one of rearing and migration and possibly spawning due to some gravel being present in the channel. However, the portion of the creek that is within the project area only has flows during large precipitation events and is flashy. High flows would scour out redds and eggs and also transport sediment (i.e., sand) downstream. Because this portion of the creek is dry in the summer and fall, it does not provide juvenile rearing habitat throughout the year.

Channel Widening Alternative

Construction

Steelhead are known to occur within San Francisquito Creek year-round, with adults migrating and juveniles emigrating through Reaches 1 and 2 during the winter and spring months. Juveniles are unlikely to be rearing in Reach 2 because the channel is typically dry once precipitation ends in the spring. Construction activities for each project element in the Channel Widening Alternative would occur in and near suitable habitat for steelhead and could disturb any individuals that are be present in San Francisquito Creek. Water quality impacts, noise impacts, and habitat disturbance from channel widening, the demolition of the existing Pope Chaucer Bridge, and pile driving for the new Pope Chaucer Bridge could all have an effect on steelhead and their habitat. Additionally, rock slope protection would be placed in the stream channel under the Pope Chaucer Bridge and on the banks around the new bridge.

Together, these activities would have a significant impact. However, steelhead would be protected during construction by implementing MM-BIO-14, MM-BIO-15, MM-BIO-16, and MM-BIO-17. These include restricting construction to the dry season, decreasing pile driving noise, evaluating the stream and native aquatic vertebrates to determine if they are present, and relocating individuals as appropriate. Further, implementation of MM-BIO-6 would inform workers on how to identify steelhead. Implementation of all these mitigation measures will reduce impacts to a less-than-significant level.

Water Quality

Construction-related ground disturbance could result in increased delivery of sediment into San Francisquito Creek, depending on the location of the work. This disturbance has potential to degrade habitat immediately adjacent to the work site, which receives direct sediment input, and could also degrade downstream habitat to the extent that fine sediment is carried downstream. In both cases, the areas of principal concern are those that support habitat for native fish and amphibians.

High concentrations of suspended sediment can have both direct and indirect effects. The severity of these effects depends on the sediment concentration, duration of exposure, and sensitivity of the affected life stage. Short-term increases in turbidity and suspended sediment could disrupt feeding activities or result in avoidance or displacement of fish from preferred habitat. Chronic exposure to high turbidity and suspended sediment could also affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995).

Valley Water routinely implements comprehensive BMPs to protect water quality during construction. Project construction work would also require implementation of a SWPPP, providing further water quality protection. These BMPs have been adopted as environmental commitments for the proposed project, described in detail in Chapter 2. These commitments include measures that would:

- Minimize stormwater pollution through implementation of erosion control measures.
- Minimize entry of new sediment into the stream channel through proper stockpiling of sediments and otherwise preventing escape of sediments from street surfaces, truck loads, and other sediment sources.

- Remove material that could affect water quality that results from project operations from any location where it could reenter any waterway.
- Monitor turbidity and avoid increasing turbidity beyond stated thresholds.
- Ensure that all equipment maintenance (i.e., vehicle washing, refueling, equipment servicing) is done either offsite or outside the stream channel, unless equipment stationed in these locations cannot be readily relocated. If emergency repairs are required, containment would be provided.
- Prevent the accidental release of hazardous materials, chemicals, fuels, lubricants, and non-storm drainage water.
- Isolate work areas from tidal flow through use of cofferdams.
- Manage groundwater, if high levels of groundwater are encountered at a project site.

With adherence to these environmental commitments, the impact would be less than significant with mitigation.

Noise and Disturbance Including from Pile Driving

Among the construction activities likely to generate noise, the use of impact hammers for pile installation or demolition of the existing bridge poses the greatest risk to fish because the levels of underwater noise produced by impulsive types of sounds can reach levels of sufficient intensity to injure or kill fish (Popper and Hastings 2009). Other pile driving methods such as vibratory, oscillatory, and drilling methods generally produce more continuous, lower energy sounds below the thresholds associated with injury. There are currently no established noise thresholds associated with continuous sound waves, and vibratory and oscillation methods are generally considered effective measures for avoiding or minimizing the risk of injury of fish from pile driving noise.

Pile driving and other sources of anthropogenic noise have the potential to adversely affect fish through a broad range of behavioral, physiological, or physical effects (Popper and Hastings 2009). These effects may include behavioral responses, physiological stress, temporary and permanent hearing loss, tissue damage (auditory and non-auditory), and direct mortality depending on the intensity and duration of exposure. In salmonids and other fish species, the presence of a swim bladder to maintain buoyancy increases their vulnerability to direct physical injury (i.e., tissue and organ damage) from underwater noise (Hastings and Popper 2005). Underwater noise may also damage hearing organs and temporarily affect hearing sensitivity, communication, and ability to detect predators or prey (Popper and Hastings 2009). Underwater noise may also cause behavioral effects (e.g., startle or avoidance responses) that can disrupt or alter normal activities (e.g., migration, holding, or feeding) or expose individuals to increased predation (Voellmy et al. 2014).

Pile driving noise has received increasing attention in recent years because of its potential to cause direct injury or mortality of fish and other aquatic animals. Factors that may influence the magnitude of effects include species, life stage, and size of fish; type and size of pile and hammer; frequency and duration of pile driving; site characteristics (e.g., water depth); and distance of fish from the source. Dual interim criteria representing the acoustic thresholds associated with the onset of physiological effects in fish have been established to provide guidance for assessing the potential for injury resulting from pile driving noise (Fisheries Hydroacoustic Working Group 2008) (Table 3.3-7). These criteria have been established for impact pile driving only.

Table 3.3-7. Interim Criteria for Assessing the Potential for Injury to Fish from Pile Driving Activities

Interim Criteria	Agreement in Principle
Peak Sound Pressure Level (SPL)	206 dB re: 1µPa (for all sizes of fish)
Cumulative Sound Exposure Level (SEL)	187 dB re: 1µPa2-sec (for fish ≥ 2 grams) 183 dB re: 1µPa2-sec (for fish < 2 grams)

Source: Fisheries Hydroacoustic Working Group 2008.
SPL = sound pressure level
SEL = sound exposure level
dB = decibel
µPa = micropascal

The dual criteria are (1) 206 decibels (dB) for peak sound pressure level (SPL); and (2) 187 dB for cumulative sound exposure level (SEL) for fish larger than 2 grams, and 183 dB SEL for fish smaller than 2 grams. The peak SPL threshold is considered the maximum sound pressure level a fish can receive from a single strike without injury. The cumulative SEL threshold is considered the total amount of acoustic energy that a fish can receive from single or multiple strikes without injury. The cumulative SEL threshold is based on the total daily exposure of a fish to noise from sources that are discontinuous (in this case, noise that occurs for up to 12 hours a day, with 12 hours between exposures). This assumes that fish are able to recover from any effects during this 12-hour period between exposures.

In the following analysis, the potential for injury to fish from exposure to pile driving sounds was evaluated using a spreadsheet model developed by NMFS to calculate the distances from the pile that sound attenuates to the peak or cumulative criteria. These distances define the area in which the criteria are expected to be exceeded as a result of impact pile driving. The NMFS spreadsheet calculates these distances based on estimates of the single-strike sound levels for each pile type (measured at 10 meters [33 feet] from the pile) and the rate at which sound attenuates with distance. In the following analysis, the standard sound attenuation rate of 4.5 dB per doubling of distance was used in the absence of other data. To account for the exposure of fish to multiple pile driving strikes, the model computes a cumulative SEL for multiple strikes based on the single-strike SEL and the number of strikes per day or pile driving event. The NMFS spreadsheet also employs the concept of "effective quiet." This assumes that cumulative exposure of fish to pile driving sounds of less than 150 dB SEL does not result in injury. Insufficient data is currently available to support the establishment of a noise threshold for behavioral effects (Popper et al. 2006). For consultation purposes, NMFS generally assumes that a noise level of 150 dB root mean square (RMS) is an appropriate threshold for behavioral effects.

Where impact driving is proposed in open water, computations were also performed to evaluate the potential effect of an attenuation device (e.g., bubble curtain) on the distances to the injury thresholds. The amount of noise reduction from attenuation devices depends on numerous factors, including water depth and flow, and attenuation type, design, and deployment. For assessment purposes, the standard practice is to assume between 5 dB and 10 dB reduction from attenuation. However, because precise site conditions where the piles would be installed are unknown, it is difficult to predict the effectiveness of an attenuation device. For this reason, it was assumed that a maximum of 5 dB reduction could be achieved with implementation of an attenuation system for the piles that would be impact driven in open water.

Table 3.3-8 presents the location, number of piles, strikes per day, and distances to the injury and behavioral thresholds for the pile driving activities. The reference levels used in the following analysis were selected from data compiled from past projects with similar pile driving operations and site characteristics. The peak level represents the maximum reported noise level. The single-strike SELs and RMS levels represent noise levels from a typical pile strike; typical pile strike levels are developed by averaging a range of data collected from past projects. The computation of cumulative SELs is based on the maximum number of piles that can reasonably be installed in one day and the estimated number of strikes required to drive each pile. Based on uncertainties in site conditions potentially encountered during pile driving operations (e.g., bed resistance), it is assumed that approximately half the length of each pile can be installed using vibratory pile driving, with impact driving used to drive the remaining half. The computed distances over which pile driving sounds are expected to exceed the injury and behavioral thresholds assume an unimpeded sound propagation path. However, site conditions such as shallow water, major channel bends, and other in-water structures can reduce these distances by impeding the propagation of underwater sound waves.

Table 3.3-8. Estimated Distances to Injury and Behavioral Thresholds for Impact Driving of 16-inch Steel Piles (Pier at Toe-of-Bank and Abutment at Top-of-Bank)

Location	Number of Piles	Number of Piles per Day	Number of Strikes per Day	Distance to 206 dB Peak Criteria (meters)	Distance to 187 dB Cumulative SEL Criteria (meters)	Distance to 183 dB Cumulative SEL Criteria (meters)	Distance to 150 dB RMS Criteria (meters)
Pier at toe-of-bank (without attenuation)	46	6	4,500	14	504	541	2,929
Pier at toe-of-bank (with bubble curtain)[1]	46	6	4,500	<10	234	251	1,359
Abutment at top-of-bank (on land)	32	6	4,500	<10	234	251	1,585

[1]A bubble curtain may not be feasible in very shallow water (less than 1 meter deep). If a bubble curtain is feasible noise reduction of 5 dB is assumed.

Based on the distance of the piles to the OHWM and measured sound levels associated with similar pile driving operations, the predicted sound levels produced by impact driving are not expected to exceed the single-strike SPL of 206 dB except without attenuation (Table 3.3-8).

The distances shown in Table 3.3-8 are for unimpeded open water conditions. Noise propagation in rivers is limited by the sinuosity of a system. For example, where a river bends, noise is unlikely to propagate. A line-of-sight rule, meaning that noise may propagate into any area that is within line-of-sight of the noise source, is used to determine the extent of noise propagation in river systems (WSDOT 2018). The first significant bend downstream occurs at about 540 feet (165 meters) and the first significant upstream bend occurs at about 430 feet (131 meters). Adverse effects on fish are assumed to be limited to these distances. Cumulative SELs exceeding the 187dB injury threshold (≥ 2 gram fish) are predicted to occur within a radius of 165 meters downstream and 131 meters upstream from the source piles, and cumulative SELs exceeding the 183 dB threshold (< 2 gram fish) are predicted to occur within the same radius due to the bends in San Francisquito Creek in the project area. The predicted sound levels produced by impact driving of the piers and abutment are expected to exceed the 150 dB RMS behavioral threshold within 1,359 and 2,929 meters of the source piles, although channel geometry would likely limit the extent of these effects.

MM-BIO-14 limits the timing of pile installation for the piers and abutments (June 1–October 15) to avoid overlap with adult and juvenile steelhead migration and MM-BIO-15 reduces pile driving noise. Implementation of MM-BIO-14 and MM-BIO-15 would reduce this impact to less than significant.

MM-BIO-14: Limit in-channel and stream bank construction to the dry season

No in-channel stream bank construction activities will occur during the steelhead migration period, from October 1 through April 30, to reduce the likelihood that steelhead are present during construction activities. This timing will also limit any excess sedimentation and runoff from entering the San Francisquito Creek.

MM-BIO-15: Reduce pile-driving noise for protection of fish

If surface water is present in the channel in or near the Pope Chaucer bridge footprint three days before commencement of pile driving, SFCJPA will develop an underwater noise monitoring and attenuation plan and obtain approval of the plan from NMFS prior to the start of construction. If there is no surface water present in or near the Pope Chaucer bridge footprint, an underwater monitoring and attenuation plan is not necessary.

The plan will provide details regarding the estimated underwater sound levels expected, sound attenuation methods, methods used to monitor and verify sound levels during pile-driving activities, and management practices to be taken to reduce pile-driving sound in the project area to below NMFS thresholds for injury to fish, as feasible. The plan will incorporate, but is not limited to, the following BMPs:

- All steel pilings will be installed with a vibratory pile driver to the deepest depth practicable. An impact pile driver may be used only where necessary to complete installation of the steel pilings, in accordance with seismic safety or other engineering criteria.
- The smallest pile driver and minimum force necessary will be used to complete the work.
- The hammer will be cushioned using a 12-inch-thick wood block during all impact hammer pile-driving operations.
- During impact pile driving, the contractor will limit the number of strikes per day to the minimum necessary to complete the work.
- No pile driving will occur at night.

Habitat Removal and Disturbance

Critical habitat for Central California coast steelhead is designated in Reaches 1, 2 and 3. Within Reach 2, riparian vegetation would be removed as necessary for the new Pope Chaucer Bridge, access roads, channel widening, and equipment access. Hydraulic changes would occur due to widening of the creek channel and installation of piles in the channel for the new bridge. There would also be the addition of rock slope protection at Pope Chaucer Bridge underneath the bridge and on the banks of the channel. MM-BIO-8 would mitigate the losses of riparian vegetation by planting riparian vegetation, thereby compensating for the loss of habitat and reducing this impact to less than significant.

Stranding

Stranding could occur during cofferdam dewatering or channel dewatering if surface water is present in the channel. Implementation of MM-BIO-16 and MM-BIO-17 would reduce the impact to less than significant.

MM-BIO-16: Implement avoidance measures for aquatic vertebrates prior to construction activities

This measure will avoid or minimize impacts on native aquatic vertebrates (fish, amphibians, and reptiles). Native aquatic vertebrates may or may not be able to rapidly recolonize a stream reach if the population is eliminated from that stream reach. If native aquatic vertebrates are present when cofferdams, water bypass structures, and silt barriers are to be installed, an evaluation of the stream and the native aquatic vertebrates will be conducted by a qualified biologist. The qualified biologist will consider:

- Native aquatic species present at the site.
- The ability of the species to naturally recolonize the stream reach.
- The life stages of the native aquatic vertebrates present.
- The flow, depth, topography, substrate, chemistry, and temperature of the stream reach.
- The feasibility of relocating the aquatic species present.
- The likelihood the stream reach will naturally dry up during the work season.

Based on consideration of these factors, the qualified biologist may decide to relocate native aquatic vertebrates during construction. The qualified biologist will document in writing the reasons to relocate native aquatic species, or not to relocate native aquatic species, prior to installation of cofferdams, water bypass structures, or silt barriers.

MM-BIO-17: Implement fish relocation activities prior to construction

A qualified fisheries biologist will survey the construction area 1 to 2 days before the project begins. If no surface water is present in the immediate construction area, fish will not be relocated. If water is present, the following procedures will be implemented:

- Before a work area is dewatered, fish will be captured and relocated to avoid injury and mortality and minimize disturbance.
- Before fish relocation begins, a qualified fisheries biologist will identify the most appropriate release location(s). Release locations should have water temperatures similar to the capture location and offer ample habitat for released fish, and should be selected to minimize the likelihood that fish will reenter the work area or become impinged on the

exclusion net or screen. At this time the open reach below the project site is anticipated to have suitable conditions for relocation.

- Seining or dip netting will be utilized to keep stress and injury to fish at a minimum.
- To the extent feasible, relocation will be performed during morning periods. Water temperatures will be measured periodically, and relocation activities will be suspended if water temperature exceeds 18^{0}C.
- Handling of salmonids will be minimized. When necessary, personnel will wet hands or nets before touching fish.
- Fish will be held temporarily in cool, shaded water in a container with a lid. Overcrowding in containers will be avoided. Fish will be relocated promptly. If water temperature within the container reaches or exceeds NMFS limits, fish will be released and relocation operations will cease.
- If fish are abundant, capture will cease periodically to allow release and minimize the time fish spend in holding containers.
- Fish will not be anesthetized or measured. However, they will be visually identified to species level, and year classes will be estimated and recorded.
- Reports on fish relocation activities will be submitted to CDFW and NMFS within 30 days of completion of the relocation activities.
- If mortality during relocation exceeds 5% or mortality of any State or Federal listed species occurs, relocation will cease and CDFW and NMFS will be contacted immediately or as soon as feasible.
- Fish relocation efforts will be performed concurrent with the installation of the diversion and will be completed before the channel is fully dewatered. The fisheries biologist will perform a second survey 1 to 2 days following the installation of the diversion to ensure that fish have been excluded from the work area and spot checks will be performed at least biweekly while the diversion is in place.

Operations and Maintenance

The replacement of the Pope Chaucer Bridge would daylight 16,500 square feet of channel, including 143 linear feet of restored creek channel that is currently a culvert with a cement bottom and which constricts flows. Riparian vegetation will be planted to restore 12,100 square feet of habitat that is currently concrete, and instream habitat will also be created for juvenile steelhead. Additionally, there will be aquatic habitat enhancement areas that will consist of three pool/riffle features along the restored channel at Pope-Chaucer Bridge and six velocity refuge features along widened reaches (rootwad or rock spur).

The aquatic habitat enhancement areas created would provide areas of refuge for aquatic species, specifically juvenile steelhead. This would be a beneficial impact on juvenile steelhead. Maintenance of the aquatic habitat enhancement areas may be needed if large woody material, boulders, or other features move or become dislodged during high flows. This could cause an increase in sediment delivery into San Francisquito Creek. The same project environmental commitments for construction would be implemented during operations and maintenance activities to avoid increased sediment input into San Francisquito Creek.

As discussed in Impact HWR-3 in Section 3.8, maintenance-related activities such as removing debris from the active channel during or after flood events could result in increased delivery of sediment into San Francisquito Creek depending on the location of the work. This disturbance has the potential to degrade habitat immediately adjacent to the project work site, which would receive direct sediment input, and could also degrade downstream habitat. This maintenance activity is presently taking place on San Francisquito Creek and typically only occurs during and after flooding events, so is rare. Vegetation monitoring and removal of invasive weeds for 3 years is not expected to result in new impacts on instream habitat. Trash removal and maintenance of benches and landscaping in creekside parks would not affect instream habitat. Emergency maintenance may need to be performed during the life of the project but is not reasonably foreseeable and would be subject to separate approval. Further, ongoing maintenance would be performed through adherence to project environmental commitments for water quality. The impact of operations and maintenance for the Channel Widening Alternative would be less than significant.

Floodwalls Alternative

Construction

Effects on steelhead and habitat discussed under the Channel Widening Alternative would be similar for the Floodwalls Alternative. Channel widening would not occur, but bank and stream substrate would still be disturbed due to staging and heavy equipment occurring and operating in the channel. Floodwalls would be constructed along the channel continuously and have greater potential for disturbance along the bank and instream channel. Implementation of mitigation measures as described for the Channel Widening Alternative would reduce the impact to less than significant.

Operations and Maintenance

Operations and maintenance impacts on steelhead and steelhead habitat would be the same as those discussed under the Channel Widening Alternative. In addition, maintenance of the floodwalls would consist of visual inspections for any damaged concrete or exposed reinforcing bar, and if found, repairing the damaged concrete. Undermining would also be visually inspected and if found, backfilling or grouting would be done. If additional concrete or grouting is needed, construction environmental commitments to protect water quality that would keep contaminants out of the creek would be implemented. The impact would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Construction of the detention basins is not likely to have any direct impacts on San Francisquito Creek or steelhead. However, construction of a weir in San Francisquito Creek could cause sedimentation and contaminant releases into the creek, which can be harmful to steelhead. Spawning habitat is available in Reach 3, and excessive sedimentation can smother eggs. Water quality protection environmental commitments would be implemented and protect water quality. If cofferdams need to be constructed to divert flow, however, fish could become stranded. Implementation of MM-BIO-14 would restrict construction to the dry season, and MM-BIO-17 would relocate fish if surface water is present. These mitigation measures would reduce this impact to less than significant.

Operations and Maintenance

During high flow events, fish could enter the detention basins and become trapped. Water quality would decrease over time and fish could die, or they could be removed with excess sediment during maintenance activities. To prevent this, a fish exclusion device would be installed at the weir in order to prevent fish from becoming trapped in the detention basin. The screen would be constructed using current NMFS guidelines for fish screens. Because flooding would rarely occur and the weir would be screened, this impact would be less than significant.

Impact BIO-7—Result in effects on California red-legged frog and habitat

Summary by Project Element: Impact BIO-7—Result in effects on California red-legged frog and habitat		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation

The California red-legged frog (*Rana draytonii*) is listed as threatened under the ESA and is a California species of special concern. The project area does not include critical habitat nor is it adjacent to critical habitat for this species. The California red-legged frog breeds in lowland and foothill streams and wetlands, including livestock ponds. It may also be found in upland habitats near breeding areas and along intermittent drainages connecting wetlands.

Channel Widening Alternative

Construction

California red-legged frogs could be directly affected by construction activities occurring in or adjacent to the project area. If California red-legged frogs are present within the construction work area, they could be inadvertently killed or wounded by construction vehicles, construction personnel, and accidental spill of toxic fluids (e.g., gasoline and other petroleum-based products). If California red-legged frogs must be captured and relocated outside the construction work area, they could be exposed to increased risk of disease, predation, stress, and competition that could result in increased mortality and/or reduced fitness.

Construction activities associated with channel widening and bridge construction in potential California red-legged frog habitat in the project area could result in indirect effects on water quality downstream from the construction work area. Increased sedimentation could reduce the suitability of California red-legged frog habitat downstream of the construction areas by filling in pools and smothering eggs. Accidental spills of toxic fluids also could result in the subsequent mortality of California red-legged frogs if these substances flow downstream from the construction area and frogs are present.

California red-legged frogs have been observed on the north side of the lower end of San Francisquito Creek. It is likely the urbanized area of the lower reaches would preclude red-legged frogs from moving in and out of San Francisquito Creek and occurring in the lower reaches. However, implementation of project environmental commitments to protect water quality would lessen the possible impacts on California red-legged frogs if they were found in the project site. MM-BIO-6 would inform workers of red-legged presence in the creek (California red-legged frog awareness would be included in the preconstruction worker awareness training required for all construction personnel). In addition, implementation of MM-BIO-16 and MM-BIO-18 would determine presence or absence of red-legged frogs and result in avoidance if red-legged frogs are present. These mitigation measures would reduce impacts to less than significant.

MM-BIO-18: Implement survey and avoidance measures for California red-legged frog prior to construction activities

SFCJPA will retain a qualified biologist to conduct a survey of the project sites and surrounding upland habitat prior to initiation of construction activities. The surveys will be conducted according to applicable protocols and will be performed during optimal observation periods of the day when detection potential for these species is maximized. The surveys will be conducted prior to initiation of construction, but such that enough time is allowed to coordinate with USFWS and CDFW to develop a species avoidance plan if needed. If California red-legged frog are observed or heard during the surveys, proposed project activities within 500 feet of the observation will be postponed. A species avoidance plan will be developed in coordination with USFWS and CDFW and implemented during construction and maintenance. If no individuals are observed during the surveys, no further action will be necessary.

Operations and Maintenance

As described under steelhead Operations and Maintenance, the aquatic habitat enhancement areas would create areas of refuge for steelhead, but may be beneficial for red-legged frogs. Maintenance of the aquatic habitat enhancement areas may be needed if large woody material, boulders or other features move or become dislodged during high flows. This could cause an increase in sediment delivery into San Francisquito Creek. Project environmental commitments for water quality would be implemented to avoid increased sediment input into San Francisquito Creek.

As discussed in Impact HWR-3 in Section 3.8, maintenance-related activities such as removing debris from the active channel during flood events could result in increased delivery of sediment into San Francisquito Creek depending on the location of the work. This disturbance has the potential to degrade habitat immediately adjacent to the project work site, which receives direct sediment input and could also degrade downstream habitat to the extent that fine sediment is carried downstream. This maintenance activity is presently taking place on San Francisquito Creek. Vegetation monitoring and removal of invasive weeds for 3 years is not expected to result in new impacts on aquatic habitat. Trash removal and maintenance of benches and landscaping in creekside parks would not affect aquatic or bank habitat. Emergency maintenance may need to be performed during the life of the project, but is not reasonably foreseeable and would be subject to separate approval. Further, ongoing maintenance would be performed through adherence to project environmental commitments. There would be no new impact.

Floodwalls Alternative

Construction

Effects on California red-legged frog and habitat discussed under the Channel Widening Alternative would be the same for this alternative. Floodwalls would be constructed instead of channel widening, but bank and stream substrate would still be disturbed. Impacts on individuals and habitat would be the same from construction and operations and maintenance activities. Implementation of mitigation measures as described for the Channel Widening Alternative would reduce the impact to less than significant.

Operations and Maintenance

In addition to the operations and maintenance activities discussed under the Channel Widening Alternative, maintenance of the floodwalls would consist of visual inspections for any damaged concrete or exposed reinforcing bar, and if found, repairing the damaged concrete. Undermining would also be visually inspected and if found, backfilling or grouting would be done. If additional concrete or grouting is needed, environmental commitments to protect water quality would keep contaminants out of the creek. Operations and maintenance impacts would be the same as under the Channel Widening Alternative, less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

California red-legged frogs (adults and larvae) have been observed in San Francisquito Creek near the proposed detention basin sites until 2007 (CDFW 2018) and have also been observed at Stanford University property within 2 miles of the project site (Stanford University 2013). Due to the ponds on Stanford property and sightings in San Francisquito Creek, habitat is appropriate for red-legged frog even if they have not been observed in recent years.

Construction

California red-legged frogs could be directly affected by construction activities occurring in or adjacent to the project area. If California red-legged frogs are present within the detention basin and/or weir construction work areas, they could be inadvertently killed or wounded by construction vehicles, construction personnel, and accidental spill of toxic fluids (e.g., gasoline and other petroleum-based products). If California red-legged frogs must be captured and relocated outside the construction work area, they could be exposed to increased risk of disease, predation, stress, and competition that could result in increased mortality and/or reduced fitness. Habitat could be affected by excavation of the detention ponds and construction of the weir. Implementation of MM-BIO-18 would reduce the impacts to less than significant.

If either of these alternatives (Former Nursery Detention Basin Alternative, Webb Ranch Detention Basin Alternative) are selected to move forward, a detailed habitat assessment would be conducted by a qualified biologist familiar with California red-legged frog habitat to determine if there would be any effects on habitat.

Operations and Maintenance

Construction of a detention basin that holds water temporarily may attract California red-legged frog during the rainy season and for breeding. The detention basins would need to be dredged to keep sediment from building up. If California red-legged frogs lay eggs in the detention basins, adults, larvae, and/or eggs would be killed if they are extracted with sediment. MM-BIO-15 would ensure no California red-legged frogs enter the detention basins and reduce the impact to less than significant.

MM-BIO-19: Prevent California red-legged frog and other amphibians and reptiles from entering the detention basin

SFCJPA will construct an impermeable fence around the detention basins so no California red-legged frog, Santa Cruz black salamander, California giant salamander, western pond turtle, and California tiger salamander can access the detention basin. The fence will be checked monthly during the rainy season (October to April) to ensure no California red-legged frog can access the basin and before any sedimentation is removed from the basin to ensure no red-legged frogs or other species such as pond turtles, California tiger salamander, or other salamander species are present in the basin. This would continue into perpetuity.

Impact BIO-8—Result in effects on western pond turtle and habitat

Summary by Project Element: Impact BIO-8—Result in effects on western pond turtle and habitat		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation

Western pond turtle is designated as a state species of special concern. Western pond turtles prefer the calm waters of ponds, reservoirs, and sluggish streams. The species occurs in a wide range of both permanent and intermittent aquatic environments. Western pond turtles also spend time in upland habitats during the spring and summer, frequently moving between aquatic and upland habitats. Western pond turtle could use San Francisquito Creek and its banks as habitat.

Channel Widening Alternative

Construction

San Francisquito Creek in the project area contains habitat for western pond turtle. Lower San Francisquito Creek, outside of the tidal zone with freshwater, is mainly pools and runs which would provide habitat. Because suitable aquatic habitat for western pond turtles is present within the project sites, pond turtles could be affected by the proposed project. Western pond turtles are very sensitive to disturbances and quickly retreat into the water when threatened. If pond turtles are present in the creek channel or along the creek bank during the construction period, they could be injured or killed during construction.

In the project area, channel widening, clearing of access ramps, heavy equipment in the channel, and replacement of Pope Chaucer Bridge have the potential to disturb upland and aquatic habitat adjacent to and in San Francisquito Creek and could result in the loss of individuals or nests; this potential for disturbance and loss would represent a significant impact.

Implementation of MM-BIO-6 would educate construction workers of pond turtle presence in the creek (western pond turtle awareness would be included in the preconstruction worker awareness training required for all construction personnel) and implementation of MM-BIO-20 would detect and relocate pond turtles as necessary. This impact would be less than significant.

MM-BIO-20: Conduct preconstruction surveys for western pond turtles; relocate if needed.

A qualified biologist will examine the project footprint for western pond turtles and their nests within 14 days of project activities beginning and during any initial removal of vegetation, woody debris, or trees, or other initial ground-disturbing activities. If a western pond turtle(s) is observed at any time within the project footprint and can be injured by project activities, all activities will cease. If western pond turtles are determined to be absent from the project footprint, no further action will be required with regard to this species. If any western pond turtles are found within the project footprint, whenever possible, construction work in their vicinity will be avoided until they have moved outside of the project footprint of their own volition. If the relocation of western pond turtle is necessary, a relocation plan will be developed and submitted to CDFW for approval. The plan will include details of monitoring by a CDFW-approved biologist, agency-approved disinfection and handling protocols, animal care while being relocated, suitable deposition locations, and reporting requirements. The CDFW-approved biologist will follow all applicable CDFW disinfection and handling protocols per the relocation plan.

Operations and Maintenance

As discussed in Impact HWR-3 in Section 3.8, maintenance-related activities such as removing debris from the active channel during flood events could result in increased delivery of sediment into San Francisquito Creek depending on the location of the work. This disturbance has the potential to degrade habitat immediately adjacent to the project work site, which would receive direct sediment input, and could also degrade downstream habitat. However, this type of maintenance activity is presently taking place on San Francisquito Creek. Vegetation monitoring and removal of invasive weeds for 3 years is not expected to result in new impacts on bank or aquatic habitat. Trash removal and maintenance of benches and landscaping in creekside parks would not affect aquatic or bank habitat. Emergency maintenance may need to be performed during the life of the project, but is not reasonably foreseeable and would be subject to separate approval. Further, ongoing maintenance would be performed with adherence to project environmental commitments and mitigation measures. The impact would be less than significant.

Floodwalls Alternative

Construction

Effects on western pond turtle and habitat discussed under the Channel Widening Alternative would be the same for this alternative. Floodwalls would be constructed instead of channel widening, but bank and stream substrate would still be disturbed. Impacts on individuals and habitat would be the same from construction. Implementation of mitigation measures as described for the Channel Widening Alternative would reduce the impact to less than significant.

Operations and Maintenance

In addition to the operations and maintenance activities discussed under the Channel Widening Alternative, maintenance of the floodwalls would consist of visual inspections for any damaged concrete or exposed reinforcing bar, and if found, repairing the damaged concrete. Also, undermining would be visually inspected and if found, backfilling or grouting would be done. If additional concrete or grouting is needed, environmental commitments to protect water quality would keep contaminants out of the creek. The impact would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Construction of the detention basins are not likely to affect western pond turtle as they will be excavated in grassland habitat. Construction of the weir in San Francisquito Creek could affect western pond turtles. If pond turtles are present in the creek channel or along the creek bank during the construction period, they could be injured or killed during construction. Implementation of MM-BIO-20 would reduce this impact to less than significant. Further, implementation of MM-BIO-6 would reduce this impact to a less-than-significant level (western pond turtle awareness would be included in the preconstruction worker awareness training required for all construction personnel).

Operations and Maintenance

As noted above for California red-legged frog (Impact BIO-7), the detention basin could be attractive to western pond turtles if it contains water. Implementation of MM-BIO-19 would keep turtles from accessing the detention basin and reduce the impact to less than significant.

Impact BIO-9—Result in effects on bats (pallid bat, hoary bat, and Townsend's big-eared bat)

Summary by Project Element: Impact BIO-9—Result in effects on bats (pallid bat, hoary bat, and Townsend's big-eared bat)		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	No Impact
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant	No Impact

Channel Widening Alternative and Floodwalls Alternative

Pallid bat, a California species of special concern and a Western Bat Working Group high-priority species, and hoary bat, a Western Bat Working Group medium priority species, have potential to occur in the project area. Both pallid and hoary bat primarily roost in trees and could occur within the valley foothill riparian habitat, which occurs along large stretches of San Francisquito Creek.

Pallid bat can roost on or in bridges and hoary bat may also use bridges as roosting substrate. Townsend's big-eared bat uses caves and abandoned buildings for roosting. It is unknown if any abandoned buildings occur in the project footprint in the Channel Widening Alternative or Floodwalls Alternative. All of the bat species could forage throughout the project area.

Construction

Potential bat roosting areas that could be directly disturbed occur in portions of the existing Pope-Chaucer Bridge and mature trees in the project area. Noise disturbances associated with demolition of the old bridge and with new bridge construction could disturb day-roosting bats if they are present in the bridge or suitable adjacent trees during construction. Removal of trees could result in direct injury or mortality of bats if present. Implementation of MM-BIO-17 would reduce the impact to less than significant. Further, implementation of MM-BIO-4 would reduce this impact to a less-than-significant level (bat species awareness would be included in the preconstruction worker awareness training required for all construction personnel).

MM-BIO-21: Implement preconstruction survey for pallid, hoary, and Townsend's big-eared bats

A qualified biologist will examine the Pope Chaucer Bridge and trees within the project site for roosting pallid and hoary bats no more than 48 hours before any initial removal of vegetation, woody debris, or trees, or other initial ground-disturbing activities. In Reach 3, abandoned buildings will be surveyed if observed within 500 feet of the project footprint. If a bat is observed roosting at any time before or during project activities, all activities will cease. SFCJPA will coordinate with CDFW to develop and implement avoidance measures before commencing project activities.

Operations and Maintenance

The project would create minimal in-channel maintenance needs, with debris removal after flooding events the primary maintenance activity, which is similar to existing conditions. Vegetation monitoring and removal of invasive weeds for 3 years is not expected to result in new impacts on trees or an increase in noise in the project sites. Further, ongoing maintenance would be performed through adherence to project environmental commitments. Trash removal and maintenance of benches and landscaping in creekside parks would not affect trees. Emergencies maintenance may need to be performed during the life of the project, but is not reasonably foreseeable and would be subject to separate approval. There would be no impact on bats during operation or maintenance.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

The detention basin sites do not have trees, nor structures that would provide habitat for roosting bats. Bats could use the area as foraging habitat, and could still utilize the area during the nighttime hours since no construction would occur at night. Construction of the weir could disturb bats due to construction noise. Implementation of MM-BIO-21 would reduce the impact to less than significant. Further, implementation of MM-BIO-6 would reduce this impact to a less-than-significant level (bat species awareness would be included in the preconstruction worker awareness training required for all construction personnel).

Townsend's big-eared bat is a state candidate for threatened status and a California species of special concern. Townsend's big-eared bat uses caves and abandoned buildings for roosting. It is unknown if any abandoned buildings occur in the project footprint in the Former Nursery Detention Basin Alternative or Webb Ranch Detention Basin Alternative. Implementation of MM-BIO-21 will check for suitable roosting places (caves and abandoned buildings) for Townsend's big-eared bats.

Operations and Maintenance

Operations and maintenance of the detention basin and weir would have no effect on bats since there is no roosting habitat in the project footprint.

Impact BIO-10—Result in effects on nesting migratory birds and raptors

Summary by Project Element: Impact BIO-10—Result in effects on nesting migratory birds and raptors		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant

Channel Widening Alternative and Floodwalls Alternative

Under the Channel Widening Alternative and Floodwalls Alternative, there is potential for northern harrier, snowy egret, white-tailed kite, saltmarsh common yellowthroat, Alameda song sparrow, great blue heron rookery, black-crowned night heron rookery, and double-crested cormorant rookery. These birds would mainly use the project footprints for foraging, but also for nesting. Nesting would be less common because the project footprints are in an urbanized area.

Construction

Heavy equipment and human activity during construction would increase noise in the vicinity of the work area, potentially resulting in disturbance of birds nesting and foraging in the area. If occupied nests are present on or adjacent to the construction area, construction activities could result in the abandonment of nests, the death of nestlings, and the destruction of eggs in active nests.

This noise increase resulting from construction activities would be of particular concern in marsh habitat, riparian habitat, and relatively isolated habitat that could provide nesting opportunities for a variety of migratory birds and raptors. However, because many migratory bird species are adapted to human presence, all of the project element sites would have the potential to support onsite or adjacent nesting and foraging by protected bird species.

Migratory birds, raptors, and their nests are protected under the MBTA and the California Fish and Game Code. Disturbance of nesting migratory birds or raptors thus represents a significant impact.

These species would be protected during construction by implementing MM-BIO-22, MM-BIO-23, and MM-BIO-24, which include installing nesting exclusion devices, conducting surveys for nesting raptors and migratory birds and establishing buffer zones around active nests. Further, implementation of MM-BIO-6 would reduce the potential for impacts on nesting raptors and migratory birds by teaching workers how to identify nests. These mitigation measures would lower the level of effect to less than significant.

MM-BIO-22: Install nesting exclusion devices

Nesting exclusion devices will be installed to prevent potential establishment or occurrence of nests in areas where construction activities would occur. All nesting exclusion devices will be maintained throughout the nesting season or until completion of work in an area makes the devices unnecessary. All exclusion devices will be removed and disposed of when work in the area is complete (Santa Clara Valley Water District Biological Resources BMP 10).

MM-BIO-23: Conduct preconstruction nesting bird surveys

Prior to the start of construction activities and/or operation and maintenance activities that begin during the migratory bird nesting period (between January 15 and August 31 of any year), SFCJPA will retain a qualified wildlife biologist to conduct a survey for nesting raptors and migratory birds that could nest along the project corridor, including special-status species such as salt marsh common yellowthroat, Alameda song sparrow, northern harrier, and white-tailed kite. Surveys will cover all suitable raptor and migratory bird nesting habitat that will be impacted directly or indirectly by project construction, including habitat potentially used by ground-nesting migratory bird species.

All migratory bird nesting surveys will be performed no more than 2 weeks (14 days) prior to any project-related activity that could pose the potential to affect migratory birds, including site preparation. If a lapse in project-related work of 2 weeks or longer occurs, another focused survey will be conducted before project work can be reinitiated. With the exception of raptor nests, inactive bird nests may be removed. No birds, nests with eggs, or nests with hatchlings will be disturbed.

MM-BIO-24: Establish buffer zones for nesting raptors and migratory birds

If an active nest is discovered during preconstruction surveys, the qualified wildlife biologist will establish a no-disturbance buffer zone around the nest tree (or, for ground-nesting species, the nest itself). The no-disturbance zone will be marked with flagging or fencing that is easily identified by the construction crew and will not affect the nesting bird. In general, the minimum buffer zone widths will be 0.5-mile for bald and golden eagles, 25 feet (radius) for nonraptor ground-nesting species; 50 feet (radius) for nonraptor shrub- and tree-nesting species; and 250 feet (radius) for all raptor species. Buffer widths may be modified based on discussion with CDFW, depending on the proximity of the nest to construction activities, whether the nest would have a direct line of sight to construction activities, existing disturbance levels at the nest, local topography and vegetation, the nature of proposed construction activities, and the species potentially affected. Buffers will remain in place as long as the nest is active or young remain in the area. No construction presence or activity of any kind will be permitted within a buffer zone until the biologist determines that the young have fledged and moved away from the area and the nest is no longer active.

If construction activities are within 10 feet of the active nest buffers, the biologist will monitor the nests to ensure birds are not being disturbed during construction activities. If disturbance from construction activities is affecting active nests, buffer widths will be increased until the disturbance no longer affects the nest(s). If the buffer cannot be extended further, then work within the area will stop until the nest is no longer active.

Operations and Maintenance

The project would create minimal in-channel maintenance needs, with debris removal after flooding events the primary maintenance activity, which is similar to existing conditions. Vegetation monitoring and removal of invasive weeds for 3 years is not expected to result in new impacts on nesting birds due to the limited duration of vegetation monitoring and removal. Further, ongoing maintenance would be performed through adherence to project environmental commitments. Trash removal and maintenance of benches and landscaping in creekside parks would not affect birds; these activities are also limited in duration. Emergency maintenance may need to be performed during the life of the project but is not reasonably foreseeable and would be subject to separate approval. There would be a less-than-significant impact on birds during operations and maintenance.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

There is a potential for Cooper’s hawk, sharp-shinned hawk, golden eagle, short-eared owl, long-eared owl, yellow warbler, American peregrine falcon, bald eagle, loggerhead shrike, Northern harrier, snowy egret, white-tailed kite, saltmarsh common yellowthroat, Alameda song sparrow, great blue heron rookery, black-crowned night heron rookery, and double-crested cormorant rookery to be present in the Reach 3 area. All of these birds could forage or nest in the Reach 3 area.

Construction

Nesting birds that occur near to construction activities could be affected by noise from heavy equipment and humans. This could cause abandonment of nests, including eggs and young. Implementation of MM-BIO-22, MM-BIO-23, and MM-BIO-24 would install nesting exclusion devices, conduct preconstruction nesting bird surveys, and establish buffer zones around nests to ensure construction noise would not affect nesting birds and reduce the impact to less than significant.

Operations and Maintenance

Operations and maintenance of the detention basin is not expected to disturb nesting birds. Maintenance of the detention basin would require sedimentation to be removed after a heavy rainfall event. This would be infrequent and it is not expected to take a long time to remove sediment from the basin. If maintenance activities occur during the nesting bird season, a biologist would survey the area before heavy equipment accesses the site to ensure no nesting birds are in the immediate project area (See MM-BIO-23). Operations and maintenance of the weir in San Francisquito Creek is not expected to disturb nesting birds, and impacts would be less than significant.

Impact BIO-11—Result in effects on Bay checkerspot butterfly

Summary by Project Element: Impact BIO-11—Result in effects on Bay checkerspot butterfly		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	No Impact	No Impact
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	No Impact	No Impact

Channel Widening Alternative and Floodwalls Alternative

See below regarding the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative for a detailed discussion of the Bay checkerspot butterfly. There would be no impact from the construction or operations and maintenance of the Channel Widening Alternative or Floodwalls Alternative because the species does not occur in Reach 2.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The bay checkerspot butterfly is known from the southern and eastern portion of the greater San Francisco Bay area. Populations, most of which have been extirpated, were known from San Francisco (Twin Peaks and Mount Davidson), San Mateo County (San Bruno Mountain south to Woodside), Santa Clara County (numerous locations), Alameda County (Oakland hills), and Contra Costa County (Franklin Canyon and Morgan Territory) (USFWS 2009).

As of 2005, all populations of the bay checkerspot butterfly on the San Francisco Peninsula were extirpated, including all populations in San Francisco, San Mateo, and northern Santa Clara Counties. In south-central Santa Clara County, the bay checkerspot butterfly is still abundant at multiple locations. Most butterflies are found along the ridge that forms the eastern boundary of the Coyote and southern Santa Clara Valleys. This ridge consists of extensive serpentine grasslands, and extends from the Silver Creek Hills, through the Edenvale Hills (sometimes called the East Hills or Coyote Hills) to Pigeon Point just north of Anderson Reservoir Dam. There are multiple populations of the butterfly along this ridge. There are smaller, scattered populations of the butterfly along the eastern foothills south of the Anderson Reservoir dam and along the western foothills of the Coyote Valley (USFWS 2009).

Currently, the bay checkerspot butterfly reproduces only in serpentine grasslands. These native species–dominated grasslands support the larval host plants, dwarf plantain (*Plantago erecta*) and either purple owl's clover (*Castilleja exserta)* or exserted Indian paintbrush (*Castilleja exserta spp. venusta*), at densities that are high enough to sustain butterfly larvae (USFWS 2009).

Topography is an additional factor determining habitat quality and a variety of microclimates are needed for bay checkerspot butterflies to persist (Singer and Ehrlich 1979; Fleishman et al. 2000). Relatively cool and moderate microclimates are critical to a butterfly population's ability to survive drought (Weiss and Murphy 1993) while warm slopes appear to be important during wet/cool years (Weiss et al. 1988). Sites lacking cool and moderate slope exposures are unable to continuously support populations of bay checkerspot butterflies.

The bay checkerspot butterfly has been studied annually by Professor Paul Ehrlich's group at Stanford since 1960. This threatened butterfly subspecies formerly had two relatively robust populations at Stanford (a third population has been recorded in the literature [population "G"], but never supported butterflies for more than a few years). The bay checkerspot butterfly has not been observed at Stanford since 1997 (despite hundreds of hours spent annually looking for them). (Stanford University 2013)

Approximately 330 acres of grasslands at Stanford are designated as critical habitat for the Bay checkerspot butterfly. The proposed detention basins are located approximately 0.2 mile east of designated critical habitat (USFWS 2018). No impacts would occur.

Construction and Operations and Maintenance

Bay checkerspot butterfly has not been observed near the project sites since 1997, so it is highly unlikely they would be present. Additionally, the project sites do not occur in serpentine grasslands, so they would not provide habitat for the butterfly. Therefore, there would be no effect on Bay checkerspot butterfly from construction or operations and maintenance activities.

Impact BIO-12—Result in effects on California tiger salamander and habitat

Summary by Project Element: Impact BIO-12—Result in effects on California tiger salamander and habitat		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	No Impact	No Impact
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation

Channel Widening Alternative and Floodwalls Alternative

See below regarding the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative for a detailed discussion of California tiger salamander. There would be no impact from construction or operations and maintenance of the Channel Widening Alternative or Floodwalls Alternative because the species does not occur in Reach 2.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

California tiger salamander requires two major habitat components: aquatic breeding sites and terrestrial aestivation or refuge sites. California tiger salamander inhabits valley and foothill grasslands and the grassy understory of open woodlands, usually within 1.3 miles (2.09 kilometers) of water (Jennings and Hayes 1994). California tiger salamander is terrestrial as an adult and spends most of its time underground in subterranean refuge sites, or *refugia*. Adults emerge from underground refuge areas to breed, but only for brief periods during the year. Tiger salamanders breed and lay their eggs primarily in vernal pools and other ephemeral ponds that fill in winter and often dry out by summer (Loredo et al. 1996); they sometimes use permanent human-made ponds (e.g., stock ponds), reservoirs, and small lakes that do not support predatory fish or bullfrogs (Zeiner et al. 1988). Streams are rarely used for reproduction.

Adult salamanders migrate from upland habitats to aquatic breeding sites during the first major rainfall events of fall and early winter and return to upland habitats after breeding. This species requires small-mammal (e.g., California ground squirrel) burrows for cover during the nonbreeding season and during migration to and from aquatic breeding sites (Zeiner et al. 1988). California tiger salamanders also use logs, piles of lumber, and shrink-swell cracks in the ground for cover (Holland et al. 1990). California tiger salamander can overwinter in burrows up to 1.3 miles from their breeding sites (Jennings and Hayes 1994).

California tiger salamander have been found on Stanford University property at Lake Lagunita and in the surrounding areas of the Stanford campus (CDFW 2018). Lake Lagunita is approximately 1.6 miles east of the Webb Ranch detention basin and 2.3 miles east of the Former Nursery detention basin on the east side of Highway 280. Stanford University has set up mitigation basins (Stanford University 2013) within 1 mile on the east side of Highway 280 of the proposed detention basin sites. Highway 280 is likely a migration barrier to California tiger salamanders moving into the project area, but they could occur in San Francisquito Creek near the proposed detention basin sites.

Construction

California tiger salamanders could be directly affected by construction activities occurring in or adjacent to the project footprint. If California tiger salamanders are present within the construction work area, they could be inadvertently killed or wounded by construction vehicles, construction personnel, and accidental spill of toxic fluids (e.g., gasoline and other petroleum-based products). If California tiger salamanders must be captured and relocated outside the construction work area, they could be exposed to increased risk of disease, predation, stress, and competition that could result in increased mortality and/or reduced fitness.

The weir and detention basin site are located in potential California tiger salamander habitat. Therefore, construction activities could result in indirect effects on water quality downstream from the construction work area. Increased sedimentation could reduce the suitability of California tiger salamanders' habitat downstream of the construction area by filling in pools and smothering eggs. Accidental spills of toxic fluids also could result in subsequent mortality if these substances flow downstream from the construction area and California tiger salamanders are present. Implementation of the avoidance and minimization measures identified for California tiger salamanders would reduce direct and indirect effects and potential habitat impacts that could occur downstream from the construction area.

MM-BIO-25 would identify and protect any California tiger salamander that may occur at the project sites. Additionally, water quality environmental commitments have been adopted as for the proposed project. These would protect water quality that may be affected by installation of the weir in San Francisquito Creek or construction of the detention basin. With implementation of this mitigation measure and environmental commitments, the impact would be less than significant.

MM-BIO-25: Implement survey and avoidance measures for California tiger salamander prior to construction activities

SFCJPA will retain a qualified biologist to conduct a survey of project sites prior to initiation of construction activities. The surveys will be conducted according to applicable protocols and will be performed during optimal observation periods of the day when detection potential for these species is maximized. The surveys will be conducted prior to initiation of construction, but such that enough time is allowed to coordinate with USFWS and CDFW to develop a species avoidance plan if needed. If California tiger salamander are observed during the surveys, proposed project activities within 500 feet of the observation will be postponed. SFCJPA will develop a species avoidance plan in coordination with USFWS and CDFW and implement the plan during construction and maintenance. If no individuals are observed during the surveys, no further action will be necessary.

Operations and Maintenance

Construction of a detention basin that holds water temporarily may attract California tiger salamanders during the rainy season and for breeding. It is anticipated that the detention basin would need to be dredged to keep sediment from building up. If California tiger salamander lay eggs in the detention basin, adults, larvae, and/or eggs would be killed if extracted from the basin. MM-BIO-19, discussed above under California red-legged frog (Impact BIO-7), would ensure no California tiger salamander enter the detention basin. With implementation of this mitigation measure the impact would be less than significant.

Impact BIO-13—Disturbance to Santa Cruz black salamander and California giant salamander and habitat

Summary by Project Element: Impact BIO-13—Result in effects on Santa Cruz black salamander and California giant salamander and habitat		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	No Impact	No Impact
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation

Channel Widening Alternative and Floodwalls Alternative

See below regarding Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative for a detailed discussion of Santa Cruz black salamander and California giant salamander. There would be no impact from project construction or operations and maintenance because these species do not occur in Reach 2.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The black salamander occurs from Del Norte and Siskiyou Counties to the Sonoma and Napa Coast. They also inhabit the hills of Santa Cruz, Santa Clara and San Mateo Counties. The Santa Cruz black salamander is a California species of special concern. In Santa Clara County, they frequent margins of permanent streams in redwood, Douglas fir, and montane hardwood forests throughout the year. (Bury 1970 cited in CWHRS 2000). There is one CNDDB occurrence of Santa Cruz black salamander found along San Francisquito Creek below Searsville Dam (CDFW 2018).

California giant salamander are year-round residents of north-central California and are state-listed as a species of special concern. They live in or near streams in damp forests. Aquatic adults and larvae are found in cool, rocky streams and occasionally in lakes and ponds (Nussbaum and Clothier 1973). Terrestrial adults are found under surface litter and in tunnels underground (Nussbaum et al. 1983, Stebbins 1985). They are usually found in cool, moist, forest habitat and associated with rocky streams and springs (Stebbins 1985). There are CNDDB occurrences of California giant salamander but they are well outside the project site, closer to the ocean (CDFW 2018).

Construction

Suitable habitat for Santa Cruz black salamander and California giant salamander is present in the project area. Therefore, Santa Cruz black salamander and California giant salamander could be directly affected by construction activities occurring in or adjacent to the project area. If they are present within the construction work area, they could be inadvertently killed or wounded by construction vehicles, construction personnel, and accidental spill of toxic fluids (e.g., gasoline and other petroleum-based products). If they must be captured and relocated outside the construction work area, they could be exposed to increased risk of disease, predation, stress, and competition that could result in increased mortality and/or reduced fitness.

Construction activities associated with the weir in San Francisquito Creek in potential habitat could result in indirect effects on water quality downstream from the construction work area. Increased sedimentation could reduce the suitability of salamander habitat downstream of the construction area by smothering eggs. Accidental spills of toxic fluids also could result in the subsequent mortality if these substances flow downstream from the construction area and salamanders are present. Implementation of the avoidance and minimization measures identified for salamanders would reduce direct and indirect effects and potential habitat impacts that could occur downstream from the construction area.

MM-BIO-25 would implement survey and avoidance measures for California tiger salamander prior to construction activities, and would also identify and protect any Santa Cruz black salamanders and California giant salamanders that may occur in the project area. Additionally, water quality environmental commitments have been adopted for the proposed project. These would protect water quality that may be affected by installation of the weir in San Francisquito Creek. With implementation of MM-BIO-25 and the environmental commitments, the impact would be less than significant.

Operations and Maintenance

The detention basins would need to have sediment removed after they have been flooded. If heavy equipment accesses the area near the basin and San Francisquito Creek, salamanders could be injured or killed. MM-BIO-19, discussed above under California red-legged frog (Impact BIO-7), would ensure no salamanders enter the detention basin. With implementation of this mitigation measure the impact would be less than significant.

Impact BIO-14—Result in effects on San Francisco dusky-footed woodrat

Summary by Project Element: Impact BIO-14—Result in effects on San Francisco dusky-footed woodrat		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	No Impact	No Impact
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	No Impact

Channel Widening Alternative and Floodwalls Alternative

See below regarding the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative for a discussion of San Francisco dusky-footed woodrat. There would be no impact from project construction or operations and maintenance because this species does not occur in Reach 2.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The San Francisco dusky-footed woodrat is a California species of concern. They are common in California and found in the coast ranges and inland. They prefer moderate canopy in forest habitats and moderate to dense understory but are commonly encountered in riparian zones. Woodrats build middens (nests) out of sticks and leaves at the base of, or in trees, around shrubs or at bases of hills.

Construction

Project construction activities could directly or indirectly disrupt nesting and foraging if woodrat middens are present in the immediate area. Implementation of MM-BIO-26 and MM-BIO-27 would conduct preconstruction surveys for woodrats and their middens, and if necessary relocate middens prior to construction. Implementation of these mitigation measures would reduce the impact to less than significant.

MM-BIO-26: Conduct preconstruction surveys for dusky-footed woodrats

SFJCA will retain a qualified biologist to conduct a survey for woodrat middens in all suitable habitat in the project area that will be affected by construction. This survey will be conducted in the non-breeding season (between October 1 and November 30) prior to any clearing or grading activities in the project area. If no middens are found within this area, no further action is required.

MM-BIO-27: Relocate woodrats and middens prior to construction activity

Any active middens that will not be in areas of project-related grading or vegetation removal will be avoided and protected with a minimum 5-foot buffer. The biologist will set up a buffer with flagging and notify the construction crew. Woodrat middens that cannot be avoided and do not contain juveniles at the time of the survey will be dismantled and relocated by the biologist prior to land clearing activities to allow animals to escape harm and to reestablish territories for the next breeding season. Dismantling will be done by hand, allowing any animals to escape either along existing woodrat trails or toward other available habitat. If a litter of young is found or suspected, the biologist shall replace the midden material and the midden left alone for 2 to 3 weeks. After 2 to 3 weeks, the biologist will verify that young are capable of independent survival before proceeding with midden dismantling. The biologist will attempt to relocate any removed middens to the same area where woodrats are released. The biologist will document any woodrat sightings and relocation of middens with a technical memorandum that will be submitted to CDFW.

Operations and Maintenance

Operations and maintenance of the detention basin and weir is not expected to affect woodrats or their middens because no terrestrial vegetation is expected to be removed during operations or maintenance activities of the detention basin or weir.

Impact BIO-15—Result in effects on western burrowing owls and habitat

Summary by Project Element: Impact BIO-15—Result in effects on western burrowing owls and habitat		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	No Impact	No Impact
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant

Channel Widening Alternative and Floodwalls Alternative

See below regarding the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative for a discussion of western burrowing owl. There would be no impact from project construction or operations and maintenance because this species does not occur in Reach 2.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Western burrowing owls have potential to nest in upland portions of the project area with suitable foraging habitat (e.g., low-growing vegetation). Near Stanford University, there have been several sightings near I-280 and Searsville Lake (eBird 2018), which is 1 mile west of the Former Nursery detention basin. Construction activities during the nesting period (February 1–August 31) could result in direct injury or mortality, as well as disturbance impacts related to elevated noise and human presence.

However, this species would be protected during construction by MM-BIO-28, which would conduct preconstruction surveys for burrowing owls, and MM-BIO-6 (western burrowing owl awareness would be included in the preconstruction worker awareness training required for all construction personnel) would reduce this impact to a less-than-significant level.

MM-BIO-28: Implement survey and avoidance measures for western burrowing owls prior to construction activities

Prior to any construction activity planned to begin during the fall and winter non-nesting season (September 1–January 31), SFCJPA will retain a qualified wildlife biologist to conduct a preconstruction survey for burrowing owls. Surveys will be conducted no more than 7 days prior to ground-disturbing activities and will cover all suitable burrowing owl habitat subject to disturbance. If any western burrowing owls are found within the disturbance area during the survey or at any time during the construction process, SFCJPA will notify CDFW and will proceed under CDFW direction. Surveys for nesting owls will be conducted by a qualified wildlife biologist prior to construction to determine if there is breeding within 250 feet of the construction footprint. This survey will provide the project team advance notice regarding nesting owls in the project area so the appropriate course of action can be discussed with CDFW. In addition, preconstruction surveys for nesting western burrowing owls will be conducted no more than 7 days prior to ground disturbance in all suitable burrowing owl habitat. If the biologist identifies the presence of a nesting burrowing owl in an area scheduled to be disturbed by construction, a 250-foot no-activity buffer will be established and maintained around the nest while it is active. Surveys and buffer establishment will be performed by qualified wildlife biologists, will be coordinated with CDFW, and will be subject to CDFW review and oversight.

Operations and Maintenance

The maintenance program for the detention basin would have the potential to disturb western burrowing owls in grassland habitat if burrowing owls are found near the project footprint. If burrowing owls are found in the project footprint during preconstruction surveys and the detention basins need to be excavated during operations and maintenance, MM-BIO-28 would be implemented to determine if there are nesting owls that could be disturbed and CDFW will be consulted. Maintenance for the weir is not expected to affect burrowing owls. The impact would be less than significant.

3.3.4 Cumulative Impacts

Two known projects will occur in the same area as the proposed project during the same time period: the Newell Road Bridge Replacement Project (Newell project) and the Searsville Dam Removal Project (Searsville project). The Newell project should be starting within the next year, and the Searsville project is still under discussion. The Newell project will replace the existing bridge and widen the creek channel under and downstream of the bridge. The proposed project and the Newell project will both remove riparian vegetation in order to facilitate the new bridges and also around the bridges to widen San Francisquito Creek channel. Both of these projects are required to replant any riparian vegetation and trees that they remove. Native vegetation will replace nonnative riparian and trees. This will be beneficial to steelhead. No negative cumulative impacts on biological resources are expected from the proposed project.

The Searsville project would affect San Francisquito Creek downstream of the dam. Sedimentation release from behind the dam could negatively affect aquatic resources by decreasing water quality and aquatic habitat by filling in pool habitat. This project will include the appropriate mitigation for the impacts it has on aquatic resources. The proposed project would not release sedimentation into San Francisquito Creek, and no negative cumulative impacts on biological resources are expected.

The project, as all cumulative projects, also would be required to be consistent with all applicable federal, state, and local codes and regulations with respect to project design and construction. The project would therefore not make a cumulatively considerable contribution to a cumulative impact.

3.3.5 References

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3.4 Cultural Resources

This section discusses the potential for the project to adversely affect cultural resources, including potential tribal cultural and historical/architectural resources. The Study Area is shown on Figures 3.4-1a and 3.4-1b. This section summarizes the applicable regulatory and environmental settings, provides the criteria used for determining impacts, discusses the impact mechanism and level of impact resulting from construction and implementation of the proposed project, and describes mitigation to minimize the level of impact.

This section is based on the background information and information regarding potential project impacts on historical and other cultural resources provided in the following document:

> Byrd, F. B., and J. Meyer. 2011. *Initial Cultural Resources Investigation San Francisquito Creek Flood Damage Reduction and Ecosystem Restoration Project, Santa Clara and San Mateo Counties, California.*

In addition, this section includes data and resources updated in 2017 and 2018, as well as a summary of results and recommendations based on consultations with local tribes.

3.4.1 Regulatory Setting

Cultural resources are protected by Federal and State laws, as well as local jurisdiction (county and city) planning process and associated guidance. This section describes the project's regulatory setting.

Federal

National Environmental Policy Act

The National Environmental Policy Act (NEPA) was signed into law on January 1, 1970. NEPA created an environmental review process requiring federal agencies to consider the effects of their actions on the environment. Under NEPA, all federal agencies must carry out their regulations, policies, and programs in accordance with NEPA's policies for environmental protection, including project compliance with Section 106 of the National Historic Preservation Act.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) (54 United States Code [U.S.C.] 300101 et seq.) requires federal agencies (e.g., U.S. Army Corps of Engineers, National Park Service), prior to implementing an undertaking (e.g. issuing a federal permit), to consider the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation and State Historic Preservation Officer a reasonable opportunity to comment on any undertaking that would adversely affect properties eligible for listing on the National Register of Historic Places (NRHP). The NRHP is the nation's official comprehensive inventory of historic resources. Administered by the National Park Service, the NRHP includes buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archaeological, or cultural significance at the national, state, or local level. Typically, a resource more than 50 years of age is eligible for listing on the NRHP if it meets any one of the four eligibility criteria and if it retains sufficient historical integrity. The four criteria are:

- Criterion A (Event): Properties associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B (Person): Properties associated with the lives of persons significant in our past.
- Criterion C (Design/Construction): Properties that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a mater, or that possess high artistic values, or that represent a significant distinguishable entity whose components lack individual distinction.
- Criterion D (Information Potential): Properties that have yielded or may be likely to yield, information important in prehistory or history.

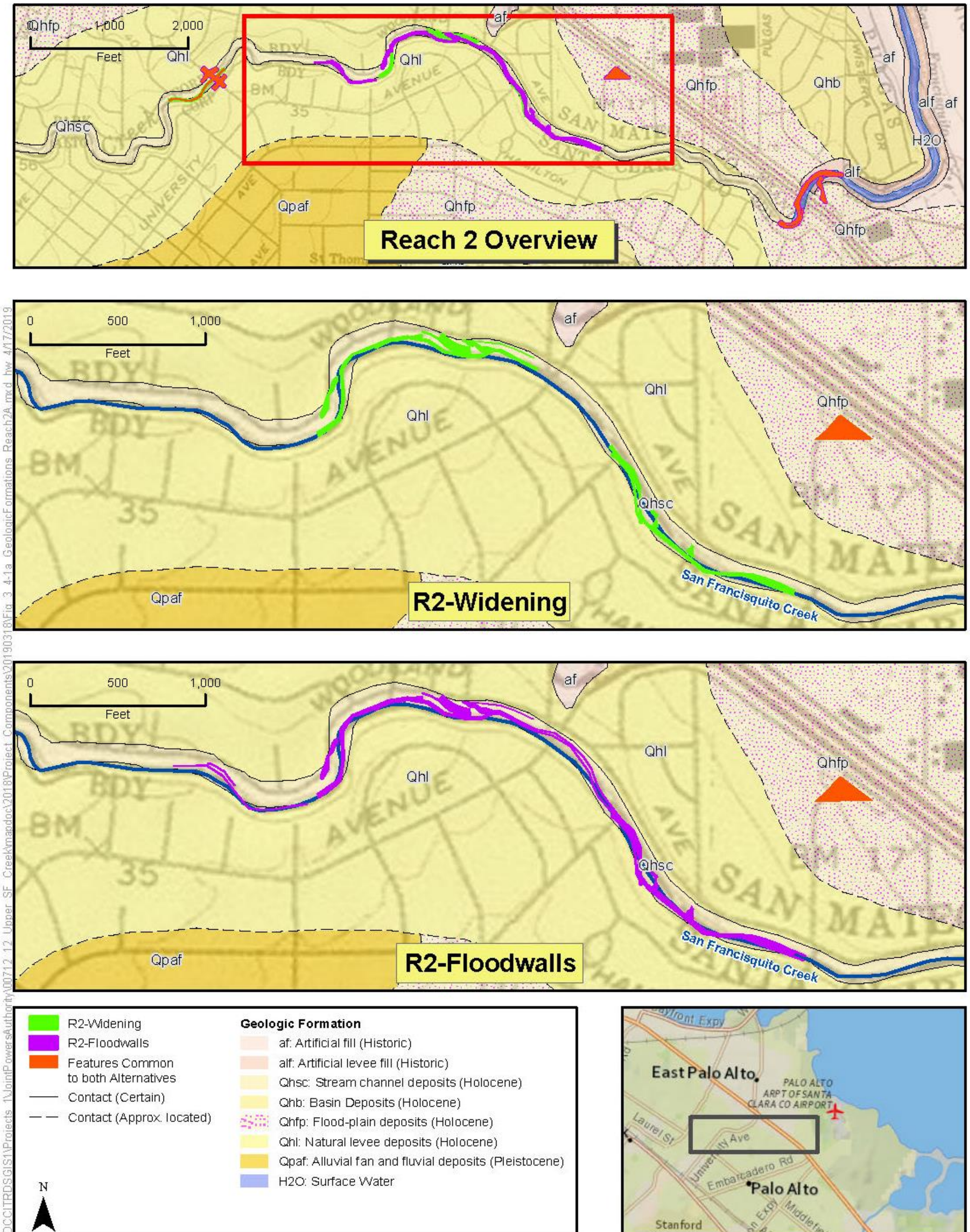
A resource can be significant to American history, architecture, archeology, engineering, and/or culture at the national, state, or local level. In addition to meeting at least one of the four criteria, a property or district must retain *integrity*, meaning that it must have the ability to convey its significance through the retention of seven aspects, or qualities, that, in various combinations, define integrity:

- **Location:** Place where the historic property was constructed.
- **Design:** Combination of elements that create the form, plans, space, structure, and style of the property.
- **Setting:** The physical environment of the historic property, inclusive of the landscape and spatial relationships of the buildings.
- **Materials:** The physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form the historic property.
- **Workmanship:** Physical evidence of the crafts of a particular culture or people during any given period in history.
- **Feeling:** The property's expression of the aesthetic or historic sense of a particular period of time.
- **Association:** Direct link between an important historic event or person and a historic property.

Properties that are listed in the NRHP, as well as properties that are formally determined to be eligible for listing in the NRHP, are automatically listed in the California Register of Historical Resources (CRHR) and are thus considered historical resources under CEQA.

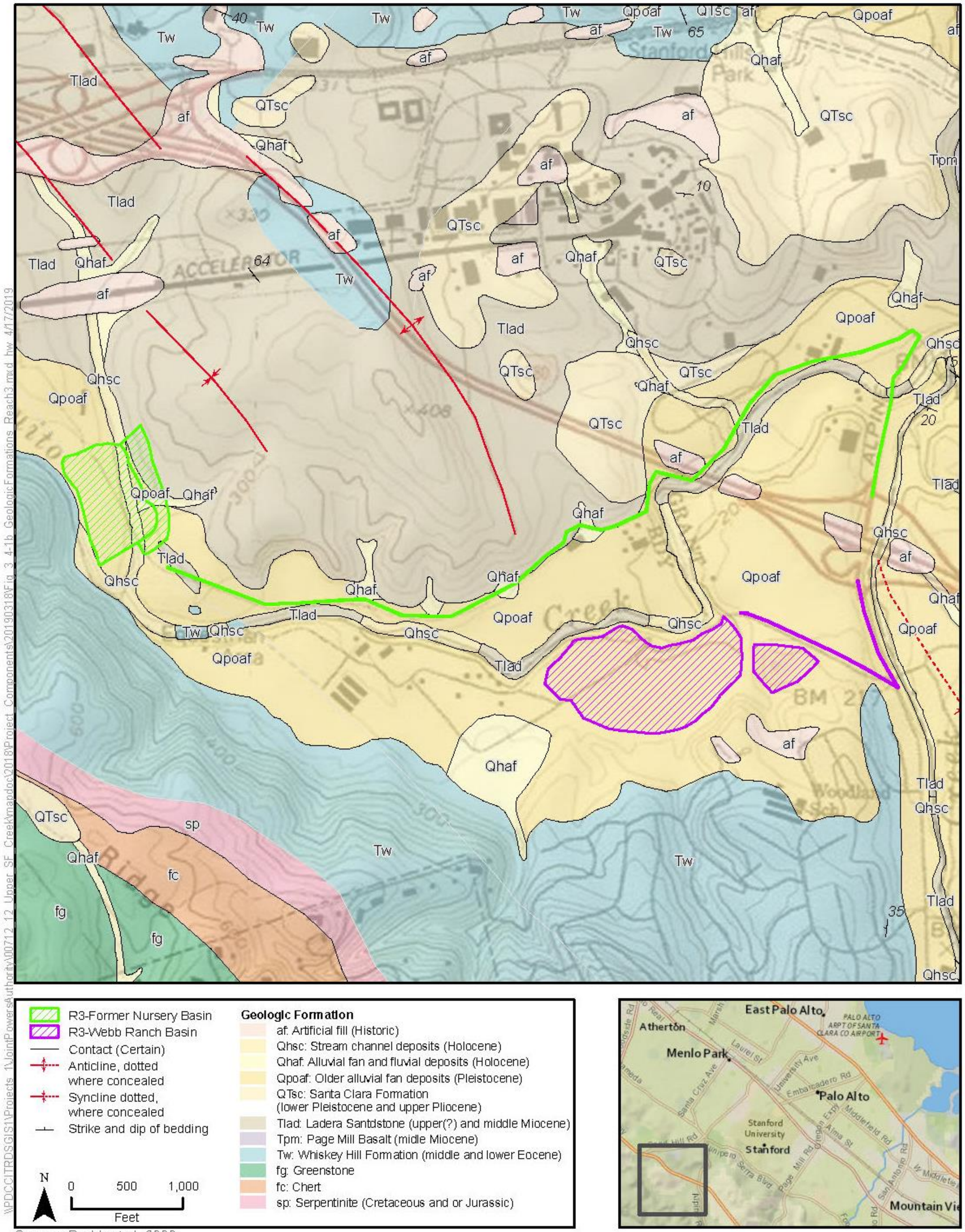
Archaeological and Historic Preservation Act

This act (16 U.S.C. Sections 469–469(c)-2) provides for preserving significant historic or archaeological data that may otherwise be irreparably lost or destroyed by construction of a project by a federal agency or under a federally licensed activity or program. This includes relics and specimens.



Source: Brabb et al. 2000

Figure 3.4-1a Cultural Resources Study Area



Source: Brabb et al. 2000

Figure 3.4-1b Cultural Resources Study Area (Continued)

American Indian Religious Freedom Act

This act (42 U.S.C. Section 1996) protects and preserves the traditional religious rights and cultural practices of American Indians, Eskimos, Aleuts, and Native Hawaiians. The act requires policies of all governmental agencies to respect the free exercise of native religion and to accommodate access to and use of religious sites to the extent that the use is practicable and is not inconsistent with an agency's essential functions. If a place of religious importance to American Indians may be affected by a project, the American Indian Religious Freedom Act promotes consultation with Indian religious practitioners, which may be coordinated with Section 106 consultation.

Native American Graves Protection and Repatriation Act

This act (25 U.S.C. Sections 3001–3013) describes the rights of Native American lineal descendants, Indian tribes, and Native Hawaiian organizations with respect to the treatment, repatriation, and disposition of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony, referred to collectively in the statutes as cultural items, with which they can show a relationship of lineal descent or cultural affiliation. One purpose of the statute is to provide greater protection for Native American burial sites and more careful control over the removal of Native American human remains, funerary objects, sacred objects, and items of cultural patrimony on federal and tribal lands.

American Antiquities Act

This act (16 U.S.C. Sections 431–433) prohibits appropriation, excavation, injury, or destruction of "any historic or prehistoric ruin or monument, or any object of antiquity" located on lands owned or controlled by the federal government. The act also establishes penalties for such actions and sets forth a permit requirement for collection of antiquities on federally owned lands.

Archaeological Resources Protection Act

The Archaeological Resources Protection Act (US Code, Title 16, Section 470[a]-11) provides for the protection of archaeological resources and sites on public lands and Indian lands; establishes a procedure for the issuance of permits for conducting cultural resources research; and prescribes penalties for unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources.

State

California Environmental Quality Act

The California Environmental Quality Act (CEQA) (California Public Resources Code [PRC] Section 21000 et seq.) is the principal statue governing the environmental review of projects in the state, and Section 21084.1 of CEQA and Section 15064.5 of the State CEQA Guidelines establish the definition of historical resource for the purposes of CEQA. CEQA also requires that significant, avoidable damage to paleontological resources be prevented by changes in projects through the use of feasible alternatives or mitigation measures.

California Public Resources Code

- California PRC Sections 5020–5029.5 authorize continuation of duties associated with the former Historical Landmarks Advisory Committee under the State Historical Resources Commission.
- California PRC Sections 5079–5079.65 define the functions and duties of the Office of Historic Preservation.
- California PRC Sections 5097.9–5097.991 provide protection to Native American historical and cultural resources and sacred sites and identify the powers and duties of the Native American Heritage Commission (NAHC).
- California PRC Section 5097.5 protects paleontological resources on public lands, where public lands are lands under the jurisdiction of the state or any city, county, district, authority, or public corporation.
- California PRC Section 5097.98 and 5097.99 Section 5097.98 discusses the procedures that need to be followed upon the discovery of Native American human remains.
- California PRC as a result of Assembly Bill (AB)-52; PRC Sections 21083.2, 21084.3 CG 15126.4, and CG 15064.5. AB 52 became effective for all projects, including this one, with NOPs published after July 1, 2015. The bill added a definition of "tribal cultural resource," which is separate from the definitions for "historical resource" and "archaeological resource" (PRC Section 21074; 21083.09). The bill also added requirements for lead agencies to engage in additional consultation procedures with respect to California Native American tribes (PRC Sections 21080.3.1, 21080.3.2, 21082.3). Specifically, PRC Section 21084.3 states: "a. Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. b. If the lead agency determines that a project may cause a substantial adverse change to a tribal cultural resource, and measures are not otherwise identified in the consultation process provided in Section 21080.3.2, the following are examples of mitigation measures that, if feasible, may be considered to avoid or minimize the significant adverse impacts: 1) Avoidance and preservation of the resources in place, including, but not limited to, planning and construction to avoid the resources and protect the cultural and natural context, or planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria."

California Register of Historical Resources

California PRC Section 5024.1 and 14 California Code of Regulations Section 4850 establishes the CRHR, the "authoritative listing and guide to be used by state and local agencies, private groups, and citizens in identifying the existing historical resources of the state and to indicate which resources deserve to be protected, to the extent prudent and feasible, from substantial adverse change."

The criteria for designation are:

- Associated with events that have made a significant contribution to the broad patterns of local or regional history or the cultural heritage of California or the United States (Criterion 1).
- Associated with the lives of persons important to local, California or national history (Criterion 2).

- Embodies the distinctive characteristics of a type, period, region or method of construction or represents the work of a master or possess high artistic values (Criterion 3).
- Has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California or the nation (Criterion 4).

Other Regulations

- California Health and Safety Code Section 7050.5(b) established that any person who knowingly mutilates, disinters, wantonly disturbs, or willfully removes any human remains in or from any location without authority of the law is guilty of a misdemeanor.
- California Code of Regulations (Title 14, Division 3, Chapter 1, Section 4307) prohibits damage to paleontological resources. Section 4309 special permits grants permits for such damage.

Local

City of Menlo Park General Plan

The City of Menlo Park General Plan includes goals, policies, and programs relevant to the identification and protection of cultural resources. Goal OSC3 is to protect and enhance historic resources, including the following policies that are relevant to the Project:

Policy OSC3.1: **Prehistoric or Historic Cultural Resources Investigation and Preservation.** Preserve historical and cultural resources to the maximum extent practical.

Policy OSC3.2: **Prehistoric or Historic Resources Protection**. Require significant historic or prehistoric artifacts to be examined by a qualified consulting archaeologist or historian for appropriate protection and preservation, and to ensure compliance with local, state, and federal regulations.

Policy OSC3.3: **Archaeological or Paleontological Resources Protection.** Protect prehistoric or historic cultural resources either on site or through appropriate documentation as a condition of removal. Require that when a development project had sufficient flexibility, avoidance and preservation of the resource shall be the primary mitigation measure, unless the City identifies superior mitigation. If resources are documented, undertake coordination with descendants and/or stakeholder groups, as warranted.

Policy OSC3.4: **Prehistoric or Historic Cultural Resources Found During Construction**. Requires that is cultural resources, including archaeological or paleontological resources, are uncovered during grading or other on-site excavation activities, construction shall stop until appropriate mitigation is implemented,

Policy OCS3.5: **Consultation with Native American Tribes**. Consult with those Native American tribes with ancestral ties to the Menlo Park city limits regarding General Plan Amendments and land use policy changes.

*Policy OSC3.6***: Identification of Potential Historic Resources**. Identify historic resources for the historic district in the Zoning Ordinance and require design review of proposals affecting historic buildings.

Chapter 16.54 outlines the requirements for protecting, enhancing, and preserving the use of structures, sites and areas that are reminders of people, events or eras, or which provide significant examples of architectural styles and the physical surroundings in which past generations lived. Under Section 16.54.030, the City Council can designate a structure, feature, or natural landscape element, identified as having a special character or historical, architectural, or aesthetic interests, as a landmark.

Chapter 16.68 outlines the requirements for attaining a building permit for the construction, alteration or remodeling of any building either than a single family dwelling, duplex and accessory building, or for any structure on land designated as a historic landmark use. Under Section 16.68.020, requests for building permits to do work on a historic landmark site shall be granted by the planning commission if the proposed work is consistent with the historic landmark sit district and if the proposed work will preserve, enhance, or restore, and not damage the exterior and interior architecture of the landmark,

City of Palo Alto Municipal Code

The City of Palo Alto Municipal Code provides the City with the ability to designate, preserve, protect, enhance, and perpetuate those historic structures, districts, and neighborhoods that contribute to the cultural and aesthetic heritage of Palo Alto (Chapter 16.49, Section 010). The ordinance declares "that the protection, enhancement, perpetuation and use of structures, districts and neighborhoods of historical and architectural significance located within the city are of cultural and aesthetic benefit to the community." It provides for the process of designating historic structures, sites and districts, as well as maintaining historic resources.

The PAMC and the Palo Alto Building Code (PABC) both offer incentives to assist historic resource owners to preserve, rehabilitate and/or otherwise improve historic structures and sites in keeping with the Secretary of the Interior's Standards for Rehabilitation. The City of Palo Alto's Planning & Community Environment Department and Historic Resources Board designate, review, and promote historic resources. The Historic Review Board is a citizen advisory board that makes recommendations to the Planning Department as well as the City of Palo Alto's Architectural Review Board, which has responsibility to review and make recommendations related to a broad range of aspects for proposed projects.

City of Palo Alto Comprehensive Plan 2030

The City's Comprehensive Plan, updated and adopted in November 2017, includes Goal L-7, conservation and preservation of Palo Alto's historic buildings, sites, and district. It is the City's policy to encourage public and private upkeep and preservation of resources that have historic merit, including residences listed in the City's Historic Resource Inventory, the CRHR, or the NRHP. Actions to meet this goal include updating and maintaining the historic resource inventory, reassessing the historic preservation ordinance to ensure its effectiveness in the maintenance and preservation of historic resources, and protection of the City's archaeological resources, including natural land formations, sacred sites, the historical landscape, historic habitats and remains of settlements here before the found of the City in the nineteenth century, as well as paleontological resources.

Vista 2035 East Palo Alto General Plan

The General Plan's Parks, Open Space and Conservation element, adopted in 2016, includes goals relating to historic and cultural resources. This includes protection of important archaeological and paleontological resources, historic buildings and sites, City history, and City resources.

Santa Clara County General Plan

The Santa Clara County General Plan 1995–2010, was adopted in December 1994 and various sections have been updated since that time. Within the Parks and Recreation element, C-PR 10 supports location and designation of recreation facilities to be compatible with each site's natural and cultural resources, with particular attention to the preservation of unique, rate, or endangered resources (including historic and archaeological sites). C-PR 20.2 recommends the establishment of trails along historically significant trail routes, whenever feasible. The Resource Conservation element identifies heritage resources—such as historical sites and structures, heritage trees, and archaeological and paleontological sites—with scientific, cultural/historical, and place value that the County is responsible for managing. Heritage resources are defined as historical sites, structures, and areas; archaeological and paleontological sites and artifacts; and historical and specimen trees. CR-RC 49 states that the cultural heritage resources in the County should be preserved, restored wherever possible, and commemorated as appropriate for their scientific, cultural, historic, and place values. Furthermore, C-RC 50 defines the general approach to heritage resource protection: inventory, evaluate, minimize adverse impacts, restore, enhance, and commemorate.

San Mateo County General Plan

The San Mateo County General Plan includes goals relating to historic resources protection, rehabilitation of historic structures, protection of archaeological/paleontological sites, historic resources inventory, planning and historic preservation, and public awareness that are supported by several policies..

San Mateo County Zoning Regulations

The County's zoning regulations preserve historic landmarks and districts (Chapter 24 Use Permits).

Santa Clara Valley Water District

Santa Clara Valley Water District has a Best Management Practice (BMP) that specifies a 100-foot standard offset for cultural resource finds.

3.4.2 Environmental Setting

Study Area

The horizontal study area for the project is defined as the project footprint plus a 50-foot buffer to conservatively account for possible scale-induced mapping error. The vertical study area extends below-ground to the maximum depth of disturbance and would be at least 5 feet below ground surface (bgs) with certain improvements, such as the Pope Chaucer Bridge, extending to up to 20 feet in depth. The detention basin is still early in the planning phase and, therefore, conceptual in nature, but would result in ground disturbance to a depth of 13 to 14 feet bgs. For the purposes of establishing cultural sensitivity for all alternatives, a 0.5-mile radius was employed during the review of previously recorded sites and studies.

The study area for cultural resources analysis is the project sites, extending vertically to the depth of disturbance.

Tribal Cultural Setting

Prehistoric Setting

The cultural chronology of the Bay Area has been evaluated by several previous reviewers (Beardsley 1948, 1954; Groza et al. 2011; Heizer and Fenenga 1939; Lillard et al. 1939; Lillard and Purves 1936; Moratto 1992; Schenck and Dawson 1929). These evaluations have divided the prehistoric cultural sequence into multiple phases or periods, which are delineated by changes in regional patterns of land use, subsistence, and tool types over time. The most recent chronologies encompass a time period that ranges from around 13,500 calibrated years[1] before present (cal BP) to around 170 cal BP.

The early periods of this section's chronology are based on research from along the California Coast (i.e., Byrd et al. 2010, Erlandson et al. 2007, Rick et al. 2001), while the later periods of this chronology are based on the time periods proposed by Groza et al. (2011), with additional information integrated from the other chronologies mentioned above.

This summary presents the prehistory of the Bay Area by the geologic time segments.

- Terminal Pleistocene (13,500–11,600 cal BP)
- Early Holocene (11,600–7700 cal BP)
- Middle Holocene (7700–3800 cal BP)
- Late Holocene (3800 cal BP onward), with further divisions of the Late Holocene based on Groza et al. (2011).

Terminal Pleistocene (13,500–11,600 cal BP)

Traditionally, it was thought that the earliest human inhabitants of North America were highly mobile terrestrial hunters. Commonly referred to as the Clovis, these people used intricate bone and stone technology. On the west coast of North America, Clovis assemblages are characterized by a wide but sparse distribution of isolated tools and caches dated to between 12,800 and 12,500 cal BP (Meltzer 2004, Erlandson et al. 2007). However, over the last few decades along the western coasts of North and South America, several archaeological sites and sets of human remains have been documented in island and mainland coastal contexts that date to the same period as the Clovis (i.e., Erlandson et al. 2007). These discoveries have forced researchers to reconsider how early humans migrated to the Americas and their land-use strategies, with a greater emphasis placed on coastal environments. Archaeological sites from this period are typically very spare lithic assemblages with few or absent archaeological features, and large and fluted projectile points—a diagnostic tool type for this period.

Early Holocene (11,600–7700 cal BP)

The Early Holocene landscape of Central California is characterized by semi-mobile hunter-gatherers exploiting a wide range of food resources from marine, lacustrine, and terrestrial contexts

[1] radio carbon dates converted to calendar dates

(Erlandson et al. 2007). Diagnostic artifact types from the Early Holocene often include stemmed points, crescents, and steep-edged formed flake tools (Byrd et al. 2010).

Middle Holocene (7700–3800 cal BP)

The Middle Holocene is characterized by a diverse range of habitation sites and artifact assemblages, which suggest higher population levels, more complex adaptive strategies, and longer seasonal occupation than took place during the Early Holocene. The presence of seasonal waterfowl within assemblages dated to the Middle Holocene suggests more diverse, local-niche based exploitation strategies. Diagnostic artifact types from this period include ground stone; side-notched dart points; cobble (large stone sized) chopping, scraping, and pounding implements; and shell beads and ornaments (Fitzgerald 1993, Meyer and Rosenthal 1998).

Late Holocene (3800–170 cal BP)

The Late Holocene is generally divided into the following three main sub-periods, with two transitional sub-periods: Early (4500/3800–2450 cal BP), Early-Middle Transition (2450–2050 cal BP), Middle (2050–900 cal BP), Middle-Late Transition (900–700 cal BP), and Late (700–170 cal BP). The Middle and Late periods have been further subdivided into four and two subdivisions, respectively, based largely on the dating of specific types of shell beads.

Early Period of the Late Holocene (4500/3800–2450 cal BP)

There are more than 200 documented Late Holocene sites in the Bay Area. The Early Period of the Late Holocene marks the establishment of a number of large shell mounds. Bay margin sites, not surprisingly, revealed a strong emphasis on marine shellfish (particularly Bay mussel and oyster), marine fishes, and marine mammals, whereas interior sites revealed a strong emphasis on freshwater fish and shellfish along with terrestrial mammals (Byrd et al. 2010). Diagnostic artifact types from this period include stemmed and short broad-leaf projectile points, square-based knife blades, both unshaped and cylindrical mortars, both short and cylindrical pestles, crescentic stones, perforated charmstones, bone awls, polished ribs, notched and grooved net sinkers, rectangular and spire lopped Olivella beads, rectangular abalone beads and various pendant types, antler wedges, and stone bars or “pencils” (Lightfoot 1997:138).

Middle Period of the Late Holocene (2050–900 cal BP)

The Middle Period of the Late Holocene is characterized by greater settlement permanence (either sedentary or multi-season occupation), mound-building, and increasing social complexity and ritual elaboration (Lightfoot 1997, Lightfoot and Luby 2002). New artifact types for this subdivision include barbless and single-barbed bone fishing spears, large mortars, ear spools (or adornments), and varied forms of *Haliotis* and *Olivella* shell ornaments. Some male burials yielded thousands of shell beads. Isotopic analyses of human bone and food remains indicate that terrestrial (faunal) resources were exploited more than shellfish, and the use of the acorn also increased (Bartelink 2006, Bickel 1978, Greengo 1951, Simons 1992, Wohlgemuth 2004, Byrd et al. 2010).

Late Period of the Late Holocene (700–170 cal BP)

The Late Period of the Late Holocene is the best-documented Late Holocene division throughout the greater Bay Area. New artifact types included clamshell disk beads, distinctive *Haliotis* shell pendants, flanged steatite pipes, chevron-etched bone whistles and tubes, elaborately finished stone “flower pot” mortars, and needle-sharp coiled basketry awls (Milliken et al. 2007:99). Small seed exploitation increased, as evidenced by archaeobotanical remains, and sea otters, rabbits, deer, clams, and horn snails were frequently exploited as foodstuffs. The bow and arrow first appeared during the Late Period, and extensive trade relations with neighboring groups continued. Funerary rituals were strongly patterned, and included flexed interments and "killed" grave offerings, along with occasional cremations (Byrd et al. 2010).

Ethnographic Setting

The study area is located on the cusp of what was traditionally the Lamchin territory, north of the border of the Puichon territory. (Milliken 1995:121). Both the Lamchin and the Puichon spoke the Ramaytush dialect of Costanoan. The Costanoan languages are part of the larger Utian language family, which is part of a larger language family, the Penutian language, with languages and dialects spoken by groups of Native Americans across California, Oregon, and Washington (Callaghan 1967). The territory of the Ohlone people, who were referred to as the Costanoans by the Spanish because they lived along the coast, extended along the coast from the Golden Gate in the north to just below Carmel to the south, as well as along several inland valleys that led from the coastline (Levy 1978:485–486).

As with other Ohlone tribelets, the Lamchin and Puichon were primarily hunters and gatherers. They hunted terrestrial game, such as mule deer, tule elk, pronged antelope, and mountain lion. Traps were set for smaller game, such as rabbit and quail. Marine resources were hunted along the shores, including sea lions and whales, which were prized for their blubber. Water fowl were a very important part of the tribal diet and trapped along the tidal marshes. Other marine resources, such as salmon, steelhead, school fish, and shellfish, including mussels, were collected and were a major dietary staple. Tule boats were used to collect both saltwater and freshwater marine resources.

The Ohlone also used a wide range of other foods, including various seeds (the growth of which was promoted by controlled burning), buckeye, berries, roots, acorns, nuts, fruits, land and sea mammals, water fowl, reptiles, and insects. The Ohlone used tule balsas for watercraft, bows and arrows, cordage, and bone and ground-stone tools to procure and process their foodstuffs (Levy 1978:491–493, Milliken 1995:20, Milliken 1991:31, Kroeber 1925:467).

The Ohlone were politically organized by tribelet, with each having a designated territory. A territory consisted of one or more villages and camps designated by physiographic features. Each tribelet consisted of several households, which averaged 10 to 15 individuals and were grouped into clans and moieties. Primary sources describe tribelets as small groups of people, averaging 60 to 90 individuals, that were located 3 to 5 miles apart. These groups within a territory were often linked by marriage. The office of tribelet chief, which was inherited patrilineally, could be occupied by a man or a woman. If there was no son to inherit the position, a sister or daughter would assume the position. Duties of the chief included providing for visitors, directing ceremonial activities, and leading fishing, hunting, gathering, and warfare expeditions. The chief served as the leader of a council of elders, which functioned primarily in an advisory capacity to the community.

As stated above, a single tribelet, comprising patrilineal family groups, would occupy a village location at different times of the year. Ohlone villages in the Late Period of the Late Holocene typically had four types of structures. Dwellings were generally domed structures with central hearths. They were thatched with tule, grass, or other vegetal material and bound with willow withes. Permanent settlements were usually placed away from the ocean shore, on high ground. Sweathouses were used by men and women and usually located along streambanks. A sweathouse consisted of a pit that was excavated into the streambank, with a thatched portion constructed against the bank. Dance structures were circular or oval in plan and enclosed by a woven fence of brush or laurel branches, standing approximately 5 feet. These structures would have one doorway, with a smaller opening directly opposite. The assembly house was a thatched dome structure that was large enough to accommodate all of the inhabitants of the village (Crespi 1927).

Although they have yet to receive formal recognition from the federal government, the Ohlone are becoming increasingly organized as a political unit and have developed an active interest in preserving their ancestral heritage. In the later part of the twentieth century, the Galvan family of Mission San José worked closely with the American Indian Historical Society and successfully prevented destruction of a mission cemetery that lay in the path of a proposed freeway. These descendants incorporated as the Ohlone Indian tribe and now hold title to the Ohlone Indian Cemetery in Fremont (Yamane 1994, in Bean 1994:xxiv). The descendants are active in maintaining their traditions and advocating for Native American issues.

Historical and Architectural Setting

Spanish colonization of what is now California began in the late 1700s, based around a system of missions intended to convert native peoples to Catholicism, gain control of the native population, and create economically self-sufficient colonial communities. When Mexico won its independence from Spain in 1824, one of the first acts of the new government was to secularize the missions and redistribute the mission land holdings in the form of land grants to individuals who promised to work the land, primarily by raising cattle. The southern portion of the project area, west of San Francisquito Creek at Jasmine Way, was part of the Rancho Rincon de San Francisquito. The land east of the levee consisted of wetlands during this period (Byrd and Meyer 2011).

In 1848, the United States won the Mexican-American War and as a result gained approximately 50% of Mexico's territory, including what would become the state of California. Within weeks of the end of the war, gold was discovered in the Sierra Nevada foothills, and by the summer of 1849, thousands of people were arriving in California in search of their fortunes. Most of the Mexican land grants were judged invalid; the land was subject to sale, opening large acreages to new ownership and initiating a shift to farming to supply the growing demand for fresh foods. In the South Bay, a combination of wheat and barley production, dairy farms, and orchards dominated the valley floor from the 1860s until the late 1870s (Jacobson 1984).

By the 1890s, orchard production was the dominant agricultural activity in the valley, remaining in this position through the 1940s. In the late nineteenth century, Leland Stanford, Sr., established the Palo Alto Stock Farm on his 8,650 acres of land along San Francisquito Creek. Population in the region grew substantially during the early twentieth century. Palo Alto expanded significantly by early World War II (Jacobson 1984, Byrd and Meyer 2011).

Following World War II, the growth of light industry, such as salt evaporating ponds, and high-tech research and development, local land subsidence from groundwater use, coupled with expanding suburbanization gradually eroded the valley's orchards. However, vestiges of the old orchards persisted throughout the area. As late as 1970, the City of San Jose—which at that time had a population of almost half a million—was still classified as partly rural by the U.S. census, and scattered areas of undeveloped land such as the Grant Road "farm parcel" in the City of Mountain View still remained (Payne 1987). One of California's earliest highways, Route 2, cut through Palo Alto, and served as the state's main north-south artery in the 1910s. By 1926, Route 2 was redesignated as U.S. 101. In 1940, the City of Palo Alto prompted the construction of a bypass route to direct traffic around the City's downtown. By the end of World War II, the Division of Highways expanded the U.S. 101 bypass to four lanes (Byrd and Meyer 2011).

The largest landowner in the area is Stanford University, which was founded in 1885 on traditional territory of the Muwekma Ohlone Tribe. The City of Palo Alto was created to house professors at Stanford University in 1894. Menlo Park was founded in 1874 but dissolved 2 years later, and was incorporated again in 1927 and remains so to this day. The Sharon Heights portion of Menlo Park was purchased in the 1960s. The City of East Palo Alto was incorporated in 1983, but Ravenswood was the first planned community dating from 1849 in what would be unincorporated San Mateo County. A tumulus was discovered in 1951 during development of the University Village subdivision near today's Costaño School in East Palo Alto. After a year-long excavation of 60 graves and 3,000 artifacts, researchers concluded that Native Americans had used the area as a cemetery and camp, rather than as a permanent settlement. In later years another mound was found near Willow Road and the railroad right-of-way.

Tribal Cultural Sensitivity

Archaeological sensitivity directly relates to potential tribal cultural resources. To assess the potential for encountering buried archaeological and tribal cultural resources (referred to here as tribal cultural sensitivity) an Initial Cultural Resources Investigation was completed for the project in 2011 (Byrd and Meyer 2011). This document outlined the existing conditions of the study area and analyzed its archaeological sensitivity. This sensitivity analysis was based on age and distribution of surface deposits. This analysis also identified landform age and correlation to human occupation in the San Francisco Bay Area, and determined Holocene-age soils generally match up to early human occupation and are considered to be more sensitive for buried archaeological deposits. Holocene-age soils were found throughout the project area, and therefore it was determined that the project area has High to Very High archaeological sensitivity (Byrd and Meyer 2011).

Existing Historical and Architectural Conditions

Two structures—the University Avenue Bridge and Pope-Chaucer Street Bridge—are in the study area, within Reach 2. Both were evaluated as part of the Caltrans statewide historic bridge inventory, which was originally completed in 1986 and updated in 2015 (Caltrans 2007). This inventory assigned NRHP eligibility status to bridges in the survey population and the State Historic Preservation Officer concurred with the findings in 2015. The University Avenue Bridge (Caltrans Bridge number 35C0029), which spans San Francisquito Creek 0.01 mile south of Woodland Avenue, was originally built in 1925 and widened in 1958. The Pope-Chaucer Street Bridge (Caltrans Bridge number 37C0759), which spans San Francisquito Creek where Pope-Chaucer Street intersects with Woodland Avenue and Palo Alto Avenue, was built in 1906, and reconstructed in 1948. Both bridges were found to be ineligible for listing in the NRHP by the Caltrans state wide bridge inventory (Caltrans 2017). The bridges were surveyed for this project, with respect to their condition and integrity, and re-evaluated for the purposes of CEQA. Both were found ineligible for listing in the CRHR. Neither bridge is listed in local or state historical resources registers.

In addition, the Palo Alto Avenue-San Francisquito Creek potential historic district was identified in 2001 as part of an update to the Palo Alto Historical Survey and is being treated as a historical resource for the purposes of CEQA. The potential historic district consists of the "linear parkland on San Francisquito Creek and the residential neighborhood that borders it along Palo Alto Avenue. The parkland consists of El Palo Alto Park between Alma and Merson streets and Timothy Hopkins

Creekside Park from Emerson to Marlowe Street" (Dames & Moore 2001). The parkland was recognized as an unspoiled remnant of the riparian environment that was present when the community was established.

3.4.3 Impact Analysis

This section describes the impact analysis related to tribal cultural and historic/architectural resources for the project. It identifies the methods used to determine the impacts and lists the thresholds used to conclude whether an impact would be significant. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant impacts accompany the discussion of each identified significant impact.

Methods and Significance Criteria

Cultural Resources

Methods

The impact analysis for cultural resources was based on consultation with two local tribes, results of the records search, a review of prior cultural resources studies within the San Francisco Bay Region and the Santa Clara Valley, and professional judgment in light of the current standard of care for cultural resources within California.

Records Search

A records search was performed at the Northwest Information Center in Rohnert Park, California, on November 28, 2017 (IC#17-1496). The search identified 55 previously recorded resources, with 1 located within the project-level study area, 2 within the program-level study area, and 52 within a 0.5-mile radius of both the project and program-level study areas. A majority of these resources are positioned along San Francisquito Creek and largely dated to the prehistoric period. These resources are described below:

Reach 2 Resources

One precontact archaeological resource has been recorded within Reach 2:

P-43-000578 (CA-SCL-583) – This resource was originally identified in the 1960s, and three human burials were removed from the area along with associated funerary items, such as several hundred Olivella beads, several hundred fraction Olivella beads, bird bone whistle, bone awl, and cut and polished bone tube. This material is curated at the Stanford Museum. The resource was revisited in 1985 at which time a formal Department of Parks and Recreation (DPR) 523 form was completed. At this time, houses had been constructed on top of the resource and additional identification was not possible (Bocek and Rutherford 1985). This resource has not been formally evaluated for its eligibility for listing in the CRHR or NRHP.

Reach 3 Resources

Four precontact tribal cultural and archaeological resources have been recorded within the Reach 3:

Former Nursery Detention Basin Alternative

P-41-000293 (CA-SMA-289) – This resource was originally recorded in 1988 as a midden deposit with associated fire cracked rock (FCR) and lithic debitage. The resource has been subject to heavy erosion by San Francisquito Creek and disturbance by activities associated with a nursery that operated at the same location. The resource was revisited in 2010 and recorded to be in similar condition. Three hand auger holes were deployed to test for a subsurface component to the site. No cultural material was recovered at this time. In 2011, 19 archaeological test units were excavated and returned lithic debitage and other various prehistoric and historic material (Daly et al. 2012). This resource has not been formally evaluated for its eligibility for listing in the CRHR or NRHP.

P-41-000294 (CA-SMA-294) – This resource was originally recorded in 1988 as a midden deposit that had been subject to heavy erosion by San Francisquito Creek. Cultural constituents include FCR and lithic debitage (chert). This site was revisited in 2010 and was noted to be in similar condition. FCR, bone, and lithic debitage were noted on the surface (Daly et al. 2010a). This resource has not been formally evaluated for its eligibility for listing in the CRHR or NRHP.

Webb Ranch Detention Basin Alternative

P-41-000290 (CA-SMA-285) – This resource was originally recorded in 1988 as a concentration of lithic debitage, FCR, and minimal shell. At the time of recordation, the site was located within rows of berry bushes. The plowing of the agricultural fields may have churned up a subsurface component of this site, which site may exist. The resource was revisited in 2011 and a minimal amount of cultural material was observed (FCR). As of 2011, the area was still being used as a berry field (Daly et al 2011). This resource has not been formally evaluated for its eligibility for listing in the CRHR or NRHP.

P-41-000291 (CA-SMA-286) – This is a large site with stone tools, flakes, cores, and tool fragments mostly composed of chert. Although not thought to be an occupation site, it was interpreted to possibly be a tool-making area. The site update mentions a mortar, likely located in a secondary context (Daly et al. 2010b). This resource has not been formally evaluated for its eligibility for listing in the CRHR or NRHP.

A three-step process was followed to identify historic built resources and update existing evaluations: (1) undertake background research of previously recorded resources and completed reports within and adjacent to the study area, (2) develop approach and historic context for evaluation, and (3) conduct onsite fieldwork to inspect and record resources. Additional desktop research was conducted at the Palo Alto Historical Association website, newspapers.com, historicaerials.com, state, and national bridge inventories.

There are no historical resources recorded in the Reach 2 study area. For Reach 3, the Palo Alto Avenue-San Francisquito Creek potential historic district was identified in 2001 as part of an update to the Palo Alto Historical Survey and is being treated as a historical resource for the purposes of CEQA.

Field Survey

A pedestrian survey of the project-level study area was conducted on April 18, 2018, by both an ICF archaeologist and architectural historian, to identify historic-age built environment resources, archaeological deposits, and surface-exposed features. The archaeological survey consisted of walking across the project-level study area and visually inspecting the ground surface for indicators of surface and subsurface archaeological deposits. The archaeological survey also involved inspecting the local topography to identify areas that have been subject to modern anthropogenic landscape alteration.

The project study area was inspected for indicators of human activity such as dark midden soils, dietary shell and bone, stone or bone artifacts, and historic artifacts. The area was also examined for any larger, earthen features such as mounds or depressions. The area has been completely developed and consists of residential neighborhoods. The majority of the project site is within the limits of the creek and includes steep banks and heavy vegetation. Any visible ground surface has been disturbed and/or covered in fill and gravel. All visible ground surfaces appear to have been graded, landscaped, or developed.

The built environment survey consisted of walking the project-level study area and visually inspecting built resources for the potential to be age-eligible (50 years or older). Photographs were taken throughout the course of the survey (Appendix C).

Summary of Native American Outreach

On August 1, 2017, San Francisquito Joint Powers Authority (SFCJPA) staff contacted the Native American Heritage Commission (NAHC) requesting the following information:

- CEQA Tribal Consultation List (AB 52) – Per PRC Section 21080.3.1, subsections (b), (d), (e) and 21080.3.2
- Identification by the NAHC of any Native American resources within the subject lands that are listed in the Sacred Lands File (SLF).

A response from the NAHC was received on August 2, 2017, and stated that a search of the SLF did not identify sites; however, the letter specified that the area is sensitive for potential tribal resources.

The response from NAHC included the following list of individuals and tribal representatives who might have an interest in the project:

- Katherine Erolinda Perez, North Valley Yokuts Tribe
- Valentin Lopez, Chairperson, Amah Mutsun Tribal Band
- Ann Marie Sayers, Chairperson, Indian Canyon Mutsun Band of Costanoan
- Rosemary Cambra, Chairperson, Muwekma Ohlone Indian Tribe of the San Francisco Bay Area
- Andrew Galvan, Ohlone Indian Tribe
- Tony Cerda, Chairperson, Coastanoan Rumsen Carmel Tribe
- Irenne Zwierlein, Chairperson, Amah Mutsun Tribal Band of Mission San Juan Bautista

These individuals were contacted to initiate consultation under AB 52 if desired. Letters were mailed via priority mail on June 19, 2018, except the letter for Chairperson Valentin Lopez, Amah Mutsun Tribal Band, which was mailed on June 20, 2018, due to an incorrect address label. Emails were successfully sent to all seven contacts on June 20, 2018.

Responses were received from three of the seven contacts: Andrew Galvan, Ann Marie Sayers, and Valentin Lopez.

Mr. Galvan stated that he would like to consult on this project due to the numerous archaeological sites within or near the project. The SFCJPA provided him with a copy of the Phase I Literature Search. Mr. Galvan also requested results of any foot surveys. Although a foot survey was conducted in April of 2018 (see *Field Survey* above), no resources were identified; however, this was likely due to vegetation covering the area.

Ms. Sayers stated that the area is very sensitive for tribal resources, and further explained that there were burials adjacent to the creek that required relocation in the Reach 3 portion on Stanford property. She recommended that during any earthwork a Native American as well as an archaeologist be on site to monitor. She stated that the tribe is much vested in this area, and feels it is important to be involved.

Chair Lopez indicated in an email on July 8, 2018, that the area was outside the Amah Mutsun Tribal Band territory, and no further action was indicated.

Follow up correspondence with Mr. Galvan and Ms. Sayers occurred on February 5, 2019, and the SFCJPA and the U.S. Army Corps of Engineers met with Mr. Galvan on March 7, 2019.

The area that borders San Francisquito Creek is considered by local tribes consulting on this project to have a high to very high sensitivity for tribal cultural resources (Galvan pers. comm., Sayers pers. comm., Byrd and Meyer 2011).

A file of correspondence is available from the SFCJPA.

Significance Criteria

For the purposes of this analysis, an impact on cultural resources was considered to be significant and to require mitigation if it would result in any of the following.

- Substantial adverse change in the significance of a "historical resource" as defined in CEQA Guidelines Section 15064.5. Historical resource means a resource that is:
  - listed, or eligible for listing, in the NRHP;
  - listed, or eligible for listing, in the CRHR; or
  - included in a local register of historical resources, or otherwise identified as an important resource by a local jurisdiction or agency.
- Substantial adverse change in the significance of an archaeological resource meeting the above qualifications.
- Substantial adverse change in a "unique archaeological resource," as defined in Section 21083.2(g) of the PRC and State CEQA Guidelines Section 15064.5.
- Disturbance of human remains, including those interred outside of formal cemeteries.
- Substantial adverse change in the significance of a tribal cultural resource as defined in PRC Section 21074.

Impacts and Mitigation Measures

Historical and Architectural Resources

Impact CULT-1—Cause a substantial adverse change in the significance of a historical or architectural resource as defined in State CEQA Guidelines Section 15064.5

Summary by Project Element: Impact CULT-1—Cause a substantial adverse change in the significance of a historical or architectural resource as defined in State CEQA Guidelines Section 15064.5		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	No Impact	No Impact
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	No Impact	No Impact

Channel Widening Alternative and Floodwalls Alternative

The Channel Widening Alternative would primarily involve creek channel widening, replacing decades-old sacked concrete walls with more vertical, vegetated soil nail or sheet-pile walls. The Floodwalls Alternative would construct floodwalls at the top of the creek's banks instead of the channel widening. Both alternatives would replace the Pope-Chaucer Bridge.

There is one potential historical/architectural resource in the study area: the Palo Alto Avenue-San Francisquito Creek Historic District. However, the activities associated with the alternative are not located within this potential historic district. As such, the project would not cause a substantial adverse change in the significance of an historical resource pursuant to State CEQA Guidelines Section 15064.5, and there would be no impact.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

No historical or architectural resources are present in at these sites. Therefore, there would be no potential for impacts to occur.

Operations and Maintenance

Maintenance of a detention basin could involve periodic removal of sediment that accumulates within the basin during flood events, and transport of that sediment to an appropriate location. There would be no impact.

Impact CULT-2—Cause a substantial adverse change in the significance of a tribal cultural or archaeological resource as defined in State CEQA Guidelines Section 15064.5 and PRC Section 21084.3

Summary by Project Element: Impact CULT-2—Cause a substantial adverse change in the significance of a tribal cultural or archaeological resource as defined in State CEQA Guidelines Section 15064.5 and PRC Section 21084.3		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation
Former Nursery Detention Basin Alternative	Less than Significant with Mitigation	No Impact
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	No Impact

Channel Widening Alternative and Floodwalls Alternative

Construction

As outlined in *Methods/Records Search* above, one tribal cultural resource was identified within the project study area. P-43-000578 (CA-SCL-583) was originally recorded as a midden deposit with three associated human burials and associated funerary objects. This resource is within the area of proposed channel widening at Site 5. Excavation in this area could significantly impact this resource. Further, the entire Reach 2 was determined to have high to very high tribal cultural and archaeological sensitivity (Byrd and Meyer 2011). This determination indicates that any ground disturbing activities have increased potential for encountering as-yet undocumented archaeological resources. This impact would be significant. The implementation of Mitigation Measures (MM-) CULT-1 and MM-CULT-2 would reduce the impacts to less than significant.

MM-CULT-1: Conduct cultural resource awareness training prior to project-related ground disturbance and stop work if archaeological deposits are encountered during ground-disturbing activities

Prior to any project-related ground disturbance, SFCJPA will ensure that all construction workers receive training overseen by a qualified professional archaeologist who is experienced in teaching nonspecialists to ensure that contractors can recognize archaeological resources in the event that any are discovered during construction.

If tribal cultural or archaeological deposits are encountered during project-related ground disturbance, work in the area (100-foot radius) is to stop immediately. The onsite Native American monitor and onsite qualified archaeologist will assess and determine the path forward. Tribal cultural and archaeological deposits include, but are not limited to, flaked stone or groundstone, midden and shell deposits, historic-era refuse and/or structure foundations.

If any human remains are discovered during ground-disturbing activities, an evaluation will be performed to assess likely age and provenance in a manner that is respectful of the disturbed remains. If determined to be, or likely to be, Native American, SFCJPA will comply with state laws regarding the disposition of Native American burials, which fall within the jurisdiction of the Native American Heritage Commission (PRC Section 5097). If human remains are discovered or recognized in any location other than a dedicated cemetery, there will be no further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains until:

1. The county coroner has been informed by SFCJPA and has determined whether investigation of the cause of death is required; and
2. If the remains are of Native American origin:
   a. The descendants of the deceased Native Americans have made a recommendation to the landowner or the person responsible for the excavation work for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods as provided in PRC Section 5097.98; or
   b. The Native American Heritage Commission was unable to identify a descendent or the descendent failed to make a recommendation within 24 hours after being notified by the commission.

A solution that was employed upstream was the dignified transfer of remains to a location suitable to the Most Likely Descendent (MLD). The SFCJPA will work with our partners to determine the best solution acceptable to the Ohlone and Indian Canyon Mutsun Band of Costanoan tribes.

According to California Health and Safety Code, six or more human burials at one location constitute a cemetery (Section 8100), and disturbance of Native American cemeteries is a felony (Section 7052). Section 7050.5 requires that excavation be stopped in the vicinity of the discovered human remains until the coroner can determine whether the remains are those of a Native American.

MM-CULT-2: Develop and implement a Tribal Cultural and Archaeological Testing Plan

Due to the presence of known tribal cultural and archaeological resources in the proposed work area, archaeological testing will occur prior to any ground disturbance to determine the extent of the resource as well as its significance under CEQA. The Tribal Cultural Archaeological Testing Plan (TCATP) will include the following steps/sections:

- Background and anticipated resource types
- Research questions that can be addressed by the collection of data from the defined resource types
- Field methods and procedures
- Cataloging and laboratory analysis
- Findings and interpretation

The TCATP will then be implemented prior to construction to help determine the extent of archaeological resources within areas where there will be ground disturbance. The results of the study will be summarized into a technical document, compiled by a qualified archaeologist, who will determine whether further study is necessary. The technical document will also determine whether additional studies and/or mitigation will be needed. All technical documents will be submitted to the Northwest Information Center.

Operations and Maintenance

No ground disturbance is anticipated in association with project-level operations and maintenance. However, site access and vegetation removal have the potential to impact surface archaeological deposits. This impact could be significant. Implementation of MM-CULT-1 and MM-CULT-3 would reduce the impact to less than significant.

MM-CULT-3: Develop and implement a Tribal Cultural and Archaeological Monitoring Plan

Given the reasonable potential for tribal cultural and archaeological resources to be present within the proposed work area, the following measures will be undertaken to avoid any significant impacts on these potential resources. A Tribal Cultural and Archaeological Monitoring Plan (TCAMP) will be developed by a qualified archaeologist prior to any project-related ground disturbance to determine specific areas of archaeological sensitivity within proposed work areas. The TCAMP will determine whether an onsite Native American and qualified archaeological monitor is required during project-related ground disturbance. The TCAMP will include protocol that outlines tribal cultural and archaeological monitoring best practices, anticipated resource types, and an Unanticipated Discovery Protocol (UDP). The UDP will describe steps to follow if unanticipated archaeological discoveries are made during project activities work and a chain of contact.

Former Nursery Detention Basin Alternative

As outlined in *Methods/Records Search,* two precontact resources have been recorded within the proposed boundaries of the Former Nursery Site Detention Basin: P-41-000293 (CA-SMA-289) and P-41-000294 (CA-SMA-294), both of which are midden deposits with lithic debitage and shell identified on surface. Subsurface testing at P-41-000294 (CA-SMA-294) identified a buried component, which was vaguely recorded as lithic material.

Construction of the 12.4-acre, 14-foot deep detention basin at the Former Nursery site would require excavation to a maximum depth of 14 feet below ground surface. In addition, installation of the fish screen would require excavation to a maximum depth of 4 feet bgs. This excavation would impact both known archaeological sites, and the impact would be significant. Implementation of MM-CULT-1 and MM-CULT-2 would reduce this impact to less than significant. Maintenance activities, which consist of maintaining detention basin depth, would not have an impact.

Webb Ranch Detention Basin Alternative

As described in *Methods/Records Search*, two precontact archaeological resources were identified within the proposed location of the Webb Ranch Site Detention Basin: P-41-000290 (CA-SMA-285) and P-41-000291 (CA-SMA-286). Both of these resources consist of lithic debitage.

Construction of the 27.4-acre, 13-foot-deep detention basin at the Webb Ranch site would require excavation to a maximum depth of 13 feet bgs. In addition, installation of the fish screen would require excavation to a maximum depth of 4 feet bgs. This ground disturbance would impact both known archaeological resources, and the impact would be significant. Implementation of MM-CULT-1 and MM-CULT-2 would reduce this impact to less than significant. Maintenance activities, which consist of maintaining detention basin depth, would not have an impact.

Impact CULT-3—Disturb any human remains, including those interred outside of formal cemeteries

Summary by Project Element: Impact CULT-3—Disturb any human remains, including those interred outside of formal cemeteries		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant with Mitigation	Less than Significant with Mitigation
Former Nursery Detention Basin Alternative	Less than Significant with Mitigation	No Impact
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	No Impact

Channel Widening Alternative and Floodwalls Alternative

Construction

One precontact resource was identified within the project study area: P-43-000578 (CA-SCL-583). This resource was originally recorded as a midden deposit with three human burials and associated funerary objects. The extent of this resource is unknown, as systematic testing was not conducted at the time of recordation. Additional burials may be present within resource boundaries or in the vicinity of the resource. P-43-000578 is located within the area of proposed channel widening at Site 5, which would include ground disturbance up to 4 feet below channel bottom, or up to 26 feet bgs. This excavation, as well as additional planned work in the area could significantly impact this resource, and the impact would be significant. Implementation of MM-CULT-1 and MM-CULT-2 would reduce this impact to less than significant.

Operations and Maintenance

No ground disturbance is anticipated in association with project-level operations and maintenance. While site access and vegetation removal have the potential to impact surface archaeological deposit, human remains tend to be located within subsurface deposits. No excavation is associated with operation and maintenance; therefore, these activities are unlikely to impact human remains. However, due to the highly sensitive nature of the area, there is the potential to encounter human remains, and this impact would be significant. Implementation of MM-CULT-1 and MM-CULT-3 would reduce the impacts to less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

As described under Impact CULT-2, two precontact archaeological resources have been identified within the proposed Former Nursery Site Detention Basin, and two were also identified within the proposed Webb Ranch Site Detention Basin. While no burials have been recorded within these sites to date, given the sensitive nature of the area the potential remains to encounter buried human remains. Further, Reach 3 was determined to be highly sensitive for buried archaeological resources, which would indicate any ground disturbance within the Reach 3 would have the potential to impact as-yet unknown archaeological resources. This impact would be significant. Implementation of MM-CULT-1 and MM-CULT-2 would reduce this impact to less than significant.

Operations and Maintenance

Maintenance of the detention basin would involve removal of sediment that accumulates within the basin during flood events and transport of that sediment to an appropriate location. Removal of the sediment would not involve excavation beyond depth of the basin floor. There would be no impact.

3.4.4 Cumulative Impacts

The project area is considered very sensitive for tribal cultural and archaeological resources. Additionally, numerous archaeological sites, including human burials, have been recorded within both Reach 2 and 3. Therefore, a cumulative impact exists. The project incorporates mitigation that would have an onsite Native American and Archaeologist during all project-related ground disturbance, and requires the development and implementation of a Tribal Cultural Archeological Testing Plan, Tribal Cultural Archaeological Monitoring Plan, and a measure to stop work if archaeological deposits are inadvertently discovered. With implementation of these mitigation measures, the project's contribution to the cumulative impact would be less than cumulatively considerable.

Due to the direct coordination with California Native American tribes during the planning process, the project is anticipated to have a beneficial effect on the cumulative impact on tribal cultural resources.

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3.5 Geology and Soils

This section provides environmental analysis of the project's potential impacts on geological resources, including paleontological resources, and soils. The section summarizes the regulatory environment, describes the geologic setting, provides criteria for assessing potential impacts, discusses impacts that may result from implementing alternatives during construction and implementation, and describes mitigation to minimize the level of impact.

3.5.1 Regulatory Setting

Federal

The Clean Water Act of 1972 contains requirements that control activities that could affect water quality, including Section 402, which establishes the National Pollution Discharge Elimination System (NPDES), a permitting system for the discharges (except for dredge or fill material) of any pollutant into waters of the United States. The Regional Water Quality Control Boards (Regional Water Boards) administer this permitting program in California. Section 402(p) and require permits for discharges of stormwater from industrial/construction and Municipal Separate Storm Sewer Systems (MS4s). See Section 3.8, *Hydrology and Water Resources*, for more information on the Clean Water Act.

State

Geologic hazards and the professional practice in geology are regulated at the state and local levels. The principal state regulations governing assessment and mitigation of risks related to geologic hazards are the Alquist-Priolo Earthquake Fault Zoning Act and the Seismic Hazards Mapping Act, which established statewide processes to identify hazard areas and assign local jurisdictions the responsibility of evaluating and mitigating hazards within designated hazard areas. These two acts regulate structures built for human habitation and do not directly pertain to the project. However, information developed in support of these laws is useful for interpreting risk at the site.

The California Building Code requires evaluation of earthquake safety standards and retrofits for state-owned buildings during remodeling, and as such are not directly applicable to the project. The Cities of Palo Alto and East Palo Alto have adopted the California Building Standards Code as their standard (City of Palo Alto Municipal Code Chapter 16.04.010, City of East Palo Alto Municipal Code Chapter 15.08.010).

Local

Many cities and counties include geologic hazards as a factor in their land use planning, with the result being that their general plans and/or zoning ordinances reflect policies specifically aimed at reducing risk to life and property as a result of seismic and other types of geologic hazards.

In California, earthwork and construction activities are regulated at the local jurisdiction level through a multi-stage permitting process—grading permits are required for most types of earthwork, and additional permits are typically needed for various types of construction.

The purpose of local jurisdiction permit review is to ensure that proposed earthwork will meet the jurisdiction's adopted codes and standards. The City of Palo Alto, the City of East Palo Alto, the City of Menlo Park, San Mateo County, and Santa Clara County have adopted policies in their General Plans to minimize exposure to geologic hazards, including expansive soils, seismic hazards, subsidence, and slope stability (City of East Palo Alto 2016, City of Palo Alto 2017, City of Menlo Park 2013, San Mateo County 1986). In addition, the jurisdictions have adopted California Building Standards Code, including soils and foundation restrictions (City of Palo Alto Municipal Code Chapter 16.04.010, City of East Palo Alto Municipal Code Chapter 15.08.010, City of Menlo Park Municipal Code Chapter 12.04.010, San Mateo County Code of Ordinances 23.08.010, and Santa Clara County Code of Ordinances Sec. C3-1). Policies and ordinances are discussed below. The soils and foundation safety restrictions of the California Building Standards Code include Chapter 16s and 16A, which describe earthquake design data, requirements for documenting the design load-bearing values of soils at a project site, and structural load design; Chapters 18 and 18A, which specify how geotechnical investigations will be carried out, describe foundation requirements, assign seismic design categories for areas where structures would be constructed, describe site grading requirements, and provide presumptive load-bearing values of various soil types, among other issues; and Appendix J, Grading, which specifies characteristics of grading. Appendix J is required only for those jurisdictions that adopt it.

Depending on the extent, nature, and location of proposed earthwork and construction, the local jurisdiction permit process may require preparation of a site-specific geotechnical investigation, sometimes called a soils report. In some cases, this is required by state regulations (see discussion of Alquist-Priolo and Seismic Hazards Mapping Acts above). It may also be required by the California Building Standards Code. The purpose of a site-specific geotechnical investigation is to provide a geologic basis for the development of appropriate project design. Geotechnical investigations typically assess bedrock and Quaternary geology, geologic structure, soils, and previous history of excavation and fill placement; as appropriate, they may also include information specifically addressing the stipulations of the Alquist-Priolo Act, the Seismic Hazards Mapping Act, and/or local regulations.

Santa Clara Valley Water District (Valley Water) would have responsibility for project construction, including the bridge replacement. Therefore, their relevant regulations and requirements are included below as well.

Santa Clara Valley Water District

Valley Water's Water Resources Protection Ordinance (Ordinance 08-1) protects water resources managed by Valley Water by regulating modifications, entry, use, or access to their facilities and/or easements. The mechanism through which this protection is effected is the encroachment permit. Encroachment permits are issued to proposed projects to ensure that they would not impede, restrict, retard, pollute, change the direction of the flow of water, catch or collect debris carried by such water; damage, weaken, erode, cause siltation or reduce the effectiveness of the banks to withhold storm and flood waters; and other related constraints.

San Mateo County

General Plan

Geology and Soils

The following goals and objectives, definitions, and policies from the San Mateo General Plan (County of San Mateo 1986b) are relevant to paleontological resources.

Goal and objective 15.1. Minimizing Risks from Natural Hazards. Minimize the potential risks resulting from natural hazards, including but not limited to, loss of life, injury, damage to property, litigation, high service and maintenance costs, and other social and economic dislocations.

Goal and objective 15.3. Incorporate Information on Natural Hazards into Land Use and Development Decisions. Integrate data on natural hazards into review of land use and development proposals in order to identify hazardous areas, potential constraints to development and/or appropriate mitigation measures.

Definition 15.4. Definition of Natural Hazards. Define natural hazards as conditions of potential danger or risk to life and/or property resulting from acts of nature, man-made alterations to the natural environment that create hazardous conditions, and/or hazardous conditions intrinsic to the natural environment. Natural hazards may include risks or vulnerabilities likely to be caused or exacerbated by climate change.

Definition 15.5. Definition of Geotechnical Hazards. Define geotechnical hazards as: (1) seismic events, including but not limited to earthquakes, earthquake-induced landslides, liquefaction, subsidence, and tidal flooding damage from earthquake-induced tsunamis and seiches; (2) non-seismic unstable conditions, including but not limited to landsliding, cliff retrenchment, erosion, subsidence, soil creep and shrink/swell conditions; and (3) debris flows and debris avalanches.

Policy 15.12. Locating New Development in Areas Which Contain Natural Hazards.

a. As precisely as possible, determine the areas of the County where development should be avoided or where additional precautions should be undertaken during review of development proposals due to the presence of natural hazards.

b. Give preference to land uses that minimize the number of people exposed to hazards in these areas.

c. Determine appropriate densities and development.

d. Require detailed analysis of hazard risk and design of appropriate mitigation when development is proposed in these areas, including assessment of hazardous conditions expected to be exacerbated by climate change, such as increased risks of fire, flooding, and sea level rise.

Policy 15.13. Abatement of Natural Hazards.

a. Inventory and, where feasible, abate, repair, or rehabilitate natural hazard conditions which most directly threaten public health, safety, and property, giving priority to those hazards which directly threaten critical facilities, life and property.

b. Where feasible, provide for adaptive reuse rather than demolition of existing facilities.

Policy 15.15. Critical Facilities.

a. Where practical, avoid the location of new critical facilities in areas which contain significant natural hazards or are likely to contain significant natural hazards due to the impacts of climate change.

b. Continue to work with public utilities, school districts, and other agencies supplying critical public services to ensure that they have incorporated structural safety and other measures to be adequately protected from natural hazards for both existing and proposed facilities and are prepared for potential disasters affecting these facilities.

Policy 15.18. Determination of Existence of a Geotechnical Hazard.

a. When reviewing development proposals, use the Natural Hazards map to determine general areas where geotechnical hazards may be present.

b. When the Natural Hazards map does not clearly illustrate the presence or extent of geotechnical hazards, use more detailed maps, including but not limited to the Geotechnical Hazards Synthesis Maps prepared by Leighton and Associates for San Mateo County, geotechnical information maps prepared by the United States Geological Survey, or any other geotechnical investigation or source of information considered to be valid by the County Department of Public Works.

Policy 15.20. Review Criteria for Locating Development in Geotechnical Hazard Areas.

a. Avoid the siting of structures in areas where they are jeopardized by geotechnical hazards, where their location could potentially increase the geotechnical hazard, or where they could increase the geotechnical hazard to neighboring properties.

b. Wherever possible, avoid construction in steeply sloping areas (generally above 30%).

c. Avoid unnecessary construction of roads, trails, and other means of public access into or through geotechnical hazard areas.

d. In extraordinary circumstances when there are no alternative building sites available, allow development in geotechnically hazardous and/or steeply sloping areas when appropriate structural design measures to ensure safety and reduce hazardous conditions to an acceptable level are incorporated into the project.

Policy 15.21. Requirement for Detailed Geotechnical Investigations.

a. In order to more precisely define the scope of the geotechnical hazards, the appropriate locations for structures on a specific site and suitable mitigation measures, require an adequate geotechnical investigation for public or private development proposals located: (1) in an Alquist-Priolo Special Studies Zone, or (2) in any other area of the County where an investigation is deemed necessary by the County Department of Public Works.

b. In order to minimize economic impacts on applicants for development and avoid duplication of information, use the existing information base when the Department of Public Works or appropriate County agency determines that it is adequate.

Paleontological Resources

The following goal and objective, definitions, and policies from the San Mateo General Plan (County of San Mateo 1986b) are relevant to paleontological resources.

Goal and objective 5.3. Protection of Archaeological/Paleontological Sites. Protect archaeological/ paleontological sites from destruction in order to preserve and interpret them for future scientific research, and public educational programs.

Definition 5.7. Definition of Historic Resource. Define historic resources as buildings, structures, signs, features, sites, places, areas or other objects of scientific, educational, cultural, architectural, archaeological, historical or paleontological significance to the citizens of the County.

Definition 5.9. Definition of Historic Landmark. Define historic landmark as any historic resource, district or paleontological site that has exceptional scientific, historic, cultural, archaeological, aesthetic character, interest, or value.

Policy 5.20. Site Survey. Determine if sites proposed for new development contain archaeological/ paleontological resources. Prior to approval of development for these sites, require that a mitigation plan, adequate to protect the resource and prepared by a qualified professional, be reviewed and implemented as a part of the project.

Policy 5.21. Site Treatment.

a. Encourage the protection and preservation of archaeological sites.

b. Temporarily suspend construction work when archaeological/paleontological sites are discovered. Establish procedures which allow for the timely investigation and/or excavation of such sites by qualified professionals as may be appropriate.

c. Cooperate with institutions of higher learning and interested organizations to record, preserve, and excavate sites.

Policy 5.26. Discovering Unrecorded Archaeological/ Paleontological Sites. Support comprehensive studies to discover unrecorded archaeological and paleontological sites, particularly in areas under pressure for development.

Municipal Code

The County of San Mateo has adopted current California Building Standards Code requirements, including seismic restrictions (San Mateo County Code of Ordinances 23.08.010).

The County requires a site development planning application and a site development permit for any work done on real property if (1) grading will exceed an area of 5,000 square feet and 5,000 cubic feet (185 cubic yards), (2) grading will exceed a volume of 550 cubic yards, or (3) grading requires special consideration because of physical site conditions or protection of public safety (23.40.030). In addition, the same requirements apply for work done on slopes as specified in the Slope Setbacks table (23.40.030).

Santa Clara County

General Plan

Geology and Soils

The following strategy and policy from the Santa Clara County General Plan (County of Santa Clara 1994) are relevant to geology and soils.

Strategy #3. Design, Locate and Regulate Development to Avoid or Withstand Hazards

Policy C-HS 33. Development in areas of natural hazards should be designed, located, and otherwise regulated to reduce associated risks, by regulating the type, density, and placement of development where it will not:

a. be directly jeopardized by hazards;

b. increase hazard potential; and

c. increase risks to neighboring properties.

Paleontological Resources

The following policy from the Santa Clara County General Plan (County of Santa Clara 1994) is relevant to paleontological resources.

Policy C-RC 1. Natural and heritage resources shall be protected and conserved for their ecological, functional, economic, aesthetic, and recreational values.

….

2. Heritage resources[1] shall be preserved to the maximum extent possible for their scientific, cultural, or place values, and they shall not be diminished due to inadequate safeguards.

Municipal Code

The County of Santa Clara has adopted current California Building Standards Code requirements, including seismic restrictions (Santa Clara County Code of Ordinances Sec. C3-1).

The County requires a grading permit for any work done on any real property that involves (a) cuts or fills, which each independently are greater than 150 cubic yards; (b) cut or fill that is greater than 5 feet in vertical depth at its deepest point when measured from the natural ground surface; or (c) work that alters, diverts, or impairs the flow of water in a watercourse (Santa Clara County Code of Ordinances Sec. C12-406). Grading permits must include final grading and drainage plans (Sec. C12-465). Such plans such include, among other issues, information for accurate contour lines, location, extent, and finished surface slopes of all proposed grading and final cut and fill lines; construction details for roads, watercourses, culverts, bridges and drainage devices, retaining walls, cribbing, dams, erosion prevention, and sediment control measures and other improvements existing or to be

[1] The County of Santa Clara's General Plan defines *heritage resources* to include paleontological resources.

constructed; and estimate of the quantity of excavation and fill adjusted for swell or shrinkage, locations of borrow sites or locations for disposal of surplus material, and location of property lines.

City of East Palo Alto

General Plan

Geology and Soils

The following goal and policies from the Safety and Noise chapter of the Vista 2035 East Palo Alto General Plan (City of East Palo Alto 2016a) are relevant to geology and soils.

Goal SN-1. Reduce the risk to people and property from earthquakes and other geologic hazards.

Policy 1.1. Construction requirements. Apply the proper development engineering and building construction requirements to avoid or minimize risks from seismic and geologic hazards.

Policy 1.2. Robust seismic guidance. Utilize and enforce the most recent State guidance for seismic and geologic hazards when evaluating development proposals.

Policy 1.3. Licensed geologist. Require that a state licensed engineering geologist prepare and/or review development proposals involving grading, unstable soils, and other hazardous conditions. Incorporate recommendations of the geologist into design plans, potentially including building modifications and open space easements.

Paleontological Resources

The following goal and policy from the Parks, Open Space, and Conservation chapter of the Vista 2035 East Palo Alto General Plan (City of East Palo Alto 2016b) are relevant to paleontological resources.

Goal POC-9. Protect historic, natural, mineral, and cultural resources.

Policy 9.1. Archeology, paleontology and natural resources. Protect areas of important archaeological paleontological and natural resources.

Municipal Code

The City of East Palo Alto has adopted current California Building Standards Code requirements, including seismic restrictions (City of East Palo Alto Municipal Code Chapter 15.08.010).

The City of East Palo Alto requires that grading shall not be commenced and no structure shall be altered except in compliance with the approved Site Plan and Design Review and associated imposed conditions (City of East Palo Alto Municipal Code Chapter 18.86.070). Grading must be conducted in conformance with performance standards specified in the Grading Permit Performance Standards Handbook (Chapter 15.48.160). To obtain a grading permit, two sets of the grading plan must be submitted. The plan shall contain, among other issues, information concerning property boundaries, location of existing structures, elevations, locations, extent, and slope of all proposed grading shown by contours, and a statement of the quantities of materials to be excavated and/or filled and the amount of such material to be imported or exported (Chapter 15.48.050).

City of Palo Alto

General Plan

Geology and Soils

The following goal and policies from the Safety chapter of the 2030 Comprehensive Plan (City of Palo Alto 2017) are relevant to geology and soils.

Goal S-2. Protection of life, ecosystems and property from natural hazards and disasters, including earthquake, landslide, flooding, and fire.

Policy S-21. Incorporate the City's Local Hazard Mitigation and Adaptation Plan (LHMP), as periodically adopted by the City Council and certified by the Federal Emergency Management Agency (FEMA), into the Safety Element. In the event of any conflict between the provisions of the LHMP and any other provision of the Safety Element, the LHMP shall control.

Policy S-25. Minimize exposure of people and structures to geologic hazards, including slope stability, subsidence and expansive soils, and to seismic hazards including groundshaking, fault rupture, liquefaction and landslides.

Paleontological Resources

No policies in the 2030 Comprehensive Plan (City of Palo Alto 2017) are relevant to paleontological resources.

Municipal Code

The City of Palo Alto has adopted current California Building Standards Code requirements, including seismic restrictions (City of Palo Alto Municipal Code Chapter 16.04.010).

The City of Palo Alto requires that a site permit for grading, filling, excavation, storing, and disposing of soil and earth materials, including temporary construction-related dewatering, except in accordance with specific listed exemptions (City of Palo Alto Municipal Code Chapter 16.28.060). Applications for the permit must include a range of plans, including a site map and grading plan, an interim erosion and sediment control and storm water pollution plan, a final erosion and sediment control and storm water pollution prevention plan, a soils engineering report (unless waived by city engineer), an engineering geology report (unless waived by city engineer), and other miscellaneous information (Chapter 16.28.090). Requirements for the site map and grading plan are described in Chapter 16.28.110, and include among other issues information about the existing and proposed topography of the site, property lines of the site, location of all existing and proposed natural and manmade drainage facilities, and location of proposed excavations, fills, and onsite storage of soil and other earth material, and onsite disposal.

City of Menlo Park

General Plan

Geology and Soils

The following goal and policies from the Open Space/Conservation, Noise and Safety Elements of the City of Menlo Park General Plan (City of Menlo Park 2013) are relevant to geology and soils.

Goal S1. Assure a safe community.

Policy S1.1. Location of Future Development. Permit development only in those areas where potential danger to the health, safety and welfare of the residents of the community can be adequately mitigated.

Policy S1.2. Location of Public Improvements. Avoid locating public improvements and utilities in areas with identified flood, geologic and/or soil hazards to avoid any extraordinary maintenance and operating expenses. When the location of public improvements and utilities in such areas cannot be avoided, assure that effective mitigation measures will be implemented.

Policy S1.3. Hazard Data and Standards. Integrate hazard data (geotechnical, flood, fire, etc.) and risk evaluations into the development review process and maintain, develop and adopt up-to-date standards to reduce the level of risk from natural and human-caused hazards for all land use.

Policy S1.13. Geotechnical Studies. Continue to require site-specific geologic and geotechnical studies for land development or construction in areas of potential land instability as shown on the State and/or local geologic hazard maps or identified through other means.

Policy S1.14. Potential Land Instability. Prohibit development in areas of potential land instability identified on State and/or local geologic hazard maps, or identified through other means, unless a geologic investigation demonstrates hazards can be mitigated to an acceptable level as defined by the State of California.

Paleontological Resources

No policies in the Menlo Park General Plan (City of Menlo Park 2013, 2016) are relevant to paleontological resources.

Municipal Code

The City of Menlo Park has adopted current California Building Standards Code requirements, including seismic restrictions (City of Menlo Park Municipal Code Chapter 12.04.010).

The City of Menlo Park requires all improvements to conform to the city's standard details and specifications on file with the city engineer, and deviation requires written approval from the city engineer (City of Menlo Park Municipal Code Chapter 15.16.140). Grading and improvement plans shall be approved by the city engineer, and permits shall be obtained before construction is started.

Other

California Building Standards Code

California Building Standards Code (CBSC) is the building code for California and Title 24 of the California Code of Regulations (CCR). Part 2 encompasses the California Building Code. CBSC lays out requirements for grading, foundations, structures, and other aspects of construction. Chapters 18 and 18A address soils and foundations, and Appendix J addresses grading.

Chapter 18 states that geohazard reports are required for all proposed construction with a few exceptions, i.e., some one-story structures not located in Earthquake Fault Zones or Seismic Hazard Zones, alterations, and structural repairs. The geohazard reports must identify geologic and seismic conditions that may require project mitigations. The reports must include data that provide an assessment of potential for earthquake damage, potential seismic shaking at the site, and project foundation conditions. Most local jurisdictions in California have adopted the current version of the CBSC.

Chapter 18 also describes requirements for geotechnical investigations that may be required by local jurisdictions granting permits. Geotechnical investigations must identify seismic, geologic, and soils conditions at a proposed project site and must include, among other information, recommendations for foundation type and design criteria. The current version is from 2016.

Society of Vertebrate Paleontology

The Society of Vertebrate Paleontology (SVP) published a set of guidelines for protecting paleontological resources from project impacts (*Society of Vertebrate Paleontology Conformable Impact Mitigation Guidelines 1995*, as revised in 2010) that are widely followed and considered industry standard for environmental evaluations.

3.5.2 Environmental Setting

Study Area

The study area for geology and soils is described by an area within a 150-foot buffer of the project footprint for fault rupture, soil hazards, and ground failure (Figures 3.5-1a and 3.5-1b). This study area is located along San Francisquito Creek west of San Francisco Bay at the southeastern edge of the San Francisco peninsula, and at two possible floodwater detention facility sites near San Francisquito Creek.

The study area for seismic ground shaking is the Peninsula and adjacent coastal, South Bay, and East Bay areas.

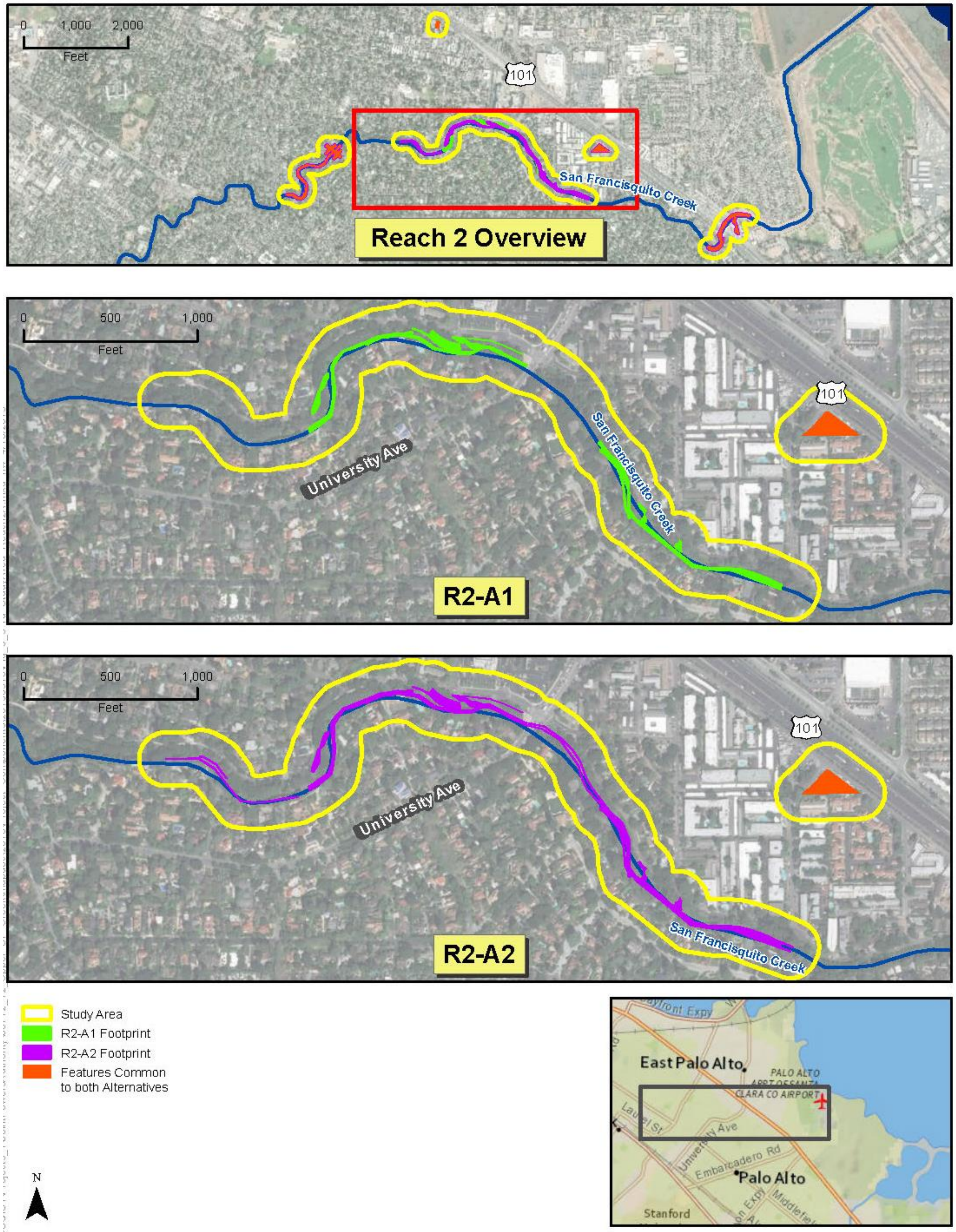


Figure 3.5-1a. Study Area, Reach 2

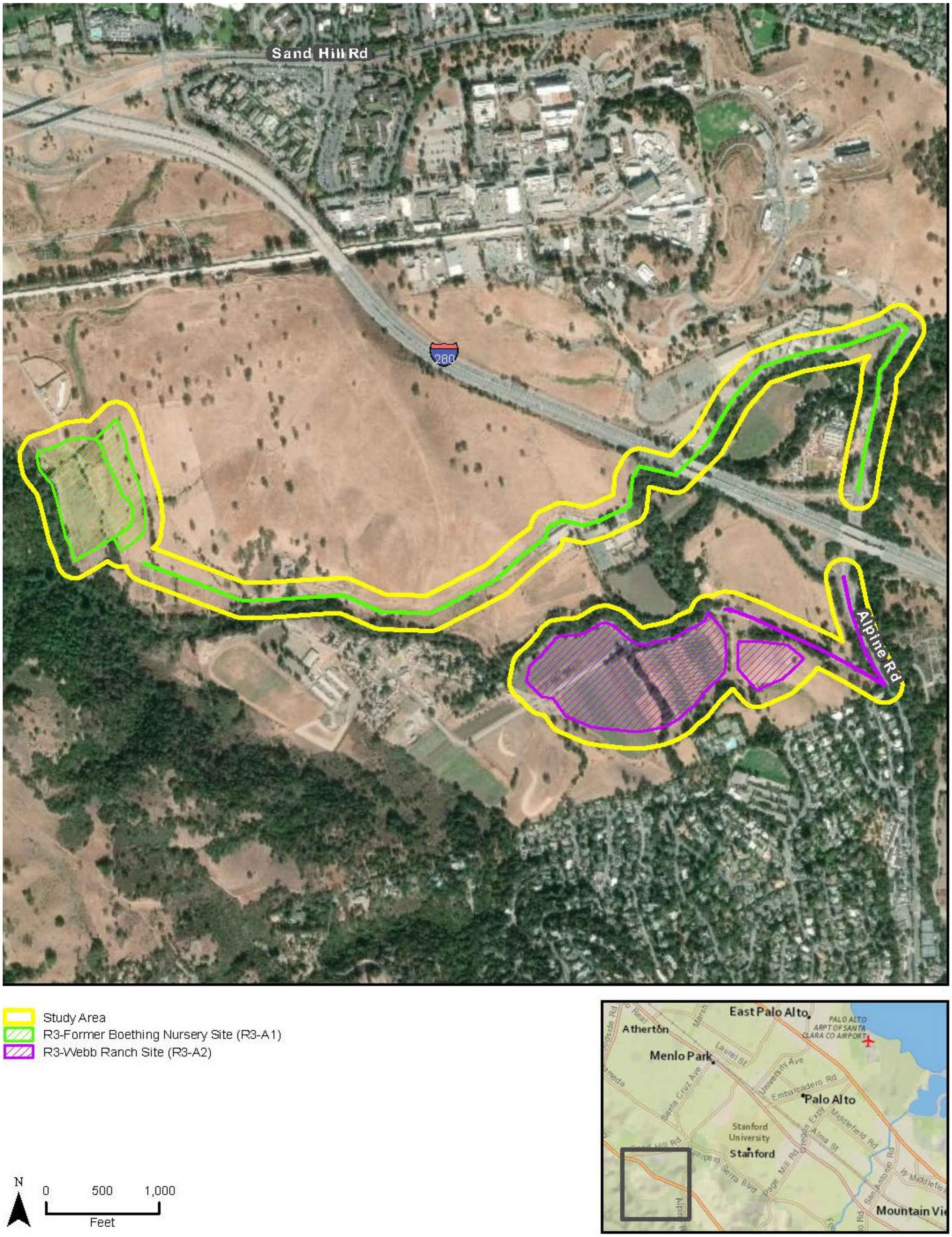


Figure 3.5-1b. Study Area, Reach 3

Project Setting

Geographic Location and Regional Geomorphic Setting

The project area falls within the California Coast Ranges Geomorphic Province. In the southern San Francisco Bay region this province is subdivided into three northwest-trending geomorphic features: the Santa Cruz Mountains on the west, the Santa Clara Valley and southern Bay, and the Diablo Range to the east. Two major fault systems (San Andreas to the west and Hayward-Calaveras to the east) approximately separate these features and have caused the central block to be progressively dropped down, allowing accumulation of a thick sequence of sediments derived from the adjacent crustal blocks.

Before the development of these fault systems, most of what is now California was formed by accretion and deformation of marine sediments and volcanic rocks carried from the west on an oceanic crustal plate and scraped off as the plate was subducted under the western edge of the North American continental plate. Rocks formed and altered by these processes range in age from about 205 million to 65 million years and are known as the Franciscan Complex (Sloan 2006). These rocks form the basement below the sequence of sedimentary deposits which underlie the study area.

San Francisco Bay occupies a regional topographic low elevation (Bay depression) that includes the Santa Clara Valley to the south as well as the Petaluma, Sonoma, and Napa Valleys to the north (Norris and Webb 1990). The Bay depression is a comparatively young feature, believed to have formed during approximately the last 1 million years (e.g., Sedlock 1995).At the latitude of the project, the Bay depression is bounded by the Santa Cruz Mountains on the west and the East Bay hills and northernmost Diablo Range on the east. Bedrock exposed in the Santa Cruz Mountains west of the study area includes Mesozoic Franciscan Complex sandstone and marine sedimentary rocks of Eocene through Miocene age; the Santa Cruz Mountains are flanked along the valley margin by an apron of Pliocene and Quaternary alluvium (Wagner et al. 1991). The San Francisco Bay and its margins are largely underlain by Holocene Bay Mud (Graymer et al. 2006). West of the Bay margin, the City of Palo Alto is largely underlain by Holocene alluvium (Graymer et al. 2006). This unconsolidated alluvium consists of deposits from the tributaries draining to San Francisco Bay during the Holocene (San Francisquito Creek Joint Powers Authority 2004), underlain by Pleistocene deposits (Maguire and Holroyd 2016).

The San Francisquito Creek watershed drains a 45-square-mile area in the southeastern San Francisco Peninsula adjacent to the San Francisco Bay, and includes portions of East Palo Alto, Menlo Park, Palo Alto, Portola Valley, and Woodside as well as unincorporated areas within San Mateo and Santa Clara Counties, and Stanford University (ICF 2012). The present project area encompasses only the lower part of San Francisquito Creek between East Bayshore Freeway (U.S. 101) and the San Francisco Bay, a channel length of 1.47 miles. In this reach, San Francisquito Creek coincides with the San Mateo/Santa Clara County boundaries.

Geologic Setting

As discussed above under *Geographic Location and Regional Geomorphic Setting*, the Franciscan Complex forms the basement below the sequence of sedimentary deposits that underlie the study area. Although a thick sequence of sedimentary rock formations of Tertiary age (65 million to 2.6 million years) exists below the lower reaches of San Francisquito Creek, only younger

(Quaternary) deposits are now present at and near the surface (Brabb et al. 2000). Most of these were deposited in the latest portion of the Quaternary Period, termed the Holocene Epoch (about 11,800 years to the present). Older sediments are present at and near the surface in the upper reaches of the creek (Brabb et al. 2000).

The Quaternary Period comprises the Pleistocene Epoch (about 2.6 million years to about 11,700 years ago) and the Holocene (Recent) Epoch, approximately the past 11,700 years (International Commission on Stratigraphy 2018). The Pleistocene Epoch is informally termed the Ice Age, although the period also includes several warm intervals during which the climate differed little from that of today. Mountain glaciers in the Sierra Range expanded during the intervening colder intervals (Moore and Moring 2013). However, there is no evidence of glaciation in the Coast Ranges in the San Francisco Bay area (e.g., Holway 1911).

During the Pleistocene Epoch, changes in world-wide sea level caused by alternating periods of glacial ice accumulation and melting resulted in several cycles of flooding and drying of the San Francisco Bay (Sloan 2006). As widespread continental glaciers melted for the last time in the late Pleistocene and early Holocene, sea level rose and began to fill the Bay, though the pace of inundation slowed between about 6,000 and 7,000 years ago (Middle Holocene), allowing accumulation of widespread tidal marsh deposits (Atwater et al. 1977). Subsequent development of floodplains and the latest widespread inundation of the Bay have left a varied sedimentary record in the upper portions of the stratigraphic record.

Sediments from the Miocene (5 to 23 million years ago) and Eocene Epochs (34 to 56 million years ago) are present at the upstream reaches of the creek. The Miocene Epoch was warmer than the preceding Oligocene or the following Pliocene Epoch. As the climate warmed and dried during the Miocene Epoch, open vegetation systems, such as grasslands and desert, began to develop, as closed vegetation systems, such as forests, shrank (University of California Museum of Paleontology 2011a). The Sierra Nevada mountains formed in California, resulting in a drier mid-continental climate. During the early Eocene Epoch, which preceded the Miocene Epoch, temperatures were warm, averaging 30 degrees Celsius (University of California Museum of Paleontology 2011b). There was high precipitation and little to no ice. During the middle Eocene, tectonic plates shifted and changed oceanic and atmospheric circulation, resulting in a global cooling.

Site Geology

Brabb et al. (2000), County of San Mateo 2018, and Ehman and Witebsky 2006 describe the following geologic map units in the project area (Figure 3.5-2a and Figure 3.5-2b).

- **Flood-plain deposits (Holocene) (Qhfp)—**Medium to dark-gray, dense, sandy to silty clay. Lenses of coarser material (silt, sand, and pebbles) may be locally present. Flood-plain deposits usually occur between levee deposits (Qhl) and basin deposits (Qhb).
- **Natural levee deposits (Holocene) (Qhl)**—Loose, moderately to well-sorted sandy or clayey silt grading to sandy or silty clay. These deposits are porous and permeable and provide conduits for transport of ground water. Levee deposits border stream channels, usually both banks, and slope away to flatter flood plains and basins. Abandoned levee systems, no longer bordering stream channels, have also been mapped.

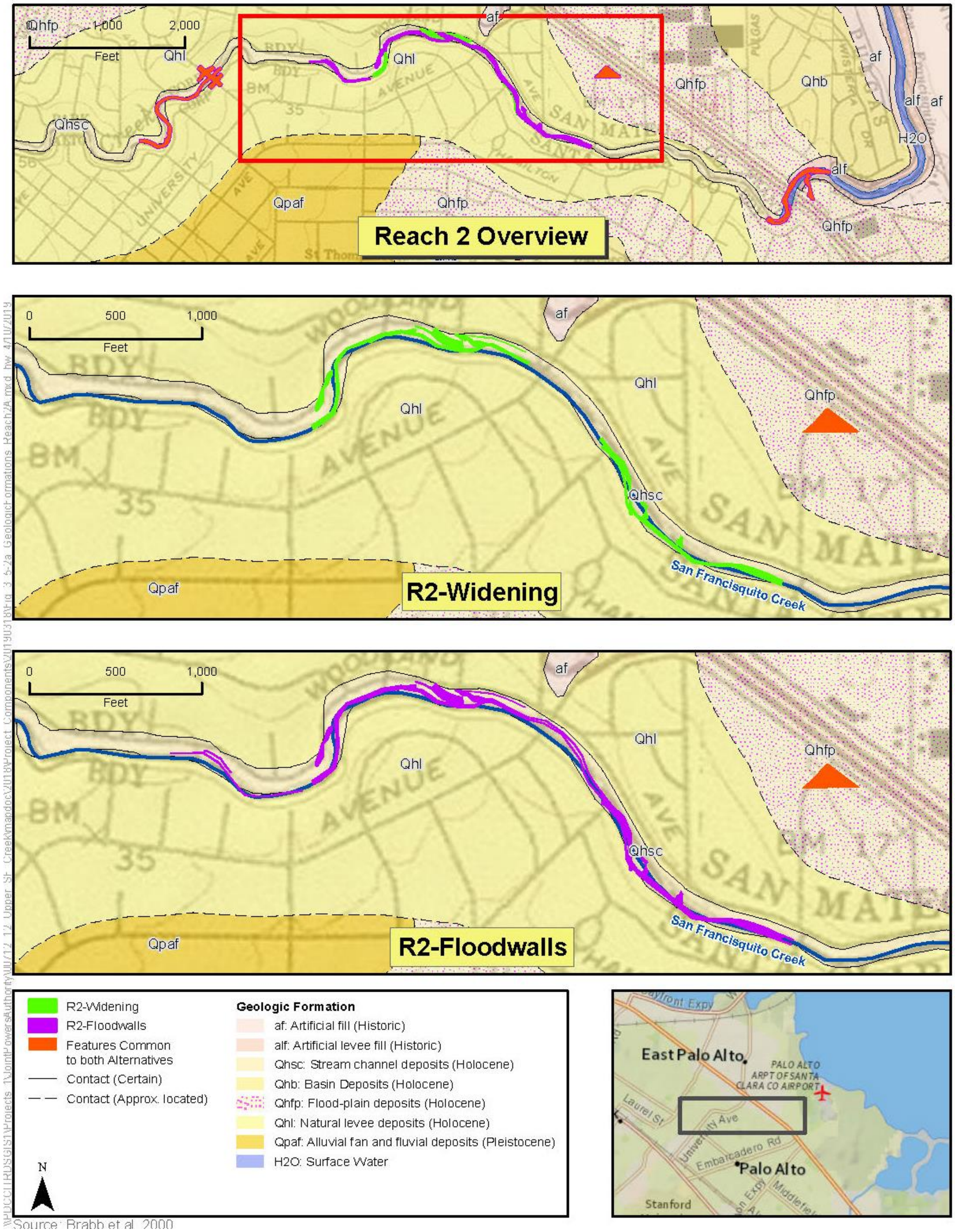
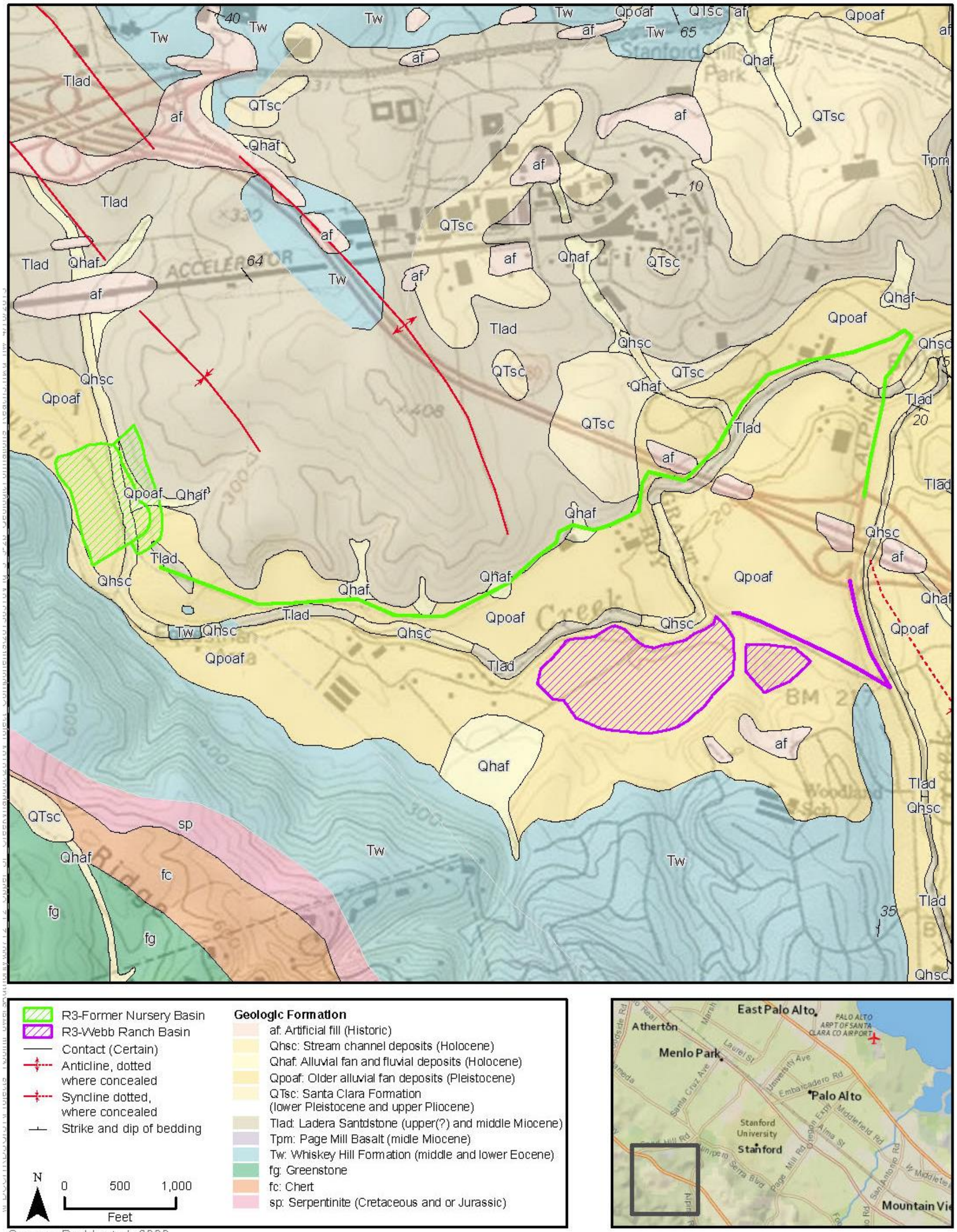


Figure 3.5-2a. Geologic Units, Reach 2



Source: Brabb et al. 2000

Figure 3.5-2b. Geologic Units, Reach 3

- **Older alluvial fan deposits (Pleistocene) (Qpoaf)**—Brown, dense, gravelly and clayey sand or clayey gravel that fines upward to sandy clay. These deposits display various sorting qualities. All deposits can be related to modern stream courses. They are distinguished from younger alluvial fans and fluvial deposits by higher topographic position, greater degree of dissection, and stronger profile development. They are less permeable than younger deposits, and locally contain fresh-water mollusks and extinct Pleistocene vertebrate fossils.
- **Ladera Sandstone (upper [?] and middle Miocene) (Tlad)**—Medium- to light-gray to yellowish-gray and buff, fine-grained, poorly cemented sandstone and siltstone, with minor amounts of coarse-grained sandstone, yellow-brown dolomitic claystone, and white to light-gray porcelaneous shale and porcelanite. Fine-grained sandstone and siltstone comprise more than 90% of the formation. Coarse-grained sandstone crops out in beds less than a few meters thick in lower half of section; dolomitic claystone and porcelaneous shale beds are less than a meter thick and outcrop through the upper half of the section; porcelanite crops out in thin-bedded lenses less than a few meters thick in the lower part of the section. At and near base of Ladera Sandstone are medium to thick lenticular beds of well-cemented, fossiliferous, chert-granule sandstone which interfingers with fine-grained sandstone.
- **Whiskey Hill Formation (middle and lower Eocene) (Tw)**—Light-gray to buff, coarse-grained arkosic sandstone, with light-gray to buff silty claystone, glauconitic sandstone, and tuffaceous siltstone. Sandstone beds constitute about 30% of the map unit. Tuffaceous and silty claystone beds are expansive. Locally, sandstone beds are well cemented with calcite. At apparent base of section on north side of Jasper Ridge, just east of Searsville Lake, a thin greenstone-pebble conglomerate is present. In places within this map unit, sandstone and claystone beds are chaotically disturbed.

Geotechnical Considerations

The project is near the mapped location of the contact between Holocene Bay Mud and Holocene alluvial deposits (San Mateo County 2002). Downstream of Alameda de Las Pulgas Road, a geologic profile shows a layer of coarse channel bed materials (gravel, cobbles, and boulders) extending to Middlefield Road. These coarse materials overlie a sandy deposit that in turn overlies a thick layer of Bay Mud sediments that contain interbedded lenses of alluvium. Bay Mud sediments are believed to extend in the subsurface upstream as far as San Mateo Drive (San Francisquito Creek Joint Powers Authority 2004).

San Francisquito Creek is deeply incised in bedrock in the upper watershed (San Francisquito Creek Joint Powers Authority 2004). Downstream of Alameda de Las Pulgas Road, the creek is deeply incised in alluvium. Debris that slides along the steep slopes of the creek banks is a significant sediment source in San Francisquito Creek, and larger debris flows have occurred episodically along the creek. Debris flows along the creek are typically caused by saturated soil as a result of heavy precipitation. Earthquakes are also a cause of debris flows in the seismically active San Francisco Bay Area (San Francisquito Creek Joint Powers Authority 2004). In the upper watershed in the Santa Cruz Mountains, landslides, including deep-seated landslides, or rotational or translational failures in bedrock, are the dominant erosion process (San Francisquito Creek Joint Powers Authority 2004). The study area in the upper watershed include areas subject to landslides (California Department of Conservation 2006).

Site-specific subsurface exploration encountered interlayered, firm lean clay, loose to medium-dense clayey and clean sand and silts (Kleinfelder 2013). The cohesive soils generally are firm. Along Reach A, soft to firm lean clay was encountered between depths of 18 to 33 feet. These may correspond to marginal Bay Mud deposits.

Paleontological Resources

Paleontological Sensitivity of Geologic Units

Flood-Plain Deposits (Qhfp) and Natural Levee Deposits (Qhl)

As stated above under *Project Setting*, the unconsolidated alluvium underlying Palo Alto consists of deposits from the tributaries draining to San Francisco Bay during the Holocene (San Francisquito Creek Joint Powers Authority 2004), underlain by Pleistocene deposits (Maguire and Holroyd 2016). This unconsolidated old alluvium can be more than 1,000 feet thick near San Francisquito Creek, while it is thinner in the upland area (San Mateo 2018). The boundary between this unconsolidated Holocene and Pleistocene alluvium in the east and the Ladera Sandstone and Whiskey Hill bedrock in the upper watershed to the west is near Alameda de las Pulgas Road (San Francisquito Creek Joint Powers Authority 2004, Metzger 2002).

Late Holocene sedimentary deposits are generally considered too young geologically to contain significant paleontological resources (Society of Vertebrate Paleontology 2010). Middle and early Holocene deposits, such as are found in parts of Santa Clara Valley, are considered capable of yielding significant fossils (Maguire and Holroyd 2016). In addition, Pleistocene vertebrate fossils have been found from multiple localities in units mapped as surficial Holocene deposits across Santa Clara Valley, including Molecular Medicine Building, Stanford University; Alma Street Underpass at Page Mill Road; Matadero Creek and Veterans Hospital, Matadero Creek, Palo Alto; and multiple localities farther south. Radiocarbon dating of the mapped Holocene sediments where the Pleistocene remains were found shows Pleistocene age for two of these finds; for the others, no dating was performed. Some of these finds may have washed down from the mountains and been deposited in Holocene waterways, but the two radiocarbon-dated finds likely originated where they were found. Depths ranged from 2 to 33 feet below present ground surface. These occurrences "demonstrate that older sediments and fossils (>10 thousand years before present) occur at or very near the surface in these areas" (Maguire and Holroyd 2016), particularly because the amount, association, and orientation of the fossils from these localities indicate that the sediments in which they occur have not been reworked through geologic or artificial processes. Accordingly, Pleistocene alluvium may be more widespread and shallower in the Santa Clara Valley than was previously thought, and Pleistocene fossils resources are likely present in Santa Clara Valley in units mapped as Holocene alluvium, including flood plain deposits and natural levee deposits. Vertebrate fossils documented include extinct species of mammoth, bear, horse, bison, and camel. The Quaternary alluvium of the Santa Clara Valley, which includes the Holocene geologic units in the study area, is considered to have high sensitivity for paleontological resources.

Older Alluvial Fan Deposits (Qpoaf)

Non-marine sedimentary deposits of Pleistocene age have potential to yield significant fossils, including vertebrate fossils. While the University of California Museum of Paleontology does not list any records specifically recorded for older alluvial fan deposits, a number of Pleistocene fossils, including vertebrate fossils, have been recorded in Santa Clara (Maguire and Holroyd 2016). This geologic unit is considered to have high sensitivity for paleontological resources.

Ladera Sandstone (Tlad)

Vertebrate fossils recovered from the marine Ladera Sandstone include seal, whale, shark, and species of *Paleoparadoxia*, a genus of large, herbivorous aquatic mammal (Pampeyan 1993, Ehman and Witebsky 2006, University of California Museum of Paleontology 2018). This unit is considered to have high sensitivity for paleontological resources.

Whiskey Hill Formation (Tw) Webb Ranch Detention Basin Alternative

Fossils recovered from this formation are marine microfossils and foraminifers (Pampeyan 1993, University of California Museum of Paleontology 2018). This unit is considered to have undetermined sensitivity for paleontological resources.

The paleontological sensitivity of each unit is summarized in Table 3.5-1.

Table 3.5-1. Geologic Units in the Paleontological Study Area

Symbol	Geologic Unit	Epoch	Paleontological Sensitivity	Alternative(s)	Notes
Qhfp	Flood-plain deposits	Holocene	High	Channel Widening Alternative Floodwalls Alternative	In most areas, units are likely too young to yield fossils. However, recent research suggests that the Quaternary alluvium of the Santa Clara Valley, including flood-plain deposits, may be more paleontologically sensitive than previously recognized.[1]
Qhl	Natural levee deposits	Holocene	High	Channel Widening Alternative Floodwalls Alternative	In most areas, units are likely too young to yield fossils. However, recent research suggests that the Quaternary alluvium of the Santa Clara Valley, including natural levee deposits, may be more paleontologically sensitive than previously recognized.[1]

Symbol	Geologic Unit	Epoch	Paleontological Sensitivity	Alternative(s)	Notes
Qpoaf	Older alluvial fan deposits	Pleistocene	High	Former Nursery Detention Basin Alternative Webb Ranch Detention Basin Alternative	Direct correlation is not known, but this unit has potential to contain fossils based on fossils found in similar local units.
Tlad	Ladera Sandstone	Upper(?) and middle Miocene	High	Former Nursery Detention Basin Alternative	This unit has yielded vertebrate fossils.[2]
Tw	Whiskey Hill Formation	Middle and lower Eocene	Undetermined	Webb Ranch Detention Basin Alternative	This unit has yielded marine microfossils, including foraminifera fossils.[2] There is no record of vertebrate fossils. Because of its age and depositional context, there is a possibility that this unit could yield significant fossils.

Sources: Society of Vertebrate Paleontology 2010, Brabb et al. 2000, University of California Museum of Paleontology 2018, Maguire and Holroyd 2016, Pampeyan 1993.

Notes:

1 Maguire and Holroyd 2016.

2 Pampeyan 1993

Location of Alternatives on Sensitive Geologic Units

Reach 2 project elements would be located on flood-plain deposits (Qhfp) and natural levee deposits (Qhl) of Holocene age (younger than 10,000 years) (Brabb et al. 2000). Specifically, one staging area would be on flood plain deposits, and all other project elements would be on natural levee deposits. Holocene materials are not typically evaluated as sensitive for paleontological resources because biological materials are not considered fossils *sensu stricto* unless they are more than 10,000 years old. However, the thickness of the Holocene sediments—and therefore the depth to potentially more sensitive deposits of Pleistocene age—at the site is not precisely known. As discussed above under *Flood-Plain Deposits (Qhfp) and Natural Levee Deposits (Qhl)*, recent research in the Santa Clara Valley, including at sites very near the paleontological resources study area, suggests that Pleistocene strata are at shallow depths throughout the Santa Clara Valley (Maguire and Holroyd 2016). Therefore, these project elements would be located on geologic units with high paleontological sensitivity.

Reach 3 alternatives would be located on older sediments that are identified above as high and undetermined paleontological sensitivity (Brabb et al. 2000). The Former Nursery Detention Basin Alternative would be on older alluvial fan deposits (Qpoaf) and on Ladera Sandstone (Tlad), both with high paleontological sensitivity. The Webb Ranch Detention Basin Alternative would be on older alluvial fan deposits and on Whiskey Hill Formation (Tw). Whiskey Hill Formation has undetermined paleontological sensitivity.

Local Seismic Setting

Primary Seismic Hazards

Primary seismic hazards include fault rupture and seismic ground shaking. Risk of fault rupture on California's mapped faults has been assessed by the California Department of Conservation under the Alquist-Priolo Earthquake Fault Zoning Act (see Section 3.5.1, *Regulatory Setting*). The study area is not within an earthquake fault zone as defined by the State of California pursuant to the Alquist-Priolo Act.

The project is located near a number of mapped faults known to be active and thus capable of generating seismic ground shaking, including the San Andreas and Monte Vista−Shannon faults to the west, and the Hayward and southern Calaveras faults across the Bay to the east. As a result, the study area is likely to be subject to periodic strong seismically induced ground shaking. Table 3.5-2 shows these fault names, their regulatory status, the maximum credible earthquake (MCE) (the largest earthquake likely to occur in the geologic framework), and the distance from the fault to the closest project facility. Figure 3.5-3 shows the locations of these principal active faults.

Table 3.5-2. Zoned Active Faults in Project Vicinity

Fault	Zoning Status[1]	MCE Magnitude	Distance from Closest Project Facility (miles)*	Closest Facility
Monte Vista–Shannon	Zoned by state	6.2[2]	1.8	Webb Ranch Detention Basin Alternative—Webb Ranch site
San Andreas	Zoned by state	7.0–7.9[2]	1.6	Former Nursery Detention Basin Alternative—Former Nursery site
Hayward	Zoned by state	7.2[2,3]	11.1	Channel Widening Alternative and Floodwalls Alternative—Site 5
Calaveras	Zoned by state	6.8–7.5[2]	16	Channel Widening Alternative and Floodwalls Alternative—Site 5
San Gregorio	Zoned by state	7.5–7.7[2,3]	10.7	Former Nursery Detention Basin Alternative—Former Nursery site

Fault	Zoning Status[1]	MCE Magnitude	Distance from Closest Project Facility (miles)*	Closest Facility
Greenville	Zoned by state	7.3[2]	29.3	Channel Widening Alternative and Floodwalls Alternative—Site 5
Green Valley	Zoned by state	6.7[2]	42.6	Channel Widening Alternative and Floodwalls Alternative—Site 2

Sources: California Geological Survey 2010, U.S. Geological Survey 2017, Bryant and Hart 2007, California Department of Conservation 2002, Mualchin 1996, Weber and Cotton 1981.

Notes: *Distances rounded to one-half mile.

[1] Bryant and Hart 2007; California Department of Conservation 2002.

[2] Mualchin 1996.

[3]Weber and Cotton 1981.

Other nearby faults, active in the Quaternary period but not zoned by the state, are the Pulgas fault, San Jose fault, and Stanford fault (U.S. Geological Survey 2017). Table 3.5-3 shows the closest proximity of each of these faults to each alternative, and Figure 3.5-4 maps the faults with respect to the Reach 2 alternatives.

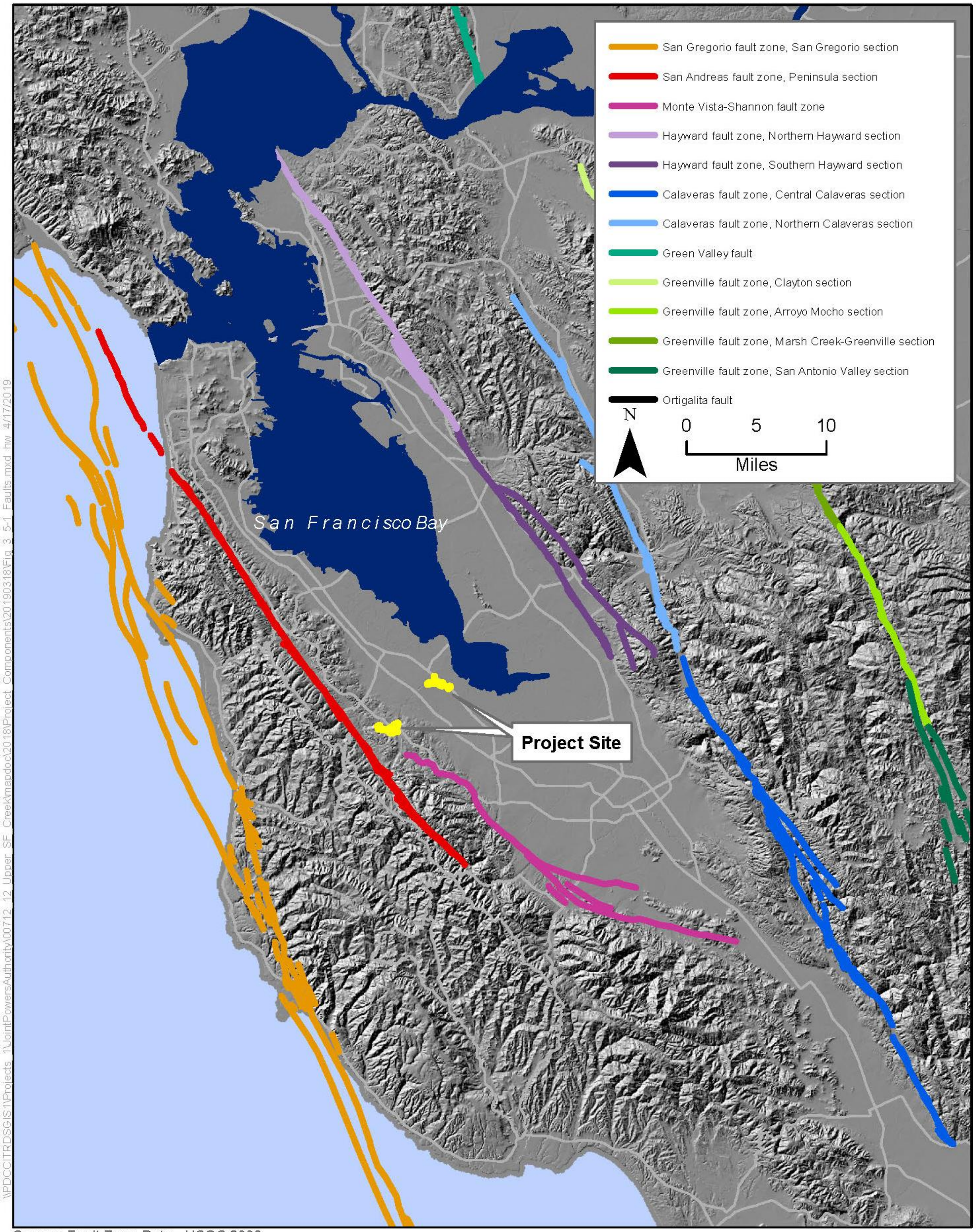
Table 3.5-3. Proximity of Quaternary Faults to the Alternatives (miles)

Alternative	Closest Facility	Pulgas	San Jose	Stanford
Channel Widening Alternative	Sites 1 and 2	0.1	2.1	1.2
Floodwalls Alternative	Floodwalls	0	2.1	1.2
Former Nursery Detention Basin Alternative	Former Nursery Site	1.1	3.8	2.1
Webb Ranch Detention Basin Alternative	Webb Ranch Site	1.4	4.2	2.5

Source: California Geological Survey 2010, U.S. Geological Survey 2017

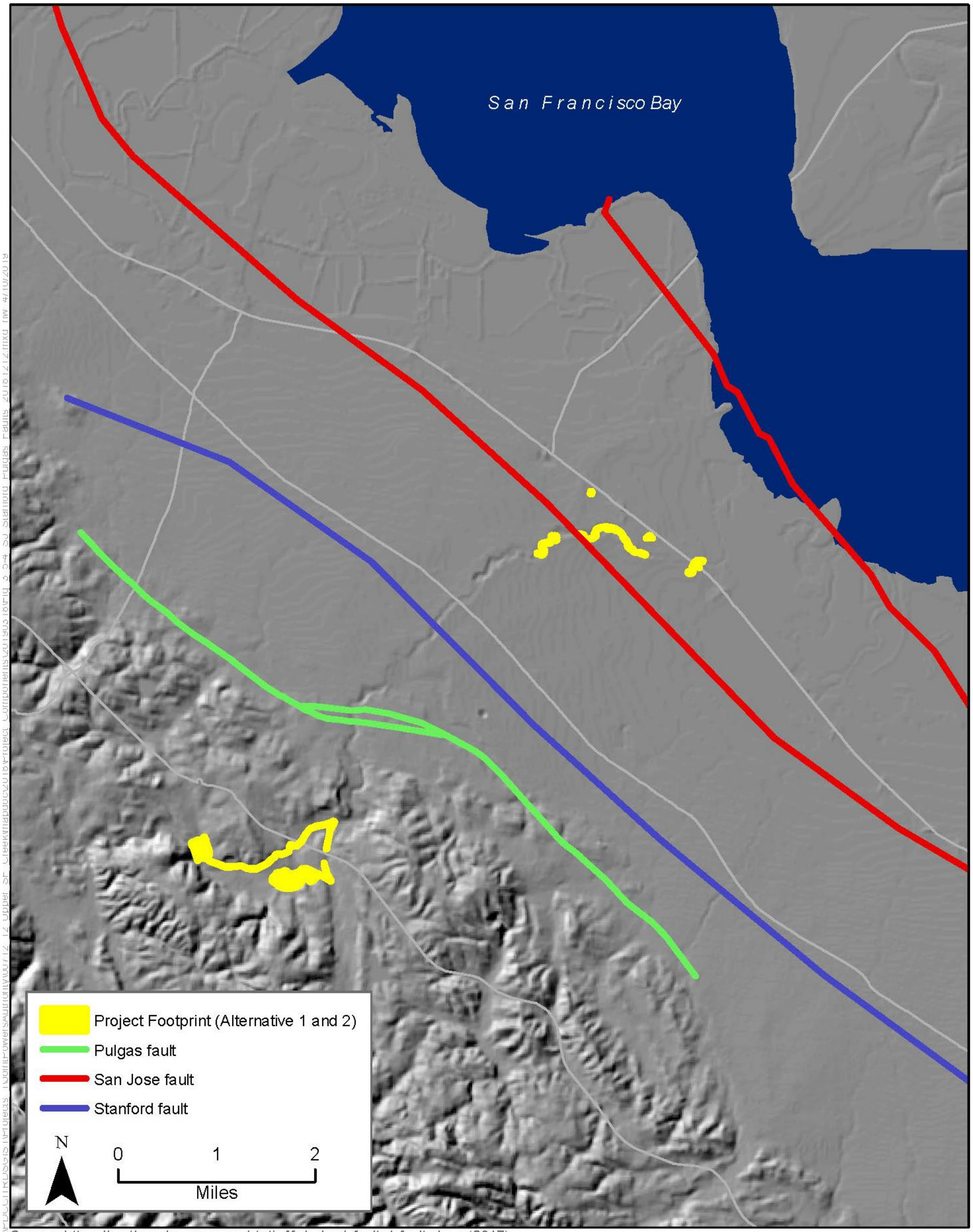
The Pulgas and Stanford faults are considered probably active (Pampeyan 1993). The most recent movement on the San Jose fault likely predates the Quaternary deposition of surficial deposits in the Santa Clara Valley; however, it is also considered potentially active (Graymer 1997).

Field et al. (2015), members of the 2014 Working Group on California Earthquake Probabilities, estimate that there is a 72% likelihood of an earthquake of magnitude 6.7 occurring in the San Francisco Bay Area over the 30-year period beginning in 2014.



Source: Fault Zone Data - USGS 2006

Figure 3.5-3. Regional Faults



Source: https://earthquake.usgs.gov/static/lfs/nshm/qfaults/qfaults.kmz (2017)

Figure 3.5.4. Faults near Reach 2

Secondary Seismic Hazards

Liquefaction

Seismically induced liquefaction is loss of bearing strength and stiffness during seismic ground shaking (GEI Consultants 2012). Soils most susceptible to liquefaction are poorly consolidated and saturated.

The area along San Francisquito Creek is identified as a seismic hazard zone for liquefaction under the California Seismic Hazards Mapping Act (California Department of Conservation 2006), discussed in Section 3.5.1, *Regulatory Setting*. Just east of Alameda de las Pulgas Road, the liquefaction hazard zone broadens from a narrow corridor along the creek in the upstream area to a broader swatch extending several blocks to the south of the creek (California Department of Conservation 2006).

Accordingly, the project elements in the Channel Widening Alternative and Floodwalls Alternative are in an area subject to seismically induced liquefaction along San Francisquito Creek and San Francisco Bay (DOC 2006a, 2006b). The detention ponds in the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are in an area subject to liquefaction along San Francisquito Creek (DOC 2006a). Further, site-specific analysis found that the upper clayey sand and silt with sand materials encountered along the analysis reaches would be susceptible to liquefaction (Kleinfelder 2013).

Lateral Spreading and Slope Failure

Lateral spreading is the horizontal movement of relatively flat-lying sediment toward an open or "free" face such as a body of water, channel, or excavation (GEI Consultants 2012). Lateral spreading is one consequence of liquefaction. Much of the site along the Channel Widening Alternative and Floodwalls Alternative lies along an incised channel in an area subject to liquefaction (California Department of Conservation 2006a, 2006b).

A possible effect of seismically induced liquefaction along the creek channel is lateral spreading and bank failure toward the channel (Kleinfelder 2013).

Landslide

Some slopes near San Francisquito Creek are identified as a seismic hazard zone for landslide under the California Seismic Hazards Mapping Act (California Department of Conservation 2006a). These include slopes south of the creek near Jasper Ridge, specifically across the creek from the Former Nursery Site and south of the creek near Stanford Golf Course adjacent to the Webb Ranch Site. The area downstream starting at Pope-Chaucer Bridge and beyond is not mapped as subject to landslide. This landslide deposit could be vulnerable to movement actuated by seismic activity but also by heavy rainfall or excavation that could destabilize the deposit.

Settlement

Settlement can result from multiple causes, including immediate settlement, consolidation settlement, and liquefaction. Immediate settlement results when a new load is placed on compressible soils. Consolidation settlement results over time in saturated or nearly saturated soils, when increased pore fluid pressure causes pore fluid to be expelled from the soil matrix. As the pore fluid is forced from the soil, the increased load is transferred from the pore fluid to the soil particles, compressing them together. The amount of possible consolidation settlement depends on compressibility of the soil and the magnitude of the load.

Settlement can also occur as a result of liquefaction when ground shaking causes soil densification. The degree of soil densification depends on the original density of the soil particles, the magnitude of the cyclic stressor (ground shaking), and presence of water. Post-liquefaction settlement could be 1 to 3 inches in case of the design earthquake[2] of magnitude 8.0 (Kleinfelder 2013).

One possible result of settlement is differential settlement. Differential settlement is the uneven settlement of soils as a result of variable compression of soils at a site. Differential settlement can damage structures.

Subsidence

Land subsidence as a result of groundwater pumping for agricultural irrigation was first detected in the Santa Clara Valley in 1933 (USGS 2018). By 1967, surveys showed that land in some areas of the Valley had subsided by up to 8 feet, with about 2 feet in Palo Alto and East Palo Alto (County of San Mateo 2018). As early as the 1930s, Valley Water began aquifer recharge through the use of dams, water importation, and, later in the 1960s, a pumping tax. In the current day, small elastic, or recoverable, subsidence occurs through seasonable changes, but subsidence as a result of groundwater pumping has been effectively halted by decreased groundwater pumping and the switch to using imported water, primarily from the Hetch Hetchy reservoir system purchased through the San Francisco Public Utilities Commission. Today, Stanford pumps groundwater from wells near San Francisquito creek for irrigation, and wells are used for potable supply for parts of East Palo Alto and Menlo Park. In Palo Alto, old supply wells are on standby status for use in an emergency. The groundwater basin is considered to be in balance; that is, groundwater withdrawals are approximately equal to groundwater recharge (County of San Mateo 2018).

Local Soils

Soils within the study area vary widely with respect to their characteristics, suitability for engineering uses, and susceptibility to runoff and erosion. In intensively developed areas, little remains of the native soil profile. Table 3.5-4 summarizes soils present in the study area and their characteristics most relevant to the project. Figures 3.5-5a and 3.5-5b map the soils in the study area.

Table 3.5-4. Soils in the Study Area

Soil Map Symbol	Soil Map Unit	Runoff Rate	Water Erosion Hazard	Wind Erosion Hazard	Shrink-Swell Potential
101	Accelerator-Fagan association, 5 to 15% slopes	High to very high	Slight to Moderate	Low	Low to moderate
102	Accelerator-Fagan-Urban land complex, 5 to 15% slopes	High to very high	Slight to moderate	Low	Low to moderate

[2] A *design earthquake* is the earthquake magnitude which a structure is designed to withstand.

Soil Map Symbol	Soil Map Unit	Runoff Rate	Water Erosion Hazard	Wind Erosion Hazard	Shrink-Swell Potential
108	Botella-Urban land complex, 0 to 5% slopes	Medium to very high	Slight	Low	Moderate
124	Orthents, cut and fill-Urban land complex, 5 to 75% slopes	Very high	Not rated	Not rated	Not rated
131u	Urban land	Very high	Not rated	Not rated	Not rated
131 and 131scl	Urban land-Elpaloalto complex, 0 to 2% slopes	Very low to very high	Slight	Low to moderate	Moderate to high
143scl	Flaskan sandy clay loam, 5 to 9% slopes	Medium	Slight	Moderate	Low to high
169 and 169scl	Urbanland-Elder complex, 0 to 2% slopes, protected	Very low to very high	Slight	Moderate	Low

Source: Natural Resources Conservation Service 2018.

Erosive Soils

As shown in Table 3.5-4, some soils in the study area present a moderate erosion hazard along Reach 2 (Figure 3.5-5a). Soils along Reach 2 present a slight to moderate erosion hazard (Figure 3.5-5b).

A particular kind of erosive vulnerability is associated with soils adjacent to streambanks. Seepage, or transport of sediment from a streambank face through liquefaction of the soil particles, can result in erosion. As discussed above under *Local Geology*, debris flows along San Francisquito Creek occur intermittently as a result of saturated soil from heavy precipitation.

As discussed in Section 3.8, *Hydrology and Water Resources*, currently, the banks of San Francisquito Creek are subject to erosion, particularly in response to high discharges, where bank instability is present, or where vegetation becomes disturbed. Erosion by surface water flows is most susceptible where slopes are steep. Five erosion monitoring sites have been established along Reach 2 to monitor potential erosion. These sites were established due to their proximity and importance for a single-family home downstream of Pope-Chaucer Bridge that was built between the Woodland Avenue and the creek bank. This is the only surface structure on the San Mateo County side of the creek that was built on the top of bank between Pope-Chaucer and Highway 101. Inspections by Valley Water engineers indicate that this area of creek bank does not currently show signs of active erosion. See Section 3.8, *Hydrology and Water Resources*, for more information about these erosion monitoring sites.

Expansive Soils

As shown in Table 3.5-4, some soils in the study area present moderate to high expansiveness or shrink-swell behavior. The soils with moderate or high shrink-swell potential may not be suitable for use in constructing flood control facility embankments or as a subgrade to bridge foundations without treatment. The engineering design for the facilities may specify that such soils be lime-stabilized or removed and replaced with imported, suitable material.

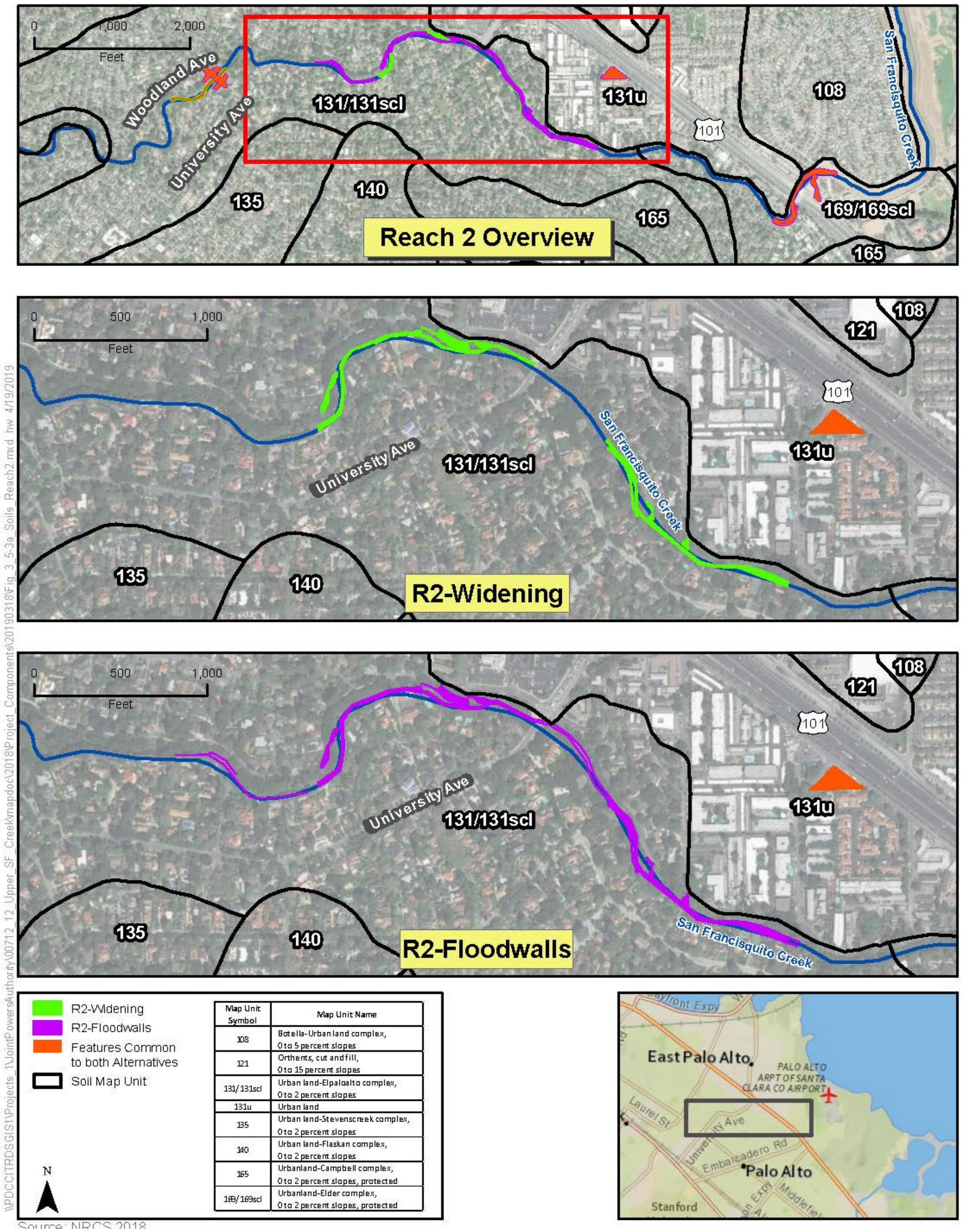
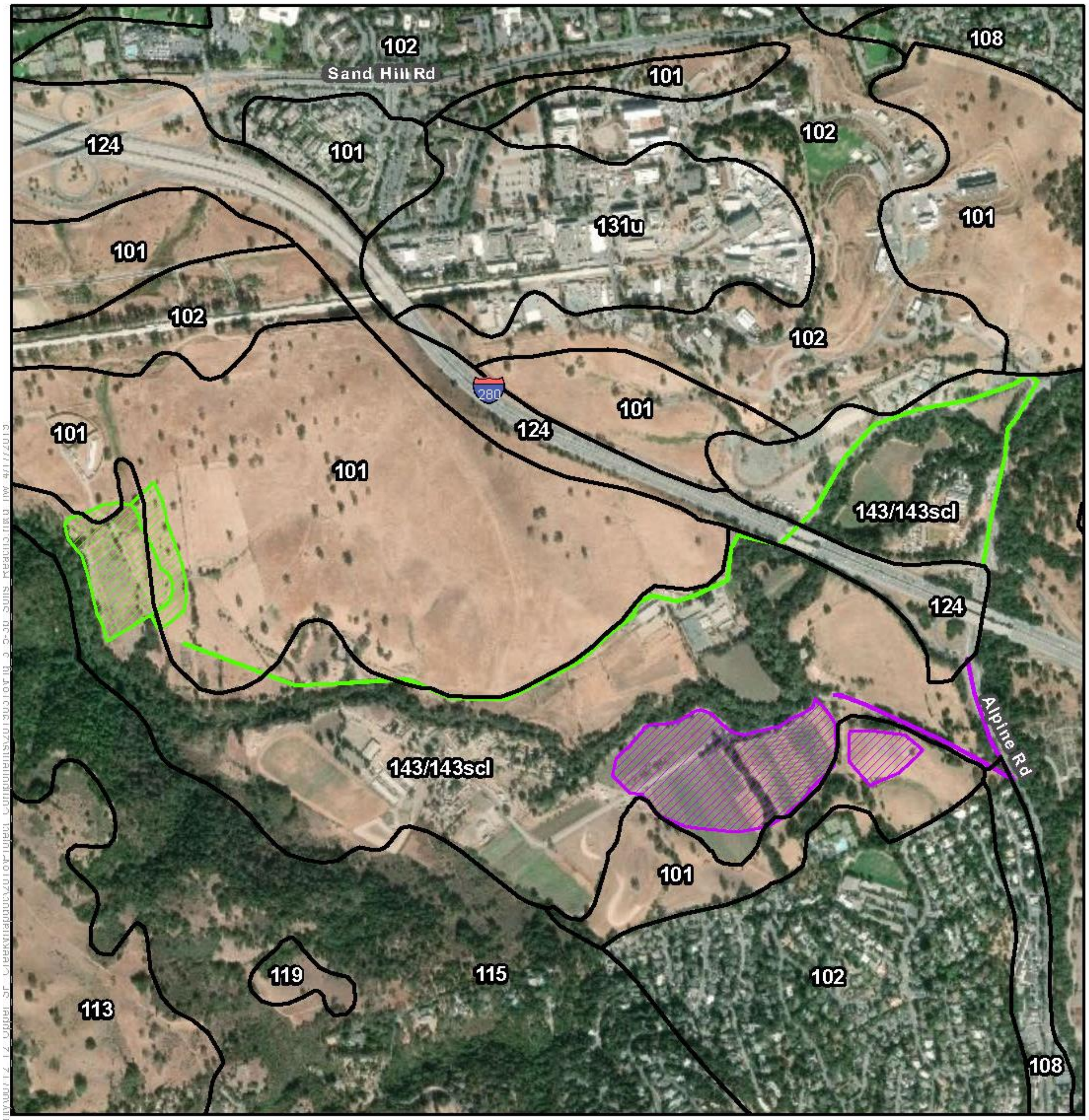


Figure 3.5-5a. Soils, Reach 2



R3-Former Nursery Basin
R3-Webb Ranch Basin
Soil Map Unit

N 0 500 1,000 Feet

Map Unit Symbol	Map Unit Name
101	Accelerator-Fagan association, 5 to 15 percent slopes
102	Accelerator-Fagan-Urban land complex, 5 to 15 percent slopes
108	Botella-Urban land complex, 0 to 5 percent slopes
113	Fagan loam, 15 to 50 percent slopes
115	Los Gatos loam, 30 to 75 percent slopes, MLRA 15
119	Obispo clay, 5 to 15 percent slopes
124	Orthents, cut and fill-Urban land complex, 5 to 75 percent slopes
131u	Urban land
143/143scl	Flaskan sandy clay loam, 5 to 9 percent slopes
335	Montavista-Togasara complex, 2 to 9 percent slopes

Source: NRCS 2018.

Figure 3.5-5b. Soils, Reach 3

Groundwater

Groundwater in the project area is part of the Santa Clara Valley Groundwater Basin, and San Francisquito Creek forms the boundary between the San Mateo Plain Groundwater Basin and the Santa Clara Groundwater Basin. Locally, groundwater has been defined by the U.S. Geological Survey (USGS) as the San Francisquito Alluvial Aquifer, and most groundwater wells are found near San Francisquito Creek (County of San Mateo 2018). Regional groundwater is from the highlands to the Bay, with the depth to groundwater encountered during field exploration along the creek from 10 to 15 feet deep, appearing to coincide with water level in the creek channel (Kleinfelder 2013). Undisclosed variations in subsurface conditions likely exist in the study area, and seasonal variation in groundwater levels is likely.

3.5.3 Impact Analysis

Methods and Significance Criteria

Impacts related to geology, paleontology, soils, and mineral resources were evaluated qualitatively, based on professional judgment in light of the current standards of care for engineering geology, hydrogeology, geotechnical engineering, and mineral resources conservation and management. Impact analysis relied on information from the published geologic literature; no new field studies or other research were conducted for the preparation of this EIR.

Impacts related to geologic, soils, and seismic hazards were considered in the context of the California Supreme Court decision *California Building Industry Association v. Bay Area Air Quality Management District* (2015) (CBIA v. BAAQMD [2015]). Pursuant to this decision, impacts of the environment on the project do not constitute an impact unless the project exacerbates the environmental hazards or conditions that already exist. In the case that a project would exacerbate environmental hazards or conditions, the project's impact on the environment would drive impact analysis, not the impact of the environment on the project.

Impacts on paleontological resources were evaluated following guidelines published by the Society of Vertebrate Paleontology (Society of Vertebrate Paleontology 2010). This analysis reflects professional judgment in light of information available from the published geologic and paleontological literature and museum databases. No new paleontological fieldwork or research was conducted for this EIR.

The methods used to analyze potential impacts on paleontological resources and to develop mitigation for the identified impacts involved the following steps:

- Assess the likelihood that the sediments affected by implementing the project contain scientifically important, nonrenewable paleontological resources that could be directly affected.
- Identify the geologic units in the paleontological study area.
- Evaluate the potential of the identified geologic units to contain significant fossils (as stated above, their *paleontological sensitivity*).
- Identify the geologic units that would be affected by the project, based on each project element's depth of excavation—either at ground surface or below ground surface, defined as at least 5 feet below ground surface.

- Identify and evaluate impacts on paleontologically sensitive geologic units as a result of near-term and longer-term construction and operation that involve ground disturbance.
- Evaluate impact significance.
- According to the identified degree of sensitivity, formulate and implement measures to mitigate potential impacts.

The potential of the project to affect paleontological resources relates to ground disturbance. Ground disturbance caused by the project would take place during construction phases; therefore, this impact analysis addresses construction impacts.

To identify the geologic units in the paleontological study area, the *Geologic Map and Database of the Palo Alto 30' X 60' Quadrangle, California* (Brabb et al. 2000) was consulted, along with work performed for the SLAC National Accelerator (Ehman and Witebsky 2006).

To evaluate the paleontological sensitivity of the geologic units, first the University of California Museum of Paleontology database was searched for records of fossils in these geologic units (University of California Museum of Paleontology 2018) and in the published scientific literature.

In addition, scientific literature reviews were conducted, including of the following material.

- Brabb, E. E., R. W. Graymer, and D. L. Jones. 2000. Geologic Map and Map Database of the Palo Alto 30' x 60' Quadrangle, California. (USGS MF-2332.)
- Maguire, Kaitlin Clare, and Holroyd, Patricia A. 2016. Pleistocene Vertebrates of Silicon Valley (Santa Clara County, California). *PaleoBios* 33(0).
- Pampeyan, Earl. 1993. Geologic Map of the Palo Alto and Part of the Redwood Point 1-1/2' Quadrangles, San Mateo and Santa Clara Counties, California. (IMAP 2371.)
- University of California Museum of Paleontology (UCMP). 2018. UCMP Specimen Search.

After the records search and literature review, the paleontological sensitivity of the units was assessed according to the Standard Guidelines (Society of Vertebrate Paleontology 2010), and a value of high potential, undetermined potential, or low potential was assigned.

Based on data from the University of California Museum of Paleontology database and published literature, each geologic unit in the study area was assigned a paleontological sensitivity according to SVP's Standard Guidelines. For the impact assessment phase, the SVP defines the level of potential as one of four sensitivity categories for sedimentary rocks: High, Undetermined, Low, and No Potential (Society of Vertebrate Paleontology 2010).

- **High Potential.** Assigned to geologic units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered; and sedimentary rock units suitable for the preservation of fossils ("e.g., middle Holocene and older, fine-grained fluvial sandstones…fine-grained marine sandstones, etc."). Paleontological potential consists of the potential for yielding abundant fossils, a few significant fossils, or "recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data."
- **Undetermined Potential.** Assigned to geologic units "for which little information is available concerning their paleontological content, geologic age, and depositional environment." In cases

where no subsurface data already exist, paleontological potential can sometimes be assessed by subsurface site investigations.

- **Low Potential.** Field surveys or paleontological research may allow determination that a geologic unit has low potential for yielding significant fossils, e.g., basalt flows. Mitigation is generally not required to protect fossils.
- **No Potential.** Some geologic units have no potential to contain significant paleontological resources, such as high-grade metamorphic rocks (such as gneisses and schists) and plutonic igneous rocks (such as granites and diorites). Mitigation is not required.

Results are discussed under *Paleontological Sensitivity of Geologic Units* above.

Once the project area's paleontological sensitivity is known, the likelihood of impact is constrained and an appropriate mitigation strategy can be developed.

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would result in any of the following.

- Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map or based on other substantial evidence of active faulting;
  - Strong seismic groundshaking;
  - Seismically induced ground failure, including but not limited to liquefaction; or
  - Landslides, including seismically induced landslides.
- Substantially accelerated soil erosion or substantial loss of topsoil.
- Location of structures on a geologic unit or soil that is unstable or that would become unstable as a result of construction, increasing the risk of onsite or offsite landslide or slope failure.
- Construction on expansive soil, creating substantial risks to life or property.
- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin.
- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

Because the project and alternatives do not involve the use of groundwater, septic tanks or alternative waste water disposal systems, the last two criteria are not applicable.

Each impact discussion includes a summary table identifying the level of impact associated with the individual project elements, followed by text analysis.

Impacts and Mitigation Measures

Impact GEO-1— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving fault rupture

Summary by Project Element: Impact GEO-1— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving fault rupture		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	No Impact	No Impact

Channel Widening Alternative

No known active faults cross the study area. No project elements are close to State-zoned faults, as shown in Figure 3.5-3. However, as discussed above under *Primary Seismic Hazards*, and shown in Figure 3.5-4, three faults active in the early Quaternary period—the Pulgas, San Jose, and Stanford faults—are close to the project.

Construction and Operations and Maintenance

The entire San Francisco Bay Area is considered tectonically active, with known major faults in the vicinity of the project area. There are no identified faults that cross the project boundary; therefore, potential risk of fault rupture during the relatively short construction period is considered low. However, the possibility exists that the Quaternary-age Pulgas fault, which runs within 0.1 mile of the Channel Widening Alternative site near channel widening sites 1 and 2 (see Table 3.5-4 and Figure 3.5-4), could rupture the surface during the lifetime of the project.

Should fault rupture occur, there would be minimal expected adverse effects on aquatic habitat enhancement as the habitat enhancement actions are designed to restore the creek to more natural functions, and remove concrete structures which would be more likely to be affected in case of fault rupture. Similarly, there would be expected minimal effect of fault rupture related to construction or operations and maintenance of creekside parks because no structures (other than benches) would be installed at the parks that could be affected by fault rupture. These effects do not constitute an exacerbation of fault rupture pursuant to CBIA v. BAAQMD, as described under *Methods and Significance Criteria*.

Fault rupture could result in damage to existing and planned structures during project construction (lower probability due to relatively shorter timeframe) and operations and maintenance. The bridge foundations and bridge structure could be damaged by fault rupture either during construction or during the project's lifetime even if they are properly constructed, depending on location and magnitude of fault rupture. Damaged foundations or structures would have to be replaced. These effects do not constitute an exacerbation of surface fault rupture. Therefore, pursuant to CBIA v. BAAQMD, there would be no impact related to the bridge foundations and bridge structure.

The cement structure and sheet pile wall constructed to support creek banks at Sites 2 and 5 for channel widening activities could be damaged by fault rupture. Damaged walls could temporarily increase potential for erosion (see Impact GEO-5) until they are repaired. Damaged walls that could temporarily increase potential for erosion constitute an exacerbation of fault rupture pursuant to CBIA v. BAAQMD (2015).

However, the local jurisdictions have adopted seismic safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report that, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would ensure that risk of exposure to fault rupture would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact for bridge replacement and channel widening at Sites 2 and 5 would be less than significant.

Floodwalls Alternative

No known active faults cross the site of the Floodwalls Alternative. No alternative elements for the Floodwalls Alternative are close to State-zoned faults, as shown in Figure 3.5-3. However, as discussed above under *Primary Seismic Hazards*, and shown in Figure 3.5-4, three faults active in the Quaternary period, the Pulgas, San Jose, and Stanford faults, are close to this alternative.

Construction and Operations and Maintenance

As with the Channel Widening Alternative, because no zoned active faults cross the site, the risk of fault rupture during construction is low. However, a slight possibility exists that the Pulgas fault, which intersects the alternative near the floodwalls and channel widening sites 1 and 2 (see Table 3.5-4), could rupture the surface during the life of the alternative.

Effects related to fault rupture with respect to aquatic restoration elements, creekside parks, and replacement of the Pope-Chaucer bridge are the same as under the Channel Widening Alternative. Impacts related to channel widening, including structures associated with channel widening, are also the same.

For the floodwalls proposed under the Floodwalls Alternative, there is a slight risk that fault rupture by the Pulgas, Stanford, or San Jose fault could damage structures. If the floodwalls are damaged by fault rupture due to flood water, the floodwalls could fail and release water downstream, potentially causing flooding. In addition, if floodwalls are damaged by fault rupture and are not repaired in time before a heavy rain, they would not perform their job of preventing flood waters from overtopping the bank. Under CBIA v. BAAQMD (2015), in the case that a project would exacerbate environmental hazards or conditions, the project's impact on the environment would drive impact analysis, not the impact of the environment on the project. These circumstances would constitute an exacerbation of fault rupture.

However, the local jurisdictions have adopted seismic safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would ensure that risk of exposure to fault rupture would be minimized. , With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact for the floodwalls would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

As discussed above under *Local Seismic Setting*, no zoned faults cross the site. However, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are within 1.6 and 1.9 miles of the San Andreas fault zone, respectively.

Construction and Operations and Maintenance

It is possible that an unmapped fault associated with the San Andreas fault zone could rupture the surface during construction or during the lifetime of the alternative. Such a fault rupture has potential to damage the weir built to detain water. In the worst case scenario in which the detention basin is full and rain is continuing to fall when an earthquake occurs, if the weir is damaged as a result of fault rupture, the damage would still not result in release of water downstream. The water level in San Francisquito Creek in this instance would approach top of bank, level with water behind the weir, and the water in the creek thus would effectively hold back the water in the detention basin until the water level in the creek goes down. The weir, if damaged, could be repaired after flood waters recede. Accordingly, pursuant to CBIA v. BAAQMD (2015), this alternative would not exacerbate risk of fault rupture.

Further, because the alternatives are not located on a zoned fault, the risk is low. The local jurisdictions have adopted seismic safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Cod*e, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would ensure that risk of exposure to fault rupture would be minimized. Because the project elements would not exacerbate risk of fault rupture, there would be no impact.

Impact GEO-2— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismic ground shaking

Summary by Project Element: Impact GEO-2— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismic ground shaking		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	No Impact	No Impact

Channel Widening Alternative

As discussed above under *Local Seismic Setting*, several faults with potential for a large earthquake associated with strong seismic ground shaking are near the study area.

Construction and Operations and Maintenance

Seismic ground shaking could result in damage to all project elements other than aquatic habitat restoration and small creekside parks during project construction and operations and maintenance. Graded slopes of channel widening activities could be vulnerable to seismic ground shaking if they are not properly shored. Bridge foundations and the bridge structure could be damaged by seismic ground shaking either during construction or during the project's lifetime if they are not properly constructed. Damaged foundations or structures would have to be replaced. These effects do not constitute an exacerbation of seismic ground shaking pursuant to CBIA v. BAAQMD (2015), and therefore there would be no impact.

The cement structure and sheet pile wall constructed to support creek banks at Sites 2 and 5 for channel widening activities could be damaged by ground shaking. Damaged walls could temporarily increase potential for erosion (see Impact GEO-5) until they are repaired. As discussed under Impact GEO-1, damage to walls that could increase potential for erosion constitutes an exacerbation of seismic ground shaking per CBIA v. BAAQMD (2015).

However, the local jurisdictions have adopted seismic safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would ensure that risk of exposure to ground shaking would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impacts for channel widening for Sites 2 and 5 would be less than significant.

Floodwalls Alternative

As discussed above under *Local Seismic Setting*, several faults with potential for a large earthquake are near the Floodwalls Alternative site.

Construction and Operations and Maintenance

Effects related to aquatic habitat enhancement, creekside parks, and bridge foundations are the same as under the Channel Widening Alternative. Under CBIA v. BAAQMD (2015), in the case that a project would exacerbate environmental hazards or conditions, the project's impact on the environment would drive impact analysis, not the impact of the environment on the project. Because these effects do not constitute an exacerbation of seismic ground shaking, they would have no impact.

Potential damage as a result of ground shaking to the sheet pile wall constructed to support creek banks at Site 5 for channel widening activities would be the same as under the Channel Widening Alternative. These effects constitute an exacerbation of seismic ground shaking per CBIA v. BAAQMD (2015).

In addition, floodwalls could be toppled or damaged as a result of ground shaking if an earthquake occurs during construction or project lifetime. If an earthquake that exceeds the design of the floodwalls occurs, the floodwalls could fail and release water downstream, potentially causing flooding. In addition, if an earthquake that exceeds the design of the floodwalls occurs and the floodwalls are not repaired in time before a heavy rain, the floodwalls would not prevent flood waters from overtopping the bank. These circumstances would also constitute an exacerbation of seismic ground shaking pursuant to CBIA v. BAAQMD (2015).

However, the local jurisdictions have adopted seismic safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would ensure that risk of exposure to ground shaking would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact for channel widening at Site 5 and flood walls would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

As discussed above under *Local Seismic Setting*, several faults with potential for a large earthquake are near the site.

Construction and Operations and Maintenance

During the detention basin's lifetime, seismic ground shaking could damage the side slopes of the detention basin, potentially reducing its capacity and impairing its function temporarily.

Seismic ground shaking could damage the weir if it is not properly constructed. In the worst case scenario in which the detention basin is full and rain is continuing to fall when an earthquake occurs, if the weir is damaged as a result of seismic ground shaking, the damage would still not result in release of water downstream. The water level in San Francisquito Creek in this instance would approach top of bank, level with water behind the weir, and thus would effectively hold back the water in the detention basin until the water level in the creek goes down. Accordingly, this alternative would not exacerbate risk of seismic ground shaking pursuant to CBIA v. BAAQMD (2015).

Further, the local jurisdictions have adopted seismic safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would ensure that risk of exposure to ground shaking would be minimized. Because this effect does not constitute exacerbation of seismic ground shaking, pursuant to CBIA v. BAAQMD, there would be no impact.

Impact GEO-3— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismically induced ground failure, including liquefaction

Summary by Project Element: Impact GEO-3— Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismically induced ground failure, including liquefaction		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative

As discussed above under *Liquefaction*, much of the study area is susceptible to liquefaction. As discussed above under *Lateral Spreading*, effects of liquefaction along the study area are lateral spreading and bank failure toward the channel. Any built project elements that are situated on the creek channel would be subject to the effects of lateral spreading.

Construction and Operations and Maintenance

Post-liquefaction effects during both the construction and operations and maintenance periods could include lateral spreading of the ground surface and bank failure toward the channel; settlement including differential settlement (Kleinfelder 2013); and side slope failure, affecting channel widening, aquatic habitat enhancement, and creekside parks. However, any damage to the creek bank could be repaired by implementing the Operations and Maintenance Plan after a major earthquake.

Seismically induced liquefaction, exacerbated by placement of a load on potentially liquefiable soils, could damage the bridge foundation and bridge structure through settlement and differential settlement during both construction and operations and maintenance periods. Similarly, liquefaction could damage the extension of the University Avenue Bridge parapet during construction and over the project's lifetime through settlement and differential settlement. Effects related to the load imposed by the bridge foundation and structure and University Avenue Bridge parapet would constitute an exacerbation of liquefaction pursuant to CBIA v. BAAQMD.

However, the local jurisdictions have adopted seismic safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would ensure that risk of exposure to liquefaction, lateral spreading, and settlement as a result of liquefaction would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact for all project elements would be less than significant.

Floodwalls Alternative

As discussed above under *Liquefaction*, much of the Floodwalls Alternative site is susceptible to liquefaction. As discussed above under *Lateral Spreading*, effects of liquefaction along the Floodwalls Alternative footprint are lateral spreading and bank failure toward the channel. Any built elements that are situated at or near the creek bank are also subject to lateral spreading.

Construction and Operations and Maintenance

The impacts related to the bridge, channel widening, aquatic habitat enhancement, and construction of creekside parks would be the same as for the Channel Widening Alternative.

Liquefaction, exacerbated by placement of a load on potentially liquefiable soils, could also affect the floodwalls through both lack of static support during the liquefaction episode, post-liquefaction differential settlement, and lateral spreading. Liquefaction could cause the soil to lose its ability to support the load of the floodwalls during the seismic event, and cause them to topple. Differential settlement due to liquefaction could be up to 1 inch along a 100-foot length of floodwall, potentially resulting in stresses on the foundation that could cause cracking. Lateral spreading could displace the floodwall from its location if it is not properly secured. However, such damage could be readily repaired before the floodwall is needed for flood protection. The probability of the design flood event and the design earthquake to co-occur is very unlikely (Kleinfelder 2013). If these two events were to occur at the same time, the loss of floodwall protection could release flood waters downstream. Effects related to the load imposed by the floodwalls would constitute an exacerbation of liquefaction pursuant to CBIA v. BAAQMD.

However, the local jurisdictions have adopted seismic safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would minimize risks of exposure to liquefaction, lateral spreading, and settlement as a result of liquefaction. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact for floodwalls would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

As discussed above under *Liquefaction*, much of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative sites is susceptible to liquefaction. As discussed above under *Lateral Spreading*, effects of liquefaction along the sites are lateral spreading and bank failure toward the channel. The structure in the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative, i.e., the weir, that is situated at or near the creek bank, is also subject to lateral spreading.

Construction and Operations and Maintenance

Seismically induced liquefaction would have the potential to result in side slope failure. In addition, liquefaction would have the potential to damage the weir, exacerbated by placement of a load on potentially liquefiable soils. If liquefaction occurs while the basin is empty, liquefaction damage would be reparable, allowing rapid restoration of full basin function. If the liquefaction occurs while the detention basin is full, similar to the seismic ground shaking scenario, any damage would still not result in release of water downstream. The water level in San Francisquito Creek in this instance would be at top of bank, level with water behind the weir, and thus would effectively hold back the water in the detention basin until the water level in the creek goes down. Although effects related to liquefaction as a result of load imposed by the weir on liquefiable soils are not anticipated, any such effect would be an exacerbation of liquefaction, pursuant to CBIA v. BAAQMD.

Further, the local jurisdictions have adopted seismic safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would ensure that weirs would be built to the appropriate design earthquake and that the risk of exposure to ground shaking would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact for weirs would be less than significant.

Impact GEO-4—Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving landslides

Summary by Project Element: Impact GEO-4—Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving landslides		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	No Impact	No Impact
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative and Floodwalls Alternative

As discussed above under *Landslide*, the study area starting at Pope-Chaucer Bridge and downstream is not mapped as subject to landslide.

Construction and Operations and Maintenance

Because the study area is not in an area subject to landslide, there would be no impact.

Former Nursery Detention Basin Alternative

As discussed above under *Landslide* above, the Former Nursery site for the proposed detention basin is across the creek from a landslide deposit.

Construction and Operations and Maintenance

Because the alternative site is not located directly in an area that is subject to landslide, the risk of project construction destabilizing the nearby existing landslide deposit is low. Project operations and maintenance similarly would have little likelihood of destabilizing the nearby landslide deposit. The impact is less than significant.

The site is near an existing landslide deposit, so the possibility exists that future landslide movement could affect the proposed detention basin if it were constructed at this site. However, such an effect of the environment on the project would not be an impact under CEQA pursuant to CBIA v. BAAQMD (2015).

Webb Ranch Detention Basin Alternative

As discussed above under *Landslide*, the Webb Ranch Site for the proposed detention basin is adjacent to a landslide deposit.

Construction

Project construction would involve excavation of the detention basin. If excavation activities encroach on the toe of the existing landslide deposit, specifically at the Webb Ranch Detention Basin

Alternative site (Webb Ranch Site) because of its adjacency to the landslide deposit, excavation could potentially destabilize the landslide deposit, increasing likelihood of future flows.

However, the local jurisdictions have adopted grading ordinances intended to ensure that grading and excavation will not destabilize slopes, including landslide deposits. Specifically, the County requires a grading permit for work done of the proposed scope of excavation. Further, Valley Water requires an encroachment permit for in-stream and stream-adjacent work. Conformance with these permits would ensure that any excavations and grading consider sediment conditions, susceptibility to of the deposit to flow, and engineering actions to be taken to stabilize the deposit as needed. In addition, the local jurisdictions have adopted safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the specifications in the geotechnical report would ensure that the risk of exposure to landslide would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact would be less than significant.

Operations and Maintenance

Project operations and maintenance could involve periodic sediment removal via dredging of the detention basin. Because the Webb Ranch Detention Basin Alternative site would be located near the toe of an existing landslide deposit, dredging activities could potentially destabilize the landslide deposit, increasing likelihood of future flows. However, the local jurisdictions have adopted grading ordinances intended to ensure that grading and excavation will not destabilize slopes, including landslide deposits. Specifically, the County requires a grading permit for excavation and grading on projects that have the scope of this alternative. Further, Valley Water requires an encroachment permit for in-stream and stream-adjacent work. Conformance with these permits would ensure that any excavations and grading consider sediment conditions, susceptibility to of the deposit to flow, and engineering actions to be taken to stabilize the deposit as needed. In addition, the local jurisdictions have adopted safety restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to the recommendations in the geotechnical report would ensure that risk of exposure to landslide would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact would be less than significant.

If, on the other hand, the detention is set back from the landslide, then dredging activities associated with maintenance would not destabilize the landslide deposit, and the impact would be less than significant.

Further, the site is adjacent to an existing landslide deposit, so the possibility exists that future landslide movement could affect the proposed detention basin if it were constructed at this site. However, such an effect of the environment on the project would not be an impact under CEQA pursuant to CBIA v. BAAQMD (2015).

Impact GEO-5—Result in substantially accelerated soil erosion or loss of topsoil

Summary by Project Element: Impact GEO-5—Result in substantially accelerated soil erosion or loss of topsoil		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative	Less than Significant	Less than Significant with Mitigation
Floodwalls Alternative	Less than Significant	Less than Significant with Mitigation
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative

As discussed above under *Erosive Soils*, some soils in the project area are subject to erosion hazard. Further, soils along the stream bank are subject to erosion resulting from seepage and increased flow velocities.

Construction

Site clearing, grading, excavation, and fill placement activities would have the potential to contribute to accelerated erosion. During construction at all project elements, erosion could take place because ground cover would be removed; while the ground is exposed, wind and water erosive forces could remove soil. However, as discussed in Impact HWR-3, *Degrade water quality*, in Section 3.8, *Hydrology and Water Resources*, because the project would require land disturbance of greater than 1 acre of land, a Storm Water Pollution Protection Plan (SWPPP) would be required under the General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Order 2009-0009-DWQ) (Construction General Permit). The SWPPP would include provisions to control erosion. Further, compliance with local municipal permits, required under the NPDES Permit for the discharge of stormwater runoff from the MS4s overseen by the San Francisco Bay Regional Water Board, would ensure that the construction site would have site-specific, and seasonally and phase-appropriate, sediment and erosion control best management practices(BMPs) (San Francisco Bay Regional Water Quality Control Board 2015). With the SWPPP in place, impacts related to erosion would be less than significant for all project elements.

In addition, construction of creekside parks would involve removal of topsoil. The project's environmental commitments require that excavated topsoil be stockpiled as appropriate so it can be reused on site for revegetation as needed. Topsoil would be stockpiled separately from other materials. With incorporation of this environmental commitment into the project design, impacts related to loss of topsoil due to construction at creekside parks would be less than significant.

Operations and Maintenance

Operations and maintenance would be similar to existing maintenance activities and would include activities such as removing sediment and debris from the channel, which could occur during any flood season, and more intensive post-flood clean-up that would be needed only after major flood events. Additionally, monitoring and maintenance of new vegetation would occur, at a minimum, for 3 years following project completion. This activity would consist of invasive plant removal, inspection of newly planted vegetation, and replanting as needed. Creekside parks would also require trash pick-up and disposal as well as routine maintenance of benches and landscaping.

All of these activities could result in removal of ground cover that could result in erosion. However, as identified in Chapter 2, *Program Description,* under the water quality protection environmental commitments and according to SWPPP requirements, the SFCJPA or responsible maintenance agencies would implement post-construction BMPs to protect water quality, which would guard against erosion. These BMPs would apply to all project maintenance activities. With these measures in place, operations and maintenance impacts resulting from erosion are expected to be less than significant. No mitigation is required.

Further, the project has the potential to result in increased flow velocities under certain circumstances at the 12 existing erosion sites within Reach 2, resulting in the potential for increased erosion at these sites. Table 3.8-5 in Section 3.8, *Hydrology and Water Resources*, provides a comparison of estimated existing and proposed velocities at these 13 erosion sites. As shown in Table 3.8-5, all locations except for Site 13 would experience an increase in flow velocity. A preliminary velocity impacts analysis (Appendix D) showed that velocity increase impacts would not occur until flows reach approximately 5,800 cubic feet per second (cfs), which corresponds to a 25-year storm event, or 4% chance of occurring. For flows below 5,800 cfs, the anticipated velocity at these 13 sites would remain the same as or less than current flow velocities as a result of project implementation.

With implementation of mitigation measure MM-WQ-1, which would require preparation of an Adaptive Management Plan to monitor creek flows for signs of increased erosion at these 13 sites and identify and implement additional erosion control as needed, these effects would be minimized and reduced to less than significant levels.

Floodwalls Alternative

Similar to the Channel Widening Alternative, the unimproved erosion areas downstream of Pope-Chaucer Street would experience an increase in velocity and could result in increased erosion beyond existing erosion rates. As discussed above under *Erosive Soils*, some soils in the area of the Floodwalls Alternative are subject to erosion hazard. Further, soils along the stream bank are subject to erosion resulting from seepage and increased flow velocities.

Construction

As discussed for the Channel Widening Alternative, construction activities would have the potential to contribute to accelerated erosion. However, because the Floodwalls Alternative would require land disturbance of greater than 1 acre of land, a SWPPP would be required under the Construction General Permit. The SWPPP would include provisions to control erosion. In addition, BMPs required by the local permits would control erosion. With the SWPPP and BMPs in place, impacts related to erosion would be less than significant for all project elements.

As discussed for the Channel Widening Alternative, construction of creekside parks would involve removal of topsoil. Environmental commitments require that excavated topsoil be stockpiled as appropriate so it can be reused onsite for revegetation as needed. Topsoil will be stockpiled separately from other materials. With incorporation of this environmental commitment into project design, impacts related to loss of topsoil due to construction at creekside parks would be less than significant.

Operations and Maintenance

Because the chances of high flows that could exacerbate existing erosion conditions in identified locations susceptible to erosion are relatively small, the potential for the project to exacerbate erosion conditions at these 12 sites is considered minimal. However, because the creek is currently impaired for sediment/sedimentation, the addition of sediment as a result of exacerbated erosion from the project's increased velocities could be considered a significant water quality impact depending on the severity of erosion. Therefore, with implementation of MM-HWR-1, which would require preparation of an Adaptive Management Plan to monitor creek flows for signs of increased erosion at these 12 sites and identify and implement additional erosion control as needed, these effects would be minimized and reduced to less than significant.

Operations and maintenance activities are similar to those described for the Channel Widening Alternative, but also include visual inspections for any damaged concrete, exposed reinforcing bar, or undermining. If damaged or deteriorating conditions are identified, repairs would be conducted per American Concrete Institute Bulletins. Otherwise, operations and maintenance activities could result in removal of ground cover that could result in erosion. However, as identified in Chapter 2 under the water quality protection environmental commitments and according to SWPPP requirements, the SFCJPA or responsible maintenance agencies would implement post-construction BMPs to protect water quality, which would guard against erosion, and these BMPs would apply to all project maintenance activities. With these measures in place, operations and maintenance impacts resulting from erosion are expected to be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

As discussed above under *Erosive Soils*, some soils in the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative areas are subject to erosion hazard.

Construction

Site clearing, grading, excavation, and fill placement activities would have the potential to contribute to accelerated erosion. During construction of the basin and weir, erosion could take place because ground cover would be removed, and while the ground is exposed, wind and water erosive forces could remove soil. However, because the alternative would require land disturbance of greater than one acre of land, a SWPPP would be required under the Construction General Permit. The SWPPP would include provisions to control erosion. With the SWPPP in place, impacts related to erosion would be less than significant for all project elements.

Operations and Maintenance

Operations and maintenance activities would involve periodic excavation of sediments deposited during flood events, trash removal, and invasive plant removal. All of these activities have potential to cause erosion by removing ground cover. However, as identified in Chapter 2 under the water quality protection environmental commitments and according to SWPPP requirements, the SFCJPA or responsible maintenance agencies would implement post-construction BMPs to protect water quality, and these BMPs would apply to all project maintenance activities. With these measures in place, operations and maintenance impacts as a result of erosion are expected to be less than significant. No mitigation is required.

Impact GEO-6—Locate structures on a geologic unit or soil that is unstable or that would become unstable as a result of construction, increasing the risk of onsite or offsite landslide or slope failure

Summary by Project Element: Impact GEO-6—Locate structures on a geologic unit or soil that is unstable or that would become unstable as a result of construction, increasing the risk of onsite or offsite landslide or slope failure		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant	No Impact
Former Nursery Detention Basin Alternative	Less than Significant	No Impact
Webb Ranch Detention Basin Alternative	Less than Significant	No Impact

Channel Widening Alternative

As discussed above under *Regional Geology*, the sediments underlying the project area are a thick layer of unconsolidated alluvium.

Construction

Construction of the Pope-Chaucer Bridge foundations and the bridge itself would be performed on stable ground. Aquatic habitat enhancement would not involve activities that would affect slope stability. There would be no impact.

Channel widening and installation of the creekside wall would involve excavation next to the creek banks, which are composed of a thick layer of unconsolidated alluvium. If excavation into these unconsolidated sediments is improperly done, the slopes could be destabilized, potentially resulting in partial collapse of the creek bank. Concrete removal at the University Avenue Bridge Parapet site would involve removal of a concrete wall, as well as in-channel concrete. Removal of the concrete wall could potentially destabilize the creek bank.

Construction of the creekside parks would involve excavation on top of and adjacent to the creek banks. If there is inadequate support beneath the top of the bank edge, collapse of the top of the bank is possible.

However, the local jurisdictions have adopted grading ordinances that would address slope stability. These ordinances are intended to ensure that grading and excavation will not destabilize slopes, including landslide deposits. Specifically, the County requires a grading permit for excavation and grading on projects that have the scope of this alternative. Further, Valley Water requires an encroachment permit for in-stream and stream-adjacent work. Conformance with these permits would ensure that any excavations and grading consider sediment conditions, susceptibility to of the deposit to flow, and engineering actions to be taken to stabilize the deposit as needed. In addition, the local jurisdictions have adopted soils restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to specifications in the geotechnical report would ensure that risk of exposure to slope collapse would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact would be less than significant.

Operations and Maintenance

As discussed above under Impact GEO-5, operations and maintenance would involve removing sediment and debris from the channel, invasive plant removal, inspection of newly planted vegetation and replanting as needed, and routine maintenance of benches and landscaping in creekside parks. None of these activities would affect stability of geologic units for any of the project elements. There would be no impact.

Floodwalls Alternative

As discussed above under *Regional Geology*, the sediments underlying the Floodwalls Alternative are a thick layer of unconsolidated alluvium.

Construction

Construction of the Pope-Chaucer Bridge foundations, the bridge, and aquatic habitat enhancement would be the same as under the Channel Widening Alternative. Construction of the channel widening and creekside parks would also be the same as under the Channel Widening Alternative.

Construction of the floodwalls would involve excavation next to the creek banks, which are composed of a thick layer of unconsolidated alluvium. If excavation into these unconsolidated sediments is improperly done, the slopes could destabilize, potentially resulting in partial collapse of the creek bank.

However, the local jurisdictions have adopted grading ordinances that would address slope stability. These ordinances are intended to ensure that grading and excavation will not destabilize slopes, including landslide deposits. Specifically, the County requires a grading permit for excavation and grading on projects that have the scope of this alternative. Further, Valley Water requires an encroachment permit for in-stream and stream-adjacent work. Conformance with these permits would ensure that any excavations and grading consider sediment conditions, susceptibility to of the deposit to flow, and engineering actions to be taken to stabilize the deposit as needed. In addition, the local jurisdictions have adopted soils restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to specifications in the geotechnical report would ensure that risk of exposure to slope collapse would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact for floodwalls, as well as for channel widening and creekside parks, would be less than significant.

Operations and Maintenance

As under the Channel Widening Alternative, there would be no impacts from operations and maintenance activities.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

As discussed above under *Regional Geology*, the sediments underlying the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are a thick layer of unconsolidated alluvium.

Construction

Construction would consist of excavation of the basin and installation of the weir. Both excavation of the basin and installation of the weir would involve cut and fill slopes, which could destabilize if not properly shored. However, the local jurisdictions have adopted grading ordinances that would address slope stability. These ordinances are intended to ensure that grading and excavation will not destabilize slopes, including landslide deposits. Specifically, the County requires a grading permit for excavation and grading on projects that have the scope of this alternative. Further, Valley Water requires an encroachment permit for in-stream and stream-adjacent work. Conformance with these permits would ensure that any excavations and grading consider sediment conditions, susceptibility to of the deposit to flow, and engineering actions to be taken to stabilize the deposit as needed. In addition, the local jurisdictions have adopted soils restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code,* must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. SFCJPA will have responsibility to prepare these reports. Preparation of these reports and conformance to specifications in the geotechnical report would ensure that risk of exposure to slope collapse would be minimized. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact would be less than significant.

Operations and Maintenance

Operations and maintenance activities would involve removing silt deposited during flood events. Such excavation would not destabilize existing soil deposits. There would be no impact.

Impact GEO-7—Involve construction on expansive soil, creating substantial direct or indirect risks to life or property

Summary by Project Element: Impact GEO-7—Involve construction on expansive soil, creating substantial direct or indirect risks to life or property		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative Channel widening, aquatic habitat enhancement, and creekside parks	No Impact	No Impact
Channel Widening Alternative Replace Pope-Chaucer Street Bridge Site 2, Placement of concrete wall Site 5, Placement of sheet pile wall	Less than Significant	Less than Significant
Floodwalls Alternative Replace Pope-Chaucer Street Bridge Site 5, Placement of sheet pile wall Floodwalls	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	No Impact	No Impact

Channel Widening Alternative

As discussed above under *Local Soils*, some soils underlying the project have moderate to high expansiveness potential.

Construction

Channel widening activities, aquatic habitat enhancement, and creekside parks would not interact with expansive soils because no structures are planned for installation. There would be no impact for these project elements.

All of the other project elements involve structures that would have foundations installed in soil. If that soil is expansive, wetting and drying cycles, as described above in *Expansive Soils*, could damage structure foundations. Table 3.5-5 shows the percentage of soils with varying potential for expansiveness for the project elements.

Table 3.5-5. Expansive Soil Ratings by Project Element, Channel Widening Alternative

Project Element	Expansive Soil Rating	Percentage of Soil at the Project Element
Pope-Chaucer Street Bridge	Moderate	28%
	High	2%
	Not rated	70%
Channel Widening Site 2 (concrete wall)	Moderate	15%
	High	1%
	Not rated	84%
Channel Widening Site 5 (sheet pile wall)	Low	28%
	Not rated	72%

Source: Natural Resources Conservation Service 2018

The Pope-Chaucer Street Bridge and the concrete wall at Site 2 would be installed in soil that is partly composed of soil that is moderately expansive. Therefore, there is potential for the soil to damage structure foundations if they are not constructed in accordance with CBSC requirements and recommendations of the site-specific geotechnical report, required by project environmental commitments.

However, the local jurisdictions have adopted soils restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. This report would provide recommendations for treatment of the expansive soil, which could include replacement, grouting, use of geofoam, and other treatments. SFCJPA will have responsibility to prepare these reports. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact would be less than significant.

Operations and Maintenance

Operations and maintenance would involve removal of debris and sediment from the channel, invasive plant removal, inspection of newly planted vegetation and replanting as needed, and routine maintenance of benches and landscaping in creekside parks. None of these activities would involve placement of structures in expansive soils or disturbance of expansive soils for any of the project elements. Accordingly, no foundations would be affected by expansive soils. Therefore, pursuant to CBIA v. BAAQMD (2015), there would be no impact.

Floodwalls Alternative

As discussed above under *Local Soils*, some soils underlying the Floodwalls Alternative have moderate to high expansiveness potential.

Construction

As with the Channel Widening Alternative, the construction of the channel widening, aquatic habitat enhancement, and creekside parks would have no impact.

All of the other project elements involve structures that would have foundations installed in soil. If that soil is expansive, wetting and drying cycles, as described above in *Expansive Soils*, could damage structure foundations. Table 3.5-6 shows the percentage of soils with varying potential for expansiveness for the project elements.

Table 3.5-6. Expansive Soil Ratings by Project Element, Floodwalls Alternative

Project Element	Expansive Soil Rating	Percentage of Soil at the Project Element
Pope-Chaucer Street Bridge	Moderate	28%
	High	2%
	Not rated	70%
Channel Widening Site 5 (sheet pile wall)	Low	28%
	Not rated	72%
Floodwalls	Moderate	28%
	High	2%
	Not rated	70%

Source: Natural Resources Conservation Service 2018

The Pope-Chaucer Street Bridge and the floodwalls would be installed in soil that is partly composed of soil that is moderately expansive. Therefore, there is potential for the soil to damage structure foundations if they are not constructed in accordance with CBSC requirements and recommendations of the site-specific geotechnical report, required by project environmental commitments.

However, the local jurisdictions have adopted soils restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. This report would provide recommendations for treatment of the expansive soil, which could include replacement, grouting, use of geofoam, and other treatments. SFCJPA will have responsibility to prepare these reports. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact would be less than significant.

Operations and Maintenance

As with the Channel Widening Alternative, operations and maintenance activities would not involve placement of structures in expansive soils or disturbance of expansive soils for any of the project elements. Accordingly, no foundations would be affected by expansive soils. Therefore, pursuant to CBIA v. BAAQMD (2015), there would be no impact.

Former Nursery Detention Basin Alternative

As discussed above under *Local Soils*, some soils underlying the Former Nursery Detention Basin Alternative have moderate to high expansiveness potential.

Construction

Construction of the Former Nursery Site detention basin involves excavation of the basin and construction of a weir along the San Francisquito Creek channel adjacent to the detention basin. Construction of the basin would not interact with any expansive soil present in the study area. There would be no impact associated with construction of the basin.

However, the weir would have a foundation installed in soil. If that soil is expansive, wetting and drying cycles, as described above in *Expansive Soils*, could damage the structure foundation. Table 3.5-7 shows the percentage of soils with varying potential for expansiveness for the project elements.

Table 3.5-7. Expansive Soil Ratings by Project Element, Former Nursery Detention Basin Alternative

Project Element	Expansive Soil Rating	Percentage of Soil at the Project Element
Former Nursery Site Detention Basin	Low	10%
	Moderate	83%
	High	5%
	Not rated	3%

Source: Natural Resources Conservation Service 2018

The weir would be installed in soil that is partly composed of soil that is moderately to highly expansive. Therefore, there is potential for the soil to damage structure foundations if they are not constructed in accordance with CBSC requirements and recommendations of the site-specific geotechnical report, required by project environmental commitments.

However, the local jurisdictions have adopted soils restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. This report would provide recommendations for treatment of the expansive soil, which could include replacement, grouting, use of geofoam, and other treatments. SFCJPA will have responsibility to prepare these reports. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact would be less than significant.

Operations and Maintenance

Operations and maintenance activities would involve removing silt deposited during flood events. These activities would not involve placement of structures in expansive soils or disturbance of expansive soils. Accordingly, no foundations would be affected by expansive soils. Therefore, pursuant to CBIA v. BAAQMD (2015), there would be no impact.

Webb Ranch Detention Basin Alternative

As discussed above under *Local Soils*, some soils underlying the Webb Ranch Detention Basin Alternative have moderate to high expansiveness potential.

Construction

As with the Former Nursery Detention Basin Alternative, there would be no impact associated with construction of the basin.

However, as with the Former Nursery Detention Basin Alternative, the weir would have a foundation installed in soil. If that soil is expansive, wetting and drying cycles, as described above in *Expansive Soils*, could damage the structure foundation. Table 3.5-8 shows the percentage of soils with varying potential for expansiveness for the project elements.

Table 3.5-8. Expansive Soil Ratings by Project Element, Webb Ranch Detention Basin Alternative

Project Element	Expansive Soil Rating	Percentage of Soil at the Project Element
Webb Ranch Site Detention Basin	Low	11%
	Moderate	83%
	High	5%
	Not rated	<0.1%

Source: Natural Resources Conservation Service 2018

As with the Former Nursery Detention Basin Alternative, the weir would be installed in soil that is partly composed of soil that is moderately to highly expansive. Therefore, there is potential for the soil to damage structure foundations if they are not constructed in accordance with CBSC requirements and recommendations of the site-specific geotechnical report, required by project environmental commitments.

However, the local jurisdictions have adopted soils restrictions for structure design from the California Building Standards Code, with which the project will be required to comply. These requirements include preparation of a geohazard report, which, as described above under *California Building Standards Code*, must assess potential seismic and geologic risks, and, as required by the local jurisdiction, preparation of a geotechnical report, which must include recommendations for foundation type and design criteria. This report would provide recommendations for treatment of the expansive soil, which could include replacement, grouting, use of geofoam, and other treatments. SFCJPA will have responsibility to prepare these reports. With adherence to the applicable CBC requirements and any recommendations in the site-specific geotechnical report, the impact would be less than significant.

Operations and Maintenance

As with the Former Nursery Detention Basin Alternative, there would be no impact.

Paleontological Resources

Impact PALEO-1—Result in the destruction or loss of a unique paleontological resource or site

Summary by Project Element: Impact PALEO-1—Result in the destruction or loss of a unique paleontological resource or site		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant with Mitigation	No Impact
Former Nursery Detention Basin Alternative	Less than Significant with Mitigation	No Impact
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	No Impact

Channel Widening Alternative

As described above under *Location of Alternatives on Sensitive Geologic Units,* all project elements for the Channel Widening Alternative are located on geologic units with high sensitivity for paleontological resources, flood-plain deposits (Qhfp), and natural levee deposits (Qhl) (Figure 3.5-2a).

Construction

Construction activities such as excavation could affect sensitive, previously undisturbed geologic units, potentially unearthing and damaging previously unknown paleontological resources or other geologic features. According to available geologic maps, such sensitive native sediments may exist at the site of all the Channel Widening Alternative project elements. In Reach 2, sensitive sediments may be at ground surface, well above the surface of the channel bottom.

Replace Pope-Chaucer Street Bridge

Replacement of the Pope-Chaucer Street Bridge would require three separate activities that could affect paleontological resources:

- The side walls of the channel would be excavated to accommodate the newly expanded channel trapezoidal cross-section.
- Sediments would be excavated to the pier footing bottom at the location of the new piers in the channel bottom. Depth of excavation is not known; however, it would be below the bottom of the channel.
- New piles would be driven into the sediment.

Excavation into the side walls of the channel would be into native sediments, that is, natural levee deposits, which have high sensitivity for paleontological resources and have potential to contain significant fossils. Excavation into the channel walls has potential to damage or destroy significant paleontological resources. Any such damage or destruction would be a significant impact. Implementation of MM-PALEO-1 through MM-PALEO-3 would reduce the impact to less than significant.

Once piles are installed, forming and placing concrete for foundations, piers, and abutments would begin. Excavation to the pier footing bottom would be into sediments deposits through recent stream erosion and depositional processes, and, depending on depth of recent sedimentation and depth of excavation, native Holocene natural levee deposits. If excavation extends below the depth of recently deposited sediments, it would affect Holocene natural levee deposits, which have high sensitivity for paleontological resources, and have potential to contain significant fossils. Excavation of the channel bottom has potential to damage or destroy significant paleontological resources. Any such damage or destruction would be a significant impact. Implementation of MM-PALEO-1 through MM-PALEO-3 would reduce the impact to less than significant.

While pile-driving would disturb geologic units, any disturbance, damage, or loss affecting paleontological resources would not be identifiable. Furthermore, pile-driving affects small areas in comparison to excavation. Therefore, pile driving is of less concern than excavation. Impacts associated with pile driving are less than significant.

Channel Widening at Sites 1–4, Channel Widening at Site 5

At the channel widening sites, bank sediments would be excavated to a maximum depth of 26 feet bgs at Sites 1 and 2 (4 feet below channel bottom), 24 feet bgs at Site 3 (4 feet below channel bottom, 25 feet bgs at Site 4 (4 feet below channel bottom), and 22 feet bgs at Site 5 (7 feet below channel bottom) as the existing concrete is removed and the channel bottom is reshaped. Activities include not only channel widening but also removing a concrete wall and replacing it with a concrete wall at Site 2, and removing a sacked concrete wall and replacing it with a sheet pile wall at Site 5. The quantities of excavated materials are 601 cubic yards (cy) of sacked concrete and bank sediments at Site 1, 3,314 cy of concrete and bank sediments at Site 2, 5,137 cy of sacked concrete and bank sediments at Site 3, 2,495 cy of sacked concrete and bank sediments at Site 4, and 6,111 cy of sacked concrete and bank sediments at Site 5. Excavation would be into native soils. Excavation at Sites 1, 2, 3, 4, and 5 would affect Holocene natural levee deposits, which have high sensitivity for paleontological resources, and have potential to contain significant fossils.

Excavation to the proposed depth at Sites 1–5 has potential to damage or destroy significant paleontological resources. Any such damage or destruction would be a significant impact. Implementation of MM-PALEO-1 through MM-PALEO-3 would reduce the impact to less than significant.

Extension of the University Avenue Bridge Parapet and Concrete Removal

Extension of the University Avenue Bridge parapet would consist of replacing an extension of a 2- to 3-foot temporary wall with a permanent concrete wall. In addition, concrete removal at this site consists of removing 273 feet of a concrete in-channel structure and wall. Removing the existing wall would require excavation to a depth of 4 feet. Excavation is unlikely to affect Holocene natural levee deposits because of the shallow depth of excavation. The impact for this project element is less than significant.

Aquatic Habitat Enhancement

Because excavation would begin at least 15 feet bgs (starting at the base of the creek banks), any depth of excavation into native sediments would have potential to encounter paleontological resources. Excavation would be into native soils. Aquatic habitat enhancement activities would occur on Holocene natural levee deposits, which has high sensitivity for paleontological resources and high potential to contain significant fossils.

Excavation associated with construction of aquatic habitat enhancements has potential to damage or destroy significant paleontological resources. Any such damage or destruction would be a significant impact. Implementation of MM-PALEO-1 through MM-PALEO-3 would reduce the impact to less than significant.

Construction of Creekside Parks

Construction of the creekside parks would require grading to a depth of 3 feet bgs. Construction of the creekside parks would occur on Holocene natural levee deposits, which are sensitive for paleontological resources and have high potential to contain significant fossils.

Excavation to the proposed depth in the creekside parks has potential to damage or destroy significant paleontological resources. Any such damage or destruction would be a significant impact. Implementation of MM-PALEO-1 through MM-PALEO-3 would reduce the impact to less than significant.

MM-PALEO-1: Conduct a preconstruction paleontological resources field survey and paleontological resources inventory and evaluation

The SFCJPA will retain a qualified paleontologist with experience in vertebrate fossil monitoring and salvage at construction sites to conduct a paleontological resources field survey of the project area with native soils to determine whether significant resources exist within the project area. The inventory and evaluation will include the documentation and result of these efforts, the evaluation of any paleontological resources identified during the survey, and paleontological resources monitoring, if the survey identifies that it is necessary.

MM-PALEO-2: Conduct worker awareness training for paleontological resources prior to construction

Prior to the initiation of any site preparation or start of construction, the applicant will ensure that all construction workers receive training overseen by a qualified professional paleontologist who is experienced in teaching nonspecialists, to ensure that forepersons and field supervisors can recognize paleontological resources in the event that any are discovered during construction.

MM-PALEO-3: Stop work immediately if paleontological resources are discovered inadvertently

If paleontological resources are discovered during ground-disturbing activities, work will stop in that area and within 100 feet of the find until a qualified paleontologist with experience in vertebrate fossil monitoring and salvage at construction sites can assess the significance of the find and, if necessary, develop appropriate treatment measures in consultation with the SFCJPA and other agencies as appropriate. Equipment operators, supervisors, inspectors, and other field personnel will be required to report to the paleontology monitor any suspected fossil discoveries. The paleontologist will have authority to halt or redirect excavation operations in the event of discovery of vertebrate, plant, or invertebrate fossils until such time as their probable significance can be assessed and, if potentially significant, appropriate salvage measures have been implemented.

The paleontologist will properly collect and document any large vertebrate remains and recognize and appropriately sample and document any sedimentary bodies revealing small vertebrate remains. Large bulk samples may be appropriate. Minimum documentation includes exact location (GPS data), orientation, depth (elevation), and detailed geologic setting of any large- or small-vertebrate finds, including detailed diagrams showing microstratigraphy in nearby excavations supplemented with good-quality field photographs. If vertebrate fossils are discovered in spoils piles during excavation, the paleontologist will make every effort to locate and record the original site of the specimen(s) prior to disturbance.

Salvage of potentially significant specimens discovered in situ in excavated surfaces will be conducted by the paleontologist in compliance with all safety regulations and with implementation of all feasible precautions. The onsite safety inspector will hold final authority to determine whether each proposed salvage operation is consistent with established safety policies at the site. Excavation equipment and operators will be made available for short periods to remove overburden above in situ specimens, to improve safety conditions during salvage operations, or to aid in transport within the site boundaries of any large salvaged specimens which cannot be safely transported by hand.

Any potentially significant fossils recovered during the monitoring and salvage phase will be cleaned, repaired, and hardened to the level required by the repository institution, and will be donated to that institution. Any collected bulk sediment samples having the potential for small fossil vertebrate remains will be wet- or dry-screened and processed as necessary for recovery of the included fossils. Requirements and conditions for transfer of salvaged specimens to the repository museum will be arranged with the identified repository museum as soon as the scope of the salvaged collection becomes apparent, and will be in accordance with the recommendations outlined in SVP's *Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources* (2010).

On completion of the above tasks, the supervising paleontologist will prepare a final report on the implementation of this mitigation and results of implementing the mitigation and submit it to the appropriate parties, institutions, and government agencies.

Operations and Maintenance

Maintenance is described as removal of woody debris, plant material, and trash; any removal of accrued sediment would not disturb native soils. As a result, no impacts are expected during project operation.

Floodwalls Alternative

As described above under *Location of Alternatives on Sensitive Geologic Units,* all elements for the Floodwalls Alternative are located on geologic units with high sensitivity for paleontological resources, flood-plain deposits (Qhfp) and natural levee deposits (Qhl) (Figure 3.5-2a).

Construction

As with the Channel Widening Alternative, construction activities such as excavation could affect sensitive, previously undisturbed geologic units, potentially unearthing and damaging previously unknown paleontological resources or other geologic features. According to available geologic maps, such sensitive native sediments may exist at the site of all elements of the Floodwalls Alternative. In Reach 2, sensitive sediments may be at ground surface, well above the surface of the channel bottom.

Replace or Bypass Pope-Chaucer Street Bridge

Implementation of the Pope-Chaucer Street Bridge would be the same as under the Channel Widening Alternative. Therefore, the impact would be the same.

Floodwalls

Installation of the floodwalls would require excavation at the top of the channel banks to a depth of 4 feet. Construction of the floodwalls would occur on Holocene natural levee deposits, which are sensitive for paleontological resources and have high potential to contain significant fossils. Excavation to the proposed depth for the floodwalls has potential to damage or destroy significant paleontological resources. Any such damage or destruction would be a significant impact. Implementation of mitigation measures MM-PALEO-1, MM-PALEO-2, and MM-PALEO-3 would reduce the impact to less than significant.

Channel Widening at Site 5

Implementation of channel widening at Site 5 would be the same as under the Channel Widening Alternative. Therefore, the impact would be the same.

Aquatic Habitat Enhancement

Implementation of aquatic habitat enhancement would be the as under the Channel Widening Alternative. Therefore, the impact would be the same.

Construction of Creekside Parks

Construction of creekside parks would be the same as under the Channel Widening Alternative. Therefore, the impact would be the same.

Operations and Maintenance

Maintenance is described as removal of woody debris, plant material, and trash; any removal of accrued sediment would not disturb native soils. As a result, no impacts are expected as a result of project operation.

Former Nursery Detention Basin Alternative

As described above under *Location of Alternatives on Sensitive Geologic Units*, all project elements for the Former Nursery Detention Basin Alternative are located on geologic units with high sensitivity for paleontological resources, older alluvial fan deposits (Qpoaf) and Ladera Sandstone (Tlad) (Figure 3.5-2b).

Construction

As with the Channel Widening Alternative, construction activities such as excavation could affect sensitive, previously undisturbed geologic units, potentially unearthing and damaging previously unknown paleontological resources or other geologic features. According to available geologic maps, such sensitive native sediments may exist at the Former Nursery Detention Basin Alternative site, where sensitive sediments would be at ground surface and below.

Construction of the 12.4-acre, 14-foot deep detention basin at the Former Nursery site would require excavation to a maximum depth of 14 feet below ground surface. In addition, installation of the fish screen would require excavation to a maximum depth of 4 feet below ground surface. Excavation would be into native sediments. Construction would affect older alluvial fan deposits and Ladera Sandstone, both with high paleontological sensitivity.

Excavation to the proposed depth has potential to damage or destroy significant paleontological resources. Any such damage or destruction would be a significant impact. Implementation of MM-PALEO-1 through MM-PALEO-3 would reduce the impact to less than significant.

Operations and Maintenance

Maintenance of the detention basin would involve removal of sediment that accumulates within the basin during flood events and transport of that sediment to an appropriate location. Removal of the sediment would not involve excavation beyond depth of the basin floor. There would be no impact.

Webb Ranch Detention Basin Alternative

As described above under *Location of Alternatives on Sensitive Geologic Units*, all project elements for Webb Ranch Detention Basin Alternative are located on geologic units with high sensitivity for paleontological resources (older alluvial fan deposits (Qpoaf)), and on geologic units with undetermined sensitivity (Whiskey Hill Formation (Tw)) (Figure 3.5-2b).

Construction

As with the Channel Widening Alternative, construction activities such as excavation could affect sensitive, previously undisturbed geologic units, potentially unearthing and damaging previously unknown paleontological resources or other geologic features. According to available geologic maps, such sensitive native sediments may exist at the Webb Ranch Detention Basin Alternative site, where sensitive sediments would be at ground surface and below.

Construction of the 27.4-acre, 13-foot deep detention basin at the Webb Ranch site would require excavation to a maximum depth of 13 feet bgs. In addition, installation of the fish screen would require excavation to a maximum depth of 4 feet bgs. Excavation would be into native sediments. Construction would affect older alluvial fan deposits and Whiskey Hill Formation. Older alluvial fan deposits have high paleontological sensitivity, and Whiskey Hill Formation has undetermined paleontological sensitivity.

Excavation to the proposed depth has potential to damage or destroy significant paleontological resources. Any such damage or destruction would be a significant impact. Implementation of MM-PALEO-1 through MM-PALEO-3 would reduce the impact to less than significant.

Operations and Maintenance

Maintenance of the detention basin would involve removal of sediment that accumulates within the basin during flood events and transport of that sediment to an appropriate location. Removal of the sediment would not involve excavation beyond depth of the basin floor. There would be no impact.

3.5.4 Cumulative Impacts

Cumulative Seismic and Geotechnical Resource Impacts

The entire Bay Area is technically active, and laws and regulations for development are in place to reduce seismic and geotechnical risks to what is considered acceptable. Cumulative impacts from any new development are not expected, as the area is already fully developed and any new infill development would be required to adhere to existing laws and regulations that would minimize seismic and geotechnical risks.

The project, as all cumulative projects, also would be required to be consistent with all applicable federal, state and local codes and regulations with respect to project design and construction. The project would therefore not make a cumulatively considerable contribution to a cumulative impact. No further analysis is required.

Cumulative Paleontological Resources Impacts

Significant paleontological resources are a nonrenewable resource; that is, when they are destroyed, they are lost forever. In addition, significant paleontological resources are rare. The early Holocene and Pleistocene setting in Silicon Valley, including Palo Alto and southern San Mateo County, is sensitive for paleontological resources and has seen rapid development. Therefore, a cumulative impact exists. The project incorporates mitigation that would require a preconstruction survey, worker awareness training, and immediate work stoppage in case paleontological resources are discovered. With implementation of these mitigation measures, project contribution to the cumulative impact would be less than cumulatively considerable.

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3.6 Greenhouse Gas Emissions and Climate Change

This section provides environmental analysis of the proposed project's impacts on greenhouse gas (GHG) emissions and climate change. The section summarizes the regulatory environment and discusses the environmental setting, provides the criteria used for determining impacts, discusses the impact mechanism and level of impact resulting from construction and operation of the proposed project, and describes mitigation to minimize the level of impact.

3.6.1 Regulatory Setting

Federal

There is no federal law specifically related to climate change or the reduction of GHG emissions. The United States Environmental Protection Agency (EPA) issued a Climate Action Plan in June 2013. EPA then developed proposed regulations under the Clean Air Act (CAA) pursuant to EPA's authority under the CAA, in 2014.[1] EPA has also adopted a Mandatory Reporting Rule and Clean Power Plan. Under the Clean Power Plan in 2015, EPA issued proposed regulations to control carbon dioxide (CO_2) emissions from new and existing coal-fired power plants. These rules were not promulgated due to potential litigation, and a stay of the regulations was issued by the Supreme Court on February 9, 2016. Former EPA Administrator Scott Pruitt signed a proposed measure to repeal the 2015 regulations and associated Clean Power Plan on October 9, 2018.

Although not overarching, there are specific settlement agreements between EPA, several states, and nongovernmental organizations to address GHG emissions from electric generating units and refineries, as well as EPA's issuance of an "Endangerment Finding" and a "Cause or Contribute Finding."

State

California has adopted statewide legislation addressing various aspects of climate change and GHG emissions mitigation. Much of this legislation establishes a broad framework for the state's long-term GHG reduction and climate change adaptation program. The Governor of California has also issued several executive orders (EOs) related to the state's evolving climate change policy. Of particular importance are Assembly Bill (AB) 32 and Senate Bill (SB) 32, which outline the state's GHG reduction goals of achieving 1990 emissions levels by 2020 and a 40% reduction below 1990 emissions levels by 2030.

In the absence of federal regulations, control of GHGs is generally regulated at the state level and is typically approached by setting emission reduction targets for existing sources of GHGs, setting policies to promote renewable energy and increase energy efficiency, and developing statewide action plans. Summaries of key policies, regulations, and legislation at the state levels that are relevant to the project are provided below.

[1] In *Coalition for Responsible Regulation, Inc., et al. v. EPA*, the United States Court of Appeals upheld EPA's authority to regulate GHG emissions under the CAA.

Assembly Bill 1493—Pavley Rules (2002, Amendments 2009, 2012 rulemaking)

Known as *Pavley I*, AB 1493 standards are the nation's first GHG standards for automobiles. AB 1493 required the California Air Resources Board (CARB) to adopt vehicle standards that will lower GHG emissions from new light-duty automobiles to the maximum extent feasible beginning in 2009. Additional strengthening of the Pavley standards (referred to previously as *Pavley II*, now referred to as the *Advanced Clean Cars* measure) has been adopted for vehicle model years 2017–2025. Together, the two standards are expected to increase average fuel economy to roughly 54.5 miles per gallon by 2025.

Executive Order S-3-05 (2005)

EO S-3-05 asserted that California is vulnerable to the effects of climate change. To combat this concern, the order established the following GHG emissions reduction targets.

- By 2010, reduce GHG emissions to 2000 levels.
- By 2020, reduce GHG emissions to 1990 levels.
- By 2050, reduce GHG emissions to 80% below 1990 levels.

Executive orders are legally binding only on state agencies. Accordingly, EO S-3-05 guides state agencies' efforts to control and regulate GHG emissions but has no direct, binding effect on local government or private actions. The secretary of the California Environmental Protection Agency (CalEPA) is required to report to the governor and state legislature biannually regarding the impacts of global warming on California, mitigation and adaptation plans, and progress made toward reducing GHG emissions to meet the targets established in this EO.

Assembly Bill 32—California Global Warming Solutions Act (2006)

AB 32 codified the state's GHG emissions target by requiring that the state's global warming emissions be reduced to 1990 levels by 2020. Since being adopted, CARB, the California Energy Commission (CEC), the California Public Utilities Commission (CPUC), and the Building Standards Commission have been developing regulations that will help meet the goals of AB 32. The AB 32 Scoping Plan identifies specific measures to reduce GHG emissions to 1990 levels by 2020, and requires CARB and other state agencies to develop and enforce regulations and other initiatives for reducing GHGs. Specifically, the AB 32 Scoping Plan articulates a key role for local governments, recommending they establish GHG reduction goals for both their municipal operations and the community consistent with those of the state.

Executive Order S-01-07—Low Carbon Fuel Standard (2007)

EO S-01-07 essentially mandates (1) that a statewide goal be established to reduce the carbon intensity of California's transportation fuels by at least 10% by 2020; and (2) that a Low Carbon Fuel Standard (LCFS) for transportation fuels be established in California. CARB approved the LCFS on April 23, 2009, and the regulation became effective on January 12, 2010 (California Air Resources Board 2011).

Senate Bill 375 (2008)

SB 375 requires regional transportation plans, developed by Metropolitan Planning Organizations (MPOs), to incorporate a "sustainable communities strategy" (SCS) in their regional transportation plans that will achieve the GHG emissions reduction targets set by CARB. CARB updated the regional targets in March 2018. SB 375 also includes provisions for streamlined CEQA review for some infill projects such as transit-oriented development. However, those provisions will not become effective until an SCS is adopted. SB 375 requires the Association of Bay Area Governments (ABAG) and Metropolitan Transportation Commission (MTC) to identify strategies that will reduce per capita GHG emissions from passenger vehicles by approximately 19% by 2035 over base year 2005. ABAG and MTC jointly released their SCS as part of *Plan Bay Area 2040.*

State CEQA Guidelines (2010)

The State CEQA Guidelines require lead agencies to describe, calculate, or estimate the amount of GHG emissions that would result from a project. Moreover, the State CEQA Guidelines emphasize the necessity to determine potential climate change effects of a project and propose mitigation as necessary. The State CEQA Guidelines confirm the discretion of lead agencies to determine appropriate significance thresholds, but require the preparation of an environmental impact report (EIR) if "there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding compliance with adopted regulations or requirements" (Section 15064.4).

State CEQA Guidelines Section 15126.4 includes considerations for lead agencies related to feasible mitigation measures to reduce GHG emissions, which may include, among others, measures in an existing plan or mitigation program for the reduction of emissions that are required as part of the lead agency's decision; implementation of project features, project design, or other measures that are incorporated into the project to substantially reduce energy consumption or GHG emissions; offsite measures, including offsets that are not otherwise required, to mitigate a project's emissions; and measures that sequester carbon or carbon-equivalent emissions.

Senate Bills 1078 (2002), 107 (2006), and 2 (2011) —Renewables Portfolio Standard

California's Renewables Portfolio Standard (RPS), which was established by SB 1078 and subsequently modified by SB 107 and SB 2, obligates investor-owned utilities, energy service providers, and Community Choice Aggregators to procure a certain amount of retail electricity sales per year from eligible renewable sources. The long-range targets established by SB 1078, SB 107, and SB 2 called for the procurement of 33% of retail electricity sales from renewable resources by 2020. The CPUC and CEC are jointly responsible for implementing the RPS program.

Senate Bills 350 and 100— Clean Energy and Pollution Reduction Act of 2015, 100 Percent Clean Energy Act of 2017 (2015, 2018)

SB 350 was approved by the California legislature in September 2015 and signed by Governor Brown in October 2015. Its key provisions include: (1) a RPS of 50% by 2030; and (2) a doubling of energy efficiency (electrical and natural gas) by 2030, including improvements to the efficiency of existing buildings. These mandates will be implemented by the CPUC and CEC. SB 100 was approved by the California legislature in August 2018 and signed by Governor Brown in September 2018. Its key provisions were to raise the RPS requirement set by SB 350 from 50 to 60% by 2030, and to create a new policy to meet all of the state's retail electricity supply with a mix of RPS-eligible and zero-carbon resources by December 31, 2045, for a total of 100% clean energy.

Senate Bill 32 (2016)

SB 32 (2016) directs CARB to work to ensure that statewide GHG emissions are reduced to at least 40% below the 1990 level by 2030, consistent with the target set forth in EO B-30-15. CARB adopted the 2017 *Climate Change Scoping Plan* in November 2017 to meet the GHG reduction requirement set forth in SB 32. The Scoping Plan proposes continuing the major programs of the previous Scoping Plan, including Cap-and-Trade Regulation, LFCS, more efficient cars, trucks, and freight movement, RPS, and reducing methane emissions from agricultural sources and other wastes. The Scoping Plan also addresses for the first time the GHG emissions from natural and working lands in California.

Local

Bay Area 2017 Clean Air Plan

The Bay Area Air Quality Management District's (BAAQMD's) *Bay Area 2017 Clean Air Plan* addresses air emissions in the San Francisco Bay Area Air Basin. One of the key objectives in the plan is climate protection. The Clean Air Plan includes emission control measures and performance objectives, consistent with the state's climate protection goals under AB 32, SB 32, EO S-3-05, and SB 375, designed to reduce emissions of GHGs to 1990 levels by 2020, 40% below 1990 levels by 2030, and 80% below 1990 levels by 2050.

City of Menlo Park General Plan

The *City of Menlo Park General Plan* includes the following goals and policies associated with GHGs:

Goal OSC4: Promote Sustainability and Climate Action Planning.

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 OSC4.8: Waste Diversion. Develop and implement a zero waste policy, or implement standards, incentives, or other programs that would lead the community towards a zero waste goal.

City of Menlo Park Climate Action Plan

The City of Menlo Park adopted its original Climate Action Plan (CAP) in 2009 and most recently updated the CAP in May 2018. The CAP proposes local emissions reduction strategies to help meet AB 32 targets.

The CAP provides an emissions inventory for 2005 to 2013, an emissions forecast for 2020, a reduction goal for 2020, and a recommendation for GHG reduction strategies. Based on the emissions inventory and forecast for 2020, the City adopted a GHG emissions reduction target in June 2013 of 27% below 2005 levels by 2020 to meet the goals of AB 32.

The CAP recommends various community and municipal strategies for near-term and mid-term consideration. The emissions reduction strategies are generally focused on community strategies rather than municipal ones, because more than 99% of the emissions are from community sources.

CEQA authorizes reliance on a previously approved GHG emissions reduction plan (i.e., a CAP) that was prepared as a "Plan for the Reduction of Greenhouse Gas Emissions," per Section 15183.5 of the State CEQA Guidelines. This section of the State CEQA Guidelines establishes opportunities for CEQA tiering when projects are consistent with adopted GHG emissions reduction plans, their impacts can be considered less than significant, and their contributions to cumulative emissions are not cumulatively considerable, provided the GHG emissions reduction plans meet certain criteria established under Section 15183.5.

The City of Menlo Park's CAP does not meet these tiering requirements, because the CAP does not include specific thresholds for determining the significance of GHG emissions, nor has the CAP been adopted in a public process following environmental review. Consequently, because the City's CAP does not satisfy the tiering requirements of CEQA established in Section 15183.5 of the State CEQA Guidelines, it is not used in this EIR to determine the significance of project-related GHG emissions.

City of East Palo Alto General Plan

The *City of East Palo Alto General Plan* includes the following goals and policies associated with GHGs:

Goal POC-8: Adapt to and mitigate climate change impacts.

Policy 8.2: Heat island reductions. Require heat island reduction strategies in new developments such as light-colored cool roofs, light-colored paving, permeable paving, right-sized parking requirements, vegetative cover and planting, substantial tree canopy coverage, and south and west side tree planting.

Policy 8.3: Public realm shading. Strive to improve shading in public spaces such as bus stops, sidewalks and public parks and plazas through the use of trees, shelters, awnings, gazebos, fabric shading and other creative cooling strategies.

Policy 8.4: Reducing GHG emissions. In consulting with applicants and designing new facilities, prioritize the selection of green building design features that enhance the reduction of greenhouse gas emissions.

City of East Palo Alto Climate Action Plan

The City of East Palo Alto adopted its CAP in 2011. The CAP proposes 23 local emissions reduction strategies to help meet AB 32 targets.

The CAP provides an emissions inventory for 2005, an emissions forecast for 2020, a reduction goal for 2020, and a recommendation for GHG reduction strategies. Based on the emissions inventory and forecast for 2020, the City committed to a GHG emissions reduction target of 15% below 2005 levels by 2020 to meet the goals of AB 32.

The CAP recommends various GHG reduction strategies focused on four sectors, including building energy use, transportation and land use, waste, and municipal operations.

The City of East Palo Alto's CAP also does not meet the CAP tiering requirements described above, because the CAP does not include specific thresholds of significance for determining the significance of GHG emissions, nor has the CAP been adopted in a public process following environmental review. Consequently, it does not satisfy the tiering requirements of CEQA established in Section

15183.5 of the State CEQA Guidelines and is not used in this EIR to determine the significance of project-related GHG emissions.

City of Palo Alto Comprehensive Plan 2030

The *City of Palo Alto Comprehensive Plan* includes the following goals and policies associated with GHGs:

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 8.4: Continue to work with regional partners to build resiliency policy into City planning and capital projects, especially near the San Francisco Bay shoreline, while protecting the natural environment.

City of Palo Alto Sustainability and Climate Action Plan

The City of Palo Alto adopted a Climate Protection Plan in 2007. In 2016, the City adopted a Sustainability and Climate Action Plan (S/CAP) framework. The S/CAP proposes local emissions reduction strategies to help achieve an 80% reduction in GHG emissions below 1990 levels by 2030. By 2015, the City of Palo Alto had already reduced GHG emissions to 36% below 1990 levels, meeting AB 32 reduction goals before 2020. In 2017, the City adopted a *2018-2020 Sustainability Implementation Plan.*

On March 18, 2019, the City adopted a sea level rise (SLR) adaptation policy as a result of projections stemming from GHG emissions and related climate change that pose significant economic, environmental, and social risks to communities along the San Francisco Bay Shoreline, including the City of Palo Alto. The City recognized that the best way to avoid long-term impacts from the worst SLR predictions and to minimize adaption response costs is to reduce GHG contributions locally and to support regional, state, and national initiatives that reduce GHGs.

The S/CAP provides an emissions inventory for 2015, an emissions forecast for 2030, a reduction goal for 2030, and a recommendation for GHG reduction strategies. Given the emissions inventory and forecast for 2030, the City adopted a GHG emissions reduction target of 80% below 1990 levels by 2030 to meet the goals of SB 32.

The S/CAP recommends various community and municipal strategies for reducing GHG emissions and adapting to the effects of climate change.

Similar to the CAPs of Menlo Park and East Palo Alto, the City of Palo Alto Sustainability and CAP does not meet these tiering requirements because the CAP does not include specific thresholds of significance for determining the significance of GHG emissions, nor has the CAP been adopted in a public process following environmental review. Consequently, it does not satisfy the tiering requirements of CEQA established in Section 15183.5 of the State CEQA Guidelines and is not used in this EIR to determine the significance of project-related GHG emissions.

Santa Clara Valley Water District Climate Change Action Plan

Since 2008, the Santa Clara Valley Water District has implemented many efforts to reduce GHG emissions and to develop adaptation strategies. Key efforts include advancing water conservation and recycled water, increasing water supply flexibility, addressing SLR, supporting ecosystem functions, and habitat restoration. Also, the Board of Directors has adopted policies including setting an explicit target for carbon neutrality, implementing a carbon reduction framework, and enacting a climate divestment monetary policy. In addition, the Santa Clara Valley Water District is currently developing a Climate Change Action Plan (CCAP) scheduled for release in 2019. The CCAP will provide a framework for consistent and comprehensive planning for climate change and reducing GHGs.

3.6.2 Environmental Setting

The unique chemical properties of GHGs enable them to become well-mixed within the atmosphere and transported over long distances. Consequently, unlike other resource areas that are primarily concerned with localized project impacts (e.g., within 1,000 feet of the project site), the global nature of climate change requires a broader analytic approach. While this section focuses on GHG emissions generated at the project site as a result of construction and operation, the analysis considers potential regional and global GHG impacts.

Greenhouse Gases

The principle anthropogenic (human-made) GHGs contributing to global warming are CO_2, methane (CH_4), nitrous oxide (N_2O), and fluorinated compounds, including sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). Water vapor, the most abundant GHG, is not included in this list because its natural concentrations and fluctuations far outweigh its anthropogenic sources.

The primary GHGs of concern associated with the project are CO_2, CH_4, and N_2O. Principal characteristics of these pollutants are discussed below.

Carbon dioxide enters the atmosphere through fossil fuels (oil, natural gas, and coal) combustion, solid waste decomposition, plant and animal respiration, and 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.

Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and from the decay of organic waste in municipal solid waste landfills.

Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

Methods have been set forth to describe emissions of GHGs in terms of a single gas to simplify reporting and analysis. The most commonly accepted method to compare GHG emissions is the global warming potential (GWP) methodology defined in the Intergovernmental Panel on Climate Change (IPCC) reference documents. The IPCC defines the GWP of various GHG emissions on a normalized scale that recasts all GHG emissions in terms of carbon dioxide equivalent (CO_2e), which compares the gas in question to that of the same mass of CO_2 (CO_2 has a global warming potential of 1 by definition).

Table 3.6-1 lists the global warming potential of CO_2, CH_4, and N_2O; their lifetimes; and abundances in the atmosphere.

Table 3.6-1. Lifetimes and Global Warming Potentials of Key Greenhouse Gases

Greenhouse Gases	Global Warming Potential (100 years)	Lifetime (years)	Current Atmospheric Abundance
CO_2	1	50–200	400 ppm
CH_4	25	9–15	1,834 ppb
N_2O	298	121	328 ppb

Sources: Intergovernmental Panel on Climate Change 2007; Blasing 2016.
CH_4 = methane
CO_2 = carbon dioxide
N_2O = nitrous oxide
ppb = parts per billion
ppm = parts per million

A GHG inventory is a quantification of all GHG emissions and sinks[2] within a selected physical or economic boundary. Table 3.6-2 outlines the most recent global, national, statewide, regional, and local GHG inventories.

Table 3.6-2. Global, National, and State GHG Emissions Inventories

Emissions Inventory	CO_2e (metric tons)
2010 IPCC Global GHG Emissions Inventory	52,000,000,000
2016 EPA National GHG Emissions Inventory	6,511,300,000
2016 CARB State GHG Emissions Inventory	429,400,000
2011 BAAQMD GHG Emissions Inventory	86,600,000
2013 City of Menlo Park GHG Emissions Inventory	360,247
2005 City of East Palo Alto GHG Emissions Inventory	140,465
2017 City of Palo Alto GHG Emissions Inventory	436,575

Sources: Intergovernmental Panel on Climate Change 2014; U.S. Environmental Protection Agency 2018; California Air Resources Board 2018; Bay Area Air Quality Management District 2011; City of Menlo Park 2018; City of East Palo Alto 2011; City of Palo Alto 2018.

3.6.3 Impact Analysis

Methods and Significance Criteria

GHG and climate change impacts associated with construction and operation of the proposed project were assessed and quantified using standard and accepted software tools, techniques, and emission factors. A summary of the methodology is provided below.

Construction

Construction activities would generate emissions of CO_2, CH_4, and N_2O from mobile and stationary construction equipment, onsite water and electricity use, and construction employee and haul truck vehicles. It is expected that construction associated with the Channel Widening Alternative would

[2] A GHG sink is a process, activity, or mechanism that removes a GHG from the atmosphere.

occur over two to three phases between March 2020 and November 2021. It is expected that construction associated with the Floodwalls Alternative would occur over three phases between March 2020 and November 2021.

GHG emissions were estimated using California Emissions Estimator Model (CalEEMod), version 2016.3.2 and EMFAC2017 emission factors. CalEEMod default values were used for some construction parameters, such as equipment load factors. The construction schedule (i.e., start and end dates), the types and horsepower of construction equipment, the number of pieces of equipment, the onsite water and electricity use, and the amount of material imported and exported, associated with the Channel Widening Alternative and Floodwalls Alternative were provided by the San Francisquito Creek Joint Powers Authority.

Using the methods described above, annual GHG emissions were estimated for each year of activity. Please refer to Appendix A for the construction modeling outputs and detailed assumptions.

Construction-related emissions associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative were qualitatively evaluated, as construction data was not available for these specific alternatives at the time of the analysis.

Operation

Operation of the project would generate emissions of CO_2, CH_4, and N_2O. GHG emissions from motor vehicles associated with development of the project were qualitatively evaluated.

The State CEQA Guidelines Appendix G (14 California Code of Regulations 15000 et seq.) identifies significance criteria to be considered for determining whether a project could have significant impacts on existing greenhouse gas emissions and climate change.

A project impact would be considered significant if construction or operation of the proposed project would cause either of the following.

1. Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment.
2. Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases.

Per the BAAQMD CEQA Air Quality Guidelines and Section 15183.5 of the CEQA Guidelines, compliance with a qualified greenhouse gas reduction strategy is one method of showing less-than-significant GHG emissions. However, the Cities of Menlo Park, Palo Alto, and East Palo Alto have not adopted qualified GHG reduction strategies, as noted above, and cannot be solely relied on to make a significance determination for Impact GHG-1.

Because the vast majority of the project's GHG emissions would be generated by construction activities, the significance determination for Impact GHG-1 is made by determining the extent to which BAAQMD's best management practices (BMPs) for construction-related GHG emissions would be incorporated into the project. For the project's GHG emissions generated by operational activities, the significance determination for Impact GHG-1 is made by determining whether the project's GHG emissions would exceed BAAQMD's 1,100 metric tons (MT) CO_2 per year threshold for land use development projects.

Project consistency with applicable GHG reduction measures outlined in the Cities of Menlo Park, Palo Alto, and East Palo Alto CAPs were also evaluated for informational purposes.

Impacts and Mitigation Measures

Impact GHG-1—Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment

Summary by Project Element: Impact GHG-1— Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation

Channel Widening Alternative and Floodwalls Alternative

Construction

Construction is expected to span approximately 9 months. The emissions generated during construction of the Channel Widening Alternative and Floodwalls Alternative are summarized in Table 3.6-3. As shown in Table 3.6-3, it is estimated that construction of the Channel Widening Alternative and Floodwalls Alternative would generate approximately 1,512 and 808 metric tons of CO_2e, respectively. These quantities of emissions are equivalent to the emissions that would be emitted from adding 324 and 173 typical passenger vehicles to the road during the construction period for the Channel Widening Alternative and Floodwalls Alternative, respectively (EPA 2017). The emissions generated during construction of the Channel Widening Alternative and Floodwalls Alternative would primarily be the result of diesel-powered construction equipment (e.g., excavators, graders). Construction emissions would cease once construction of the alternatives is complete, and, thus, they are considered short-term.

Table 3.6-3. Estimated Unmitigated GHG Emissions from Project Construction (metric tons per year)

Year 2019	CO_2	CH_4	N_2O	CO_2e
Channel Widening Alternative	1,477	0.3	0.1	1,512
Floodwalls Alternative	788	0.1	0.1	808

CO_2 = carbon dioxide
CH_4 = methane
N_2O = nitrous oxide
CO_2e = carbon dioxide equivalent, which includes the relative warming capacity (i.e., global warming potential) of each GHG

BAAQMD's CEQA Air Quality Guidelines do not identify a GHG emission threshold for construction-related emissions, but they recommend that GHG emissions from construction be quantified and disclosed, and that a determination regarding the significance of these GHG emissions be made with respect to whether a project is consistent with the AB 32 GHG emission reduction goals.

The Channel Widening Alternative and Floodwalls Alternative would implement MM-GHG-1 to reduce GHG emissions during construction.

MM-GHG-1: Implement BAAQMD's best management practices to reduce GHG emissions from construction

- Use alternative-fuel (e.g., biodiesel, electric) construction vehicles/equipment (more than 15% of the fleet).
- Use local building materials (more than 10%).
- Recycle more than 50% of construction waste or demolition materials.

Mitigation Measure MM-AQ-2, which is required to reduce nitrogen oxide emissions (see Section 3.2, *Air Quality*), would also reduce GHG emissions from construction activities by requiring haul trucks associated with the Channel Widening Alternative and Floodwalls Alternative to use model year 2010 and newer engines. The emissions generated during construction, with implementation of MM-AQ-2, of the Channel Widening Alternative and Floodwalls Alternative are summarized in Table 3.6-4. As shown in Table 3.6-4, it is estimated that construction of the Channel Widening Alternative and Floodwalls Alternative would generate approximately 1,500 and 800 metric tons of CO_2e, respectively. These quantities of emissions are equivalent to the emissions that would be emitted from adding 321 and 171 typical passenger vehicles to the road during the construction period for the Channel Widening Alternative and Floodwalls Alternative, respectively (EPA 2017).

Table 3.6-4. Estimated GHG Emissions from Project Construction with Implementation of Mitigation Measure MM-AQ-2 (metric tons per year)

Year 2019	CO_2	CH_4	N_2O	CO_2e
Channel Widening Alternative	1,465	0.3	0.1	1,500
Floodwalls Alternative	781	0.1	0.1	800

CO_2 = carbon dioxide
CH_4 = methane
N_2O = nitrous oxide
CO_2e = carbon dioxide equivalent, which includes the relative warming capacity (i.e., global warming potential) of each GHG

Because construction of the project would implement MM-GHG-1 and emissions would occur for a relatively short period of eight months, this impact would be less than significant with mitigation.

Operations and Maintenance

As described in Chapter 2, the Channel Widening Alternative would require maintenance activities similar to existing maintenance activities, including removing debris from channels, which would occur before the rainy season (October to May), and more intensive post-rain event clean-up that could be needed after major rainfall events. The Floodwalls Alternative would require visual inspections for any damaged concrete or exposed reinforcing bar, and if found, repairing damaged concrete; and visually inspecting for any undermining, and if found, backfilling or grouting. Additionally, monitoring and maintenance of new vegetation would occur, at a minimum, for 3 years following completion of the Channel Widening Alternative and Floodwalls Alternative. This activity would consist of removing invasive plants, watering newly planted vegetation for establishment, and replanting as needed. In-channel pools and refugia would be inspected to ensure functionality. Any creekside parks would require trash pick-up and disposal as well as routine maintenance of benches and landscaping, but this would be the responsibility of either the landowner or a city, and not part of operations and maintenance.

The operational activities described above would likely involve occasional light duty vehicle trips to transport personnel to the site and handheld landscaping equipment. Based on the average employee commute distance within the BAAQMD, a single vehicle trip would result in less than 1 MT CO_2e. Therefore, these activities would generate annual GHG emissions far below BAAQMD's significance threshold of 1,100 MT CO_2e per year for land use development projects.

Based on the types of vehicles and equipment and occasional nature of activities, operational emissions would be considered minor and less than significant. No mitigation is required.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Construction of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative is expected to span approximately 6 months, which is 2 months less than the construction durations of the Channel Widening Alternative and Floodwalls Alternative. The emissions generated during construction of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would primarily be the result of diesel-powered construction equipment. Construction emissions would cease once construction of the alternatives is complete, and, thus, they are considered short-term.

As discussed above, BAAQMD's CEQA Guidelines do not identify a GHG emission threshold for construction-related emissions; rather, the guidelines recommend that GHG emissions from construction be quantified and disclosed and that a determination regarding the significance of these GHG emissions be made with respect to whether a project is consistent with the AB 32 GHG emission reduction goals.

Construction activities would include implementation of MM-GHG-1 as discussed for the Channel Widening Alternative and Floodwalls Alternative, as recommended by BAAQMD to reduce GHG emissions during construction.

Similarly, MM-AQ-2, which is required to reduce nitrogen oxide emissions (see Section 3.2, *Air Quality*), would also reduce GHG emissions from construction activities by requiring haul trucks associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative to use model year 2010 and newer engines. Because construction of the project would implement MM-GHG-1 and emissions would occur for a relatively short period of 6 months, this impact would be less than significant with mitigation.

Operations and Maintenance

As described in Chapter 2, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative may require occasional removal of sediments that accumulate within the basin during large flood events to be removed and hauled by haul truck to an appropriate location once the basin empties out. However, sediment removal activities would occur on an infrequent basis and would be temporary in nature. In addition, because these activities would require construction equipment and vehicles, MM-GHG-1 would be implemented during sediment removal activities.

Additionally, MM-AQ-2, which is required to reduce nitrogen oxide emissions (see Section 3.2), would also reduce GHG emissions from operations and maintenance activities by requiring haul trucks associated with the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative to use model year 2010 and newer engines. Because operations and maintenance of the project would implement MM-GHG-1 and emissions would occur for a relatively short period of 6 months, this impact would be less than significant with mitigation.

Impact GHG-2—Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases

Summary by Project Element: Impact GHG-2—Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative and Floodwalls Alternative

AB 32 establishes a statewide goal to reduce GHG emissions to 1990 levels by 2020. The CARB adopted the AB 32 Scoping Plan as a framework for achieving AB 32 goals. The scoping plan outlines a series of technologically feasible and cost-effective measures to reduce statewide GHG emissions. CARB adopted the *2017 Climate Change Scoping Plan Update* in November 2017 to meet the GHG reduction requirement set forth in SB 32, and it proposes continuing the major programs of the previous Scoping Plan. Similarly, the CAPs for the Cities of Menlo Park, Palo Alto, and East Palo Alto include a variety of measures to reduce a portion of their estimated GHG emissions to assist the Cities in reducing GHG emissions to comply with AB 32 and SB 32.

The Channel Widening Alternative and Floodwalls Alternative would enhance habitat within the project area, particularly interconnected habitat for threatened and endangered species by installing in-channel pools and refugia features and removing invasive species. In addition, the Channel Widening Alternative and Floodwalls Alternative would protect life, property, and infrastructure from floodwaters exiting the creek. These actions are consistent with Goal 6.2 – Protect the City from climate change induced hazards, Goal 6.3 – Adapt to current and projected environmental conditions, and Goal 7.1 – Renew, restore and enhance resilience of our natural environment, from the City of Palo Alto's CAP. These goals and plans were adopted to help the Cities achieve the State's overall GHG reduction goals indicated in AB 32, SB 32, and EO S-3-05.

BAAQMD's *2017 Clean Air Plan* includes performance objectives, consistent with the State's climate protection goals under AB 32 and SB 375, designed to reduce emissions of GHG emissions to 1990 levels by 2020 and 40% below 1990 levels by 2030. The *2017 Clean Air Plan* identifies a range of Transportation Control Measures, Land Use and Local Impacts Measures, and Energy and Climate Measures that make up the Clean Air Plan's control strategy for emissions, including GHGs. The project is consistent with BAAQMD's *2017 Clean Air Plan* measures, including TR19 – Medium and Heavy Duty Trucks, and TR22 – Construction, Freight, and Farming Equipment, because the implementation of MM-AQ-1 and MM-AQ-2 would require the use of clean diesel-powered equipment and haul trucks during construction. The project is also consistent with Clean Air Plan measure SS36 – Particulate Matter from Trackout, because the project would incorporate BAAQMD's Basic Construction Mitigation Measures as an Environmental Commitment.

Under the requirements of SB 375, MTC and ABAG have developed and adopted a sustainable community strategy, *Plan Bay Area 2040*, to achieve the Bay Area's regional GHG reduction target. Targets for the San Francisco Bay Area, approved in March 2018 by CARB, include a 10% reduction in GHG per capita from passenger vehicles by 2020 compared to emissions in 2005. The adopted target for 2035 is a 19% reduction per capita from passenger vehicles compared to emissions in 2005. The emission reduction targets are for those associated with land use and transportation strategies only. The project would not contribute to a substantial increase in passenger vehicle travel within the region, because no new land use development would be constructed.

In addition, the Channel Widening Alternative and Floodwalls Alternative would temporarily generate GHG emissions over the 9-month construction period, but would not generate significant long-term GHG emissions. The Channel Widening Alternative and Floodwalls Alternative would also implement BAAQMD's construction GHG BMPs, as shown in Impact GHG-1. Accordingly, the proposed project would not conflict with the GHG reduction goals of AB 32, SB 32, EO S-3-05, local Cities' CAPs, BAAQMD's *2017 Clean Air Plan*, or *Plan Bay Area 2040.*

Based on the above analysis, the project includes numerous objectives and measures that are consistent with applicable policies described in the Scoping Plans for AB 32, SB 32, applicable local CAPs, BAAQMD's *2017 Clean Air Plan*, and *Plan Bay Area 2040*. Consequently, the project would not conflict with achievement of AB 32 reduction goals for 2020, SB 32 reduction goals for 2030, and the *Regional Transportation Plan/Sustainable Communities Strategy* (RTP/SCS) reduction goals for 2020 and 2035. Therefore, this impact would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

With respect to the project's potential to conflict with applicable plans, policies, or regulations adopted for the purpose of reducing GHG emissions, the discussion in Impact GHG-2 of the GHG plans relevant to the Channel Widening Alternative and Floodwalls Alternative is also applicable to the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative.

The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would protect life, property, and infrastructure from floodwaters exiting the creek. These actions are consistent with Goal 6.2 – Protect the City from climate change induced hazards and Goal 6.3 – Adapt to current and projected environmental conditions, from the City of Palo Alto's CAP. As described above, these goals and plans were adopted to help the Cities achieve the State's overall GHG reduction goals indicated in AB 32, SB 32, and EO S-3-05.

BAAQMD's *2017 Clean Air Plan* includes performance objectives, consistent with the State's climate protection goals under AB 32 and SB 375, designed to reduce emissions of GHG emissions to 1990 levels by 2020 and 40% below 1990 levels by 2035. The *2017 Clean Air Plan* identifies a range of Transportation Control Measures, Land Use and Local Impacts Measures, and Energy and Climate Measures that make up the Clean Air Plan's control strategy for emissions, including GHGs. The project is also consistent with BAAQMD's *2017 Clean Air Plan* measures including TR19 – Medium and Heavy Duty Trucks, and TR22 – Construction, Freight, and Farming Equipment, because the implementation of MM-AQ-1 and MM-AQ-2 would require the use of clean diesel-powered equipment and haul trucks during construction. The project is also consistent with Clean Air Plan measure SS36 – Particulate Matter from Trackout, because the project would incorporate BAAQMD's Basic Construction Mitigation Measures as an Environmental Commitment. The GHG mitigation measures would be specified in the construction bid and awarded contract.

As discussed for the Channel Widening Alternative and Floodwalls Alternative, MTC and ABAG have developed a sustainable community strategy with the adopted *Plan Bay Area 2040* to achieve the Bay Area's regional GHG reduction target. As described above, the project would not contribute to a substantial increase in passenger vehicle travel within the region, because no new land use development would be constructed.

In addition, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would generate GHG emissions over the 6 month construction period, but would not generate significant long-term GHG emissions. the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would also implement BAAQMD's construction GHG BMPs, as shown in Impact GHG-1. Accordingly, the proposed project would not conflict with the GHG reduction goals of AB 32, SB 32, EO S-3-05, local Cities' CAPs, BAAQMD's *2017 Clean Air Plan*, or *Plan Bay Area 2040.*

Based on the above analysis, the project includes numerous objectives and measures that are consistent with applicable policies described in the Scoping Plans for AB 32, SB 32, applicable local CAPs, BAAQMD's *2017 Clean Air Plan*, and *Plan Bay Area 2040*. Consequently, the project would not conflict with achievement of AB 32 reduction goals for 2020, SB 32 reduction goals for 2030, and the RTP/SCS reduction goals for 2020 and 2035. In addition, as described in Impact GHG-1, the project's GHG emissions would be temporary and mitigated. Therefore, this impact would be less than significant.

3.6.4 Cumulative Impacts

As described above in Section 3.6.2, the unique chemical properties of greenhouse gases (GHGs) enable them to become well mixed within the atmosphere and transported over long distances. Climate change is largely a cumulative issue, and the geographic scope for cumulative impacts related to GHG emissions is global because GHGs are emitted by innumerable sources worldwide. Thus, the analysis presented in Section 3.6, *Greenhouse Gas Emissions and Climate Change,* is inherently cumulative.

The following is a summary regarding GHG emissions from construction and operation and their cumulative impacts. Refer to Section 3.6, *Greenhouse Gas Emissions and Climate Change,* for the complete analysis.

Construction of the Channel Widening Alternative and Floodwalls Alternative would generate approximately 1,512 and 808 metric tons of carbon dioxide equivalent (CO_2e), respectively. As described in Impact GHG-1, all project alternatives would implement all feasible BAAQMD-recommended best management practices (BMPs) to reduce GHG emissions during construction. Mitigation Measure AQ-2, which is required to reduce nitrogen oxide emissions (see Section 3.2, *Air Quality*), would also reduce GHG emissions from all project construction activities.

Operation and maintenance activities associated with the Channel Widening Alternative and Floodwalls Alternative would likely involve occasional light duty vehicle trips to transport personnel to the site and handheld landscaping equipment and would generate a minor amount of GHG emissions. Operation and maintenance activities associated with the Former Nursery Detention

Basin Alternative and Webb Ranch Detention Basin Alternative may include occasional removal of sediments that accumulate within the basin during large flood events. BAAQMD's BMPs to reduce GHG emissions would be implemented during sediment removal activities. Mitigation Measure AQ-2, which is required to reduce nitrogen oxide emissions (see Section 3.2, *Air Quality*), would also reduce GHG emissions from the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative operations and maintenance activities.

All Project alternatives include numerous objectives and measures that are consistent with the applicable policies described in the scoping plans for Assembly Bill 32, Senate Bill 32, City CAPs, BAAQMD's *2017 Clean Air Plan*, and *Plan Bay Area 2040.* Accordingly, the project's incremental contribution to this cumulative impact would not be considered substantial. The impact would be less than significant.

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3.7 Hazardous Materials and Public Health

This section provides environmental analysis of the proposed project's impacts on hazardous materials and public health. The section summarizes the regulatory environment and discusses the environmental setting, provides the criteria used for determining impacts, discusses the impact mechanism and level of impact resulting from construction and implementation of the proposed project, and describes mitigation to minimize the level of impact.

3.7.1 Regulatory Setting

Public health is protected by numerous federal and state regulations, including the federal Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Act) and Resource Conservation and Recovery Act. Key state regulations include the Hazardous Materials Release Response Plans and Inventory Act (1985), the Hazardous Waste Control Act, and the Safe Drinking Water and Toxic Enforcement Act (1986). This section describes the project's regulatory setting.

Federal

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, 42 U.S. Code (USC) 9605, commonly known as Superfund, created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. CERCLA establishes prohibitions and requirements concerning closed and abandoned hazardous waste sites, provides for liability of persons responsible for releases of hazardous waste at these sites, and establishes a trust fund to provide for cleanup when no responsible party can be identified. CERCLA was amended by the Superfund Amendments and Reauthorization Act of 1986.

Superfund Amendments and Reauthorization Act

The Superfund Amendments and Reauthorization Act (SARA), also known as the Community Right-to-Know Act of 1986, imposes requirements to ensure that hazardous materials are properly handled, used, stored, and disposed of and to prevent or mitigate injury to human health or the environment in the event that such materials are accidentally released.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA), 42 USC 6901 et seq., authorizes the U.S. Environmental Protection Agency (EPA) to control hazardous waste from "cradle-to-grave," which encompasses its generation, transportation, treatment, storage, and disposal. RCRA's Federal Hazardous and Solid Waste Amendments from 1984 include waste minimization and phasing out land disposal of hazardous waste as well as corrective action for releases. The Department of Toxic Substances Control (DTSC) is the lead State agency for corrective action associated with RCRA facility investigations and remediation.

Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act (HMTA) delegates authority to the United States Department of Transportation (DOT) to develop and implement regulations pertaining to the transport of hazardous materials and hazardous wastes by all modes of transportation. Additionally, EPA's Hazardous Waste Manifest System is a set of forms, reports, and procedures for tracking hazardous waste from a generator's site to the disposal site. Applicable Federal regulations are contained primarily in Code of Federal Regulations (CFR) Titles 40 and 49.

Toxic Substance Control Act

The Toxic Substance Control Act (TSCA) of 1976, 15 U.S.C. §2601 et seq. addresses the production, importation, use, and disposal of specific chemicals including polychlorinated biphenyls (PCBs), asbestos, radon. and lead-based paint. The TSCA provides EPA with authority to require reporting, record-keeping and testing requirements, and restrictions relating to chemical substances and/or mixtures. TSCA specifically regulates PCBs and authorizes the EPA to regulate disposal of PCBs.

State

Hazardous Materials Release Response Plans and Inventory Act

Pursuant to the Hazardous Materials Release Response Plans and Inventory Act of 1985, local agencies are required to develop "area plans" for response to releases of hazardous materials and wastes. These emergency response plans depend to a large extent on the business plans submitted by persons who handle hazardous materials. An area plan must include pre-emergency planning of procedures for emergency response, notification, coordination of affected government agencies and responsible parties, training, and follow-up.

Hazardous Waste Control Act

The Hazardous Waste Control Act (HWCA), California Code of Regulations Title 26, is the California equivalent of the Federal RCRA of 1976. The HWCA, which is more stringent than RCRA, establishes requirements for the proper management of hazardous substances and wastes with regard to criteria for (1) identification and classification of hazardous wastes; (2) generation and transportation of hazardous wastes; (3) design and permitting of facilities that recycle, treat, store, and dispose of hazardous wastes; (4) treatment standards; (5) operation of facilities; (6) staff training; (7) closure of facilities; and (8) liability requirements. In California, the DTSC regulates the generation, transportation, treatment, storage, and disposal of hazardous waste.

Safe Drinking Water and Toxic Enforcement Act

Proposition 65, officially known as the Safe Drinking Water and Toxic Enforcement Act of 1986, was enacted as a ballot initiative in November 1986. The act protects the state's drinking water sources from being contaminated with chemicals known to cause cancer, birth defects, or other reproductive harm, and requires businesses to inform Californians about exposures to such chemicals. The act prohibits businesses from knowingly discharging listed substances into drinking water sources or onto land where the substances can pass into drinking water sources, and prohibits businesses from knowingly exposing individuals to listed substances without providing a clear and reasonable warning.

San Francisco Bay Water Quality Control Plan (Basin Plan)

San Francisco Bay waters are under the jurisdiction of the San Francisco Bay Regional Water Board, which established regulatory standards and objectives for water quality in San Francisco Bay in its Water Quality Control Plan for the San Francisco Bay Basin, commonly referred to as the Basin Plan. The board is required to develop, adopt (after public hearing), and implement a basin plan for the region. Basin plans are updated and reviewed every 3 years. They provide the technical basis for determining WDRs, taking enforcement actions, and evaluating clean water grant proposals. A basin plan must include (1) a statement of beneficial water uses that the regional water board will protect, (2) the water quality objectives needed to protect the designated beneficial water uses, and (3) strategies to be implemented, with time schedules for achieving the water quality objectives. The San Francisco Bay Basin Plan was last updated in 2015 (San Francisco Bay Regional Water Quality Control Board 2015).

Porter-Cologne Water Quality Control Act

California's Porter-Cologne Water Quality Control Act, enacted in 1969, provides the legal basis for water quality regulation within California. This act requires a "Report of Waste Discharge" for any discharge of waste (liquid, solid, or gaseous) to land or surface waters that may impair beneficial uses for surface and/or groundwater of the state. It predates the CWA and regulates discharges to waters of the State, which include more than just waters of the United States (e.g., groundwater and surface waters not considered waters of the United States), from both point and non-point sources. The Act prohibits discharges of "waste," as defined under the Act; this definition is broader than the CWA definition of "pollutant." Regional Water Boards regulate discharges through the issuance of National Pollutant Discharge Elimination System (NPDES) permits for point source discharges, and through waste discharge requirements (WDR) for non-point discharges.

The State Water Resources Control Board (State Water Board) and Regional Water Boards are responsible for establishing the water quality standards (objectives and beneficial uses) required by the CWA, and regulating discharges to ensure compliance with the water quality standards. Details regarding water quality standards in a project area are contained in the applicable Regional Water Board Basin Plan. In California, regional water boards designate beneficial uses for all water body segments in their jurisdictions, and then set criteria necessary to protect these uses. Consequently, the water quality standards developed for particular water segments are based on the designated use and vary depending on such use.

Hazardous Waste Control Act (Cal. Health and Safety Code § 25100 et seq.)

The Department of Toxic Substances Control is responsible for the enforcement of the Hazardous Waste Control Act (California Health and Safety Code Section 25100 et seq.), which creates the framework under which hazardous wastes are managed in California. The law provides for the development of a state hazardous waste program that administers and implements the provisions of the federal RCRA cradle-to-grave waste management system in California. It also provides for the designation of California-only hazardous waste and development of standards that are equal to or, in some cases, more stringent than federal requirements.

The DTSC also has a number of other advisories and guidance documents for evaluation of school sites with potential contamination from lead based paint; protocol for reporting environmental findings during school construction hazardous waste disposal procedures and imported fill material;

guidance for naturally occurring asbestos sites; PCBs in schools; and for conducting Environmental Site Assessments.

Local

San Mateo County

The following goals and objectives from the San Mateo County General Plan Hazardous Materials section are relevant to the project:

16.47: Strive to Protect Life, Property, and the Environment From Hazardous Material Exposure

Strive to protect public health and safety, environmental quality, and property from the adverse effects of hazardous materials through adequate and responsible management practices.

16.48: Strive to Ensure Responsible Hazardous Waste Management

Strive to ensure that hazardous waste generated within San Mateo County is stored, treated, transported and disposed of in a legal and environmentally safe manner so as to prevent human health hazard and/or ecological disruption.

16.49: Strive to Reduce Public Exposure to Hazardous Materials

Strive to reduce public exposure to hazardous materials through programs which: (1) promote safe transportation, (2) prevent accidental discharge, and (3) promote effective incident response, utilizing extensive inventory and monitoring techniques.

Santa Clara County

The following strategy and policy from the Health and Safety section of the Santa Clara County General Plan (Santa Clara County 1994) are relevant to the project:

Strategy #1: **Manage Hazardous Materials Safely and Efficiently**

Policy C-HS 14 – All feasible measures to safely and effectively manage hazardous materials and site hazardous materials treatment facilities should be used, including complying with all federal and state mandates.

City of East Palo Alto

The following policies from the Health and Noise section of the City of East Palo Alto 2035 General Plan are relevant to the project:

Policy 4.1 – Contamination: Avoid or minimize risk to the community from exposure to contaminated soils or groundwater.

Policy 4.2 – Management of hazardous materials: Continue to cooperate with federal, state, and county agencies to effectively regulate the management of hazardous materials and hazardous waste.

City of Palo Alto

The following policy from the Natural Environment chapter of the City of Palo Alto's Comprehensive Plan is relevant to the project:

> **Policy N-30**: **Minimize the use of toxic and hazardous materials**. Encourage the use of alternative materials and practices that are environmentally benign.

City of Menlo Park

The following policy from the Open Space/Conservation, Noise and Safety Elements of the City of Menlo Park's General Plan is relevant to the project:

> **Policy S1.16 – Hazardous Materials Regulations**: Review and strengthen, if necessary, regulations for the structural design and/or uses involving hazardous materials to minimize risk to local populations. Enforce compliance with current State and local requirements for the manufacturing, use, storage, transportation and disposal of hazardous materials, and the designation of appropriate truck routes in Menlo Park.

Other

San Mateo Countywide Water Pollution Prevention Program

The San Mateo Countywide Water Pollution Prevention Program was established in 1990 to reduce the pollution carried by stormwater into local creeks, the San Francisco Bay, and the Pacific Ocean. The program is a partnership of the City/County Association of Governments, each incorporated city and town in the county, and the County of San Mateo, which share a common NPDES permit. The Federal Clean Water Act and the California Porter-Cologne Water Quality Control Act require that large urban areas discharging stormwater into the San Francisco Bay or the Pacific Ocean have an NPDES permit to prevent harmful pollutants from being dumped or washed by stormwater runoff, into the stormwater system, then discharged into local waterbodies. Appendix F of the C.3 Stormwater Technical Guidance report of the Program includes mosquito control guidelines. The appendix presents guidance from the Countywide Program's Vector Control Plan for designing and maintaining stormwater treatment measures to control mosquitoes.

San Francisquito Creek Multi-agency Coordination

The San Francisquito Creek Multi-agency Coordination (SFC MAC) deals with hazards near the Creek. The SFC MAC will mobilize for maximum utilization of all available resources during a severe storm or flood that present a risk to public safety or where disruption of transportation, utilities or other services or infrastructure is anticipated or occurs. The SFC MAC is composed of representatives from the City of East Palo Alto, City of Menlo Park, City of Palo Alto, County of San Mateo, County of Santa Clara, Menlo Park Fire Protection District, Santa Clara Valley Water District, San Francisquito Creek Joint Powers Authority and Stanford University (City of Palo Alto 2019).

3.7.2 Environmental Setting

Study Area

The study area for the hazards and hazardous materials section encompasses the project site parcels and immediately adjacent parcels.

Project Setting

This section describes existing conditions related to hazards and hazardous materials within the study area as well as potential hazards posed by the proposed project. Hazards related to flood risks are addressed in Section 3.8, *Hydrology and Water Resources,* and traffic-related hazards are addressed in Section 3.13, *Traffic and Transportation*.

Hazardous materials concerns may arise from three causes:

- Hazardous materials may be present in the project area as a result of historic contamination (hazardous materials sites).
- Hazardous materials may be brought to the project as a result of routine construction and maintenance activities.
- Hazardous materials may be generated from demolition of existing structures.

Routine generation, use, management, and transport of hazardous materials does not pose a risk as long as activities occur in compliance with existing laws and regulations.

Hazardous Materials Databases

The term *hazardous material* is defined in different ways for different regulatory programs. The California Health and Safety Code Section 25501 definition is: "any material that because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment."

The California Department of Toxic Substances Control (DTSC) divides hazardous material sites into three categories: clean-up sites, permitted sites, and other sites. Sites listed within these three categories can be at various stages of evaluation or clean up, from the beginning to the end of the process. DTSC's Hazardous Waste and Substances Sites and the State Water Resources Control Board's (SWRCB) list of leaking underground fuel tanks include hazardous material release sites, along with other categories of sites or facilities, specific to each agency's jurisdiction. EnviroStor, the DTSC hazardous material sites database, records properties where extensive investigation and hazardous materials clean-up actions have been planned or completed. GeoTracker is the SWRCB's data managing system for monitoring hazardous materials sites that impact groundwater.

A search of the project site was conducted on DTSC's EnviroStor database and SWRCB's GeoTracker database on October 17, 2018. According to the most recent search on EnviroStor, the project site, which was defined to include 500 feet along either side of the creek and the detention basins, are not identified as a hazardous materials site (Department of Toxic Substances Control 2018). A search of the SWRCB's GeoTracker database revealed five records of Leaking Underground Fuel Tank (LUFT) sites within 500 feet of the project Site (State Water Resources Control Board 2018). All five sites are recorded as "Completed – Case Closed," meaning site investigation and any appropriate remedial activities have been completed to the satisfaction of the responsible regulatory agency. A permitted underground storage tank (UST) exists approximately 150 feet northwest of the creek at 80 Willow Road, Menlo Park.

Airports

The project site is approximately 0.9 mile west of the Palo Alto Municipal Airport. The Palo Alto Airport is a general aviation field, owned and operated by the City of Palo Alto. The airport has one paved runway, Runway 13/31, measuring 2,443 feet long and 70 feet wide. The project site is within the Traffic Pattern Airport Safety Zone, which is the portion of the airport area routinely overflown by aircraft operating in the airport traffic pattern. The potential for aircraft accidents is relatively low and the need for land use restrictions is minimal (Santa Clara County Airport Land Use Commission 2016:3-12–3-15).

Moffett Field is approximately 5 miles to the southeast of the project site, and San Francisco International Airport is approximately 15 miles to the northwest.

Wildland Fire

Some areas of Santa Clara and San Mateo Counties are subject to serious wildfire hazards due to local microclimate conditions, vegetation characteristics, and/or topography. The California Department of Forestry and Fire Protection (CAL FIRE) defines Fire Hazard Severity Zones for areas within the state. According to CAL FIRE maps for San Mateo and Santa Clara Counties, the project sites are not located in a Very High Fire Hazard Severity Zone (CAL FIRE 2008a, 2008b). Very High Fire Hazard Severity Zones do exist to the west of Searsville Lake. The areas of potential instream work are in urban areas designated as Local Responsibility Areas with local fire departments providing fire protection services

Evacuation Routes

During floods the low-lying areas of Palo Alto, which include the Bayshore Corridor (East and West Bayshore Roads and U.S. 101), are known to collect runoff from storms. Depending on the local road conditions, evacuation routes are established to divert traffic away from the Bayshore Corridor, Westward, toward higher ground. Embarcadero Road, Oregon Expressway, and San Antonio Road are primary east–west egress routes. These routes connect with Central Expressway, Foothills Expressway, or I-280 to move traffic north and south along the Peninsula. If Embarcadero and Oregon underpasses are flooded, other smaller east–west surface streets must be used instead, such as Charleston Road and Churchill Road (City of Palo Alto 2015).

In Menlo Park, the closest evacuation route to the project site is just north of San Francisquito Creek on Gilbert Avenue to Willow Road to the designated evacuation facility at the Burgess Gym.

University Avenue is the primary evacuation route in East Palo Alto west of the Bayshore Corridor.

Vector-Borne Disease Hazards

The principal vector-borne disease concern in the project area relates to diseases spread by mosquitoes.

Although 12 mosquito-borne viruses are known to occur in California, only west Nile virus (WNV), western equine encephalomyelitis virus (WEE), and St. Louis encephalitis virus (SLE) are significant causes of human disease. At the time of this writing, WNV is having a serious impact upon the health of humans, horses, and wild birds throughout the state. In 2018 (through October 12), there were 132 WNV human cases in the state (California Department of Public Health, Mosquito & Vector Control Association of California, and University of California Davis Arbovirus Research and Training 2018); there was one case in Santa Clara County and no cases in San Mateo County (California Department of Public Health, Mosquito & Vector Control Association of California, and University of California Davis Arbovirus Research and Training 2018).

Mosquito Breeding

Many mosquitoes lay their eggs on the surface of fresh or stagnant water. Any standing water body represents a potential breeding habitat for mosquitoes, including water in cans, barrels, horse troughs, ornamental ponds, swimming pools, puddles, creeks, ditches, and marshy areas. Within cities and developed areas, runoff from landscape watering, car washing, and storms often collects in retention ponds or catch basins long enough to produce mosquitoes. Mosquito larvae can develop anywhere water stands for at least 5 days. (American Mosquito Control Association 2018)

In California, local vector control agencies have the authority to conduct surveillance for vectors, prevent the occurrence of vectors, and abate production of vectors (California Health and Safety Code Section 2040). Vector control agencies also have authority to review, comment, and make recommendations for projects with respect to their potential vector production (California Health and Safety Code Section 2041). (California Department of Public Health 2008)

To reduce mosquito populations, vector control agencies utilize a combination of abatement procedures tailored to the period in the mosquito life cycle and specific habitat conditions. Mosquito control methods may include the use of biological agents (such as mosquito fish), microbial control agents (such as *Bacillus thuringiensis israelensis* and *B. sphaericus*), pesticides, and source reductions (i.e., draining water bodies that produce mosquitoes). (California Department of Public Health 2008)

All project elements on the Palo Alto bank are within the Santa Clara County Vector Control District (SCCVCD) jurisdiction. The project elements on the Menlo Park bank are within the San Mateo County Mosquito and Vector Control District (SMCMVCD).

3.7.3 Impact Analysis

This section analyzes impacts related to hazards and hazardous materials for the project. It describes the methods used to determine project impacts and lists the thresholds used to conclude whether an impact would be significant. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant impacts accompany the discussion of each identified significant impact.

Methods and Significance Criteria

The analysis considered the potential for adverse impacts on public health and safety as a result of hazardous materials exposure, vector-borne diseases, airport hazards, and wildland fire. Risks were evaluated qualitatively. Analysis focused on potential for previously unreported contamination.

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would result in any of the following.

- Substantially increase hazards to the public or the environment due to the routine transport, use, or disposal of hazardous materials.
- Expose workers or the public to existing hazardous materials contamination.
- Generate hazardous emissions or handle hazardous or acutely hazardous materials, substances, or wastes within 0.25 mile of an existing or proposed school.
- Be located on a site which is included on a list of hazardous materials site compiled pursuant to Government Code 65962.5 and, as a result, would it create a significant hazard to the public or the environment.
- Have a substantial adverse effect on level of risk to the public or the environment related to:
  - Air traffic.
  - Emergency response or evacuation plans.
  - Wildland fire.
- Increase breeding or harborage of disease vector organisms, leading to elevated public health risk.

Each impact discussion includes a summary table identifying the level of impact associated with the individual project elements, followed by text analysis.

Impacts and Mitigation Measures

This section includes a discussion of each impact as it corresponds to the significance criteria presented above.

Impact HAZ-1—Substantially increase hazards to the public or the environment due to the routine transport, use, or disposal of hazardous materials

Summary by Project Element: Impact HAZ-1—Substantially increase hazards to the public or the environment due to the routine transport, use, or disposal of hazardous materials		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
All Project Alternatives and Elements	Less than Significant with Mitigation	Less than Significant with Mitigation

Construction

For all project alternatives, construction of project elements would require the use of fuels and hazardous substances, including equipment and vehicle fuels, lubricants, pesticides/herbicides, and potentially other chemicals. Improper storage and handling, including spills and releases, could result in exposure of workers and the general public to toxins and carcinogens, a significant impact. However, hazardous and potentially hazardous materials used in construction would be transported, stored, and handled in a manner consistent with all relevant regulations and guidelines, including those recommended and enforced by the U.S. Department of Transportation, Santa Clara County Department of Environmental Health, and San Mateo County Environmental Health Department. Mitigation Measure (MM-) HAZ-1 requires the preparation and implementation of a Spill Prevention, Control, and Countermeasure Plan and MM-HAZ-2 requires that the storage and handling of potential pollutants and hazardous materials be in accordance with all local, state, and federal laws. These measures would include provisions for appropriate handling of any hazardous materials used on the project site, as well as a Spill Prevention, Control, and Countermeasure Plan to minimize the potential for, and effects of, inadvertent spills occurring during project construction. The San Francisquito Creek Joint Powers Authority (SFCJPA) will be responsible for ensuring that all BMPs for hazardous materials handling and use are properly implemented. With these procedures in place, impacts related to hazardous materials used during construction are expected to be less than significant.

Operation and Maintenance

For all project alternatives, periodic activities required to maintain the new project elements would require the use of vehicle fuels, lubricants, etc., and could also require chemicals, paints, paving media, and other substances and would be specified in the O&M manual. With implementation of Mitigation Measure MM-HAZ-1 impacts related to the necessary use of hazardous materials during maintenance activities would be less than significant. Water quality protection environmental commitments described in detail in Chapter 2, *Program Description* would also be observed.

MM-HAZ-1: Prepare and implement a Spill Prevention, Control, and Countermeasure Plan

The construction contractor would prepare and implement a Spill Prevention, Control, and Countermeasure (SPCC) Plan to minimize the potential for, and effects from, accidental spills of hazardous, toxic, or petroleum substances during construction of the project. The SPCC will be completed before any construction activities begin.

MM-HAZ-2: Require proper storage and handling of potential pollutants and hazardous materials

The storage and handling of potential pollutants and hazardous materials, including, but not necessarily limited to, gasoline, diesel, oils, paint, and solvents, will be in accordance with all local, state and federal laws and other requirements. Temporary storage enclosures, double walled tanks, berms, or other protective facilities will be provided as required by law. All hazardous materials will be stored and handled in strict accordance with the Material Safety Data Sheets for each product. A copy of each Materials Safety Data Sheet will be submitted to the Project Engineer at the time of delivery of the products to the project site.

Impact HAZ-2—Expose workers or the public to existing hazardous materials contamination

Summary by Project Element: Impact HAZ-2—Expose workers or the public to existing hazardous materials contamination		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
All Project Alternatives and Elements	Less than Significant with Mitigation	Less than Significant with Mitigation

Construction

For all project alternatives, during construction, routine transport of hazardous materials to and from the project area or the discovery of unknown hazardous materials could indirectly result in an incremental increase in the potential for accidents. The California Department of Transportation

(Caltrans), the Federal Department of Transportation, and the California Highway Patrol (CHP) regulate the transportation of hazardous materials and wastes, including container types and packaging requirements, as well as licensing and training for truck operators, chemical handlers, and hazardous waste haulers. Because the cities of East Palo Alto, Palo Alto, and Menlo Park; the Counties of San Mateo and Santa Clara; and contractors and other construction service providers would be required to comply with existing hazardous materials laws and regulations for the transport of hazardous materials, the impacts associated with the potential to create a significant hazard to the public or the environment would be less than significant.

This translates to some risk that construction workers or the public could be exposed to hazardous substances through disturbance during project construction, potentially constituting a significant impact. As described in MM-HAZ-3, further investigation would be required if unexpected hazardous materials are encountered during construction monitoring or testing of soil suitability. MM-HAZ-1 would further ensure that all potentially hazardous materials are handled and stored in accordance with all applicable local, state, and federal laws and regulations. Any impacts would be reduced to a less-than-significant level by implementing MM-HAZ-1 and MM-HAZ-3.

MM-HAZ-3: Stop work and implement hazardous materials investigations and remediation in the event that unknown hazardous materials are encountered

In the event that unknown hazardous materials are encountered during construction monitoring or testing of soil suitability, all work in the area of the discovery will stop, and SFCJPA will conduct an investigation to identify the nature and extent of contamination and evaluate potential impacts in accordance with local and state requirements and guidance. If indicated based on the results of the investigation, the SFCJPA or designee will implement remediation measures consistent with all applicable local, state, and federal codes and regulations. Construction in areas known or reasonably suspected to be contaminated will not resume until remediation is complete. If waste disposal is necessary, SFCJPA will ensure that any hazardous materials removed during construction are handled and disposed of by a licensed waste-disposal contractor and transported by a licensed hauler to an appropriately licensed and permitted disposal or recycling facility, in accordance with local, state, and federal requirements.

Operation and Maintenance

No reasonably foreseeable ground-disturbing activities beyond the removal of post-project accumulated silt would occur during project maintenance and operation. This ground-disturbing activity would not expose workers to hazardous substances.

Impact HAZ-3—Generate hazardous emissions or handle hazardous or acutely hazardous materials, substances, or wastes within 0.25 mile of an existing or proposed school

Summary by Project Element: Impact HAZ-3—Generate hazardous emissions or handle hazardous or acutely hazardous materials, substances, or wastes within 0.25 mile of an existing or proposed school		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant with Mitigation	Less than Significant with Mitigation
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant with Mitigation

Channel Widening Alternative and Floodwalls Alternative

Access Ramp 6 within Reach 1 is within 0.25 mile of the International School of the Peninsula, which is located in Palo Alto. In addition, the Alto International School is located at 475 Pope Street in Menlo Park, approximately 0.18 mile north of the Chaucer Street Bridge in Reach 2. Because construction could require the use of a variety of fuels and/or hazardous substances, such as equipment or vehicle fuels and lubricants, paving media, paints, solvents, etc., there could be some potential for exposure of students, school employees, and the public to hazardous materials. The same would be true for ongoing maintenance activities. However, MM-HAZ-1 requires all hazardous materials to be handled, stored, and used in a manner consistent with relevant regulations and guidelines. This would reduce risks related to the use of hazardous materials in proximity to schools to a level consistent with the current standard of care, and impacts would be less than significant.

Former Nursery Detention Basin Alternative

The Former Nursery Detention Basin site is not within 0.25 mile of a school. There would be no impact.

Webb Ranch Detention Basin Alternative

The Webb Ranch site is within 0.25 mile of a school. Woodland School is approximately 0.2 mile southwest of the detention basin at 360 La Cuesta Drive in Portola Valley. As with the Channel Widening Alternative, construction could require the use of a variety of hazardous substances, including vehicle fuels and lubricants, paving media, paints, etc., and there would be some potential for exposure of students, school employees, and the public to hazardous materials. The same would be true for ongoing maintenance activities. However, MM-HAZ-1 requires all hazardous materials to be handled, stored, and used in a manner consistent with relevant regulations and guidelines. This would reduce risks related to the use of hazardous materials in proximity to schools to a level consistent with the current standard of care, and impacts would be less than significant.

Impact HAZ-4—Be located on a site that is included on a list of hazardous materials sites

Summary by Project Element: Impact HAZ-4—Be located on a site that is included on a list of hazardous materials sites		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	No Impact	No Impact

Channel Widening Alternative and Floodwalls Alternative

The project site is not included on a list of hazardous materials sites complied pursuant to Government Code Section 65962.5. A search of the SWRCB's GeoTracker database revealed five records of LUFT sites within 500 feet of the project site (State Water Resources Control Board 2018). All five sites are recorded as "Completed – Case Closed," meaning site investigation and any appropriate remedial activities have been completed to the satisfaction of the responsible regulatory agency. A permitted UST exists approximately 150 feet northwest of the creek at 80 Willow Road, Menlo Park. Because the project site is not located on a hazardous materials site, the project would not create a significant hazard to the public or the environment. The impact is less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

A search of the SWRCBs GeoTracker database did not identify any LUFT or leaking underground storage tank (LUST) sites in the vicinity of either the Former Nursery site or the Web Ranch site (State Water Resources Control Board 2018). The nearest cleanup sites are east of Junipero Serra Boulevard. No other known hazardous materials sites are located in the project vicinity. There would be no impact.

Impact HAZ-5—Create a safety hazard for people in the project area due to the proximity to an airport

Summary by Project Element: Impact HAZ-5—Create a safety hazard for people in the project area due to the proximity to an airport		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	No Impact	No Impact

Channel Widening Alternative and Floodwalls Alternative

The Palo Alto Municipal Airport is approximately 0.9 mile east of the project site. The farthest downstream reach of the project site is located within the airport influence area (AIA) of Palo Alto Airport. Airport safety zones have been established by the Palo Alto Airport Comprehensive Land Use Plan (CLUP) in accordance with Federal Aviation Administration (FAA) requirements (Santa Clara County Airport Land Use Commission 2016) to minimize the number of people exposed to potential aircraft accidents by imposing density and land use limitations. According to the Palo Alto Airport CLUP, the farthest downstream reach, access ramps 5 and 6, and the instream staging and construction areas of the project site are located in the Traffic Pattern Zone (TPZ). The TPZ is a portion of the airport area routinely overflown by aircraft operating in the airport traffic pattern. The potential for aircraft accidents in this area is relatively low.

The Palo Alto Municipal Airport has requirements for safety and efficient use of navigable airspace within the airport influence area. An obstruction aeronautical study is required by the Federal Aviation Administration (FAA) to evaluate any proposed structures, and make a determination of permanent and temporary impacts. The FAA Obstruction Evaluation / Airport Airspace Analysis (Form FAA 7460-1 – Notice of Proposed Construction or Alteration) will need to be submitted when design details are finalized, and additional filings are required to the FAA to assess temporary construction impacts at a minimum of 45 days prior to the start of work.

The upstream portions of the project site generally west of U.S. 101 are located outside the TPZ. The project would not include the construction of any project elements in any other zone but the TPZ. Therefore, the project would not create a safety hazard for people in the project area due to the proximity of the Palo Alto Airport. This impact would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

There are no public use or private airports within 2 miles of either the Former Nursery site or the Webb Ranch site. The closest airport is the Palo Alto Airport, approximately 5.6 miles to the northeast. No impact would occur.

Impact HAZ-6—Interfere with an emergency response or evacuation plan

Summary by Project Element: Impact HAZ-6—Interfere with an emergency response or evacuation plan		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative	Less than Significant with Mitigation	No Impact
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	No Impact

Channel Widening Alternative and Floodwalls Alternative

The presence of construction equipment and vehicles, worker activities, and materials storage would have the potential to impede emergency access to the project site and/or interfere with emergency evacuation plans. This could also be true for maintenance activities, although to a lesser degree because fewer pieces of equipment and vehicles would typically be involved. Replacement of the Pope-Chaucer Bridge would require temporary closure of the existing bridge travel lane. To ensure that project construction does not impede emergency response or evacuations, the SFCJPA would require contractors to develop and implement a traffic control plan for each site (see MM-TT-2), including a requirement to maintain emergency access to/through and/or around the site. With successful implementation of traffic control, construction impacts on emergency access and evacuations are expected to be less than significant. Trips to the project site during maintenance for inspections and monitoring are expected to be limited, and could be temporarily halted and/or rescheduled to accommodate emergency response vehicles.

MM-TT-2: Require a site-specific Traffic Control Plan

This measure is described in detail in Section 3.13, *Traffic and Transportation*.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The presence of construction equipment and vehicles, worker activities, and materials storage during the approximately 6-month construction period would have the potential to impede emergency access to both the Former Nursery and Webb Ranch sites and/or interfere with emergency evacuation plans. Ansel Lane would be re-routed to go around the Former Nursery site detention basin, and San Francisquito Creek Road would be re-routed to go around the Webb Ranch site detention basin. To ensure that project construction does not impede emergency response or evacuations, the SFCJPA will require contractors to develop and implement a traffic control plan for each site (see MM-TT-1), including a requirement to maintain emergency access to/through the site. No impact is anticipated for maintenance activities because there would be limited site visits and no planned roadway or lane closures.

Impact HAZ-7—Expose people or structures, either directly or indirectly, to risk of wildland fires

Summary by Project Element: Impact HAZ-7—Expose people or structures to risk of wildland fires		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	No Impact	No Impact
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative and Floodwalls Alternative

As described above, the project sites are located in a non-VHFHSZ area. This area is not considered to be subject to wildland fire risk because the area is urban and not adjacent to wildlands. The project would not introduce individuals or structures to an area at risk of wildland fires. Therefore, there would be no impact from wildland fires.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The Former Nursery and Webb Ranch sites are located in CAL FIRE's jurisdiction in areas of the county that are partially undeveloped to undeveloped. Neither site is located in a VHFHSZ area. During the approximate 6-month construction period there is the potential for a fire to start from a cigarette butt or engine exhaust system, for example; however, the potential for ignition is low. The fire hazard severity rating for the Web Ranch site is High and Moderate, and the Former Nursery site has a fire hazard severity rating of High. However, the construction of detention basins would not introduce or increase the risk to individuals or structures to a wildland fire over existing conditions. The impact is less than significant.

Impact HAZ-8—Increase breeding or harborage of disease vector organisms

Summary by Project Element: Impact HAZ--8—Increase breeding or harborage of disease vector organisms		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant with Mitigation	Less than Significant with Mitigation
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative and Floodwalls Alternative

The principal concern relative to disease vectors relates to the potential for the project to create or expand mosquito breeding in the project area. During construction, MM-HAZ-4 will require contractors to employ “good housekeeping” measures (California Department of Public Health 2008) to prevent the accumulation of standing water on construction sites. With this requirement in place, construction is not expected to result in a significant increase in mosquito breeding.

Over the long-term, the project elements would provide no new opportunities for standing water to accumulate and would have no impact on mosquito breeding. The addition of floodwalls to San Francisquito Creek would have no effect on low flows in the channel (those most subject to potential stagnancy). There would be no impact related to these elements, and no mitigation is required. The widened portions of the Creek channels would be designed to be consistent with current engineering standards to ensure efficient flow and prevent stagnancy during the summer low-flow months.

MM-HAZ-4: Prevent mosquito breeding during project construction

To prevent mosquito breeding during project construction, SFCJPA will ensure that standing water that accumulates on the construction site is gone within 4 days (96 hours). All outdoor grounds will be examined, and unnecessary water that may stand longer than 96 hours will be drained. Construction personnel will properly dispose of unwanted or unused artificial containers and other obstructions (e.g., tires). If possible, any container or object that holds standing water that must remain outdoors will be covered, inverted, or have drainage holes drilled.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

As with the Channel Widening Alternative the principal concern relative to disease vectors relates to the potential for the detention basins to create or expand mosquito breeding in the project area. During construction, MM-HAZ-4 would be implemented as described above. Implementation of MM-HAZ-4 would result in a less than significant impact during construction.

After construction the Former Nursery site detention basin would be able to store up to approximately 180 acre-feet of water, and the Webb Ranch site detention basin would be able to store up to approximately 440 acre-feet of water. The storage of water could create the potential for mosquito breeding. Per the Mosquito Control Guidelines of the San Mateo Countywide Water Pollution Prevention Program, facilities that pond water for an extended period (e.g., extended detention basins and constructed wetlands) must be designed to drain water completely within 72 hours of a storm event (San Mateo Countywide Water Pollution Prevention Program 2016; Appendix F). Adherence to the Mosquito Control Guidelines of the San Mateo Countywide Water Pollution Prevention Program would result in a less-than-significant impact.

3.7.4 Cumulative Impacts

The proposed project would incorporate mitigation consistent with all applicable federal, state, and local regulations related to the transport, use, or disposal hazardous materials and mosquito vector control. Therefore, the project is not expected to have significant effects related to creation of new areas of contamination or exposure of workers or the public to existing contamination. Therefore, would not make a cumulatively considerable contribution to the existing cumulative impact. No further analysis is required.

3.7.5 References

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3.8 Hydrology and Water Resources

This section provides environmental analysis of the project's impacts on hydrology and water resources. It also summarizes the regulatory environment and discusses the environmental setting, provides the criteria used for determining impacts, discusses the impact mechanisms and level of impact resulting from construction and operations and maintenance of the project, and describes mitigation to minimize the level of impact. Impacts related to wetlands and riparian habitat and vegetation are discussed in Section 3.3, *Biological Resources*. Impacts related to soils and geological resources along the creek are discussed in Section 3.5, *Geology and Soils*. Impacts related to groundwater contamination are described in Section 3.7, *Hazardous Materials and Public Health*. Unless noted otherwise, the information in this section is based on the U.S. Army Corps of Engineers (USACE) 2011 *San Francisquito Creek Feasibility Study*.

3.8.1 Regulatory Setting

Federal

Clean Water Act

In 1972 Congress amended the Federal Water Pollution Control Act, making the addition of pollutants to the waters of the United States from any point source unlawful unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. This is now known as the Clean Water Act (CWA). In 1987 amendments to the CWA, Congress directed dischargers of storm water from municipal and industrial/construction point sources to comply with the NPDES permit scheme. Important CWA sections for this analysis are as follows.

- Sections 303 and 304, which require states to promulgate water quality standards, criteria, and guidelines.
- Section 401, which requires an applicant for a federal license or permit to conduct any activity, which may result in a discharge to waters of the United States to obtain certification from the state that the discharge will comply with other provisions of the act (most frequently required in tandem with a Section 404 permit request).
- Section 402, which establishes the NPDES, is a permitting system for the discharges (except for dredge or fill material) of any pollutant into waters of the United States. The Regional Water Quality Control Boards (Regional Water Boards) administer this permitting program in California. Section 402(p) and require permits for discharges of storm water from industrial/construction and Municipal Separate Storm Sewer Systems (MS4s).
- Section 404 establishes a permit program for the discharge of dredge or fill material into waters of the United States. This permit program is administered by the USACE.

National Flood Insurance Program

In 1968, Congress created the National Flood Insurance Program (NFIP) in response to the rising cost of taxpayer-funded disaster relief for flood victims and the increasing amount of damage caused by floods. The NFIP makes federally backed flood insurance available for communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage. The Federal Emergency Management Agency (FEMA) manages the NFIP. FEMA creates Flood Insurance Rate Maps that designate 100-year floodplain zones and delineate flood hazard areas. A 100-year floodplain zone is the area that has a one in one hundred (1%) chance of being flooded in any one year based on historical data. Portions of the project are located within a FEMA designated 100-year floodplain.

State

Porter-Cologne Water Quality Control Act

California's Porter-Cologne Water Quality Control Act, enacted in 1969, provides the legal basis for water quality regulation within California. This act requires a "Report of Waste Discharge" for any discharge of waste (liquid, solid, or gaseous) to land or surface waters that may impair beneficial uses for surface and/or groundwater of the state. It predates the CWA and regulates discharges to waters of the State, which include more than just waters of the United States (e.g., groundwater and surface waters not considered waters of the United States), from both point and non-point sources. The Act prohibits discharges of "waste," as defined under the Act; this definition is broader than the CWA definition of "pollutant." Regional Water Boards regulate discharges through the issuance of NPDES permits for point source discharges, and through waste discharge requirements (WDR) for non-point discharges.

The State Water Resources Control Board (State Water Board) and Regional Water Boards are responsible for establishing the water quality standards (objectives and beneficial uses) required by the CWA, and regulating discharges to ensure compliance with the water quality standards. Details regarding water quality standards in a project area are contained in the applicable Regional Water Board Basin Plan. In California, regional water boards designate beneficial uses for all water body segments in their jurisdictions, and then set criteria necessary to protect these uses. Consequently, the water quality standards developed for particular water segments are based on the designated use and vary depending on such use.

San Francisco Bay Water Quality Control Plan (Basin Plan)

San Francisco Bay waters are under the jurisdiction of the San Francisco Bay Regional Water Board, which established regulatory standards and objectives for water quality in San Francisco Bay in its Water Quality Control Plan for the San Francisco Bay Basin, commonly referred to as the Basin Plan. The board is required to develop, adopt (after public hearing), and implement a basin plan for the region. Basin plans are updated and reviewed every 3 years. They provide the technical basis for determining WDRs, taking enforcement actions, and evaluating clean water grant proposals. A basin plan must include (1) a statement of beneficial water uses that the regional water board will protect, (2) the water quality objectives needed to protect the designated beneficial water uses, and (3) strategies to be implemented, with time schedules for achieving the water quality objectives. The San Francisco Bay Basin Plan was last updated in 2015 (San Francisco Bay Regional Water Quality Control Board 2015).

National Pollution Discharge Elimination System Program

Municipal Separate Storm Sewer Systems

Section 402(p) of the CWA requires the issuance of NPDES permits for five categories of stormwater dischargers, including MS4s. The U.S. Environmental Protection Agency defines an MS4 as "any conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, human-made channels, and storm drains) owned or operated by a state, city, town, county, or other public body having jurisdiction over stormwater, that are designed or used for collecting or conveying stormwater." The project is located within the jurisdiction of the MS4 Phase I San Francisco Bay Region Municipal Regional Stormwater NPDES Permit (San Francisco Bay MS4 Permit).

Construction General Permit

The General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Order 2009-0009-DWQ) (Construction General Permit) was adopted on November 16, 2010, and became effective on February 14, 2011. The permit regulates stormwater discharges from construction sites that result in a disturbed soil area of 1 acre or greater, or are smaller sites that are part of a larger common plan of development. For all projects subject to the Construction General Permit, applicants are required to develop and implement an effective Stormwater Pollution Prevention Plan (SWPPP). By law, all stormwater discharges associated with construction activity where clearing, grading, and excavation results in soil disturbance of at least 1 acre must comply with the provisions of the Construction General Permit. Operators of regulated construction sites are required to have a Qualified SWPPP Developer prepare the SWPPP; to implement sediment, erosion, and pollution prevention control measures; and to obtain coverage under the Construction General Permit. The SWPPP will include a description of Best Management Practices (BMPs) to minimize the discharge of pollutants from the site during construction as well as appropriate monitoring, sampling, and reporting. Refer to Chapter 2, *Program Description,* for a list of Water Quality Protection measures. The SWPPP requires implementation of a construction monitoring plan to monitor BMP performance during construction activities. A Qualified SWPPP Practitioner is required to oversee implementation of the SWPPP during construction activities.

Regional

Santa Clara Valley Water District Act of 1951

The Santa Clara Valley Water District (Valley Water) was created by an act of the California Legislature in 1951 and amended in October 2009. The act created Valley Water with the purpose of authorizing the district to provide comprehensive water management for all beneficial uses and protection from flooding within Santa Clara County. Objectives and purposes of the act relating to surface water hydrology include protecting Santa Clara County from floodwater and stormwater; providing for the conservation and management of floodwater, stormwater, or recycled water, or other water from any sources; and enhancing, protecting, and restoring streams, riparian corridors, and natural resources.

Under the Water Resources Protection Ordinance (as Amended by Ordinance 08-1, formerly Ordinance 83-2), Valley Water requires encroachment permits for all construction activities along or within a Valley Water right-of-way. Activities requiring a permit include grading adjacent to the watercourse, along the levees, or within the channel, and/or any activity resulting in modifications to the drainage, discharge, or conveyance of the watercourse. Permits, if granted, may require mitigation for any disturbance to the health of the watercourse.

Valley Water provides for the control and conservation of floodwaters and stormwater, and the protection of watercourses, watersheds, public highways, and life and property from damage or destruction from such waters. Valley Water also oversees the acquisition, retention, and reclamation of drainage, stormwater, floodwaters, and other waters to save, conserve, and distribute such waters for beneficial use in the district.

In addition to protecting water supplies, Valley Water is also charged with flood protection and stream stewardship. The Valley Water stream stewardship mission is carried out through all of Valley Water's operations, including the Clean Safe Creeks and Natural Flood Protection Program. The program is designed to protect property from flooding, keep streams and creeks clean, and protect and enhance the ecosystem function of streams.

To help protect the Santa Clara Valley's creeks and rivers, Valley Water adopted Ordinance O8-1 that requires a project review and permitting process to minimize impacts on watercourses resulting from development or community activities. Anyone who plans a project within 50 feet of a creek or waterway, or within 50 feet of Valley Water property or easements, must first obtain a permit from Valley Water 's Community Projects Review Unit.

To protect groundwater resources, Valley Water Ordinance 90-1 requires permitting for any person digging, boring, drilling, deepening, refurbishing, or destroying a water well, cathodic protection well, observation well, monitoring well, exploratory boring (45 feet or deeper), or other deep excavation that intersects the groundwater aquifers of Santa Clara County.

San Mateo County Flood Control District Act

The San Mateo County Flood Control District (SMCFCD) Act of 1959 established SMCFCD for the following purposes:

- Control and conserve stormwaters and floodwaters.
- Prevent waste or exportation of water.
- Retain drainage, stormwaters, floodwaters, and other waters for beneficial use in the SMCFCD.
- Prevent pollution or diminution of water supply.

SMCFCD is a special district created by the California legislature. While SMCFCD has jurisdiction throughout all of San Mateo County, the cities within San Mateo County may also undertake flood control projects and regulate activities in the floodplain within their respective communities.

Santa Clara County Drainage Manual

The *Santa Clara County Drainage Manual* provides a framework for the various hydraulic and hydrologic analyses necessary to plan and design storm drainage and flood control facilities within Santa Clara County. The Manual includes computational techniques and criteria for the estimation of runoff, discharges, and volumes for use in hydrology study submittals (Santa Clara County 2007). The goal of the *Santa Clara County Drainage Manual* is to provide flood protection, for all habitable structures and other non-flood-proofed structures, consistent with the Santa Clara County Floodplain Management Ordinance.

Santa Clara Valley Urban Runoff Pollution Prevention Program—C.3 Stormwater Handbook

The project is located within the jurisdiction of the San Francisco Bay MS4 Permit. The San Francisco Bay Regional Water Board issued the San Francisco Bay MS4 Permit No. CAS029718 (Order No. R2-2015-0049-DWQ) on November 19, 2015, and it became effective on January 1, 2016. The Regional Water Board re-issued these county-wide municipal stormwater permits as one Bay Area Municipal Regional Stormwater NPDES Permit (MRP) to regulate stormwater discharges from municipalities and local agencies including San Mateo and Santa Clara counties. Provision C.3 of the San Francisco Bay MS4 Permit is for new development and redevelopment projects. It requires authorities to include appropriate source control, site design, and stormwater treatment measures in new development and redevelopment projects to address both soluble and insoluble stormwater runoff pollutant discharges and prevent increases in runoff flows from new development and redevelopment projects. The *C.3 Stormwater Handbook* provides post-construction stormwater controls to meet local municipal requirements and requirements of the Bay Area MRP. Municipalities covered by the MRP must require post-construction stormwater controls on development projects as part of their obligations under Provision C.3 of the MRP (Santa Clara Valley Urban Runoff Pollution Prevention Program 2006). This permit is a NPDES permit issued by the San Francisco Bay Regional Water Board, allowing municipal stormwater systems to discharge stormwater to local creeks, San Francisco Bay, and other water bodies if municipalities conduct prescribed actions to control pollutants.

San Mateo Countywide Water Pollution Prevention Program

The San Mateo Countywide Water Pollution Prevention Program is a partnership of the City/County Association of Governments, which consists of the County of San Mateo and each incorporated city and town in the County. The municipalities that are part of the City/County Association of Governments share a common MS4 permit. Each municipality in San Mateo County is responsible for implementing a stormwater program in compliance with MS4 permit requirements to prevent discharges of polluted stormwater runoff from its streets into the local storm drain system and nearby surface waters. The permit prescribes how each local municipality will regulate new development and redevelopment projects, conduct its municipal maintenance activities, eliminate non-stormwater discharges, inspect businesses to control stormwater pollutants, and encourage the public's help in preventing pollution.

In order to meet local municipal requirements and requirements of the San Francisco Bay MS4 Permit, the County of San Mateo developed its *C.3 Stormwater Technical Guidance Handbook* to help developers, builders, and project sponsors include post-construction stormwater controls in their projects (County of San Mateo 2013). The municipalities must require post-construction stormwater controls as part of their obligations under Provision C.3 of the MS4 permit. The countywide program has also prepared a *Sustainable Green Streets and Parking Lots Design Guidebook* to assist municipalities and project applicants with designing street and parking lot projects that treat stormwater runoff in landscape-based treatment measures.

Hydromodification Management Plan

In the Santa Clara Valley, development projects must comply with the NPDES permit issued to the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) by the Regional Water Board. SCVURPPP is an association of 13 cities in Santa Clara Valley, Santa Clara County, and the Valley Water.

A Hydromodification Management Plan (HMP) was prepared by SCVURPPP and adopted by the Regional Water Board in 2005. The HMP delineates areas where increases in runoff are most likely to impact channel health and water quality and provides management options for maintaining pre-project runoff patterns. The HMP is not designed to correct existing erosion problems, but to prevent worsening of creek channel erosion problems from new or redevelopment projects (Santa Clara Valley Urban Runoff Pollution Prevention Program 2006).

Hydromodification controls are required under SCVURPPP NPDES Permit Provision C.3.f, as follows.

- Increase in runoff peak flow, volume, and duration shall be managed for all Group 1 Projects (projects that add or replace greater than or equal to 1 acre of impervious surface).
- Post-project runoff shall not exceed estimated pre-project rates and durations.
- These conditions apply to areas where such increases in runoff flow or volume can cause increased erosion of creek beds and banks.

3.8.2 Environmental Setting

Study Area

The study area lies within the San Francisquito Creek watershed, which is the northernmost creek within Santa Clara County and represents the boundary with San Mateo County. The mainstem of the Creek is approximately 14 miles long. It begins at the confluence of Corte Madera Creek and Bear Creek, just below Searsville Dam, and ends where it flows through a 115-foot wide channel into San Francisco Bay. The study area is located in the downstream portion of San Francisquito Creek, which consists of an approximate 8.8-mile segment extending from U.S. 101/West Bayshore Road Bridge to about 1 mile south of the Searsville Dam. For the purposes of the hydrological analysis, the study area was broken into 3 reaches. Reach 1 extends from San Francisco Bay to the upstream side of U.S. 101. Reach 2 extends from the upstream side of U.S. 101 to the upstream side of Pope-Chaucer Bridge. Reach 3 extends from the upstream side of Pope-Chaucer Bridge to Searsville Dam.

Climate and Precipitation

The San Francisco Bay Area has a Mediterranean climate with mild wet winters and warm dry summers. Coastal ocean currents moderate the effects of seasonal changes in temperature. The Santa Cruz Mountains impose a moderate "rain-shadow" effect to their east in the San Francisquito Creek watershed. This orographic effect contributes to variability in average annual precipitation in the watershed, ranging from about 40 inches at the crest of the mountains to approximately 15 inches in Palo Alto (National Weather Service, Palo Alto gage 046646). Average temperatures in Palo Alto generally range (in degrees Fahrenheit (°F)) from the high 30s in December and January to the upper 70s from June through September (National Weather Service, Palo Alto Gage 046646). Temperatures are rarely low enough for snowfall in the region.

Hydrology

Surface Water Drainage

The San Francisquito Creek watershed encompasses an area of approximately 45 square miles, extending from the ridge of the Santa Cruz Mountains to San Francisco Bay. San Francisquito Creek starts at the base of Searsville Dam in Stanford University's Jasper Ridge Biological Preserve, and flows into the South Bay south of the Dumbarton Bridge. Downstream from the confluence of Searsville Dam, West Union Creek joins the mainstem and contributes unregulated flows from the northwestern portion of the watershed. Los Trancos Creek joins San Francisquito Creek between Interstate (I-) 280 and Junipero Serra Boulevard. Downstream from this point, there are no additional large tributaries and the drainage basin narrows dramatically. The proposed project is in the lower reach of the mainstem of the Creek. Figure 1-1 shows the extent of the San Francisco Creek Watershed.

There are three small reservoirs in the San Francisquito Creek watershed that were built for water conservation and storage purposes: Searsville Reservoir on Corte Madera Creek, and Felt Reservoir and Lagunita Reservoir, which are off-stream reservoirs fed by diversions from Los Trancos Creek and San Francisquito Creek, respectively. All three reservoirs are owned and maintained by Stanford University.

Searsville Reservoir (capacity 175 acre-feet) and Dam is situated just west of the University's Jasper Ridge Biological Preserve. Searsville Reservoir serves Stanford University's irrigation and fire protection needs, and does not provide potable water, flood control, or hydropower. Water typically overtops Searsville Dam and flows out to San Francisquito Creek throughout the rainy season, and generally stops flowing over the dam in late spring or early summer. During years with much higher than average rainfall, overflow to San Francisquito Creek can continue until midsummer. Water also seeps through Searsville Dam year-round during both wet and dry years because of the dam's multiple block construction. The original capacity of the Searsville Reservoir was approximately 1,000 acre-feet, and its current capacity is approximately 175 acre-feet. A 2002 study found that the level of sediment deposition within the reservoir is approximately 12 feet below the dam's spillway, and an average of 15,000 cubic yards of sediment is deposited in the reservoir each year. The reservoir once covered 90 acres in a "Y" shape, with arms reaching through wetlands and marshlands. Today, the wetlands are drying out, and the reservoir itself covers less than 23 acres. More than 45 feet of silt has gathered on the bottom, reducing the reservoir's depth to only 22 feet at the center. In 2015, after several years of study, the Searsville Steering Committee released its preferred alternative to modify the Dam with an opening at its base to provide fish passage and attenuate high flows. Since then, Stanford has been evaluating the feasibility of, and acceptable methods to, both stabilizing much of the Reservoir's accumulated sediment behind the Dam and transporting some of that sediment to San Francisco Bay through flushing in order to create a channel within the Reservoir. This work has included the development of an advanced hydraulic and sediment transport model, with results discussed among technical experts from academia and government agencies. The feasibility and acceptability of this alternative is still being determined; should Stanford implement this alternative, the Dam would delay high creek flows from reaching the downstream stretches of the creek until after peak flows during major storms subside.

Felt Reservoir is an offstream impoundment located just east of Los Trancos Creek and west of I-280 in Palo Alto, and is the largest storage reservoir in the Stanford University water system. It is owned and operated by Stanford University for water supply. Felt Reservoir is formed by Felt Dam, a 67-foot-high earthen dam built in 1930. Storage capacity at Felt Reservoir is approximately 1,050 acre-feet, and the surface area of the reservoir covers about 40 acres. Felt Reservoir is filled from December to April through diversions from Los Trancos Creek. The reservoir is drawn down between May and November for irrigation and fire protection. Flows are released from Felt Reservoir back to Los Trancos Creek via a return channel. Recent system upgrades allow for water from the pump station on San Francisquito Creek (located at the Stanford University golf course) and Searsville Reservoir to be moved to Felt Reservoir for storage and distribution. With implementation of Stanford University's Habitat Conservation Plan, sediment removal activities will continue in Felt Reservoir in the dry season, when the water level is low and areas requiring sediment removal are exposed (USACE 2011, Stanford University 2013).

Lagunita Reservoir is a small offstream impoundment located east of San Francisquito Creek on the Stanford University campus, created in the late 1870s as a stock pond and water-holding facility for Leland Stanford's Palo Alto stock farm and vineyard. The earthen berm at Lagunita Reservoir is 16 feet tall and 2,500 feet long. Lagunita Reservoir is owned by Stanford University and was historically operated for water supply and recreational use. The Lagunita Reservoir lakebed and berm are permeable, losing an estimated 500 gallons per minute to percolation. For Lagunita Reservoir to hold water for more than a few weeks at a time, and provide suitable California tiger salamander breeding habitat, water is diverted to Lagunita Reservoir from San Francisquito Creek; during winter and spring, several acre-feet per day are diverted from San Francisquito Creek, just upstream from San Francisquito Creek U.S. Geological Survey (USGS) Station 11164500, to fill Lagunita Reservoir and maintain its water level. During most years, Stanford University diverts water to Lagunita Reservoir between mid-March and mid-June, and Lagunita Reservoir typically dries up by late July. Without supplemental diversions from San Francisquito Creek, Lagunita Reservoir would typically dry by May (Stanford University 2013).

The USGS owns and operates a continuous stream gage on San Francisquito Creek at Stanford University, just upstream from Junipero Serra Boulevard, about 1.1 miles downstream from Los Trancos Creek (USGS Station 11164500). Hydrological information from this site provides a good long-term record of flow in San Francisquito Creek that is important for understanding the likely magnitude and frequency of hydrologic and processes, such as flood events. Streamflow measurements are available at this station from 1931 to 1941 and then from 1951 to present. Average annual flow between 1931 to 2016 was approximately 20.4 cubic feet per second (cfs) and in 2016 the average flow was 22.7 cfs (U.S. Geological Survey 2017).

Daily flow measurements at USGS Station 11164500 demonstrate strong seasonal variation in streamflow, with portions of the creek drying up during summer months. Low-flow measurements at the station typically occur in the late summer or early fall, before winter rains begin. The historical annual minimum 30-day low flow at this station ranged from zero to about 1 cfs. Downstream of the stream gage, low flows infiltrate to groundwater. Average streamflow losses between USGS Station 11164500 and the Palo Alto Municipal Golf Course, which is approximately 0.34 mile south of U.S. 101, are estimated at 1,050 acre-feet per year. Approximately 595 acre-feet per year of this seepage loss occurs through the 1.8-mile-long section between San Mateo Drive and Middlefield Road. These streamflow losses to groundwater are attributed to predominantly coarse-grained alluvial deposits and a shallow groundwater table that is below the bottom of the channel. Downstream from Middlefield Road, streamflow gains from groundwater and losses through seepage may be masked by urban runoff, changes in bank storage, and tidal effects from the South

Bay. Water quality measurements in San Francisquito Creek indicate that urban runoff constitutes most of the streamflow in some reaches during low flow.

Flood Risks and Flood Protection

The steep topography of the upper watershed results in short duration, high intensity runoff during storm events. Runoff in the lower, urbanized portion of the watershed is conveyed to the tributary creeks by the municipal storm drain system, which tends to increase the magnitude of the more frequent events while slightly reducing the magnitude of very large events. The average slopes of the tributary creeks range from 100 to 160 feet/mile (0.02 to 0.03 feet/feet), whereas the slope of the lower portion of San Francisquito Creek downstream of Alpine Road ranges from 10 to 40 feet/mile (0.002 to 0.007 feet/feet) (Santa Clara Valley Water District 2007).

Flooding from the creek is a relatively common occurrence and portions of the creek channel within the project area are located within the FEMA 100-year flood zone (FEMA 2012a, 2012b, 2012c). The northern portion of Reach 1 is located in Zone AE. Reach 2 is located within flood zones A and AE and adjacent to Zone X as a result of the levee or floodwalls in some locations. The southern end of Reach 3 is primarily located outside the 100-year floodplain. The northern end of Reach 3 at Searsville Dam is located in Zone a. The 100-year flood is a flood that has a 1% chance of being equaled or exceeded in any single year, and can occur in subsequent years. The flow discharge of the creek generally increases from upstream to downstream as a result of the increasing drainage areas. The estimated 100-year flow increases from 8,800 cfs at the Stanford Golf Course (USGS Station 11164500) to 9,400 cfs at Palo Alto Airport (at the mouth of the creek), or an approximately 7% increase (USACE 2009).

Between 1910 and 1972, San Francisquito Creek overflowed its banks eight times, and prior to 1998, the largest flood on record occurred during December 1955 when the estimated flow measured 5,560 cfs and inundated about 1,200 acres of commercial and residential property, about 70 acres of agricultural property, and the Palo Alto Airport and Palo Alto Municipal Golf Course. The creek had overtopped its banks in several locations, including the bridge at Middlefield Road, the bridge at the point where Pope Street becomes Chaucer Street (the Pope/Chaucer Bridge), the bridge at U.S. 101, and two locations along the low levees upstream from U.S. 101. The maximum instantaneous peak flow recorded at San Francisquito Creek USGS Station 11164500 occurred on February 3, 1998, with a peak of 7,200 cfs. After record rainfalls, the creek overtopped its banks and inundated over 11,000 acres of land in Palo Alto, East Palo Alto, and Menlo Park, affecting approximately 1,700 residential and commercial structures. A storm on December 22–23, 2012, with a peak discharge of 5,400 cfs recorded at USGS gauge 11164500 (at Stanford Golf Course) represents the third highest since recording began in 1930. The storm caused the creek to overtop its banks, causing loss of roads and land and damage to several homes adjacent to the creek. Two of the general areas along San Francisquito Creek where damage has been documented include at the southwest side of U.S. 101 in the vicinity of University Avenue and on the northeast side of U.S. 101 east of Pulgas Avenue, both of which are located within the study area (ICF 2013).

A risk-based analysis completed by the USACE in March 2000 suggests that under existing conditions, the creek does not have adequate capacity to convey a 100-year flood event at several locations downstream from El Camino Real. In response to these recurring flood events, San Francisquito Creek Joint Powers Authority (SFCJPA) has undertaken several projects within the San Francisquito Creek watershed to improve flood conveyance capacity and reduce the potential for flood damages to adjacent properties. The proposed project is a key piece of SFCJPA's long-term comprehensive flood management strategy (San Francisquito Creek Joint Powers Authority 2017).

Bridge Hydraulics

Within the tidally influenced area of Reach 1, the bridges over San Francisquito Creek at U.S. Highway 101 and its frontage roads, East Bayshore Road and West Bayshore Road, were recently rebuilt to allow the passage of a 100-year flow event, with substantial sea level rise. On the upstream face of West Bayshore Road, San Francisquito Creek has not yet been widened on the Palo Alto side to "take advantage" of much of that increased bridge capacity, which is why channel widening to achieve flood protection at that location (Site 5) is considered part of the proposed project within Reach 2.

Also, within Reach 2 are three vehicular bridges that do not have adequate flow area underneath to allow passage of a 100-year flow event. Heading upstream from Highway 101, these include bridges that connect the cities of East Palo Alto and Palo Alto at Newell Road and then at University Avenue, and a bridge that connects the cities of Menlo Park and Palo Alto at Pope and Chaucer Streets.

The City of Palo Alto is pursuing a separate project that will increase flow capacity under the Newell Road Bridge to over 7,500 cfs. Farther upstream, the University Avenue bridge has a current capacity of 6,800 cfs, which will be increased to 7,500 cfs with modifications to the creek channel immediately downstream (Sites 3 and 4) and upstream (Sites 1 and 2) of that structure proposed as part of the proposed project.

Bridge capacity is defined as the quantity of water flow in cubic feet per second that is able to pass, or be conveyed, under a structure from the upstream to downstream sides. Relative to the adjacent creek channel, the bridges at Newell Road, and especially at Pope-Chaucer, present the greatest need for replacement. Following project implementation, all four bridges and the channel adjacent to them will have the capacity to convey at least 7,500 cfs, which represents the estimated maximum flow in this area during the 1998 flood of record. Additionally, in concert with an upstream detention project that would temporarily remove at least 800 cfs during a 100-year storm, each bridge would not cause flooding during that size event. Table 3.8-1 explains this by listing the flows associated with the 1998 and modeled 100-year storm events, as well as the bridge and creek conveyance capacities now and after the proposed project is constructed.

Table 3.8-1. Approximate Flows during 1998 and Modeled 100-year Storms, and Bridge and Creek Capacities Now and After the Proposed Project is Built (maximum flow reaching area is 7,500 cfs)

	Approximate Storm Event Flows (in cfs)[1]		Bridge and Adjacent Creek Minimum Capacity (cfs)	
Bridge Location	**1998 flood**	**100-year**	**Existing**	**Post-Project**
Pope-Chaucer Streets	7,380	8,150	5,800	7,500
University Avenue	7,440	8,250	6,800	7,500
Newell Road	7,490	8,310	6,600	7,500
U.S. Highway 101[3]	7,550	8,410	>8,000	9,400

Sources: USACE 2009, 2011; Valley Water 2016; Caltrans 2017.

cfs = cubic feet per section

[1] The storm event flow values for the bridges at University Avenue and Newell Road are interpolated based on the values at the Pope-Chaucer Streets and U.S. Highway 101 bridges.

[2] The capacity of the creek adjacent to each bridge assumes no obstruction from that existing bridge.

[3] Refers to the three connected bridges at U.S. Highway 101, East Bayshore Road, and West Bayshore Road.

Levees and Bank Protection Structures

Valley Water lined approximately 800 linear feet of the south bank of San Francisquito Creek with sacked concrete between U.S. 101 and Newell Road after a flood event in 1995. Hydraulic structures along the creek from U.S. 101 to El Camino Real are shown in Figure 3.8-1. After a flood event in 1958, Valley Water constructed about 800 linear feet of low berm along the south bank of San Francisquito Creek, which was previously lined with sacked concrete in 1955. Valley Water also placed approximately 2,200 linear feet of sacked concrete along the south bank of San Francisquito Creek between the low berm and the Newell Road Bridge. SMCFCD constructed low floodwalls along San Francisquito Creek and Woodland Avenue in East Palo Alto, upstream from U.S. 101. In 1969, Valley Water and the SMCFCD implemented interim flood control measures along the creek between U.S. 101 and Middlefield Road to reduce residential flooding until alternatives for permanent solutions could be studied and implemented. The project included the installation of low berms at the Middlefield Road and Pope/Chaucer Street bridges, and intermittent sacked concrete revetment and low floodwalls along both banks from approximately 1,200 feet upstream of University Avenue to U.S. 101. The flood protection improvements were designed to increase the capacity of the creek between U.S. 101 and Middlefield Road to 6,000 cfs (4–10% probability of exceedance flood event). In addition to these projects, many private homeowners have attempted erosion repair projects on their property along the creek. These projects range in complexity from dumped concrete rubble to engineered retaining walls.

SFCJPA approved the San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project from San Francisco Bay to U.S. 101 in 2012, and construction was completed in 2018. That project increased conveyance and retention capacity of floodwaters from runoff and San Francisco Bay tides to protect residents and property from flood events along the lower section of the creek, from East Bayshore Road to the San Francisco Bay. Components included opening the creek channel to flow in to the outer portion of the Baylands Preserve, reconfiguring and raising levees, creating a marsh plain terrace to convey high flows, installing floodwalls, widening of the creek channel. and; constructing access roads for maintenance purposes.

Bank Erosion

Currently, the banks of San Francisquito Creek are subject to erosion, particularly in response to high discharges, where bank instability is present, or where vegetation becomes disturbed. Erosion by surface water flows is most susceptible where slopes are steep. Five erosion monitoring sites have been established due to their proximity and importance for a single family home downstream of Pope-Chaucer Bridge that was built between the Woodland Avenue and the creek bank (Figure 3.8-2). This is the only surface structure on the San Mateo County side of the creek that was built on the top of bank between Pope-Chaucer and Highway 101. Inspections by Valley Water engineers indicate that this area of creek bank does not currently show signs of active erosion. The banks along this property (sites 1-5 below) are armored with boulders, concrete and other hard surfaces, so small changes in velocities are not expected to increase erosion potential. These sites will be monitored carefully as described in the remainder of this section. Additionally, six sites of active erosion (sites 6–11 below) have been identified within Reach 2 downstream of the Pope-Chaucer Street Bridge. Figure 3.8-2 shows the location of all 11 sites, and Table 3.8-2 summarizes the existing flow velocities experienced at these sites. Appendix D provides the Valley Water hydrology report, which provides the basis for this analysis.

Table 3.8-2. Existing Velocities at Potential Erosion Sites Downstream of Pope-Chaucer Street Bridge

Site #	Existing Velocity (feet/second)[1]	Location/Description
1	6.3	Placed boulder – entry to first bend downstream of Pope-Chaucer Street Bridge
2	6.3	Placed boulder – entry to first bend downstream of Pope-Chaucer Street Bridge
3	6.09	Top of bank – Woodland and Menalto
4	6.26	Toe of bank – first bend downstream of Pope-Chaucer Street Bridge
5	6.3	Bank below home at first bend downstream of Pope-Chaucer Street Bridge
6	5.82	Top of bank, Menlo Park
7	7.24	Upstream toe of sacked concrete structure, Palo Alto
8	8.15	Channel downcutting, looking upstream from Maple Street
9	7.6	Upstream toe of cribwall, Menlo Park
10	7.95	Downstream cut of terrace structure, Menlo Park
11	7.88	Interface between hardscape and native soil, East Palo Alto

Source: Xu pers. comm.

[1] 5,800 cubic feet per second

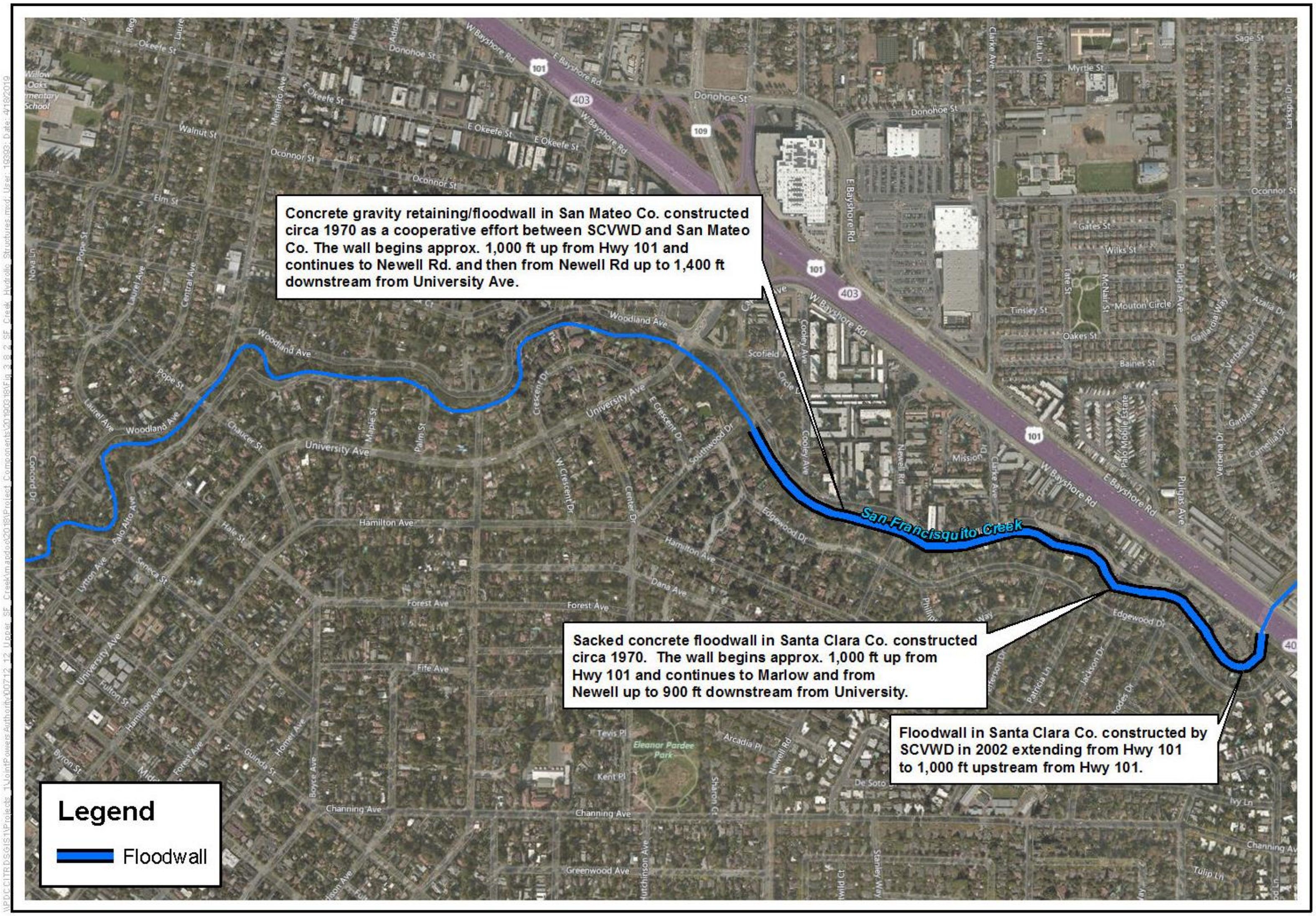

Figure 3.8-1 **Hydraulic Structures**

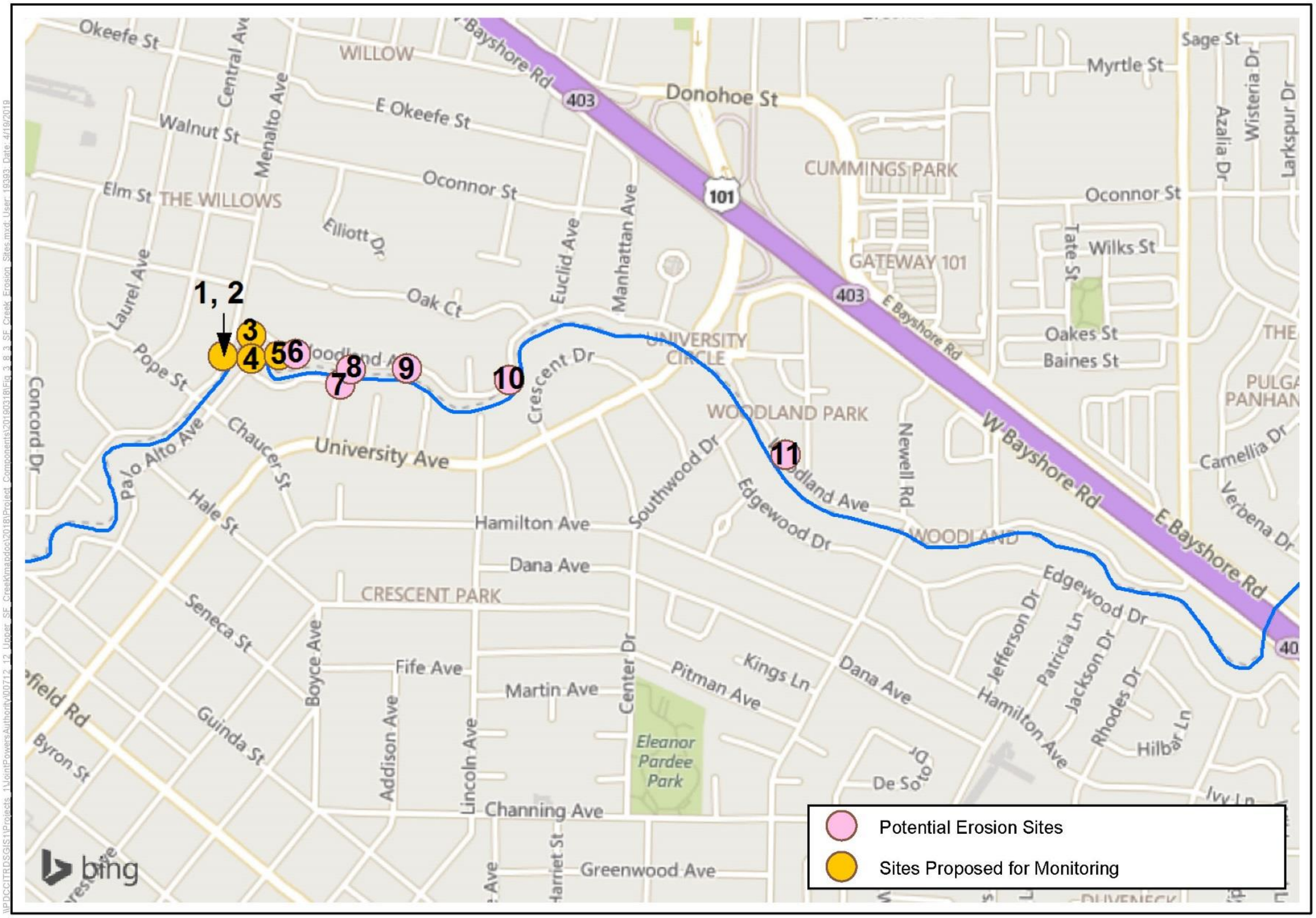

Figure 3.8-2 Potential Erosion Sites

Groundwater Hydrology

The San Francisquito Creek watershed overlays the Santa Clara Valley Groundwater Basin, including portions of the Santa Clara and San Mateo Plain subbasins. San Francisquito Creek is the boundary between the two subbasins, with the San Mateo Plain Subbasin to the north and Santa Clara Subbasin to the south. Groundwater in these two subbasins is managed by Valley Water in the Santa Clara Subbasin and by San Mateo County in the San Mateo Plain Subbasin. Groundwater flow direction is primarily in the direction of the San Francisco Bay, but may be locally influenced by the creeks or groundwater wells.

The aquifer that underlies the San Francisquito alluvial fan is an arbitrary subbasin that was termed the San Francisquito Alluvial Cone by the USGS, and is the primary source of recharge to the larger aquifer that extends into the Santa Clara Valley (San Mateo County 2018). This alluvial cone includes both a shallow aquifer in the sandy deposits that lie beneath San Francisquito Creek and a deeper aquifer with water-bearing strata at depths greater than 200 feet below the local ground surface. The shallow aquifer extends to depths of up to 100 feet, and lies above a layer of clayey bay deposits. This confining layer ends near San Mateo Drive, approximately 0.5 mile upstream from El Camino Real. Flow monitoring along San Francisquito Creek on May 16, 2017, indicates that most leakage from the creek to the aquifer occurs in the upper reaches of the creek(San Mateo County 2018).

As mentioned above, San Francisquito Creek stream flows infiltrate the streambed and recharge the aquifers. These streamflow losses to groundwater are attributed to predominantly coarse-grained alluvial deposits and a shallow groundwater table that is below the bottom of the channel. Seepage from Lagunita Reservoir, infiltration of runoff from the foothills, over-irrigation, urban watering, and leakage from water distribution and stormwater systems also contribute to aquifer recharge. Analysis of surface water-groundwater interactions suggests that increased groundwater use could potentially affect baseflow in some hydraulically coupled sections of San Francisquito Creek, with potential implications for aquatic species such as steelhead trout (San Mateo County 2018).

Currently, groundwater in the vicinity is used for irrigation, public drinking water, and private drinking water. The majority of pumping for irrigation occurs in the southern portion of the San Mateo Plain Subbasin, where about 90% of the irrigation wells are located. Of the wells in the South San Mateo Plain Subbasin, approximately 65% are located in Atherton. Stanford University has four production wells near the creek on Stanford University land. While the majority of the wells in Atherton and Menlo Park are screened in the deeper aquifer, the majority of the irrigation wells in other cities in the South San Mateo Plain Subbasin are drilled and screened in the shallower aquifer. Public drinking water wells are located in East Palo Alto (Palo Alto Park Mutual Water Company), Menlo Park (O'Connor Tract Corporation and Menlo College), and San Mateo (San Mateo High School). Emergency supply wells are located in Menlo Park and Palo Alto.

Groundwater in the area is currently considered to be balanced; meaning that withdrawals approximately equal recharge (San Mateo County 2018). Historical overdraft (defined as long-term pumping that exceeds recharge) that resulted in historical land subsidence and salinity intrusion led to extensive investigations by the Department of Water Resources and local groundwater management agencies, such as Valley Water. Regional groundwater levels have been trending upward until the most recent drought due to reductions in regional irrigation pumping, and through augmented groundwater recharge programs. Before the mid-1960s, groundwater production resulted in lowered groundwater elevations in Palo Alto, Menlo Park, and Atherton; movement of saline water inland from San Francisco Bay; and land subsidence in parts of Palo Alto and East Palo Alto. Groundwater levels have recovered since the mid-1960s

Water Quality

Surface Water Quality and Impairments

In general, water quality in streams depends on the mineral composition of the soils and associated parent material in the watershed, the hydrologic and hydraulic characteristics of the stream and its watershed, and the types of contaminant sources present in the watershed. As shown in Table 3.8-3, the creek is listed by the State Water Board under the 303(d) list as impaired for Diazinon, sedimentation/siltation, and trash. Placement of a water body and its offending pollutant(s) on the 303(d) list, initiates the development of a Total maximum Daily Load (TMDL). TMDLs may establish "daily load" limits of the pollutant, or in some cases require other regulatory measures, with the ultimate goal of reducing the amount of the pollutant entering the water body to meet water quality standards.

Erosion and sediment loading are the primary water quality concerns in the study area. Bank erosion is a principal water quality concern in upper San Francisquito Creek, where some sections of the creek have enlarged due to invert degradation/bank undercutting, and other areas have been narrowed by the placement of revetment in an attempt to control erosion. Despite previous repairs and stabilization efforts in some areas, several areas along upper San Francisquito Creek (upstream of the Stanford gage station) likely do not meet safety standards for slope stability. A storm in December 2012 caused major scouring, undercutting of banks, and several relatively shallow slope failures in localized areas over a ±200-foot-long section of creek. Because of the urbanized nature of the San Francisquito Creek watershed, surface water quality in the project area is directly affected by stormwater runoff from adjacent streets and properties delivering fertilizers, pesticides, metals, hydrocarbons, and other pollutants. Typically, pollutant levels in the creeks are highest following the first storm flows of the season when constituents accumulated during the dry season are "flushed" into the creeks.

Table 3.8-3. Overview of Water Quality Impairments in the Project Area

Water Body	Listed Impairments Per 2010 303(d) List	Potential Sources	Estimated Size Affected	EPA TMDL Completion
San Francisquito Creek	Diazinon	Urban runoff/ storm sewers	12 miles	2007[3]
	Sedimentation/siltation	Nonpoint source	12 miles	2013[1]
	Trash	Illegal dumping, urban runoff/storm sewers	12 miles	Est. 2029[2]
South San Francisco Bay	Chlordane	Nonpoint source	9,204 acres	2013[1]
	DDT (Dichlorodiphenyl-trichlorothane)	Nonpoint source	9,204 acres	2013[1]
	Dieldrin	Nonpoint source	9,204 acres	2013[1]
	Dioxin compounds (including 2,3,7,8-TCDD)	Atmospheric deposition	9,204 acres	2019[1]

Water Body	Listed Impairments Per 2010 303(d) List	Potential Sources	Estimated Size Affected	EPA TMDL Completion
	Furan Compounds	Atmospheric deposition	9,204 acres	2019[1]
	Invasive Species	Ballast water	9,204 acres	2019[1]
	Mercury	Atmospheric deposition, industrial point sources, municipal point sources, natural source, nonpoint source, resource extraction	9,204 acres	2008[3]
	PCBs and Dioxin-Like PCBs (polychlorinated biphenyls)	Unknown nonpoint source	9,204 acres	2010[3]
	Selenium	Domestic use and groundwater	9,204 acres	2019[1]

Source: State Water Resources Control Board 2018.
EPA = U.S. Environmental Protection Agency; TMDL = total maximum daily load
[1] Expected TMDL completion date. Completion has not yet occurred.
[2] TMDL requirement status is being addressed by action other than a TMDL.
[3] EPA TMDL Approval.

Groundwater Quality

Groundwater in the Santa Clara Valley subbasin is generally of a bicarbonate type, with sodium or calcium being the principal ions. Basin wide evaluation of groundwater quality indicates that groundwater quality reflects the varying influence and interaction of groundwater sources of recharge, including stream and rainfall recharge, Hetch Hetchy water return flow, and near shore seawater intrusion in the shallow zone (San Mateo County 2018). Mineral salt content is elevated in localized areas, and a few wells have levels of manganese that are greater than the secondary drinking water standard ; however, overall, water quality objectives are met. All drinking water standards are met at public supply wells.

Designated Beneficial Uses

The San Francisco Bay Basin Plan (San Francisco Bay Regional Water Quality Control Board 2015) describes beneficial uses for the waters in San Francisco Bay. Beneficial uses represent the services and qualities of a water body (i.e., the reasons the water body is considered valuable). Table 3.8-4 summarizes the designated beneficial uses identified for San Francisquito Creek, downstream water bodies (South San Francisco Bay), and groundwater in the project area as designated by the San Francisco Bay Regional Water Board.

Table 3.8-4. Designated Beneficial Uses

Water Body	Designated Beneficial Uses
San Francisquito Creek	Cold Freshwater Habitat (COLD); Fish Migration (MGR); Preservation of Rare and Endangered Species (RARE); Fish Spawning (SPWN); Warm Freshwater Habitat (WARM); Wildlife Habitat (WILD); Water Contact Recreation (REC-1); Noncontact Water Recreation (REC-2)
South San Francisco Bay	Industrial Service Supply (IND), Commercial (COMM), Shell Fish Harvesting (SHELL); Estuarine Habitat (EST); Fish Migration (MGR); Preservation of Rare and Endangered Species (RARE); Fish Spawning (SPWN); Wildlife Habitat(WILD); Water Contact Recreation (REC-1); Noncontact Water Contact Recreation (REC-2); Navigation (NAV)
Santa Clara Valley groundwater	Municipal and Domestic Supply (MUN), Industrial Process Supply (PROC), Industrial Service Supply (IND), Agricultural Supply (AGR)

Source: San Francisco Bay Regional Water Quality Control Board 2015.

3.8.3 Impact Analysis

Methods and Significance Criteria

Impacts were analyzed qualitatively based on professional judgment in light of the hydrologic and hydraulic analyses prepared for project design. Analysis focused on issues related to flood hazards, groundwater supply, and surface and groundwater quality. The project would not include dam construction, new development protected by levees or floodwalls, or new construction placing persons or structures at significant risk due to mudflow and debris flow. These issues are not discussed further in this EIR.

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would result in any of the following:

- Increased flood risks.
- Substantial depletion of groundwater resources or interference with groundwater recharge; interruption of groundwater supply.
- Degradation of water quality potentially affecting beneficial uses, including degradation that would result in violation of any applicable water quality standard or waste discharge requirements (WDRs).

For the analysis, two baseline conditions were used in order to fully disclose the impacts of the project alternatives in comparison to both existing and projected future conditions: (1) under existing conditions, sediment mobilized from the upper San Francisquito Creek watershed would continue to be deposited and retained behind Searsville Dam, and storm flows would be attenuated by Searsville Reservoir; and (2) under projected future conditions (20 years), Searsville Reservoir would have filled with sediment, and storm flow and sediment would overtop Searsville Dam. The amount of storm flow and the volume of sediment transported downstream would vary from year-to-year based on annual precipitation events.

Over the past several years, the SFCJPA has discussed with Stanford the University's efforts to develop a project at the Searsville Dam and Reservoir, as described in Chapters 1 and 2 of this DEIR. These efforts include the development of hydraulic and sediment transport models for the watershed, which have helped to inform the development of this environmental document in regards to quantifying the effects of sediment deposition and evaluating cumulative impacts of various potential projects. The SFCJPA's evaluation indicates that if Stanford implements its preferred project at Searsville Dam and Reservoir and flushes accumulated sediment downstream, then the University may need to work with the SFCJPA to remove some sediment downstream after that initial flushing is complete. This analysis also indicates that following the flushing period, adaptive and infrequent management of the annual sediment moving downstream from the upper watershed as the natural sediment process is restored may be required near Highway 101. The SFCJPA has considered this future, annual additional sedimentation in its project planning, and intends to collaborate with Stanford for future sediment management of the creek system.

Impacts and Mitigation Measures

Impact HWR-1—Increase flood risks

Summary by Project Element: Impact HWR-1—Increase flood risks		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant	No Impact

Channel Widening Alternative

Construction

Construction activities undertaken as part of the proposed project would include bridge replacement, grading, excavation, pile driving, terracing, vegetation removal, fill and rock slope protection, installation of soil nail walls and/or reinforced concrete walls, extension of the parapet, as well as installation of vegetation, all of which involve mobilizing sediment within the creek. The construction activities would take place within the existing channel for approximately 6 months (between April 15 and October 15). This is generally considered the dry season, which would limit potential flooding impacts. Sediment from project-induced erosion could accumulate in downstream drainage facilities and interfere with stream flow, thereby aggravating downstream flooding conditions during the wet season. Construction activities at the channel widening sites and at the Pope-Chaucer Street Bridge would also require clear water diversions to minimize potential erosion, sediment loss, scour or increases in turbidity. Any channel flows in San Francisquito Creek would be kept separate from construction activities using temporary flow diversion procedures. As identified in Section 2.9, *Environmental Commitments*, *Water Quality Protection,* to protect the active stream the contractor would employ one of the following BMPs depending in part on the amount of stream flows: piping installed between upstream and downstream cofferdams (filled with cleaned gravel) to allow for upstream flow to bypass the work site; a temporary low flow channel lined with sandbag levees; or using the existing culvert while it remains in place. Dewatering may also be necessary during instream staging and construction at channel widening sites and at the Pope-

Chaucer Street Bridge to remove any shallow groundwater potentially encountered at these sites. These activities have the potential to disrupt stormwater flows within the creek during significant storm events. If necessary, dewatering outflows would be directed downstream outside of the construction footprint using settling tanks and pumps. However, construction activities are not anticipated to occur within the channel during significant storm events.

At channel widening Sites 1–4, the instream staging/construction areas would be sealed off with sandbags and visquine. Cofferdams would be built to prevent/reduce downstream influence and upstream freshwater influence. Within these areas, a gas generator–driven pump would be used to pump water downstream of the site from a shallow groundwater well with corrugated piping inserted.

At channel widening Site 5, the instream staging/construction area would be dewatered during construction. Dewatering is expected to require installation of about eight groundwater wells, each approximately 12–20 feet deep, with continuous pumping for a total of about 130,000 gallons per day to effectively dewater the area (Caltrans 2017). A hollow stem auger drilling rig would be used to install the wells. Cofferdams would be built to prevent/reduce downstream tidal influence and upstream freshwater influence. Downstream of the dewatered area, a sheet pile cofferdam would be built. Fish will be relocated prior to dewatering. Upstream of the dewatered area, gravel bags would be used. Water would be gravity fed through a pipe around the site or pumped if needed.

With implementation of the environmental commitments listed in Chapter 2, *Program Description*, and specifically the Water Quality Protection Measures, the impacts of the temporary disruption of stormwater flows within the creek would be minimized. The environmental commitments include measures that would manage stormwater to minimize flooding impacts and includes the appropriate use and installation of coffer dams in tidal work areas. Moreover, the SFCJPA would be responsible for ensuring compliance with all stormwater regulatory requirements and programs as well as obtaining a Valley Water drilling/ destruction permit for dewatering wells. Therefore, with implementation of environmental commitments and compliance with regulatory requirements and programs, impacts resulting from potential disruption of stormwater flows would be less than significant. No mitigation is required.

Operations and Maintenance

Currently, the creek does not have adequate flood conveyance capacity to protect residents and property at several locations within Reach 2 of the creek from the Pope-Chaucer Street Bridge to U.S. 101 during a 100-year flood event. Increased flood protection under the proposed project would be achieved by widening the creek at five sites, including upstream and downstream from the University Avenue bridge (parapet extension), upstream from the Newell Road bridge, and upstream from the U.S. 101 bridge, as well as replacing the Pope-Chaucer Street bridge. Newell Road and U.S. 101 projects were recently approved to upgrade these bridge crossings to accommodate higher flow volumes. To improve flood control protections to the public, the proposed project would be designed to increase design flows in the creek to 7,500 cfs at the five widening sites described above and at the Pope-Chaucer Street Bridge. Under existing conditions, the creek and Pope/Chaucer Street Bridge have capacity for flows between approximately 5,800 and 7,500 cfs. Therefore, although the proposed project would not increase the design capacity within this segment of the creek to the 100-year flood level of protection, it would represent a beneficial impact on the overall function of existing flood protection infrastructure and improve the general state of the local flood safety for the protection of life and property adjacent to the project area. Furthermore, as stated in the project objectives, this alternative would not preclude future actions to bring the cumulative flood protection up to a 100-year flow event.

There are several locations within Reach 2 that would not be improved under the Channel Widening Alternative and would continue to have insufficient capacity for floodwater conveyance, similar to existing conditions. As shown in Table 3.8-5, existing erosion monitoring locations would experience an increase in velocity with the exception of Site 11, which is anticipated to experience a decrease in velocity of approximately 0.62 feet per second. Sites 7–10 are anticipated to see an increase in velocity of approximately 1 foot per second. The existing flow capacity within this area is identified between 5,800 and 7,500 cfs. As the Channel Widening Alternative would increase capacity for flows of up to 7,500 cfs both upstream and downstream of these unimproved erosion locations, continued erosion would occur in this area. This would only occur for storm events larger than 5,800 cfs. A 4% chance (25-year) storm event, or 5,800 cfs, has occurred once (in 1998) since records began in the 1930s, but several storms have gotten close to 5,800 cfs. For flows below 5,800 cfs, this reach would contain the flood waters similar to existing conditions. While the proposed project would result in continued flooding and erosion in this unimproved section of Reach 2 for larger storm events, the Channel Widening Alternative and Newell Road and U.S. 101 projects would result in overall increased flood protection in Reach 2 compared to existing conditions. Operations and maintenance activities associated with these actions would not result in an increase in overall flood risks beyond existing conditions.

Table 3.8-5. Estimated Existing and Proposed Velocities at Erosion Monitoring Sites Downstream of Pope-Chaucer Street Bridge

Site #	Existing Velocity (feet/second) [1]	Proposed Velocity (feet/second) [2]	Potential Velocity Increase (feet/second)
1	6.3	6.91	0.61
2	6.3	6.91	0.61
3	6.09	6.73	0.64
4	6.26	6.88	0.62
5	6.3	6.67	0.37
6	5.82	6.52	0.70
7	7.24	8.05	0.81
8	8.15	9.21	1.06
9	7.6	8.54	0.94
10	7.95	9	1.05
11	7.88	7.26	-0.62

Source: Xu pers. comm.

[1] 5,800 cfs

[2] 7,500 cfs

The Channel Widening Alternative could result in construction of two creekside parks at the locations shown in Figures 2-3 through 2-5. Operations activities associated with these actions would not result in an increase in flood risks and would provide a beneficial effect.

The Channel Widening Alternative would also perform aquatic habitat restoration at the channel widening sites. Operations and maintenance activities associated with these actions would not result in an increase in flood risks.

Maintenance would include removing debris from channels, which could occur during any flood season; more intensive post-flood cleanup would be needed only after major flood events. Post-project maintenance would be similar to existing maintenance. In addition, the monitoring and maintenance of new vegetation would occur, at a minimum, for 3 years following completion of the project. This activity would consist of removing invasive plant species, inspecting newly planted vegetation, and replanting as needed. These maintenance activities could result in mobilizing sediment within the creek. However, this is anticipated to be minimal and the maintenance activities would result in maintaining the Channel Widening Alternative's improved flood protection through the project site. Operations and maintenance activities associated with these actions would not result in an increase in flood risks.

Under projected future conditions (20 years), Searsville Reservoir would have filled with sediment, and storm flow and sediment would overtop Searsville Dam. The amount of storm flow and the volume of sediment transported downstream would vary from year-to-year based on annual precipitation events. The return of the watershed's sediment transport to historic conditions could cause transient aggradation of the channel, which could reduce conveyance capacity. However, because this is not considered an impact of the project, but rather the future filling of Searsville Reservoir or the result of a future project by another entity, no mitigation is required at this time.

Floodwalls Alternative

Construction

Flood protection under the Floodwalls Alternative would be achieved by constructing approximately 7,260 linear feet of floodwalls. All other project elements (including replacement of the Pope/Chaucer Street Bridge; channel widening at Site 5; construction of creekside parks; and aquatic habitat enhancement) would be same as under the Channel Widening Alternative; therefore, the following analysis only evaluates the impacts of development of the proposed floodwalls.

The floodwalls would be constructed of concrete with a maximum height of 2 feet from the top of the bank. For floodwall installation, all access would be from Woodland Avenue. Access ramps and the upland staging area shown for Alternative R1-A1 (Figures 2-3 through 2-6) would also be used for this alternative. Installation of the floodwalls would be preceded by excavation and compaction to prepare the foundation. An excavator and dump trucks would be in the channel to remove excavated soil and bring in the form work and rebar. In-stream work is necessary to access many of the sites given the proximity of private property and physical barriers such as trees and fences. Concrete would be pumped across the channel from Woodland Avenue using a concrete truck with an articulating boom. Pieces of the floodwalls would be brought to the project site by tractor trailer. Installation of the floodwalls would require approximately 3 months: 72 days for installation of the floodwall panels and 10 days for miscellaneous construction activities and contingencies.

As with the Channel Widening Alternative, construction activities could result in interference with storm flows thereby aggravating flooding conditions during the wet season. Construction activities at the floodwall sites would also require clear water diversions to minimize potential erosion, sediment loss, scour, or increases in turbidity. Dewatering may also be necessary during instream staging and construction to remove any shallow groundwater potentially encountered at these sites. These activities have the potential to disrupt stormwater flows within the creek during significant storm events. However, as with the Channel Widening Alternative, with implementation of the environmental commitments listed in Chapter 2, and specifically the Water Quality Protection Measures, temporary disruption of stormwater flows within the creek would be minimized. These include measures that would manage stormwater to minimize flooding impacts, and the appropriate use and installation of cofferdams in tidal work areas. Moreover, the SFCJPA would be responsible for ensuring compliance with all stormwater regulatory requirements and programs as well as obtaining a Valley Water drilling/destruction permit for dewatering wells. Therefore, with implementation of environmental commitments and compliance with regulatory requirements and programs, impacts resulting from potential disruption of stormwater flows would be less than significant. No mitigation is required.

Operations and Maintenance

As described above under the Channel Widening Alternative, the creek does not currently have adequate flood conveyance capacity to protect residents and property at several locations within Reach 2 of the creek from the Pope-Chaucer Street Bridge to U.S. 101 during a 100-year flood event. Increased flood protection under the Floodwalls Alternative would be achieved by constructing approximately 7,260 linear feet of floodwalls from south of the Pope-Chaucer Street Bridge to U.S. 101 as well as replacement of the Pope-Chaucer Street bridge and channel widening at Site 5. To improve flood control protections to the public, the Floodwalls Alternative would be designed to increase design flows in the creek to 7,500 cfs at the floodwall construction sites south of the Pope-Chaucer Street Bridge to U.S. 101. Therefore, as with the Channel Widening Alternative, although the Floodwalls Alternative would not increase the design capacity within this segment of the creek to the 100-year flood level of protection, it would represent a beneficial impact on the overall function of existing flood protection infrastructure and improve the general state of the local flood safety for the protection of life and property adjacent to the project area. Furthermore, as stated in the project objectives, this alternative would not preclude future actions to bring the cumulative flood protection up to a 100-year flow event.

Operations and maintenance for the Floodwalls Alternative operations activities would involve visual inspections for any damaged concrete, exposed reinforcing bar, or undermining. If damaged or deteriorating conditions are identified, repairs would be conducted per American Concrete Institute Bulletins. These maintenance activities could result in mobilizing sediment or other construction pollutants within the creek. However, this is anticipated to be minimal and the maintenance activities would result in maintaining the Floodwalls Alternative improved flood protection through the project site. Operations and maintenance activities associated with these activities would not result in an increase in flood risks.

Under projected future conditions (20 years), Searsville Lake would have filled with sediment, and storm flow and sediment would overtop Searsville Dam. The amount of storm flow and the volume of sediment transported downstream would vary from year-to-year based on annual precipitation events. The return of the watershed's sediment transport to historic conditions could cause transient aggradation of the channel which could reduce conveyance capacity. However, because this is not considered an impact of the project, but rather the filling of Searsville Lake, no mitigation is required.

Former Nursery Detention Basin Alternative

Construction

The Former Nursery Detention Basin Alternative would involve the construction of an approximately 12.4-acre detention basin at the Former Nursery site roughly 1.5 miles upstream from I-280) along the northeastern side of San Francisquito Creek. The 14-foot-deep basin would store approximately 180 acre-feet of water, hold back approximately 500 cfs during a peak flow, and have a cut of 1,310,000 cubic yards. The detention basin would be dug with an excavator, and excavated material would be loaded into trucks for hauling to an offsite location for reuse or disposal. The detention basin would not be lined. A weir would be constructed along San Francisquito Creek channel adjacent to the detention basin. A notch (spillway) would be cut into the weir to allow water to flow over into the detention basin during high flows. Construction of the detention basin is expected to take approximately 6 months. A fish screen would be installed to prevent fish stranding using National Marine Fisheries Service guidelines. During the rare storm events of 5,800 cfs or greater, water would flow over the notch from San Francisquito Creek to the detention basin. Sediment that accumulates within the basin during flood events would need to be removed and hauled to an appropriate location once the basin empties out. The general site access, staging areas, and basin location are shown in Figure 2-10.

The Former Nursery Detention Basin Alternative detention basin would not be located within a 100-year floodplain and thus would not impede flows within a floodplain. The proposed detention basin would be within approximately 100 feet of the San Francisquito Creek; however, no segment of the creek is identified as a special flood hazard area within the vicinity of the proposed detention basin. The nearest segment of the creek identified as a 100-year flood hazard area is approximately 3 miles downstream where the creek meets Sand Hill Road.

Construction activities involving grading, excavation, and removal and placement of vegetation would mobilize sediment that could potentially leave the site via runoff and enter the creek. Such sediment could accumulate downstream and interfere with stream flows, potentially aggravating downstream flooding conditions during the wet season. However, as described as part of Impact HWR-3 below and required as part of the water quality protection environmental commitments, measures would be implemented to control erosion and sedimentation as part of the project SWPPP. Therefore, these impacts would be less than significant, and no mitigation is required.

Similar to the other project alternatives, dewatering activities and a clear water diversion may be necessary, should construction of the weir along the creek channel require work to be performed within the creek itself. Temporary disruption of stormwater flows within the creek would be minimized with implementation of the Water Quality Protection Measures that are listed as environmental commitments in Chapter 2. These include measures that require sediments to be stored and transported in a manner that minimize water quality impacts, and the appropriate use and installation of cofferdams. Moreover, the SFCJPA would be responsible for ensuring compliance with all stormwater regulatory requirements and programs, as well as obtaining a Valley Water drilling/destruction permit for dewatering wells. Therefore, with implementation of the environmental commitments and compliance with regulatory requirements and programs, impacts resulting from the potential disruption of stormwater flows would be less than significant. No mitigation is required.

Operations and Maintenance

As described above, the creek does not have adequate flood conveyance capacity to protect residents and property at several locations within Reach 2 during a 100-year flood event. Increased flood protection under the Former Nursery Detention Basin Alternative would be achieved by construction of an approximately 12.4-acre detention basin that would store approximately 180 acre-feet of water and hold back approximately 500 cfs during a peak flow. The basin footprint was determined based on topography, and implementation would achieve an approximately 7% 100-year peak flood reduction at Middlefield Road, less than 1 mile upstream from the Pope-Chaucer Street Bridge (PWA 2009). A weir would be constructed along San Francisquito Creek channel adjacent to the detention basin. A notch (spillway) would be cut into the weir to allow water to flow over into the detention basin during high flows. Thus, development of the detention basin would decrease, but not eliminate, downstream flood hazards, thereby representing an overall beneficial impact, and would improve the general state of the local flood safety for the protection of life and property adjacent to the project area.

Regular operations and maintenance activities could include but not be limited to visual inspections, sediment removal, trash pick-up and disposal, as well as vegetation maintenance and removal. These maintenance activities would have a limited potential for mobilizing sediment within the creek. However, this is anticipated to be minimal and the maintenance activities would result in maintaining the detention basin flood protection capacity. These activities are not anticipated to result in an increase in flood risks.

Under projected future conditions (20 years), Searsville Lake would have filled with sediment, and storm flow and sediment would overtop Searsville Dam. The amount of storm flow and the volume of sediment transported downstream would vary from year-to-year based on annual precipitation events. The return of the watershed's sediment transport to historic conditions could cause transient aggradation of the channel which could reduce conveyance capacity. The Former Nursery Detention Basin Alternative would capture some of these flows including sediment discharged from Searsville Lake, which could result in additional maintenance requirements for the basin to remove sediment to maintain the basin's capacity. However, because this is not considered an impact of the project, but rather the filling of Searsville Lake, no mitigation is required.

Webb Ranch Detention Basin Alternative

Construction

As stated in Chapter 2, the Webb Ranch Detention Basin Alternative would involve the construction of an approximately 27.4-acre detention basin at the Webb Ranch site approximately 0.5 mile upstream from I-280 along the southern side of San Francisquito Creek. The 13-foot-deep basin would store approximately 440 acre-feet of water and hold back approximately 1,000 cfs during a peak flow, and have a cut of approximately 1,040,000 cubic yards. The general design and construction of the Webb Ranch site detention basin would be the same as described above for the Former Nursery Detention Basin Alternative. Sediment that would accumulate within the basin would need to be removed and hauled to an appropriate location, particularly after large flow events.

As with the Former Nursery Detention Basin Alternative, the Webb Ranch Detention Basin Alternative detention basin would not be located within a 100-year floodplain and thus would not impede flows within a floodplain. The proposed detention basin would be within approximately 100 feet of the San Francisquito Creek; however, no segment of the creek is identified as a special flood hazard area within the vicinity of the proposed detention basin. The nearest segment of the creek identified as a 100-year flood hazard area is approximately 2 miles downstream from the proposed detention basin where the creek meets Sand Hill Road.

Construction activities involving grading, excavation, and removal and placement of vegetation would mobilize sediment that could potentially leave the site via runoff and enter the creek, accumulating downstream and resulting in interference with stream flows and potentially aggravating downstream flooding conditions during the wet season. However, as described as part of Impact HWR-3 below and required as part of the water quality protection environmental commitments, measures would be implemented to control erosion and sedimentation as part of the project SWPPP. Therefore, these impacts would be less than significant and no mitigation is required.

Similar to the other project alternatives, dewatering activities and a clear water diversion may be necessary, should construction of the detention basin require work within the creek itself. Temporary disruption of stormwater flows within the creek would be minimized with implementation of the Water Quality Protection Measures listed as environmental commitments in Chapter 2. These include measures that would require sediments to be stored and transported in a manner that minimize water quality impacts, and the appropriate use and installation of cofferdams. Moreover, the SFCJPA would be responsible for ensuring compliance with all stormwater regulatory requirements and programs as well as obtaining a Valley Water drilling/ destruction permit for dewatering wells. Therefore, with implementation of environmental commitments and compliance with regulatory requirements and programs, impacts resulting from potential disruption of stormwater flows would be less than significant. No mitigation is required.

Operations and Maintenance

As described above, the creek does not have adequate flood conveyance capacity to protect residents and property at several locations within Reach 2 during a 100-year flood event. Increased flood protection under the Webb Ranch Detention Basin Alternative would be achieved by construction of an approximately 27.4-acre detention basin that would be 13 feet deep and would store approximately 440 acre-feet of water and hold back approximately 1,000 cfs during a peak flow. The basin footprint was determined based on topography, and implementation would achieve an approximately 14% 100-year peak flood reduction at Middlefield Road, less than 1 mile upstream from the Pope-Chaucer Street Bridge (PWA 2009). A weir would be constructed along San Francisquito Creek channel adjacent to the detention basin. A notch (spillway) would be cut into the weir to allow water to flow over into the detention basin during high flows. Thus, development of the detention basin would decrease downstream flood hazards compared to existing conditions thereby representing a beneficial impact that would improve the general state of the local flood safety for the protection of life and property adjacent to the project area.

Regular operations and maintenance activities could include but not be limited to visual inspections, sediment removal, trash pick-up and disposal, as well as vegetation maintenance and removal. These maintenance activities would have a limited potential for mobilizing sediment within the creek.

However, this is anticipated to be minimal and the maintenance activities would result in maintaining the detention basin flood protection capacity. These activities would not result in an increase in flood risks.

Under projected future conditions (20 years), Searsville Lake would have filled with sediment, and storm flow and sediment would overtop Searsville Dam. The amount of storm flow and the volume of sediment transported downstream would vary from year-to-year based on annual precipitation events. The return of the watershed's sediment transport to historic conditions could cause transient aggradation of the channel which could reduce conveyance capacity. The Webb Ranch Detention Basin Alternative would capture some of these flows including sediment discharged from Searsville Lake, which could result in additional maintenance requirements for the basin to remove sediment to maintain the basin's capacity. However, because this is not considered an impact of the project, but rather the filling of Searsville Lake, no mitigation is required.

Impact HWR-2—Deplete groundwater resources or interfere with groundwater recharge or supply

Summary by Project Element: Impact HWR-2—Deplete groundwater resources or interfere with groundwater recharge or supply		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative

Construction

None of the proposed project elements would require the use of groundwater. Dewatering is expected to require installation of about eight groundwater wells, each approximately 12–20 feet deep, with continuous pumping for a total of about 130,000 gallons per day to effectively dewater the area (Caltrans 2017). A hollow stem auger drilling rig would be used to install the wells. While channel widening activities and replacement of the Pope-Chaucer Street Bridge would involve localized temporary groundwater dewatering activities, the proposed project would not significantly affect groundwater resources because the required excavations would intersect only the shallow water table; dewatering would temporarily remove groundwater with only localized and inconsequential effects on the regional groundwater system. Dewatering could result in short-term, localized alterations in groundwater levels near the surface in the immediate vicinity of the construction sites, but this reduction would not cause a widespread, regional drawdown. Changes to groundwater occurrence and levels due to project construction, operation, and maintenance, if groundwater levels are affected at all, would not detrimentally affect regional groundwater production or change the existing water quality. The San Francisco Bay Regional Water Board also has regulations specific to dewatering activities that involve reporting and monitoring requirements. There would be no long-term impact related to increased groundwater use or reduction of supply. Furthermore, no existing water wells would be decommissioned during construction. Therefore, impacts on existing groundwater supplies would be less than significant, and no mitigation is required.

Operations and Maintenance

As mentioned above, the proposed project elements would not require the use of groundwater, and project operations and maintenance are not expected to result in substantial changes in impervious surfaces which would affect groundwater supply and recharge. The proposed project's activities that would involve some development of impervious surfaces include:

- Soil nail wall construction,
- Reinforced concrete wall construction,
- Sheet pile wall construction, and
- Rock slope protection.

However, the increase in impervious area as a result of construction of these facilities would not significantly impact groundwater supply or recharge given that stormwaters would still percolate into the creek bed. Maintenance would include removing debris from channels, and post-project maintenance would be similar to existing maintenance. Post-construction restoration would consist of removing invasive plant species, inspecting newly planted vegetation, and replanting as needed, which may require initial watering for plant establishment. However, this is not anticipated to require a large amount of water that would impact groundwater resources. Following plant establishment, no long-term watering would be required. Therefore, impacts on groundwater as a result of these proposed project elements are not expected to be significant. No mitigation is required.

Floodwalls Alternative

Construction

None of the Floodwalls Alternative elements would require the use of groundwater or deviate substantially from the construction activities required for the proposed project. Therefore, construction related impacts on groundwater supply and recharge would be the same as those described above for the proposed project. Impacts would be less than significant and no mitigation is required.

Operations and Maintenance

Similar to the Channel Widening Alternative, operations and maintenance are not expected to result in substantial changes in impervious surfaces that would affect groundwater supply and recharge. The Floodwalls Alternative activities that would involve development of impervious surfaces would include installation of approximately 7,260 linear feet of floodwalls from south of the Pope-Chaucer Street Bridge to U.S. 101. However, as with the Channel Widening Alternative, the increase in impervious area, would not significantly impact groundwater supply or recharge given that stormwaters would still percolate into the creek bed. Therefore, impacts on groundwater as a result of these The Floodwalls Alternative elements are not expected to be significant. No mitigation is required.

Operations and maintenance for The Floodwalls Alternative operations activities would involve visual inspections for any damaged concrete, exposed reinforcing bar, or undermining. If damaged or deteriorating conditions are identified, repairs would be conducted per American Concrete Institute Bulletins. These maintenance activities would not result in a change in impervious cover and would not result in related impacts on groundwater supply and recharge. Impacts would be less than significant and no mitigation is required.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Similar to other project alternatives, no element of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would require the use of groundwater. As mentioned above, the Former Nursery Detention Basin Alternative detention basin would cover approximately 12.4 acres and be approximately 14 feet deep, while the Former Nursery Detention Basin Alternative basin would cover approximately 27.4 acres and be approximately 13 feet deep. Thus, construction of either detention basin would lower the existing ground surface and would likely require localized groundwater dewatering activities. However, as with other project alternatives, dewatering is not anticipated to significantly affect groundwater resources because the required excavations would intersect only the shallow water table; dewatering would temporarily remove groundwater with only localized and inconsequential effects to the regional groundwater system. Dewatering could result in short-term, localized alterations in groundwater levels near the surface in the immediate vicinity of the construction site, but this reduction would not cause a widespread, regional drawdown. Changes to groundwater occurrence and levels due to construction and operations and maintenance of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative, if groundwater levels are affected at all, would not detrimentally affect regional groundwater production or change the existing water quality. The San Francisco Bay Regional Water Board has regulations specific to dewatering activities that involve reporting and monitoring requirements. There would be no long-term impact related to increased groundwater use or reduction of supply. Impacts on existing groundwater supplies would be less than significant, and no mitigation is required.

Operations and Maintenance

As mentioned above, the detention basins would be unlined, and, thus, it is expected that groundwater supply and recharge in the shallow aquifer could increase as a result of the detention basin. However, inundation would vary based on the size of rain event. For smaller storms, the detention basin could empty within a couple days, while larger storm events would result in longer retention times and increased percolation into the groundwater. Overall, groundwater impacts associated with operation of the detention basin are expected to be less than significant.

Regular operations and maintenance activities could include but not be limited to visual inspections, sediment removal, trash pick-up and disposal, as well as vegetation maintenance and removal. These maintenance activities would have a limited potential for groundwater impacts. The maintenance activities would result in maintaining the detention basin flood protection capacity, which could help promote incidental groundwater recharge during storm events. These activities are not anticipated to result in less than significant groundwater impacts.

Impact HWR-3—Degrade water quality

Summary by Project Element: Impact HWR-3—Degrade water quality		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant	Less than Significant with Mitigation
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative

Construction

Activities required to construct all project elements would have the potential to contribute to erosion and subsequent increased input of fine sediments into the creek, potentially resulting in degraded water quality. The creek is currently listed on the State Water Board 303d list as impaired for sediment/sedimentation. As such, construction activities could further impair the creek with potential discharges of this pollutant. Additionally, hazardous materials such as gasoline, oils, grease, and lubricants from construction equipment could be released accidentally during construction. Accidental discharge of these materials to the creek could adversely affect water quality, endanger aquatic life, or result in violation of water quality standards or waste discharge requirements. The proposed project would result in land disturbance of greater than 1 acre of land, and would be required to prepare a SWPPP as part of compliance with the Construction General Permit. The SWPPP would include provisions to control erosion and sedimentation, as well as a Spill Prevention, Control, and Countermeasure Plan to avoid and, if necessary, clean up accidental releases of hazardous materials (see Section 3.7, *Hazardous Materials and Public Health*). The environmental commitments listed in Chapter 2, and specifically the Water Quality Protection Measures require the proposed project to sample and test stormwater discharges from the site for turbidity.

In addition, as part of the local MS4permit, overseen by the San Francisco Bay Regional Water Board, all construction sites are required to have site-specific, and seasonally and phase-appropriate, sediment and erosion control BMPs (San Francisco Bay Regional Water Quality Control Board 2015). The Santa Clara and San Mateo Countywide Water Pollution Prevention Programs include a construction site inspection and control program at all construction sites to prevent construction site discharges of pollutants and impacts on beneficial uses of receiving waters (San Francisco Bay Regional Water Quality Control Board 2015). SFCJPA would be responsible for ensuring compliance with these stormwater requirements and programs. The project specifications and Construction General Permit requires that the project construction contractor employ a Qualified SWPPP Practitioner to implement and document the pollution prevention measures outlined in the SWPPP prepared for the project. With the SWPPP and associated Water Quality Protection Measures in place, impacts related to degradation of water quality during construction are expected to be less than significant, and no mitigation is required.

Operations and Maintenance

Post construction, the project has the potential to result in increased flow velocities at the 11 locations within Reach 2 that would not receive channel improvements and will be monitored for signs of erosion. As such, the project has the potential for increasing erosion rates at these sites, which could exacerbate the creek's impairment for sediment/sedimentation, thereby further degrading water quality. Table 3.8-5 provides a comparison of estimated existing and proposed velocities at the 12 erosion monitoring sites.

As shown in Table 3.8-5, all locations would experience an increase in velocity with the exception of Site 12, which is anticipated to experience a decrease in velocity of approximately 0.26 foot per second. Also, Sites 1, 10 and 12 are anticipated to see an increase in velocity of over 1 foot per second. In order to determine erosion impacts to the bank more accurately, a preliminary velocity impacts analysis was prepared by Valley Water to determine if velocity increases would be on the banks, which would result in bank erosion impacts, or if they would be in the channel, which would result in sediment transport impacts. The purpose of the preliminary velocity impacts analysis was to determine if velocity increases would be on the banks, which would result in bank erosion impacts, or if they would be in the channel, which would result in sediment transport impacts. The preliminary velocity impacts analysis identified the channels permissible velocities based on the study area soil types. The velocity in both the existing and proposed project conditions exceed the values, which indicates a potential for erosion that is confirmed through existing erosion conditions. The preliminary velocity impacts analysis found that increases would be approximately the same in the channel and on the banks, between 0 and 20%, or about 1 foot per second. However, this does not necessarily result in increased erosion beyond existing erosion rates. The preliminary velocity impacts analysis determined that these velocity increase impacts would not occur until flows reach approximately 5,800 cfs, which is about a 4% chance (25-year) storm event and has historically been surpassed only once since records began in the 1930s (in 1998); however, several storms have gotten close to 5,800 cfs. For flows below 5,800 cfs, the anticipated velocity at these sites would remain the same or decrease as a result of construction of the proposed project and would not result in an increased potential for erosion and sedimentation. Because the chances of high flows that could exacerbate existing erosion conditions in these locations are relatively small, the potential for the project to exacerbate erosion conditions at these 12 sites is considered minimal. However, because the creek is currently impaired for sediment/sedimentation, the addition of sediment as a result of exacerbated erosion from the proposed project's increased velocities could be considered a significant water quality impact depending on the severity of erosion. Therefore, with implementation of Mitigation Measure (MM-) HWR-1, which would require preparation of an Adaptive Management Plan to monitor creek flows for signs of increased erosion at these 12 sites and identify and implement additional erosion control as needed, these effects would be minimized and reduced to less than significant. This adaptive management approach provides a framework for understanding the cause-and-effect linkages between project components and the erosion response of the system. The Adaptive Management Plan would identify management triggers that indicate when erosion control responses are required. Ongoing monitoring would determine the effectiveness of the adaptive management actions.

Operations and maintenance would be similar to existing maintenance activities and would include activities such as removing debris from the channel, which could occur during any flood season, and more intensive post-flood clean-up that would be needed only after major flood events. Additionally, monitoring and maintenance of new vegetation would occur, at a minimum, for 3 years following completion of the project. This activity would consist of invasive plant removal, inspection of newly planted vegetation, and replanting as needed, which could also result in mobilization of sediments.

Ongoing maintenance activities would have some potential to degrade water quality through mechanisms very similar to those discussed for construction—sediment mobilization, inadvertent spills, and releases of fuels and lubricants, and others. Potential spills and leaks occur infrequently and would be addressed using spill kits provided in maintenance vehicles. As necessary, pesticides would be applied in compliance with California Department of Pesticide Regulation requirements to minimize impacts on water quality. Creekside parks would also require trash pick-up and disposal as well as routine maintenance of benches and landscaping. These activities would remove potential materials that would threaten water quality and result in a beneficial impact. However, as identified in Chapter 2 under the water quality protection environmental commitments and per Construction General Permit SWPPP requirements, the SFCJPA or responsible maintenance agencies would implement post-construction BMPs to protect water quality, and these BMPs would apply to all project maintenance activities. With these measures in place, operations and maintenance impacts on water quality are expected to be less than significant. No mitigation is required.

Under projected future conditions (20 years), Searsville Lake would have filled with sediment, and storm flow and sediment would overtop Searsville Dam. The amount of storm flow and the volume of sediment transported downstream would vary from year-to-year based on annual precipitation events. Under projected future conditions, sediment mobilized from the upper San Francisquito Creek watershed would no longer be deposited and retained behind Searsville Dam, but would overtop Searsville Dam and discharge into the creek. Because the creek is already impaired for sediment, this future condition could exacerbate the impairment. In addition, the increase in storm flows that are not attenuated by Searsville Lake could result in increased erosion at the 12 sites subject to erosion monitoring. However, because this is not considered an impact of the project, but rather the filling of Searsville Lake, no additional mitigation is required.

MM-HWR-1: Prepare an Adaptive Management Plan

SFCJPA will prepare an Adaptive Management Plan with respect to stream erosion and sedimentation within San Francisquito Creek at the five erosion monitoring sites within Reach 2. The Adaptive Management Plan will be developed based on field inspection/observations and quantitative monitoring/qualitative assessments. The objective of the Adaptive Management Plan will be to ensure that the improvements proposed as part of the project within the San Francisquito Creek are monitored in order to evaluate changes in erosion of the streambed and streambanks. This will include evaluating assessments of recorded stream data in order to evaluate the performance of the channel system, as well as identification and implementation of erosion control protection, as determined is needed in the Adaptive Management Plan. An adaptive approach to the monitoring program will be applied that fulfills the following purposes:

- Establish well-defined monitoring program to:
    - Identify trends of the creek within and downstream of the project.
    - Evaluate the response of the creek system to storm events over 5,800 cfs.
    - Assess long term streambed and streambank stability or instabilities.

- Monitor impacts on applicable public and private structures within the creek system.

The monitoring program will include, at a minimum, (1) a list of the sites to be monitored; (2) methods for monitoring each site, including monitoring frequency and the location of monitoring stations; and (3) an explicit timetable for the monitoring program including data collection, data analysis, and reporting of results

- Application of qualitative and quantitative geomorphic and engineering techniques for evaluation of collected data.
- Identification of an action plan to implement interim and long-term erosion control measures for erosion sites that are exacerbated as a result of construction of the proposed project.
- Ongoing monitoring to determine the effectiveness of the Adaptive Management Plan.

The Adaptive Management Plan will be reviewed and approved by the SFCJPA prior to the start of construction activities. The Adaptive Management Plan will be implemented following construction of the proposed project and shall continue until long-term bank stability is achieved.

Floodwalls Alternative

Construction

Similar to the Channel Widening Alternative, activities required to construct all Floodwalls Alternative elements would have the potential to contribute to erosion and subsequent increased input of fine sediments into the creek, potentially resulting in degraded water quality. Additionally, hazardous materials such as gasoline, oils, grease, and lubricants from construction equipment could be released accidentally during construction. Construction materials such as concrete from the floodwall could be accidentally discharged into the creek. Accidental discharge of these materials to the creek could adversely affect water quality, endanger aquatic life, or result in violation of water quality standards or waste discharge requirements. However, because this alternative would require land disturbance of greater than 1 acre of land, a SWPPP would be required under the Construction General Permit. The SWPPP would include provisions to control erosion and sedimentation, as well as a Spill Prevention, Control, and Countermeasure Plan to avoid and, if necessary, clean up accidental releases of hazardous materials (see Section 3.7).

In addition, as part of the local municipal permits, required under the NPDES permit for the discharge of stormwater runoff from the MS4s overseen by the San Francisco Bay Regional Water Board, all construction sites are required to have site specific, and seasonally and phase-appropriate, effective BMPs (San Francisco Bay Regional Water Quality Control Board 2015). The Santa Clara and San Mateo Countywide Water Pollution Prevention Programs include a construction site inspection and control program at all construction sites to prevent construction site discharges of pollutants and impacts on beneficial uses of receiving waters (San Francisco Bay Regional Water Quality Control Board 2015). SFCJPA would be responsible for ensuring compliance with these stormwater requirements and programs. The project specifications and Construction General Permit require that the project construction contractor employ a Qualified SWPPP Practitioner to implement and document the pollution prevention measures outlined in the SWPPP prepared for the project. With the SWPPP and associated measures in place, impacts related to degradation of water quality during construction are expected to be less than significant, and no mitigation is required.

Operations and Maintenance

Similar to the Channel Widening Alternative, the unimproved erosion areas downstream of Pope-Chaucer Street would experience an increase in velocity and could result in increased erosion beyond existing erosion rates. Also, because the chances of high flows that could exacerbate existing erosion conditions in these locations are relatively small, the potential for the project to exacerbate erosion conditions at these 12 sites is considered minimal. However, because the creek is currently impaired for sediment/sedimentation, the addition of sediment as a result of exacerbated erosion from the project's increased velocities could be considered a significant water quality impact depending on the severity of erosion. Therefore, with implementation of MM-HWR-1, which would require preparation of an Adaptive Management Plan to monitor creek flows for signs of increased erosion at these 12 sites and identify and implement additional erosion control as needed, these effects would be minimized and reduced to less than significant.

Ongoing maintenance activities would have some potential to degrade water quality through mechanisms very similar to those discussed for construction—sediment mobilization, inadvertent spills, and releases of fuels and lubricants, and others. In addition, pesticides could be used to prevent the growth of vegetation in and around floodwalls. Potential spills and leaks occur infrequently and would be addressed using spill kits provided in maintenance vehicles. Pesticides would be applied in compliance with California Department of Pesticide Regulation requirements to minimize impacts on water quality.

The Floodwalls Alternative operations and maintenance activities would involve visual inspections for any damaged concrete, exposed reinforcing bar, or undermining. If damaged or deteriorating conditions are identified, repairs would be conducted per American Concrete Institute Bulletins. As discussed above for the proposed project, these maintenance activities could result in the potential for discharge of materials that could threaten water quality. However, as identified in Chapter 2 under the environmental commitments, the SFCJPA or responsible maintenance agencies would implement water quality protection measures. With these measures in place, operations and maintenance impacts on water quality are expected to be less than significant.

Under projected future conditions (20 years), Searsville Lake would have filled with sediment, and storm flow and sediment would overtop Searsville Dam. The amount of storm flow and the volume of sediment transported downstream would vary from year-to-year based on annual precipitation events. Under projected future conditions, sediment mobilized from the upper San Francisquito creek watershed would no longer be deposited and retained behind Searsville Dam, but would overtop Searsville Dam and discharge into the creek. Because the creek is already impaired for sediment, this future condition could exacerbate the impairment. In addition, the increase in storm flows that are not attenuated by Searsville Lake could result in increased erosion at the 12 sites subject to erosion monitoring. However, because this is not considered an impact of the project, but rather the filling of Searsville Lake, no additional mitigation is required. With implementation of MM-HWR-1, which would require preparation of an Adaptive Management Plan to monitor creek flows for signs of increased erosion at these 12 sites and identify and implement additional erosion control as needed, these effects would be minimized and reduced to less than significant levels.

Former Nursery Detention Basin Alternative

Construction

Construction activities would have the potential to contribute to erosion and subsequent increased input of fine sediments into the creek, potentially resulting in degraded water quality. Additionally, hazardous materials such as gasoline, oils, grease, and lubricants from construction equipment could be released accidentally during construction. Accidental discharge of these materials to the creek could adversely affect water quality, endanger aquatic life, or result in violation of water quality standards. However, because this alternative would require land disturbance of greater than 1 acre of land, a SWPPP would be required under the Construction General Permit. The SWPPP would include provisions to control erosion and sedimentation, as well as a Spill Prevention, Control, and Countermeasure Plan to avoid and, if necessary, clean up accidental releases of hazardous materials (see Section 3.7).

The Santa Clara and San Mateo Countywide Water Pollution Prevention Programs include a construction site inspection and control program at all construction sites to prevent construction site discharges of pollutants and impacts on beneficial uses of receiving waters (San Francisco Bay Regional Water Quality Control Board 2015). SFCJPA would be responsible for ensuring compliance with these program requirements. SFCJPA would be responsible for ensuring compliance with stormwater requirements and programs. The project specifications and Construction General Permit requires that the project construction contractor employ a Qualified SWPPP Practitioner to implement and document the pollution prevention measures outlined in the SWPPP prepared for the project. With the SWPPP and associated measures in place, impacts related to degradation of water quality during construction are expected to be less than significant, and no mitigation is required.

Operations and Maintenance

The proposed detention basin site is currently open, undeveloped land of a former tree and plant nursery site on Stanford University property located near Stanford's closed Primate Research Center. The proposed detention basin is not expected to increase contamination to groundwater as a result of flow attenuation. The floodwaters from the creek are not anticipated to include large quantities of pollutants that would impair the groundwater basin.

Ongoing maintenance activities would have minor potential to degrade water quality.

Operations and maintenance activities could include but not be limited to visual inspections, sediment removal, trash pick-up and disposal, as well as vegetation maintenance and removal. These activities would remove potential materials that would threaten water quality and result in a beneficial impact. However, as identified in Chapter 2 under the water quality protection environmental commitments and per SWPPP requirements, the SFCJPA or responsible maintenance agencies would implement water quality protection measures that would apply to all project maintenance activities. With these measures in place, operations and maintenance impacts on water quality are expected to be less than significant. No mitigation is required.

Under projected future conditions (20 years), Searsville Lake would have filled with sediment, and storm flow and sediment would overtop Searsville Dam. The amount of storm flow and the volume of sediment transported downstream would vary from year-to-year based on annual precipitation events. Under projected future conditions, sediment mobilized from the upper San Francisquito creek watershed would no longer be deposited and retained behind Searsville Dam, but would overtop Searsville Dam and discharge into the creek. Because the creek is already impaired for sediment, this future condition could exacerbate the impairment. In addition, the increase in storm flows that are not attenuated by Searsville Lake and the Former Nursery Detention Basin Alternative could result in increased erosion at the 12 sites subject to erosion monitoring. However, because this is not considered an impact of the project, but rather the filling of Searsville Lake, no additional mitigation is required.

Webb Ranch Detention Basin Alternative

Construction

As described for the Former Nursery Detention Basin Alternative, construction activities would have the potential to contribute to erosion and subsequent increased input of fine sediments into the creek, potentially resulting in degraded water quality. Impacts on surface water quality would be similar to those described above for the Former Nursery Detention Basin Alternative, and impacts are expected to be less than significant, with no mitigation required.

Operations and Maintenance

The proposed detention basin site is currently used as agricultural lands known as Webb Ranch. The Webb Ranch detention site consists of a U-Pick field and associated parking area with San Francisquito Road running through the central portion and San Francisquito Creek to the north. It is unknown if pollutants associated with agricultural land uses, such as fertilizers and pesticides, have built up in the soil that could percolate into the groundwater during use of the basin. However, as part of basin construction, there would be a cut of approximately 1,040,000 cy of material removed off site. As such, top soil contaminates would be removed as part of the basin construction. The proposed detention basin would not increase pollutant discharges to groundwater.

As with the Former Nursery Detention Basin Alternative, ongoing maintenance activities would have some potential to degrade water quality through mechanisms very similar to those discussed for construction—sediment mobilization. Regular operations and maintenance activities could include but not be limited to visual inspections, sediment removal, trash pick-up and disposal, as well as vegetation maintenance and removal. These activities would remove potential materials that would threaten water quality and result in a beneficial impact. However, as identified in Chapter 2 under the environmental commitments, the SFCJPA or responsible maintenance agencies would implement water quality protection measures, and these BMPs would apply to all project maintenance activities. With these water quality protection measures in place, operations and maintenance impacts on water quality are expected to be less than significant. No mitigation is required.

Under projected future conditions (20 years), Searsville Lake would have filled with sediment, and storm flow and sediment would overtop Searsville Dam. The amount of storm flow and the volume of sediment transported downstream would vary from year-to-year based on annual precipitation events. Under projected future conditions, sediment mobilized from the upper San Francisquito Creek watershed would no longer be deposited and retained behind Searsville Dam, but would overtop Searsville Dam and discharge into the creek. Because the creek is already impaired for sediment, this future condition could exacerbate the impairment. In addition, the increase in storm flows that are not attenuated by Searsville Lake and the Webb Ranch Detention Basin Alternative could result in increased erosion at the 12 sites subject to erosion monitoring. However, because this is not considered an impact of the project, but rather the filling of Searsville Lake, no additional mitigation is required.

Impact HWR-4—Affect designated beneficial uses

Summary by Project Element: Impact HWR-4—Affect designated beneficial uses		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative

Construction

The proposed flood protection improvements are intended to improve flood safety and surface hydrologic function in the San Francisquito Creek and would not physically impede the abilities of these water bodies or downstream waters (South San Francisco Bay and Santa Clara Valley groundwater) to satisfy their designated beneficial uses.

As shown in Table 3.8-4, the beneficial uses of Cold Freshwater Habitat, Fish Migration, Fish Spawning, Preservation of Rare and Endangered Species, Warm Freshwater Habitat, and Wildlife Habitat, as well as the potential beneficial uses of Water Contact Recreation and Noncontact Water Recreation, have been identified for the creek. All of these uses could be affected by degradation of water quality. As discussed under Impact HWR-3 and in Section 3.3, *Biological Resources*, however, construction- and maintenance-related impacts on water quality would be controlled to a less-than-significant level by implementation of sediment and erosion control BMPs in compliance with the Construction General Permit and implementation of an Adaptive Management Plan for the 12 erosion monitoring sites (MM-HWR-1). The Santa Clara and San Mateo Countywide Water Pollution Prevention Programs include a construction site inspection and control program at all construction sites to prevent construction site discharges of pollutants and impacts on beneficial uses of receiving waters (San Francisco Bay Regional Water Quality Control Board 2015). SFCJPA would be responsible for ensuring compliance with these program requirements. Project activities are therefore not expected to result in water quality degradation affecting beneficial uses for the creek, or downstream waters.

The project is also considered unlikely to result in significant increases in water temperature in the creek. Trees removed for construction of the Channel Widening Alternative would be replaced as required by local ordinances, mitigation for impacts on riparian habitat, and the terms and conditions of project permits (see Section 3.3). Existing riparian vegetation in the project area is limited. Particularly given the influence of regular tidal influx of bay water on ambient water temperatures, the loss of riparian vegetation is not anticipated to impact water temperatures. No mitigation is required.

Operations and Maintenance

Project operation is not expected to affect water temperatures in a manner that would significantly degrade Cold Freshwater Habitat values. As discussed in Section 3.12, *Recreation*, project construction would result in temporary reduction in recreational access to some parts of the creek corridor with established recreational uses, but uses would be restored following construction. In addition, implementation of the Channel Widening Alternative would result in the construction of two additional creekside parks and connections to existing trails where possible. Therefore, there would be no long-term impedance of Non Water Contact Recreational Uses, and impacts would be less than significant. Impacts on wildlife habitat values, including fisheries uses, are discussed in detail in Section 3.3 and are similarly expected to be less than significant with incorporation of the biological resources mitigation measures. The Channel Widening Alternative would include habitat restoration that would focus on reducing water velocities and creating a high-water-velocity refuge for steelhead to migrate through within Reach 2. This would be achieved by adding hydraulic control structures such as J-weirs, root wads, boulders, and/or other features at the toe of newly constructed bank walls. Therefore, there would be a positive effect on the beneficial uses for Fish Migration, Fish Spawning, Preservation of Rare and Endangered Species, and Wildlife Habitat. Overall, impacts on beneficial uses in the creek are expected to be less than significant, and additional benefits would occur with the construction of the proposed habitation restoration and creekside parks and connections to existing trails. No additional mitigation is required.

No impacts are associated with the designated beneficial uses for the South San Francisco Bay. The project would not modify, use, or replenish these waters directly and therefore could only affect their beneficial uses indirectly, via the quality of flows entering the Bay from the creek and of recharge waters entering the aquifer through pervious creek bed materials.

Potential dewatering of groundwater aquifers for channel widening and replacement of the Pope-Chaucer Street Bridge would not have long-term impacts on the beneficial uses of the Santa Clara Valley Groundwater. Dewatering activities would be temporary and localized, and would only affect shallow groundwater; and groundwater would ultimately be recharged by infiltration of water from streams, percolation of precipitation, and landscape irrigation.

Floodwalls Alternative

Construction

As with the Channel Widening Alternative, flood protection improvements proposed under the Floodwalls Alternative are intended to improve flood safety and surface hydrologic function in the San Francisquito Creek and would not physically impede the abilities of these water bodies or downstream waters (South San Francisco Bay and Santa Clara Valley groundwater) to satisfy their designated beneficial uses. Therefore, construction-related impacts on designated beneficial uses would be the same as those described for the Channel Widening Alternative. Impacts would be less than significant, and no mitigation is required.

Operations and Maintenance

Operations and maintenance activities would be similar to those required for the Channel Widening Alternative and are not expected to affect water temperatures in a manner that would significantly degrade Cold Freshwater Habitat values. Similarly, the Floodwalls Alternative would include habitat restoration that would focus on reducing water velocities and creating a high-water-velocity refuge for steelhead to migrate through within Reach 2. Therefore, there would be a positive effect on the beneficial uses for Fish Migration, Fish Spawning, Preservation of Rare and Endangered Species, and Wildlife Habitat. Consequently, operations and maintenance–related impacts on designated beneficial uses would be the same as those described for the Channel Widening Alternative. Impacts would be less than significant, and no mitigation is required.

Detention Alternatives Reach 3, Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

Similar to the Reach 2 alternatives, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative flood protection improvements are intended to improve flood safety and surface hydrologic function in the San Francisquito Creek and would not physically impede the abilities of these water bodies or downstream waters (South San Francisco Bay and Santa Clara Valley groundwater) to satisfy their designated beneficial uses. As shown in Table 3.8-4, the beneficial uses of Cold Freshwater Habitat, Fish Migration, Fish Spawning, Preservation of Rare and Endangered Species, Fish Spawning, Warm Freshwater Habitat, and Wildlife Habitat, as well as the potential beneficial uses of Water Contact Recreation and Noncontact Water Recreation, have been identified for the creek. All of these uses could be affected by degradation of water quality. As discussed under Impact HWR-3 and in Section 3.3, *Biological Resources*, however, construction- and maintenance-related impacts on water quality would be controlled to a less-than-significant level by sediment and erosion control BMPs. The Santa Clara and San Mateo Countywide Water Pollution Prevention Programs include a construction site inspection and control program at all construction sites to prevent construction site discharges of pollutants and impacts on beneficial uses of receiving waters (San Francisco Bay Regional Water Quality Control Board 2015). SFCJPA would be responsible for ensuring compliance with these program requirements. Project activities are therefore not expected to result in water quality degradation affecting beneficial uses for the creek or downstream waters. Thus, impacts would be less than significant.

Potential dewatering of groundwater aquifers for detention basin construction would not have long-term impacts on the beneficial uses of the Santa Clara Valley groundwater (Municipal and Domestic Supply, Industrial Process Supply, Industrial Service Supply, Agricultural Supply). Dewatering activities would be temporary and localized, and would only affect shallow groundwater. Groundwater would ultimately be recharged by infiltration of water from operation of the detention basin, water from the creek itself, from other streams, and percolation of precipitation and landscape irrigation. As with the other alternatives, because the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are not expected to affect water quality significantly, impacts on downstream beneficial uses are also expected to be less than significant, and no mitigation is required.

These alternatives are also considered unlikely to result in significant increases in water temperature in the creek. Any trees that must be removed for construction of the alternatives would be replaced as required by local ordinances, mitigation for impacts on riparian habitat, and the terms and conditions of project permits (see Section 3.3). Moreover, events large enough to bring the detention basin into use would be infrequent (and thus, not affect baseline conditions in the creek) and would also be expected to occur during the cooler parts of the year. These impacts would be less than significant, and no mitigation is required.

Operations and Maintenance

Similar to the Reach 2 alternatives, operations and maintenance of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are not expected to affect water temperatures in a manner that would significantly degrade Cold Freshwater Habitat values. In addition, these alternatives would not result in temporary reduction in public access to the creek. Therefore, there would be no impedance of Non Water Contact Recreational Uses, and impacts would be less than significant. A fish screen would be installed to prevent fish stranding using National Marine Fisheries Service guidelines. Impacts on wildlife habitat values, including fisheries uses, are discussed in detail in Section 3.3 and are similarly expected to be less than significant with incorporation of mitigation measures identified in Section 3.3. Overall, impacts on beneficial uses in the creek are expected to be less than significant and would possibly have a beneficial effect with flows attenuated for high flow storm events. No additional mitigation is required.

No impacts are associated with the designated beneficial uses for the South San Francisco Bay, Ocean, Commercial, and Sport Fishing, Estuarine Habitat, Industrial Service Supply, Fish Migration, Navigation, Preservation of Rare and Endangered Species, Water Contact Recreation, Non-water Contact Recreation, Shell Fish Harvesting, Fish Spawning, and Wildlife Habitat. Similar to the other alternatives, these alternatives would not modify, use, or replenish these waters directly and therefore could only affect their beneficial uses indirectly, via the quality of flows entering the Bay from the creek and of recharge waters entering the aquifer through pervious creek bed materials. No additional mitigation is required.

3.8.4 Cumulative Impacts

The cumulative study areas include San Francisquito Creek, which has the potential to be affected by construction of past, present, and future neighboring projects. Neighboring projects include, but are not limited to, the San Francisquito Creek Flood Reduction, Ecosystem Restoration, and Recreation Project; Newell Road Bridge Replacement Project; and Stanford University Searsville Dam and Reservoir. SFCJPA approved the San Francisquito Creek Flood Reduction, Ecosystem Restoration, and Recreation Project from San Francisco Bay to Highway 101 in 2012. That project, which was constructed in 2018, increased the conveyance and retention capacity of floodwaters from runoff and San Francisco Bay tides to protect residents and property from flood events along the lower section of the creek, from East Bayshore Road to the San Francisco Bay. Components included opening the creek channel to flow in to the Baylands Preserve, reconfiguring levees, creating a marsh plain terrace to convey high flows, and installing floodwalls; widening of the creek channel; and constructing access roads for maintenance purposes. In addition, California Department of Transportation (Caltrans), in cooperation with the City of Palo Alto, approved the Newell Road Bridge Replacement Project, which would replace the bridge over San Francisquito Creek and provide additional flood capacity at this crossing. Both of these projects served to increase flood protection capacity from Newell Road to the Bay.

As described in Chapter 2, *Program Description*, Stanford University has extensively studied a proposed project for its Searsville Dam and Reservoir that could provide substantial flood protection for communities downstream. The university has conducted detailed hydraulic and sediment analyses and has discussed with environmental regulatory agencies and the SFCJPA a project whereby the university would create an opening at the base of Searsville Dam and excavate a channel through the reservoir basin to enable fish passage under most flow conditions. Very high flows that exceed the capacity of the new opening would back up behind the dam, thereby providing temporary detention. When these projects are combined with the Preferred Alternative, the flood capacity of San Francisquito Creek would be enhanced compared to existing conditions, resulting in a net positive effect for flood flow conveyance in the creek. Because the Preferred Alternative involves improvements to creek flow capacity, the proposed project would not have adverse effects on hydrology in the project area and therefore would not contribute to cumulative flood impacts when combined with other recent flood improvement projects.

Construction and operation of the related projects, and other cumulative growth and development, could result in the release of sediments or other pollutants in the local stormwater system and into the creek, adversely affecting water quality. Construction and operation of the Preferred Alternative could also generate and release sediment from erosion contributing to cumulative adverse water quality effects. However, all construction projects disturbing more than 1 acre, which includes the Preferred Alternative, would be required to comply with NPDES Construction General Permit requirements and prepare a SWPPP to minimize water quality impacts during construction. Related projects would need to comply with the NPDES Construction General Permit (for projects disturbing more than 1 acre) and implement construction BMPs during the construction phase. These measures would prevent a cumulative adverse water quality impact during construction.

The Preferred Alternative could result in an increase in erosion in areas currently subject to existing erosion in the creek during large storm events, as identified in Table 3.8-5. San Francisquito Creek is listed as impaired for sediment/sedimentation, which could exacerbate an existing 303d list impairment. However, as discussed above for the Preferred Alternative, the potential for large storm events to exacerbate erosion is considered low. And with implementation of MM-HWR-1, which would require preparation of an Adaptive Management Plan to monitor creek flows for signs of increased erosion at the existing erosion sites and identify and implement additional erosion control as needed, these effects would be minimized and reduced to less than significant. The Adaptive Management Plan would identify management triggers that indicate when erosion control responses are required. Given the implementation of the Adaptive Management Plan, the Preferred Alternative is not anticipated to contribute to an adverse cumulative impact.

The Stanford University Searsville Dam and Reservoir Project could release accumulated fine sediment trapped behind the dam to downstream into San Francisco Bay. This project could combine with the Preferred Alternative during large storm events to contribute to an overall increase in sediment discharged to San Francisquito Creek, further impairing the waterbody for sediment and sedimentation. The University may need to work with the SFCJPA to remove some sediment downstream after an initial flushing is complete to lessen the potential impact on the existing impairment, and continue to collaborate on long-term sediment management of the creek system. The sediment build up behind the dam is both fine and coarse. The fine sediment would likely flow to San Francisco Bay, nourishing salt marsh habitat and providing a net positive effect. However, the disposition of the coarse sediment, which stabilizes the marsh area upstream of the dam, must be managed differently to minimize the potential to reduce channel capacity. The Preferred Alternative would implement MM-HWR-1 in the areas subject to existing erosion and would include a monitoring plan for these areas. The plan would identify trends of the creek within and downstream of the project, which would also identify if sediment deposition is impacting the capacity and function of the channel in those areas. While MM-HWR-1 would not monitor effects of the Stanford University Searsville Dam and Reservoir Project, it would identify potential impacts associated with that cumulative project. However, because the Preferred Alternative would implement MM-HWR-1, the project's contribution to cumulative effects would be less than significant, and any potential impacts would be the result of the Stanford University Searsville Dam and Reservoir Project. In addition, the Stanford University Searsville Dam and Reservoir Project would undergo future CEQA review and would identify potential impacts from the project and further evaluate the potential for that project to exacerbate sedimentation within the creek and result in a cumulative impact. As such, the Preferred Alternative is not anticipated to contribute to an adverse cumulative water quality impact.

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3.9 Land Use and Planning and Agricultural Resources

This section analyzes the compatibility of the project with existing planning documents and regulations related to land use and planning and the project's impact on agricultural resources.

3.9.1 Regulatory Setting

Local

Lands at the project site are planned and managed according to the following general and master plans.

- *City of Palo Alto Comprehensive Plan 2030* (City of Palo Alto 2017)
- *Palo Alto Baylands Master Plan* (City of Palo Alto 2008)
- *Vista 2035 East Palo Alto General Plan* (City of East Palo Alto 2016)
- *City of Menlo Park General Plan* (City of Menlo Park 2016)

The housing element was adopted in 2014, Open Space/Conservation, Noise and Safety Elements were adopted in 2013. The project site is also within the Palo Alto Airport Influence Area (AIA), as defined by the *Palo Alto Airport Comprehensive Land Use Plan* (CLUP). Land uses within the AIA should be compatible with airport use.

Each city also has specific requirements regarding trees, as listed below:

- City of Palo Alto Regulated Trees Title 8, Palo Alto Municipal Code (Reference: https://www.cityofpaloalto.org/gov/depts/pwd/trees/dev/regulated.asp)
- City of East Palo Alto Tree Removal Municipal Code Chapter 18.28.40 (Reference: https://www.ci.east-palo-alto.ca.us/index.aspx?NID=625)
- City of Menlo Park Heritage Tree Ordinance (reference: https://menlopark.org/205/Heritage-tree-protections)

Any project must comply with applicable tree removal requirements.

General Plans

Land use and planning are the province of local governments in California. All cities and counties are required by the state to adopt a general plan establishing goals and policies for long-term development, protection from environmental hazards, and conservation of identified natural resources (California Government Code 65300). General plans lay out the pattern of future residential, commercial, industrial, agricultural, open-space, and recreational land uses within a community. To facilitate implementation of planned growth patterns, general plans typically also include goals and/or policies addressing the coordination of land use patterns with the development and maintenance of infrastructure facilities and utilities.

Government Code Section 65302 lists seven "elements" or chapters that cities and counties must include in their general plans: land use, circulation, housing, conservation, open space, noise, and safety. The land use element typically has the broadest scope of the mandatory general plan elements. This central element describes the desired distribution, location, and extent of the jurisdiction's land uses, which may include housing; business; industry; open space, including agriculture, natural resources, recreation, and enjoyment of scenic beauty; education, public buildings, and grounds; solid and liquid waste disposal facilities; and other public and private uses of land.

Local jurisdictions implement their general plans by adopting zoning, grading, and other ordinances. Zoning identifies the specific types of land uses that are allowed on a given site and establishes the standards that would be imposed on new development.

City of Palo Alto Comprehensive Plan 2030

The *Palo Alto Comprehensive Plan* contains the City's official policies on land use and community design, transportation, housing, natural environment, safety, business and economics, and community services. Its policies apply to both public and private properties, and its focus is on the physical form of the city.

Palo Alto is essentially a "built-out" community. Approximately 55 percent of the total land area includes existing and designated parks, open space preserves, and agricultural land conservation areas with controlled development regulations. A large portion of open space land is occupied by the Baylands Preserve, a 1,940-acre tract of undisturbed marshland (the largest remaining marshland in the San Francisco Bay).

The Comprehensive Plan strives to build a coherent vision of the City's future from the input of a diverse population. It integrates the aspirations of the City's residents, businesses, neighborhoods, and officials into a strategy for managing change. The Comprehensive Plan is the primary tool for guiding the future development of the City.

Land Use Designations

The *City of Palo Alto Comprehensive Plan* describes the following open space land use designations for land within the project site and immediately surrounding areas (City of Palo Alto 2017) (Map L-6).

Publicly Owned Conservation Land: Open lands whose primary purpose is the preservation and enhancement of the natural state of the land and its plants and animals. Only compatible resource management, recreation, and educational activities are allowed.

Public Park: Open lands whose primary purpose is public access for active recreation and whose character is essentially urban. These areas, which may have been planted with non-indigenous landscaping, may provide access to nature within the urban environment and require a concerted effort to maintain recreational facilities and landscaping.

Streamside Open Space: This designation is intended to preserve and enhance corridors of riparian vegetation along streams. Hiking, biking and riding trails may be developed in the streamside open space. The corridor will generally vary in width up to 200 feet on either side of the center line of the creek. However, along San Francisquito Creek between El Camino Real and the Sand Hill Road bridge over the creek, the open space corridor varies in width between approximately 80 and 310 feet from the center line of the creek.

Open Space/Controlled Development: Land having all the characteristics of open space but where some development may be allowed on private properties. Open space amenities must be retained in these areas. Residential densities range from 0.1 to 1 dwelling unit per acre but may rise to a maximum of 2 units per acre where second units are allowed, and population densities range from 1 to 4 persons per acre. Other uses such as agricultural, recreational and non-residential uses may be allowed consistent with the protection and preservation of the inherent open space characteristics of the land.

Goals and Policies

The *City of Palo Alto Comprehensive Plan* includes "goals, policies and programs that are the essence of the Plan and provide a framework to guide decisions on a wide range of issues." The plan includes a goal for "attractive and safe parks, civic and cultural facilities provided in all neighborhoods and maintained and used in ways that foster and enrich public life." Policies most applicable to the proposed project are presented in Table 3.9-1.

Table 3.9-1. City of Palo Alto Comprehensive Plan 2030 Policies Relevant to the Project

Land Use and Community Design	**L-9.6 –** Create, preserve and enhance parks and publicly accessible, shared outdoor gathering spaces within walking and biking distance of residential neighborhoods.
Natural Environment	**N-1.13 –** Evaluate and mitigate the construction impacts associated with park and recreational facility creation and expansion.
	N-3.1 – All creeks are valuable resources for natural habitats, connectivity, community design, and flood control, and need different conservation and enhancement strategies. Recognize the different characteristics along creeks in Palo Alto, including natural creek segments in the city's open space and rural areas, primarily west of Foothill Expressway; creek segments in developed areas that retain some natural characteristics; and creek segments that have been channelized. Pursue opportunities to enhance riparian setbacks along urban and rural creeks as properties are improved or redeveloped.
	N-3.2 – Prevent the further channelization and degradation of Palo Alto's creeks.
	N-3.4 – Recognize that riparian corridors are valued environmental resources whose integrity provides vital habitat for fish, birds, plants and other wildlife, and carefully monitor and preserve these corridors.
	N-3.5 – Preserve the ecological value of creek corridors by preserving native plants and replacing invasive, non-native plants with native plants.
	N-3.6 – Discourage bank instability, erosion, downstream sedimentation, and flooding by minimizing site disturbance and nearby native vegetation removal on or near creeks and by reviewing grading and drainage plans for development near creeks and elsewhere in their watersheds.
	N-3.7 – Avoid fencing, piping and channelization of creeks when flood control and public safety can be achieved through measures that preserve the natural environment and habitat of the creek.
	N-3.8 – Work with the SCWVD, San Francisquito Creek Joint Powers Authority (JPA) and other relevant regional and non-governmental agencies to enhance riparian corridors, provide compatible low-impact recreation and ensure adequate flood control.

Source: City of Palo Alto 2017.

City of Palo Alto Baylands Master Plan

The *City of Palo Alto Baylands Master Plan* policies generally encourage preservation and enhancement of the Baylands' environmental quality; guide recreation development so that it is least destructive to wildlife habitat; and limit development, vehicle parking areas, and aboveground utility lines. The Baylands Master Plan covers the areas east of U.S. 101, which includes Access Ramp 6 of Reach 1. Policies applicable to the proposed project are presented in Table 3.9-2.

Table 3.9-2. City of Palo Alto Baylands Master Plan Policies Relevant to the Project

Resource Area	Policies
Access and Circulation	Expand bicycle and pedestrian activities and reduce motorized vehicle traffic. Maintain, protect, and improve existing trails and paths, including expansion of continuous trails and access to the regional trail system. Implement bicycle circulation improvements described in the Palo Alto Bicycle Transportation Plan and the Palo Alto Comprehensive Plan, including improving pedestrian and bicycle access at San Francisquito Creek. Restrict recreational access to the flood basin.
Flood Protection	Coordinate flood protection with relevant jurisdictions. Mitigate new levee construction that intrudes on marsh or wetlands.
Baylands Athletic Center	Continue current activities. Maintain and improve night lighting standards to minimize glare.
Golf Course	Continue present use.
Airport	Airport activities should not increase the level of activity or intrusion into open space.
Private Lands	Ensure future development is consistent with the Palo Alto Comprehensive Plan.
Source: City of Palo Alto 2008.	

City of Palo Alto Airport Comprehensive Land Use Plan

The farthest downstream reach of the project site is located within the AIA of Palo Alto Airport. Airport safety zones have been established by the Palo Alto Airport CLUP in accordance with Federal Aviation Administration (FAA) requirements (Santa Clara County Airport Land Use Commission 2016) to minimize the number of people exposed to potential aircraft accidents by imposing density and land use limitations. According to the Palo Alto Airport CLUP, the farthest downstream reach, Access Ramps 5 and 6 and the instream staging and construction areas of the project site are located in the Traffic Pattern Zone (TPZ). The TPZ is a portion of the airport area routinely overflown by aircraft operating in the airport traffic pattern. The potential for aircraft accidents in this area is relatively low. The upstream portions of the project site generally west of U.S. 101 are the TPZ.

Vista 2035 East Palo Alto General Plan

The current *Vista 2035 East Palo Alto General Plan* was adopted in 2016. The General Plan includes a vision, guiding principles, and a list of the major strategies needed to achieve the vision.

The *Vista 2035 East Palo Alto General Plan* identifies areas of the city with distinct character and issues. The neighborhoods adjacent to the project site are the Willow, Woodland, and Gardens neighborhoods. The Willow and Woodland neighborhoods are located in the Westside Area Plan on the west side of U.S. 101 with San Francisquito Creek as their southwest boundary. The west side area is predominantly residential, accounting for 81 percent of the land area. Two of the guiding principles (10 and 14) are "…improving flood protection from San Francisquito Creek…" and improving…recreation opportunities along San Francisquito Creek."

The Gardens neighborhood is adjacent to the Baylands neighborhood, and is bounded by San Francisquito Creek to the east and U.S. 101 to the southwest. The eastern portion of the neighborhood is single-family residential and resource management, the resource management lands encompassing San Francisquito Creek, and the portion of the neighborhood that is in the Baylands.

Land Use Designations

The *Vista 2035 East Palo Alto General Plan* describes the following open space land use designations for land adjacent to the project site (City of East Palo Alto 2016).

Parks/Recreation/Conservation: Provides for public parks such as local, community and regional parks. Trails, community gardens, and other similar uses that provide open space resources to surrounding neighborhoods, communities and the region are permitted. Recreation facilities with an emphasis on outdoor use are also allowed.

Office: Provides for medium- and large-scale uses such as professional, legal, medical, financial, high-tech, and research and development uses. Other supporting uses such as restaurants, medical services, community facilities and similar uses which together create concentrations of office employment or community activity are also allowed.

Mixed Use Low. Provides for both additional housing needs in the City and to expand neighborhood-serving commercial uses, where appropriate. The designation allows buildings that are residential only, commercial only or a mix of the two.

Low Density Residential: Detached single-family dwellings at a density of up to 12 units per acre.

Medium/High Density Residential. Single-family and multi-family dwellings at a density of up to 43 units per acre.

Issues and Policies

The *Vista 2035 East Palo Alto General Plan* includes Goal POC-1 to create new parks and open spaces throughout the City and Goal POC-2 to improve and enhance existing parks and trails. Goal SN-2 of the Safety and Noise Element calls for the City to provide adequate flood control and storm drainage facilities to minimize the risk of flooding. Policies applicable to the proposed project are provided in Table 3.9-3.

Table 3.9-3. Vista 2030 East Palo General Plan Policies Relevant to the Project

Resource Area	Policies
Land Use and Urban Design	**9.3-Landscaping.** Require development projects to incorporate drought tolerant, native species landscaping in order to extend and enhance the green space network of the City.
Parks/Open Space and Conservation	**1.10-New Trails and Paths**. Construct new trails or multi-use paths, particularly along the San Francisquito Creek or in the Baylands. **4.7-Native Species**. Encourage or require the use of native and/or non-invasive plants in privately built landscaping or new open spaces near natural open space areas, in order to provide foraging, nesting, breeding and migratory habitat for wildlife. Discourage herbicides and fertilizers. **4.9-Riparian and Flood Buffer**. Do not allow new development within a 100-foot buffer zone from the top of the San Francisquito creek bank.

Resource Area	Policies
Safety	**2.7-San Francisquito Creek Joint Powers Authority (JPA)**. Continue to work with the JPA on projects that will reduce the risk of flooding in East Palo Alto.
Source: City of East Palo Alto 2016.	

City of Menlo Park General Plan

The *City of Menlo Park General Plan* Land Use Element was adopted in 2016 (City of Menlo Park 2016). San Francisquito Creek is an important natural feature for Menlo Park, and is the City's eastern border with Palo Alto within the project site**.** A majority of land in Menlo Park is designated for residential use (54.8 percent). Other major land use categories include Bayfront Innovation Area (14.5%), Parks and Recreation (9.9%), Commercial (7.2%), Public/Quasi Public (6.6%), Specific Plan Area (3.5%), Unclassified (3.4%) (City of Menlo Park 2016). Where San Francisquito Creek borders portions of Menlo Park, the land uses adjacent to the creek are primarily residential with a small area of commercial use. The neighborhood adjacent to the project site is the Willows neighborhood.

Issues and Policies

The *City of Menlo Park General Plan* Open Space/Conservation, Noise and Safety Element includes Goal OSC1 to maintain, protect, and enhance open space and natural resources. Policies applicable to the proposed project are presented in Table 3.9-4.

Table 3.9-4. City of Menlo Park General Plan Policies Relevant to the Project

Resource Area	Policies
Land Use	LU-6.7 Habitat Preservation. Collaborate with neighboring jurisdictions and enhance the Bay, shoreline, San Francisquito Creek, and other wildlife habitat and ecologically fragile areas to the maximum extent possible.
Open Space/ Conservation, Noise and Safety	**OSC1.4-Habitat Enhancement**. Require new development to minimize the disturbance of natural habitats and vegetation and requires revegetation of disturbed natural habitat areas with native or non-invasive naturalized species. **OSC1.5-Invasive, Non-Native Plant Species**. Avoid the use of invasive, non-native species, as identified on the lists of invasive plants maintained at the California Invasive Plant Inventory and United States Department of Agriculture invasive and noxious weeds database, or other authoritative sources, in landscaping on public property. **OSC1.7- San Francisquito Creek Joint Powers Authority**. Continue efforts through San Francisquito Creek Joint Powers Authority to enhance the value of the creek as a community amenity for trails and open space, conservation and educational opportunities.
Safety	**S1.25-Creeks and Drainage-ways.** Seek to retain San Francisquito and Atherton creeks/channels in their natural state in order to prevent undue erosion of creek banks. Protect creek-side habitat and provide maintenance access along creeks where appropriate. **S1.26-Erosion and Sediment Control**. Continue to require the use of best management practices for erosion and sediment control measures with proposed development in compliance with applicable regional regulations.
Source: City of Menlo Park 2013.	

San Mateo County General Plan

The *San Mateo County General Plan* was adopted in November 1986. The General Plan is currently being updated but is not anticipated to be adopted until 2020 or thereafter. The General Plan Land Use designation of Agriculture is defined as resource management and production uses including but not limited to agriculture and uses considered accessory and ancillary to agriculture. Policies applicable to the proposed project with regard to agricultural resources are presented below.

- **Policy 9.28 Encourage Existing and Potential Agricultural Activities** a. Encourage the continuance of existing agricultural and agriculturally-related activities. b. Encourage agricultural activities on soils with agricultural capability which are currently not in production. c. Consider agricultural land use designations for parcels which have existing agricultural activities or which contain soils with agricultural capability that are presently designated General Open Space, during future review of area plans. d. Consider open space designations for agricultural parcels that are no longer capable of agricultural activities during future reviews of area plans.
- **Policy 9.30 Development Standards to Minimize Land Use Conflicts With Agriculture** a. Avoid to the greatest extent possible locating non-agricultural activities on soils with agricultural capability or lands in agricultural production. Regulations should place priorities according to the relative productive characteristics of the resource. b. Locate non-agricultural activities in areas of agricultural parcels which cause the least disturbance to feasible agricultural activities. c. Buffer any non-agricultural activities from agricultural activities by means of distance, physical barriers or other non-disruptive methods. d. Ensure that any extension of public services and facilities to serve nonagricultural activities will not impair feasible agricultural activities.

3.9.2 Environmental Setting

Study Area

The land use and planning study area encompasses the project site and immediately adjacent lands in the cities of East Palo Alto, Menlo Park, and Palo Alto (reference Figures 2-3 through 2-8). The study area for agricultural resources encompasses the proposed detention basins and staging areas southwest of Interstate 280 in San Mateo County.

Existing Conditions

The project site is located within the cities of East Palo Alto, Menlo Park, and Palo Alto. The project site is bounded on the northeast by U.S. 101; to the north and northeast by Woodland Avenue; to the northwest by Willow Avenue and East Creek Drive; to the west and southwest by the Pope-Chaucer Bridge; and to the south by Palo Alto Avenue, several streets (Marlowe Street, Maple Street, Palm Street, Lincoln Avenue, and Crescent Drive) connecting to University Avenue, and Edgewood Drive.

In the San Francisquito Creek watershed, approximately 8,800 acres (32 percent) are protected by public agencies, property easements, or private land trusts, providing undeveloped, natural land within much of the watershed. The west side of the watershed is largely unpopulated, consisting primarily of forest and grasslands. The lower watershed, including Reach 2 of the project, is highly urbanized, and primarily supports residential and commercial development. However, large, contiguous areas of open space, including riparian areas of San Francisquito Creek, forest, rangeland, and agricultural areas, are interspersed throughout the urban land uses (USACE 2011).

The Reach 3 alternatives would occur upstream of Pope-Chaucer Bridge on Stanford University property (Figure 2-8) and include the Former Nursery Site detention basin and Webb Ranch Site detention basin. The Webb Ranch site is composed of row crops with San Francisquito Road running through the central portion and San Francisquito Creek to the north. The Former Nursery site is composed of undeveloped grassland with a few trees and San Francisquito Creek to the south. Ansel Lane runs through the central portion of the proposed detention basin.

San Francisquito Creek flows through the project site largely in its natural alignment where it forms the southern boundary of the cities of East Palo Alto and Menlo Park and the northern boundary of the City of Palo Alto. Riparian vegetation around San Francisquito Creek spans a 25- to 75-meter-wide space, depending on adjacent land use and topography. Land uses adjacent to San Francisquito Creek in the project area are predominantly residential or commercial. Residential neighborhoods include the Woodland and Willows (also known as the Westside) neighborhoods in East Palo Alto; the Crescent Park and Duveneck/St. Francis neighborhoods in Palo Alto; and the Willows neighborhood in Menlo Park. Nearby commercial or office land uses are located in the vicinity of the bridge at University Avenue (SCVJPA 2013).

The detention basins and staging areas for the detention basins are located in San Mateo County and have a General Plan Land Use designation of Institutional/Open Study/Future Study and zoning designation of Residential Estates District with the combining district of Residential Density District Number 11 (R-E/S-11) (San Mateo County 2018). The Webb Ranch Site detention basin is within the Webb Ranch and Farm property. A portion of the proposed Webb Ranch Site detention basin along San Francisquito Creek Road is a u-pick berry farm with an assortment of berries available to the public. The Former Nursery Site detention basin and staging areas are not under any kind of agricultural production. The detention basins and staging areas for the detention basins are not under Williamson act contract.

3.9.3 Impact Analysis

Methods and Significance Criteria

Impacts on land use and planning were analyzed based on general plans, planning maps, zoning ordinances, and local and regional plans including Santa Clara Valley Water District planning documents concerning use of and access to the San Francisquito Creek within the project site, and zoning maps for the cities of East Palo Alto, Menlo Park, and Palo Alto.

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would:

- Physically divide an established community.
- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect.
- Conflict with any applicable habitat conservation plan or natural community conservation plan.

- Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use.
- Conflict with existing zoning for agricultural use, or a Williamson Act contract.
- Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g)).
- Result in the loss of forest land or conversion of forest land to non-forest use.
- Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use.

Each impact discussion includes a summary table identifying the level of impact associated with the individual project elements, followed by text analysis.

Impacts and Mitigation Measures

Impact LU-1—Physically divide an established community

Summary by Project Element: Impact LU-1—Physically divide an established community		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	No Impact	No Impact
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	No Impact	No Impact

Channel Widening Alternative and Floodwalls Alternative

The proposed project would be implemented along the San Francisquito Creek corridor, which forms a natural boundary between the communities on either side, as well as providing common recreational space. The project would not change the boundaries of, or access between, communities. Replacement of the Pope-Chaucer Bridge would require temporary closure of the existing bridge; however, this would be temporary, lasting up to 9 months. The temporary closure of the bridge would not physically divide the communities of Palo Alto and Menlo Park as there would still be open crossings of the creek to the east and west. There would be no impact, and no mitigation is required. See also discussion of bridge closure under Traffic.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

No aspect of the construction and implementation of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would physically divide an established community. There would be no impact, and no mitigation is required.

Impact LU-2—Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect

Summary by Project Element: Impact LU-2—Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
All Project Elements and Alternatives	Less than Significant	No Impact

Construction

Construction activities for all project elements and alternatives would involve impacts that could be disruptive to local residents. However, any such potential impacts (e.g., noise or traffic) would be controlled through local code requirements and through resource-specific mitigation measures, as required under the California Environmental Quality Act (CEQA). Impacts under construction would be less than significant. No further mitigation is required.

Operations and Maintenance

Operations and maintenance for all project elements and alternatives would be compatible with the goals and policies in the general plans of East Palo Alto, Menlo Park, and Palo Alto as identified in *Regulatory Setting* above. The project would not conflict with any of the policies identified in Tables 3.9-1 through 3.9-4, but would rather implement many of these policies. For example, the project would prevent the further channelization and degradation of Palo Alto's creeks (*Palo Alto General Plan* Policy N-3.2); preserve the ecological value of creek corridors by preserving native plants and replacing invasive, non-native plants with native plants (*Palo Alto General Plan* Policy N-3.5); coordinate flood protection with relevant jurisdictions (*City of Palo Alto Baylands Master Plan*); continue coordination between East Palo Alto and San Francisquito Creek Joint Powers Authority on projects that will reduce the risk of flooding in East Palo Alto (*City of East Palo Alto General Plan* Policy 2.7); and continue efforts through San Francisquito Creek Joint Powers Authority to enhance the value of the creek as a community amenity for trails and open space, conservation and educational opportunities (*City of Menlo Park General Plan* Policy OSC1.7). There would be no impact, and no mitigation is required.

Impact LU-3—Conflict with any applicable habitat conservation plan or natural community conservation plan

Summary by Project Element: Impact LU-3— Conflict with any applicable habitat conservation plan or natural community conservation plan		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
All Project Elements and Alternatives	No Impact	No Impact

None of the project alternatives are within the study area/permit area covered by the *Santa Clara Valley Habitat Plan*, *Stanford Habitat Conservation*, or another habitat conservation plan or natural community conservation plan. There would be no impact, and no mitigation is required.

Impact AG-1— Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use

Summary by Project Element: Impact AG-1— Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	No Impact	No Impact
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	Less than Significant Impact	Less than Significant Impact

According to the Important Farmland map for San Mateo County prepared by the California Department of Conservation, the Channel Widening Alternative and Floodwalls Alternative are designated Urban and Built-Up Land (California Department of Conservation 2018). The Former Nursery Site detention basin and staging area is on land designated Grazing Land and Other Land (California Department of Conservation 2018). Therefore, there would be no impact for the Channel Widening Alternative, Floodwalls Alternative, and Former Nursery Detention Basin Alternative. The Webb Ranch Site detention basin is on land designated Prime Farmland and the staging areas to the northeast are designated Grazing Land (California Department of Conservation 2018). The loss of Prime Farmland associated with the construction and operation of the Webb Ranch Site detention basin would be significant impact. However, it is expected that the detention basin will still be usable for agriculture. While there may be some impact to agriculture during construction and when the basin is used to retain water, the impact is less than significant.

Impact AG-2—Conflict with existing zoning for agricultural use, or a Williamson Act contract

Summary by Project Element: Impact AG-2— Conflict with existing zoning for agricultural use, or a Williamson Act contract		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
All Project Elements and Alternatives	No Impact	No Impact

None of the project elements and alternatives are on lands zoned for agricultural use or are under a Williamson Act contract, therefore, no impact would occur.

Impact AG-3—Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))

Summary by Project Element: Impact AG-3— Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
All Project Elements and Alternatives	No Impact	No Impact

None of the project elements and alternatives are on lands zoned for forest land, timberland, or on land zoned Timberland Production, therefore, there would be no impact.

Impact AG-4—Result in the loss of forest land or conversion of forest land to non-forest use

Summary by Project Element: Impact AG-4— Result in the loss of forest land or conversion of forest land to non-forest use		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
All Project Elements and Alternatives	No Impact	No Impact

None of the project elements and alternatives are on forest lands or on lands zoned for forest land, timberland, or on land zoned Timberland Production, therefore, there would be no impact.

Impact AG-5—Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use

Summary by Project Element: Impact AG-5— Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative	No Impact	No Impact
Former Nursery Detention Basin Alternative	No Impact	No Impact
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

As noted above under Impact AG-1, there would be no loss of agricultural land associated with the Channel Widening Alternative, Floodwalls Alternative, and Former Nursery Detention Basin Alternative. As noted above under Impact AG-4, none of the project elements and alternatives are on forest lands or on lands zoned for forest land, timberland, or on land zoned Timberland Production. The Webb Ranch Site detention basin is on land designated Prime Farmland and in agricultural production as a u-pick berry farm with an assortment of berries available to the public. There would be a temporary impact to agricultural uses during construction. However, the area of the detention basin could be used for agricultural activities after it is built. Hence, the impact is less than significant.

3.9.4 Cumulative Impacts

The proposed project (the Channel Widening Alternative) would be implemented over approximately 24 months. Bridge replacement would be in year 1, followed by channel widening in year 2. As described above there would be no significant impacts with regard to land use and planning under the proposed project. The only land use impact identified for the proposed project was the potential during construction to conflict with an applicable plan, policy, or regulation of the Cities of East Palo Alto, Palo Alto, and Menlo Park General Plans, Zoning Ordinances, and applicable master plans. However, in most instances the project is consistent with and implements the policies from these plans. Any impacts would be temporary and would be reduced through local code requirements and resource-specific mitigation measures. Accordingly, the impact is less than significant. All future projects would be subject to CEQA review for consistency with applicable plans, policies, and regulations; therefore, there would be no cumulatively considerable effects. The loss of Prime Farmland associated with the Webb Ranch Detention Basin Alternative is a significant impact and the loss of approximately 30 acres of Prime Farmland in the county as a whole would also be cumulatively considerable.

3.9.5 References

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3.10 Noise and Vibration

This section provides environmental analysis of the proposed project's impacts associated with noise and vibration. The section summarizes the regulatory environment and discusses the environmental setting, provides the criteria used for determining impacts, discusses the impact mechanism and level of impact resulting from construction and operation of the proposed project, and describes mitigation to minimize the level of impact.

3.10.1 Background

Terminology

- **Sound.** A vibratory disturbance transmitted by pressure waves through a medium such as air and capable of being detected by a receiving mechanism, such as the human ear or a microphone.
- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
- **Decibel (dB)**. A measure of sound intensity based on a logarithmic scale that indicates the squared ratio of actual sound pressure level to a reference sound pressure level (20 micropascals). Because the decibel scale is based on logarithms, two noise sources do not combine in a simple additive fashion; rather, they combine logarithmically. For instance, if two identical noise sources each produce noise levels of 50 dBA (see definition immediately following), the combined sound level would be 53 dBA, not 100 dBA.
- **A-Weighted Decibel (dBA).** An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear. The dBA scale is the most widely used for environmental noise assessments.
- **Equivalent Sound Level (L_{eq})**. L_{eq} represents an average of the sound energy occurring over a specified period. In effect, L_{eq} is the steady-state sound level that would contain the same acoustical energy as the time-varying sound that actually occurs during the monitoring period. The 1-hour A-weighted equivalent sound level (L_{eq} 1h) is the energy average of A-weighted sound levels occurring during a 1-hour period.
- **Maximum Sound Levels (L_{max}).** The maximum (L_{max}) sound levels measured during a measurement period.
- **Day-Night Level (L_{dn}).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with a 10-dB penalty added to sound levels between 10:00 p.m. and 7:00 a.m.
- **Community Noise Equivalent Level (CNEL).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 5 dB added to the sound levels occurring during the period from 7:00 p.m. to 10:00 p.m. and 10 dB added to the sound levels occurring during the period from 10:00 p.m. to 7:00 a.m. L_{dn} and CNEL are typically within 1 dBA of each other and, for all intents and purposes, interchangeable.
- **Peak Particle Velocity (PPV).** A measurement of ground vibration defined as the maximum speed at which a particle in the ground is moving, expressed in inches per second (in/sec).

- **Vibration Velocity Level (or Vibration Decibel Level, VdB).** The root mean square velocity amplitude for measured ground motion expressed in dB. The vibration velocity level is another way to express groundborne vibration in addition to PPV.
- **Noise-Sensitive Land Uses.** Noise-sensitive land uses are generally defined as locations where people reside or the presence of unwanted sound could adversely affect use of the land. Noise-sensitive land uses typically include single- and multi-family residential areas, health care facilities, lodging facilities, and schools. Recreational areas where quiet is an important part of the environment can also be considered sensitive to noise. Some commercial areas may be considered noise sensitive as well, such as the outdoor restaurant seating areas.

Overview of Sound and Noise

Noise is commonly defined as unwanted sound that annoys or disturbs people and potentially causes an adverse psychological or physiological effect on human health. Because noise is an environmental pollutant that can interfere with human activities, an evaluation of noise is necessary when considering the environmental impacts of a proposed project.

Sound is characterized by various parameters, including the rate of oscillation of sound waves (frequency), the speed of propagation, and the pressure level or energy content (amplitude). In particular, the sound pressure level is the most common descriptor used to characterize the loudness of an ambient (existing) sound level. Although the decibel scale, a logarithmic scale, is used to quantify sound intensity, it does not accurately describe how sound intensity is perceived by human hearing. The human ear is not equally sensitive to all frequencies over the entire spectrum; therefore, noise measurements are weighted more heavily toward frequencies to which humans are sensitive through a process referred to as A-weighting. Table 3.10-1 summarizes typical A-weighted sound levels for different noise sources.

Human sound perception, in general, is such that a change in sound level of 1 dB cannot typically be perceived by the human ear, a change in sound level of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as doubling or halving the sound level. A doubling of actual sound energy is required to result in a 3 dB (i.e., barely noticeable) increase in noise; in practice, for example, this means that the volume of traffic on a roadway would typically need to double to result in a noticeable increase in noise (California Department of Transportation 2013a).

The decibel level of a sound decreases (or attenuates) exponentially as the distance from the source of that sound increases. For a point source, such as a stationary compressor or construction equipment, sound attenuates at a rate of 6 dB per doubling of distance. For a line source, such as free-flowing traffic on a freeway, sound attenuates at a rate of 3 dB per doubling of distance. Atmospheric conditions, including wind, temperature gradients, and humidity, can change how sound propagates over distance and affect the level of sound received at a given location. The degree to which the ground surface absorbs acoustical energy also affects sound propagation. Sound that travels over an acoustically absorptive surface, such as grass, attenuates at a greater rate than sound that travels over a hard surface, such as pavement. The increased attenuation is typically in the range of 1 to 2 dB per doubling of distance. Barriers, such as buildings and topography, which block the line of sight between a source and receiver, also increase the attenuation of sound over distance

Table 3.10-1. Typical A-Weighted Sound Levels

Common Outdoor Activities	Sound Level (dBA)	Common Indoor Activities
Jet flyover at 1,000 feet		
	100	
Gas lawnmower at 3 feet		
	90	
Diesel truck at 50 mph at 50 feet		Food blender at 3 feet
	80	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawnmower at 100 feet	70	Vacuum cleaner at 3 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60	
		Large business office
Quiet urban area, daytime	50	Dishwasher in next room
Quiet urban area, nighttime	40	Theater, large conference room (background)
Quiet suburban area, nighttime		
	30	Library
Quiet rural area, nighttime		Bedroom at night, concert hall (background)
Rustling of leaves	20	
		Broadcast/recording studio
	10	
Lowest threshold of human hearing	0	Lowest threshold of human hearing

Source: California Department of Transportation 2013a.

In urban environments, simultaneous noise from multiple sources may occur. Because sound pressure levels in decibels are based on a logarithmic scale, they cannot be added or subtracted in the usual arithmetical way. Adding a new noise source to an existing noise source, with both producing noise at the same level, will not double the noise level. If the difference between two noise sources is 10 dBA or more, the higher noise source will dominate, and the resultant noise level will be equal to the noise level of the higher noise source. In general, if the difference between two noise sources is 0 to 1 dBA, the resultant noise level will be 3 dBA higher than the higher noise source, or both sources if the sources are equal. If the difference between two noise sources is 2 to 3 dBA, the resultant noise level will be 2 dBA above the higher noise source. If the difference between two noise sources is 4 to 10 dBA, the resultant noise level will be 1 dBA higher than the higher noise source.

Community noise environments are generally perceived as quiet when the 24-hour average noise level is below 45 dBA L_{dn}, moderate in the 45 to 60 dBA L_{dn} range, and loud above 60 dBA L_{dn}. Very noisy urban residential areas are usually around 70 dBA L_{dn} or CNEL. Along major thoroughfares, roadside noise levels are typically between 65 and 75 dBA L_{dn} or CNEL. Incremental increases of 3 to 5 dB to the existing 1-hour L_{eq}, or to the L_{dn}/CNEL, are common thresholds for an adverse community reaction to a noise increase. However, there is evidence that incremental thresholds in this range may not be sufficiently protective in areas where noise-sensitive uses are located and L_{dn}/CNEL is already high (i.e., above 60 dBA). In these areas, limiting noise increases to 3 dB or less is recommended (Federal Transit Administration 2018). Noise intrusions that cause short-term interior noise levels to rise above 45 dBA L_{dn} at night can disrupt sleep. Exposure to noise levels greater than 85 dBA over 8 hours or longer can cause permanent hearing damage.

Overview of Ground-borne Vibration

The operation of heavy construction equipment, particularly pile-driving equipment and other impact devices (e.g., pavement breakers), creates seismic waves that radiate along the surface of the ground and downward. These surface waves can be felt as ground vibration. Vibration from the operation of this type of equipment can result in effects that range from annoyance for people to damage for structures.

Perceptible ground-borne vibration is generally limited to areas within a few hundred feet of construction activities. As seismic waves travel outward from a vibration source, they cause rock and soil particles to oscillate. The actual distance that these particles move is usually only a few ten-thousandths to a few thousandths of an inch. The velocity (in inches per second) at which these particles move is referred to as PPV, the commonly accepted descriptor of vibration amplitude.

Vibration amplitude attenuates (or decreases) over distance. This attenuation is a complex function of how energy is imparted into the ground as well as the soil or rock conditions through which the vibration is traveling (variations in geology can result in different vibration levels).

The following equation is used to estimate the vibration level at a given distance for typical soil conditions (Federal Transit Administration 2018). PPV_{ref} is the reference PPV at 25 feet:

$$PPV = PPV_{ref} \times (25/\text{distance})^{1.5}$$

Table 3.10-2 summarizes typical vibration levels generated by construction equipment at a reference distance of 25 feet and other distances, as determined with use of the attenuation equation above.

Table 3.10-2. Vibration Source Levels for Construction Equipment

Equipment	PPV at 25 Feet	PPV at 50 Feet	PPV at 75 Feet	PPV at 100 Feet	PPV at 175 Feet
Large bulldozer	0.089	0.0315	0.0171	0.0111	0.0048
Loaded trucks	0.076	0.0269	0.0146	0.0095	0.0041
Jackhammer	0.035	0.0124	0.0067	0.0044	0.0019
Small bulldozer	0.003	0.0011	0.0006	0.0004	0.0002

Source: California Department of Transportation 2013b.
PPV = peak particle velocity

As discussed under *Background,* vibration can also be expressed in terms of decibels (VdB). The Federal Transit Administration (FTA) has also published vibration source levels for construction equipment, and these levels are shown in Table 3.10-3 in terms of both PPV and VdB at a distance of 25 feet.

Table 3.10-3. Vibration Source Levels for Construction Equipment

Equipment	PPV at 25 feet (in/sec)	Approximate VdB at 25 feet
Pile driver (impact)	0.644–1.518	104–112
Pile driver (sonic)	0.170–0.734	93–105
Hoe Ram	0.089	87
Large bulldozer	0.089	87
Loaded trucks	0.076	86
Jackhammer	0.035	79
Small bulldozer	0.003	58

Source: Federal Transit Administration 2018.

Tables 3.10-4 and 3.10-5 summarize the guidelines developed by the California Department of Transportation for damage and annoyance from the transient and continuous vibration that is usually associated with construction activity. Impact pile drivers, "pogo stick" compactors (small hand-held soil compactors), crack-and-seat equipment (equipment that breaks and re-seats pavement), excavation equipment, static compaction equipment, tracked vehicles, vehicles on highways, vibratory pile drivers, pile-extraction equipment, and vibratory compaction equipment are typically associated with continuous vibration. The activities that are typically associated with single-impact (transient) or low-rate, repeated impact vibration include blasting and the use of drop balls or dropped metal plates (California Department of Transportation 2013b).

Table 3.10-4. Vibration Damage Potential, Threshold Criteria Guidelines

Structure and Condition	Maximum PPV (in/sec) Transient Sources	Maximum PPV (in/sec) Continuous/ Frequent Intermittent Sources
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Normal dwelling houses (with plastered walls & ceilings)	0.4[1]	0.2
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Source: California Department of Transportation 2013b.

Note: Transient sources create a single, isolated vibration event (e.g., blasting or drop balls). Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

PPV = peak particle velocity

[1] Based on the recommendation that continuous vibration criteria should be about half the amplitude of criteria for transient sources (California Department of Transportation 2013b).

Table 3.10-5. Vibration Annoyance Potential, Criteria Guidelines

	Maximum PPV (in/sec)	
Human Response	**Transient Sources**	**Continuous/ Frequent Intermittent Sources**
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Source: California Department of Transportation 2013b.

Note: Transient sources create a single, isolated vibration event (e.g., blasting or drop balls). Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

PPV = peak particle velocity

3.10.2 Regulatory Setting

Federal

Federal Transit Administration: FTA guidelines specify two separate limits on construction vibration: one to prevent structural damage and a second, lower, limit to avoid annoyance. This analysis uses the FTA's annoyance threshold as the California Environmental Quality Act (CEQA) significance threshold, because it is the more stringent of the two FTA limits. The FTA's vibration impact thresholds are based on the number of times per day the vibration-generating event typically occurs. Based on the "occasional event" definition (between 30 to 70 vibration events per day), the allowable vibration limit is 75 VdB for residential areas, assuming between 30 to 70 vibration events per day (4–9 per hour, over an 8-hour workday) (Federal Transit Administration 2018).

State

California Code of Regulations, Title 24, Part 2

Title 24 of the California Code of Regulations, Part 2, California Noise Insulation Standards, establishes minimum noise insulation standards to protect persons within new hotels, motels, dormitories, long-term care facilities, apartment houses, and dwellings other than single-family residences. Under this regulation, interior noise levels that are attributable to exterior noise sources cannot exceed the 45 L_{dn} in any habitable room. The noise metric is either the L_{dn} or the CNEL, consistent with the noise element of the local general plan.

Ground-borne vibration is not regulated explicitly, although the FTA and California Department of Transportation (Caltrans) have identified thresholds at which vibration becomes a concern (annoying and/or damaging) (Federal Transit Administration 2018; California Department of Transportation 2013b). Additionally Caltrans identifies the limit on construction vibration for potential cosmetic damage to plaster-walled residences as 0.2 in/sec PPV (California Department of Transportation 2013b).

Local

Acceptable levels of environmental noise are regulated at the local level through the general plan process and city and county noise ordinances. Local regulations pertaining to construction noise have been established by the Cities of Palo Alto, East Palo Alto, and Menlo Park, and the County of San Mateo.

- **City of Palo Alto:** Noise within Palo Alto is regulated by Chapter 9.10 of the Palo Alto Municipal Code. The ordinance specifies prohibited actions for construction noise in the Section 9.10.060(b). No individual piece of equipment can produce a noise level exceeding 110 dBA at a distance of 25 feet, and the noise level at any point outside of the property plane of the project cannot exceed 110 dBA. Construction activities are prohibited between the hours of 6 p.m. and 8 a.m. on weekdays, between the hours of 6 p.m. and 9 a.m. on Saturdays, or at any time on Sundays and holidays.
- **City of East Palo Alto:** Noise within East Palo Alto is regulated by Chapter 8.52 (Noise Control) of the East Palo Alto Municipal Code. The ordinance specifies prohibited actions for construction noise in the Section 8.52.350.E. Noise from construction activity is exempt from the noise standards in the ordinance, provided that all construction is limited to the daytime hours between 7 a.m. and 8 p.m.
- **City of Menlo Park:** Noise within Menlo Park is regulated by Chapter 8.06 (Noise) of the City Municipal Code. There are two relevant provisions to the project in Chapter 8.06.040:
  - Construction. Noise is limited at residential properties in Section 8.06.030 of the Code. Noise from construction activity is exempt from the noise limitations in the ordinance pursuant to Section 8.06.040, provided that all construction is limited to the daytime hours between 8 a.m. and 6 p.m. Monday through Friday.
  - Powered Equipment. Powered equipment used on a temporary, occasional or infrequent basis operated between the hours of 8 a.m. and 6 p.m. Monday through Friday. No piece of equipment shall generate noise in excess of 85 dBA at 50 feet.
- **County of San Mateo:** Noise within the unincorporated areas of San Mateo County is regulated by Chapter 4.88 (Noise Control) of the Municipal Code. Noise is limited by the exterior and interior standards and the general noise regulation sections of the code. Construction activity is exempt from the noise standards, provided that construction activity is limited to the daytime hours between 7 a.m. and 6 p.m. on weekdays and 9 a.m. and 5 p.m. on Saturdays. Construction activity is not exempt on Sundays.
- **Palo Alto Airport Land Use Plan:** The Palo Alto Airport Comprehensive Land Use Plan (CLUP) is intended to provide an evaluation of the compatibility of new residential uses, with respect to aircraft noise, developed within the affected environment of the Palo Alto Airport. The CLUP, while intended for projects with residential development, show aircraft noise level contours in the area around the airport. As discussed in the CLUP, the 55 CNEL contour is considered by the State Office of Noise Control to be a threshold that distinguishes normally acceptable noise from conditionally acceptable noise for residential uses (Santa Clara County 2016).

3.10.3 Environmental Setting

The ambient noise environment in the project vicinity was identified based on the land uses present and published studies of noise levels at similar land uses. The study area for noise impacts includes the areas in the project vicinity that could be affected by construction or operational noise from the project, which would be land uses within 1,000 feet of the project sites.

The principal noise sources in the project vicinity are local roadway and U.S. 101 traffic, along with other typical suburban noise sources, such as lawn care equipment, fire and police sirens, and aircraft overflights. Typical background noise levels in suburban residential areas are approximately 55 dBA L_{dn}. (Hoover and Keith 2000).

Noise-Sensitive Land Uses in the Study Area

As discussed above, noise-sensitive land uses typically include residential areas, health care facilities, lodging facilities, schools, and some recreational areas. Using aerial imagery of the study area, noise-sensitive land uses within 1,000 feet of the project area have been identified and are shown in Table 3.10-6.

Table 3.10-6. Noise-Sensitive Land Uses in the Project Vicinity

Receptor	Distance of Nearest Sensitive Use to Project Site
Channel Widening Alternative and Floodwalls Alternative	
International School of the Peninsula	275 feet east
Laurel School Upper Campus	545 feet northwest
CEI Medical Group	150 feet north
Residences	Immediately adjacent[1]
Former Nursery Detention Basin Alternative	
Residence	400 feet east
Webb Ranch Detention Basin Alternative	
Ladera Recreation District	235 feet south
Woodland School	650 feet south
Residences	35-1,000 feet south[2]

[1] There are residences north, south, east, and west of the Pope-Chaucer Bridge and along the entirety of Reach 2. The closest residence is approximately 15 feet south of the site's property line.

[2] There are residences south of the entirety of the Webb Ranch Detention Basin Alternative project site. The closest residence is approximately 35 feet south of the site's property line.

3.10.4 Impact Analysis

Methods and Significance Criteria

The noise impact analysis evaluates the temporary noise increase associated with project construction activities, and operational noise generated by equipment and onsite activities.

Noise impacts associated with onsite demolition and construction activities were evaluated using the noise calculation method and construction equipment noise data in the Federal Highway Administration (FHWA) Roadway Construction Noise Model. The noise data include the A-weighted L_{max}, measured at a distance of 50 feet from the construction equipment, and the utilization factors for the equipment. The utilization factor is the percentage of time each piece of construction equipment is typically operated at full power over the specified time period and is used to estimate

L_{eq} values from L_{max} values. For example, the L_{eq} value for a piece of equipment that operates at full power over 50% of the time is 3 dB less than the L_{max} value (Federal Highway Administration 2006).

Table 3.10-7 shows the noise levels and utilization factors for the types of construction equipment that are anticipated to be used during project construction activities for the Channel Widening Alternative and Floodwalls Alternative. These construction equipment source levels were used to calculate noise levels at varying distances from the activity. An attenuation rate of 7.5 dB per doubling of distance was used to account for both point source attenuation (6 dB attenuation per doubling of distance) and ground absorption (1.5 dB attenuation per doubling of distance). The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are evaluated at the program-level in this analysis, as certain details about the projects are not yet available. Thus, a project-level analysis of construction noise for those alternatives cannot be conducted.

Operational noise impacts associated with onsite activities have been evaluated qualitatively, based on the types of activities that are anticipated to occur. Additionally, the operations and maintenance activities for the project would be similar to the current maintenance work for the existing sites. Because the noise environment with the project would not represent a substantial change from the existing noise environment, the analysis of noise impacts focuses primarily on noise levels during construction of each project element.

Table 3.10-7. Typical Maximum Noise Emission Levels by Construction Equipment

Alternative and Activity	Acoustical Use Factor	Typical Maximum Noise Level (dBA)	
		25 feet from Source	50 feet from Source
Channel Widening Alternative			
Widen Channel at Sites 1-4[1]			
Backhoe[2]	40%	84	78
Cement Truck w/Boom[2,3]	40%	85	79
Pump Truck	20%	87	81
Excavator[2]	40%	87	81
Track Mounted Dump Truck	40%	82	76
Pick Up Truck	40%	81	75
Man Lift	20%	81	75
Fork Lift[4]	40%	81	75
University Avenue Bridge Parapet			
Cement Truck w/Boom[2]	40%	85	79
Backhoe[2]	40%	84	78
Floodwalls Alternative			
Construct Floodwalls			
Cement Truck w/Boom[2]	40%	85	79
Backhoe[2]	40%	84	78

Alternative and Activity	Acoustical Use Factor	Typical Maximum Noise Level (dBA) 25 feet from Source	50 feet from Source
Channel Widening Alternative and Floodwalls Alternative			
Replace Pope-Chaucer Bridge			
Front End Loader	40%	85	79
Backhoe	40%	84	78
Grader[2]	40%	91	85
Dump Truck	40%	82	76
Crane	16%	87	81
Pile Driver[2,5]	20%	107	101
Trailer Mounted Generator	50%	87	81
Pick-Up Truck	40%	81	75
Concrete Pump[6]	50%	86	80
Compaction Equipment[2]	20%	89	83
Widen Channel at Site 5[1]			
Backhoe	40%	84	78
Cement Truck w/ Boom	40%	85	79
Pump Truck	20%	87	81
Excavator[2]	40%	87	81
Dump Truck	40%	82	76
Pick-Up Truck	40%	81	75
Man Lift	20%	81	75
Fork Lift[4]	40%	90	84
Drill Rig	20%	85	79
Vibrahammer[2,5,7]	20%	96	90
Dewatering Pumps[2]	50%	87	81

Source: Federal Highway Administration 2006

Notes:

[1] Equipment associated with constructing Creekside parks and enhancing aquatic habitats is represented by the same equipment used to widen the channel.

[2] These equipment types are among the loudest for each project element and were used in the construction noise impact evaluation.

[3] Assumed to be represented by a concrete mixer truck.

[4] Assumed to be represented by a pickup truck.

[5] These equipment types are considered to be impact equipment, based on the *FHWA Roadway Construction Noise Model User's Guide.*

[6] Assumed to be represented by a drum mixer.

[7] Assumed to be represented by a mounted impact hammer (hoe ram).

The State CEQA Guidelines, Appendix G (14 California Code of Regulations 15000 et seq.), identify significance criteria to be considered for determining whether a project could have significant impacts on the existing noise environment.

A project impact would be considered significant if construction or operation would result in any of the following:

1. Generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies. The relevant noise ordinances to the project are discussed above in the *Regulatory Setting*. With respect to temporary and permanent increase in ambient noise, substantial increases are considered to be
   - Construction noise creating substantial annoyance or disruption to adjacent land uses.
   - a substantial construction-related traffic noise increase (6 dB or more).
   - a substantial traffic noise increase during operations (6 dB or more).
2. Generate excessive ground-borne vibration or ground-borne noise levels. For this analysis, excessive ground-borne vibration is considered to be vibration
   - in excess of 75 VdB (the FTA "annoyance threshold" for occasional vibration events).
   - in excess of 0.2 in/sec PPV (the threshold reported by Caltrans for cosmetic damage to plaster-walled residences). This threshold is directly applicable to the project area, because the primary structures that would be affected by construction are typical residential dwellings. This threshold is supported by substantial evidence, comprised of analysis and surveys conducted by a research laboratory. More detail about this threshold can be found in Caltrans' *Transportation and Construction Vibration Guidance Manual* (California Department of Transportation 2013b).
3. For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, expose people residing or working in the project area to excessive noise levels?

Impacts and Mitigation Measures

Impact NV-1—Generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies

Summary by Project Element: Impact NV-1—Expose persons to or generate noise levels in excess of standards		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Significant and Unavoidable	Less than Significant
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant	Less than Significant

Channel Widening Alternative

Construction

The Channel Widening Alternative would involve the use of heavy-duty equipment that would result in an increase in the level of noise above existing conditions. The types of construction equipment that would be required for Channel Widening Alternative construction activities (as shown in Table 3.10-7) have been evaluated to determine the noise levels that could occur from the simultaneous operation of the three loudest pieces of equipment, which is a reasonable worst-case scenario.

Table 3.10-8 shows the estimated maximum and L_{eq} noise levels at distances of 25, 50, 100, 250, 500, and 1,000 feet from the construction sites for each project element. As stated above, these noise level estimates assume the simultaneous operation of three loudest pieces of equipment. As shown in Table 3.10-6, noise-sensitive land uses are located as close as approximately 15 feet to the construction sites. The Channel Widening Alternative elements are near the jurisdictional boundaries of Menlo Park, Palo Alto, and East Palo Alto, and noise-sensitive land uses in each of these jurisdictions could be affected by construction noise.

Table 3.10-8. Estimated Construction Noise Levels by Distance from the Channel Widening Alternative

Project Phase	Distance from Construction Site (feet)	Maximum Noise Level (dBA)	L_{eq} Noise Level (dBA)
Widen Channel at Sites 1–4[1]	25	92	88
	50	84	80
	100	77	73
	250	67	63
	500	59	55
	1,000	52	48
University Avenue Bridge Parapet	25	89	85
	50	82	78
	100	74	70
	250	64	60
	500	57	53
	1,000	49	45
Replace Pope-Chaucer Bridge	25	109	102
	50	101	94
	100	94	87
	250	84	77
	500	76	69
	1,000	69	62

Project Phase	Distance from Construction Site (feet)	Maximum Noise Level (dBA)	L_{eq} Noise Level (dBA)
Widen Channel at Site 5[1]	25	98	92
	50	91	84
	100	83	77
	250	73	67
	500	66	59
	1,000	58	52

Noise levels are assumed to be the result of the three loudest piece of equipment for each project element.

Noise levels at 15 feet would be about 6 dB higher than the levels shown at 25 feet.

[1] Equipment associated with constructing Creekside parks and enhancing aquatic habitats is represented by the same equipment used to widen the channel.

At a distance of 15 feet, which is the closest distance between some of the nearest homes and the construction activities, L_{eq} noise levels would range between 91 and 107 dBA, while maximum noise levels would range between 95 and 114 dBA. Given that the typical noise levels in suburban residential areas are in the range of 50–60 dBA, the Channel Widening Alternative and Floodwalls Alternative construction noise could be substantial at some residences. It should be noted, however, that a separation distance of 15 feet is anticipated to be a worst-case scenario that may not occur for an appreciable amount of time or at all.

As described in Section 3.13, *Traffic and Transportation*, construction of the Channel Widening Alternative and Floodwalls Alternative would require truck trips to haul equipment and material to and from the site, resulting in an increase of up to 60 trips per day (20 trucks trips and 40 worker trips). Truck traffic to and from the construction site would create additional intermittent noise at nearby residences along the haul routes; however, the noise impact would be limited to several seconds of elevated noise during each truck pass. Existing PM peak-hour traffic volumes on roadways in the project vicinity range from 24 vehicles per hour (Palo Alto Avenue north of Chaucer Street) to 2,626 vehicles per hour (University Avenue north of Woodland Avenue). The project increase of 60 trips per day would likely occur throughout the day and would be dispersed among multiple roadways, primarily the higher volumes roadways (e.g., University Avenue, Middlefield Road). Because the existing traffic volumes on roadways in the area are substantially greater than 60 vehicles per day, there would not likely be a substantial change in the noise environment due to the increased construction traffic. As discussed above, traffic volumes typically need to double to result in a noticeable increase in noise (California Department of Transportation 2013a). As such, the noise increase related to construction traffic is expected to be less than the "substantial increase" criterion of 6 dB. As noise impacts related to construction traffic are considered less than significant, no additional mitigation is required to address construction traffic.

As discussed above, noise from construction activities that occur during the daytime hours is considered exempt from the noise ordinance limits in the Cities of East Palo Alto and Menlo Park. Channel Widening Alternative construction activities would mostly occur during daytime hours, and noise from the majority of construction equipment would not be subject to noise ordinance limits in these cities. However, it is likely that, to complete necessary aspects of the project, construction activity may be required outside of the exemption hours, such as after 8 p.m. in East Palo Alto or on a Saturday in Menlo Park. In East Palo Alto, construction noise that is not exempt (i.e., when construction occurs outside of the exempted hours), the City's exterior noise level standards would apply. The most stringent of these standards are 75 dBA from 7 a.m. to 10 p.m. and 70 dBA from 10 p.m. to 7 a.m., as measured at a noise-sensitive land use. Given the noise levels associated with construction shown in Table 3.10-8, it is highly probable that any non-exempt construction activity would exceed East Palo Alto's noise standards.

Additionally, Menlo Park's noise limit on powered equipment of 85 dBA at 50 feet would be exceeded by the pile driver and vibrahammer, as shown in Table 3.10-7. Consequently, construction activity would cause an increase in noise that would exceed the applicable noise standards established by East Palo Alto and Menlo Park.

In the City of Palo Alto, construction noise is not exempt and is subject to a limit of 110 dBA at a distance of 25 feet and at any point outside the property plane. Table 3.10-8, which shows the worst-case scenarios for each Channel Widening Alternative element, indicates that all activities would comply with the noise ordinance limit of 110 dBA at 25 feet. The loudest element, replacing the Pope-Chaucer Bridge, would have a maximum noise level of 107 dBA and an L_{eq} noise level of 100 dBA at 25 feet. Consequently, construction activities would not result in noise levels that exceed Palo Alto's noise ordinance limit.

As discussed in Chapter 2, the San Francisquito Creek Joint Powers Authority (SFCJPA) would implement noise control practices during construction that would reduce noise, including:

- Conducting work in accordance with the applicable noise ordinance working hours and working outside of those hours only as necessary to complete some aspects of the project;
- Equipping engines with adequate mufflers;
- Prohibiting excessive idling of vehicles;
- Equipping all equipment with the manufacturers' standard noise control devices;
- Limiting the arrival and departure of haul trucks to only the hours of construction; and
- Prohibiting Jacobs Compression Release Brakes in residential areas.

These noise control practices are expected to reduce the modeled noise levels reported in in Table 3.10-8; however, it is possible that construction noise could still result in a substantial increase at some residences. Consequently, implementation of MM-NV-1, MM-NV-2, and MM-NV-3 would be required to attempt to further reduce noise. These mitigation measures would provide advance notice to nearby residences, designate a disturbance coordinator to handle resident complaints, and install noise barriers to further attenuate noise. Even with implementation of these measures, it is unlikely that construction would be able to comply with the noise ordinance limits in the Cities of East Palo Alto and Menlo Park. Consequently, this impact is significant and unavoidable.

MM-NV-1: Provide advance notification of construction and operations schedule and 24-hour hotline to residents

SFCJPA will provide advance written notification of the proposed construction activities and major operational activities (i.e., debris removal) to all property owners and occupants and other noise-sensitive receptors within 1,000 feet of the construction or operations site. Notification will include a brief overview of the proposed project and its purpose, as well as the proposed construction activities and schedule. It will also include the name and contact information of SFCJPA's project manager or another SFCJPA representative or designee responsible for ensuring that reasonable measures are implemented to address the problem (the construction noise; see MM-NV-3).

MM-NV-2: Designate a noise disturbance coordinator to address resident concerns

SFCJPA will designate a representative to act as construction noise disturbance coordinator, responsible for resolving construction and operations noise concerns. The disturbance coordinator's name and contact information will be included in the preconstruction notices sent to area residents (see MM-NV-2). The coordinator will be available during regular business hours to monitor and respond to concerns; if the extension of construction hours would be required for some project components as determined by both the contractor and SFCJPA, the disturbance coordinator will also be available during the extended hours. In the event a noise complaint is received, she or he will be responsible for determining the cause of the complaint and ensuring that all reasonable measures are implemented to address the problem.

MM-NV-3: Install temporary noise barriers

As described in MM-NV-2 and MM-NV-3, SFCJPA will notify noise-sensitive land uses near the site of upcoming activity before construction or operations activity begins, will require construction-site noise reduction measures, and will provide a 24-hour complaint hotline. If a resident or other noise-sensitive person submits a complaint about construction or operations noise and SFCJPA is unable to reduce noise to a level that does not cause annoyance or disruption to adjacent land uses through other means, SFCJPA will install temporary noise barriers to reduce noise levels below the applicable construction noise or powered equipment standard. Barriers will be installed as promptly as possible, and work responsible for the disturbance will be suspended or modified until barriers have been installed. SFCJPA would be responsible for ensuring that noise barriers are installed immediately in response to noise concerns from the community. The following minimum criteria will be required of the contractor:

- The barrier will be 10 feet tall. It will surround the work area to block the line of sight for all diesel-powered equipment on the ground, as viewed from any private residence or any building.
- The barrier will be constructed of heavyweight plywood (5/8 inch thick) or other material providing a Sound Transmission Classification of at least 25 dBA. (Note that 5/8 inch is sufficiently thick to provide optimal noise buffering; increasing the thickness of the barrier above 5/8 inch would not provide a noticeable improvement in noise reduction.)
- The barrier will be constructed with no gaps or holes that would allow noise to transmit through the barrier.
- To minimize reflection of noise toward workers at the construction site, the surface of the barrier facing the workers will be covered with a sound-absorbing material meeting a Noise Reduction Coefficient of at least 0.70.
- The barrier would be installed in a location that is functional but avoids impacts on trees, habitat, or line of sight for vehicles.

Operations and Maintenance

Operational activities associated with the Channel Widening Alternative would consist of occasional vehicle trips by maintenance staff to remove debris from channels, monitor and maintain new vegetation, and collect trash and maintain the benches and landscaping at the Creekside parks. After major flood events, which are anticipated to occur infrequently, debris removal, concrete repair, and clean up could potentially require heavy-duty equipment that generates noise. The use of heavy-duty equipment to remove debris or repair concrete is a construction-type activity, because it would involve the repair of an existing structure and would be subject to the requirements governing construction noise in the applicable local noise ordinances. As discussed above, construction noise is exempt from noise limitations, so long as it occurs between the hours of 7 a.m. and 8 p.m. in the City of East Palo Alto, and between the hours of 8 a.m.–6 p.m. Monday through Saturday in the City of Menlo Park. In Menlo Park, powered equipment is nevertheless limited to 85 dBA at 50 feet. As discussed for the impacts of construction activities, only the pile driver and vibrahammer would exceed this noise limit, and the repair of concrete structures or debris removal would be unlikely to involve either of these equipment types. In Palo Alto, construction noise is limited to 110 dBA at a distance of 25 feet and at any point outside the property plane. As discussed above, even the loudest piece of equipment during the construction period, a pile driver, would not exceed Palo Alto's noise limit. Because the equipment required to occasionally remove debris from the channel and repair concrete would be less noise intensive than a pile driver, the debris removal and concrete repair equipment would not exceed the limit of 110 dBA. Further, these occasional operational activities would be similar to the existing maintenance activities that currently occur in the area, and, as such, the Channel Widening Alternative is not likely to introduce new types of noise sources to the area. To ensure that construction activities do not result in substantial increases in noise. implementation of MM-NV-1, MM-NV-2, and MM-NV-3 would require notification to residents of major upcoming noise-generating activity and installation of temporary noise barriers, and these measures would reduce the increase in noise that could occur during the infrequent debris removal or concrete repair activities.

The vehicle trips by maintenance staff to the Creekside parks to collect trash and maintain benches and landscaping would occur infrequently and not involve prolonged used of heavy-duty equipment. The Channel Widening Alternative would not involve the construction of any new buildings or add any new residents or employees, there would be minimal new sources of permanent operational noise. The Channel Widening Alternative would construct two new small parks, but these parks would only have passive uses and no active sports uses on site. The number of additional vehicle trips associated with visitors traveling to and from the new parks is anticipated to be small. As such, any permanent increases in noise would be less than significant. Therefore, no exceedance of applicable noise standards is anticipated with implementation of MM-NV-1, NV-2, and NV-3.

Floodwalls Alternative

Construction

Similar to the Channel Widening Alternative, the Floodwalls Alternative would involve the use of heavy-duty equipment that would result in an increase in the level of noise above the existing conditions, although the type of construction activities that would occur for this alternative differ from the Channel Widening Alternative. Construction equipment required for construction activities (as shown in Table 3.10-7) has been evaluated for this alternative to determine the noise levels that could occur from the simultaneous operation of the three loudest pieces of equipment.

Table 3.10-9 shows the estimated maximum and L_{eq} noise levels at distances of 25, 50, 100, 250, 500, and 1,000 feet from the construction sites for each element. As stated above, these noise level estimates assume the simultaneous operation of three loudest pieces of equipment. As shown in Table 3.10-6, noise-sensitive land uses are located as close as 15 feet to the construction sites.

Table 3.10-9. Estimated Construction Noise Levels from the Floodwalls Alternative

Project Phase	Distance from Construction Site (feet)	Maximum Noise Level (dBA)	L_{eq} Noise Level (dBA)
Construct Floodwalls	25	89	85
	50	82	78
	100	74	70
	250	64	60
	500	57	53
	1000	49	45
Replace Pope-Chaucer Bridge	25	109	102
	50	101	94
	100	94	87
	250	84	77
	500	76	69
	1000	69	62
Widen Channel at Site 5	25	98	92
	50	91	84
	100	83	77
	250	73	67
	500	66	59
	1000	58	52

Noise levels are assumed to be the result of the three loudest piece of equipment for each project element.
Noise levels at 15 feet would be about 6 dB higher than the levels shown at 25 feet.

Similar to the Channel Widening Alternative, L_{eq} noise levels at a distance of 15 feet for Floodwalls Alternative construction would range between 91 and 107 dBA, while maximum noise levels would range between 95 and 114 dBA, and such noise levels would be a substantial increase relative to existing ambient noise levels. As discussed for the Channel Widening Alternative, most construction activity would occur during the exemption hours in the Cities of East Palo Alto and Menlo Park, but the occurrence of activity outside of these hours would violate the noise limits of East Palo Alto's noise ordinance. Additionally, the powered equipment limit of Menlo Park's noise ordinance would be exceeded by multiple pieces of equipment used for the Floodwalls Alternative.

Construction noise in Palo Alto is subject to a limit of 110 dBA at a distance of 25 feet and at any point outside the property plane. Table 3.10-9, which shows the worst-case scenarios for each Floodwalls Alternative element, indicates that all activities would comply with the noise ordinance limit of 110 dBA at 25 feet. The loudest element for the Floodwalls Alternative would be the same as the Channel Widening Alternative, which is the replacement of the Pope-Chaucer Bridge. This element would have a maximum noise level of 107 dBA and an L_{eq} noise level of 100 dBA at 25 feet. Consequently, construction activities would not result in noise levels that exceed Palo Alto's noise ordinance limit.

Additionally, the same approximate number of vehicles trips (60 per day) as the Channel Widening Alternative would occur for the Floodwalls Alternative. As discussed above, such an increase in vehicle trips per day would not be noticeable given the magnitude of existing traffic volumes.

The noise control practices to be implemented by SFCJPA, discussed in Chapter 2 and above, would reduce noise, but additional mitigation would be required to further reduce impacts. Implementation of MM-NV-1, NV-2, and NV-3 would be required to attempt to further reduce noise. However, even with implementation of these measures, it is unlikely that construction would be able to comply with the noise ordinance limits in the Cities of East Palo Alto and Menlo Park. Consequently, this impact is significant and unavoidable.

Operations and Maintenance

Operational activities associated with the Floodwalls Alternative would consist of occasional vehicle trips by maintenance staff to visually inspect for any damaged concrete, and collect trash and maintain the benches and landscaping at the Creekside parks. If damaged concrete is found, it would need to be repaired, possibly with heavy-duty equipment. The use of heavy-duty equipment to repair concrete is a construction-type activity, because it would involve the repair of an existing structure, and would be subject to the requirements governing construction noise in the applicable local noise ordinances. As discussed above, construction noise is exempt from noise limitations, so long as it occurs during daytime hours, in the Cities of East Palo Alto and Menlo Park. In Menlo Park, powered equipment is nevertheless limited to 85 dBA at 50 feet. As discussed for the impacts of construction activities, only the pile driver and vibrahammer would exceed this noise limit, and the repair of concrete structures would be unlikely to involve either of these equipment types. In Palo Alto, construction noise is limited to 110 dBA at a distance of 25 feet and at any point outside the property plane. As discussed above, even the loudest piece of equipment during the construction period, a pile driver, would not exceed Palo Alto's noise limit. Because the equipment required to occasionally repair concrete would be less noise intensive than a pile driver, the equipment would not exceed the limit of 110 dBA. To ensure that construction activities do not result in substantial increases in noise, implementation of MM-NV-1, MM-NV-2, and MM-NV-3, which require notification to residents of major upcoming noise-generating activity and installation of temporary noise barriers, are required. These measures would reduce the increase in noise that could occur during the infrequent debris removal or concrete repair activities.

The vehicle trips by maintenance staff to any Creekside parks to collect trash and maintain benches and landscaping would occur infrequently and not involve prolonged used of heavy-duty equipment, no exceedance of applicable noise standards is anticipated, and no mitigation is required.

The Floodwalls Alternative would not involve the construction of any new buildings or add any new residents or employees, there would be minimal new sources of permanent operational noise. The Floodwalls Alternative would construct two new small parks, but these parks would only have passive uses and no active sports uses on site. The number of additional vehicle trips associated with visitors traveling to and from the new parks is anticipated to be small. As such, any permanent increases in noise would be less than significant.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

Construction

The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would involve the use of heavy-duty equipment to construct the detention basin and would result in an increase in the level of noise above the existing conditions. As discussed in Chapter 2, *Project Description,* these alternatives are evaluated at the program level in this EIR because detailed information is not yet available, and the noise level associated with construction of the elements of this alternative cannot be quantified. It is possible but cannot be stated with certainty that the noise levels would be comparable to the Channel Widening Alternative and Floodwalls Alternative, because heavy-duty construction equipment would be required to construct the detention basin. Unlike the Channel Widening Alternative and Floodwalls Alternative, however, these alternatives are located in a rural area of unincorporated San Mateo County with little development in the vicinity.

As shown in Table 3.10-6, the nearest sensitive land uses to the Former Nursery Detention Basin Alternative are 400 feet away. Although construction noise at the detention basin would attenuate by more than 20 decibels over a distance of 400 feet, the resulting noise at the nearest residences could still constitute a substantial temporary increase. The nearest sensitive land uses to the Webb Ranch Detention Basin Alternative are 35 feet away, and the resulting noise at the nearest residences could constitute a substantial temporary increase.

As discussed in the *Regulatory Setting*, noise from construction activity in the County is considered exempt if it occurs between 7 a.m. and 6 p.m. on weekdays and 9 a.m. and 5 p.m. on Saturdays. Because construction of the detention basin would occur during these hours and would thus be exempt from the noise ordinance, any construction-related noise would not exceed applicable noise standards. This impact is less than significant. No mitigation is required.

Operations and Maintenance

Occasional maintenance associated with the detention basin would be required to remove and haul away sediment from the basin. These activities would require heavy-duty equipment and hauling trucks and would thus be considered construction-type activity, because such activities are considered site preparation, repair, or alteration of land, consistent with the County's definition of construction activities. As such, the operations and maintenance activities would also be exempt from the County's noise ordinance limits, because the activities would occur during daytime hours. The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would not construct any new buildings or add any new residents or employees, and thus there would be no new sources of permanent operational noise. This impact is less than significant. No mitigation is required.

Impact NV-2—Expose persons to or generate excessive ground-borne vibration or ground-borne noise levels

Summary by Project Element: Impact NV-2—Expose persons to or generate excessive ground-borne vibration or ground-borne noise levels.		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant with Mitigation	Less than Significant
Former Nursery Detention Basin Alternative	Less than Significant	Less than Significant
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	Less than Significant

Channel Widening Alternative

The operation of heavy equipment would generate localized ground-borne vibration during construction of all project elements. Vibration from non-impact construction activity and truck traffic is typically below the threshold of perception when the activity is more than about 50 feet from the receiver (refer to Tables 3.10-2 and 3.10-4 above for vibration reference levels). Consequently, for construction activities without the use of high-impact equipment where the activity is located more than 50 feet from noise-sensitive land uses, ground-borne vibration impacts are expected to be less than significant. The same would be true for maintenance activities, which would be similar in nature to existing maintenance and are not expected to use high-impact equipment.

For construction activities associated with the replacement of Pope-Chaucer Bridge and widening the channel at sites 1–5, one piece of impact equipment would be required for each of those elements (a pile driver and a vibrahammer, respectively). The level of vibration generated by pile driving and transmitted to nearby structures would depend on the type of pile driver used and site-specific soil properties. Under "average" soil conditions an impact pile driver is expected to generate a vibration level of 0.644–1.518 in/sec PPV, or 104–112 VdB at a distance of 25 feet (Federal Transit Administration 2018). Similarly, a vibrahammer would generate a vibration level of 0.089 in/sec PPV or 87 VdB at a distance of 25 feet based on the reference levels for a hoe ram from the Federal Transit Administration. Some existing homes are located 25 feet from where the pile driver could be operated, and under "average" soil conditions, those homes could be exposed to vibration levels in excess of the 0.2 in/sec PPV and 75 VdB thresholds at which vibration may become an annoyance and/or damage plaster-walled residential structures. The vibrahammer could also create vibration levels in excess of the 75 VdB threshold. Consequently, vibration impacts at homes closest to the bridge and the channel widening at Site 5 could be significant. Implementation of MM-NV-4 would reduce ground-borne vibration impacts to a less-than-significant level by ensuring via vibration monitoring that vibration levels are below the applicable thresholds.

Vibration impacts may also be significant for homes located within approximately 50 feet of the construction sites using non-impact construction equipment. These residences could experience vibration levels as high as 87 VdB or 0.089 in/sec PPV (these levels correspond to a large bulldozer, as cited in Table 3.10-3), which would exceed the threshold of annoyance (75 VdB). Exceedance of this threshold would be a significant impact. Implementation of mitigation measure MM-NV-4 would reduce ground-borne vibration impacts to a less than significant level.

MM-NV-4: Conduct construction vibration monitoring and implement control approach(es)

During periods of construction, SFCJPA will retain a qualified acoustical consultant or engineering firm to conduct vibration monitoring at homes or occupied vibration-sensitive buildings located within 100 feet of pile driving locations and 25 feet of construction sites using other non-impact equipment. Vibration monitoring will be conducted on each day of construction until it can be determined that all affected structures would not experience significant groundborne vibration. If a structure would not experience significant vibration at a distance of 50 feet from pile driving activities, on subsequent days, when construction activity would occur farther away from that structure, vibration monitoring would not be required. If at any point the measured PPV is in excess of 0.2 in/sec, construction activity will cease and alternative methods of construction and excavation will be considered to prevent possible exposure of vibration-sensitive buildings and structures to levels of 0.2 in/sec PPV or higher. Prior to construction activity, and assuming the property owner gives permission, a preconstruction survey will be conducted that documents any existing cracks or structural damage at vibration-sensitive receptors located within the distances identified above by means of color photography or video. Additionally, a designated complaint coordinator will be responsible for handling and responding to any complaints received during such periods of construction. SFCJPA will also implement a reporting program will be required that documents complaints received, actions taken and the effectiveness of these actions in resolving disputes.

Floodwalls Alternative

As discussed for the Channel Widening Alternative, heavy equipment would generate localized ground-borne vibration during construction of all the Floodwalls Alternative elements; however, vibration from non-impact construction activity would be below the vibration thresholds at distances greater than 50 feet. Thus, for construction activities without the use of high-impact equipment where the activity is located more than 50 feet from noise-sensitive land uses, ground-borne vibration impacts are expected to be less than significant. The same would be true for maintenance activities for this alternative, which would be similar in nature to existing maintenance and are not expected to use high-impact equipment.

Because the Floodwalls Alternative would include the same two elements of the Channel Widening Alternative that require impact equipment (replacing Pope-Chaucer Bridge and widening the channel at site 5), the discussion above for the Channel Widening Alternative applies equally to this alternative. Implementation of mitigation measure MM-NV-4 would reduce ground-borne vibration impacts to a less-than-significant level.

Former Nursery Detention Basin Alternative

As previously discussed, a project-level analysis of the Former Nursery Detention Basin Alternative is not currently possible. It is a possibility that this alternative, during construction and/or operations and maintenance activities, could require the use of a pile-driver, other impact equipment, or other large non-impact equipment. However, as shown in Table 3.10-6, the nearest sensitive land uses to this alternative are 400 feet away. At this distance, ground-borne vibration from construction activities would not be considered excessive, because 400 feet would be sufficient distance for the vibration to attenuate to a level that is below damage and annoyance thresholds. Thus, the Former Nursery Detention Basin Alternative would not create excessive ground-borne vibration levels, and this impact is less than significant. No mitigation is required.

Webb Ranch Detention Basin Alternative

As previously discussed, a project-level analysis of the Webb Ranch Detention Basin Alternative is not currently possible. It is a possibility that this alternative, during construction and/or operations and maintenance activities, could require the use of a pile-driver, other impact equipment, or other large non-impact equipment. As shown in Table 3.10-6, the nearest sensitive land uses to this alternative are 35 feet away.

At this distance, ground-borne vibration from construction activities could potentially exceed the 0.2 in/sec PPV and 75 VdB thresholds. To ensure that ground-borne vibration would not be excessive at the nearest sensitive land uses, MM-NV-4 would be required.

Impact NV-3—Expose people residing or working in the project area to excessive noise levels

Summary by Project Element: Impact NV-5—Expose people residing or working in the project area to excessive noise levels if within 2 miles of a public airport or public use airport		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
Channel Widening Alternative and Floodwalls Alternative All Project Elements	Less than Significant	Less than Significant
Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	No Impact	No Impact

Channel Widening Alternative and Floodwalls Alternative

The closest airport to the Channel Widening Alternative and Floodwalls Alternative sites is Palo Alto Airport, approximately 0.75 mile northeast of Site 5 (the nearest element) and 2 miles east of the Pope-Chaucer Bridge (the farthest element). The project would have no effect on the operations of the airport and would thus not change the existing noise levels associated with this airport. All of the Channel Widening Alternative and Floodwalls Alternative elements are outside of the 55 CNEL contour for the airport, as shown in the *2017 Airport Annual Noise Report* (City of Palo Alto 2018). Consequently, aircraft activity at Palo Alto Airport would not expose any people currently working or residing in the area, including construction workers at the project site, to excessive noise levels. Because the Channel Widening Alternative and Floodwalls Alternative would not construct any new land use developments, no new residents or permanent workers would be exposed to airport noise either. There are no private airstrips in the vicinity of the Channel Widening Alternative and Floodwalls Alternative. This impact would be less than significant. No mitigation is required.

Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative

The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are not within an airport land use plan, and there are no public airports or private airstrips within 2 miles of the Former Nursery Detention Basin Alternative or Webb Ranch Detention Basin Alternative. Therefore, the project would not expose people working in the project area to excessive noise levels as a result of an airport. There would be no impact in this regard.

3.10.5 Cumulative Impacts

The proposed project (Channel Widening Alternative) would be implemented over approximately 9 months, with work taking place within the existing channel for approximately 6 months (between April 15 and October 15). As described above, even with the implementation of mitigation measures there would be significant and unavoidable impacts with respect to noise under the proposed project. Similarly, for cumulative noise impacts, the proposed project could contribute to cumulatively considerable effects. It is currently unknown what other projects in the vicinity could overlap in geography and timing with the proposed project. However, because of the proposed project's inability to comply with the noise ordinance limits for East Palo Alto and Menlo Park, there is a potential for cumulatively significant impacts. If other noise-generating activity occurs in the study area (i.e., within 1,000 feet of the project sites), that activity's noise could combine cumulatively with the proposed project's noise and result in a greater noise level. Any overlapping activity could result in noise that even further exceeds the noise ordinance limits for East Palo Alto and/or Menlo Park. In Palo Alto, the construction noise would be subject to the 110 dBA limit at 25 feet, which, because of the localized nature of sound, would not likely be exceeded by the proposed project even in combination with reasonably foreseeable development in the immediate vicinity. Overall, however, the project would contribute to a cumulatively considerable noise impact from the exceedance of the noise ordinance limits in East Palo Alto and Menlo Park.

For temporary noise increases that would occur during operations, the proposed project would result in less than significant impacts, because ongoing operational activity would be infrequent and minimal. Operational activity would only be required occasionally to repair concrete or remove debris. As discussed above, noise is highly localized, and the potential for this infrequent and short-term source of proposed project noise to contribute cumulatively with other major activities and development in the vicinity would be limited.

Likewise, ground-borne vibration is also a highly localized phenomenon, such that vibration impacts from the proposed project would be less than significant at distances greater than 100 feet for pile-driving activities. Consequently, vibration generated by the proposed project construction activities would not likely combine with vibration from other activities in the vicinity in a cumulatively considerable manner.

3.10.6 References

California Department of Transportation. 2013a. Technical Noise Supplement to the Traffic Noise Analysis Protocol. September. Available: http://www.dot.ca.gov/hq/env/noise/pub/TeNS_Sept_2013A.pdf. Accessed: March 21, 2019.

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Federal Transit Administration. 2018. *Transit Noise and Vibration Impact Assessment Manual (FTA-Report No. 0123).* September. Available: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf. Accessed: November 29, 2018.

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Santa Clara County. 2016. *Comprehensive Land Use Plan – Palo Alto Airport.* Amended November 16, 2016. Available: https://www.sccgov.org/sites/dpd/DocsForms/Documents/ALUC_PAO_CLUP.pdf. Accessed: March 21, 2019.

3.11 Public Services

This section provides the environmental analysis of the project's impacts on public services (e.g., fire protection, police protection, schools and other public facilities such as libraries). The section summarizes the regulatory environment and discusses the environmental setting, provides the criteria used for determining impacts, discusses the impact mechanisms and level of impact resulting from construction and implementation of the project, and describes mitigation to minimize the level of impact, if necessary.

3.11.1 Regulatory Setting

There are no federal or state regulations applicable to the proposed project. The *Vista 2035 East Palo Alto General Plan* (City of East Palo Alto 2016), the *City of Menlo Park General Plan* (City of Menlo Park 2016), and the *City of Palo Alto Comprehensive Plan 2030* (City of Palo Alto 2017) contain policies related to the provision of public services in the project area.

Local Vista 2035 East Palo Alto General Plan

The *Vista 2035 East Palo Alto General Plan* was adopted on October 4, 2016. One of the guiding principles of the General Plan is to provide high quality public facilities and infrastructure. The Infrastructure, Services, and Facilities Element includes goals to ensure safe and well-maintained telecommunications services.

- **Goal ISF-6**. Ensure safe and well-maintained telecommunications services.
- **Goal ISF-7**. Ensure high-quality educational opportunities for East Palo Alto students.
- **Goal ISF-8**. Provide high-quality public and civic facilities for the community.
- **Goal ISF-10**. Provide excellent emergency services to the community.
- **Goal SN-3**. Reduce the risk of fire and wildfire hazards in the community.

City of Menlo Park's General Plan

The *City of Menlo Park's General Plan* was adopted on November 29, 2016. One of the guiding principles in the General Plan is "equity in the provision of education, and public services for all community members." The Safety Element includes Goal S1 to "minimize risk to life and damage to the environment and property from natural and human-caused hazards and assure community emergency preparedness and a high level of public safety services and facilities.".

City of Palo Alto Comprehensive Plan 2030

The *City of Palo Alto Comprehensive Plan 2030* was adopted on November 13, 2017. The Comprehensive Plan has eight major themes: Building Community and Neighborhoods, Maintaining and Enhancing Community Character, Reducing Reliance on the Automobile, Meeting Housing Supply Challenges, Protecting and Sustaining the Natural Environment, Keeping Palo Alto Prepared, Meeting Residential and Commercial Needs, and providing Responsive Governance and Regional Leadership. The Comprehensive Plan includes the seven state-mandated elements and the optional elements of Business and Economics and Community Services and Facilities. Each element includes goals, policies, and programs that are the essence of the Comprehensive Plan and provide a framework to guide decisions on a wide range of issues.

Other

The San Francisquito Creek Multi-agency Coordination (SFC MAC) deals with hazards near the Creek. The SFC MAC will mobilize for maximum utilization of all available resources during a severe storm or flood that present a risk to public safety or where disruption of transportation, utilities or other services or infrastructure is anticipated or occurs. The SFC MAC is currently composed of the following:

- City of East Palo Alto
- City of Menlo Park
- City of Palo Alto
- County of San Mateo
- County of Santa Clara
- Menlo Park Fire Protection District (MPFPD)
- Santa Clara Valley Water District
- San Francisquito Creek Joint Powers Authority (SFCJPA)
- Stanford University

The SFC MAC Plan is maintained by the Palo Alto Office of Emergency Services, serving as the chair of the SFC MAC.

3.11.2 Environmental Setting

Study Area

The study area for this public services analysis is the project site and the jurisdiction of each of the project area's service providers. The west/north bank of the project site is located in the Cities of Menlo Park and East Palo Alto. Service providers include Menlo Park Municipal Water, MPFPD, Menlo Park Police Department (MPPD), Menlo Park City School District, East Palo Alto Police Department, Ravenswood City School District (RCSD), and Sequoia Union High School District. The south/east bank of the project site is located in the City of Palo Alto. Service providers include the Palo Alto Police Department (PAPD), the Palo Alto Fire Department (PAFD), and the Palo Alto Unified School District (PAUSD). The north bank of the project site near U.S. 101 is located in the City of East Palo Alto. Service providers to East Palo Alto include the MPFPD, the East Palo Alto Police Department, RCSD, and the Sequoia Union High School District (SUHSD). Each of these providers serves the project site.

Existing Conditions

Fire Protection

East Palo Alto and Menlo Park. The MPFPD, which is a special service district separate from the cities, provides fire protection services to the City of East Palo Alto and areas on the west side of U.S.

101 within East Palo Alto and Menlo Park. The MPFPD service area comprises 30 square miles and covers the communities of Atherton, Menlo Park, East Palo Alto, and some of the unincorporated areas of San Mateo County. MPFPD staffs five fire stations in Menlo Park, one fire station in Atherton, and one fire station in East Palo Alto. The nearest station to the project site within East Palo Alto is Fire Station 2, located at 2290 University Avenue, approximately 0.7 mile north of the project site. The nearest station to the project site within Menlo Park is Fire Station 1, at 300 Middlefield Road, approximately 0.3 mile northwest of the project site (Menlo Park Fire Protection District 2018).

Palo Alto. The City of Palo Alto's PAFD provides fire protection services to the City of Palo Alto and areas on the east/south side of the project site. The PAFD service area comprises 50 square miles from Skyline Boulevard in the Palo Alto foothills to the Palo Alto Baylands. PAFD staffs seven fulltime fire stations located throughout the city. An eighth station in the foothills is operated during summer months when fire danger is high. The nearest fire station to the project site is Fire Station 1, at 301 Alma Street in Palo Alto, approximately 0.2 mile southeast of the project site. PAFD has mutual aid agreements with Menlo Park, Mountain View, Los Altos, and Woodside (City of Palo Alto 2018a).

Police Services

East Palo Alto. The East Palo Alto Police Department provides police service to the City of East Palo Alto. The East Palo Alto Police Department operates from its headquarters at 141 Demeter Avenue, which is approximately 1 mile north of the closest portion of the project site in East Palo Alto. It is divided into four beats with one police officer patrolling each beat. The portion of the project site in East Palo Alto, west of U.S. 101, is in Beat 4 (City of East Palo Alto 2018).

Menlo Park. MPPD provides police service to the City of Menlo Park and the portion of the project site within Menlo Park. MPPD divides its service area by three beats. Beat 2 covers the area between El Camino Real and U.S. 101. The MPPD is at 701 Laurel Street, approximately 0.5 mile west of the closest portion of the project site.

Palo Alto. PAPD provides police service to the City of Palo Alto and the portion of the project site within Palo Alto. PAPD responds to approximately 60,000 service calls each year and has approximately 169 employees. PAPD is at 275 Forest Avenue, approximately 0.5 mile southeast of the closest portion of the project site (City of Palo Alto 2018b).

Schools

East Palo Alto. The City of East Palo Alto, including the area to the west of the project site, is served by two school districts: the RCSD for grades K through 8 and SUHSD for grades 9 through 12 (Ravenswood City School District 2018; Sequoia Union High School District 2018).

RCSD serves the communities of East Palo Alto and East Menlo Park and has its headquarters in East Palo Alto. RCSD consists of six elementary schools (K-5 or K-8), three middle schools, and one charter high school. The nearest RCSD school to the project site is the Ronald McNair Academy at 2033 Pulgas Avenue in East Palo Alto, approximately 0.5 mile north of the project site (Ravenswood City School District 2018).

SUHSD serves approximately 8,900 students from the communities of Atherton, Belmont, East Palo Alto, Menlo Park, Portola Valley, Redwood City, Redwood Shores, San Carlos, and Woodside. SUHSD consists of four high schools; the nearest SUHSD school to the project site is the East Palo Alto

Academy, at 1050 Myrtle Street in East Palo Alto, approximately 0.6 mile north of the project site (Sequoia Union High School District 2018).

Menlo Park. The City of Menlo Park is served by four elementary school districts (Menlo Park City School, Redwood City School, Las Lomitas School, and Ravenswood City School Districts) and one high school district (Sequoia Union High School District) (Placeworks 2016:4.12-28). The closest school to the project site is the German American International School at 475 Pope Street in Menlo Park, approximately 0.2 mile north of the project site.

Palo Alto. The City of Palo Alto, including the area to the south of the project site, is served by the PAUSD. PAUSD serves approximately 11,000 students and consists of 13 elementary schools (grades K-5), three middle schools (grades 6–8), and two high schools (grades 9–12). The closest PAUSD school to the project site is the Duveneck Elementary School, at 705 Alester Avenue, approximately 0.3 mile south of the project site (Palo Alto Unified School District 2018).

Other Public Facilities

East Palo Alto. East Palo Alto is part of the San Mateo County Library network. The San Mateo County Library has 12 branches, including the East Palo Alto Library at 2415 University Avenue, approximately 1.0 mile north of the project site (Circlepoint 2016:4.13-10).

Menlo Park. The City of Menlo Park has one public library system with two locations: the Main Library on Alma Street and the Branch Library on Ivy Drive. The Main Library at 800 Alma Street is approximately 0.7 mile northwest of the project site (Placeworks 2016:4.12-43).

Palo Alto. The City of Palo Alto's public library system comprises six libraries. The closest Palo Alto library to the project site is the Main Library (a.k.a. Rinconada Library), at 1213 Newell Road, approximately 0.7 mile south of the project site (City of Palo Alto 2017:164).

3.11.3 Impact Analysis

Methods and Significance Criteria

Impacts on public services were analyzed based on a review of the service providers' websites, the Vista 2035 East Palo Alto General Plan, City of Menlo Park's General Plan, and City of Palo Alto Comprehensive Plan.

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would:

- Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:
    - Fire protection
    - Police protection
    - Schools
    - Other public facilities

Each impact discussion includes a summary table identifying the level of impact associated with the individual project elements, followed by text analysis.

Impacts and Mitigation Measures

Impact PS-1—Adversely affect fire protection services or require the provision of new or physically altered fire protection facilities

Summary by Project Element: Impact PS-1— Adversely affect fire protection services or require the provision of new or physically altered fire protection facilities		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
All Project Elements and Alternatives	Less than Significant	Less than Significant

Construction

For all alternatives, project construction is expected to require two years, with bridge construction approximately 9 months. It is unlikely that construction activities would materially increase the need for emergency fire protection during this time. Existing fire services are expected to be adequate and capable of ensuring safety during project construction. Site plans would be subject to review by the Cities of East Palo Alto, Menlo Park, and Palo Alto; and by the PAFD and MPFPD. Therefore, construction-period impacts on fire protection services would be less than significant. No mitigation is required.

Operation and Maintenance

As described above, the project site is currently served by the SFC MAC, including PAFD and MPFPD. The project is designed to reduce the floodplain of San Francisquito Creek and would not adversely affect access to any populated areas. Therefore, the project would not alter the fire protection service providers' ability to serve the project site. The replacement of Pope-Chaucer Bridge would require an alternative route for up to 9 months during construction; however, there would still be access across San Francisquito Creek to the east and west, and the impact would be temporary. Additionally, project site plans would be reviewed by all fire protection service providers in the project area to ensure usability and access. Therefore, implementation of the project would result in less-than-significant impacts on fire protection services. No mitigation is required.

Impact PS-2—Adversely affect police services or require the provision of new or physically altered police facilities

Summary by Project Element: Impact PS-2—Adversely affect police services or require the provision of new or physically altered police facilities		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
All Project Elements and Alternatives	Less than Significant	Less than Significant

Construction

Project construction (except detention basins) is expected to take place over 2 years. Similar to the discussion under Impact PS-1, it is unlikely that construction activities would increase the need for police services during this time. Existing police services are expected to be adequate and capable of ensuring safety during project construction. Site plans would be subject to review by the Cities of Palo Alto, Menlo Park and East Palo Alto; and by the PAPD, MPPD, and East Palo Alto Police Department. Therefore, construction-period impacts on police services would be less than significant. No mitigation is required.

Operation and Maintenance

The project site is currently served by the PAPD, MPPD, and the East Palo Alto Police Department. Implementation of the project would not alter the police service providers' ability to serve the project site. The project is designed to reduce the floodplain of San Francisquito Creek, which would not adversely affect access to any populated areas or alter the police service's ability to serve the project site. The replacement of Pope-Chaucer Bridge would require an alternative route for up to approximately 9 months during construction; however, there would still be access across San Francisquito Creek to the east and west, and the impact would be temporary. Therefore, implementation of the project would result in a less-than-significant impact for police services. No mitigation is required.

Impact PS-3—Adversely affect schools or require the provision of new or physically altered school facilities

Summary by Project Element: Impact PS-3—Adversely affect schools or require the provision of new or physically altered school facilities		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
All Project Elements and Alternatives	No Impact	No Impact

For all alternatives, the project is designed to reduce the floodplain of San Francisquito Creek and does not include residential development. The need for school services is generally associated with increases in residential populations as households may contain school-aged children. Because the project would not result in a population increase or a corresponding increase in school-aged children, there would be no impact on school facilities. No mitigation is required.

Impact PS-4—Adversely affect other public facilities or require the provision of new or physically altered governmental facilities

Summary by Project Element: Impact PS-4—Adversely affect other public facilities or require the provision of new or physically altered governmental facilities		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
All Project Elements and Alternatives	No Impact	No Impact

No alternative would affect the demand for any other public services. There would be no impact. No mitigation is required.

3.11.4 Cumulative Impacts

Impacts associated with the proposed project would be primarily short-term, construction-related impacts, and specific to a particular location and time along San Francisquito Creek or the detention basin. However, ongoing maintenance and monitoring activities may include vegetation removal, ongoing riparian planting, and/or repeated excavation or removal of deposited sediments. Construction and operational activities would neither contribute to nor cause a significant cumulative impact because any potential project impacts would be less than significant, and it is unlikely that other projects would impact the same public services at the same time during the 9-month construction window. Another bridge across San Francisquito Creek within Palo Alto/East Palo Alto is planned for replacement (Newell Bridge). However, this bridge needs to be replaced prior to implementation of the proposed project, or increased flows allowed by the proposed project would cause an increase in the incidence of flooding at the Newell Bridge site. Based on the factors described above, the proposed project would not have cumulatively considerable effects relative to public services.

3.11.5 References

Circlepoint. 2016. *East Palo Alto General Plan Update Draft Environmental Impact Report*. Prepared for City of East Palo Alto.

City of East Palo Alto. 2016. *Vista 2035 East Palo Alto General Plan*. Adopted October 4, 2016.

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Sequoia Union High School District. 2018. *Sequoia Union High School District*. Available: http://www.seq.org/. Accessed: November 5, 2018.

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3.12 Recreation

This section provides environmental analysis of the proposed project's impacts on recreation. Specifically, it summarizes the regulatory environment, discusses the environmental setting, provides the criteria used for determining impacts, discusses the level of impact resulting from construction and implementation of the project, and describes mitigation to minimize the level of impact.

3.12.1 Regulatory Setting

Public recreational facilities in the project vicinity are provided by the Counties of Santa Clara and San Mateo, and the Cities of Palo Alto, Menlo Park, and East Palo Alto. The plans listed below establish planning guidelines for recreational facilities in the project vicinity.

Santa Clara County General Plan

The *Santa Clara County General Plan* was adopted in December 1994 (County of Santa Clara 1994). It presents broad objectives and policies to guide land use decisions within the County and represents a vision for the County's future. The Parks and Recreation chapter of the general plan describes strategies and policies for accommodating the increased demand for recreational resources. The following policies are applicable to the proposed project:

Policy C-PR 1: An integrated and diverse system of accessible local and regional parks, scenic roads, trails, recreation facilities, and recreation services should be provided.

Policy C-PR 2: Sufficient land should be acquired and held in the public domain to satisfy the recreation needs of current and future residents and to implement the trailside concept along our scenic roads.

Policy GC- PR 5: Water resource facilities, utility corridors, abandoned railroad tracks, and reclaimed solid waste disposal sites should be used for compatible recreational uses, where feasible.

Policy C-PR 9: The parks and recreation system should be designed and implemented to help attain open space and natural environment goals and policies.

San Mateo County General Plan

The *San Mateo County General Plan* was adopted in November 1986 (County of San Mateo 1986). The general plan provides information on the existing natural and man-made conditions of the physical environment; identifies key plans, regulations, and agencies that make planning decisions; and makes recommendations for improving this coordination. The plan also indicates the type of development that the County desires, where it should be located, and how it should be regulated. The following policies are applicable to the proposed project:

Policy 6.2: Meet Recreational Need. Meet identified relative park and recreation needs in a manner that best enhances the physical, mental, and spiritual quality of life of San Mateo County residents.

Policy 6.3: Build upon Existing System. Design all park and recreation systems on the strengths and potentials of existing facilities and develop programs for meeting current and future needs.

Policy 6.4: Environmental Compatibility. Protect and enhance the environmental quality of San Mateo County when developing park and recreation facilities.

City of Palo Alto Comprehensive Plan

The *City of Palo Alto Comprehensive Plan* was adopted in November 2017 (City of Palo Alto 2017). The Comprehensive Plan is the primary tool for guiding future development of the City. It includes the Natural Environment Element and Community Services and Facilities Element, which includes goals and policies related to parks and recreation facilities. The following goals and policies are applicable to the proposed project:

Goal L-8: Provide attractive and safe parks as well as civic and cultural facilities in all neighborhoods and maintain and use in ways that foster and enrich public life.

Policy L-8.1: Facilitate creation of new parkland to serve Palo Alto's residential neighborhoods, consistent with the Parks, Trails, Open Space, and Recreation Master Plan.

Goal N-1: Protect, conserve, and enhance Palo Alto's citywide system of open space, including connected and accessible natural and urban habitats, ecosystems, and natural resources, providing a source of public health, natural beauty, and enjoyment for Palo Alto residents.

Policy N-1.2: Maintain a network of parks and urban forests from the urban center to the foothills and Baylands that provide ecological benefits and access to nature for all residents.

Policy N-1.7: Carefully manage access and recreational use of environmentally sensitive areas, including the Baylands, foothills, and riparian corridors, in order to protect habitats and wildlife from the impacts of humans and domesticated animals.

Policy N-1.10: Support regional and sub-regional efforts to acquire, develop, operate, and maintain a seamless open space system, including habitat linkages and trail connections extending north–south and east–west from Skyline Ridge to San Francisco Bay.

Policy N-1.13: Evaluate and mitigate the construction impacts associated with park and recreational facility creation and expansion.

City of Menlo Park General Plan

The *City of Menlo Park General Plan* was adopted in November 2016 (City of Menlo Park 2016). The general plan embraces and carries out, through its goals, policies, and programs, the community's vision for the future physical development of the City. The Open Space/Conservation, Noise, and Safety Element includes goals and policies related to recreation. The following goal and policies are applicable to the proposed project:

GOAL LU-6: Preserve open space lands for recreation, protect natural resources and air and water quality, and protect and enhance scenic qualities.

Policy LU-6.1: Parks and Recreation System. Develop and maintain a parks and recreation system that provides areas, playfields, and facilities that are conveniently located and properly designed to serve the recreation needs of all Menlo Park residents.

Policy LU-6.7: Habitat Preservation. Collaborate with neighboring jurisdictions to preserve and enhance the bay, shoreline, San Francisquito Creek, and other wildlife habitats and ecologically fragile areas to the maximum extent possible.

Policy OSC1.1: Natural Resources Integration with Other Uses. Protect Menlo Park's natural environment and integrate creeks, utility corridors, and other significant natural and scenic features into development plans.

Policy OSC1.2: Habitat for Open Space and Conservation Purposes. Preserve, protect, maintain, and enhance water, water-related areas, and plant and wildlife habitat for open space and conservation purposes.

Policy OSC1.7: San Francisquito Creek Joint Powers Authority. Continue efforts through the San Francisquito Creek Joint Powers Authority to enhance the value of the creek as a community amenity for trails and open space, conservation, and educational opportunities.

Policy OSC2.1: Open Space for Recreation Use. Provide open space lands for a variety of recreation opportunities, make improvements, construct facilities, and maintain programs that incorporate sustainable practices and promote healthy living and the quality of life.

Vista 2035 East Palo Alto General Plan

The *Vista 2035 East Palo Alto General Plan* was adopted in October 2016 (City of East Palo Alto 2016). It describes a vision for East Palo Alto for the next 20 to 30 years and includes a vision statement, guiding principles, and a list of the major strategies needed to achieve the vision. The following goal and policies are applicable to the proposed project:

Goal POC-1: Create new parks and open spaces throughout the City.

Policy 1.1: New Parks and Open Space. Maintain a park standard of 3 acres per 1,000 residents. Undertake a program to add 79 acres of new formalized park spaces, prioritizing the areas of the City currently underserved by parks (Weeks, Kavanaugh, Willow, and Woodland).

Policy 1.10: New Trails and Paths. Construct new trails or multiuse paths, particularly along San Francisquito Creek or in the Baylands.

Policy 1.11: Gap Closure. Work to fill critical gaps in the City's trail network, particularly by completing the Bay Trail and other planned connections in the Ravenswood Employment District and along San Francisquito Creek between O'Connor and University Avenue.

3.12.2 Environmental Setting

Study Area

The study area for this analysis includes recreational resources within 0.25 mile of the creek, between U.S. 101 and Searsville Lake, which includes the Counties of Santa Clara and San Mateo and the Cities of East Palo Alto, Palo Alto, and Menlo Park.

Existing Conditions

Uses adjacent to the project site include mainly single- and multi-family residential uses, with limited commercial development. In addition, seven parks or recreational facilities are located within the study area:

- Hopkins Creekside Park
- Johnson Park
- El Palo Alto Park
- El Camino Park
- Stanford Golf Course
- Lagunita Reservoir
- Jasper Ridge Biological Preserve

Hopkins Creekside Park is located in Reach 2. All other designated parks or recreational facilities are located in Reach 3.

Hopkins Creekside Park is adjacent to the project site and north of Palo Alto Avenue, stretching from Emerson Street to Marlowe Street. The park consists of approximately 12.4 acres of mostly undeveloped land along the banks of San Francisquito Creek. In general, the park is about 1.5 miles long and 200 feet wide at its widest point. Two open areas provide amenities such as maintained lawns, benches, picnic tables, and trash receptacles (City of Palo Alto 2007a).

Johnson Park is located between Waverley and Kipling Streets and Everett and Hawthorne Avenues, approximately 0.13 mile southeast of the creek. This 2.5-acre neighborhood park provides a children's playground, basketball hoop, picnic tables, benches, volleyball sand pit, community garden plots, and pathways (City of Palo Alto 2007b).

El Palo Alto Park is located between Alma Street, the Caltrain tracks, and San Francisquito Creek. The 0.5-acre park includes a lighted bicycle/pedestrian pathway that connects Palo Alto to Menlo Park. In addition to the pathway, as well as a bridge that spans over the creek, the park includes six interpretive plaques that provide a history of the area and environmental information pertaining to the San Francisquito Creek watershed. The park also features El Palo Alto, a redwood tree that is more than 1,000 years old and designated as California Heritage Landmark #2 (City of Palo Alto 2010). In addition to El Palo Alto Park, another bicycle/pedestrian bridge links Palo Alto to Menlo Park in the vicinity of Waverley Street. This bridge connects Willow Road (in Menlo Park) to Palo Alto Avenue (in Palo Alto); however, no designated trails are located in this area. The San Francisquito Creek Trail is part of a larger trail system that, when complete, will extend from the Stanford University campus to the west to the bay margin to the east, generally following the creek. In the vicinity of the project site, however, this trail is limited; only a small segment exists in El Palo Alto Park before crossing over the Caltrain tracks and El Camino Real.

El Camino Park is the City of Palo Alto's oldest park. It opened in 1914 and has been used for sports activities ever since. The 12.9-acre park is on the corner of El Camino Real and Alma Street, across from the Stanford Shopping Center and approximately 200 feet south of San Francisquito Creek. The park includes a soccer field and a softball field with bleachers, lights, and a parking lot (City of Palo Alto 2015).

Stanford Golf Course is an 18-hole golf course on Stanford University property. San Francisquito Creek flows through the course, which is in the foothills above the Stanford University campus. Because this resource is privately owned and not freely open to the public, it is not considered further in this analysis.

Lagunita Reservoir is a small offstream reservoir. Water is diverted from San Francisquito Creek to feed the reservoir, which is on Stanford University property. Popular walking and jogging trails follow the perimeter of the reservoir.

Jasper Ridge Biological Preserve is an 1,189-acre area that provides a natural laboratory for researchers, educational experiences for students and docent-led visitors, and refuge for native plants and animals. It is owned and managed by Stanford University. The preserve is not open to the general public; however, docent-led tours are available by appointment. Searsville Reservoir was once a popular location for swimming but has been closed to the general public since its incorporation into the Jasper Ridge Biological Preserve in 1975 (Jasper Ridge Biological Preserve 2017). This small reservoir is on Corte Madera Creek, which is Stanford University property.

3.12.3 Impact Analysis

Methods and Significance Criteria

Assessments of recreational impacts were based on professional judgment, with consideration of standard land use and recreation planning practices. The analysis considered temporary impacts during construction as well as long-term impacts.

For the purposes of this analysis, an impact was considered to be significant, therefore requiring mitigation, if it would result in any of the following:

- A need for new parks or recreational facilities or expansion of existing facilities.
- Increased use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facilities would occur or be accelerated.
- Substantially reduced access to existing recreational facilities or substantially reduced availability of existing recreational facilities or uses.

Each impact discussion includes a summary table, identifying the level of impact associated with the individual project elements, followed by text analysis.

Impacts and Mitigation Measures

This section includes a discussion of each impact as it corresponds to the significance criteria presented above.

Impact REC-1—Result in the need for development of new parks or recreational facilities, the need for expansion of existing facilities, or increased use of existing parks or other recreational facilities, thereby resulting in substantial physical deterioration

The following table shows the construction as well as operations and maintenance impact level for each project element as it relates to the need for development of new parks and recreational facilities, the need for expansion of existing facilities, and increased use of existing facilities such that substantial physical deterioration would result.

Summary by Project Element: Impact REC-1—Result in the need for development of new parks or recreational facilities, the need for expansion of existing facilities, or increased use of existing parks or other recreational facilities, thereby resulting in substantial physical deterioration		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
All Project Elements	Less than Significant	Less than Significant

Construction

The need for development of new parks and recreational facilities, the need for expansion of existing facilities, and increased use of existing facilities are directly related to the potential for a project to either directly or indirectly induce population growth in an area. Construction of the project would include construction of temporary access ramps; however, these roads would be used for temporary construction activities and would not result in population growth. Construction activities for the other project elements, including replacing Pope-Chaucer Bridge, channel widening, extension of University Avenue Bridge parapet and concrete removal, aquatic habitat enhancement, construction of Creekside parks, and detention basin construction would also not result in population growth because construction activities would be temporary.

Construction activities would occur within the Cities of East Palo Alto and Palo Alto but would not result in the displacement of any officially designated parks or recreational facilities. However, replacement of the Pope-Chaucer Bridge would result in the loss of approximately 4,000 square feet of recreation/respite area. This area would be replaced by construction of the Creekside pocket parks, which would offset this impact.

During the construction period, construction workers could use nearby parks and recreational facilities while on a break (e.g., during lunch, before or after shifts), but this would result in a very small increase in the use of existing facilities. It would not be substantial enough to result in the need for new facilities, expansion of existing facilities, or substantial physical deterioration. Therefore, construction of the project elements would not result in the need for the development of new parks and recreational facilities, the need for expansion of existing facilities, or increased use of existing facilities such that substantial physical deterioration would result. Impacts would be less than significant.

Operations and Maintenance

The project would not require an extension of existing roads or other infrastructure that would directly or indirectly induce substantial population growth. In addition, the project would not add any new housing or businesses that could contribute to the population of the area.

The project may include construction of two small creekside parks along Woodland Avenue in Reach 2. The parks may include landscaping and benches. The total area of each creekside park would be a maximum of 400 square feet. This project feature would add new parks and recreational facilities to the study area, which would be a beneficial effect.

Required project operations and maintenance activities would include inspections, debris removal in the channel, post-flood cleanup, new vegetation monitoring and maintenance, trash pickup and disposal, and routine maintenance of benches and landscaping at the creekside parks. These activities would involve a small number of workers who could use nearby parks and recreational facilities during breaks or before or after shifts. However, it would not be substantial enough to result in the need for new facilities, expansion of existing facilities, or substantial physical deterioration. Therefore, operation and maintenance of any of the project elements would not result in the need for the development of new parks and recreational facilities, the need for expansion of existing facilities, or increased use of existing facilities such that substantial physical deterioration would result. Impacts would be less than significant.

Impact REC-2—Substantially reduced access to existing recreational facilities and substantially reduced availability of existing recreational facilities or uses

The following table shows the impact level of construction and of operations and maintenance for each project element, as related to reduced access to existing facilities or reduced availability of existing facilities.

Summary by Project Element: Impact REC-2—Substantially reduced access to existing recreational facilities and substantially reduced availability of existing recreational facilities or uses		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
Channel Widening Alternative:		
Replace Pope-Chaucer Bridge	Less than Significant	No Impact
Channel Widening at Sites 1 through 4	No Impact	No Impact
Channel Widening at Site 5	No Impact	No Impact
Extension of University Avenue Bridge Parapet and Concrete Removal	No Impact	No Impact
Aquatic Habitat Enhancement	No Impact	No Impact
Construction of Creekside Parks	No Impact	No Impact
Floodwalls Alternative	Less than Significant	No Impact
Former Nursery Detention Basin Alternative	Less than Significant with Mitigation	No Impact
Webb Ranch Detention Basin Alternative	Less than Significant with Mitigation	No Impact

Construction

Channel Widening Alternative: Replace Pope-Chaucer Bridge

The nearest officially designated park or recreational facility to the Pope-Chaucer Bridge is Hopkins Creekside Park, approximately 0.7 mile west of the bridge. Replacement of the Pope-Chaucer Bridge would require temporary closure of the existing bridge for approximately 9 months. Vehicles, pedestrians, and bicyclists would be required to use other nearby crossings, such as Middlefield Road, during the construction period. These construction activities would diminish access at the creek. However, this reduction in access would not substantially affect access to Hopkins Creekside Park because of the distance between the park and the bridge.

In addition, construction activities would not result in the displacement of any officially designated parks or recreational facilities. However, replacement of the Pope-Chaucer Bridge would result in the loss of approximately 4,000 square feet of recreation/respite area. This area could be replaced by construction of the Creekside pocket parks, which would offset this impact.

Therefore, replacement of the Pope-Chaucer Bridge would have a less-than-significant impact on access and the availability of parks and recreational facilities during construction.

Channel Widening Alternative: Channel Widening at Sites 1 through 4 and at Site 5

There are no parks or recreational facilities in the vicinity of channel widening Sites 1 through 5. The nearest park is Hopkins Creekside Park, approximately 1 mile west of Access Ramp 1. Even though there would be temporary traffic stops, with flaggers, at each access ramp and traffic would be one way on Woodland Avenue when a concrete truck is operating from the road, these temporary changes in access would not reduce access or the availability of park and recreational facilities because of the distance between the parks and Sites 1 through 5. Therefore, there would be no impact related to access or the availability of resources.

Channel Widening Alternative: Extension of University Avenue Bridge Parapet and Concrete Removal

There are no parks or recreational facilities in the vicinity of the University Avenue Bridge parapet extension and concrete removal. The nearest park is Hopkins Creekside Park, which is more than 1 mile west of the site. In addition, construction activities would not require street or lane closures or other changes in access. Therefore, there would be no impact.

Channel Widening Alternative: Aquatic Habitat Enhancement

Construction activities related to aquatic habitat enhancement would not require street or lane closures or other changes in access. Therefore, there would be no impact on parks or recreational facilities related to access or the availability of resources.

Channel Widening Alternative: Construction of Creekside Parks

There are no parks or recreational facilities in the vicinity of the creekside parks. The nearest park is Hopkins Creekside Park, which is more than 1 mile west of the sites. In addition, construction activities would not require street or lane closures or other changes in access. Therefore, there would be no impact related to access or the availability of resources.

Floodwalls Alternative

The Floodwalls Alternative includes the construction of floodwalls, in addition to the following elements, which are described in the Channel Widening Alternative section above: Pope-Chaucer Bridge replacement, channel Site 5 widening, aquatic habitat restoration, and construction of creekside parks. The impact determinations for Pope-Chaucer Bridge replacement, channel Site 5 widening, aquatic habitat restoration, and construction of creekside parks are the same as described above.

Construction of the floodwalls would require access from Woodland Avenue. The access ramps and upland staging area shown for the Channel Widening Alternative in Figures 2-3 through 2-6 would be used for this alternative. Traffic would be controlled (flagged) in areas where the concrete truck would be operating. However, there are no parks or recreational facilities in the vicinity of this alternative. The nearest park is Hopkins Creekside Park, approximately 1 mile west of Access Ramp 1. Therefore, temporary changes in access during construction would have no effect on the availability of parks or recreational facilities. The impact would be less than significant because of potential minor access changes resulting from construction at the Pope-Chaucer Bridge.

Former Nursery Detention Basin Alternative

The Former Nursery Detention Basin Alternative would be east of the Jasper Ridge Biological Preserve, adjacent to the closed Stanford Primate Research Center. Land for the detention basin and staging area would require some of the surrounding roads to be acquired, which would affect access to the preserve. Although access would be still available south of the proposed detention basin, this impact would be potentially significant. However, MM-REC-1 would be implemented, which would ensure that access to the preserve would be maintained. With implementation of this mitigation measure, impacts would be less than significant.

MM-REC-1—Maintain access to Jasper Ridge Biological Preserve for the Former Nursery Detention Basin Alternative

Prior to construction activities, the San Francisquito Creek Joint Powers Authority will ensure continued access to Jasper Ridge Biological Preserve by realigning Ansel Lane so that the roadway still connects to the north side of the preserve.

Webb Ranch Detention Basin Alternative

The Web Ranch Detention Basin Alternative would be approximately 0.5 mile east of the Jasper Ridge Biological Preserve. Land for the detention basin would require part of San Francisquito Creek Road, which leads to the beginning of a trail access point in the Jasper Ridge Biological Preserve, to be acquired. Acquisition of this road would affect access to the preserve. Although access would be still available north of the proposed detention basin, this impact would be potentially significant. MM-REC-2 would be implemented, which would ensure that access to the preserve would be maintained. With implementation of this mitigation measure, impacts would be less than significant.

MM-REC-2—Maintain access to Jasper Ridge Biological Preserve Webb Ranch Detention Basin Alternative

Prior to construction activities, the project sponsor will ensure continued access to Jasper Ridge Biological Preserve by realigning San Francisquito Creek Road, thereby ensuring access to all trails within the preserve.

Operations and Maintenance

Operation and maintenance of the project elements for any of the alternatives would not affect access or the availability or park resources because no lane closures, detours, or other changes in access would be required. Therefore, there would be no impact.

3.12.4 Cumulative Impacts

As discussed above, the proposed project would incorporate mitigation to ensure access to parks and recreational facilities throughout construction and operation of the project. Therefore, the project is not expected to have significant effects related to substantially reduced access to existing recreational facilities or substantially reduced availability of existing recreational facilities or uses and would not make a cumulatively considerable contribution to a cumulative impact. No further analysis is required.

3.12.5 References

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3.13 Traffic and Transportation

3.13.1 Regulatory Setting

Traffic and transportation planning in the project area is guided by California Government Code Section 65300, which requires each local government to include a circulation element as part of its general plan. The primary area potentially affected by project traffic (referred to in this EIR as the *transportation study area* or *study area*) includes roadways under the jurisdiction of the California Department of Transportation and the Cities of Palo Alto, Menlo Park, and East Palo Alto. A traffic analysis report, *Traffic Analysis for the Upstream of U.S. 101 San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project*, was prepared for the project by TJKM and used for the analysis of traffic impacts (TJKM 2018). The traffic analysis has been reviewed by the Cities, and is included as Appendix E (the traffic count sheets and Synchro reports are not included).

The quality of service provided by a roadway or intersection is typically measured in terms of three parameters:

- **Volume-to-capacity ratio (V/C):** The number of vehicles that travel on a transportation facility divided by the vehicular capacity of that facility (the number of vehicles the facility was designed to convey).
- **Delay:** The additional travel time experienced by a vehicle or traveler because of inability to travel at optimal speed and/or stops due to congestion or traffic control.
- **Level of service (LOS):** A scale used to determine the operating quality of a roadway segment or intersection, based on V/C or average delay experienced by vehicles on the facility. The levels range from A to F, with LOS A representing free traffic flow and LOS F representing severe traffic congestion.

The adopted roadway LOS standards for the project area are as follows:

- **Congestion Management Program (CMP) Roadway System:** The Santa Clara Valley Transportation Authority (VTA) is responsible for maintaining the performance and standards of the CMP roadway system in Santa Clara County. The City/County Association of Governments of San Mateo County (C/CAG) is responsible for maintaining the performance and standards of the CMP roadway system in San Mateo County. VTA and C/CAG strive to maintain LOS E operations on all CMP-monitored facilities, with the exception of segments that were operating at LOS F in 1991 (the date when the CMP was adopted). The LOS standard applied to such segments is LOS F (Santa Clara Valley Transportation Authority 2017; C/CAG 2018).
- **City of East Palo Alto:** LOS is calculated from average daily traffic (ADT) volumes. The performance criterion for evaluating roadway volumes to capacities is LOS D (City of East Palo Alto 2016).
- **City of Menlo Park:** The adopted LOS standard include Section V.B. of the *City of Menlo Park's Transportation Impact Analysis Guidelines*, which describe the LOS thresholds for roadway segments. The City strives to maintain LOS D or better at all City-controlled signalized intersections during peak hours, except at the intersection of Ravenswood Avenue and

Middlefield Road and intersections along Willow Road from Middlefield Road to U.S. 101, which are local approaches to state-controlled intersections which should not exceed LOS E.

- **City of Palo Alto:** The City of Palo Alto follows the CMP standards adopted by the VTA. Palo Alto uses a minimum LOS standard of D for intersections that are not monitored as part of the VTA CMP program.

The analysis of freeway ramp operations is based on a V/C ratio evaluation. Ramp capacities, which were obtained from the *Highway Capacity Manual* (Transportation Research Board 2000), consider free-flow speeds and the number of lanes on a ramp. Table 3.13-1 shows average intersection delay and typical driving conditions for each LOS, as defined by the *Highway Capacity Manual* methodology.

Table 3.13-1. Intersection Average Delay and Traffic-Flow Conditions for LOS Designations

	Average Delay (seconds per vehicle)		
LOS	**Stop-Controlled Intersection**	**Signalized Intersection**	**Traffic-Flow Conditions**
A	≤ 10.0	0–10.0	Free-flow operations; vehicles unimpeded in ability to maneuver in traffic stream
B	10.1–15.0	10.1–20.0	Reasonable free-flow conditions; only slightly restricted ability to maneuver
C	15.1–25.0	20.1–35.0	Flows still near free-flow speed but noticeably restricted ability to maneuver
D	25.1–35.0	35.1–55.0	Speeds begin to decline; maneuverability limited, and queues begin to form
E	35.1–50.0	55.1–80.0	Operation at capacity of roadway; maneuverability extremely limited, and queues form with any disruption
F	> 50	> 80	Failure conditions, indicating breakdowns in vehicular flow, with long queues forming at breakdown points

Source: Transportation Research Board 2000

City of East Palo Alto General Plan

Applicable goals and policies of the *City of East Palo Alto General Plan* are as follows:

Goal T-3. Create a complete, safe, and comfortable pedestrian network for people of all ages and abilities.

Policy 3.3 Pedestrian Network. Create a safe, comfortable, and convenient pedestrian network that focuses on a) safe travel; b) improving connections between neighborhoods and commercial areas, and across existing barriers; c) providing places to sit or gather, pedestrian-scaled street lighting, and buffers from moving vehicle traffic; and d) includes amenities that attract people of all ages and abilities.

City of Palo Alto General Plan

Applicable goals and policies of the *Palo Alto General Plan* are as follows:

Policy T-1.18. Increase cooperation with surrounding communities and other agencies to establish and maintain off-roadway bicycle and pedestrian paths and trails that are integrated with creek, utility, railroad rights-of-way and green spaces in a manner that helps enhance and define the community and avoids environmental impacts.

Policy T-1.20. Regularly maintain off-roadway bicycle and pedestrian paths, including sweeping, weed abatement and surface maintenance.

Policy T-4.1. Keep all neighborhood streets open as a general rule.

3.13.2 Environmental Setting

Study Area

The study area for transportation includes the project site and immediately surrounding roadways and intersections (as illustrated in Figure 2-2 and Figure 2-8) as well as the following construction haul routes: U.S. 101 to University Avenue for sites 1 through 4 and the U.S. 101 Embarcadero Road exit to East and West Bayshore Road.

Existing Conditions

Roadway System

The only roadway that would be closed during project construction is Pope Street/Chaucer Street at the Pope-Chaucer Bridge over San Francisquito Creek; therefore, the discussion that follows is limited to the existing roadway system, including the Pope-Chaucer Bridge and project vicinity roadways. The existing Pope-Chaucer Bridge over San Francisquito Creek is a 40-foot-wide, two-lane bridge between Woodland Avenue and Palo Alto Avenue. Surrounding land uses near the bridge are primarily single-family residential homes, with a few small businesses on Gilbert Avenue and Menalto Avenue. Key roadways within the project vicinity are described below.

- **University Avenue** is two-lane arterial street that runs from El Camino Real in the south to U.S. 101 in the north.
- **Middlefield Road** is a two- to four-lane arterial street that runs from Willow Road in the west to University Avenue in the east within the project vicinity.
- **Woodland Avenue** is primarily a two-lane local street that runs from University Avenue to Middlefield Road.
- **Chaucer Street** is a two-lane local street that runs from Hamilton Avenue in the east to Woodland Avenue in the west.
- **Pope Street** is a two-lane local street that runs from Woodland Avenue in the east to Walnut Street in the west.
- **Palo Alto Avenue** is a two-lane local street that runs from University Avenue in the north to Middlefield Road in the south.
- **Gilbert Avenue** is a two-lane collector street that runs from Willow Road in the west to Menalto Avenue in the east.

- **Willow Road** is primarily a two-lane arterial that runs from U.S. 101 in the north to Middlefield Road in the south within the project vicinity.

Figure 2 in the traffic analysis report (Appendix E) illustrates existing lane geometry and traffic controls at the study intersections. Figure 3 of the traffic analysis report illustrates 2018 traffic volumes.

Existing Level of Service

The existing-conditions (2018) scenario evaluated all study intersections using existing lane geometry, traffic controls, and traffic volumes. The results of the analysis of LOS, delay, and 95th-percentile queue length (in feet), using Synchro software, are summarized in Tables 2 and 3, respectively, in Appendix E.

Under the existing-conditions (2018) scenario, all study intersections operate within the applicable jurisdictional standards of the City of Palo Alto (LOS D or better) and the City of Menlo Park (LOS D or better) during the AM and PM peak hours, with the exception of the following:

- Middlefield Road/Woodland Avenue-Palo Alto Avenue – LOS F during PM peak hours

Transit

The study area is served by major transit providers and free shuttles services. The San Mateo County Transit District provides local and regional bus service, Caltrain provides commuter rail service, and Alameda-Contra Costa County Transit District provides service between Menlo Park and the Union City Bay Area Rapid Transit station.

Two bus stops are close to the Pope-Chaucer Bridge: Woodland Avenue and Woodland Court for Routes 83 and 88, and University Avenue and Chaucer Street for Routes 280, 281, 296 and 397.

Bicycle and Pedestrian Facilities

Bicycle facilities in the study area are divided into three classes, as follows:

- *Bike paths (Class I)* are paved facilities that are designated for bicycle use and physically separated from roadways by spaces or physical barriers.
- *Bike lanes (Class II)* are lanes on the outside edge of roadways that are reserved for the exclusive use of bicycles.
- *Bike routes (Class III)* are roadways that are recommended for bicycle use and often connected to bike lanes and bike paths.

Class II bike lanes in the study area include Willow Road and Alma Street in Menlo Park and Alma Street, Lytton Avenue, University Avenue, and Newell Road in Palo Alto. A Class I bike path in the study area runs between Stanford University and Alma Street. Bryant Street is a *bicycle boulevard* in Palo Alto (City of Palo Alto 2009).

Turning movement counts for vehicles, pedestrians, and bicycles at study area intersections were collected by TJKM on Tuesday, May 22, 2018, a typical weekday when schools were in session. The turning movement counts were collected for the weekday AM (7:00 a.m.–9:00 a.m.) and PM (4:00 p.m.–6:00 p.m.) peak periods. Figure 4 in Appendix E illustrates pedestrian and bicycle volumes for all study intersections.

Pedestrian facilities in the study area consist of sidewalks and crosswalks along the roadways in the residential neighborhoods and commercial areas. Sidewalks and crosswalks are found on at least one side of all roadways within the study area.

3.13.3 Impact Analysis

Methods and Significance Criteria

Project construction would intermittently generate substantial volumes of traffic related to material deliveries and construction employee access. Once the project is constructed, operation and maintenance needs would be limited. Traffic generation would be well within the capacity of the local roadway system and would not differ materially from current levels. Therefore, the analysis of traffic impacts focused on the project construction phase.

The analysis used estimated construction traffic generation (expressed as the maximum number of trips per day) to develop a qualitative evaluation of short-term impacts on local and regional roadways in the project vicinity. For the purposes of this analysis, an impact was considered to be significant, therefore requiring mitigation, if it would:

- Conflict with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation, including mass transit and non-motorized travel, and relevant components of the circulation system, including, but not limited to, intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit.
- Conflict with an applicable CMP, including, but not limited to, LOS standards and travel demand measures or other standards established by the County congestion management agency for designated roads or highways.
- Result in a substantial increase in hazards or risk of accident for vehicular or nonmotorized traffic due to a design feature (e.g., sharp curves or dangerous intersections) or the introduction of incompatible uses (e.g., slow-moving vehicles).
- Result in inadequate emergency access.
- Conflict with adopted policies, plans, or programs regarding public transit or bicycle or pedestrian facilities or otherwise decrease the performance or safety of such facilities.

Impacts and Mitigation Measures

Impact TT-1—Potential to conflict with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system

Summary by Project Element: Impact TT-1—Potential to conflict with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
All Project Elements and Alternatives Excluding the Replacement of Pope-Chaucer Bridge	Less than Significant	No Impact
Replace Pope-Chaucer Bridge	Less than Significant with Mitigation	No Impact

Construction

Implementation of the project would require hauling construction equipment/materials and transporting construction workers to and from the project area along major highways and local surface streets. Many of the construction-generated trips would involve slow-moving trucks, which would further affect highway traffic. Construction-generated traffic would temporarily increase daily and peak-hour traffic along specified routes, including residential streets; however, traffic levels on haul route roads would return to normal once construction is completed.

With the addition of construction-generated traffic, the maximum increase in traffic for any particular project feature or alternative would be 60 trips per day (20 truck trips and 40 worker trips), using conservative estimates. Replacing the Pope-Chaucer Bridge would require the most workers at any one time (20), while channel widening at sites 1 through 4 would require the most haul trips per day (20) of all project components and alternatives. The number of workers and number of trips for the Reach 3 alternatives is unknown but anticipated to be less than the number required to replace the Pope-Chaucer Bridge.

Traffic conditions on project access roads within the study area are within associated LOS standards during the peak hour. It is anticipated that an increase of eight trips per hour would not cause operation of these roadway segments to exceed LOS standards. However, there could be delays of up to 30 minutes at access ramps and there are alternate routes available. (Note that there would be no access ramp closures, just lane closures, with flaggers for guidance.) Therefore, the impact would be less than significant, and no mitigation is required.

According to the traffic analysis prepared by TJKM (Appendix E), under existing conditions with closure of the Pope-Chaucer Bridge, all study intersections would operate within the applicable jurisdictional standards of the City of Palo Alto (LOS D or better) and the City of Menlo Park during the AM and PM peak hours, with the exception of the following:

- Middlefield Road/Woodland Avenue-Palo Alto Avenue – LOS F during AM and PM peak hours

Under existing conditions, the Middlefield Road/Woodland Avenue-Palo Alto Avenue intersection operates at LOS C in the AM peak hours and LOS F in the PM peak hours. With the temporary bridge closure, the intersection would operate at LOS F during the AM peak period, because of the rerouted trips. During the PM peak period, this intersection would continue operate at LOS F; however, the delay experienced at the Woodland Avenue approach would be substantially higher than under existing conditions. To reduce this impact to a less-than-significant level, the following mitigation is included:

Construction at additional sites is not expected to occur at the same time due to current timing of known projects in the vicinity, and therefore would have minimal impact on intersections LOS.

MM-TT-1—Require a temporary traffic signal at Middlefield Road/Woodland Avenue-Palo Alto Avenue

San Francisquito Creek Joint Powers Authority (SFCJPA) will provide a temporary traffic signal at Middlefield Road/Woodland Avenue-Palo Alto Avenue for the duration of the closure of the Pope-Chaucer Bridge. This temporary traffic signal should be coordinated with the traffic signal on Willow Road at Middlefield Road due to the close proximity between the two signals.

Implementation of MM-TT-2, discussed below, would also help reduce this impact to a less-than-significant level by identifying working hours, allowable and restricted streets, allowable times for lane closures, emergency vehicle access, detours, and access to private and public properties.

Operation and Maintenance

During project operation and maintenance, the only trips to the project site would be occasional trips by operations and maintenance crews to inspect or possibly remove debris from the channel; these would occur before and possibly during the flood season after major flood events. Any creekside parks would require trash pickup and disposal as well as routine maintenance of benches and landscaping. In addition, new vegetation would be monitored and maintained, at a minimum, for 3 years following completion of the project. This would consist of weeding, inspecting newly planted vegetation, and replanting as needed. The number of trips would be minimal and would not decrease the performance of the local roadway system. No impact would occur.

Impact TT-2—Potential to conflict with an applicable congestion management program

Summary by Project Element: Impact TT-2—Conflict with an applicable congestion management program		
Project Component	Construction Impact Level	Operation and Maintenance Impact Level
All Project Elements and Alternatives	Less than Significant	No Impact

Construction

Segments of U.S. 101 in the study area operate at LOS F during peak hours, thereby exceeding the CMP LOS standard of LOS E. However, most of these segments have been assigned a CMP LOS standard of LOS F, because they have been operating at LOS F in 1991. Given the traffic LOS threshold defined by the CMP, for segments that operate at LOS F, the added vehicle trips from the project should not be more than 1 percent of freeway capacity (Santa Clara Valley Transportation Authority 2017).

As discussed in Impact TT-1, above, the maximum number of daily trips generated by project construction would be approximately 60, which is less than 1 percent of the daily traffic volume on

U.S. 101 in the study area (215,000 vehicles per day at the Santa Clara-San Mateo county line) (California Department of Transportation 2016:118). Therefore, the project is not expected to significantly degrade operations on regional highways or conflict with any applicable CMP. No mitigation is required.

Operation and Maintenance

As discussed in Impact TT-1, above, during project operation and maintenance, the only trips to the project site would be occasional trips by employees to remove debris from the channel, pick up trash, or perform other routine maintenance activities. The number of trips would be minimal and would not degrade operations on regional highways or conflict with any applicable CMP. No impact would occur.

Impact TT-3—Potential to create traffic safety hazards

Summary by Project Element: Impact TT-3—Potential to create traffic safety hazards		
Project Component	Construction Impact Level	Operation and Maintenance Impact Level
All Project Elements and Alternatives	Less than Significant with Mitigation	No Impact

Construction

For all project components and alternatives, the presence of large, slow-moving construction-related vehicles and equipment among the general-purpose traffic on roadways in the study area could result in potential local safety hazards. Safety concerns could also arise from the use of residential streets to access construction areas. On the Menlo Park and East Palo Alto side of the creek, project construction traffic would travel on West Bayshore Road and Woodland Avenue in proximity to sites that are regularly accessed by parents and children, including but not limited to, the German American International School, East Palo Alto High School and Willow Oaks School. On the Palo Alto side of the creek, heavy construction traffic would travel on University Avenue and Palo Alto Avenue in proximity to sites that are regularly accessed by parents and children, including Addison Elementary School, Duveneck Elementary School, Palo Alto High School, Walter Hayes Elementary School, and other schools in the vicinity. To address the potential for safety hazards related to construction traffic, SFCJPA would implement MM-TT-2. The traffic control plan specified in MM-TT-2 would be developed with input from school, park, and community stakeholders, ensuring that all safety needs would be identified and addressed. With the implementation of this measure, impacts related to traffic safety are expected to be less than significant.

MM-TT-2—Require a site-specific traffic control plan

SFCJPA will develop a site-specific traffic control plan to minimize the effects of construction traffic on surrounding roadways. The plan will be prepared with oversight by a licensed traffic engineer, with input from school district, park, and community stakeholders to ensure that all concerns are appropriately addressed. The plan will be subject to review and approval by the Cities of Palo Alto, Menlo Park and East Palo Alto. SFCJPA will be responsible for ensuring that the plan is effectively implemented.

The traffic control plan will include, at a minimum, information regarding working hours, allowable and restricted streets, allowable times for lane closures, emergency vehicle access, detours, and access to private and public properties. All construction traffic control plans will contain, at a minimum, the following general requirements:

- Restrict work site access to the roadways indicated on the traffic control plan.
- Prohibit access via residential streets unless expressly approved by the City with jurisdiction.
- Maintain two-way traffic flow on arterial roadways to active work areas to accommodate construction of project facilities, unless otherwise allowed by the City with jurisdiction.
- Provide 72-hour advance notification to affected residents or businesses if access to driveways or private roads will be affected. Limit effects on driveway and private roadway access to working hours and ensure that access to driveways and private roads is uninterrupted during non-work hours. If necessary, use steel plates, temporary backfill, or another accepted measure to provide access.
- Provide clearly marked pedestrian detours to address any sidewalk or pedestrian walkway closures.
- Provide clearly marked bicycle detours if bicycle route closures would occur or if bicyclist safety would be compromised.
- Provide crossing guards and/or flaggers as needed to avoid traffic conflicts and ensure pedestrian and bicyclist safety.
- Use non-skid traffic plates over open trenches to minimize hazards.
- Locate all stationary equipment as far away as possible from areas used by vehicles, bicyclists, and pedestrians.
- Notify and consult with emergency service providers, and provide emergency access by whatever means necessary to expedite and facilitate the passage of emergency vehicles. Ensure clear emergency access to all existing buildings and facilities at all times.
- Queue trucks only in areas and at times allowed by the City with jurisdiction.
- Provide adequate parking for construction vehicles, equipment, and workers within the designated staging areas throughout the construction period. If inadequate space for parking is available at a given work site, provide an off-site staging area at another suitable location, and coordinate the daily transport of construction vehicles, equipment, and personnel to and from the work site as needed.
- Fences, barriers, lights, flagging, guards, and signs will be installed as determined appropriate by the public agency having jurisdiction to give adequate warning to the public of the construction and of any dangerous condition to be encountered as a result thereof.

Operation and Maintenance

As discussed in Impact TT-1, above, during project operation and maintenance, the only trips to the project site would be occasional trips by employees to inspect and remove debris as needed from the channel, or perform other maintenance activities. The number of trips would be minimal and would not create a potential traffic safety hazard.

Impact TT-4—Potential to obstruct emergency access

Summary by Project Element: Impact TT-4—Potential to obstruct emergency access		
Project Component	Construction Impact Level	Operation and Maintenance Impact Level
All Project Elements and Alternatives	Less than Significant with Mitigation	No Impact

Construction

All project work areas, including the Pope-Chaucer Bridge, which would be closed temporarily during construction, would have the potential to affect emergency vehicle access. Construction-related traffic could also delay or obstruct the movement of emergency vehicles on local area roadways. However, the temporary traffic signal provided at Middlefield Road/Woodland Avenue-Palo Alto Avenue during closure of the Pope-Chaucer Bridge under MM-TT-1 and the site-specific traffic control plan required under MM-TT-2 would ensure unrestricted access and passage for emergency vehicles. With the implementation of MM-TT-1 and MM-TT-2, impacts on emergency access are expected to be less than significant.

MM-TT-1—Require a temporary traffic signal at Middlefield Road/Woodland Avenue-Palo Alto Avenue

MM-TT-2—Require a site-specific traffic control plan

These measures are described in detail above.

Operation and Maintenance

During operation and maintenance, the project would not have the potential to affect emergency vehicle access; therefore, no impact would occur.

Impact TT-5—Potential to conflict with alternative transportation

Summary by Project Element: Impact TT-5—Potential to conflict with Alternative Transportation		
Project Component	Construction Impact Level	Operation and Maintenance Impact Level
All Project Elements and Alternatives	Less than Significant with Mitigation	No Impact

Construction potential impact to alternative transportation modes.

MM-TT-2—Require a site-specific traffic control plan

This measure is described in detail above.

Operation and Maintenance

After construction is completed, the Pope-Chaucer Bridge would be open to bicyclists and pedestrians. There would be no other impediments to bicyclists and pedestrians with operations and maintenance activities. Therefore, no long-term impacts on pedestrian and bicycle circulation or transit ridership are expected.

3.13.4 Cumulative Impacts

Palo Alto, Menlo Park, and East Palo Alto General Plans identify several locations where traffic conditions are known or predicted to exceed the applicable LOS standard. U.S. 101 from Embarcadero Road to University Avenue and University Avenue to Willow Road exceed the LOS D standard. Given the heavy commute traffic on the project area's principal routes, other areas of significant congestion may also exist.

The City of Palo Alto is developing plans for replacement of the Newell Street Bridge over San Francisquito Creek. Construction would result in traffic delays at this site. These delays, combined with delays associated with the project's proposed replacement of Pope-Chaucer Bridge, could be significant but have not been analyzed in detail. The City of Palo Alto and SFCJPA will coordinate to ensure that replacement of the Newell Street Bridge and Pope-Chaucer Bridge do not occur at the same time.

As discussed above, the project would result in a short-term increase in construction-related traffic on local streets in the project area. Once the project is constructed, maintenance needs would be limited to occasional trips two to four times per year. Traffic generation would be well within the capacity of the local roadway system and would not differ materially from current levels. Therefore, the project's contribution to cumulative traffic impacts is expected to be less than cumulatively considerable.

3.13.5 References

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3.14 Utilities and Service Systems

This section provides environmental analysis of the proposed project's impacts on utilities and service systems. The section summarizes the regulatory environment and discusses the environmental setting, provides the criteria used for determining impacts, discusses the impact mechanism and level of impact resulting from construction and implementation of the proposed project, and describes mitigation to minimize the level of impact.

3.14.1 Regulatory Setting

Federal

Resource Conservation and Recovery Act (42 U.S.C. § 6901 et seq.)

The Resource Conservation and Recovery Act was enacted in 1976 to ensure that solid and hazardous wastes are properly managed, from their generation to ultimate disposal or destruction. Implementation of the Resource Conservation and Recovery Act has largely been delegated to federally approved State waste management programs and, under Subtitle D, further promulgated to local governments for management of planning, regulation, and implementation of nonhazardous solid waste disposal (U.S. Environmental Protection Agency 2016). The U.S. Environmental Protection Agency retains oversight of State actions under 40 Code of Federal Regulations (CFR) (Part 239–259). Where facilities are found to be inadequate, 40 CFR Part 256.42 requires that necessary facilities and practices be developed by the responsible State and local agencies or by the private sector (U.S. Government Printing Office 2016). In California, that responsibility was created under the California Integrated Waste Management Act of 1989.

State

California Integrated Waste Management Act (AB 939)

In response to the Resource Conservation and Recovery Act, the California Integrated Waste Management Act of 1989 was enacted by Assembly Bill (AB) 939. It requires cities and counties to prepare an integrated waste management plan, including a countywide siting element, for each jurisdiction. Pursuant to Public Resources Code Sections 41700–41721.5, the countywide siting element provides an estimate of the total permitted disposal capacity needed for a 15-year period, or whenever additional capacity is necessary. Countywide siting elements in California must be updated by each operator and permitted by the Department of Resources Recycling, which is within the Natural Resources Agency, every 5 years. AB 939 mandated that local jurisdictions meet solid waste diversion goals of 50 percent by 2000 (CalRecycle 2018).

Protection of Underground Infrastructure (Cal. Gov. Code § 4216)

This code requires that an excavator must contact a regional notification center (i.e., send an underground service alert) at least 2 days before excavation of any subsurface installations. The underground service alert will then notify the utilities that may have buried lines within 1,000 feet of the excavation. Representatives of the utilities are required to mark the specific location of their facilities within the work area prior to the start of excavation. The construction contractor is required to probe and expose the underground facilities by hand prior to using power equipment.

Local

Local policies and regulations related to utilities and service systems generally relate to new construction and buildings. The majority of these policies and regulations are not applicable to the proposed project.

Urban Water Management Plans

The cities of Palo Alto, Menlo Park and East Palo Alto all have Urban Water Management Plans (UWMPs). UWMPs describe the suppliers' service area, water use by customer class, water supply and demand, water service reliability and shortage response options, water transfer and exchange opportunities, water recycling efforts, and conservation measures. UWMPs document historical water supply and demand, and provide projections in 5-year increments at least 20 years into the future. Updated every 5 years, UWMPs provide important information on an urban community's water supply and demand planning.

East Palo Alto Groundwater Management Plan

The City of East Palo Alto adopted its Groundwater Management Plan (GWMP) on August 31, 2015. As a public water agency overlying a designated groundwater basin, the City is authorized by the current Water Code to develop and implement the GWMP. Goals of the City's GWMP include: provide the City of East Palo Alto with a long-term, reliable and affordable high-quality supply; maintain or improve groundwater quality and quantity for the benefit of all groundwater users; and provide integrated water resource management for resilience during droughts, with service interruptions and emergencies, and with long-term climate change effects. The goals are consistent with the 2014 Resolution in Support of Sustainable Groundwater Management in the San Francisquito Creek Area, of which the City is a signatory. The goals include recognition of the interconnection and multiple beneficial uses of groundwater and surface water in the San Francisquito Creek area.

Other

Stormwater Resource Plans

Both San Mateo County and Santa Clara County have adopted Stormwater Resource Plans. These plans form a comprehensive document that represents a transformation in watershed resource planning and stormwater runoff management. The San Mateo County Stormwater Resource Plan was developed in coordination with the City/County Association of Governments of San Mateo County's (C/CAG's) member agencies and was approved under Resolution 17-04 by the C/CAG Board of Directors February 9, 2017 (City/County Association of Governments of San Mateo County 2017).

The Santa Clara Valley Urban Runoff Pollution Prevention Program, an association of the 13 cities and towns in Santa Clara Valley, within Santa Clara County, and the Santa Clara Valley Water District led the effort to develop the *Santa Clara Basin Stormwater Resource Plan*, with a public draft in August 2018.

These documents form the basis to identify and prioritize local and regional Green Stormwater Infrastructure projects that can be implemented to improve local surface water quality through enhanced stormwater management.

The San Francisquito Creek Joint Powers Authority reviewed and submitted potential projects for consideration during development of these plans.

One Water

Santa Clara Valley Water District is developing a *One Water Plan* that will manage Santa Clara County water resources holistically and sustainably to benefit people and the environment in a way that is informed by community values (Santa Clara Valley Water District 2019). The *One Water Plan* will serve as the district's flood management plan and stream stewardship master plan. It will also identify where there is a nexus between the district's flood protection, stream stewardship, and water supply functions. The plan will provide a 50-year roadmap for integrated water resource planning on a watershed scale and a framework for measuring improvements in watershed health through science-based metrics and targets. The Santa Clara Basin Stormwater Resource plan is considered to be a component of the *One Water Plan*.

The framework and plan for Coyote Creek was completed in 2018 and the remainder of the watersheds by are planned to be completed by 2020.

Study Area

The study area for the utilities and service systems analysis is the project site and adjacent lands in the jurisdiction of each of the project's service providers.

3.14.2 Environmental Setting

Water

East Palo Alto. The City of East Palo Alto obtains most of its potable water from the San Francisco Public Utilities Commission (SFPUC) Regional Water System. In addition, the City uses groundwater wells, not only from private entities (O'Connor Tract Co-Operative Water Company and the Palo Alto Park Mutual Water Companyhttp://www.paloaltoparkmutualwatercompany.com/), but also City-owned wells. East Palo Alto has two wells: Gloria Way Well that was rehabilitated in 2017, and a new well at the Pad D site at Clark Road and East Bayshore (City of East Palo Alto 2015).

The City's managed water system draws its domestic water supply through three turnouts off the SFPUC Bay Division Pipelines 1 and 2.

Menlo Park. The City of Menlo Park obtains its potable water from Menlo Park Municipal Water, which serves approximately half of Menlo Park. Other purveyors within the city limits include the California Water Service Company, which serves the Bear Gulch District; the O'Connor Tract Co-operative Water Company, which serves a small area of the city using groundwater production wells; and the Palo Alto Park Mutual Water Company, which serves fewer than 10 homes within the eastern portion of the city (City of Menlo Park 2016a). In addition, the City of Menlo Park has installed three groundwater wells for emergency supply purposes (City of Menlo Park n.d.).

Palo Alto. Palo Alto also receives water from the City and County of San Francisco's SFPUC. This supply is predominantly from the Sierra Nevada, delivered through the Hetch Hetchy aqueducts, but it also includes treated water produced by the SFPUC from its local watersheds and facilities in Alameda and San Mateo Counties.

Approximately 7 percent of Palo Alto's water supply is recycled water from its Regional Water Quality Control Plant (RWQCP), and used for non-potable purposes such as irrigation (City of Palo Alto Utilities 2016). In addition, the City of Palo Alto maintains groundwater wells and appurtances for emergency supply, as well several reservoirs, including an underground storage reservoir adjacent to San Francisquito Creek at El Camino Park. (City of Palo Alto Utilities n.d.).

Wastewater

East Palo Alto. East Palo Alto does not have a wastewater treatment plant. Wastewater is conveyed by two different sanitary districts: the East Palo Alto Sanitary District (EPASD), which covers the majority of the city's service area and a portion of Menlo Park, and the West Bay Sanitary District (WBSD), which covers a small portion of the city as part of its larger service area to the north and east. EPASD conveys wastewater to the Palo Alto RWQCP for treatment and discharge to San Francisco Bay, and WBSD conveys wastewater, via the Menlo Park Pump Station and force main, to Silicon Valley Clean Water (SVCW) in Redwood City for treatment and discharge to the San Francisco Bay.

EPASD has connections to 3,327 single-family residential units, 3,510 multifamily units, and 229 commercial, industrial, and institutional facilities. EPASD infrastructure includes 32 miles of sewer pipeline and 560 manholes. EPASD has a 2.9-million gallons daily (MGD) annual average dry-weather flow capacity allotment at the Palo Alto RWQCP. Currently, the EPASD is operating below its system dry-weather flow capacity, with an average dry-weather flow of 1.5 MGD, or 548 million gallons of wastewater per year (City of East Palo Alto 2016a).

Menlo Park. WBSD provides wastewater collection and conveyance services to Menlo Park and the project area. The WBSD service area encompasses approximately 8,325 acres and includes approximately 19,000 service connections to serve a population of 52,900. WBSD conveys raw wastewater to SVCW for treatment through the Menlo Park Pump Station and force main. SVCW then discharges treated water to the San Francisco Bay. The SVCW wastewater treatment plant has an existing dry weather capacity of 29 MGD and wet weather capacity of 71 MGD. As reported by the WBSD *Sewer System Management Plan*, WBSD has an average dry weather flow of 3.57 MGD with Peak Wet Weather Flows of 18.81 MGD as measured by the SVCW in 2017 (West Bay Sanitary District 2018).

Palo Alto. To collect wastewater from its customers and deliver it to the RWQCP, City of Palo Alto Utilities owns roughly 18,100 sewer laterals (which collect wastewater from customers' plumbing systems) and 217 miles of sewer mains (which transport the waste to the treatment plant). These laterals and mains, along with the associated manholes and cleanouts, represent the vast majority of infrastructure used to collect wastewater in Palo Alto. The RWQCP is designed to have an average dry weather flow capacity of 39 MGD and an average wet weather flow capacity of 80 MGD. Average daily flow is 20 MGD. According to the City of Palo Alto, the RWQCP does not experience any major treatment system constraints and capacity is sufficient for current dry and wet weather loads and for future load projections (City of Palo Alto 2016).

Stormwater

East Palo Alto. Stormwater in East Palo Alto drains into two major drainage systems: the Runnymede Storm Drain System and the O'Connor Storm Drain System. Approximately two-thirds of the city's stormwater drains into the Runnymede Storm Drain System outfall. A drainage ditch originating at the terminus of the storm drain at Runnymede Street receives water from the storm drain and transports it to the detention basin at the O'Connor Pump Station, where it is pumped into San Francisquito Creek and ultimately flows into San Francisco Bay (City of East Palo Alto 2016b).

Menlo Park. Menlo Park is within the approximately 45-square-mile San Francisquito Creek watershed, which includes portions of both Santa Clara County and San Mateo County. Water flows west to east through natural creeks and streams, and channelized waterways. Most storm drains in Menlo Park discharge to San Francisquito Creek; a small portion of Menlo Park drain to Atherton Channel (City of Menlo Park 2016b).

Palo Alto. The Palo Alto Department of Public Works Storm Drain Management Program is responsible for the approval, construction, and maintenance of the storm drain system in Palo Alto. There are four primary watersheds within Palo Alto: San Francisquito, Matadero, Barron, and Adobe Creek. Within these watersheds, stormwater flows directly to creeks and the San Francisco Bay without treatment. The City of Palo Alto owns and maintains a municipal storm drain system consisting of approximately 107 miles of pipeline and 2,750 catch basins, 800 manholes, and six pump stations (City of Palo Alto 2016).

Voters in Palo Alto approved in 2017 a special tax to upgrade the stormwater infrastructure, via a Storm Water Management fee. The Storm Water Management Program provides for storm water system improvements that prevent street flooding and funds routine water system maintenance and operation that keep the City's storm water infrastructure clean and at peak performance. The stormwater program also provides litter reduction, creek pollution prevention programs, commercial and residential rebates, and flooding emergency-response services. Constructing Green Infrastructure Projects is a City of Palo Alto priority, which includes infiltrating and cleansing storm water to decrease peak flows to the conveyance system.

Solid Waste

East Palo Alto. East Palo Alto is a member of the South Bay Waste Management Authority, a joint powers authority with 12 member agencies (the cities of Belmont, Burlingame, East Palo Alto, Foster City, Menlo Park, Redwood City, San Carlos, and San Mateo; the towns of Atherton and Hillsborough; the County of San Mateo; and WBSD) in San Mateo. The Shoreway Environmental Center in San Carlos serves as a regional solid waste and recycling facility for the receipt, handling, and transfer of solid waste and recyclables collected from the South Bay Waste Management Authority service area. Materials are consolidated and loaded into large transfer trailers for shipment off the site to the Ox Mountain Landfill and to recycling facilities for construction and demolition waste and organic materials (City of East Palo Alto 2016b).

Menlo Park. Recology Incorporated provides solid waste collection and conveyance service for Menlo Park. Collected recyclables, organics, and garbage are conveyed to the Shoreway Environmental Center in San Carlos for processing and shipment. As of 2014, San Mateo County disposed of 22 percent less trash in a landfill than in 2010, from 75,223 tons to 58,553 tons. This was accompanied by a 2 percent increase in recycling and a 28 percent increase in composting of organics. Materials not composted or recycled at Shoreway are landfilled at the Ox Mountain Landfill near Half Moon Bay in San Mateo County (City of Menlo Park 2016b).

Palo Alto. GreenWaste of Palo Alto is the City of Palo Alto's contractor for the collection and transportation of municipal solid waste, commercial organics, residential yard trimmings, and mixed recycling. All municipal solid waste is processed at the Sunnyvale Materials Recovery and Transfer Station at 301 Carl Road, Sunnyvale, where recyclable materials in the municipal solid waste are recovered. The station recovers around 18 percent of the material that would have otherwise been landfilled. Palo Alto achieved a waste diversion rate of 80 percent in 2014, well above the State-mandated rate of 50 percent (City of Palo Alto 2016).

Electricity, Natural Gas and Telephone

Pacific Gas & Electric Company provides electricity and natural gas to the communities of East Palo Alto and Menlo Park. Palo Alto provides its own gas and electric service. AT&T owns and maintains the telephone lines in the project area.

3.14.3 Impact Analysis

Methods and Significance Criteria

Impacts on utilities and services systems were analyzed based on the service providers' websites and the 2015 UWMPs for the cities of Palo Alto, Menlo Park, and East Palo Alto.

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would result in any of the following:

- Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board.
- Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.
- Require or result in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.
- Have insufficient water supplies available to serve the project from existing entitlements and resources, or require new or expanded entitlements.
- Result in a determination by the wastewater treatment provider that serves or may serve the project that it has inadequate capacity to serve the project's expected demand in addition to the provider's existing commitments.
- Be served by a landfill with insufficient permitted capacity to accommodate the project's solid waste disposal needs.
- Does not comply with federal, state, and local statutes and regulations related to solid waste.

Each impact discussion includes a summary table identifying the level of impact associated with the individual project elements, followed by text analysis.

Impacts and Mitigation Measures

Impact UT-1—Adversely affect water supply, water treatment facilities, wastewater treatment facilities, storm drainage facilities and utilities

Summary by Project Element: Impact UT-1—Adversely affect water supply, water treatment facilities, wastewater treatment facilities, and storm drainage facilities		
Project Element	Construction Impact Level	Operations and Maintenance Impact Level
All Project Elements and Alternatives	Less than Significant	No Impact

Construction

No construction is planned near City of Palo Alto's underground reservoir at El Camino Park. Construction is planned in areas that could have temporary effects on utilities and storm drain systems and/or require relocation to accommodate construction of the project.

An electrical transmission box at Access Ramp 2 would need to be moved a short distance within the footprint of the access ramp that would be reconstructed. Access Ramps 3 and 4 have poles and overhead wires that would be relocated a short distance to a previously disturbed unvegetated area. At Access Ramp 5, a transmission box would be relocated a short distance to a previously disturbed unvegetated area. There would be no relocation of utilities associated with the Reach 3 alternatives. There would be no service disruptions. There would be no impacts on water supply, water treatment facilities, or wastewater treatment facilities. No mitigation is required.

Construction would require the occasional use of water for mixing concrete, controlling dust, and other construction-related activities. There will be no onsite vehicle or equipment washing; if this occurs, accommodations for wash water discharge to local treatment facilities will be made. The amount of water used during construction on a daily basis would be minimal. Construction water is water imported for use on the site. It does not go anywhere; it is used for mixing concrete, dust control, etc., and ultimately evaporates. It is expected that there would be no discharges of water used for construction to wastewater treatment facilities; therefore, there would be no impact. Recycled water is expected to be used for dust control, minimizing consumptive use of potable water.

The proposed project would result in land disturbance of greater than 1 acre of land, and would be required to prepare a Storm Water Pollution Prevention Plan (SWPPP) as part of compliance with the Construction General Permit. The SWPPP would include provisions to control erosion and sedimentation, as well as a Spill Prevention, Control, and Countermeasure Plan to avoid and, if necessary, clean up accidental releases of hazardous materials (see Section 3.7). The SWPPP would include site-specific, and seasonally and phase-appropriate, effective best management practices. Overall, construction impacts would be less than significant.

No aspect of the detention basins construction would adversely affect water supply, water treatment facilities, wastewater treatment facilities, storm drainage facilities and utilities. As discussed under Impact HWR-2 (Deplete groundwater resources or interfere with groundwater recharge or supply), there would be no long-term impact related to increased groundwater use or reduction of supply. Impacts on existing groundwater supplies would be less than significant, and no mitigation is required.

Operation and Maintenance

The project is designed to increase channel capacity for creek flows in San Francisquito Creek and would not lead to a land use that would require additional water supply or wastewater treatment for its operation. Therefore, the project would not require new or expanded water entitlements, result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, or exceed wastewater treatment requirements or wastewater treatment capacity of the RWQCP or SVCW.

The project would ensure that San Francisquito Creek can safely convey stormwater delivered to it by the existing storm drain system and, to that end, the project is being designed to integrate with existing infrastructure. Therefore, there would be no impact on water supply or water and wastewater treatment facilities; however, there would be a beneficial effect on storm drainage. If detention basins are built, the water would also beneficially recharge groundwater along the creek by detaining flow.

Operations and maintenance activities associated with the detention basins would not adversely affect water supply, water treatment facilities, wastewater treatment facilities, and storm drainage facilities and utilities. As discussed in Section 3.8, *Hydrology and Water Resources,* all impacts would be less than significant.

Impact UT-2—Adversely affect landfill capacities and not comply with federal, state, and local statutes and regulations related to solid waste

Summary by Project Element: Impact UT-2—Adversely affect landfill capacities and not comply with federal, state, and local statutes and regulations related to solid waste.		
Project Element	Construction Impact Level	Operation and Maintenance Impact Level
All Project Elements and Alternatives	Less than Significant	No Impact

Because the project involves flood protection and would not generate solid waste during operation and maintenance, the following discussion is limited to construction effects.

During construction, waste would be generated with the removal of Pope-Chaucer Bridge, the removal of sacked concrete and bank soil material associated with channel widening, concrete removal associated with the extension of the University Avenue Bridge parapet, and other project activities, including trash and debris. For Pope-Chaucer Bridge, approximately 1,000 cubic yards (cy) of material would be removed below the ordinary high-water mark, and approximately 5,000 cy would be removed between the ordinary high-water mark and the top of the bank. For channel widening Sites 1 through 4, in total, approximately 10,424 cy of bank soil, 804 cy of sacked concrete, and 318 cy of concrete terracing would be removed by widening these four channel sites (total of 11,546 cy). For channel widening at Site 5, excavated and removed materials would include approximately 6,111 cy of bank soil and concrete material. For the Reach 3 alternatives, approximately 1,310,000 cy of fill would be excavated for the Former Nursery Site Detention Basin, or approximately 1,040,000 cubic yards of fill would be excavated for the Webb Ranch Site Detention Basin. The detention basin would be dug with an excavator, and excavated material would be loaded into trucks for hauling to an offsite location for reuse or disposal.

It is anticipated that all non-recyclable, non-hazardous waste from the project site would be transferred from the Sunnyvale Materials Recovery and Transfer Station to either the Kirby Canyon Landfill, Monterey Peninsula Landfill, or Ox Mountain Landfill for disposal. The Kirby Canyon Landfill is at 910 Coyote Creek Golf Drive in San Jose and has a permitted throughput capacity of 2,600 tons per day. Its maximum permitted capacity is 36.4 million cubic yards, and it has a "cease operation date" of December 31, 2022. The Monterey Peninsula Landfill in Marina has a permitted throughput capacity of 3,500 tons per day. Its remaining permitted capacity is 48.6 million cubic yards, and it has an estimated "cease operation date" of February 28, 2107. The Ox Mountain Landfill is a sanitary landfill in Half Moon Bay and has a permitted throughput capacity of 3,598 tons per day. Its remaining permitted capacity is 26.9 million cubic yards, and its estimated closure year is 2023 (City of Palo Alto 2016). These landfills have enough capacity for any non-recyclable, non-hazardous wastes generated by project construction. Therefore, any non-recyclable waste generated from project construction diverted to the Kirby Canyon, Monterey Peninsula, or Ox Mountain landfills would not adversely affect the landfills.

3.14.4 Cumulative Impacts

As discussed above, the project would have no impacts related to new or expanded water or wastewater treatment facilities, water supply availability, and wastewater treatment capacity. Therefore, it would not contribute to cumulative impacts on these resources. The project would result in a long term beneficial effect on stormwater drainage facilities.

The project would result in less-than-significant impacts related to solid waste disposal. Minimal waste would be generated by the project, and any soil removed from the detention basins under the Reach 3 alternatives would be loaded into trucks for hauling to an offsite location for reuse or disposal. The small amount of remaining waste would not result in a considerable contribution to impacts on landfill capacity.

The incremental effect on cumulative utilities and service systems during construction and operation of the project would be less than significant. Therefore, the contribution is not cumulatively considerable, and construction and operation of the project would not result in cumulative utilities and service systems impacts under the California Environmental Quality Act.

3.14.5 References

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3.15 Energy

This section describes the regulatory and environmental setting for energy. It also describes impacts on energy use that would result from implementing the project and mitigation for any significant impacts where feasible and appropriate.

3.15.1 Regulatory Setting

Federal

The Energy Policy Act of 2005 establishes a comprehensive, long-term federal energy policy and is implemented by the U.S. Department of Energy. The Energy Policy Act addresses energy production in the United States, including oil, gas, coal, and alternative forms of energy and energy efficiency and tax incentives. Energy efficiency and tax incentive programs include credits for the construction of new energy efficient homes, production or purchase of energy efficient appliances, and loan guarantees for entities that develop or use innovative technologies that avoid the production of greenhouse gases (GHGs). The federal government has also adopted the Energy and Independence Security Act of 2007, which sets energy management requirements in several areas.

State

Assembly Bill 2076, Reducing Dependence on Petroleum (2000)

The California Energy Commission (CEC) and California Air Resources Board (CARB) are directed by Assembly Bill (AB) 2076 to develop and adopt recommendations for reducing dependence on petroleum. A performance-based goal is to reduce petroleum demand to 15% less than 2003 demand by 2020.

Senate Bill 1389 (2002) and California Integrated Energy Policy Report

Senate Bill (SB) 1389 requires the CEC to develop an integrated energy plan for electricity, natural gas, and transportation fuels. The energy plan is to be updated biannually and support improvements to the California energy system that reduce air pollution, congestion, and wasteful energy use. The current Integrated Energy Policy Report was updated in 2018 and covers a broad range of topics, including, but not limited to, environmental performance of the electricity generation system, landscape-scale planning, transportation fuel supply reliability, climate adaptation activities, and climate and sea level rise scenarios.

Assembly Bill 1493—Pavley Rules (2002, Amendments 2009, 2012 rulemaking)

Known as *Pavley I*, AB 1493 standards are the nation's first GHG standards for automobiles. AB 1493 required CARB to adopt vehicle standards that will lower GHG emissions from new light-duty automobiles to the maximum extent feasible beginning in 2009. Additional strengthening of the Pavley standards (referred to previously as *Pavley II*, now referred to as the *Advanced Clean Cars* measure) has been adopted for vehicle model years 2017–2025. Together, the two standards are expected to increase average fuel economy to roughly 54.5 miles per gallon by 2025.

Senate Bills 1078 (2002), 107 (2006), and 2 (2011)—Renewables Portfolio Standard

In 2002, California established its Renewables Portfolio Standard (RPS) Program, with the goal of increasing the percentage of renewable energy in the state's electricity mix to 20% of retail sales by 2010. In 2006, California's 20% by 2010 RPS goal was codified under SB 107. Under the provisions of SB 107, investor-owned utilities were required to generate 20% of their retail electricity using qualified renewable energy technologies by the end of 2010. In 2008, Executive Order S-14-08 was signed into law requiring retail sellers of electricity to generate 33% of their load with renewable energy by 2020.

Senate Bills 350 and 100—Clean Energy and Pollution Reduction Act of 2015, 100 Percent Clean Energy Act of 2017 (2015, 2018)

SB 350 was approved by the California legislature in September 2015 and signed by Governor Brown in October 2015. Its key provisions include: (1) a RPS of 50% by 2030; and (2) a doubling of energy efficiency (electrical and natural gas) by 2030, including improvements to the efficiency of existing buildings. These mandates will be implemented by future actions of the California Public Utilities Commission (CPUC) and CEC. SB 100 was approved by the California legislature in August 2018 and signed by Governor Brown in September 2018. Its key provisions were to raise the RPS requirement set by SB 350 from 50 to 60% by 2030, and to create a new policy to meet all of the state's retail electricity supply with a mix of RPS-eligible and zero-carbon resources by December 31, 2045, for a total of 100% clean energy.

Building Codes

The Energy Efficiency Standards for Residential and Nonresidential Buildings, as specified in Title 24, Part 6, of the California Code of Regulations (Title 24), was established in 1978 in response to a legislative mandate to reduce California's energy consumption. Title 24 is updated approximately every 3 years, and the 2016 Title 24 updates went into effect on January 1, 2017. Compliance with Title 24 is mandatory at the time new building permits are issued by city and county governments. In January 2010, the state adopted the California Green Building Standards Code (CALGreen), which established mandatory green building standards for buildings in California. CALGreen was also updated and went into effect on January 1, 2017. The code covers five categories: planning and design, energy efficiency, water efficiency and conservation, material conservation and resource efficiency, and indoor environmental quality.

3.15.2 Environmental Setting

This section provides a discussion of the existing conditions related to energy use on the project sites and in the surrounding project area. The study area for this analysis is the project sites and the jurisdiction of the utility service provider.

Petroleum, Natural Gas, and Electricity

With a relatively mild Mediterranean climate and strict energy-efficiency and conservation requirements, California has lower energy consumption rates than other parts of the country. According to the Department of Energy, California's per capita energy consumption ranked 48th in the nation as of 2016 (U.S. Department of Energy 2016). California has among the lowest annual electrical consumption rates per person of any state, and its residential uses consume 6.9% of the total energy consumed nationwide (U.S. Energy Information Administration 2017).

Pacific Gas and Electric Company (PG&E) provides natural gas and electric service within 70,000 square miles of northern and central California, including the cities of East Palo Alto, Menlo Park, and part of the project site. PG&E purchases both gas and electrical power from a variety of sources, including other utility companies. PG&E obtains its energy supplies from power plants and natural gas fields in northern California. It also purchases energy from outside the service area and delivers it through high-voltage transmission lines. PG&E operates a grid distribution system that channels all power produced at the various generation sources into one large energy pool for distribution throughout the service territory.

The City of Palo Alto Utilities is the only municipal utility in California that operates electric, fiber optic, natural gas, water, and wastewater services. The City of Palo Alto Utilities provides electrical and natural gas service within their jurisdiction, with aggressive goals for the purchase of carbon neutral and renewable power.

Electricity usage for different land uses varies substantially by the type of uses in a building, the type of construction materials used, and the efficiency of the electricity-consuming devices used. Electricity in Santa Clara County in 2016 was consumed primarily by the commercial sector (77%), followed by the residential sector consuming 23%. In 2017, a total of approximately 17,190 and 4,368 gigawatt hours of electricity was consumed in Santa Clara County and San Mateo County, respectively (California Energy Commission 2019a). A total of 445 million therms and 211 million therms of natural gas were consumed in 2017 in Santa Clara County and San Mateo County, respectively (California Energy Commission 2019b).

Total gasoline and diesel fuel usage in California in 2017 is estimated at 15,584 million and 3,124 million gallons, respectively (CEC 2019c).

3.15.3 Impact Analysis

Criteria for Determining Significance

Appendix G of the State CEQA Guidelines and Public Resources Code Section 21100(b)(3) state that a project would have a significant effect if it would result in “wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation,” or if it would “conflict with or obstruct a state or local plan for renewable energy or energy efficiency.” Neither of those provisions offers a precise threshold of significance for determining whether a project would result in wasteful, inefficient, or unnecessary energy use. This lack of a threshold of significance has made it difficult for lead agencies to conduct the analysis contemplated in Appendix G and Section 21100(b)(3). A recent court decision, *California Clean Energy Committee v. City of Woodland* (2014), 225 Cal. App. 4th 173, held that an EIR had not discussed energy use in sufficient detail. However, that case also did not establish a threshold for determining what constitutes wasteful, inefficient, or unnecessary energy use. Considering the implications of the *City of Woodland* decision, this EIR applies a “common sense” threshold, whereby a project’s energy usage would be considered wasteful, inefficient, and unnecessary if the project were to violate California Code of Regulations Title 24,[1] be inconsistent with the energy-related measures in the City's Climate Action Plan, or otherwise consume a substantially greater amount of energy, in either the construction or operational phase, than similar projects of a similar size that did not incorporate the project's design features and mitigation. This analysis will employ such metrics to judge significance.

Impacts and Mitigation Measures

Impact EN-1—Consume energy resources in a wasteful, inefficient, or unnecessary manner

Summary by Project Element: Impact EN-1— Consume energy resources in a wasteful, inefficient, or unnecessary manner		
Project Alternative and Element	Construction Impact Level	Operations and Maintenance Impact Level
All Alternatives and Elements	Less than Significant	Less than Significant

The project would use energy for both construction and operation. Energy sources include gasoline and diesel fuels required for operating employee vehicles, haul trucks, and construction equipment. Construction energy consumption would also be in the form of indirect energy used for the production of materials used for construction (e.g., concrete).

Estimated fuel usage for the project have been quantified using the Climate Registry's default emission factors for general reporting protocols (Climate Registry 2018). The Channel Widening Alternative and Floodwalls Alternative would consume approximately 144,137 and 77,156 gallons of fuel, respectively, over their entire construction periods. The Channel Widening Alternative would require more fuel use than the Floodwalls Alternative due to the relative intensity of construction activities (i.e., more construction equipment, more haul trips, etc.) associated with the Channel Widening Alternative. Compared to other states and the country as whole, construction projects in California generally use more energy-efficient equipment in order to meet state and local goals for criteria air pollutant and greenhouse gas emissions reductions. Specifically, construction activities associated with the Channel Widening Alternative and Floodwalls Alternative would implement MM-AQ-1 and MM-AQ-2, requiring the use of more fuel-efficient heavy-duty construction equipment and vehicles. Consequently, construction activities would not have an appreciable effect on the region's energy supplies or on peak energy demand resulting in a need for additional capacity.

Operational activities associated with the Channel Widening Alternative and Floodwalls Alternative would likely include occasional light duty vehicle trips to transport personnel and handheld landscaping equipment to the sites. Fuel consumption for these light-duty vehicle trips is anticipated to be used at an increasingly efficient rate each year as increased vehicle fuel efficiencies are mandated at the state and/or federal level and electric vehicles continue to displace internal combustion vehicles. Because of the intermittent and unpredictable nature of the operational activities for the Channel Widening Alternative and Floodwalls Alternative, energy consumption for these activities cannot be quantified. Based on the types of vehicles and equipment and occasional nature of activities, however, operational fuel usage would be considered minor and less than

[1] No other federal or state regulatory energy-efficiency standards apply to the project.

significant, because operations would require infrequent activities on an as-needed basis to remove debris or repair damaged structures.

Construction and operations of the Former Nursery Detention Basin and Webb Ranch Detention Basin would consume an unknown amount of gasoline and diesel fuel. The magnitude of fuel usage for construction activities associated with the Former Nursery Detention Basin and Webb Ranch Detention Basin Alternatives is anticipated to be greater than the magnitude of fuel usage for construction activities associated with the Channel Widening and Floodwall Alternatives due to the greater intensity of equipment usage that would occur during construction. However, construction activities associated with the Former Nursery Detention Basin and Webb Ranch Detention Basin Alternatives also would implement MM-AQ-1 and MM-AQ-2, requiring the use of more fuel-efficient heavy-duty construction equipment and vehicles.

Operational activities associated with the Former Nursery Detention Basin and Webb Ranch Detention Basin Alternatives would likely include occasional light duty vehicle trips to transport personnel to the sites, and heavy-duty construction equipment and vehicles to remove sediment from the detention basins after large flood events. Fuel consumption for the light-duty vehicle trips is anticipated to be used at an increasingly efficient rate each year as increased vehicle fuel efficiencies are mandated at the state and/or federal level and electric vehicles continue to displace internal combustion vehicles. In addition, operational activities associated with the Former Nursery Detention Basin and Webb Ranch Detention Basin Alternatives would implement MM-AQ-1 and MM-AQ-2, requiring the use of more fuel-efficient heavy-duty construction equipment and vehicles.

Because of the intermittent and unpredictable nature of the operational activities for the Former Nursery Detention Basin and Webb Ranch Detention Basin Alternatives, energy consumption for these activities cannot be quantified. Based on the types of vehicles and equipment and occasional nature of activities, however, operational fuel usage would be considered minor and less than significant, because operations would require infrequent activities on an as-needed basis to remove debris and sediment.

All alternatives would serve to protect life, property, and infrastructure from floodwaters and minimize operational and maintenance requirements. In addition, the alternatives would not directly require the construction of new energy generation or supply facilities, because operation would not require the use of electricity or natural gas in appreciable quantities. The alternatives are predominantly comprised of construction-type activity and do not entail new land uses that would require a connection to existing energy infrastructure. Consequently, SFCJPA finds no evidence that the project's energy use would be wasteful, inefficient, or unnecessary.

Overall, none of the alternatives would result in inefficient, wasteful, or unnecessary consumption of energy, and development of the sites would not result in adverse environmental impacts related to energy demand. The impacts would be less than significant. No mitigation is required.

Impact EN-2—Conflict with or obstruct a state or local plan for renewable energy or energy efficiency

Summary by Project Element: Impact EN-2—Conflict with or obstruct a state or local plan for renewable energy or energy efficiency		
Project Alternative and Element	Construction Impact Level	Operations and Maintenance Impact Level
All Alternatives and Elements	Less than Significant	Less than Significant

As described above for Impact EN-1, the project alternatives would not directly require the construction of new energy generation or supply facilities because operation would not require the use of electricity or natural gas in appreciable quantities. The alternatives predominantly comprise construction-type activities and do not entail new land uses that would require a connection to existing energy infrastructure.

Consequently, the alternatives would not conflict with or obstruct a state or local plan for renewable energy or energy efficiency. The impact would be less than significant and no mitigation is required.

3.15.4 Cumulative Impacts

Potential cumulative energy impacts include contributing to the wasteful, inefficient, or unnecessary consumption of energy resources, or conflicting with or obstructing a state or local plan for renewable energy or energy efficiency.

As discussed under Impact EN-1, construction activities associated with the Channel Widening Alternative and Floodwalls Alternative would not have an appreciable effect on the region's energy supplies or on peak energy demand resulting in a need for additional capacity. Cumulative operational activities associated with the alternatives would be considered minor and less than significant.

Also as discussed under Impact EN-1, construction of the Former Nursery Detention Basin and Webb Ranch Detention Basin Alternatives is anticipated to consume more fuel than the Channel Widening and Floodwall Alternatives due to the greater intensity of equipment usage. However, the Former Nursery Detention Basin and Webb Ranch Detention Basin Alternatives would not have an appreciable effect on the region's energy supplies or on peak energy demand resulting in a need for additional capacity. Cumulative operational activities associated with the alternatives would be considered minor and less than significant.

None of the alternatives would result in inefficient, wasteful, or unnecessary consumption of energy, and development of the sites would not result in adverse environmental impacts related to energy demand.

As discussed under Impact EN-2, the project alternatives would not directly require the construction of new energy generation or supply facilities, because operation would not require the use of electricity or natural gas in appreciable quantities. The alternatives predominantly comprise construction-type activities and do not entail new land uses that would require a connection to existing energy infrastructure. Consequently, the alternatives would not conflict with or obstruct a state or local plan for renewable energy or energy efficiency.

3.15.5 References

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Chapter 4
Other CEQA-Required Sections

This chapter includes the following discussions required by the California Environmental Quality Act (CEQA):

- Significant and unavoidable environmental impacts
- Significant irreversible environmental changes
- Growth-inducing impacts
- Identification of the Environmentally Superior Alternative

4.1 Significant and Unavoidable Environmental Impacts

Section 15126.2(b) of the State CEQA Guidelines requires that an environmental impact report (EIR) describe any significant impacts, including those that can be mitigated but not reduced to a less-than-significant level. Furthermore, where there are impacts that are significant and unavoidable, their implications and the reasons why the project is being proposed, notwithstanding their effect, should also be described.

Discussed below are the significant and unavoidable impacts resulting from project implementation, mitigation measures that would be required but would not reduce this impact to a less-than-significant level, and, for those impacts for which no feasible mitigation or alternatives exist, the reason that no mitigation or alternatives are proposed.

4.1.1 Air Quality

As discussed in Impact AQ-4 in Section 3.2, *Air Quality*, the project's construction emissions were estimated to exceed the Bay Area Air Quality Management District's (BAAQMD's) daily emission thresholds. With implementation of Mitigation Measures MM-AQ-1 and MM-AQ-2 emissions would still exceed BAAQMD's threshold. Therefore, the proposed project's construction activities and cumulative air quality impacts are expected to be significant and unavoidable. San Francisquito Creek Joint Powers Authority's (SFCJPA's) judgment is that the flood control benefits to residents outweigh the temporary significant and unavoidable emissions during project construction.

4.1.2 Noise and Vibration

As discussed in Impact NV-1 in Section 3.10, *Noise and Vibration,* noise control practices are expected to reduce modeled noise levels; however, it is possible that construction noise could still result in a substantial increase at some residences. Implementation of MM-NV-1, MM-NV-2, and MM-NV-3 would be required to attempt to further reduce noise. These mitigation measures would provide advance notice to nearby residences, designate a disturbance coordinator to handle resident complaints, and install noise barriers to further attenuate noise. However, even with implementation of these measures, it is unlikely that construction would be able to comply with the noise ordinance limits in the Cities of East Palo Alto and Menlo Park. Consequently, this impact is significant and unavoidable.

4.2 Significant Irreversible Environmental Changes

Section 15126.2(c) of the State CEQA Guidelines requires that an EIR consider any significant irreversible environmental changes that would be caused by the project should it be implemented. Section 15126.2(c) reads as follows.

> Uses of nonrenewable resources during the initial and continued phases of the project may be irreversible since a large commitment of such resources makes removal or nonuse thereafter unlikely. Primary impacts and, particularly, secondary impacts (such as highway improvement which provides access to a previously inaccessible area) generally commit future generations to similar uses. Also, irreversible damage can result from environmental accidents associated with the project. Irretrievable commitments of resources should be evaluated to assure that such current consumption is justified.

A project would result in significant irreversible environmental changes if:

- The primary and secondary impacts would generally commit future generations to similar uses.
- The project would involve a large commitment of nonrenewable resources.
- The project would involve uses in which irreversible damage could result from any potential environmental accidents associated with the project.
- The proposed consumption of resources is not justified (e.g., the project involves the wasteful use of energy).

The environmental effects of the proposed project are analyzed in detail in the resource sections of this Draft EIR.

The proposed project would require the use of nonrenewable resources such as metal and aggregate resources for physical construction components. Furthermore, fossil fuels would be consumed during construction and operation activities. Fossil fuels in the form of diesel oil and gasoline would be used for construction equipment and vehicles. During operations, diesel oil and gasoline would be used by passenger vehicles. Electrical energy (in part derived from fossil fuel generation) and natural gas would also be consumed during construction. The consumptive use of these energy resources would be irretrievable and their loss irreversible. Construction use of fossil fuels is limited to the construction period. Operational direct and indirect use of fossil fuels would be consistent with baseline conditions.

The project would result in significant irreversible changes due to the use of raw materials and fossil fuels during construction and operation. While many of these impacts can be avoided, lessened, or mitigated, some of these impacts are irreversible consequences of development, which are described in greater detail in the resource sections of this Draft EIR.

4.3 Growth-Inducing Impacts

Section 15126.2(d) of the State CEQA Guidelines requires that an EIR discuss the ways in which a proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Furthermore, Section 15126.2(d) states:

> [i]ncluded in this are projects which would remove obstacles to population growth…. Increases in the population may tax existing community service facilities, requiring construction of new facilities that could cause significant environmental effects. Also discuss the characteristic of some projects which may encourage and facilitate other activities that could significantly affect the environment, either individually or cumulatively. It must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment.

This analysis evaluates whether the project would directly or indirectly induce economic, population, or housing growth in the surrounding environment.

As discussed in Chapter 1, *Introduction*, and Chapter 2, *Program Description,* the project focuses on reducing flood risks to communities along San Francisquito Creek. It would not develop new housing, and project construction would draw on the large work force already available in the San Francisco Bay Area and its surroundings; worker demand would not be large enough to drive substantial relocation to the south San Francisco Bay Area. Thus, the project would not directly induce or result in population growth. In addition, the project was proposed to support and provide improved flood protection for land uses already existing and planned under the Palo Alto, East Palo Alto and Menlo Park General Plans; the project would not alter the existing mosaic of land uses, and thus would not induce population growth indirectly by increasing development density or adding new employment centers. Finally, because lands along the project reaches and greater watershed are already developed despite the existing insufficient level of flood protection, the project would not remove an obstacle to growth by providing improved flood protection. The project would have no impact related to inducement of population growth.

The project is expected to provide some level of long-term benefit for local economies by increasing flood security for residents and businesses. However, the project's role should be viewed as protecting economic growth rather than driving it. Thus, although the project would have a long-term beneficial impact on local economies, it would have no impact related to inducement of economic growth.

4.4 Identification of the Environmentally Superior Alternative

CEQA requires that an EIR evaluate a "reasonable range" of alternatives to a proposed project. An EIR is not required to consider every conceivable alternative to a project; rather, consideration should focus on alternatives that appear to be feasible, would meet the project objectives, and would avoid or substantially lessen at least one of the proposed project's significant environmental effects. In addition, although the No Project Alternative is not the baseline for determining whether impacts related to the proposed activities would be significant, an EIR must evaluate the impacts of the No

Project Alternative to allow decision makers to compare the impacts of approving the project to the impacts of not approving it.

EIRs are required to include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison to the proposed project or program (State CEQA Guidelines Section 15126.6(a), (d), (f)). This requirement enables the lead agency to identify the *environmentally superior alternative*—that is, the alternative that would least affect the environment while still accomplishing project objectives. If the No Project Alternative is identified as environmentally superior but would not meet project objectives, the lead agency must also identify the environmentally superior alternative that would implement the project (State CEQA Guidelines Section 15126.6(e)).

This EIR assesses four different project alternatives: two in Reach 2 (including the proposed project, which is the Channel Widening Alternative) and two in Reach 3. These alternatives, and the alternatives that were considered but rejected from further consideration, are described in Chapter 2. Reach 3 alternatives were described with less detail because less information is available for them at present. The Reach 3 alternatives could be implemented following further, more detailed, analysis under CEQA to increase flood protection after one of the Reach 2 alternatives is constructed. With this strategy, implementation of a Reach 2 and a Reach 3 alternative may be considered part of an overall program. However, implementation of a Reach 3 alternative instead of the proposed project would also contribute toward flood protection objectives. Hence, it is informative to compare the proposed project (the Channel Widening Alternative) with the Reach 3 alternatives, as well as with the Floodwalls Alternative and the No Project Alternative. This comparison is provided in Table 4-1.

Table 4-1. Anticipated Environmental Impacts of Alternatives and the No Project Alternative in Relation to the Proposed Project

	Alternative		
Resource	**Floodwalls Alternative**	**Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative**	**No Project**
Aesthetics	This alternative differs from the proposed project in that floodwalls would be built instead of channel widening. Effects of construction activities on aesthetics would be similar to the proposed project. Rather than the proposed project's removal of vegetation associated with construction of soil nail walls and a sheet pile wall, vegetation would be removed for construction of floodwalls at the top of banks. Overall, the aesthetic impact of the proposed project and the Floodwalls Alternative are similar.	Due to the location of the proposed detention basins, construction activities and the detention basins would be viewed by fewer people than elements of the proposed project. Overall, aesthetic impacts would be less than the proposed project.	The No Project Alternative would not alter the visual characteristics of the project area. Hence, visual impacts would be less than the proposed project.
Air Quality	Air quality impacts for the Floodwalls Alternative would be similar to those of the proposed project. Both would result in significant unavoidable impacts due to exceedance of BAAQMD thresholds.	These alternatives would have less air quality impacts than the proposed project because the proposed locations of the detention basins are farther from sensitive receptors.	Under the No Project Alternative, there would be no immediate project-related air quality impacts. Over the long-term, repair and/or piecemeal replacement of aging flood protection infrastructure could result in impacts. The extent and severity is not known at this time.
Biological Resources	Impacts on biological resources would be similar to those of the proposed project. However, the proposed project would benefit aquatic species by improving hydrologic functions of the creek through channel widening.	These alternatives would have less immediate biological impacts than the proposed project because there would not be the same amount of in-channel work, including removal of vegetation. However, in the long term, these alternatives would not have the benefits to aquatic species offered by the proposed project. These	Under the No Project Alternative, no new flood protection or habitat enhancements would occur. The proposed project's biological impacts during construction would not occur, but aquatic species would not benefit from the channel widening and

	Alternative		
Resource	Floodwalls Alternative	Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	No Project
		benefits include improvement of hydrologic functions through channel widening and construction of habitat enhancement features.	habitat enhancements that would be implemented by the proposed project.
Cultural and Paleontological Resources	Impacts on cultural and paleontological resources would be similar to the proposed project's impacts. Both alternatives involve excavation that would occur in areas with high potential for cultural resources to be encountered.	Impacts on cultural and paleontological resources would be similar to the proposed project's impacts. All of the alternatives involve excavation and occur in areas with high potential for cultural resources to be encountered.	Under the No Project Alternative, there would be no immediate project-related ground disturbance. Over the long-term, repair and/or piecemeal replacement of aging flood protection infrastructure could result in ground disturbance, with some potential to disturb buried cultural and paleontological resources. The extent and severity of disturbance are not foreseeable at this time, but there would likely be some potential for significant impacts on cultural and paleontological resources, although it is unknown whether this potential would increase relative to the current baseline.
Energy	Impacts would be less than significant without mitigation for all alternatives.	Impacts would be less than significant without mitigation for all alternatives.	Impacts would be less than significant without mitigation for all alternatives.
Geology and Soils	Noise impacts for the Floodwalls Alternative would be similar to those of the proposed project. Both would result in significant unavoidable impacts.	These alternatives' elements are closer to landslide deposits than the proposed project. However, the elements (weir and detention basins) are less prone to failure due to seismic events than the proposed project elements (e.g., a bridge, sheet pile, and soil nail walls). Failure of Former Nursery Detention Basin Alternative or Webb Ranch Detention Basin Alternative	Under the No Project Alternative, there would be no impact related to geology or soils.

Resource	Alternative: Floodwalls Alternative	Alternative: Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Alternative: No Project
		structures could expose people or structures to potential adverse impacts.	
Greenhouse Gases and Climate Change	Greenhouse gas and climate change impacts would be less than under the proposed project.	Although not currently quantified, the shorter duration of construction would likely result in less contribution of greenhouse gases and climate change impacts than the proposed project.	Under the No Project Alternative,. there would be no new or substantially altered impacts on greenhouse gases or climate change.
Hazardous Materials and Public Health	Public health and safety impacts would be similar to those described for the proposed project.	Public health and safety impacts would be less than under the proposed project because the alternatives' project sites are (1) more than 0.25 mile from a school (the Former Nursery Detention Basin Alternative only), (2) not on a list of hazardous material sites, and (3) not within 2 miles of an airport. In addition, the proposed project would have greater impacts on trees.	The No Project Alternative would not result in any foreseeable activities expected to release hazardous materials or change public health conditions relative to the current baseline.
Hydrology and Water Quality	This alternative's impacts on hydrology and water quality are similar to the proposed project's. However, the proposed project would have greater benefits for beneficial uses (e.g., salmonid habitat) than the Floodwalls Alternative because it would widen the channel, creating more habitat and improving hydrologic processes.	These alternatives' impacts on hydrology and water quality are similar to the proposed project's. However, the proposed project would have greater benefits for beneficial uses (e.g., salmonid habitat) than these alternatives because it would (1) widen the channel creating more habitat and improved hydrologic processes, and (2) install fish habitat enhancement structures.	Under the No Project Alternative, no new flood protection infrastructure would be installed in San Francisquito Creek. Although there would be no new or substantially altered impact on hydrologic function or water quality under the No Project Alternative, flood protection would not be improved and the project area would not have the capacity to accommodate proposed future improvements. Additionally there would not be increased beneficial uses.

	Alternative		
Resource	Floodwalls Alternative	Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	No Project
Land Use	This alternative would have similar impacts as the proposed project.	These alternatives would have similar impacts as the proposed project.	Under the No Project Alternative, there would be no new or substantially altered impact on land uses in the project area.
Noise and Vibration	This alternative would have similar impacts as the proposed project.	These alternatives would have less noise impacts than the proposed project because the project sites are farther from sensitive receptors (e.g., residences).	Over the short term, there would be no new construction and thus no impact on noise generation under the No Project Alternative. Over the longer term, as existing infrastructure continues to age, more extensive and frequent maintenance, repairs, and/or replacement are likely to be needed, and noise generation would increase. Increases could be less than under the proposed project, until or unless replacement of facilities becomes necessary.
Public Services	This alternative would have similar impacts as the proposed project.	These alternatives would have similar impacts as the proposed project.	The No Project Alternative would have similar impacts as the proposed project.
Recreation	This alternative would have similar impacts as the proposed project.	These alternatives would have less impact on transportation routes to areas where recreational activities occur (e.g., parks) than the proposed project.	The No Project Alternative would have no foreseeable impact on recreational facilities or uses and thus would have reduced recreational impacts compared to the proposed project.
Transportation and Traffic	This alternative would have similar impacts as the proposed project.	These alternatives would have less transportation/traffic impacts than the proposed project because they would result in considerably less traffic delays and particularly because they do not involve temporary closure of Pope-Chaucer Bridge.	Over the short term, the No Project Alternative would have no impact on traffic or transportation because there would be no new construction and thus no construction-related traffic. Over the longer term, as existing infrastructure continues to age, more

Resource	Alternative: Floodwalls Alternative	Alternative: Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative	Alternative: No Project
			extensive and frequent maintenance, repairs, and/or replacement are likely to be needed, so traffic related to flood protection operations could increase in comparison to the current baseline condition. Increases could be less than under the proposed project, until replacement of facilities becomes necessary. Future replacement of aging facilities could generate enough construction traffic to result in significant impacts on traffic and transportation, but details are not foreseeable at this time.
Utilities and Service Systems	This alternative would have similar impacts as the proposed project.	These alternatives would likely have fewer impacts than the proposed project because the project sites are not within an urban area where utilities are more abundant.	The No Project Alternative would have no foreseeable impact on utilities and service facilities and thus would reduce impacts in comparison to the proposed project.

4.4.1 Conclusion

The conclusion drawn here, along with information regarding the technical and logistical feasibility and cost of project alternatives, will be taken into account by the SFCJPA Board and others in deciding whether and how to proceed with this project.

The No Project Alternative would have less immediate environmental impacts than the proposed project. However, it would delay needed flood protection actions. Due to this delay, an increase in maintenance and emergency flood protection activities would be expected. These activities may not be as well planned, and may not avoid, minimize or mitigate environmental impacts. Thus, it is likely that the environmental impacts of no immediate action would ultimately exceed those of the proposed project. The No Project Alternative also would not result in the environmental benefits (e.g., habitat enhancement) of the proposed project. Therefore, the No Project Alternative is not identified as the environmentally superior alternative.

The Floodwalls Alternative would have impacts similar to the proposed project but over a greater area of the top of creek bank. However, the proposed project would result in improved hydrologic conditions through channel widening that would be beneficial to fish and other aquatic species. Hence, the proposed project is considered environmentally superior to the Floodwalls Alternative.

The proposed project is in an urban area, whereas the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative are within an open space area with relatively few people ever present. Primarily due to the location of the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative, potential impacts on the following resources would be less than for the proposed project:

- Aesthetics
- Air Quality
- Hazardous Materials and Public Health
- Noise and Vibration
- Recreation
- Transportation and Traffic
- Utilities and Service Systems

Additionally, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would have fewer impacts than the proposed project on the following resources:

- Biology
- Geology and Soils
- Greenhouse Gases and Climate Change

The Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative have less environmental impacts than the proposed project on many resources. However, the Former Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative impacts would be of short duration and would be less than significant. Also, other than flood protection, the Former

Nursery Detention Basin Alternative and Webb Ranch Detention Basin Alternative would have limited environmental benefits. In contrast, the proposed project would permanently restore hydrologic functions and enhance habitats in the San Francisquito Creek channel. Due to these environmental benefits, the proposed project is identified as the environmentally superior alternative.

Chapter 5
List of Preparers

An environmental study team led by ICF under contract to the San Francisquito Creek Joint Powers Authority (SFCJPA) prepared this Environmental Impact Report. The analyses were coordinated with SFCJPA Executive Director Len Materman and Project Managers Tess Byler and Kevin Murray.

ICF Staff

Name	Role
Kevin MacKay	Project Director
Adam Wagschal	Project Manager
Jennifer Ban	Aesthetics
Darrin Trageser	Air Quality, Greenhouse Gas Emissions
Donna Maniscalco	Biology
Eric Christensen	Biology
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Cory Matsui	Noise and Vibration
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To support preparation of this EIR, a traffic study was prepared by Shruti Shrivastava (TJKM) and an arborist report was prepared by Ryan Gilpin (HortScience/Bartlett Consulting).

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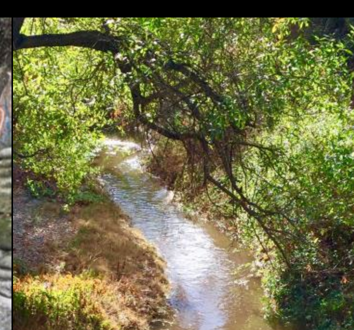
San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101

Draft Environmental Impact Report – April 2019
Volume 2: Appendices



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Appendix A

Air Quality/Greenhouse Gas Emissions: Analysis of Models and Tools to Correlate Project-Generated Criteria Pollutant Emissions to Health End Points

Analysis of Models and Tools to Correlate Project-Generated Criteria Pollutant Emissions to Health End Points

Several models and tools capable of translating mass emissions of criteria pollutants to various health endpoints have been developed. Table E-1 summarizes key tools, identifies the analyzed pollutants, describes their intended application and resolution, and analyzes whether they could be used to reasonably correlate project-level emissions to specific health consequences. As shown in Table E-1, almost all tools were designed to be used at the national, state, regional, and/or city-levels. These tools are not well suited to analyze small or localized changes in pollutant concentrations associated with individual projects. Accordingly, they are generally not recommended for CEQA analyses. This attachment may be included in CEQA documents with significant air quality impacts with appropriate modification (i.e., read word-for-word the table and tailor as needed), as shown in the example text in Attachment D.

Table E-1. Analysis of Models and Tools to Correlate Project-Generated Criteria Pollutant Emissions to Health End Points

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
AirCounts[1]	Abt Assoc.	Online tool that helps large and medium-sized cities quickly estimate the health benefits of PM2.5 emission reductions and economic value of those benefits. The tool estimates the number of deaths (mortality) avoided and economic value related to user-specified regional, annual PM2.5 emissions reduction. The modeling year is 2010; avoided deaths are expected to occur over a 20-year period and their present value is shown in 2010 US dollars at a 3% discount rate.	City-level	Primary PM2.5	This tool is only illustrative, as it is limited to certain cities and does not target specific sectors. Given that it was designed as a screening-level tool, is not sector specific, and includes limited California data, the tool is **not recommended** for project-level CEQA analysis.
AP2 (formerly Air Pollution Emission Experiments	Mueller and Mendelsohn, 2006	AP2 is an integrated assessment model developed to assess marginal damage impacts from emissions at the national scale but can be applied at the county-level. The model connects emissions to monetary damages through six modules: emissions (per EPA's	National or county-level	SO_2, ROG, NOx, ozone, PM2.5, PM10	The model operates at the national scale but may be applied at the county-level (although it is not clear how this adjustment should be made). The tool is also not commercially

[1] https://www.abtassociates.com/tools

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
and Policy [APEEP])[2]		national inventory), air quality modeling, concentrations, exposures, physical effects, and valuation. Damages are presented on a dollar-per-ton basis. Model extends damage assessment beyond human health, and includes assessment on reduced crop and timber yields, reductions in visibility, enhanced depreciation of man-made materials and damages due to lost recreation services.			available. Accordingly, the tool is **not recommended** for project-level CEQA analysis.
Methodology for Estimating Premature Deaths Associated with Long-Term Exposure to Fine Airborne Particulate Matter in California[3]	CARB	The staff report identifies a relative risk of premature death associated with PM2.5 exposure based on a review of all relevant scientific literature, and a new relative risk factor was developed. This new factor is a 10% increase in risk of premature death per 10 $\mu g/m^3$ increase in exposure to PM2.5 concentrations (uncertainty interval: 3% to 20%)	National		The primary author of the CARB staff report notes that the analysis method is not suited for small projects and may yield unreliable results due to various uncertainties (SCAQMD 2015). Accordingly, the tool is **not recommended** for project-level CEQA analysis.
Co-Benefits Risk Assessment (COBRA)[4]	US EPA	Preliminary screening tool that contains baseline emission estimates of a variety of air pollutants for a single year (2017). COOBRA is targeted to state and local governments as a screening assessment for clean energy policies. Users specify changes to the baseline emission estimates. COBRA then uses	National, regional, state, or county-levels	PM2.5, SO_2, NOx, NH_3, and ROG	COBRA is a preliminary screening tool only and cannot be used at sub-county resolution. It also does not account for secondary emission changes resulting from market responses. Accordingly, the tool

[2] Original APEEP: https://www.researchgate.net/publication/253359043_The_Air_Pollution_Emission_Experiments_and_Policy_Analysis_Model_APEEP_Technical_Appendix

[3] https://www.arb.ca.gov/research/health/pm-mort/PMmortalityreportFINALR10-24-08.pdf

[4] https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
		"canned" source-receptor matrix model to estimate PM changes and resulting health outcomes and monetized values. The results can be mapped to visually represent air quality, human health, and health-related economic benefits. Analysis can be performed across the 14 major emissions categories included in the EPA's National Emissions Inventory. Note that COBRA is based on EPA's BenMAP-CE (discussed in a separate entry).			is **not recommended** for project-level CEQA analysis.
Environmental Benefits and Mapping Program-Community Edition (BenMAP-CE)[5]	US EPA	BenMAP is EPA's detailed model for estimating the health impacts from air pollution. It relies on input concentrations and applies concentration-response (C-R) health impact functions, which relate a change in the concentration of a pollutant with a change in the incidence of a health endpoint, including premature mortality, heart attacks, chronic respiratory illnesses, asthma exacerbation and other adverse health effects. Detailed inputs are required for air quality changes (concentrations from AERMOD), population, baseline incidence rates, and effect estimates.	National, County, City, and sub-regional levels	Ozone, PM, NO_2, SO_2, CO	The smallest default analysis resolution for BenMAP-CE is 144 square kilometers (equivalent to approximately 56 square miles or 36,000 acres). This tool could be used to derive average health incidence/ton estimates that can be used for illustrative purposes only for most projects with proper disclosure of the inherent inaccuracies involved in averaging. It is **not recommended** for individual modeling of smaller projects, however. The tool may be appropriate for certain large-scale planning-level analyses.

[5] https://www.epa.gov/benmap

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
Fast Scenario Screening Tool (TM5-FASST)[6]	Joint Research Centre (Italy)	Tool allows users to evaluate how air pollutant emissions affect large scale pollutant concentrations and their impact on human health (mortality and years of life lost) and crop yield from national to regional air quality policies, such as climate policies. The tool is web-based and does not require coding or modelling. Users must gain access through publishers.	Global and national-levels	PM2.5, ozone, NOx, NH_3, CO, ROG, EC, CH_4, SO_2	This tool is applicable at national to global scales. Accordingly, the tool is **not recommended** for project-level CEQA analysis.
Long-range Energy Alternatives Planning System--Integrated Benefits Calculator (LEAP-IBC)	Climate and Clean Air Coalit-ion (CCAC)	Allows users to rapidly estimate the impacts of reducing emissions on health, climate, and agriculture. Tool uses sensitivity coefficients that link gridded emissions of air pollutants and precursors to health, climate and agricultural impacts at a national level. The sensitivity coefficients are generated by a chemical transport model, so air quality modeling not necessary. Tool is currently Excel-based and is available through the developers only. A web-based interface is currently under development.	National-level	PM2.5, ozone, NO_2	This tool is applicable at national scale. Accordingly, the tool is **not recommended** for project-level CEQA analysis.
Multi-Pollutant Evaluation Method (MPEM)[7]	BAAQMD	Estimates the impacts of control measures on pollutant concentration, population exposures, and health outcomes for criteria, toxic, and GHG pollutants. Monetizes the value of total health benefits from reductions in PM2.5, ozone, and certain carcinogens, and the social value of GHG reductions. MPEM was designed for development of a Clean Air Plan for the San Francisco Bay Area. The inputs are specific to the SF region and are not appropriate for projects outside BAAQMD.	Regional level in the SFBAAB	Ozone, PM, air toxics, GHG	This tool is designed to support the BAAQMD in regional planning and emissions analysis within the SFBAAB. The model applies changes in pollutant concentrations over a four-square kilometer grid. This tool could be used to derive average health incidence/ton estimates that can be used for illustrative purposes only for

[6] http://tm5-fasst.jrc.ec.europa.eu/

[7] http://www.baaqmd.gov/~/media/files/planning-and-research/plans/2017-clean-air-plan/mpem_nov_dec_2016-pdf.pdf?la=en

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
					most projects with proper disclosure of the inherent inaccuracies involved in averaging. It is **not recommended** for individual modeling of smaller projects, however. The tool may be appropriate for certain large-scale planning-level analyses in the SFBAAB (with permission of BAAQMD).
Response Surface Model (RSM)-based Benefit-per-Ton Estimates[8]	US EPA	Consists of tables reporting the monetized PM2.5-related health benefits from reducing PM2.5 precursors from certain source types nationally and for 9 US cities/regions. Applying these estimates simply involves multiplying the emissions reduction by the relevant benefit per-ton metric. The resulting value is the PM mortality risk estimate at a 3% discount rate. Note that RSM is based on EPA's BenMAP-CE (discussed in a separate entry).	National or regional (San Joaquin County only) levels	EC, SOx, VOC, NH_3, NOx	While RSM includes regional values specific to San Joaquin County, the metrics only reflect the benefits of reductions in exposure to ambient PM alone and do not include the benefits of reductions in other pollutants. The values are also dated as new sector-based BPT values are more current. Accordingly, the tool is **not recommended** for project-level CEQA analysis (even in San Joaquin County).

[8] https://www.epa.gov/benmap/response-surface-model-rsm-based-benefit-ton-estimates. Note that the tables with the RSM values shown in this link break down BPT by sector and region and are from Fann's 2009 study, which is now outdated. However, the values in EPA's 2018 Technical Support Document do include updated Values of Statistical Life (United States Environmental Protection Agency 2018).

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
Sector-based Benefit-per-Ton Estimates[9]	US EPA	Two specific sets of BPT estimates for 17 key source categories are available. Both are a reduced-form approach based on BenMAP modeling. The first are based on Fann et al. (2012) values and available from EPA's website. The second is based on updated modeling from Fann et al. (2017) and available in a Technical Support Document (TSD) from EPA. Applying these factors involves multiplying the emissions reduction (in tons) by the relevant benefit (economic value) or incidence (rates of mortality and morbidity) per-ton metric. The resulting value is the economics, mortality, and morbidity of direct and indirect PM2.5 emissions. All values are based on a national-scale study. Local values are preferred, but not available from any existing reduced form model and use of reduced form estimates for another city is unlikely to provide a better-than-national value. Use of the current values from EPA's 2018 TSD represent the most current estimate of monetized or incidence risk. Values from Lepeule et al. (2012) represent the most current estimate of mortality.	National-scale	PM2.5, SO_2, NOx	Due to the complex non-linear chemistry governing ozone formation, EPA was not able to derive ozone or secondary PM BPT values. The BPT estimates provide a rough order-of-magnitude analysis of health consequences from directly-emitted PM and precursors to PM (with no secondary formation). However, the multipliers do not account for project-specific characteristics, receptor locations, or local dispersion characteristics. The resultant health effects are therefore reflective of national averages and may not be exact when applied to the project-level. Nonetheless, the estimates can be used to present an informational and scaled health risk analysis of directly-emitted PM and precursors to PM (with no secondary formation.

[9] https://www.epa.gov/benmap/sector-based-pm25-benefit-ton-estimates. The updated Technical Support Document (February 2018) is available at: https://www.epa.gov/sites/production/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf.

Appendix B
San Francisquito Tree Impacts

September 26, 2018

Kevin MacKay
ICF
201 Mission St., Suite 1500
San Francisco, CA 94105

HORT SCIENCE
BARTLETT CONSULTING
A Division of The F.A. Bartlett Tree Expert Company

Subject: San Francisquito Tree Impacts

Dear Kevin MacKay,

ICF is planning a bank stabilization project along the San Francisquito Creek. You asked HortScience | Bartlett Consulting to assess 15 trees on private property that may be impacted by the construction. You and I were together in the field to identify which trees were included in the assessment.

Summary

In total, I assessed fifteen (15) large trees on five properties that you identified as potentially affected by the bank stabilization project.

Tree impacts are expected to be limited to root damage from shallow excavations near the top of the bank to remove the existing sacked concrete (Sakrete) atop the creek bank and to build a new retaining wall. For most trees this process should result in no or very little injury (Table 1). Some trees growing within 10 feet of the top of bank may have roots at the interface between the soil and the sakrete that would be affected by excavations.

It is difficult to predict impacts to four trees:

- For the property 79 Crescent Drive (trees #8-10) the property boundary and construction plans have not been determined.
- Tree #15 at 63 Cresent Dr. was growing close to a masonry wall. I did not have access to the creek side of the masonry wall to determine the distance from the tree to the top of bank.

Table 1. Tree Disposition Data

Tag #	Species	Diameter (in.)	Disposition	Distance from impact
1	Blue gum	81	Preserve	12 feet from top of bank
2	Blue gum	55	Preserve	4 feet from top of bank
3	Blue gum	64	Preserve	Approx. 10 feet from top of bank
4	Blue gum	41	Preserve	Approx. 10 feet from top of bank
5	Blue gum	53	Preserve	Approx. 10 feet from top of bank
6	Blue gum	64	Preserve	Approx. 10 feet from top of bank
7	Blue gum	112	Preserve	Approx. 20 feet from top of bank
8	Coast live oak	32	Depending on plans	Approx. 10 feet from top of bank
9	Coast redwood	35	Depending on plans	7 feet from top of bank
10	Blue gum	36	Depending on plans	Adjacent to top of bank
11	Coast redwood	45	Preserve	6 feet from masonry wall
12	Coast live oak	14	Preserve	7 feet from masonry wall
13	Coast live oak	13	Preserve	11 feet from masonry wall
14	Coast live oak	34	Preserve	14 feet from masonry wall
15	Coast redwood	48	Depending on plans	1 foot from masonry wall

I recommend an arborist observe excavation and sakrete removal along the top of bank to document root damage and to determine if any trees require removal or further mitigation.

Tree Assessment Methods

Trees were assessed on September 13, 2018. ICF determined which trees were included. The identified trees were primarily large trees, near the top of the creek bank, with a potential to become destabilized due to possible root interference during construction. The assessment procedure consisted of the following steps:

1. Identifying the tree as to species;
2. Tagging each tree with an identifying number and recording its location on a map; off-site trees were not tagged;
3. Measuring the trunk diameter at a point 54" above grade
4. Evaluating the health and structural condition using a scale of 1 – 5 based on a visual inspection from the ground. Portions of trees not visible from the ground could not be assessed and are not included in the rating:

   5 **-** A healthy, vigorous tree, reasonably free of signs and symptom of disease, with good structure and form typical of the species.
   4 **-** Tree with slight decline in vigor, small amount of twig dieback, minor structural defects that could be corrected.
   3 **-** Tree with moderate vigor, moderate twig and small branch dieback, thinning of crown, poor leaf color, moderate structural defects that might be mitigated with regular care.
   2 **-** Tree in decline, epicormic growth, extensive dieback of medium to large branches, significant structural defects that cannot be abated.
   1 **-** Tree in severe decline, dieback of scaffold branches and/or trunk; most of foliage from epicormics; extensive structural defects that cannot be abated.

5. Rating the suitability for preservation as "high", "moderate" or "low". Suitability for preservation considers the health, age and structural condition of the tree, and its potential to remain an asset to the site for years to come.

   High: Trees with good health and structural stability that have the potential for longevity at the site.
   Moderate: Trees with somewhat declining health and/or structural defects that can be abated with treatment. The tree will require more intense management and monitoring, and may have shorter life span than those in 'high' category.
   Low: Tree in poor health or with significant structural defects that cannot be mitigated. Tree is expected to continue to decline, regardless of treatment. The species or individual may have characteristics that are undesirable for landscapes and generally are unsuited for use areas.

Properties Visited

We visited nine properties in Palo Alto, CA. Several smaller trees may be affected as well. In four properties no trees were assessed because no large trees were growing near the creek.

- 1401 Edgewood Drive – Trees #1 and 2
- 1411 Edgewood Drive – Trees #3-6
- 1417 Edgewood Drive – Tree #7
- 1425 Edgewood Drive – No trees assessed

- 87 Crescent Drive – No trees assessed
- 79 Crescent Drive – Trees #8-10
- 75 Crescent Drive – No trees assessed (#10 is near boundary)
- 63 Crescent Drive – Trees #12-15
- 51 Crescent Drive – No trees assessed

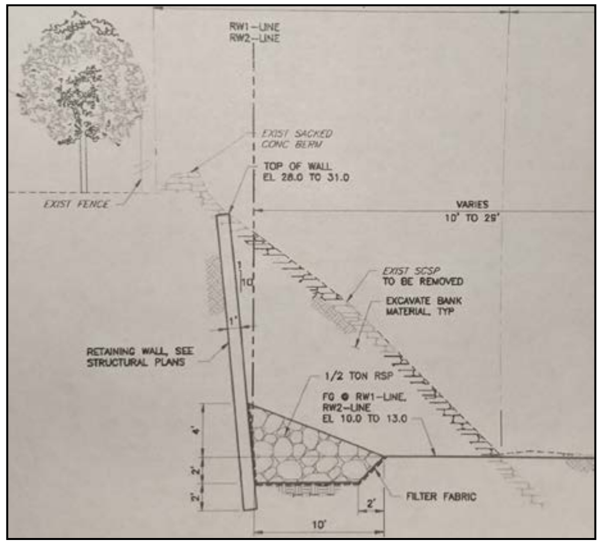


Figure 1. Construction plans showing existing sakrete and future retaining wall.

Construction Impacts

The majority of the sites that we visited had slopes covered with sakrete that was to be replaced with retaining walls (Figure 1). The sakrete will be removed. Minimal excavation will take place at the top of the bank during sakrete removal. A new near-vertical retaining wall will be built which will require significant excavation lower on the slope. Most of the existing slopes that I observed were steeper than that illustrated in Fig. 1, and so would require less excavation. Twenty-five (25) foot long soil nails will be drilled into the slope at a downward slope angle of 15º. The closest nail to the surface will be five feet below top of slope.

At 87 Crescent Drive sakrete will be added to the top of the existing sakrete, and no excavation will be required. Rebar will be pounded into the ground to attach the new sakrete to the slope. No trees were identified for assessment at 87 Crescent Drive.

At 79 Crescent Drive a concrete retaining wall already exists rather than sakrete. No construction is planned in this area at this time.

Tree impacts are expected to be limited to root damage from shallow excavations near the top of the bank to remove the sakrete atop the creek bank and to and build the new retaining wall. For most trees this process should result in no or minor injury. Some trees growing within 10 feet of the top of bank may have roots at the interface between the soil and the sakrete that would be affected by excavations.

It is difficult to predict impacts to four trees:

- For the property 79 Crescent Drive (trees #8-10) the property boundary and construction plans have not been determined.
- Tree #15 is growing in close proximity to a masonry wall. I did not have access to the creek side of the masonry wall to determine the distance from the tree to the top of bank.

Installation of the soil nails are of minimal concern because the highest nail will be installed approximately 5 feet below grade. The equipment will drill an 8 inch- diameter hole approximately 25 feet in length into the bank at a downward slope of 15º. The nails will be spaced 5 feet on center in a grid pattern.

Most tree roots are found in the top 3 feet of soil. So, at 5 feet deep, it is unlikely that significant root damage would occur that would destabilize or kill a tree. It is possible that the roots growing near the interface of the soil and sakrete will be within the pathway of a soil nail. I recommend noting these roots during excavation and adjusting soil nails to avoid them.

Equipment access and operations needs to consider surrounding vegetation. I assume that the equipment needed to construct the wall will be working from the creek bed and require no additional clearance or tree removal on private property. Similarly, I was told that the crews will pound rebar at 87 Crescent Drive by hand and require no large equipment, nor tree crown pruning will be needed to complete construction.

Site-Specific Trees and Construction

Tree descriptions are provided in the attached Tree Assessment table.

1401 Edgewood Drive

Two mature blue gums (*Eucalyptus globulus*) were assessed at 1401 Edgewood Drive. Tree #1 was 81" in diameter and 12 feet from the top of the bank. Tree #2 was 55" and 4 feet from the top of the bank. Both trees had been topped and were in poor condition with extensive epicormic growth (Photo 1).

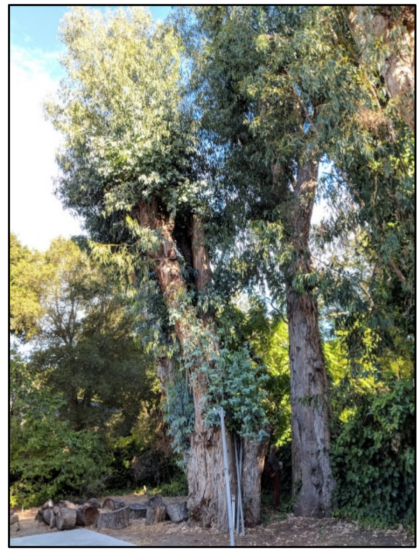


Photo 1. Blue gums #1 and 2 were growing in the backyard of 1401 Edgewood Drive.

Both trees are likely to experience some root loss during excavation near the top of the bank. Because of its close proximity to the creek, tree #2 is of greater concern. I think that both trees will survive construction and will not be destabilized by excavation. I recommend an arborist observe excavation to document root loss and provide mitigation recommendations based on those observations.

1411 Edgewood Drive

Four mature blue gums were assessed (trees #3-6) at 1411 Edgewood Drive. The four trees had trunk diameters ranging from 41" to 64" and were approximately 10 feet away from the top of creek bank. The trees were in fair condition except for tree #6 with tall, difficult to see crowns and their bases fused together. Tree #6 was in poor condition with a 4 foot wide cavity and large basal flare growing over the pavement.

The four trees will likely have some root loss associated with the construction. I expect root loss of trees #3-6 to be minor; an arborist should monitor excavation to see what root loss does occur.

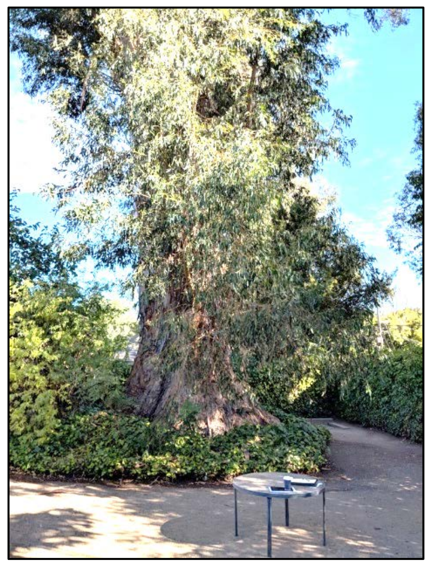


Photo 2. Blue gums #7 was the largest tree assessed (112" trunk diameter).

1417 Edgewood Drive

The largest tree assessed (tree #7) was growing in the backyard of 1417 Edgewood Drive (112" trunk diameter). It appeared to be in good condition, but the upper crown was difficult to see (Photo 2). It was approximately 20 feet from the top of the bank of the creek. If tree #7 loses any roots, I expect it to be minor; an arborist should monitor excavation.

79 Crescent Drive

Three trees were assessed (trees #8-10) at 79 Crescent Drive. Tree #8 was a 32" coast live oak (*Quercus agrifolia*) in poor condition with decay fungus fruiting bodies and a heavy lean and old prop (Photo 3). Tree #9 was a 35" coast redwood (*Sequoia sempervirens*) in good condition. Blue gum #10 had a trunk diameter of approximately 36" and was growing at the corner of the property at the intersection of three fences. The fences were not on the property boundaries, and tree ownership was uncertain in the field. Construction plans are not certain at the time of this writing. Therefore, potential impacts to trees could not be adequately assessed.

63 Crescent Drive
Five trees were assessed (trees #11-15) at 63 Crescent Drive. Coast redwood #11 had a trunk diameter of 45" and was in fair condition with signs of water stress. Tree #11 was 6 feet from the masonry wall. Coast live oaks #12-14 had trunk diameters of 14, 13 and 34" respectively. Tree #12 was the closest to the masonry wall (7 feet) with the others growing in a row behind. The coast live oaks were in fair condition and were heavily bowed either towards the creek (trees #12 and 13) or away from the creek (tree #14). Coast redwood #15 had a trunk diameter of 48" and was in good condition with a dense crown (Photo 4). Tree #15 was 1 foot away from the masonry wall.

Access was not available on the creek side of the masonry wall to see how far the trees are from the top of bank. The two unknowns are:

- How far is the wall from the top of bank?
- What is the footing of the wall and extent of roots growing under it?

Assuming that excavation will take place near the masonry wall and roots can freely grow underneath the wall, impacts to trees will range from none (tree #14) to potentially severe (tree #15). Trees #13 and 14 should not be impacted by construction. Trees #11 and 12 will likely experience minor to severe root loss. Tree #15 may be 1 or 2 feet from the excavation which has the chance of destabilizing or killing the tree.

I recommend an arborist observe excavation near trees #11, 12 and 15 to document root loss and provide mitigation recommendations.

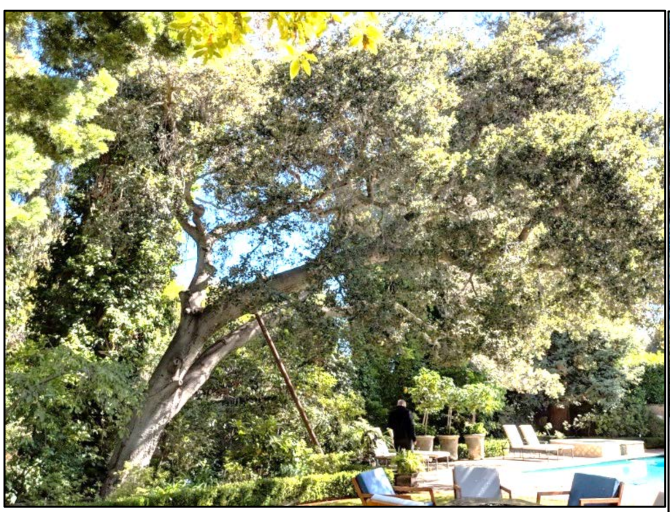


Photo 3 (above). Coast live oak #8 was leaning heavily and being partially supported by a prop. **Photo 4 (right).** Coast redwood #15 was 1 foot from the masonry wall and may experience severe root impacts.

Tree Preservation Guidelines
The goal of tree preservation is not merely tree survival during development but maintenance of tree health and beauty for many years. Trees retained on sites that are either subject to extensive injury during construction or are inadequately maintained become a liability rather than an asset. The response of individual trees will depend on the amount of excavation and grading, the care with which demolition is undertaken, and the construction methods. Coordinating any construction activity inside the **TREE PROTECTION ZONE** can minimize these impacts.

The following recommendations will help reduce impacts to trees from development and maintain and improve their health and vitality through the clearing, grading and construction phases.

1. The demolition and construction superintendents shall meet with the Project Arborist before beginning work to review all work procedures, access routes, storage areas, and tree protection measures.
2. The Project Arborist shall monitor excavation and removal of sakrete as well as and drilling for soil nails within 25 feet of the 15 trees included in this assessment.
3. If roots 2" and greater in diameter are encountered during site work and must be cut to complete the construction, the Project Arborist must be consulted to evaluate effects on the health and stability of the tree and recommend treatment.
4. Sakrete within 25 feet of trees shall be removed with equipment that will minimize damage to trees above and below ground, and operate from outside the dripline of the trees.
5. All contractors shall conduct operations in a manner that will prevent damage to trees to be preserved.
6. If injury should occur to any tree during construction, it should be evaluated as soon as possible by the Project Arborist so that appropriate treatments can be applied.
7. No excess soil, chemicals, debris, equipment or other materials shall be dumped or stored within the dripline of any trees.
8. Any additional tree pruning needed for clearance during construction must be performed by a Certified Arborist and not by construction personnel.

This report summarizes my observations and comments which are limited to the planned project work. Tree owners are encouraged to have their trees inspected regularly to assess tree conditions and to provide appropriate treatments to enhance health and structural stability. In particular, owners of large blue gum trees are advised to consider having aerial inspections by a climbing arborist to assess the structure of the tree crown that is not visible from the ground. Where internal decay indicators are present, such as tree #6 at 1411 Edgewood Dr. and tree #8 at 79 Crescent Dr., the owners are advised to have an advanced inspection to assess the extent of decay and its effects on tree stability. Pruning to manage weight distribution on mature trees is an important part of tree management and is the responsibility of the owner.

Our procedures included assessing trees for observable, visible defects. This is not to say that trees without significant defects will not fail. Failure of apparently defect-free trees does occur, especially during storm events. Wind forces, for example, can exceed the strength of defect-free wood causing branches and trunks to break. Wind forces coupled with rain can saturate soils, reducing their ability to hold roots, and blow over defect-free trees.

Furthermore, trees change over time. Our inspections represent the condition of the tree at the time of inspection. Annual tree inspections are recommended to identify changes to tree health and structure. In addition, trees should be inspected after storms of unusual severity to evaluate damage and structural changes. Initiating these inspections is the responsibility of the tree owner.

Please contact me if you have any questions regarding my observations or recommendations.

Sincerely,

Ryan Gilpin
Certified Arborist WE-10268A

Tree Assessment Map

San Francisquito Creek
Palo Alto, CA

Prepared for:
ICF

September 2018

Notes:
1. Tree locations are approximate.

2. Aerial image provided by ESRI.

Legend

○ Tree

Parcel

N

100
Feet

HORT SCIENCE
BARTLETT CONSULTING

325 Ray Street
Pleasanton, CA 94566
Phone (925) 484-0211
Fax (925) 484-0596

Tree Assessment Map

San Francisquito Creek
Palo Alto, CA

Prepared for:
ICF

September 2018

Notes:
1. Tree locations are approximate.

2. Aerial image provided by ESRI.

Legend

Tree

Parcel

N

100 Feet

HORT SCIENCE
BARTLETT CONSULTING

325 Ray Street Phone (925) 484-0211
Pleasanton, CA 94566 Fax (925) 484-0596

Tree No.	Species	Trunk Diameter (in.)	Protected Tree?	Condition 1=poor 5=excellent	Suitability for Preservation	Comments
				1401 Edgewood Drive		
1	Blue gum	81	No	2	Low	Multiple trunks arise from 5 feet; topped at 25 feet; bushy epicormic regrowth.
2	Blue gum	55	No	2	Low	Multiple trunks arise from 20 feet; topped at 30 feet; bushy epicormic regrowth.
				1411 Edgewood Drive		
3	Blue gum	64	No	3	Moderate	Group of 4 trees; bases fused together with massive burls; branch from adjacent tree pushing against trunk; circling root; upright high crown.
4	Blue gum	41	No	3	Moderate	Group of 4 trees; bases fused together with neighboring trees; codominant trunks arise from 20 feet; tall; upright crown; difficult to see top of tree.
5	Blue gum	53	No	3	Low	Group of 4 trees; bases fused together with neighboring trees; tall; upright crown; difficult to see top of tree; basal flare extends over pavement 1 foot in 3 foot wide.
6	Blue gum	64	No	2	Low	Group of 4 trees; bases fused together with neighboring trees; tall; upright crown; slightly thin; long heavy branches; basal flare extends over pavement 2 feet by 3 foot wide; four foot wide cavity at base from driveway damage.
				1417 Edgewood Drive		
7	Blue gum	112	No	4	High	Huge tree; growing in mounded ivy; root pruning relatively well healed on creek side; bushy lower growth; wide spreading crown slightly one sided towards creek.

Tree Assessment

San Francisquito Creek
Palo Alto, CA
September 2018

HORT SCIENCE
BARTLETT CONSULTING

Tree No.	Species	Trunk Diameter (in.)	Protected Tree?	Condition 1=poor 5=excellent	Suitability for Preservation	Comments
			79 Crescent Drive			
8	Coast live oak	32	Yes	2	Low	Codominant trunks arise from 10 feet; one side propped with growth around it; bleeding; fungal fruiting body (Ganoderma lucidum); crown one sided over pool away from creek; buried and then dug out.
9	Coast redwood	35	Yes	4	High	Good form and structure; dense crown; slightly poor color; slightly thin top; narrow form.
10	Blue gum	36	No	2	Low	At corner of property; multiple trunks arise from 10 feet; bushy; covered in ivy; hard to see much of tree.
			63 Crescent Drive			
11	Coast redwood	45	Yes	3	Moderate	Good form and structure; dense foliage; narrow branches; dark green color.
12	Coast live oak	14	Yes	3	Low	Bowed heavily over creek; corrected past other trees crowns; dieback; dense crown.
13	Coast live oak	13	Yes	3	Low	Bowed heavily over creek; dieback; dense crown; growth cracks; interior tree.
14	Coast live oak	34	Yes	3	Low	Bowed heavily away from creek; epicormic growth; dense crown; growth cracks; dominant tree.
15	Coast redwood	48	Yes	4	High	Good form and structure; dense crown; dark green color; epicormic sprouting around base.

Appendix C

Cultural Resources Pedestrian Survey

Memorandum

To:	Ruzel Ednalino, M.A. Archaeologist USACE San Francisco District
From:	Lily Arias, MA Archaeologist ICF
Date:	February 19, 2019
Re:	**Cultural Resources Pedestrian Survey for the San Francisquito Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101**

This memorandum is to document the pedestrian survey conducted as part of the cultural resources review for the Draft Environmental Impact Report (DEIR) of the San Francisquito Creek Joint Powers Authority's (SFCJPA) San Francisquito Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101 (project).

For the DEIR, San Francisquito Creek is described in three reaches. Reach 1 extends from San Francisco Bay to the upstream side of U.S. 101. The SFCJPA has completed construction of flood protection improvements in Reach 1; CEQA documentation was completed in 2012 and this Reach 1 is not included in this memorandum. Given program-level improvements are still early in the planning phase and, therefore, conceptual in nature, the reaches are categorized as program-level improvements and project-level improvements. Project-level improvements include construction activities associated with Reach 2, which extends from the upstream side of U.S. 101 to the upstream side of the Pope-Chaucer Bridge. Reach 2 is the subject of this memorandum. Program-level improvements include construction activities associated Reach 3, which begins on the upstream side of the Pope-Chaucer Bridge and extends throughout the upper watershed. Project-level improvements for Reach 3 have not been defined and Reach 3 is not included in this memorandum. Only Reach 2 was subject to pedestrian survey (Figure 1).

Methods

Records Search

A records search was performed at the Northwest Information Center in Rohnert Park, California, on November 28, 2017 (IC#17-1496). The search identified 55 previously recorded resources, with one located within the Reach 2 study area, in an area of proposed channel widening.

P-43-000578 (CA-SCL-583) – This resource was originally identified in the 1960s, and three human burials were removed from the area along with associated funerary items, such as several hundred Olivella beads, several hundred fraction Olivella beads, bird bone whistle, bone awl, and cut and polished bone tube. This material is curated at the Stanford Museum. The resource was revisited in 1985 at which time a formal Department of Parks and Recreation (DPR) 523 form was completed. At this time, houses had been constructed on top of the resource and additional identification was not possible (Bocek and Rutherford 1985). This resource has not been formally evaluated for its eligibility for listing in the CRHR or NRHP.

A three-step process was followed to identify historic built resources and update existing evaluations: (1) undertake background research of previously recorded resources and completed reports within and adjacent to the study area, (2) develop approach and historic context for evaluation, and (3) conduct onsite fieldwork to inspect and record resources. Additional desktop research was conducted at the Palo Alto Historical Association website, newspapers.com, historicaerials.com, state, and national bridge inventories.

Field Survey

A pedestrian survey of the project-level study area was conducted on April 18, 2018, by both an ICF archaeologist and architectural historian, to identify historic age built environment resources, archaeological deposits and surface-exposed features. The archaeological survey consisted of walking across the project-level study area and visually inspecting the ground surface for indicators of surface and subsurface archaeological deposits. The archaeological survey also involved inspecting the local topography to identify areas that have been subject to modern anthropogenic landscape alteration.

The built environment survey consisted of walking the project-level study area and visually inspecting built resources for the potential to be age-eligible (50 years or older). Photographs were taken throughout the course of the survey.

Findings

As discussed above a records search conducted at the NWIC identified one precontact archaeological site within the project-level study area. P-43-000578 (CA-SCL-583) identified within Site 5 of Reach 2. This resource was not accessible during the pedestrian survey.

The pedestrian survey encompassed portions of the project-level study area adjacent to the University Avenue Bridge and the Pope-Chaucer Bridge, as well as 200 meter radius around the bridges.

The project-level study area was inspected for indicators of human activity such as dark midden soils, dietary shell and bone, stone or bone artifacts, and historic artifacts. The area was also examined for any larger, earthen features such as mounds or depressions. The area has been completely developed and consists of residential neighborhoods. The majority of the project-level study area is within the limits of the creek and includes steep banks and heavy vegetation. Any visible ground surface has been disturbed and/or covered in fill and gravel. All visible ground surfaces appear to have been graded, landscaped, or developed.

No archaeological resources were identified during the course of the pedestrian survey.

Two known built environment resources, The University Avenue Bridge and the Pope-Chaucer Street Bridge, were identified and revisited during the pedestrian survey. Photographs were taken of the two structures and a visual inspection of the bridges was conducted to note alterations and existing conditions.

No additional built environment resources were identified during the course of the pedestrian survey.

Conclusions

While no evidence of archaeological deposits was identified during the pedestrian survey, the potential remains that subsurface archaeological deposits are present in the project-level study area. Only a portion of the project-level study area was available for pedestrian survey and the area adjacent to the stream channel was heavily developed and vegetated. As described in Chapter 3.4 *Cultural and Paleontological Resources* of the DEIR over 55 archaeological sites have been identified within overall project area, the majority of which are situated along San Francisquito Creek. Additionally, the areas directly adjacent to the stream contain Holocene-aged alluvium that indicates that the project area has high archaeological sensitivity (Byrd and Meyer 2011; ICF 2018).

Chapter 3.4 *Cultural and Paleontological Resources* of the DEIR states that any ground disturbing activities occurring within Reach 2 have the potential to have significant impacts to documented and as-yet undocumented archaeological resources. The implementation of Mitigation Measures (MM-) CULT-1: *Stop Work if Archaeological Deposits are Encountered During Ground-Disturbing Activities*, MM-Cult-2: *Develop and Implement an Archaeological Testing Plan,* and MM- CULT-3: *Develop and Implement an Archaeological Monitoring Plan* would reduce the impacts to less than significant. Halting work in an area where potential archaeological resources, including human remains, are identified allows the resources to avoid further impact as well as allows for further analysis. All potential archaeological resources should be assessed by a qualified archaeologist to determine its significance under CEQA. If work is to occur within an area where an archaeological site is present, the creation and implementation of an Archaeological Testing Plan before construction activities begin, would allow for understanding of the extent of the resource as well as its significance under CEQA. Due to the highly sensitive nature of Reach 2, the creation and implementation of an

Archaeological Monitoring Plan in areas where project related ground disturbance has the potential to encounter as-yet undocumented archaeological resources would allow for the early identification of archaeological resources by qualified archaeologist and thus avoid destruction of the resource. These mitigation measures are discussed at length in Chapter 3.4 Cultural and Paleontological Resources of the DEIR (ICF 2018).

References

Byrd, F. B., and J. Meyer. 2011. *Initial Cultural Resources Investigation San Francisquito Creek Flood Damage Reduction and Ecosystem Restoration Project, Santa Clara and San Mateo Counties, California.*

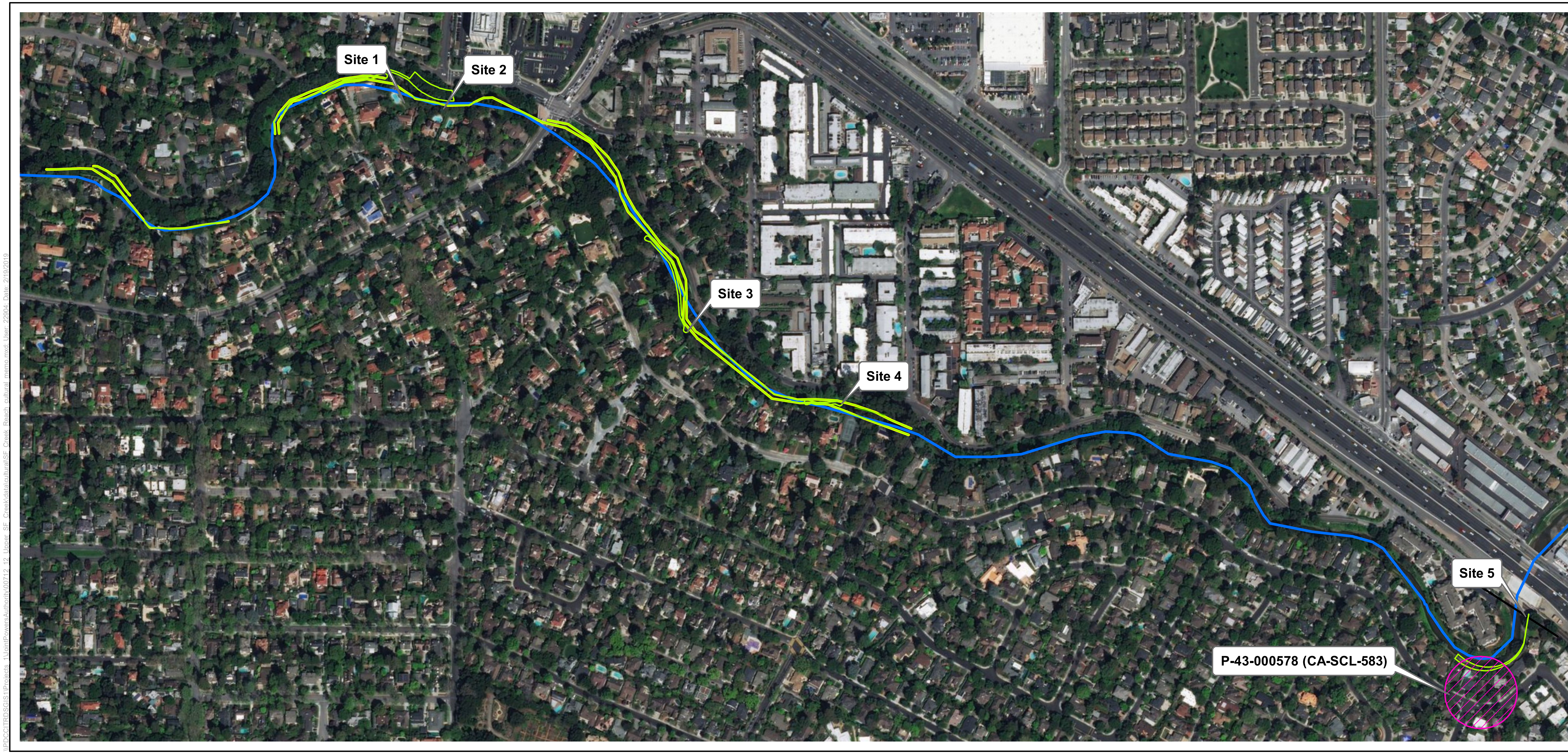
ICF. 2018. *DRAFT Environmental Impact Report San Francisquito Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101*. Prepared for the San Francisquito Creek Joint Powers Authority.

Photographs

Overview of San Francisquito Creek, directly south of the University Avenue Bridge, view southeast

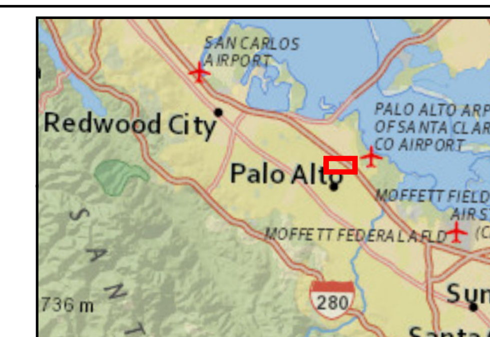
Overview of San Francisquito Creek, directly south of the University Avenue Bridge, view south

Overview of the north side of the Pope-Chaucer Bridge, view southwest



Legend

- San Francisquito Creek
- Study Area (Reach 2)
- Archaeological Resource



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1:5,000

Figure 1
Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101
Cultural Resource Pedestrian Survey Memorandum

Appendix D
Hydrology Report

SAN FRANCISQUITO CREEK HYDROLOGY STUDY

Hydraulics, Hydrology and Geomorphology Unit

FINAL (ADDENDUM #1)

Prepared by:

Jack Xu, PE
Associate Civil Engineer

Under the Direction of:

Liang Xu, Ph.D, PE
Engineering Unit Manager

DECEMBER 2016

ADDENDUM #1

An error was discovered after Corps ATR certification where the incorrect k-value was used to interpolate the 50-yr peak flows in the original report dated November 2015. The k-value was replaced in this addendum, which is dated December 2016. The only changes to the report are in the 50-yr column in Table 15. The changes are documented below.

Table 15: Design Flows (Addendum Updates)

Location	50-Yr Original (2015)	50-Yr Addendum (2016)
Searsville Inflow	3,880	3,700
Searsville Outflow	2,760	2,630
Bear Creek U/S SFC	2,670	2,570
Los Trancos U/S SFC	1,410	1,350
SFC U/S Los Trancos	5,750	5,500
USGS	7,010	6,710
Pope Chaucer	7,490	7,170
US-101	7,730	7,400
K-Value	1.77716	1.72033

The U.S. Army Corps of Engineers San Francisco District Water Resources Section was notified of the change, reviewed the update, and approved the addendum because there was a minimal adjustment to the 50-yr event flows that was determined insignificant.

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TABLES

FIGURES

APPENDICES

Appendix A: Technical Memorandum - Effect of Searsville Lake on Large Storm Events. SCVWD. March 25, 2015.

Appendix B: US Army Corps of Engineers Agency Technical Review (ATR) Certification background documents.

Attached separately as electronic files

- HEC-RAS v5.0 BETA Searsville 2D Hydraulic Model
- HEC-HMS v4.0 San Francisquito Hydrologic Model
- SFC Flood Frequency Analysis PeakFQSA Output
- Balance Hydrologics Recorded Data Spreadsheet
- Hydrologic Parameters Spreadsheet
- Channel Routing Spreadsheet
- Design Rainfall Spreadsheet
- 2D Model Output Spreadsheet
- Model Plans Spreadsheet

1. INTRODUCTION

1.1. BACKGROUND

San Francisquito Creek forms the boundary of the Santa Clara Valley Water District's (SCVWD) jurisdiction to the north with San Mateo County. The watershed is approximately 45 square miles, with the majority of the watershed in the rural foothills of the San Francisco Peninsula. The Creek's watershed impacts the cities of Palo Alto, East Palo Alto, and Menlo Park. Stanford University is also a major landowner in the region and owns several reservoirs within the watershed.

San Francisquito has three main tributaries that combine to form the creek proper once it leaves the foothills and enters the urbanized valley. Bear Creek is the northernmost tributary and is unimpaired. To the south, Searsville Lake and Dam collect runoff from Alambique, Dennis Martin, Sausal, and Corte Madera Creeks. Searsville Lake offers some attenuation, but has experienced severe sedimentation over time. On the southeastern edge of the watershed, Los Trancos Creek flows unimpaired, passing Felt Lake, a diversion pond owned by Stanford. All three of these tributaries meet before traveling downstream toward the bay through urbanized neighborhoods.

A location map with information about the creek watershed and sub-watersheds is on Figure 1.

1.2. PURPOSE

The purpose of this report is to update the 2007 San Francisquito Hydrology Report[1] by improving the following items from the old report:

1. Upgrading the numerical model from HEC-1 to HEC-HMS v4.0.

2. Characterizing the routing effects of Searsville Lake and dam by using a 2D hydraulic model.

3. Using revised and improved methodology for design storms, loss, and Clark's hydrograph parameters (Tc & R).

4. Calibrating the numerical model to historical storms.

5. Performing a flood frequency analysis (FFA) on the USGS stream gage and validating the hydrologic design model to the FFA.

To do this, a new hydrologic model that reflects the existing San Francisquito Creek watershed was developed. This model will be used to determine revised 1% and 10% design flows for the entire creek.

[1] Wang, James et al. SCVWD. San Francisquito Creek Hydrology Report. April 2006, Revised December 2007.

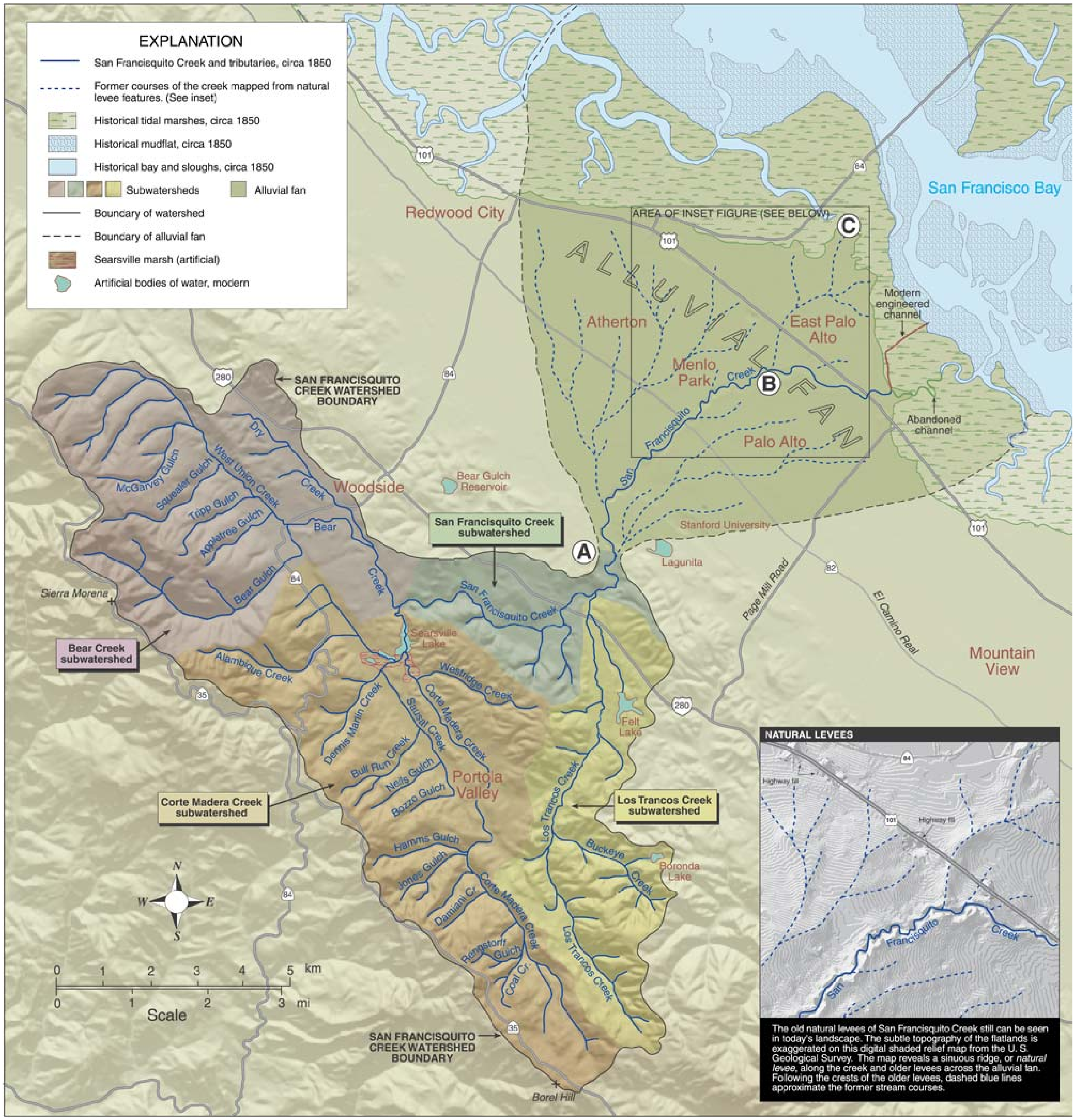

Figure 1: San Francisquito Creek Watershed Map

2. MODEL INPUT PARAMETERS

2.1. WATERSHED DELINEATION

Sub-basin watershed delineation was performed by using the ArcHydro add-on to the original ArcGIS software suite. A digital elevation model (DEM) was created from two sources. For Santa Clara County, the 2006 LiDAR data was used, while for San Mateo County, USGS data was used. These elevation datasets were used to determine flow accumulation patterns and ultimately sub-basin delineations. Each sub-basin within an urban area was double checked manually to ensure that terrain features not picked up by the DEM were included, such as walls and levees. In addition, delineations were manually created at stream gage locations and dams.

Two delineated sub-basins were determined not to contribute to San Francisquito Creek flow. The first is the area tributary to Felt Lake. The second is the Stanford golf course.

2.2. SURFACE RUNOFF METHOD

The Army Corp's HEC-HMS hydrologic modeling software was used to perform this study. The Soil Conservation Service (SCS) Curve Number (CN) method was selected as the loss method, and Clark's Unit Hydrograph (CUH) was selected as the transform method. Since the model will primarily be used to determine design flow rates, it will be used as an event-based model, which is appropriate for the SCS loss method. The CUH method is robust for watersheds of different sizes and shapes. Based on previous experiences, the SCS method combined with CUH transform method works well within the Santa Clara Valley Watershed. This method has been used on studies in adjacent Matadero and Steven's Creek watersheds[2], as well as studies in the nearby Saratoga and San Tomas Creek watersheds[3], all of which have drainage areas from 20 to 45 square miles.

2.3. SUB-BASIN PARAMETERS

Six different variables; (2.3.1) Area, (2.3.2) Initial Abstraction, (2.3.3) Curve Number (CN), (2.3.4) Impervious Area, (2.3.5) Time of Concentration, and (2.3.6) Reach Coefficients must be characterized for each sub-basin and are listed below in further detail.

2.3.1. AREA

This is defined as the total area of the sub-basin in square miles. It is determined from area measurements performed in ArcGIS.

2.3.2. INITIAL ABSTRACTION

Initial abstraction represents the initial loss on each sub-basin, and also has bearing on the runoff equation used in HEC-HMS for CN method. The default relationship outlined in the SCS CN loss method is that initial abstraction is 20% of sub-basin storage. However, recent

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[2] SCVWD. Lower Peninsula Watershed Hydrology Report. July 2004, revised December 2007.
[3] SCVWD. Hydrology Report – Saratoga and San Tomas Aquino Creeks. May 8, 2013.

research[4],[5] suggests that 5% is a more appropriate value. Storm calibrations within this model have also supported the 5% value suggested by Hawkins and Lim et al. The initial abstraction used for rural sub-basins is defined by:

$$Initial\ Abstraction = 0.05 \times \left(\frac{1000}{CN} - 10\right)$$

While changing the initial abstraction for the SCS CN method, proper procedure dictates that the CN be modified as well, since HEC-HMS adjusts rainfall excess based on initial abstraction, and initial abstraction is related to the sub-basin storage index (S) that was fixed using a 20% ratio during the development of the SCS method. Since S is directly related to CN, the CN number would need to be adjusted as well if the ratio was changed to 5%. However, calibrations suggested that overall volume was matching observations without adjusting CN.

2.3.3. CURVE NUMBER (CN)

Curve number represents the pervious sub-basin characteristic for surface runoff. Internal parameters of curve number are; soil group, land cover type, and antecedent moisture condition (AMC). Curve number development was performed in accordance with a District memorandum[6] on SCS CN determination.

2.3.4. IMPERVIOUS AREA

Impervious area characterizes the amount of area, in percent, within the sub-basin that will experience negligible loss. These areas are generally considered paved urban areas. This value is based on the 2006 National Land Cover Dataset (NLCD) and is aggregated for each sub-basin in ArcGIS.

For watersheds with large amounts of urban areas, an impervious area reduction is commonly used to account for unconnected impervious areas. However, due to the majority rural makeup of the San Francisquito watershed, a reduction was not used.

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[4] Kyoung Jae Lim, et al. Effects of Initial Abstraction and Urbanization on Estimated Runoff Using CN Technology. June 2006. Journal of the American Water Resources Association.
[5] Hawkins, Richard H. Woodward, Donald E. Runoff Curve Number Method: Examination of the Initial Abstraction ratio. 2002.
[6] Xu, Jack. SCVWD Technical Memorandum. SCS Curve Number Determination, Update #1. January 10th, 2015.

2.3.5. TIME OF CONCENTRATION (Tc)

Time of concentration is the maximum travel time for each sub-basin. The velocity method described in NEH Chapter 15[7] was used to determine time of concentration. General guidelines used by the District are outlined in a technical memorandum[8] on this subject.

In general, possible collectors and collector combinations were categorized into similar slopes and cross sections. A reiterative process was used to solve manning's equation for velocity, given a certain flow depth. The flow depth was determined from a given flow rate that was selected based on USGS regression equations. The equations serve as a broad estimation of the flow for different recurrence events given the sub-basins characteristics. Therefore, several times of concentrations for each sub-basin were developed, depending on the flow.

2.3.6. STORAGE COEFFCIENT (R)

The storage coefficient represents the amount of storage and attenuation that will not be lost within the sub-basin for the CUH method. This variable will change the shape of the runoff hydrograph. Studies[9] have shown that the storage coefficient ratio remains constant over a large watershed area:

$$Ratio = \frac{R}{R + Tc}$$

A ratio above 0.5 implies more storage and a wider hydrograph with a smaller peak flow. A ratio below 0.5 implies a narrow response with a larger peak flow. This value is held constant for each general topographic area within the Coyote Watershed for all calibration events. For the entire San Francisquito Creek watershed, calibrations supported a storage coefficient ratio of 0.5.

---

[7] USDA NRCS. Part 630 Hydrology, National Engineering Handbook. Chapter 15, Time of Concentration.
[8] Xu, Jack. SCVWD Technical Memorandum. Time of Concentration (Tc). November 10, 2014.
[9] USACOE HEC-HMS Users Manual v3.5. August 2010. Chapter 7, pg.141.

2.4. REACH ROUTING PARAMETERS

All reach routing was performed from sub-basin to sub-basin using the Muskingum-Cunge method in the hydrologic model, except for Searsville Reservoir. Muskingum-Cunge is an extension of the Muskingum method, which overcomes difficulty in estimating parameters that are not physically based. According to the HEC-HMS technical reference manual[10], Table 19 lists the Muskingum-Cunge routing method as having the most flexibility. In addition, this routing method has been used successfully in previous studies, similar to CUH as mentioned in Section 2.2.

Slopes were taken using elevations at 10% and 85% of the reach length. Manning's roughness coefficients and channel geometry were estimated using aerial images and field visits. For creek reaches downstream of the Los Trancos Creek confluence, a HEC-RAS existing conditions model is available[11]. Channel geometries and slopes were taken from this model and input into the hydrologic model. These geometric parameters did not change during calibration and are summarized in Table 1.

The following assumptions were made to fit the scope of this report in determining design flows:

- All stream channels contain all the flows. There are no breakouts or spills.
- There are no flows entering or leaving the watershed boundaries from spills.

[10] USACOE HEC-HMS Technical Reference Manual. March 2000.

[11] Noble Consultants. Final Report – San Francisquito Creek Hydraulic Modeling and Floodplain Mapping, Existing Condition. Volume I: Channel Hydraulic Modeling. August 2, 2010. Prepared for USACE SF District.

Table 1: Reach Routing Parameters

Reach ID	Length (ft)	Channel n-value	Slope (ft/ft)	Slope/n Determination
SFQ_A1_ChnRT	9596	0.05	0.002111	GIS & Field Visit
SFQ_AA14_Z_ChnRT	5293	0.05	0.003862	GIS & Field Visit
SFQ_E_z_ChnRT	18751	0.043	0.00544	RAS
SFQ_G1_ChnRT	7200	0.05	0.021	GIS & Field Visit
SFQ_G2_Z_ChnRT	11000	0.05	0.0137	GIS & Field Visit
SFQ_G5_Z_ChnRT	2049	0.05	0.007112	GIS & Field Visit
SFQ_G6_Z_ChnRT	6264	0.043	0.00694	RAS
SFQ_H_Z_ChnRT	7062	0.043	0.00565	RAS
SFQ_J2_Z_ChnRT	4971	0.043	0.00322	RAS
SFQ_L_Z_ChnRT	10142	0.043	0.00252	RAS
SFQ_M_Z_ChnRT	9361	0.043	0.00201	RAS
SFQ_N_Z_ChnRT	7761	0.03	0.00045	RAS
SFQ_B1_ChnRT	17495	0.05	0.005323	GIS & Field Visit
SFQ_D_ChnRT	6588	0.06	0.002921	GIS & Field Visit
Reaches only in "No Searsville Lake" Model				
SFQ_BB11_ChnRT	7172	0.05	0.003923	GIS & Field Visit
SFQ_BB13_ChnRT	6616	0.05	0.006561	GIS & Field Visit
SFQ_C6_ChnRT	6197	0.05	0.003009	GIS & Field Visit

2.5. DETENTION FACILITIES

In the San Francisquito Creek watershed, there are three notable detention facilities; Felt Lake, Lake Lagunita, and Searsville Lake.

Felt Lake is used as a water supply source for Stanford University, and generally does not impact the overall flow of the watershed. This is also true for Lake Lagunita, which detains runoff from the campus golf course. Conversations with Stanford facilities revealed that Felt Lake and Lake Lagunita have never overtopped, even during the storm of record in 1998. In addition, a sensitivity study performed by peer review showed very little impact. Therefore, both lakes and the contributing runoff area were taken out of the model.

Searsville Dam is a 68-foot-high concrete gravity dam that is comprised of large concrete blocks. It was built in 1892 by the for-profit Spring Valley Water Company, and was acquired by Stanford University in 1919. Stanford University has not used the reservoir for water supply since 2013[12]. Searsville Lake impounds almost 15 square miles of the watershed behind it.

Due to ongoing sedimentation, at rates that are estimated to vary between 3.6 acre-feet to 23.5 acre-feet per year over the lifespan of the dam[13], the lake only has about four feet of storage before spilling, if empty. This amounts to less than 10% of the original water capacity, which is approximately 90 acre-feet. However, the backwater effect caused by the dam, the wetland behind it, and surrounding low-lying areas, has caused significant attenuation in the past. Observations from historical events suggest that typical volume/discharge methods would not be sufficient. To route the flow from the upland tributaries, through the lake, and out the dam, a 2D hydraulic model was used.

[12] Stanford University Website. http://news.stanford.edu/searsville/. Updated 5/5/2015. Accessed 10/5/2015.
[13] Northwest Hydraulic Consultants, Balance Hydrologics, HT Harvey Associates, Jones & Stokes, Matt Kondolf, Jerry Smith. Searsville Lake Sediment Impact Study. March 2002. Stanford University, Facilities Operations

2.6. SEARSVILLE LAKE 2-D HYDRAULIC MODEL

HEC-RAS Version 5.0 BETA, October 2014 release, was used to properly model Searsville Lake. A 2D computation mesh was created by using a *.LAS dataset from the 2006 LiDAR survey that generated a digital terrain model with 10' x 10' squares. This dataset was cleaned to remove errant reflectivity data from foliage and buildings by the survey vendor. Relevant hydraulic structures were inputted with data from Balance Hydrology's 1D HEC-RAS model[14] of Searsville that was sent to the District for review in 2014. The outfall of the entire model was modeled as a 2D Boundary Condition Line, whose conditions were determined using a rating curve generated from Balance Hydrology's model. This curve was double checked with recorded stage and flow data from historical events, which was also provided by Balance.

The 2D Boundary Condition Line spans six grid elements, and during simulation, five of those grid elements are wetted. Due to program limitations in the beta, water surface elevations can only be determined on a grid-by-grid basis while in the 2D domain. Conversation with Gary Brunner, lead developer at HEC, revealed that the computational scheme allows for different water surface elevations within each grid at the boundary condition line. Each grid independently uses the rating curve based on its connection at the boundary condition line. Therefore, there are slight variations in the water surface elevations, depending on grid characteristics. To force a singular output for the water surface, the 2D domain would need to be connected to a 1D cross section within the reservoir. Since bathymetry is not available, the five wetted grids will be averaged to determine a single water surface elevation, which will be used to determine flow from the rating curve.

Late in the peer review process, inaccuracies in the terrain data were discovered regarding the resolution of Corte Madera Creek and the Stanford Causeway gap. The former was addressed by using recently surveyed cross sections present in an existing Balance Hydrologics HEC-RAS model. The cross sections were used to adjust the terrain to reflect surveyed conditions. For the Stanford Causeway, the bridge piers in the crossing were added to the terrain. The bridge deck was not modeled since the 100-yr WSEL does not reach the low chord. A sensitivity analysis was performed between the two sets of terrain using both the 24-hr and 72-hr 100-yr design storms. The outcome was a 0.05' difference in WSEL at the dam and a resulting flow change of under 5%. Therefore revised terrain was only used in determining the 10-yr and 100-yr design storms, while the original terrain was still used for calibration and sensitivity studies.

Computational point spacing for the mesh was set at 100' x 100' and 50' x 50', depending on the detail required. A sensitivity analysis that ran the same model at a 10' x 10' mesh showed negligible output difference. The diffusive wave computational method was selected over the full dynamic solution due to the lack of potential energy losses through obstructions. A sensitivity analysis using different methods also yielded negligible difference.

[14] Sears_US_JPA_052114.prj. Balance Hydrology is Stanford University's consultant.

To properly characterize the lake, several historical calibrations needed to be run to determine if the model is accurate. When available, stream gage data was used as input into the model. HEC-RAS inputs from other tributaries that were not gaged were estimated. Using the following storm events, a final manning's roughness coefficient of 0.1 worked well for all the storms.

- December 2012 (Figure 2)
- March 2011 (Figure 3)
- January 2010 (Figure 4)
- December 2005 (Figure 5)
- February 1998 (Figure 6)

To estimate the HEC-RAS inflow inputs from the Searsville Lake tributaries, several methods were employed. For the 2011 and 2010 events, only one tributary (Corte Madera Creek) was gaged. For 1998, there were no gages upstream of the dam. These events also had reliable gage adjusted radar rainfall data, and were used in the historical calibrations for the hydrologic model. Therefore, outputs from the HEC-HMS hydrology model were used as tributary inflow inputs for the HEC-RAS models. Parameters used in the HMS model were the same as in the model calibrations for the specific event.

For the 2005 event, only Corte Madera Gage was gaged. However, rainfall data was not reliable. Therefore, the remainders of the tributary inflows were determined by scaling the Corte Madera Creek hydrograph based on drainage area.

The 2012 event had two gaged tributaries. Additionally, a third tributary had visual observations for estimated flow. For the remaining tributaries, flow was determined by scaling the hydrographs from the average of the two gaged tributaries, much like in the 2005 event. However, for the tributary with visual observations, the hydrograph was modified so that the observed flow values properly fit within the rising and receding values of the hydrograph.

Using the calibrated 2D hydraulic model and recorded data, a separate technical memorandum[15] was published. This report attempted to quantify the causes of attenuation for Searsville Lake and the effects of the Lake on San Francisquito Creek during significant storm events. This memorandum is included in this report in Appendix A.

[15] Xu, Jack. SCVWD. Technical Memorandum - Effect of Searsville Lake on Large Storm Events. March 25, 2015.

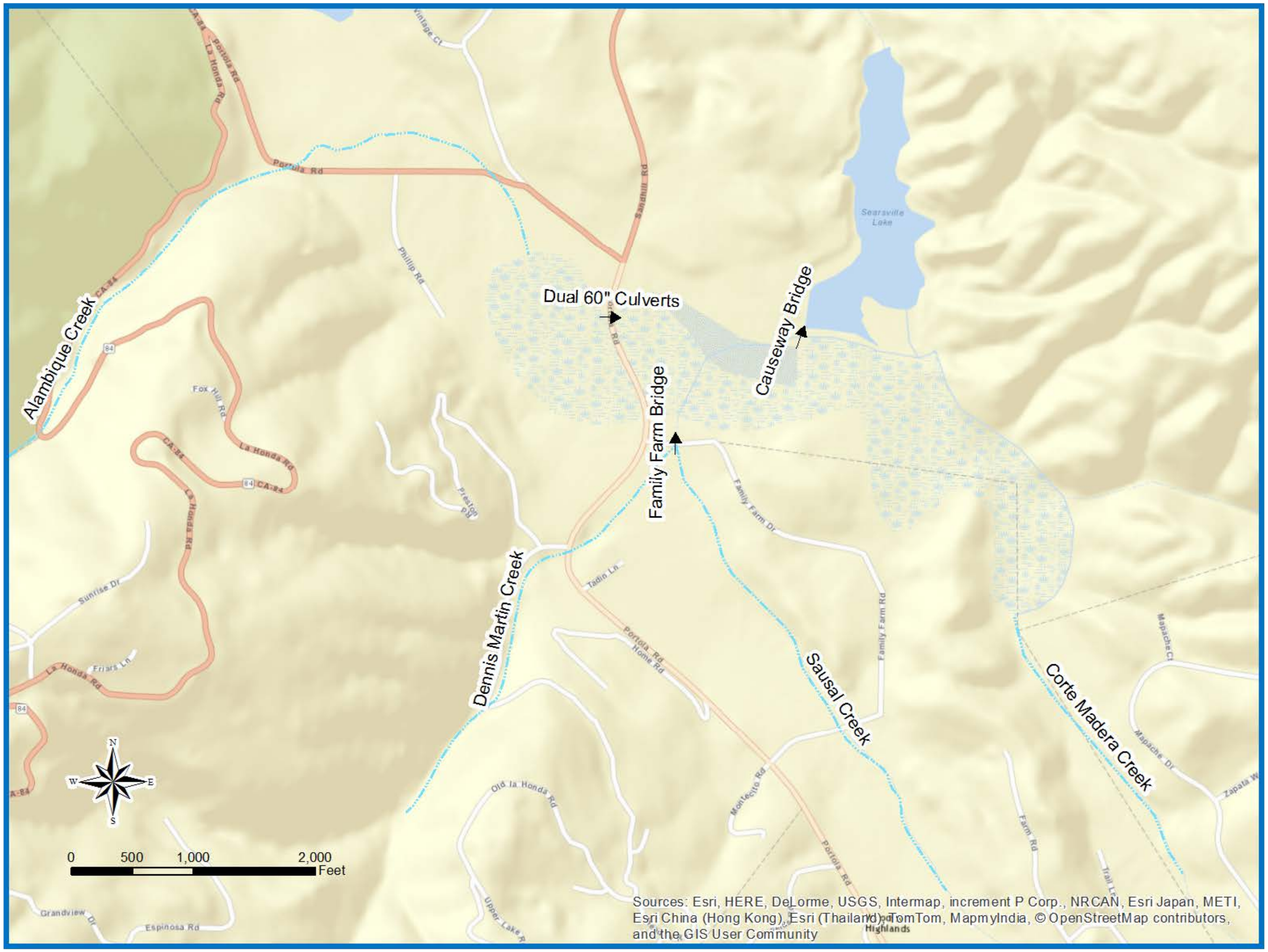


Figure 2: Searsville Lake Detail Map

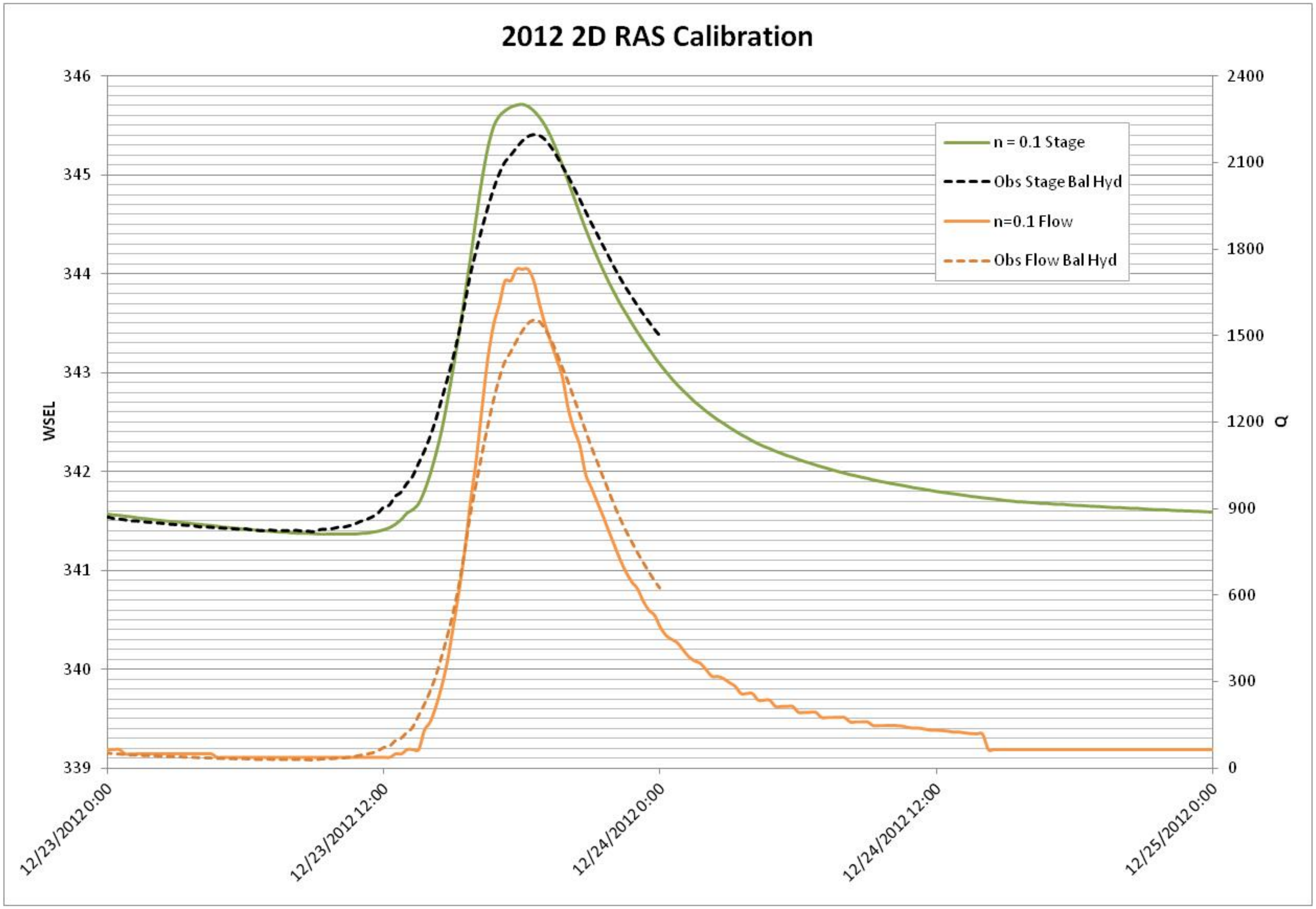


Figure 3: 2012 Searsville 2D Model Calibration

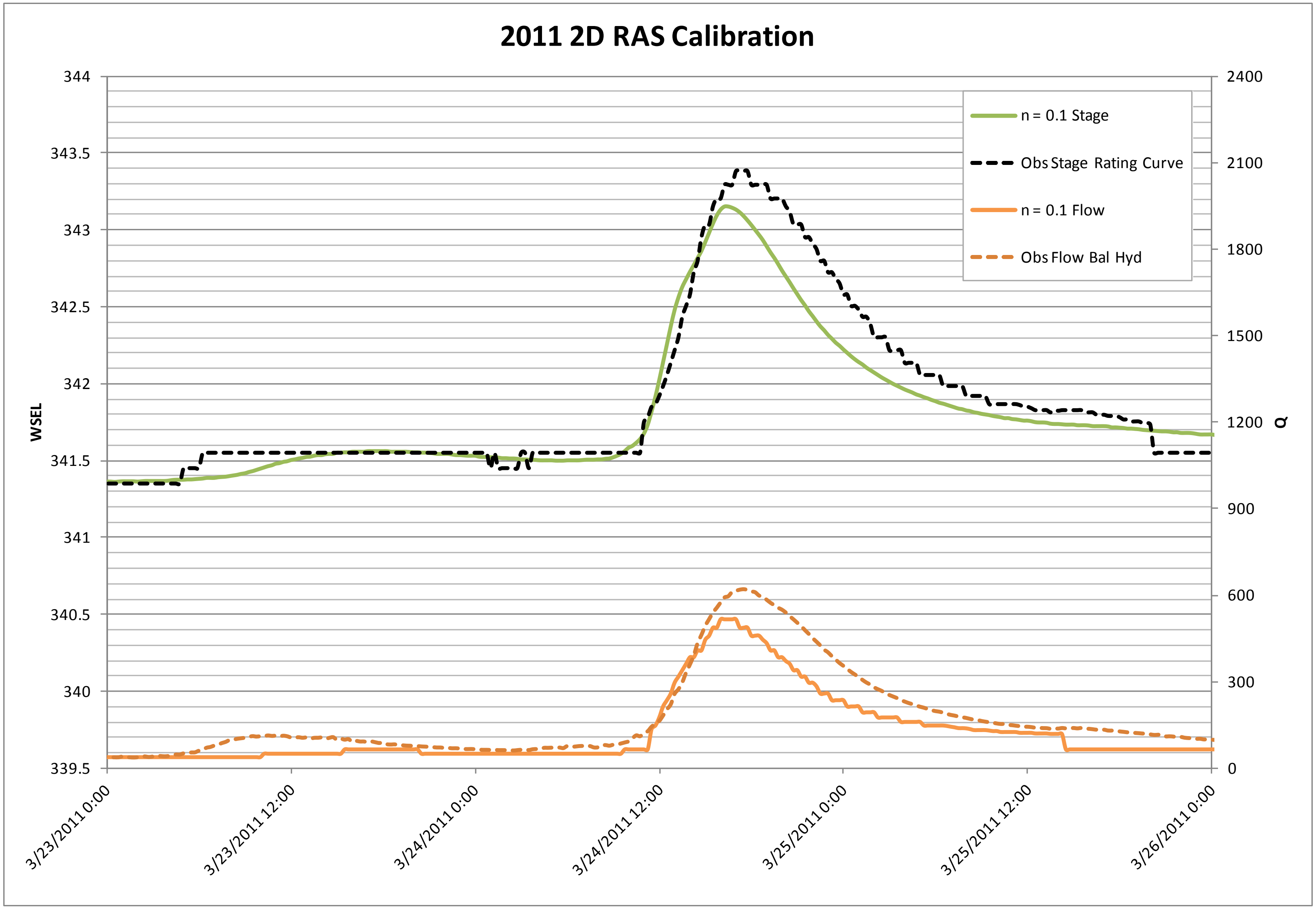


Figure 4: 2011 Searsville 2D Model Calibration

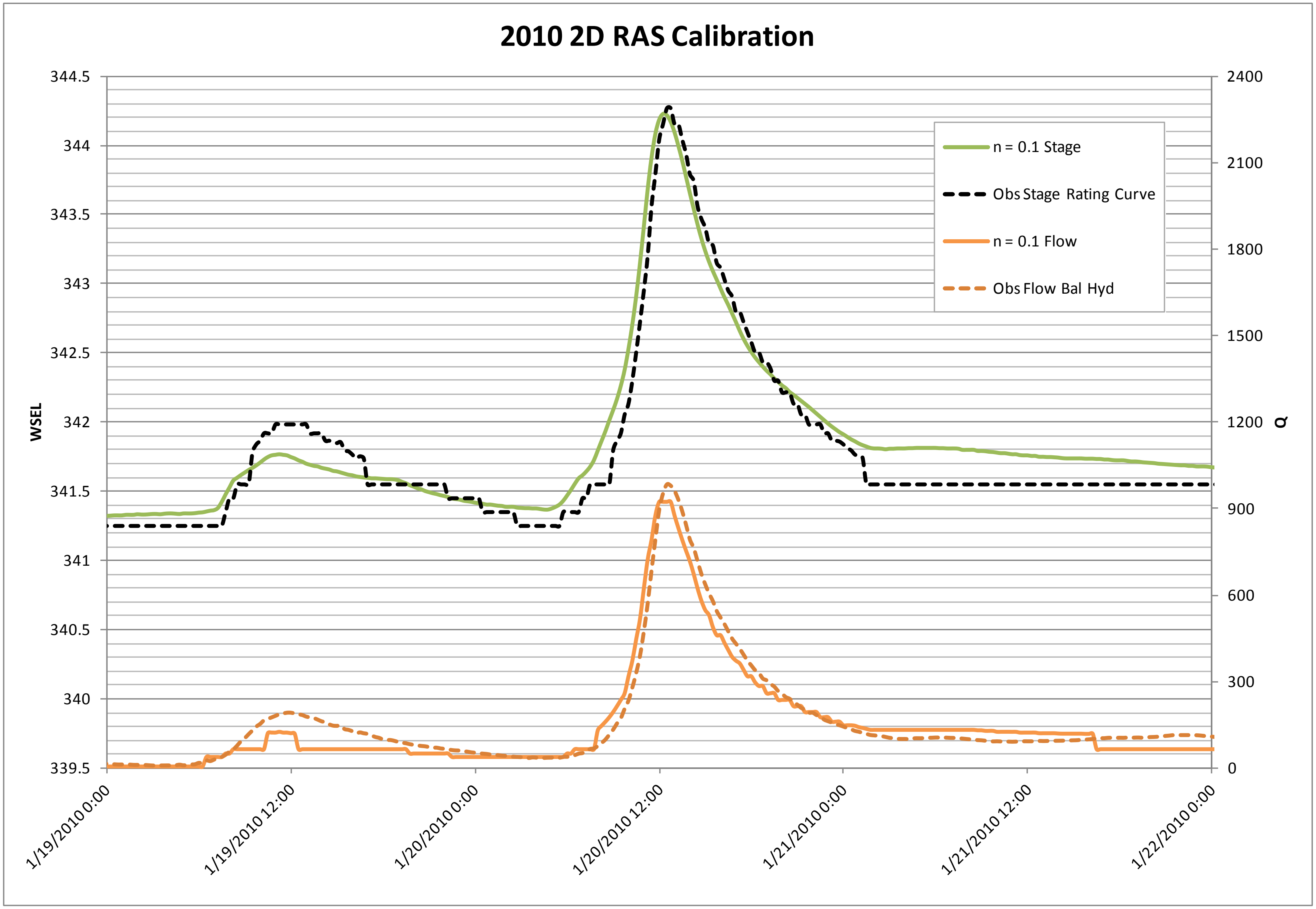


Figure 5: 2010 Searsville 2D Model Calibration

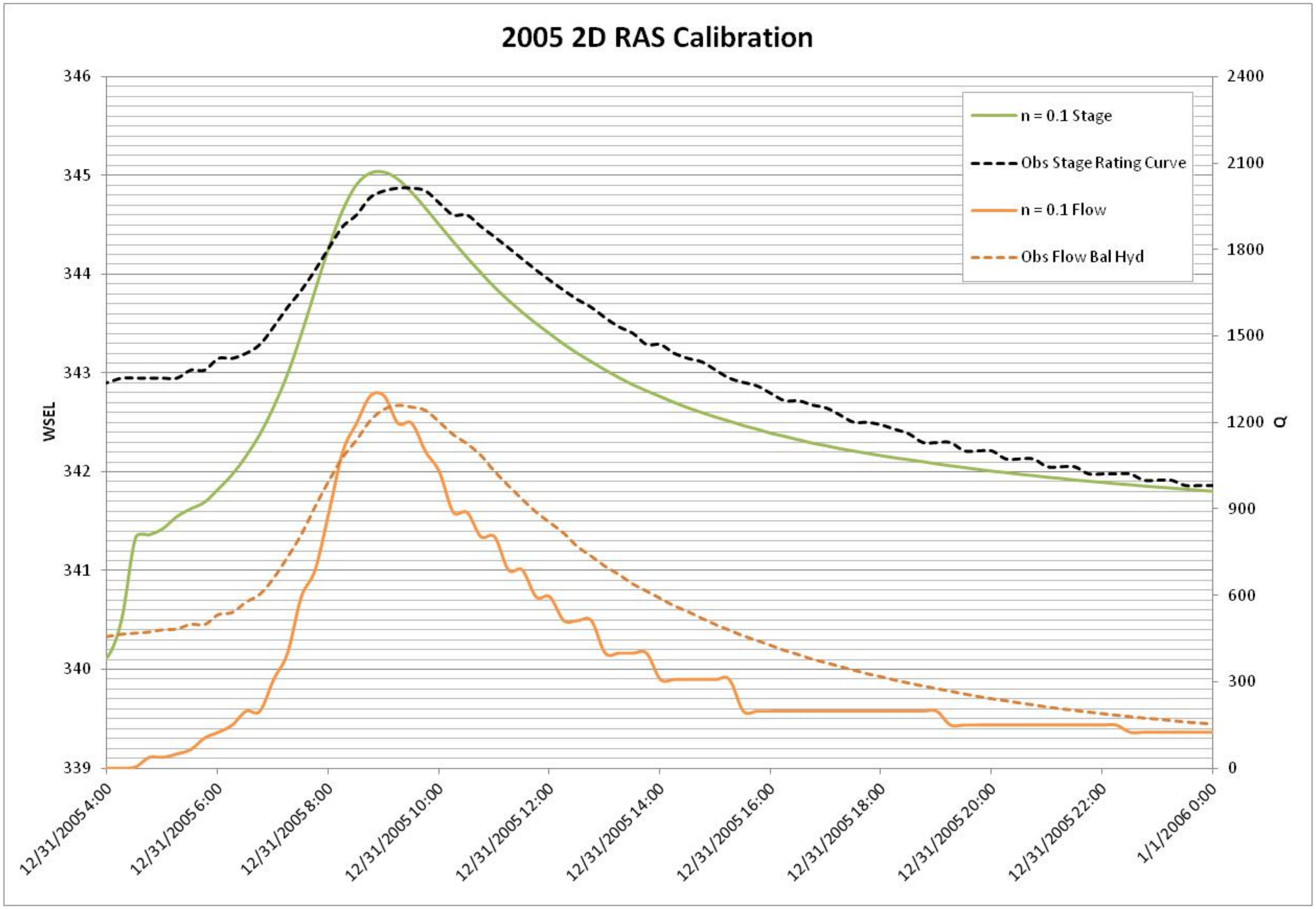


Figure 6: 2005 Searsville 2D Model Calibration

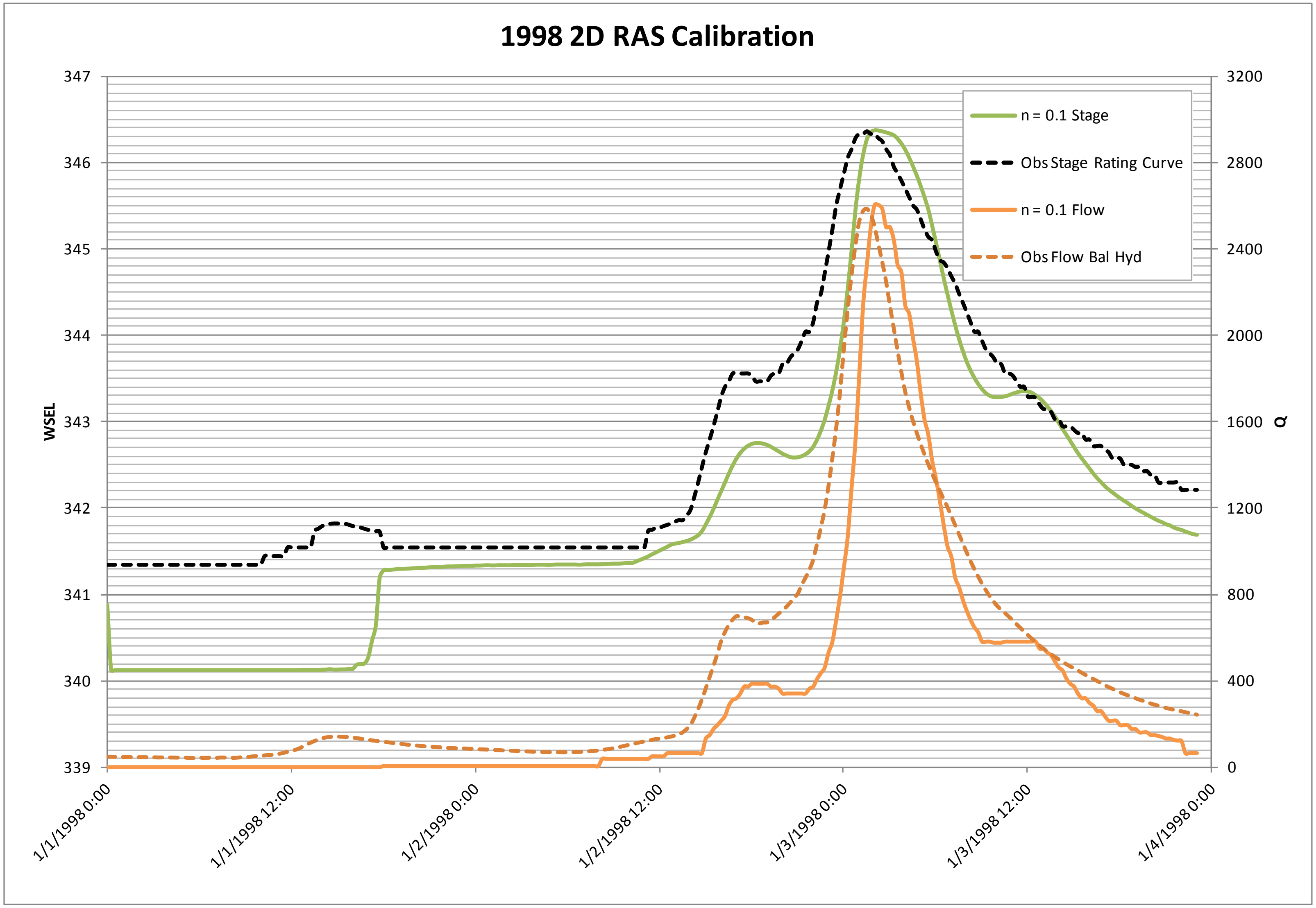


Figure 7: 1998 Searsville 2D Model Calibration

3. MODEL CALIBRATION AND VERIFICATION

3.1. STREAM GAGES

Several stream gages operated by Balance Hydrology (Stanford) have been installed recently on the upstream tributaries of San Francisquito Creek, but data availability for storm events is spotty. There is also a USGS gage, #11164500, near Stanford that has 74 annual maximum observations over 83 years. This gage will be used to determine the flood frequency analysis (FFA).

3.2. CALIBRATION PROCEDURE

The San Francisquito Creek HEC-HMS hydrology model was calibrated and verified to observed stream gage data by using historical gage adjusted rainfall radar data that has been calibrated to observed rain gage data. In short, observed rainfall data was used as input into the hydrologic model for several historic storm events, and the output values compared to observed stream gage data for the same event.

Calibration and verification was done by using the USGS gage recorded flows as the primary gage, since it is considered the most reliable. Gages operated by Balance upstream of the USGS gage were considered suspect for some events. The observed data from these gages were used when evidence did not prove them suspect. However, the observed data was still used as a general reference for suspect events to determine peak timing. Five sub-areas were categorized based on gage catch points to facilitate discussion of model calibration results. The general flowchart is shown in Figure 7.

- Searsville, which includes the area tributary to Searsville Lake and Dam.
- Bear, which includes all of Bear Creek and tributaries up to its confluence to San Francisquito Creek below the Dam.
- Los Trancos, which includes all of Los Trancos Creek and tributaries up to the stream flow gage.
- USGS, which includes all the drainage area from Searsville, Bear, and Los Trancos, to the USGS stream gage
- Urban, which includes the area between the USGS stream gage and the San Francisco Bay.

A map of the five sub-areas, along with the locations of flow measurement stations can be seen in Figure 12.

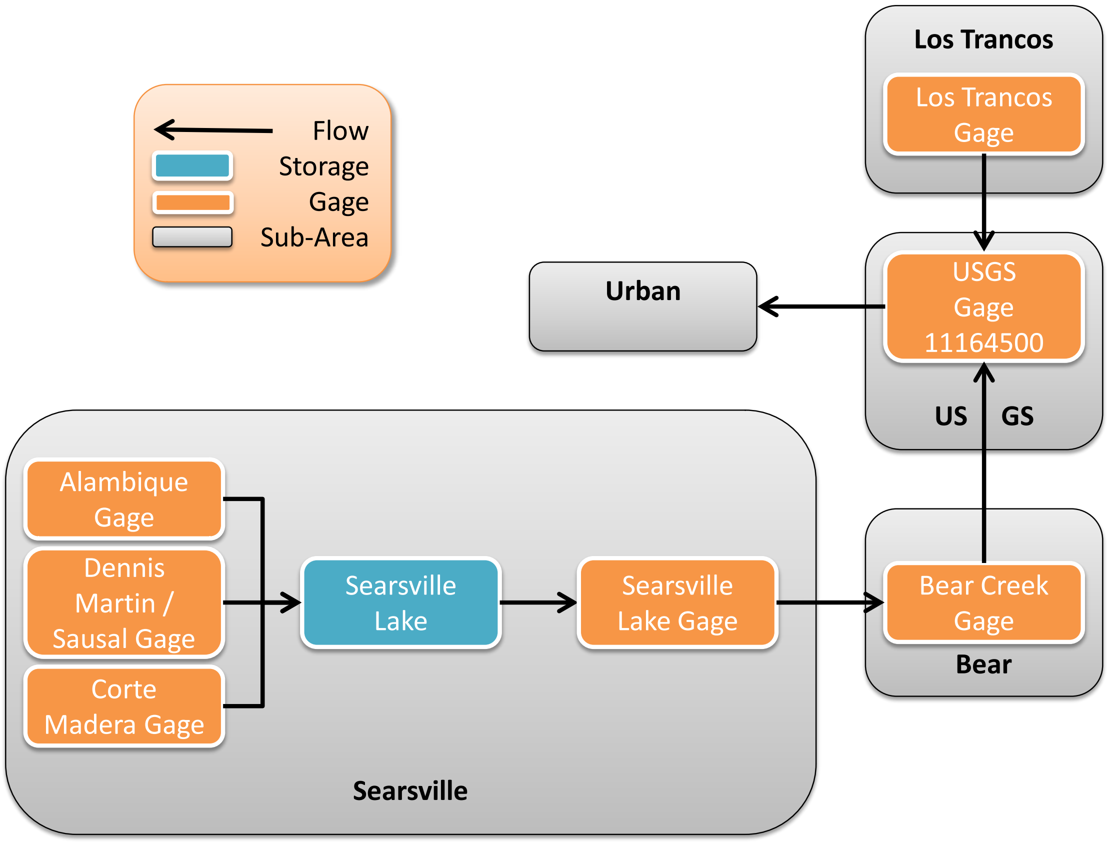


Figure 8: Calibration Sub-Areas

3.3. STREAM GAGE ERRORS

Recorded stream gage data in 2010 and 2011 from Balance are suspiciously low compared to flows measured at the downstream USGS gage. Almost all the runoff is contributed by the majority of the upstream hill watershed, which also gets the most rain. In 2012 and 2006, the total of all the Balance gages was very close to the USGS gage, as shown in Figure 8 and Figure 9. However, in 2011 and 2010, a large amount of flow is missing, shown in Figure 10 and Figure 11. It is likely that there was error in flow measurements from Balance under these circumstances. Therefore, observed Balance stream gate data points for 2011 and 2010 will be used for reference only.

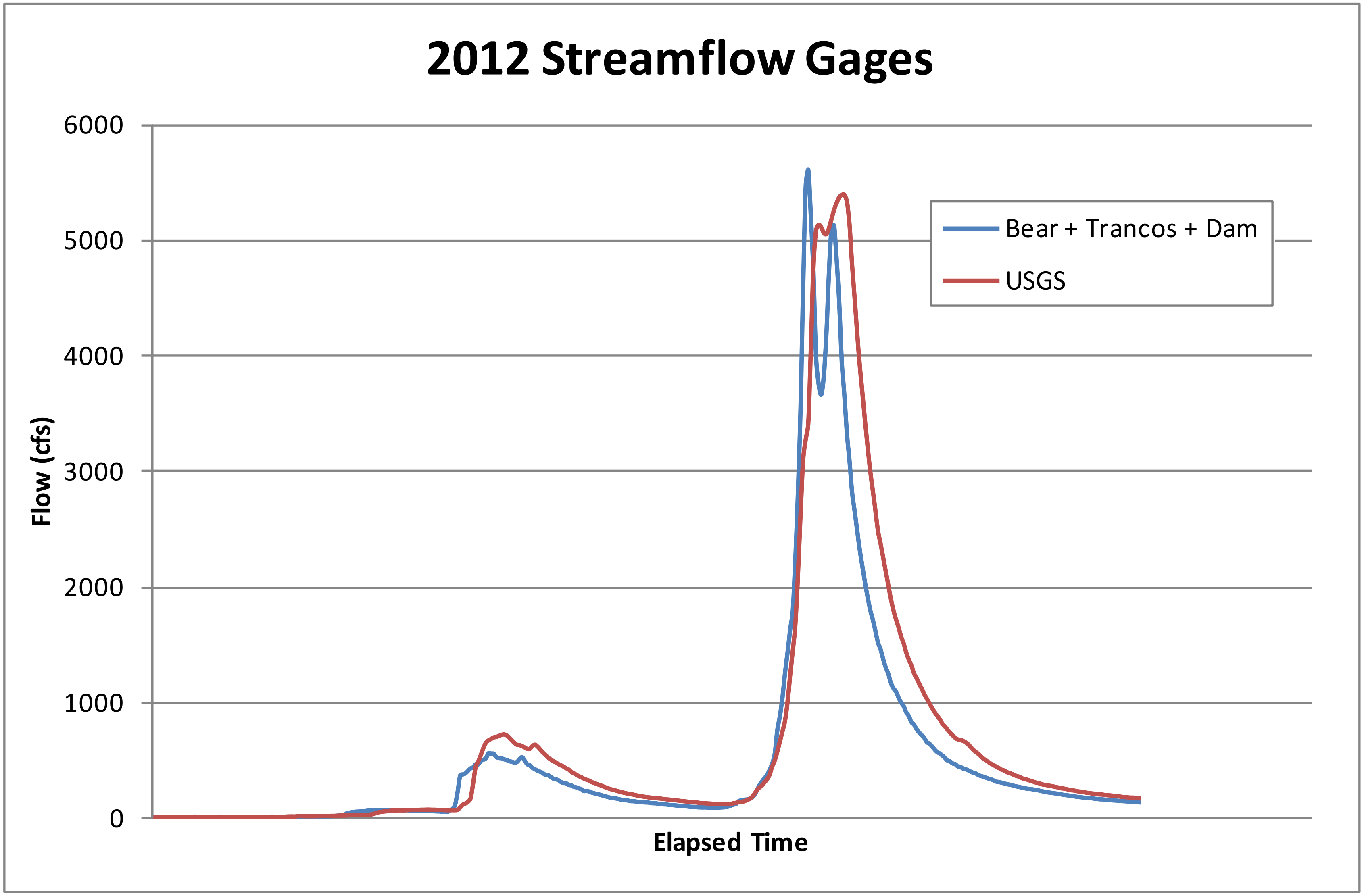


Figure 9: 2012 Streamflow Gage Comparison

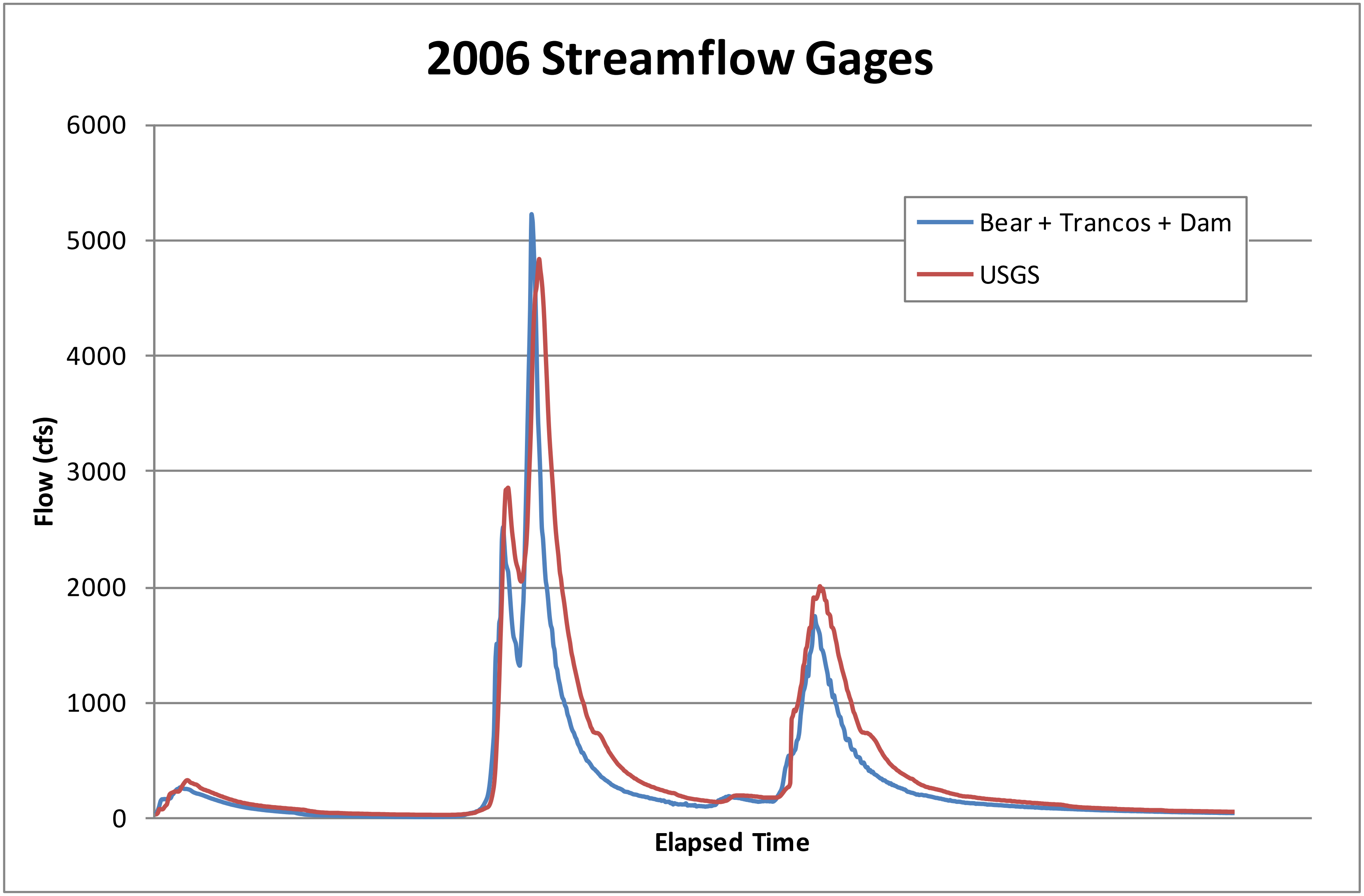


Figure 10: 2006 Streamflow Gage Comparison

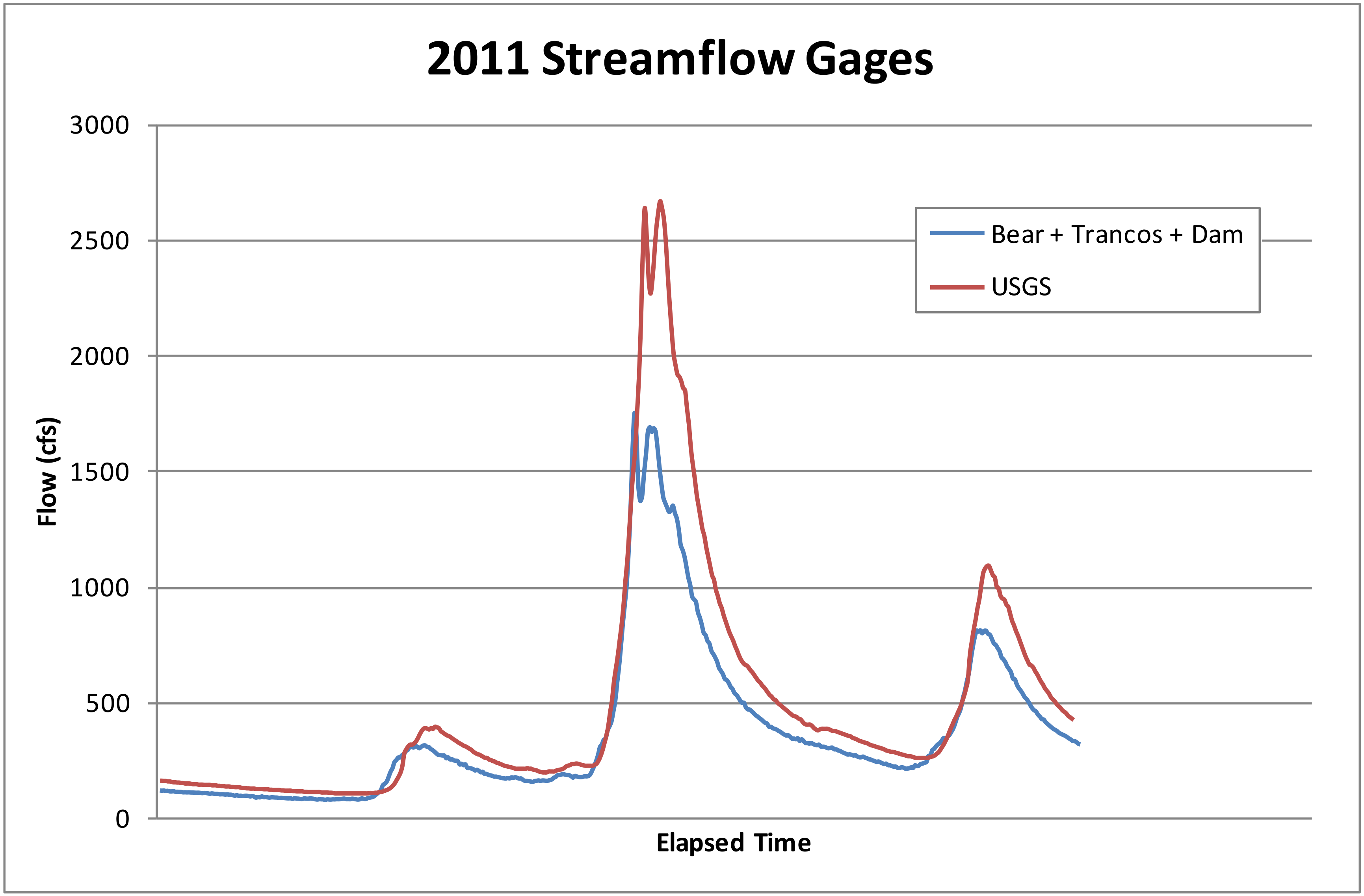


Figure 11: 2011 Streamflow Gage Comparison

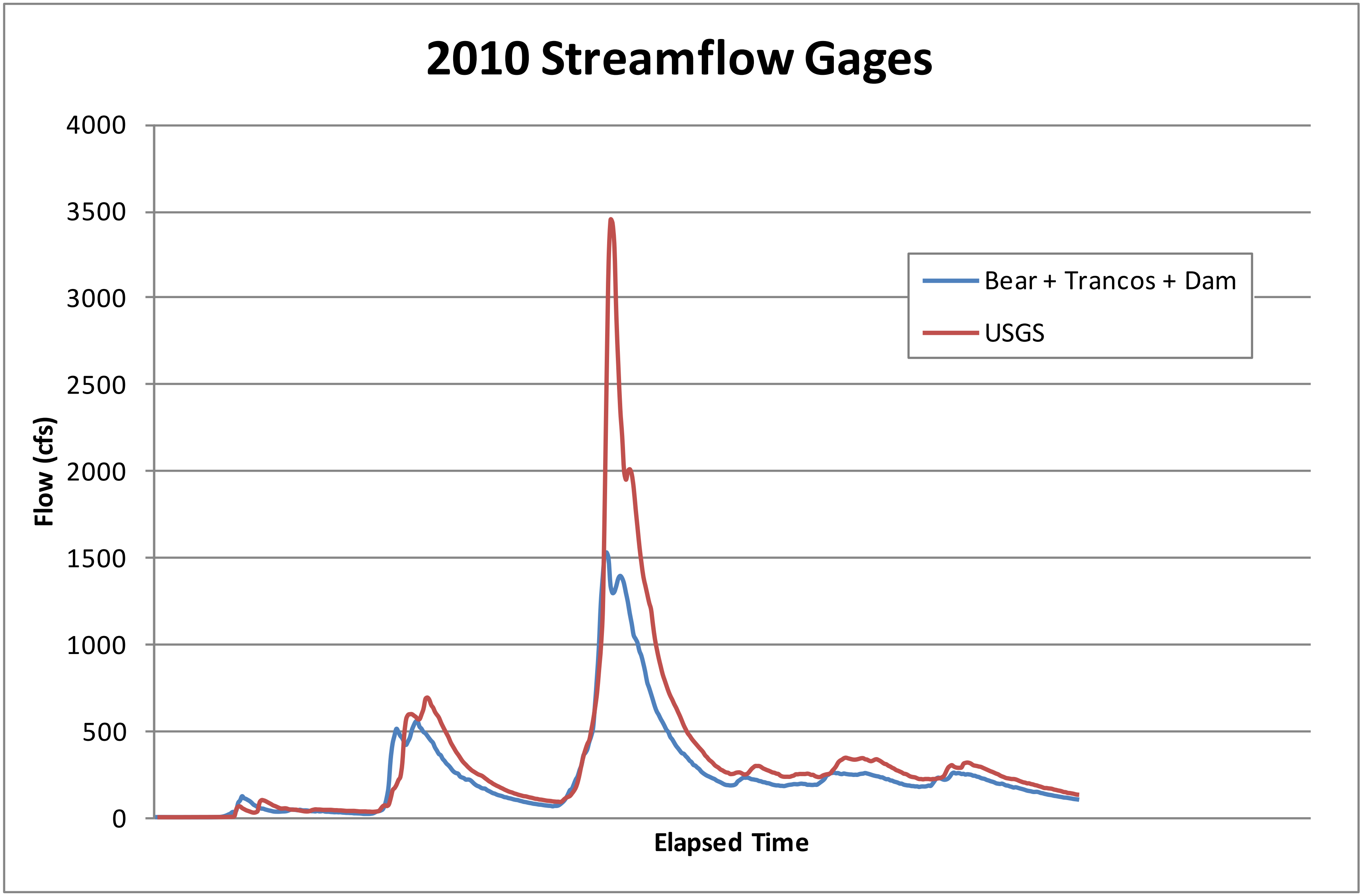


Figure 12: 2010 Streamflow Gage Comparison

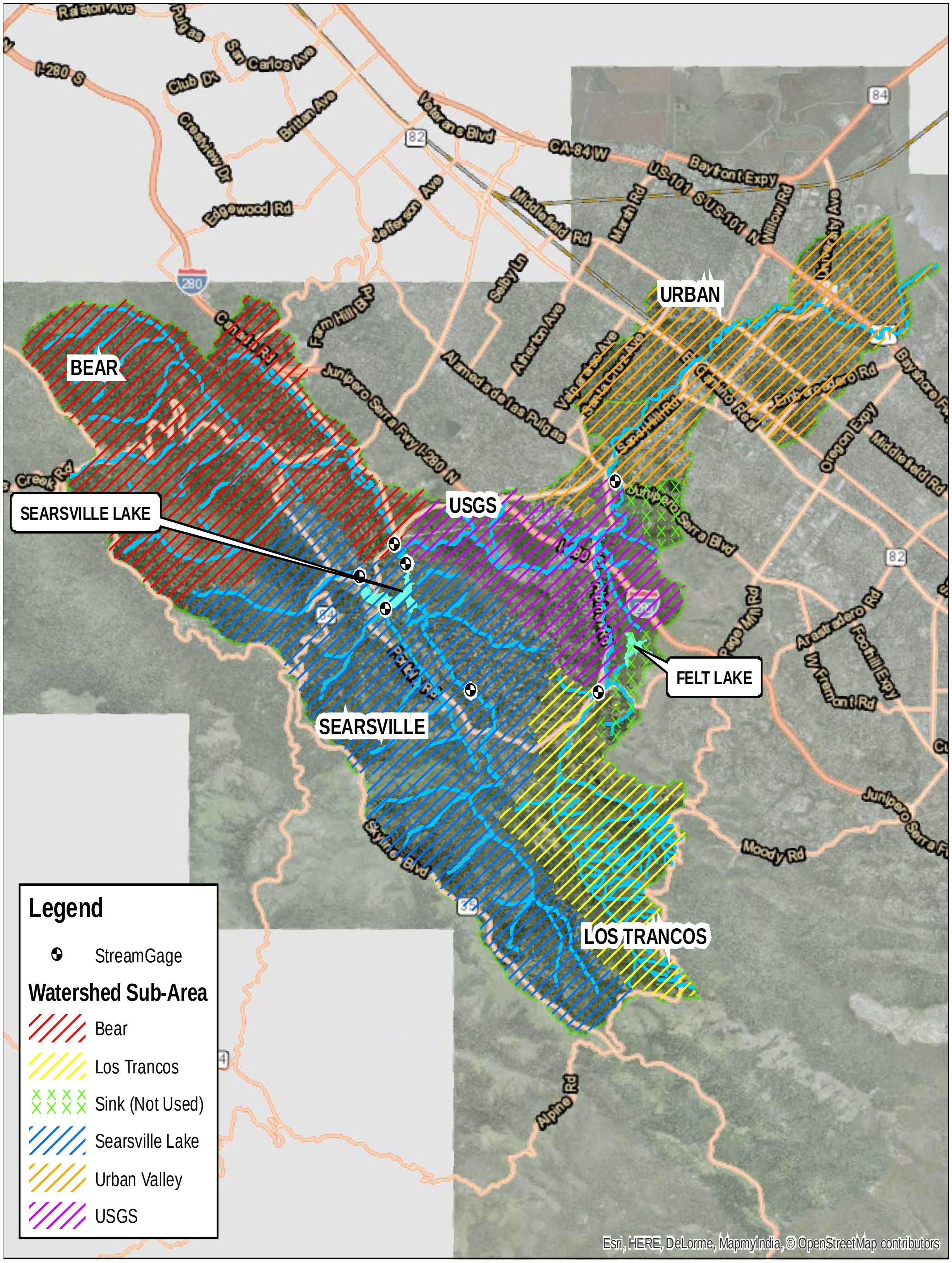


Figure 13: Basin Map

4. CALIBRATION AND VERIFICATION RESULTS

4.1. 02 FEBRUARY 1998

Table 2: February 1998 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q*	Storage Coefficient (R) Ratio
Bear	2.25	Q25	0.5
Searsville	1.75	Q10	0.5
Los Trancos	2.0	Q25	0.5
USGS	2.0	Q25	0.5
Urban	2.0	Q25	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Three gage locations were in operation for this storm event: USGS, Searsville Lake, and Los Trancos. Since Searsville Lake has already been calibrated, and no gages were in operation upstream of the dam, the observed gage outflow from the dam will be used as input for this calibration event. A 1.75 AMC value for Searsville with a slightly lower time of concentration flow matched well for the 2D model calibration. Flow at the USGS gage matched well.

The peak timing for the Los Trancos gage is slightly later for the modeled result. However, this gage experienced backwater from the downstream fish ladder according to notes by Balance Hydrology. Therefore, this reading serves only as a reference.

The peak timing for the USGS gage is also slightly later for the modeled result and there is slightly less volume in the front end of the hydrograph. However, the calibration results are acceptable. The Bear sub-area antecedent moisture condition (AMC) was increased slightly to 2.25 to bring flows at the USGS gage up to observed values.

Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

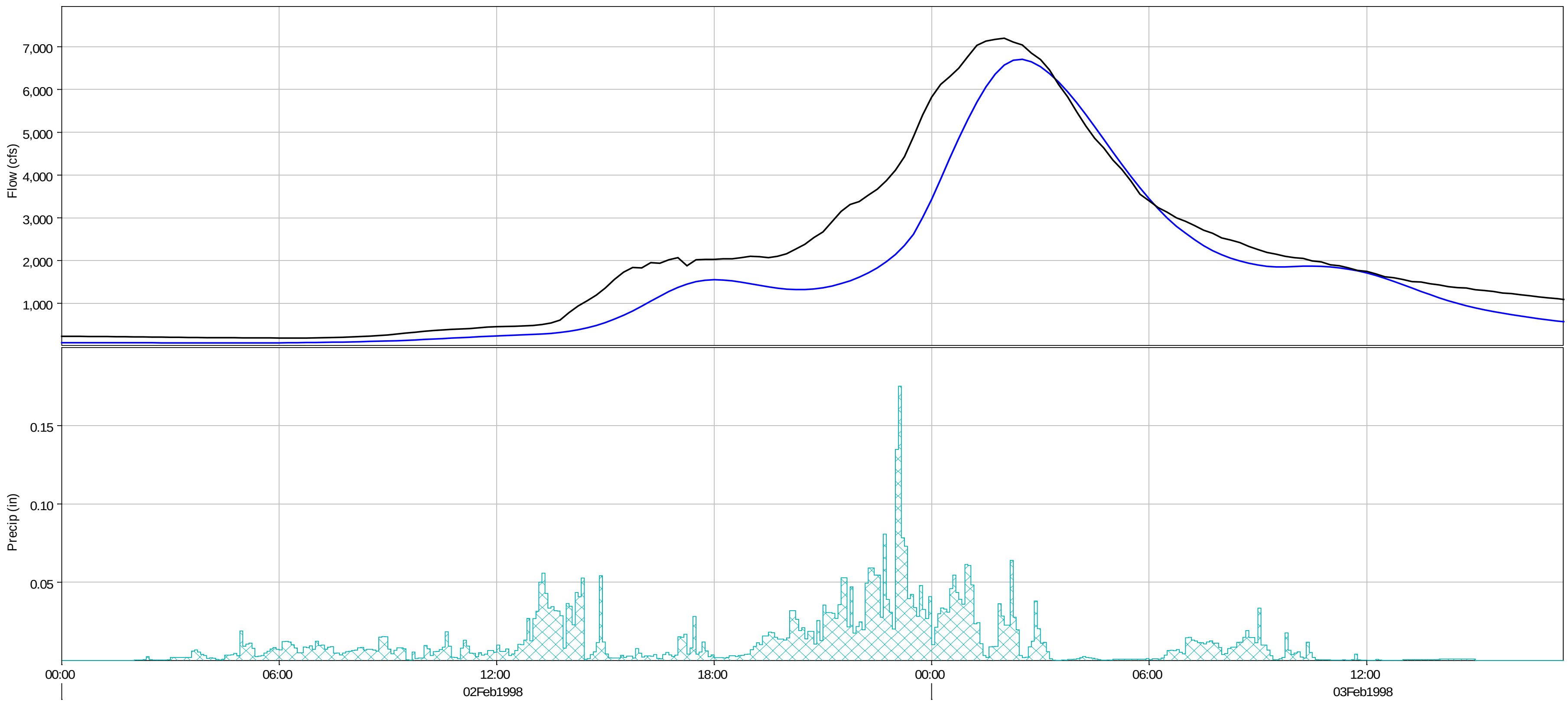
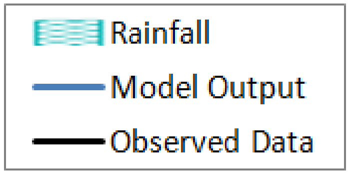


Figure 14: USGS – February 1998



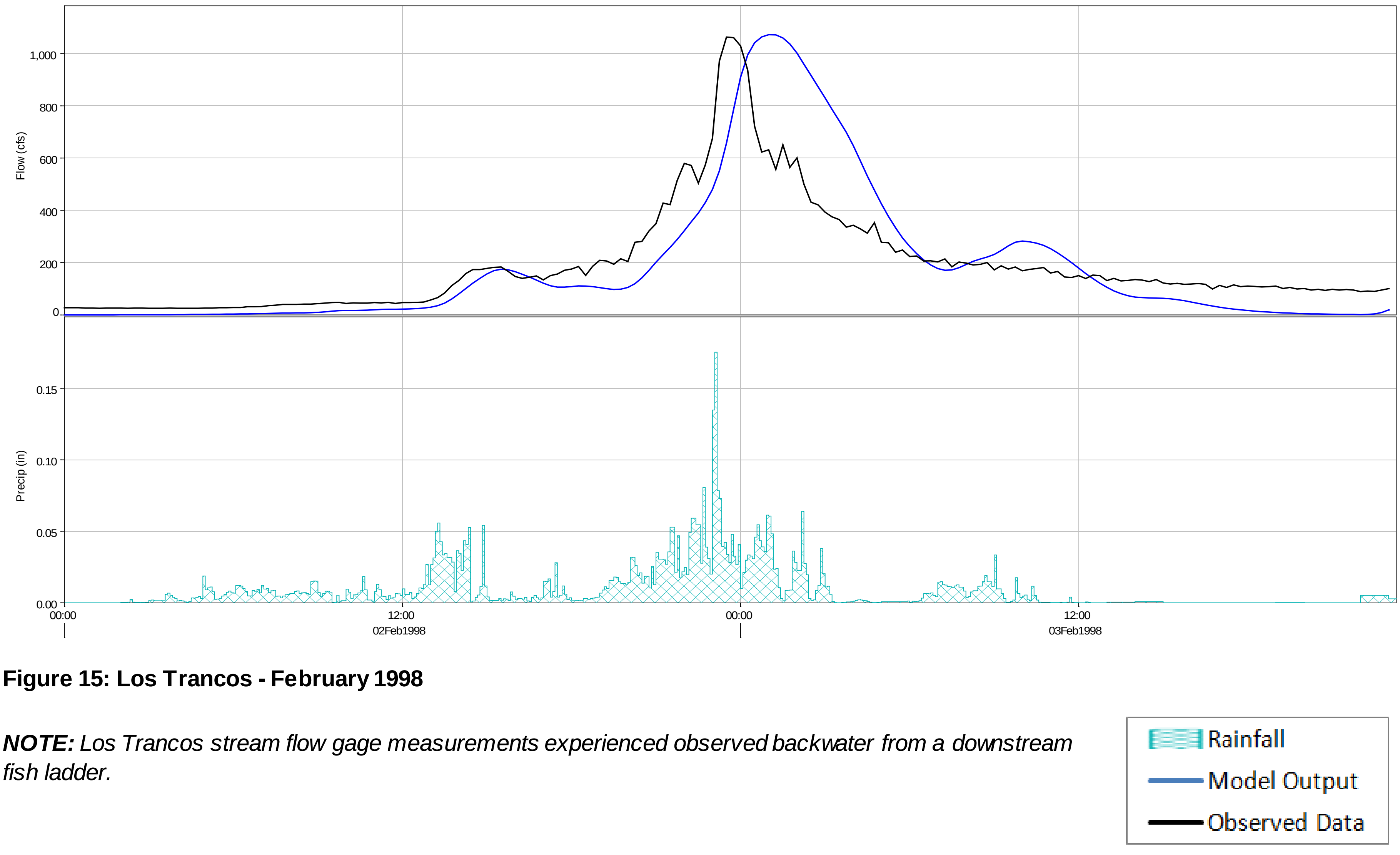


Figure 15: Los Trancos - February 1998

NOTE: *Los Trancos stream flow gage measurements experienced observed backwater from a downstream fish ladder.*

4.2. 12 FEBRUARY 2000

Table 3: February 2000 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q	Storage Coefficient (R) Ratio
Bear	2.75	Q10	0.5
Searsville	2.0	Q10	0.5
Los Trancos	1.75	Q5	0.5
USGS	2.0	Q10	0.5
Urban	2.0	Q10	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Three gage locations were in operation for this storm event: USGS, Bear, and Los Trancos. Searsville Lake observed outflow was not available for this date so the 2D hydraulic model was used to supplement. The hydrologic model was run with the parameters shown above, and the output hydrographs upstream of Searsville Lake were used as flow inputs into the 2D model. The resulting 2D spill from Searsville Dam was used as input into the hydrologic model to complete the calibration.

The Bear gage required a very high AMC value of 2.75 to reach the flows observed from the gage. It is suspected that poor rainfall data is to blame. Downstream, observed gage data was used as input. Los Trancos Creek experienced little flow comparatively.

The recorded USGS gage hydrograph has more volume and peak flow than the model. Since most of the flow is controlled by the inputs of Bear, Searsville, and Los Trancos, it is suspected that a combination of low rainfall data affecting runoff volume (evidenced by Bear) and observed stream gage data that is slightly off. Overall, the timing and peak still match well.

Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

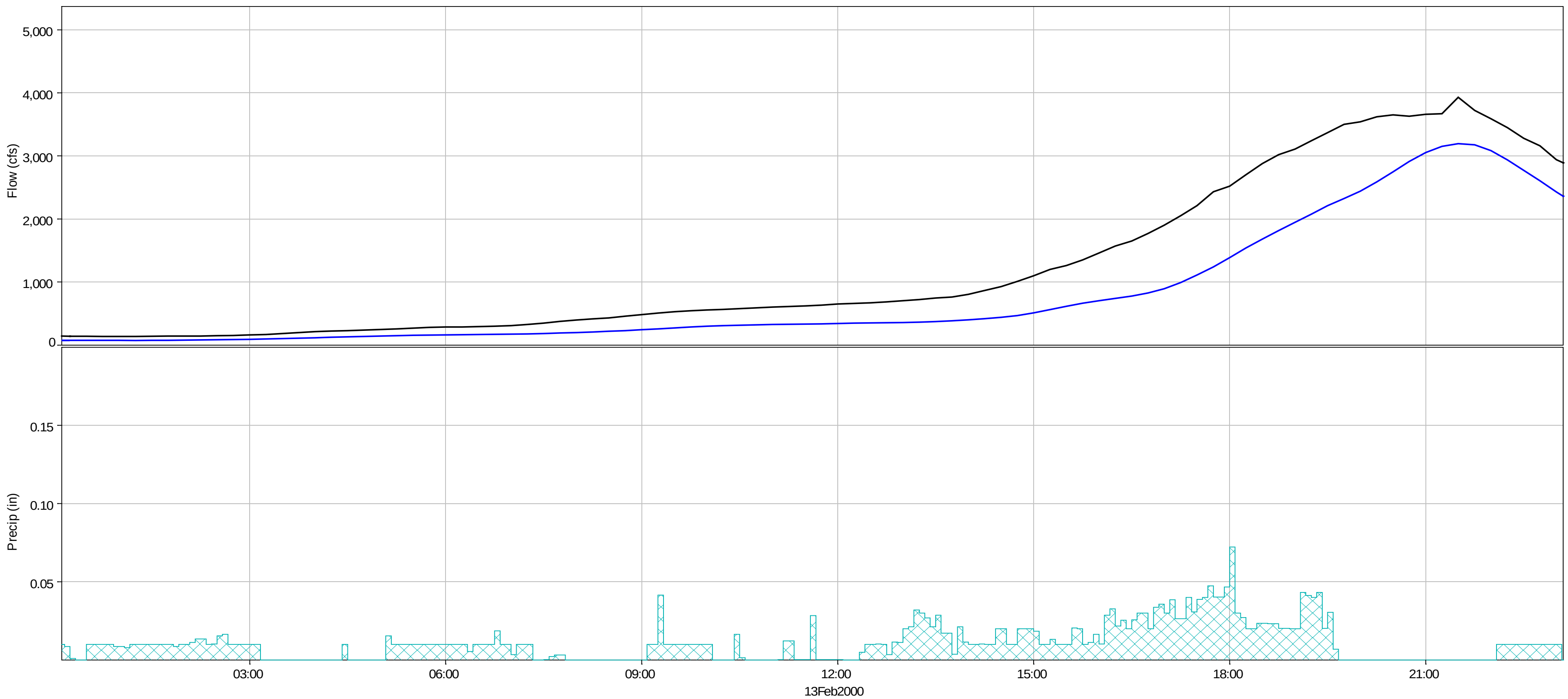
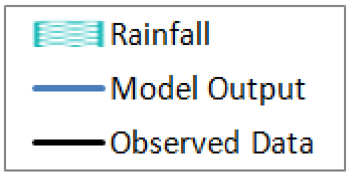


Figure 16: USGS – February 2000

NOTE: *Bear Creek and Los Trancos observed flow data were used as inputs in determining flow at USGS.*



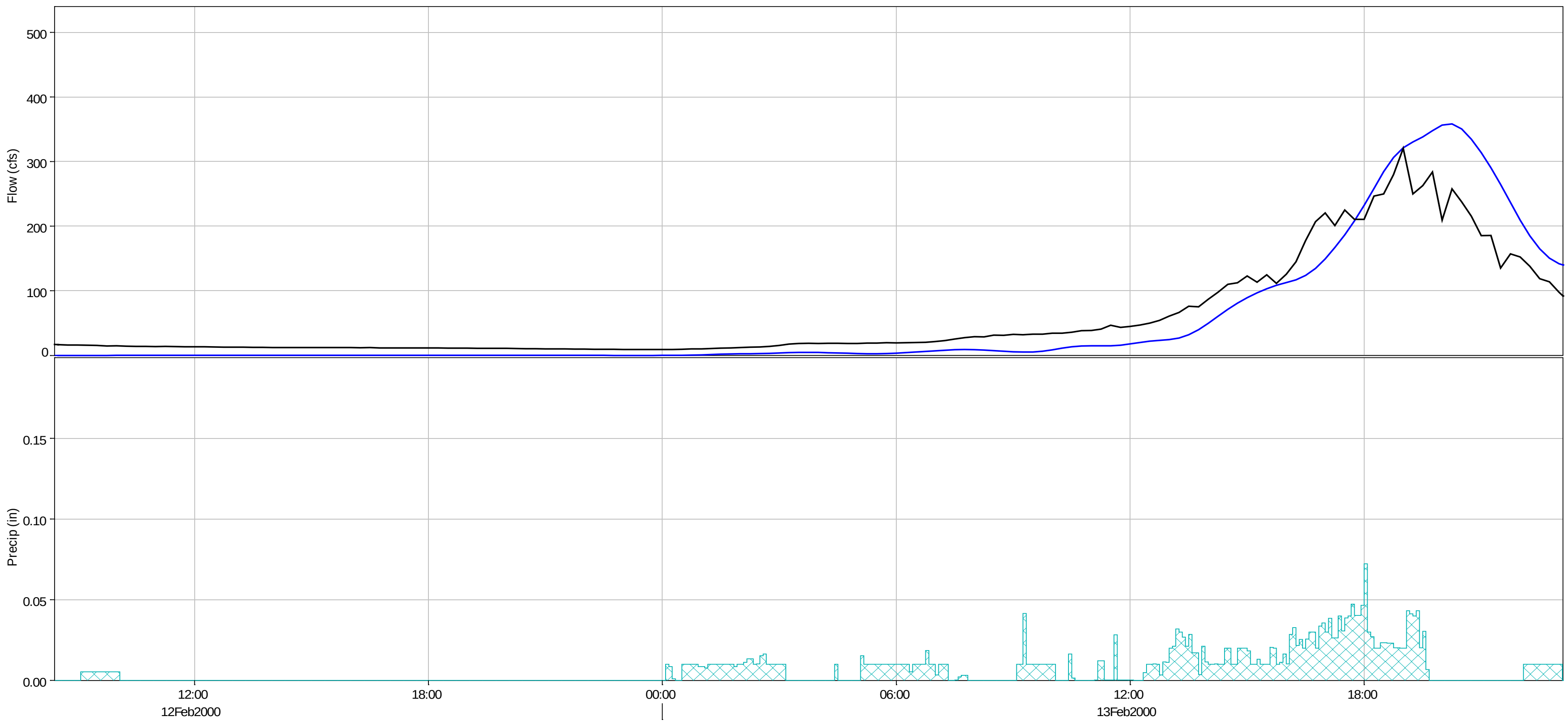
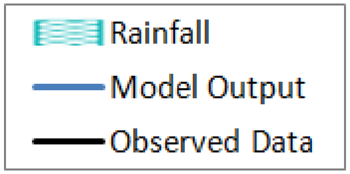


Figure 17: Los Trancos – February 2000



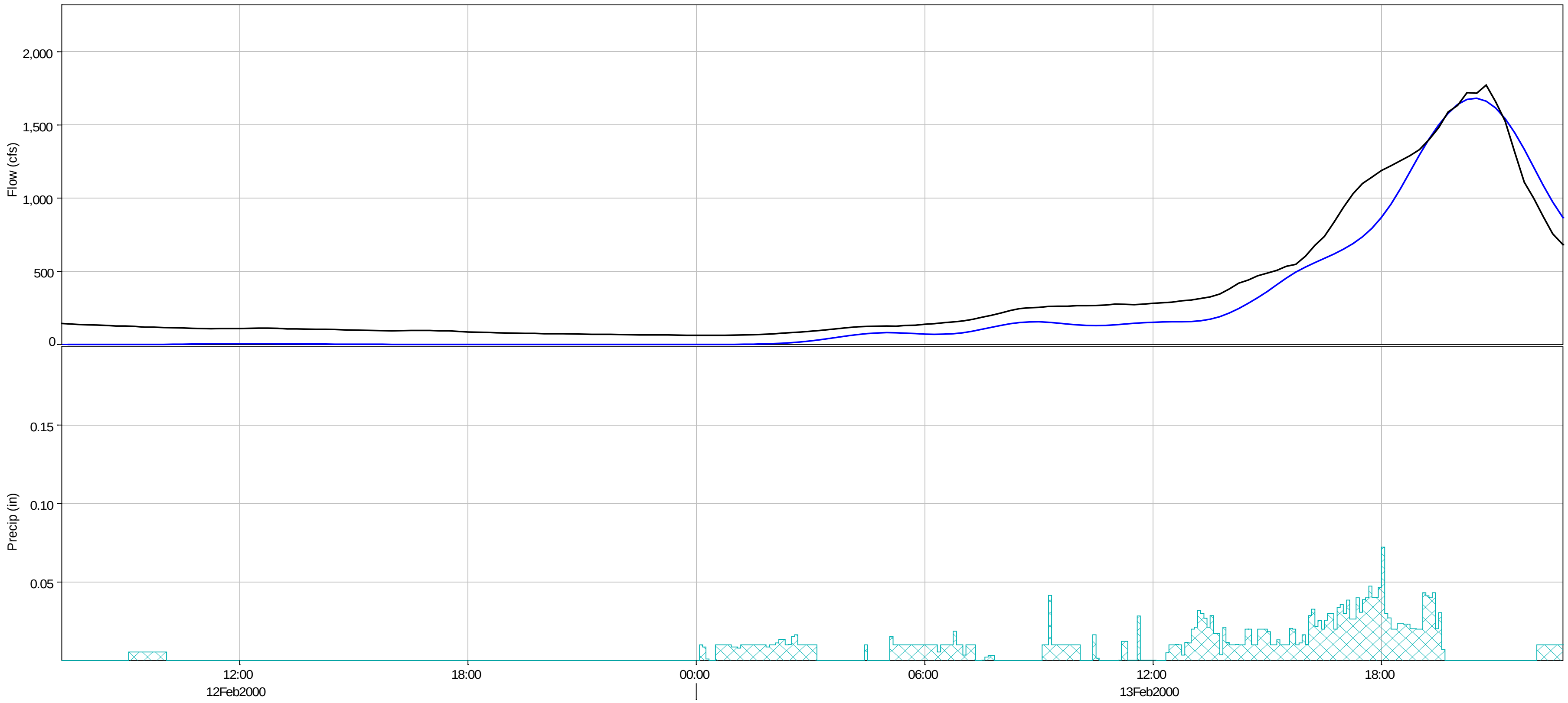
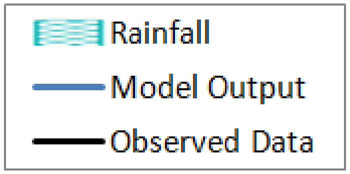


Figure 18: Bear – February 2000



4.3. 18 JANUARY 2010

Table 4: January 2010 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q	Storage Coefficient (R) Ratio
Bear	2.0	Q10	0.5
Searsville	1.75	Q10	0.5
Los Trancos	2.0	Q10	0.5
USGS	2.0	Q10	0.5
Urban	2.0	Q10	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Five gage locations were in operation for this storm event: USGS, Searsville Dam, Bear, Corte Madera, and Los Trancos. From previous discussion about possible gage errors stemming from Bear and Los Trancos, the observed flow from these gages were not used as inputs. Downstream reference points relied solely on the model.

Using the Searsville recorded outflow, combined with Bear and Los Trancos watersheds at an AMC of 2.0, the modeled flow at the USGS gage matched well with the observed data.
For the Searsville watershed, the only operational gage upstream was Corte Madera. The catch point in the model is downstream of the gage, and therefore a higher modeled flow would be expected. An AMC value of 1.75 computed a flow that is slightly larger than recorded.

Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

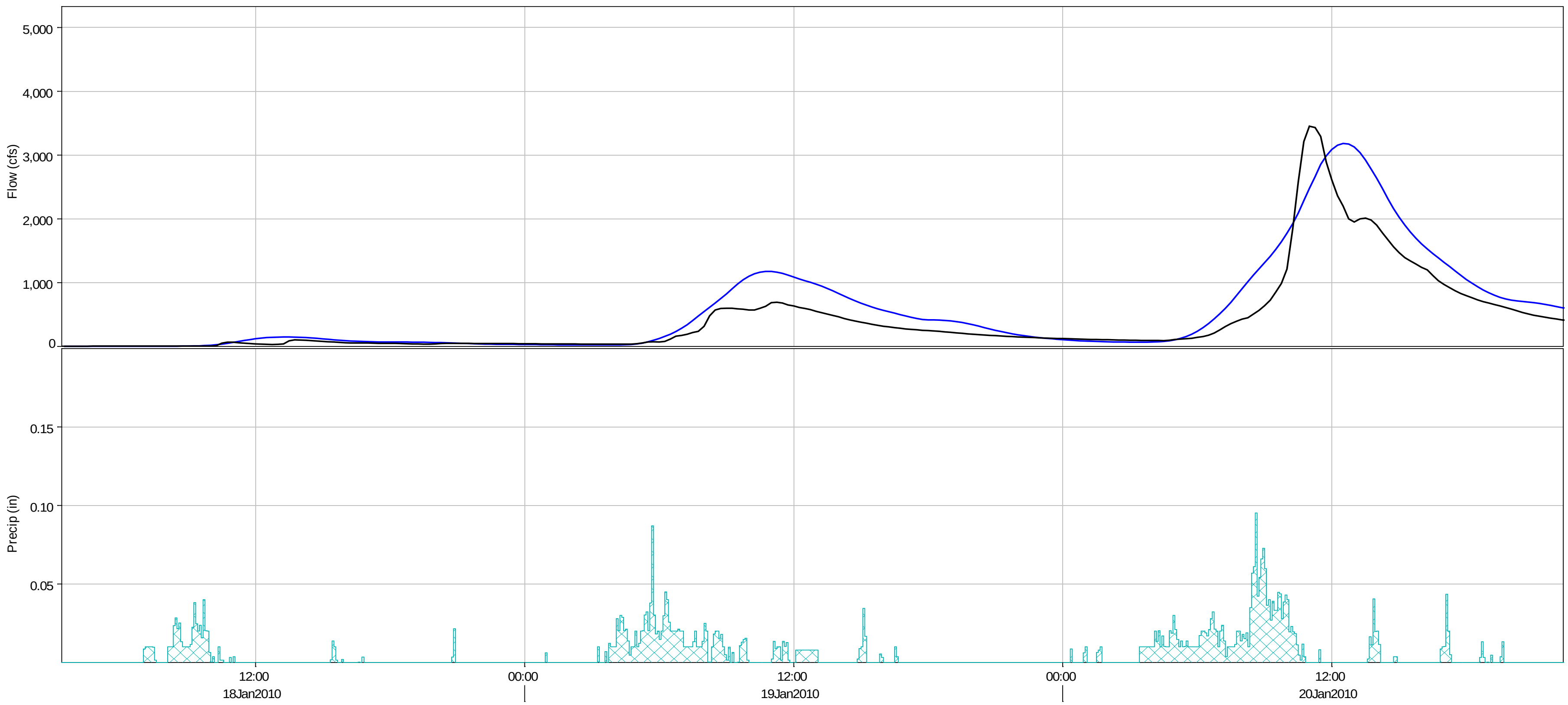
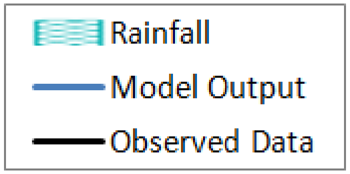


Figure 19: USGS – January 2010



NOTE: *Bear Creek and Los Trancos observed flow data were removed and not used as inputs in determining flow at USGS.*

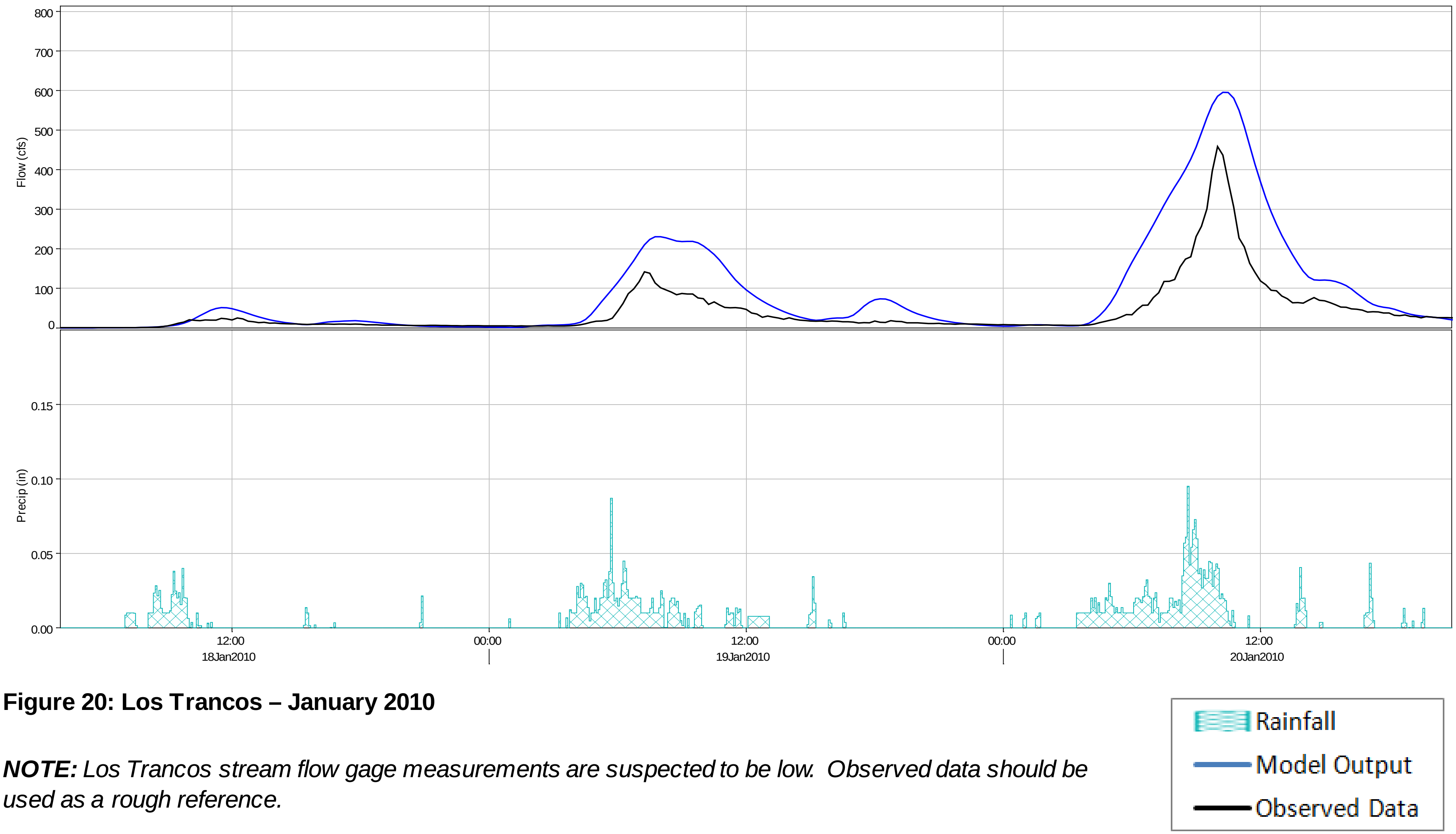


Figure 20: Los Trancos – January 2010

NOTE: *Los Trancos stream flow gage measurements are suspected to be low. Observed data should be used as a rough reference.*

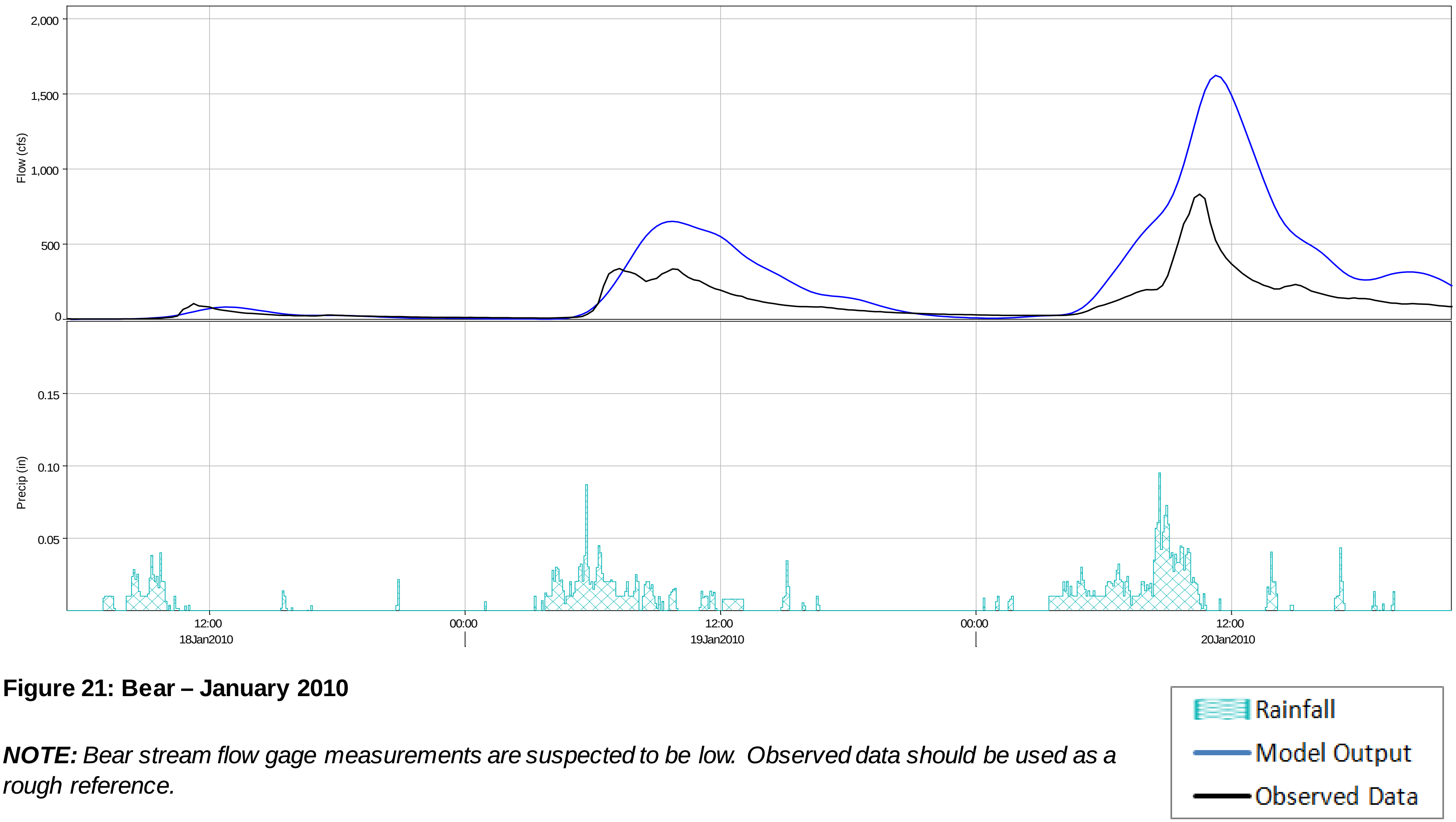


Figure 21: Bear – January 2010

NOTE: *Bear stream flow gage measurements are suspected to be low. Observed data should be used as a rough reference.*

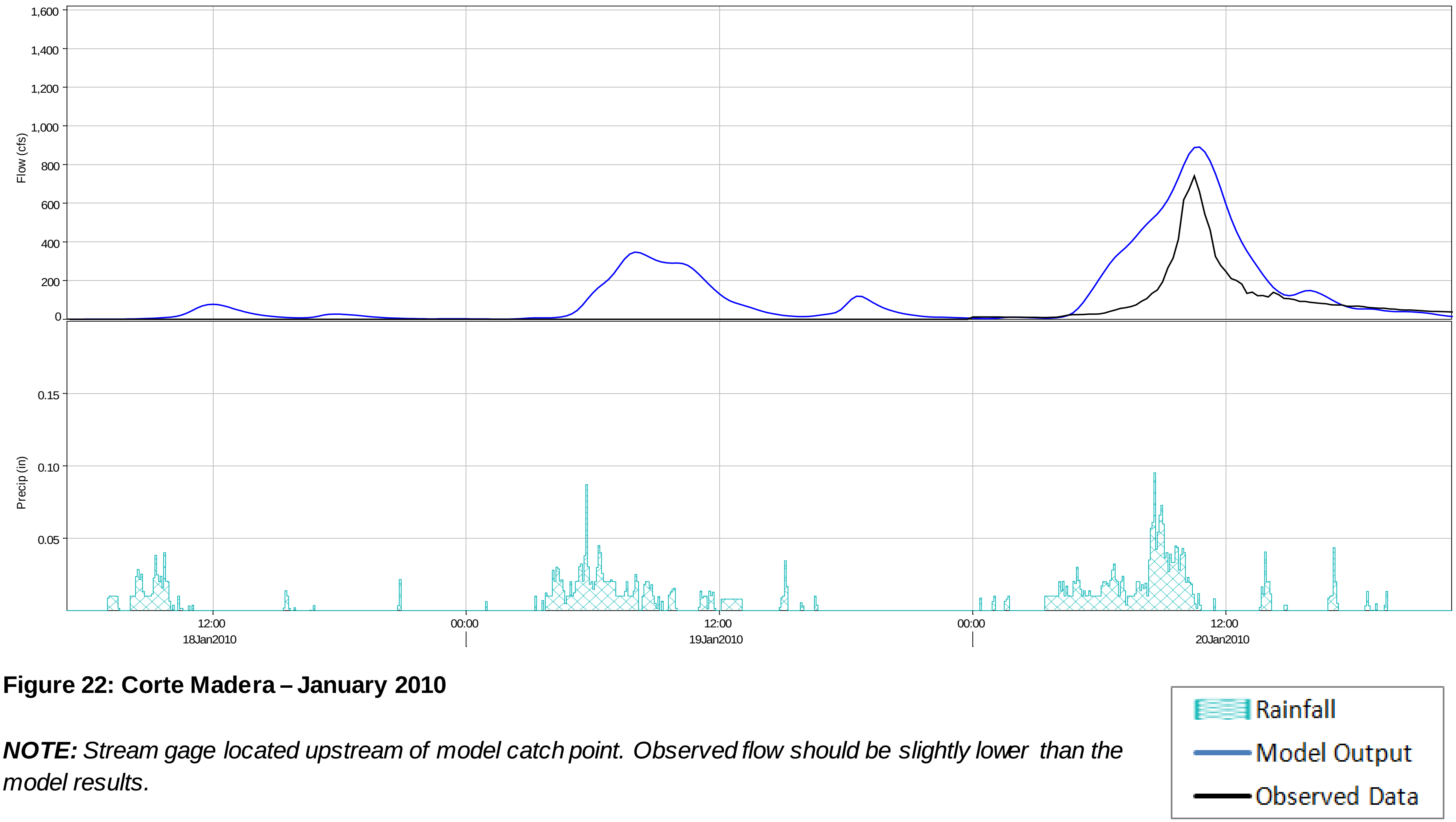


Figure 22: Corte Madera – January 2010

NOTE: *Stream gage located upstream of model catch point. Observed flow should be slightly lower than the model results.*

4.4. 22 MARCH 2011

Table 5: March 2011 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q	Storage Coefficient (R) Ratio
Bear	2.0	Q10	0.5
Searsville	1.75	Q10	0.5
Los Trancos	2.0	Q10	0.5
USGS	2.0	Q10	0.5
Urban	2.0	Q10	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Five gage locations were in operation for this storm event: USGS, Searsville Dam, Bear, Corte Madera, and Los Trancos. Similar to the 2010 calibration, there are possible gage errors stemming from Bear and Los Trancos. Therefore, the observed flows from these gages were not used as inputs. Downstream reference points relied solely on the model. However, Los Trancos gage matched perfectly with modeled output without any effort, which puts suspicion on the Bear gage.

Using the Searsville outflow, combined with Bear and Los Trancos watersheds at AMC 2.0, the modeled flow at the USGS gage matched very well with the observed data.

For the Searsville watershed, the only operational gage upstream was Corte Madera. The catch point in the model is downstream of the gage, and therefore a higher modeled flow would be expected. An AMC value of 1.75 computed a flow that is slightly larger than observed. Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

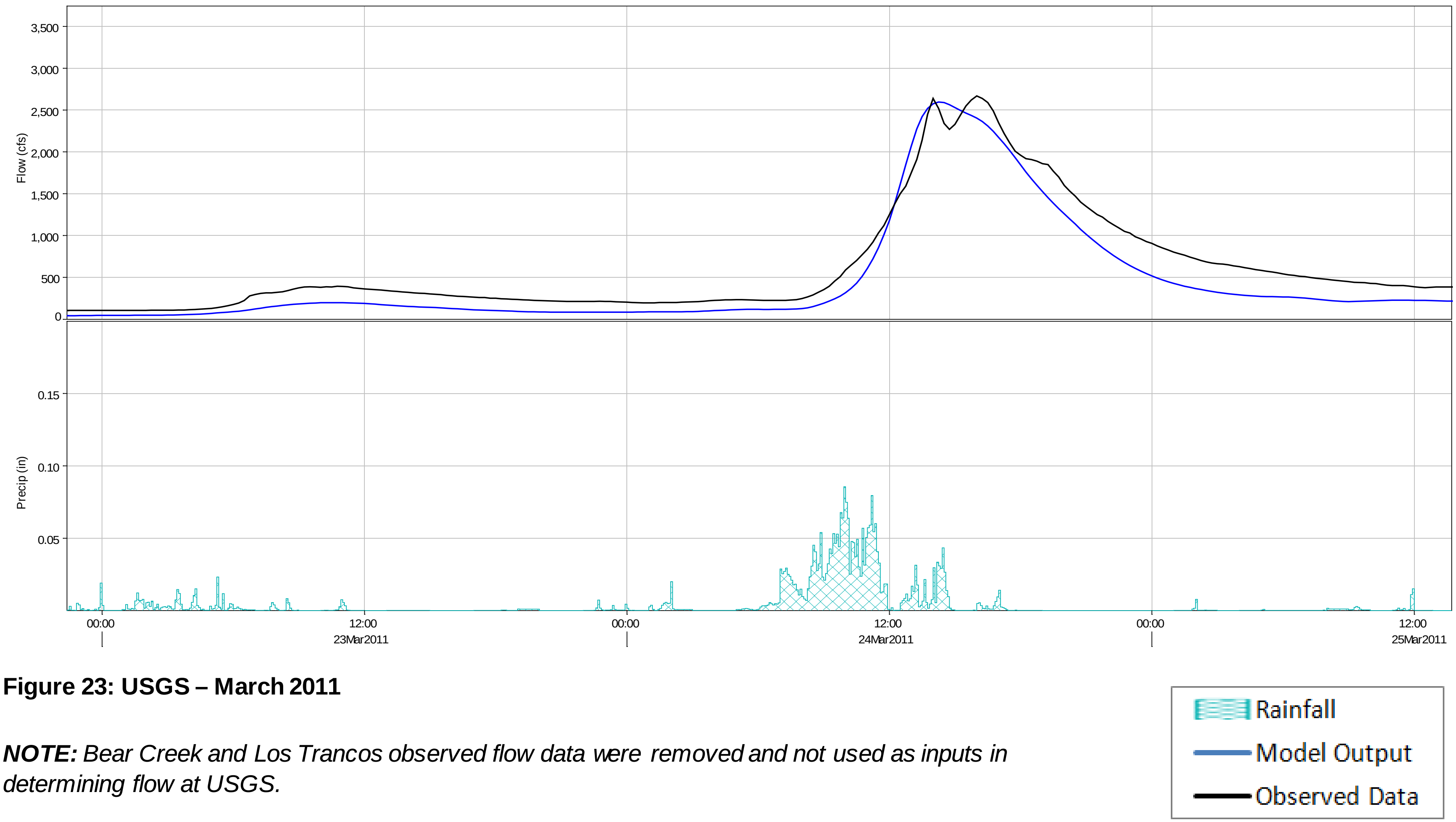


Figure 23: USGS – March 2011

NOTE: *Bear Creek and Los Trancos observed flow data were removed and not used as inputs in determining flow at USGS.*

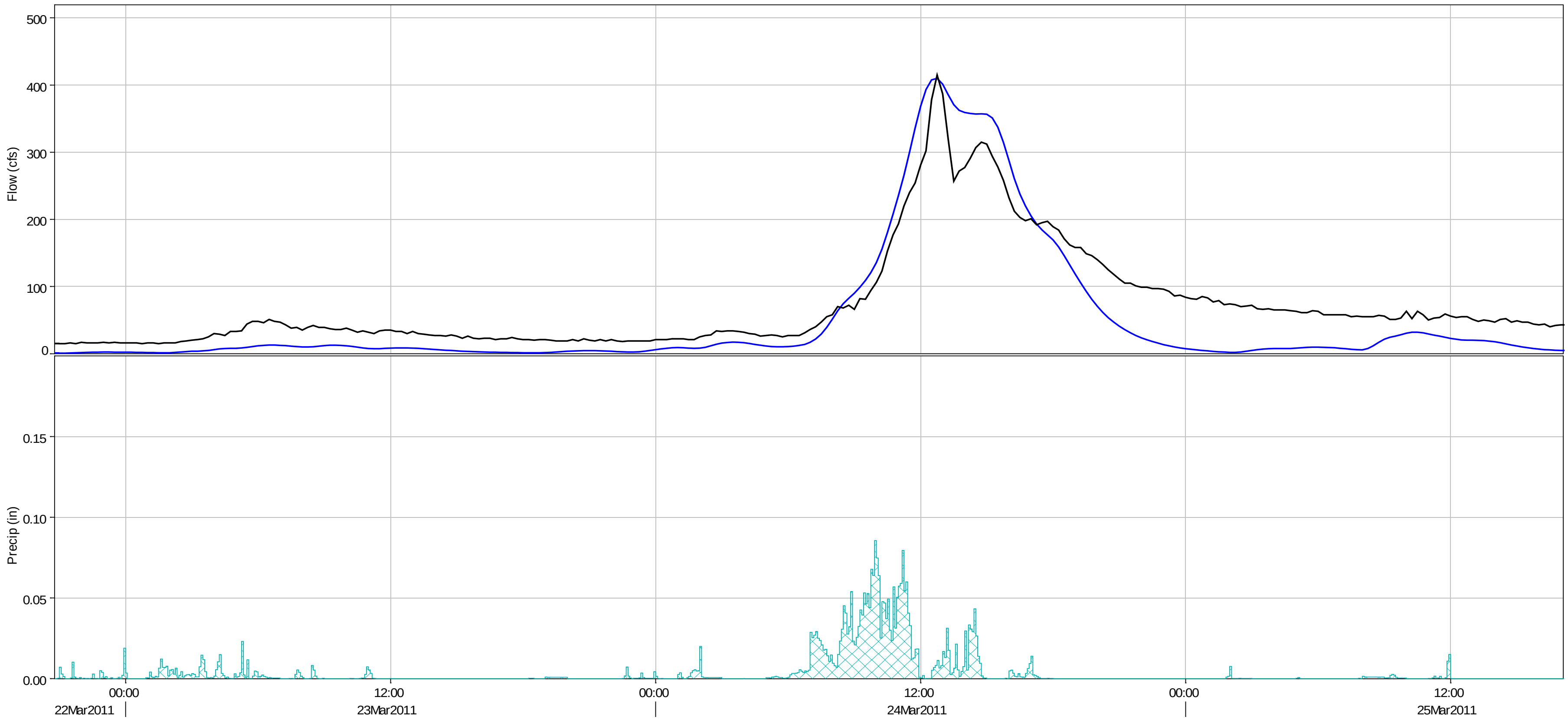


Figure 24: Los Trancos – March 2011

NOTE: *Los Trancos stream flow gage measurements might be suspect, quality unknown.*

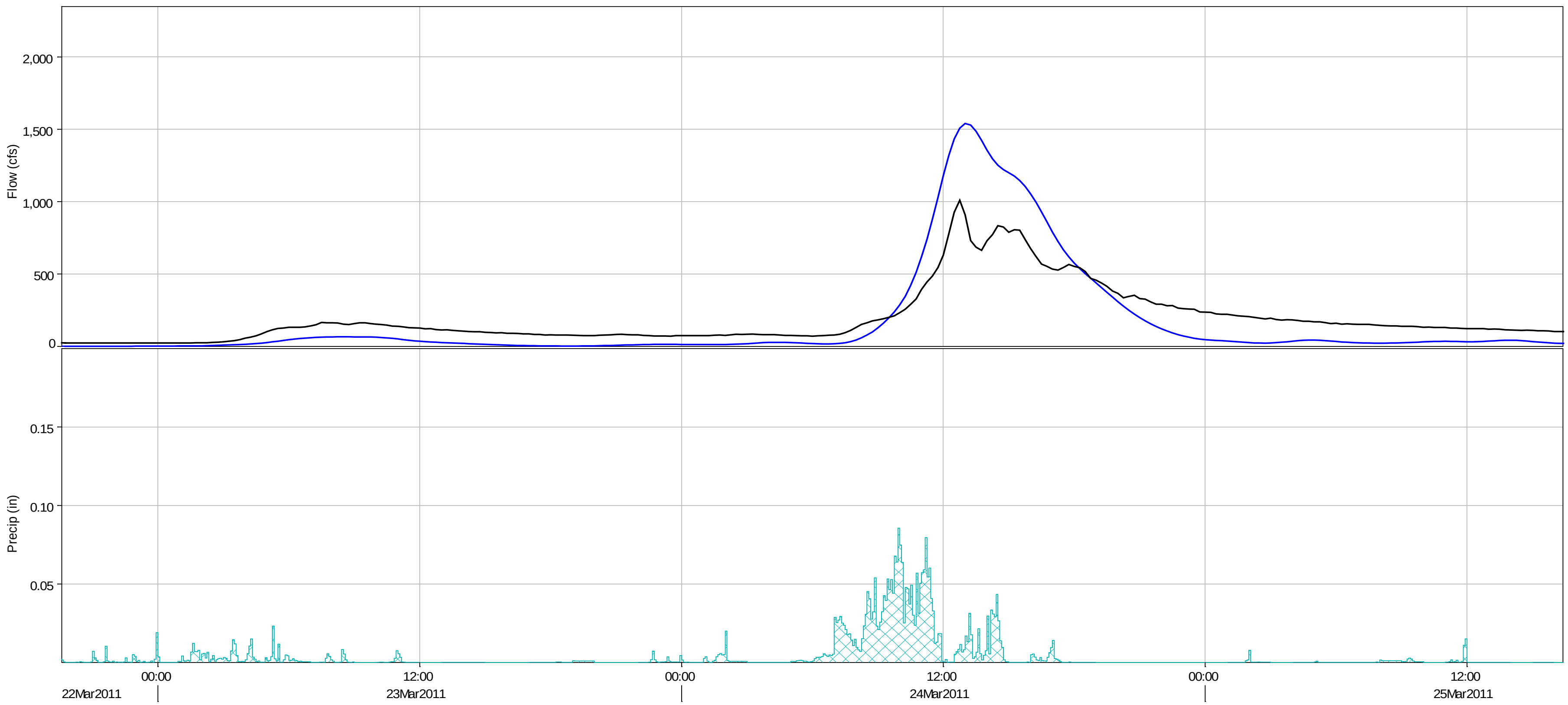
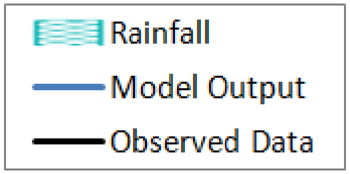


Figure 25: Bear – March 2011



NOTE: *Bear stream flow gage measurements are suspected to be low. Observed data should be used as a rough reference.*

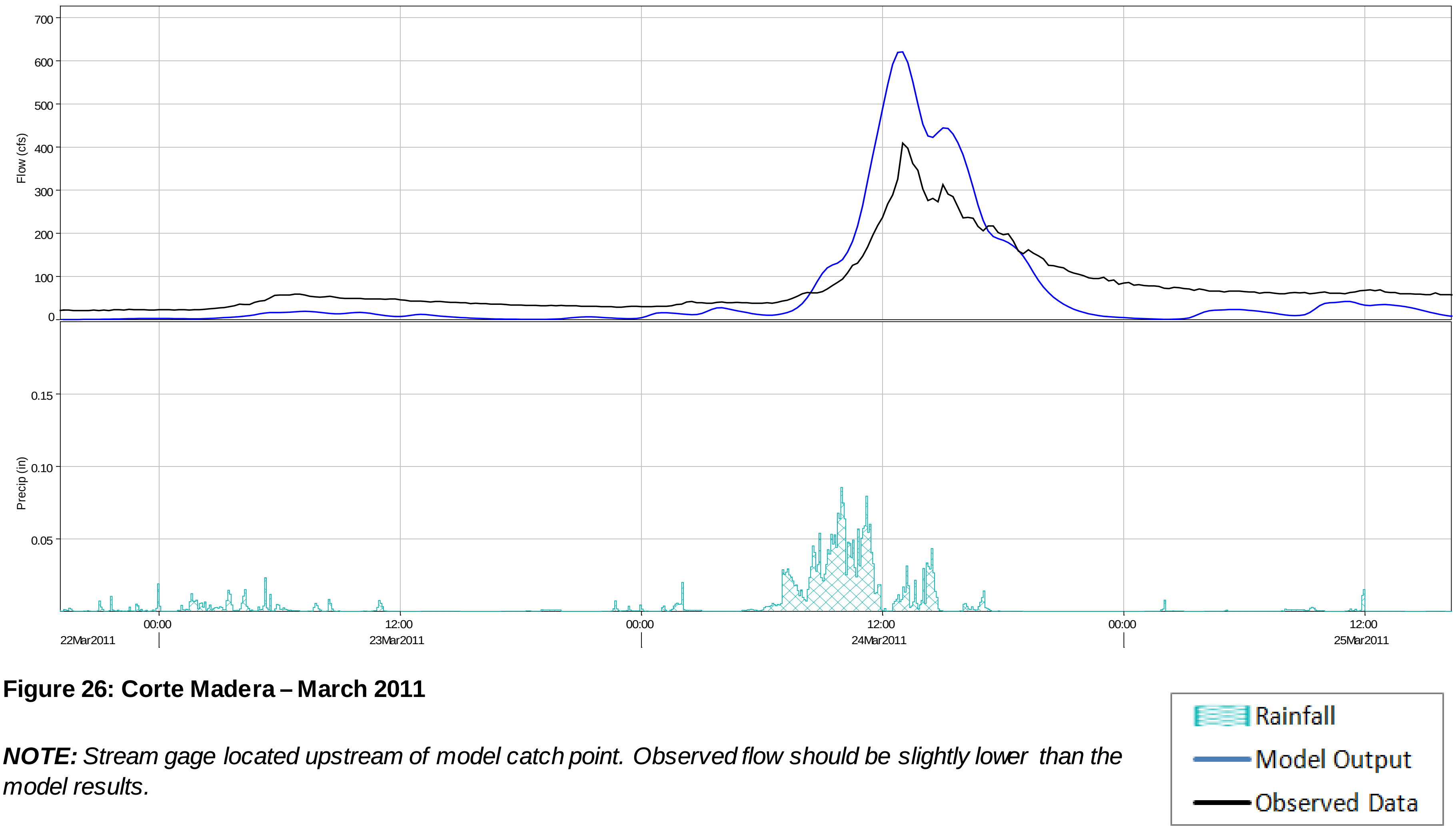


Figure 26: Corte Madera – March 2011

NOTE: *Stream gage located upstream of model catch point. Observed flow should be slightly lower than the model results.*

4.5. 21 DECEMBER 2012

Table 6: December 2012 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q	Storage Coefficient (R) Ratio
Bear	2.5	Q200	0.5
Searsville	1.5 – 2.0	Q10	0.5
Los Trancos	1.5	Q10	0.5
USGS	2.0	Q10	0.5
Urban	2.0	Q10	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Seven gage locations were in operation for this storm event: USGS, Searsville Dam, Bear, Corte Madera, Alambique, Dennis Martin/Sausal, and Los Trancos. Alambique gage experienced debris and clogged culvert issues, and therefore will only be used as reference. Alambique, Dennis Martin/Sausal, and Corte Madera gages are all upstream of Searsville Dam, and will be used to determine parameters for the Sub-Area Searsville.

For the Searsville watershed, Corte Madera sub-basins were given an AMC value of 2.0, while the rest of the northern sub-basins, including Alambique and Dennis Martin / Sausal, were given an AMC of 1.5 in the Searsville sub-area. This northern sub-area shares a boundary with Bear. It is likely that the rainfall error for Bear is also present in the northern Searsville sub-area as well.

The measured flow at the Bear Creek gage is very high, approaching a 200-year return period when using the USGS gage as a reference. AMC was set at 2.5, but the model could not reproduce the flows that were measured. Erroneous rainfall data is suspected, as a high stream flow at Bear is required to produce the flows seen at USGS. In addition, rainfall discrepancies are seen for sub-basins at higher elevations. This error probably stems from a District rain gage malfunction during this storm, which removed an important calibration point for the radar data. However, there is also a possibility of stream flow gage error, as the peak lasts for much longer, and the volume much higher at the USGS gage.

Using the Searsville outflow, combined with Bear and Los Trancos at an AMC 2.0, the modeled flow at the USGS gage matches the initial rising peak, but is not able to sustain the peak for very long.

Los Trancos is given an AMC of 1.5, and modeled flows are slightly higher than observed. Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

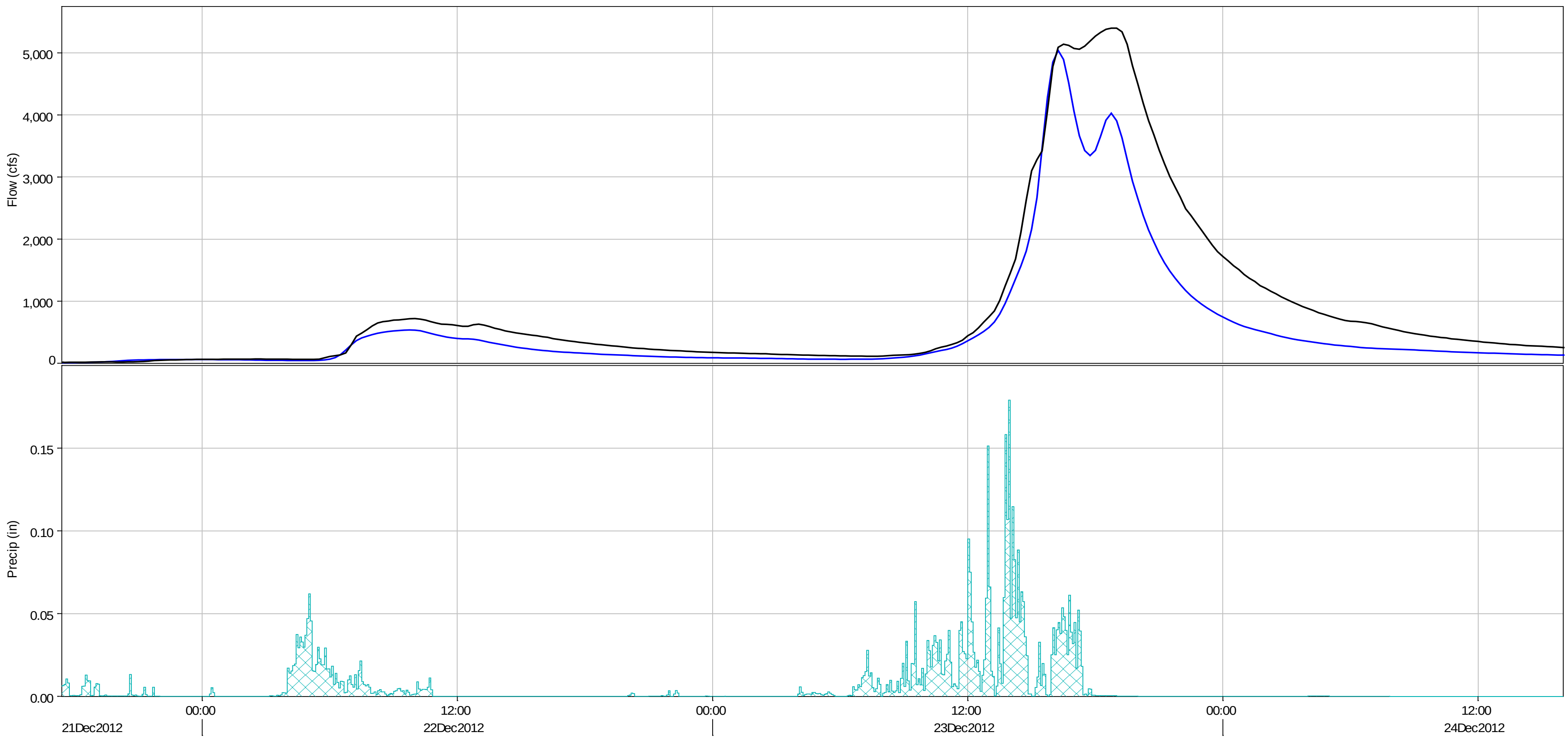
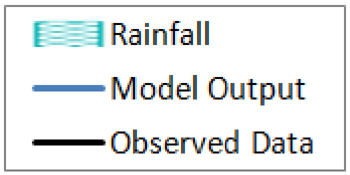


Figure 27: USGS – December 2012

NOTE: *Bear Creek and Los Trancos observed flow data were used as inputs in determining flow at USGS.*



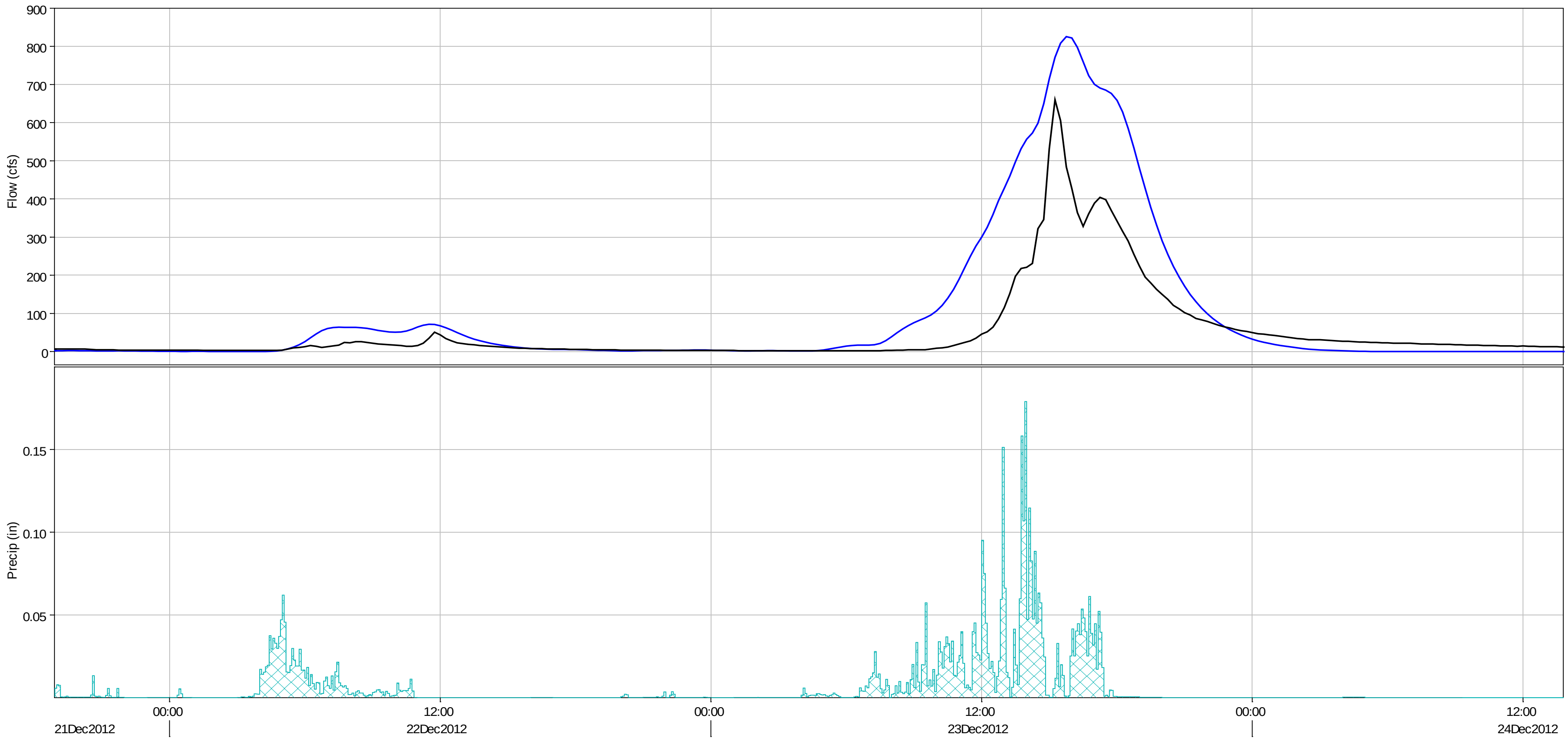
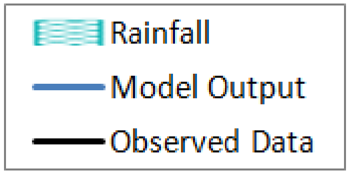


Figure 28: Los Trancos – December 2012



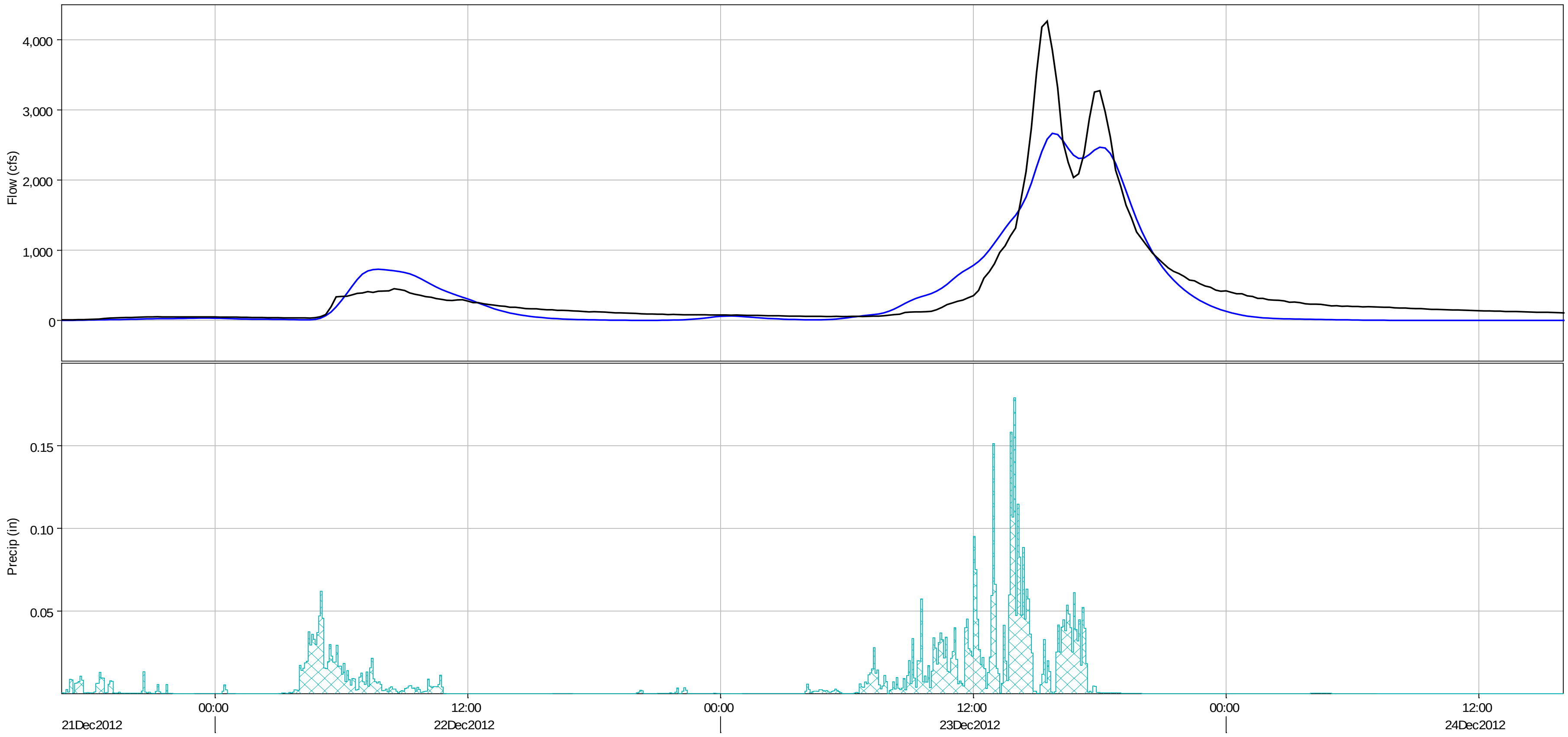
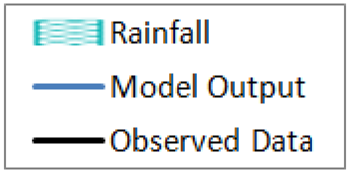


Figure 29: Bear – December 2012

NOTE: *Suspected rainfall data errors.*



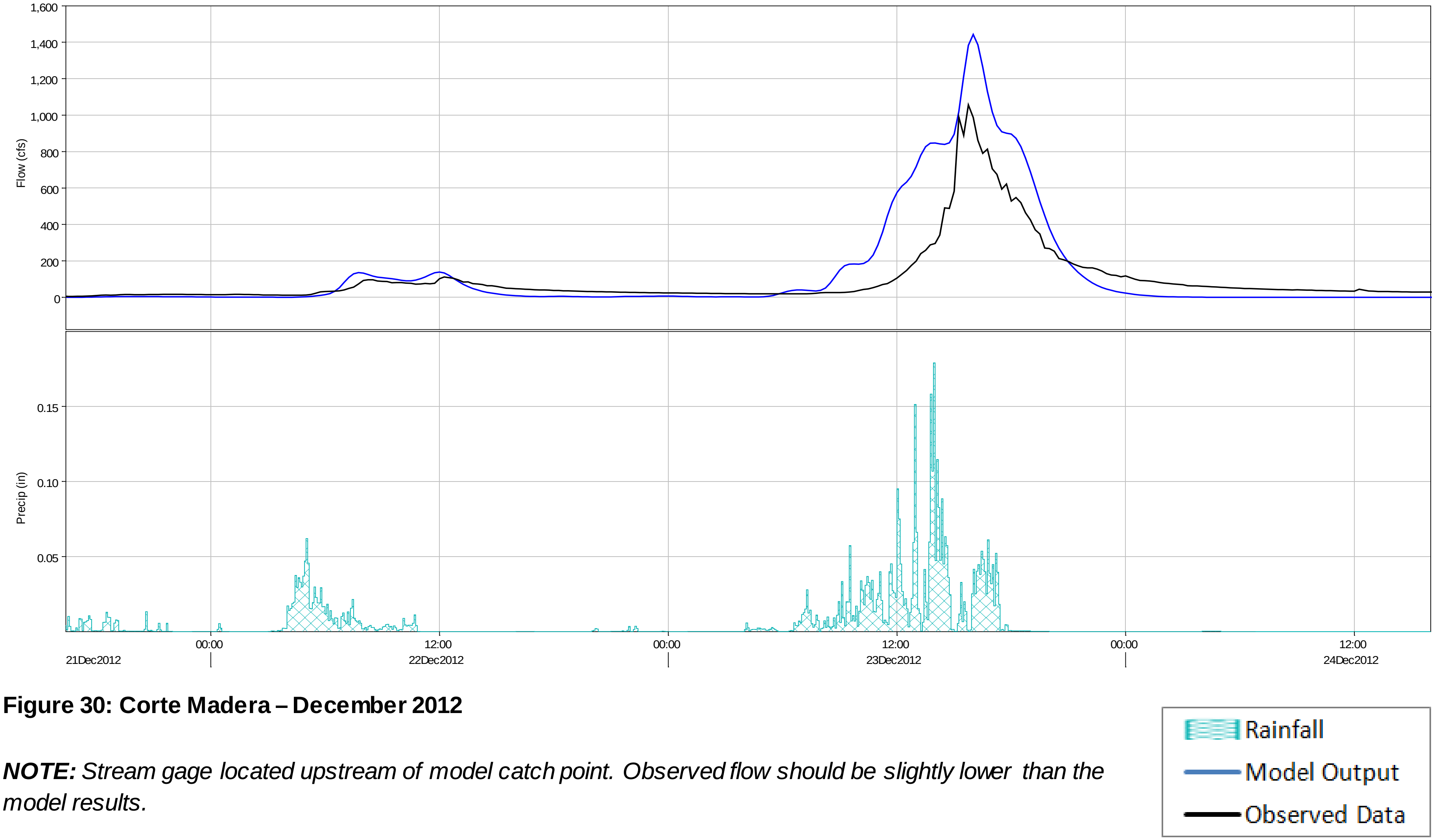


Figure 30: Corte Madera – December 2012

NOTE: *Stream gage located upstream of model catch point. Observed flow should be slightly lower than the model results.*

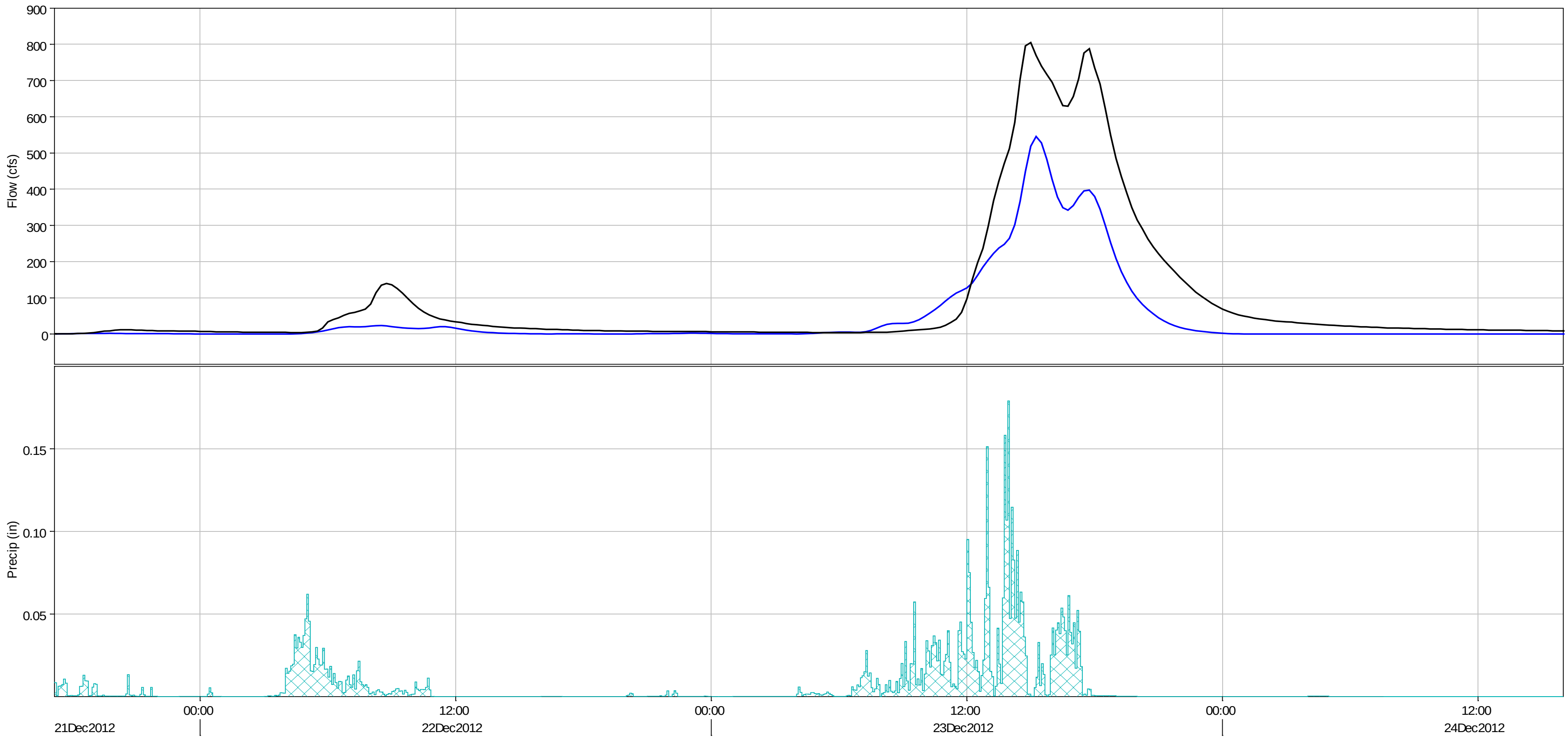
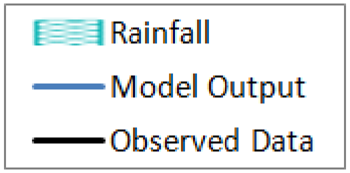


Figure 31: Dennis Martin / Sausal – December 2012



NOTE: *Suspected rainfall data errors.*

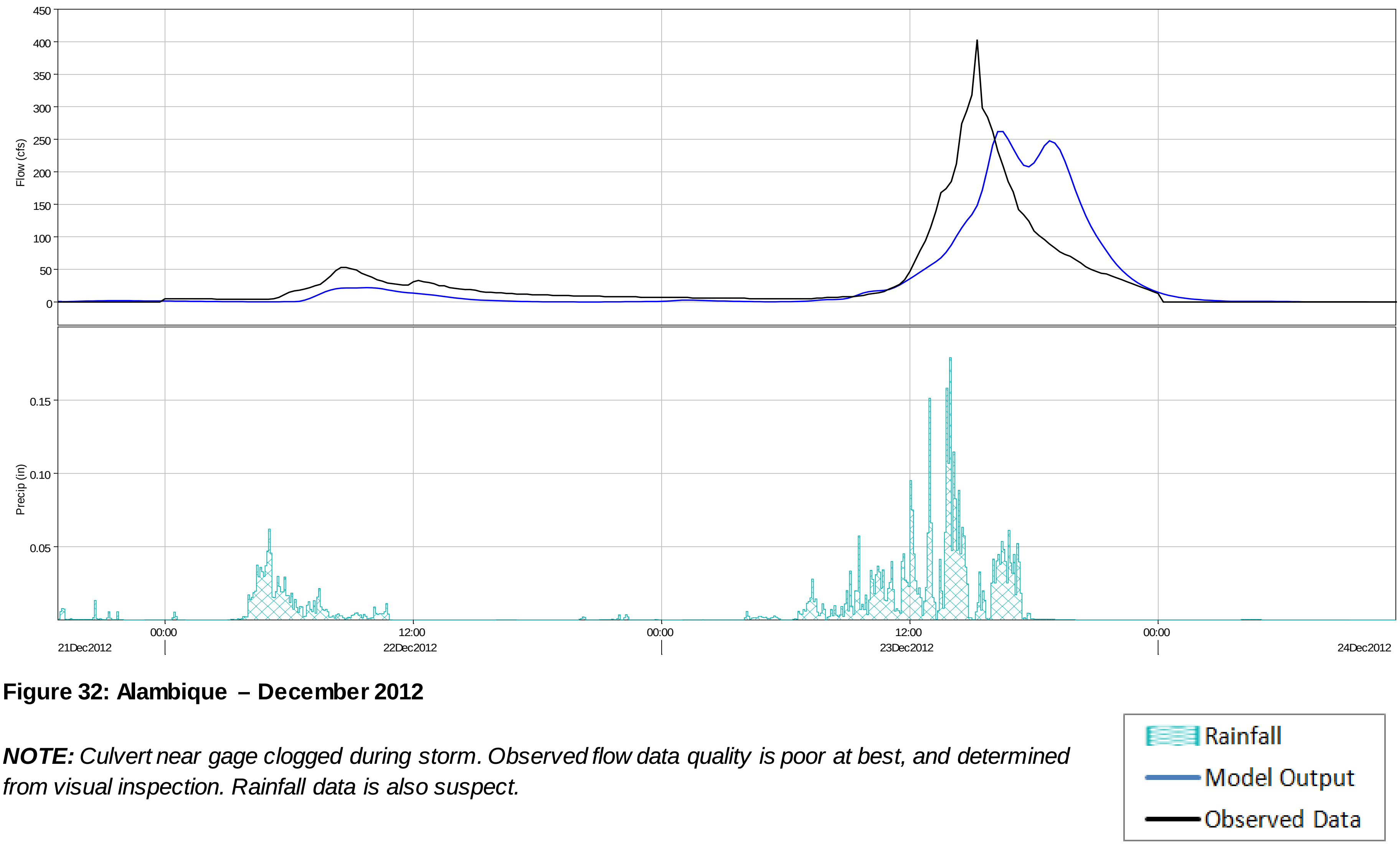


Figure 32: Alambique – December 2012

NOTE: *Culvert near gage clogged during storm. Observed flow data quality is poor at best, and determined from visual inspection. Rainfall data is also suspect.*

5. DESIGN STORM

5.1. PATTERN

Traditionally, the District has used a center-loaded 24-hour storm pattern based on rainfall statistics. This storm pattern is shown in Figure 32. However, a 72-hour storm pattern will also be used to account for the wetting behavior of Searsville Lake.

The storm of record for the entire county was in December 1955, and will be used as the basis for the 72-hr design storm. The storm pattern was modified by using precipitation frequency depths described in below. Depth durations of 1-hr, 2-hr, 3-hr, 6-hr, 12-hr, 24-hr, 48-hr and 72-hrs were used to ensure that within the 1955 pattern, each duration interval inside the design storm represented the statistically determined precipitation depths.

Rainfall depths are contingent upon mean annual precipitation (MAP) when using District rainfall equation, as explained in the next section. In lieu of creating a unique pattern for each sub-basin, the weighted-average MAP was determined for the entire watershed and used in the pattern modification for several reasons:

- The majority of the watershed is in the hills, and therefore does not have such a large variation in MAP compared with the valley.
- The differences in the patterns if each sub-basin was performed individually would be very slight, and from previous experience, not very sensitive.
- The design flow, regardless of rainfall depth and pattern, is calibrated to a gage FFA.

The aforementioned procedure was only done with 100-yr depths. The same pattern used for the 100-yr was adopted for the 10-yr design storm pattern for most of the same reasons listed above. The original 1955 storm pattern, as well as the modified storm pattern, is shown in Figure 33 and Figure 34.

5.2 RAINFALL DEPTH

NOAA-14 depths were not used to characterize the design storm. Previous hydrology studies using NOAA-14 rainfall depths yielded extremely high design flows, in many instances almost double the stream gage flood frequency analysis (FFA) flows. Similarly in this study, attempts to balance the flows by modifying model parameters became unreasonable. Therefore, The District's TDS regional equation is used to calculate the design rainfall depths. The District performed a statistical analysis on all forty rain gages within its jurisdiction to create the regression equation that can estimate precipitation for ungaged watersheds within this hydrometeorologic region.

Table 7 below compares 1% depths for both the 72-hr and 24-hr durations on all the San Francisquito sub-basins, and details the percent increase between the District and NOAA-14, which generally ranges from 20%-35%. Additionally, Table 8 compares the 1% depths between NOAA-14 and District statistical analysis for several durations at a District rain gauge that has been operating since 1966. Not only has the NOAA-14 depth increased for all durations, but the shorter duration depths now represent a higher percentage of the longer duration depths. The second point is important when producing the design storm pattern, and will increase the intensity design storm pattern at the peak, causing more runoff.

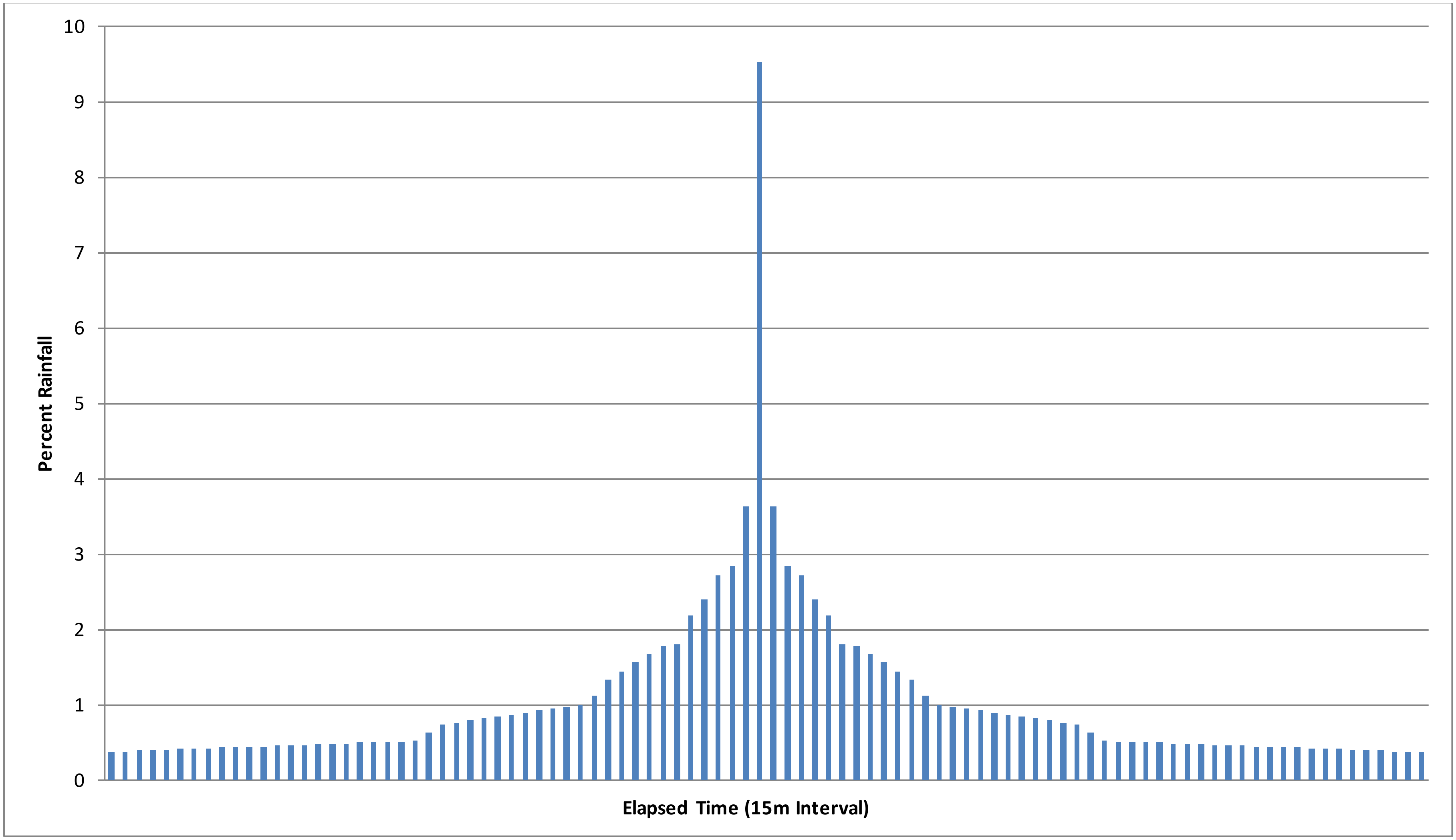


Figure 33: 24-hr Design Storm Pattern

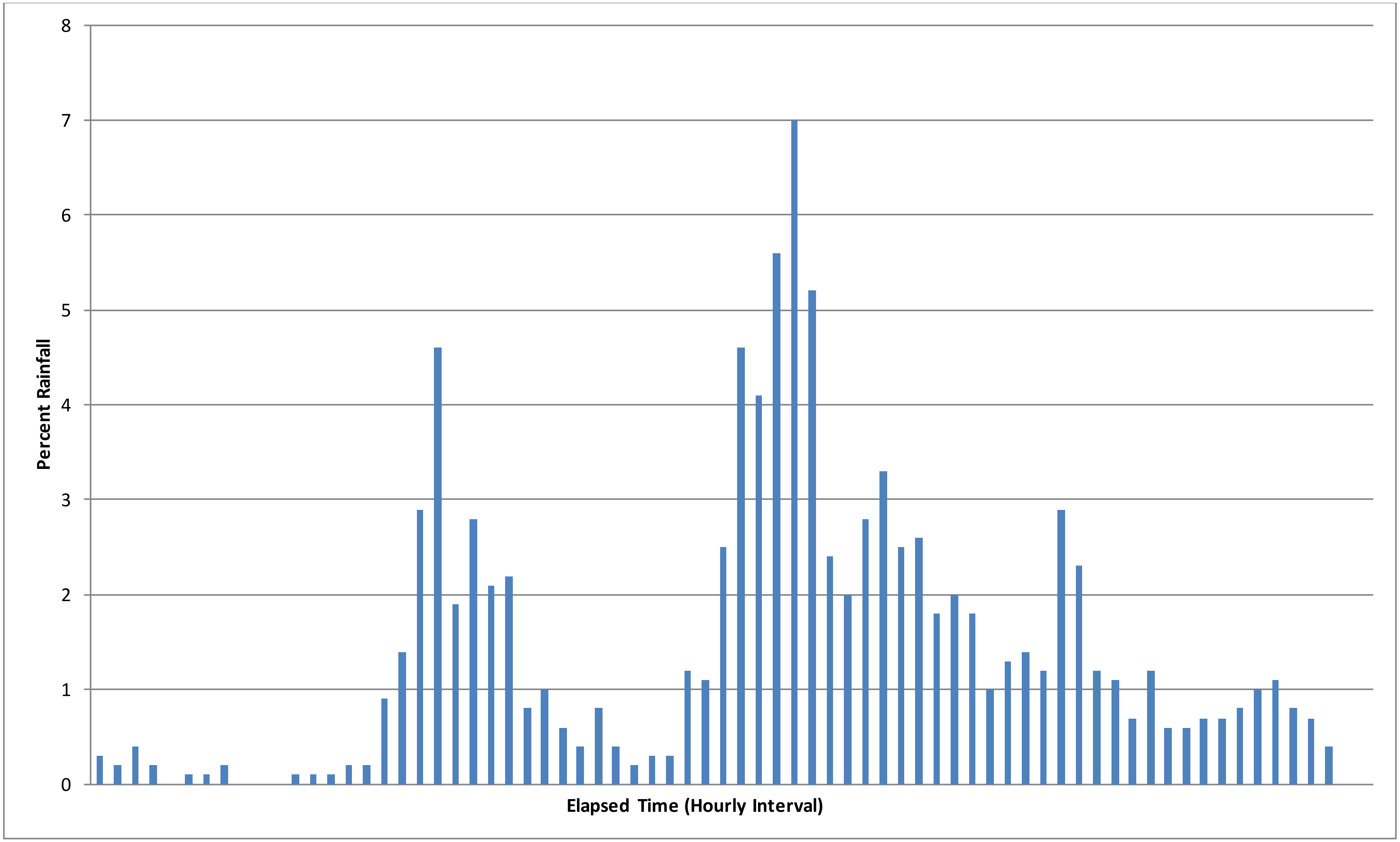


Figure 34: 1955 Storm Pattern

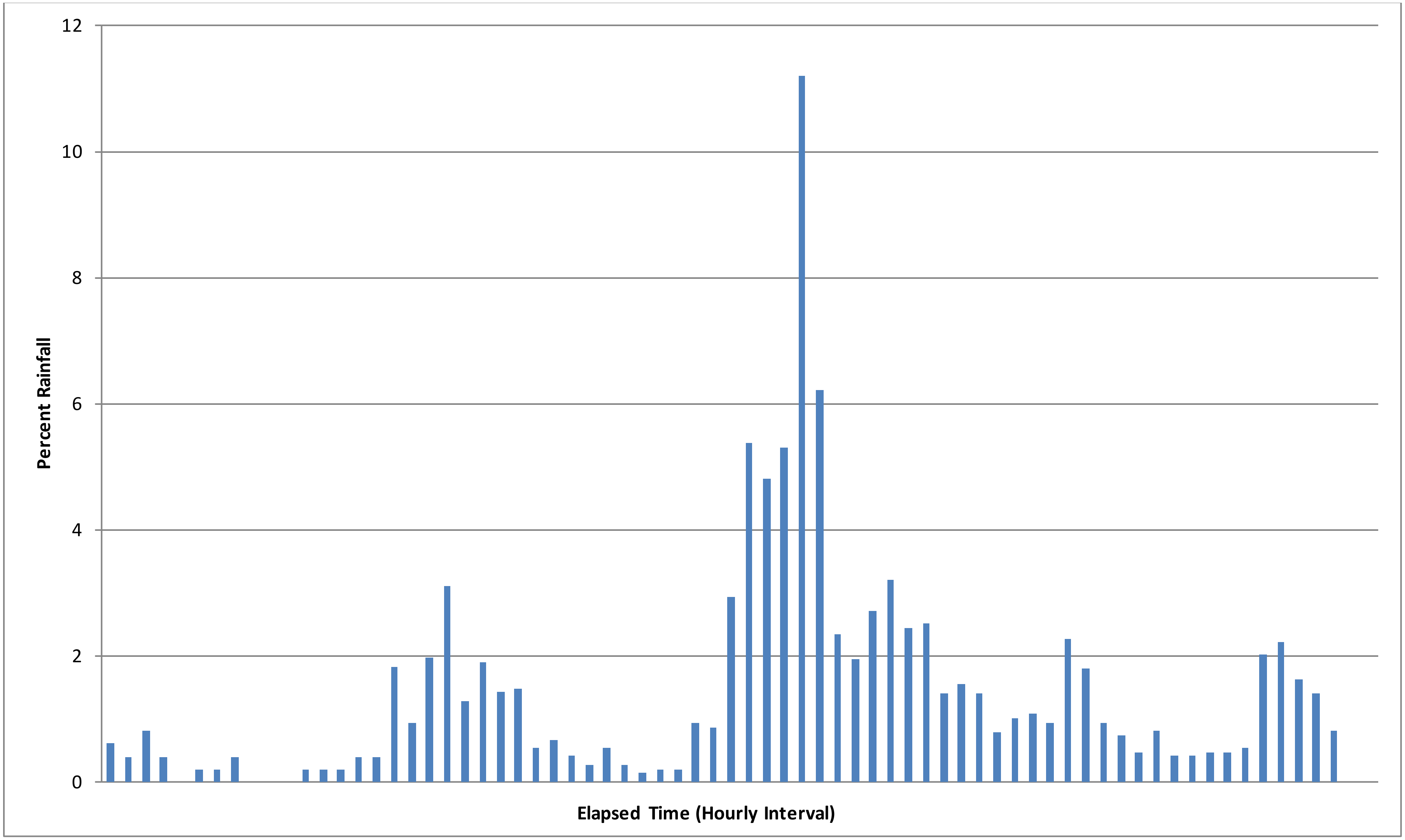


Figure 35: 72-hr Design Pattern

Table 7: Rainfall Depth Comparison

Basin ID	1% 72-hr			1% 24-hr		
	TDS	NOAA-14	% Increase	TDS	NOAA-14	% Increase
SFQ_AA14	8.34	11.4	36.7%	5.504	7.59	37.9%
SFQ_AA15	8.687	11.6	33.5%	5.727	7.58	32.4%
SFQ_A1	10.297	13.97	35.7%	6.76	9.16	35.5%
SFQ_A2	10.73	14.58	35.9%	7.038	9.46	34.4%
SFQ_BB11	9.363	12.27	31%	6.161	7.91	28.4%
SFQ_BB13	8.383	11.43	36.3%	5.532	7.43	34.3%
SFQ_B1	11.053	13.81	24.9%	7.245	8.76	20.9%
SFQ_C1	10.237	13.9	35.8%	6.722	8.89	32.3%
SFQ_C6	10.818	14.9	37.7%	7.095	9.51	34%
SFQ_D	10.677	14.56	36.4%	7.004	9.35	33.5%
SFQ_E	8.974	12.32	37.3%	5.911	7.97	34.8%
SFQ_F	7.676	10.2	32.9%	5.078	6.72	32.3%
SFQ_G1	10.049	12.05	19.9%	6.601	7.71	16.8%
SFQ_G2	9.163	11.1	21.1%	6.033	7.21	19.5%
SFQ_G3	7.649	9.92	29.7%	5.061	6.52	28.8%
SFQ_G4	8.197	9.91	20.9%	5.413	6.5	20.1%
SFQ_G5	7.347	9.14	24.4%	4.867	6.07	24.7%
SFQ_G6	6.784	8.69	28.1%	4.506	5.81	28.9%
SFQ_H	6.343	8.33	31.3%	4.223	5.62	33.1%
SFQ_I	6.226	8.12	30.4%	4.148	5.51	32.8%
SFQ_J1	5.961	7.84	31.5%	3.978	5.32	33.7%
SFQ_J2	5.624	7.52	33.7%	3.762	5.14	36.6%
SFQ_K	5.59	7.13	27.5%	3.74	4.96	32.6%
SFQ_L	5.565	6.87	23.5%	3.724	4.77	28.1%
SFQ_M	5.39	6.43	19.3%	3.612	4.52	25.1%
SFQ_N	5.151	6.06	17.6%	3.459	4.3	24.3%
SFQ_O	4.813	5.89	22.4%	3.242	4.2	29.5%

Table 8: Rainfall Depth and Percentage Comparison for Dahl Ranch Gauge

	1% Depth (and Percent)	
Duration	**SCVWD Gauge Stats**	**NOAA-14**
72-Hr	9.67	11.82
24-Hr	6.27	7.56
6-Hr	3.06	4.47
% of 72-hr	32%	38%
% of 24-hr	49%	59%
1-Hr	1.05	1.69
% of 72-hr	11%	14%
% of 24-hr	17%	22%

The total precipitation for a given storm duration and frequency can be determined from the following TDS equation published by the District[16].

$$P_{f,d} = A_{f,d} + B_{f,d} \times MAP$$

Where:

$P_{f,d}$ = Precipitation depth in inches for a given f, frequency (%) and d, duration (hours).
$A_{f,d}$ & $B_{f,d}$ = Regression constants and coefficients given in the table below
MAP = Mean annual precipitation, in inches, from SCVWD

Table 9: TDS Equation Constants

	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr	48-hr	72-hr
A (1%)	0.5074	0.5317	0.498	0.3228	0.2588	0.1102	0.3239	-0.0876
B (1%)	0.019	0.0389	0.0579	0.1082	0.1613	0.217	0.2751	0.3382
A (10%)	-	-	-	-	-	0.0028	-	-0.1569
B (10%)	-	-	-	-	-	0.1653	-	0.2552

Precipitation depth was calculated individually for each sub-basin in the hydrologic model using the TDS equation shown above due to the variation of MAP. TDS equations for the 10-year recurrence event were only used for the full 24-hr and 72-hr depths, as the other durations were not required since the pattern was already created using the 100-year event.

[16] SCVWD 2013. Precipitation Gage Data and Depth-Duration-Frequency Analysis. Revised from Saah et al, 2004

5.3 DEPTH AREA REDUCTION FACTOR (DARF)

When accounting for spatial variation in rainfall depth over a large watershed, DARFs are commonly used. As the study area increases in size, there is a decrease in rainfall depth. To properly account for the spatial variation, the depth-area reduction table 13.3 in HMR 59[17] was used. HMR 59 analyzed the largest recorded storms in California to produce the DARFs. Values between the discrete points in the table were interpolated linearly. For San Francisquito, all depths were multiplied by 92.1%, which represents the DARF for a watershed area of 44.95 square miles.

5.4 SEARSVILLE LAKE

To properly model the hydraulic effects of Searsville Lake, a 2D model was used to route flows from the upper lake to the dam spillway. Output from the hydrologic model was used as input to the hydraulic 2D model, and the resulting output used as dam outflow for the hydrologic model.

[17] NOAA. Hydrometeorological Report No. 59. Probable Maximum Precipitation for California, February 1999.

6. FLOOD FREQUENCY ANALYSIS (FFA)

6.1. DATA

The only stream gage with a significant historical record to perform a FFA is the USGS gage #11164500 at the Stanford golf course. This gage began measuring stream flow in 1932 and has since maintained a continuous length of record, except for a gap from 1942 to 1950. To date, there are 73 annual peak discharges over a period of 83 years.

Stream gage data was downloaded from the USGS National Water Information System[18] (NWIS). Analysis was performed using USGS PeakFQSA[19] software, which also includes an automatic low outlier test improved upon from the original Bulletin 17B, also known as 17C[20]. Gage analysis was performed using a weighted skew, with regional skews determined by USGS SIR 2010-5260[21], which followed the following equation:

$$Regional\ Skew = -0.62 + 1.3\ [\ 1 - e^{(-Mean\,Basin\,Elevation/6500)^2}\ ]$$

Input parameters are listed below in Table 8. Station skew was calculated by the PeakFQSA program and varied depending on the outlier selection.

Table 10: USGS Gage Regional Skew & Mean Square Error

Location	Average Basin Elev	Skew	Mean Square Error
USGS Gage 11164500	953’	-0.60	0.14

6.2 RESULTS

Analysis was performed with two separate low-outlier test methods. The first was the Multiple Grubbs-Beck Test (MGBT) method, which is the default 17C method. The second MGBT method calculated a low-outlier threshold of approximately 1,600cfs. To test sensitivity, a manual low-outlier threshold of 139cfs was used based on visual examination of the data set. Both methods produced similar 100-year flows. 100-yr flows for both methods can be seen in Table 9. Graphs can be seen below in Figure 35 for the MGBT and Figure 36 for the manual threshold. Final FFA results for the MGBT method are in Table 9.

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18 http://nwis.waterdata.usgs.gov/nwis

19 Tim Cohn, USGS. PeakFQSA Version 0.998. Flood Frequency Analysis with the Expected Moments Algorithm

20 Recommended Revisions to Bulletin 17B. June 12, 2013. Subcommittee on Hydrology, Advisory Committee on Water Information. Hydrologic Frequency Analysis Work Group (HFAWG) Memorandum.

21 Parrett, C., Veilleux, A., Stedinger, J.R., Barth, N.A., Knifong, D.L., and Ferris, J.C., 2011, Regional skew for California, and flood frequency for selected sites in the Sacramento–San Joaquin River Basin, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2010–5260, 94 p.

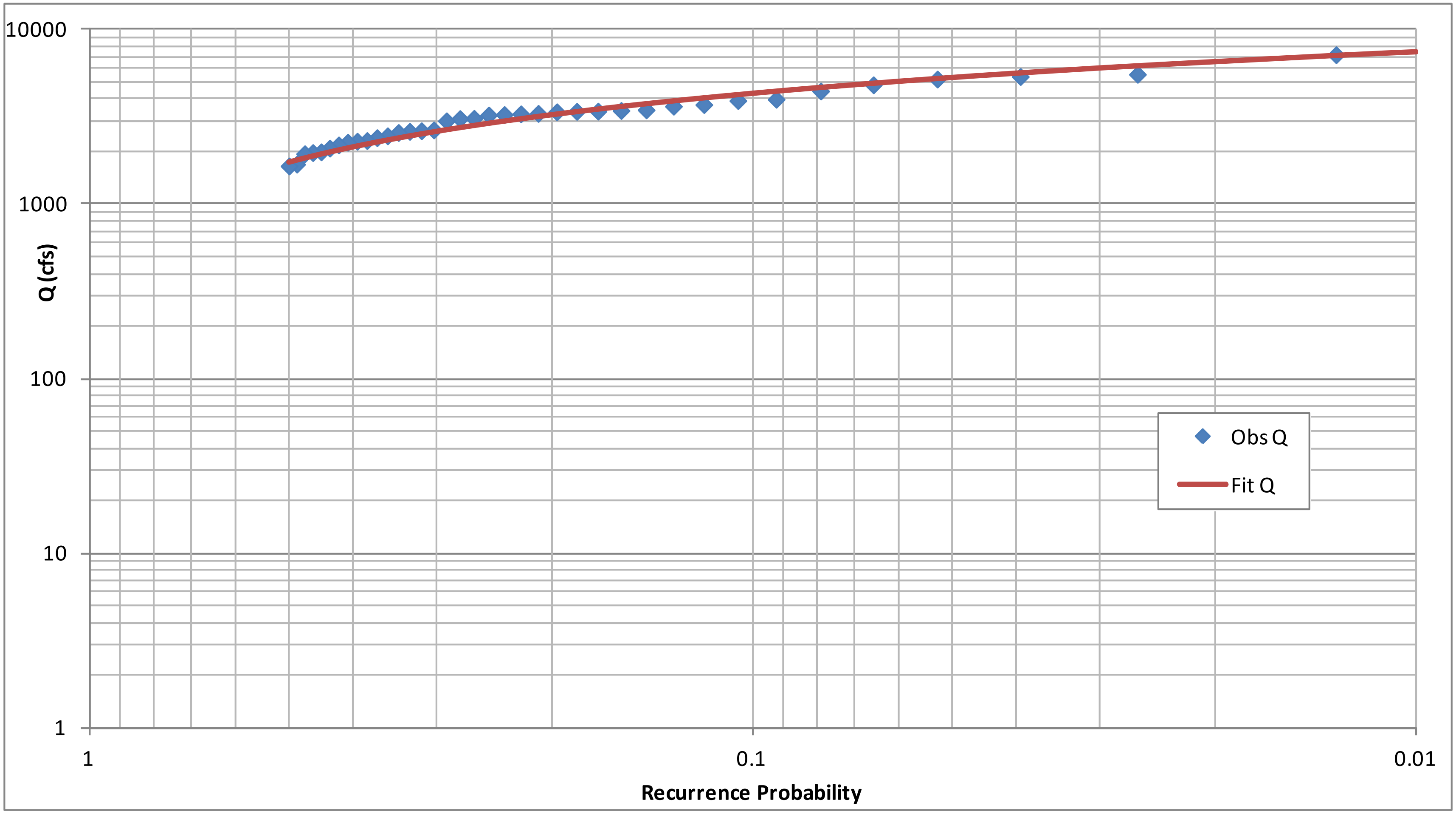

Figure 36: USGS Gage FFA Plot (MGBT)

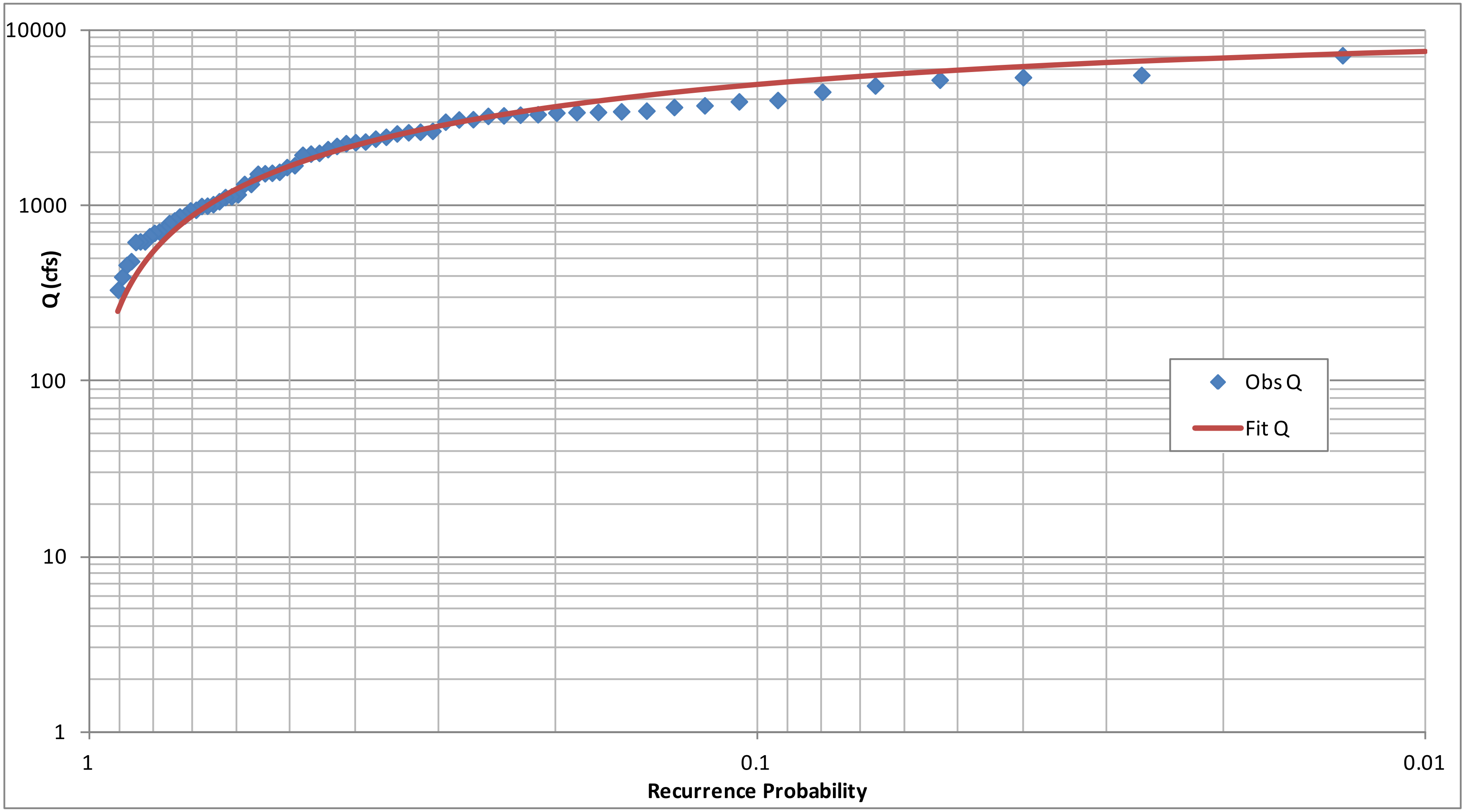

Figure 37: USGS Gage FFA Plot (139cfs Minimum Threshold)

Table 11: USGS Gage 11164500 FFA (MGBT)

Recurrence	Q Flow (cfs)
500yr	9,456cfs
200yr	8,382cfs
100yr	7,519cfs
50yr	6,612cfs
25yr	5,660cfs
10yr	4,330cfs
5yr	3,261cfs
2yr	1,734cfs

6.3 PREVIOUS INDEPENDENT ANALYSES

Two separate independent FFA studies were previously completed for the same gage. The first was a part of the Palo Alto Flood Basin Study by Shaaf and Wheeler in 2014[22]. The second was SIR 2010-5260, a study by the USGS in 2010 on all stream gages within the state of California that presents the most recent regional regression equations. Values vary slightly, due to additional data points, regional skew values, and low-outlier tests. However, all values are reasonably close. Table 10 below compares the different values.

Table 12: USGS Gage 100-yr FFA Comparisons

Study	Q100
Current Study (MGBT)	7,519cfs
Current Study (Manual Threshold)	7,547cfs
USGS SIR 2010-5260	7,690cfs
Shaaf & Wheeler PAFB	7,810cfs

6.4 SEARSVILLE DAM

The historical peak flows recorded by the USGS gage are influenced by the presence of Searsville Dam on the system. It is evident from recent large events that the lake and the dam provide a level of flood protection. However, given the dynamic change of the lake through sedimentation and the resulting topographic change upstream of the lake, it is not clear how the dam has affected the measured flows since the advent of the USGS gage.

[22] Schaaf & Wheeler. Palo Alto Flood Basin Hydrology. July 2014. Prepared for SCVWD.

The prevailing thought is that as time passed, the lake gradually filled up with sediment, reducing the storage, and thereby increasing runoff downstream. Therefore, it is expected that the annual peak flows measured at the USGS gage would be higher in the past if Searsville Lake and dam, in its current state, was present. This might make our current FFA slightly low given the current conditions. However, this theory has not been verified. To offset this possible uncertainty, the design flow should be set conservatively higher than the results of the FFA.

7. DESIGN FLOWS

7.1. DESIGN MODEL PARAMETERS

Two design storm durations were used to ensure that the most conservative effect of Searsville Lake was captured. Although the design model will be calibrated to FFA value at the USGS gage, other catch points upstream of the gage do not have an index point and might be affected by storm duration.

For the 24-hr design storm pattern, an AMC of 1.65 was used. For the 72-hr design storm pattern, an AMC of 1.4 was used. Time of concentration values were based on a Q100 flows based on USGS regional regression values for each sub-basin, similar to the method used during model calibration. Storage coefficient ratios were left at 0.5 for all sub-basins.

A secondary HEC-HMS basin geometry was created as a “no Searsville lake” option. This model contained a few extra routing reaches to account for the distance in the HEC-RAS 2D model. This basin geometry was used to determine Searsville inflow values, as the Searsville tributaries in the original geometry was disconnected to allow the routing to be performed in the 2D model.

7.2 RESULTS

Model results for both the 24-hr and 72-hr design storms are below. The higher flow value between the two storms will be used as the final design storm.

Table 13: SFC 100-yr Design Model Output

Location	HEC-HMS ID	Q100 (24-hr AMC 1.65)	Q100 (72-hr AMC 1.4)	Final Design Flows
Searsville Inflow	SFQ_E_Lake	4,087	4,261	4,261
Searsville Outflow	Searsville Gage	2,938	3,022	3,022
Bear Creek U/S SFC	SFQ_AA15_Junction	2,863	2,883	2,883
Los Trancos U/S SFC	SFQ_G6_Junction	1,508	1,520	1,520
SFC U/S Los Trancos	SFQ_F_Junction	6,178	6,257	6,257
USGS	SFW_H_USGS_Junction	7,575	7,633	7,633
Pope Chaucer	SFQ_M_Junction	8,146	8,134	8,146
US-101	SFQ_N_Junction	8,404	8,352	8,404

Table 14: SFC 10-yr Design Model Output

Location	HEC-HMS ID	Q10 (24-hr AMC 1.65)	Q10 (72-hr AMC 1.4)	Final Design Flows
Searsville Inflow	SFQ_E_Lake	2,373	2,360	2,373
Searsville Outflow	Searsville Gage	1,690	1,690	1,690
Bear Creek U/S SFC	SFQ_AA15_Junction	1,768	1,784	1,784
Los Trancos U/S SFC	SFQ_G6_Junction	920	934	934
SFC U/S Los Trancos	SFQ_F_Junction	3,606	3,668	3,668
USGS	SFW_H_USGS_Junction	4,434	4,473	4,473
Pope Chaucer	SFQ_M_Junction	4,813	4,802	4,813
US-101	SFQ_N_Junction	4,976	4,943	4,976

7.3 FINAL FLOWS

Using the computed 10-yr and 100-yr design flows, interpolation and extrapolation was performed using Log-Pearson Type III methodology described in Bulletin 17B[23]. The general distribution fit is defined by the following equation:

$$Log\ Q = \bar{X} + K \times S$$

In this case, the flow variable Q is known for the 1% and 10% frequencies, as well as the constant factor K that is obtained from Appendix 3 of Bulletin 17B given a general skew coefficient G, which is determined to be -0.60. That leaves X-bar and S as two unknowns that can be solved.

Final design flows, along with associated K, S, and X-bar values can be seen in Table 13.

[23] Guidelines for Determining Flood Flow Frequency– Bulletin #17B of the Hydrology Subcommittee. Interagency Advisory Committee on Water Data. Revised 1981. Editorial Corrections March 1982. USGS.

Table 15: Final Design Flows

	Recurrence Interval								Calculated Values	
Location	**2.33-Yr**	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**	**200-Yr**	**500-Yr**	**S**	**X-bar**
Searsville Inflow	1,080	1,780	2,380	3,140	3,700	4,270	4,760	5,420	0.36963	2.93164
Searsville Outflow	780	1,270	1,690	2,230	2,630	3,030	3,370	3,840	0.36701	2.78738
Bear Creek U/S SFC	940	1,410	1,790	2,250	2,570	2,890	3,160	3,510	0.30309	2.88760
Los Trancos U/S SFC	490	740	940	1,180	1,350	1,520	1,670	1,860	0.30752	2.60124
SFC U/S Los Trancos	1,790	2,820	3,670	4,740	5,500	6,260	6,920	7,790	0.33724	3.15965
USGS	2,180	3,430	4,480	5,780	6,710	7,640	8,440	9,500	0.33747	3.24554
Pope Chaucer	2,370	3,710	4,820	6,190	7,170	8,150	8,990	10,100	0.33228	3.28358
US-101	2,460	3,840	4,980	6,390	7,400	8,410	9,270	10,410	0.33094	3.29966
K-Value	0.27047	0.85718	1.20028	1.5283	1.72033	1.888029	2.01644	2.16884		

8. FUTURE CONDITIONS

8.1. WATERSHED URBANIZATION

In the hills, much of the area is open space preserve and protected from development. In the upper valley, by Searsville Lake, there is very light urbanization on mostly rural tracts of land. In the lower valley, Palo Alto and Menlo Park are essentially fully built out.

Given this information, it is not likely that imperviousness, a measure of urbanization, will change considerably in the next fifty or so years.

8.2. SEARSVILLE DAM

8.2.1. EXISTING CONDITION

Currently the dam provides very little storage in the reservoir proper due to sedimentation. However, there is a definite observed attenuation[24] from historical storms and modeling observations seem to indicate two main factors causing attenuation upstream of the lake:

- For the tributaries feeding into Searsville Lake, the channel capacity is very limited. There is significant usage of floodplains by these tributaries once the low flow channel is exceeded.
- Two constrictions from roadway crossings exist that divide the area upstream of the reservoir. The first is Portola Road crossing Alambique Creek. The second is the Stanford Causeway that spurs off Lakeshore Drive, which is a part of the Stanford Jasper Ridge preserve.

The combination of floodplain usage and roadway constrictions creates artificial detention ponds upstream of Searsville Lake, causing the observed attenuation. Map details can be seen in Figure 2.

[24] Xu, Jack. SCVWD. Technical Memorandum - Effect of Searsville Lake on Large Storm Events. March 25, 2015.

8.2.2. FUTURE CONDITION

Stanford's Searsville Alternatives Study Committee (SASC) was formed in 2011 by the Stanford University Provost to develop a recommended course of action to address the future of Searsville Dam and Reservoir. SASC is comprised of twelve Stanford University administrators, prominent faculty, including specialists in conservation, land use, environmental sustainability, and water conservation. The results of their findings are published in the Searsville Alternatives Study[25].

SASC has identified not exacerbating flood risk as a primary goal of future Searsville operations. Future Searsville operation is uncertain as Stanford is currently in litigation. However, the Searsville Alternatives Study put forth by SASC recommends two options:

- Let the dam silt in and build a fish ladder passage.
- Create an orifice at the dam base and excavate the sediment inside the lake.

To reflect a the possibility of a silted in dam, a hypothetical condition of a filled in dam was analyzed, where the 1% design storm for both the 24-hr and 72-hr was run with a starting water surface at the invert of the lowest gate in the 2D model to simulate a completely full dam. Results were compared to the existing run and there was no difference in peak flow or timing.

As for the second orifice condition, the details of the orifice size and invert are not known at this point. It is known that the opening needs to facilitate fish passage, but also provide attenuation during high flows.

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[25] Searsville Alternatives Study, Steering Committee Recommendations. Stanford University. April 2015.

APPENDIX A

TECHNICAL MEMORANDUM

PROJECT: San Francisquito Creek – Searsville Lake **DATE**: March 25, 2015

SUBJECT: Effect of Searsville Lake on Large Storm Events

PREPARED: Jack Xu, PE

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1. PURPOSE

The purpose of this report is to quantify the causes of attenuation for Searsville Lake and the effects on San Francisquito Creek flows during significant storm events.

2. BACKGROUND

Searsville Dam is owned and operated by Stanford University, and was constructed in 1892, creating Searsville Lake. The watershed upstream of the dam is approximately 14.5 square miles, which accounts for about a third of the total watershed of San Francisquito Creek. A general map can be seen in Figure 1.

The lake experiences severe sedimentation from upstream sources. According to the Searsville Lake Impact Study[1], varying sedimentation rates averaging about 9 acre-feet per year have occurred over the past 100-plus years. This has significantly decreased the amount of storage that the lake can hold. Currently, from field visits and conversations with Stanford and Balance Hydrologics, the dam will spill through manual gates even during a very minor storm event, and experience uncontrolled overtopping soon thereafter.

However, observations from recent large flood events show that heavy runoff routed through Searsville Lake provided a flood benefit for San Francisquito Creek and communities downstream, either by delaying the timing of the peak flow, or by attenuating the peak flow and releasing the volume over a longer period of time. A case study was performed for the 2012 event to detail the benefits of a lake and no lake scenario in this analysis. Benefits vary widely, and subsequent discussion will focus on determining the behavior of the lake.

3. METHODOLOGY

Analysis focused on using measured data where available. Effort was made to interpret the data to evaluate probable explanations for the attenuation. To augment the dataset where there was missing information, a two-dimensional hydraulic model was constructed, since field visits and general knowledge of the area surrounding the Lake revealed that the attenuation effects were too complicated for a simple model. Using multiple historic events, the 2D model was calibrated and verified. Most of the modeling work and calibration was done for the 2015 San Francisquito Hydrology Study[2]. This study is currently in a draft-review phase, but the calibrated 2D model, along with input data, and historical storms, were utilized for this study used to help analyze the effects of Searsville Lake.

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[1] NHC. Balance Hydrologics. HT Harvey & Associates. Jones & Stokes. Kondolf, Matt. Smith, Jerry. Searsville Lake Sediment Impact Study. Stanford University, Facilities Operations. March 2002.

[2] SCVWD. Xu, Jack. San Francisquito Hydrology Study. 2015.

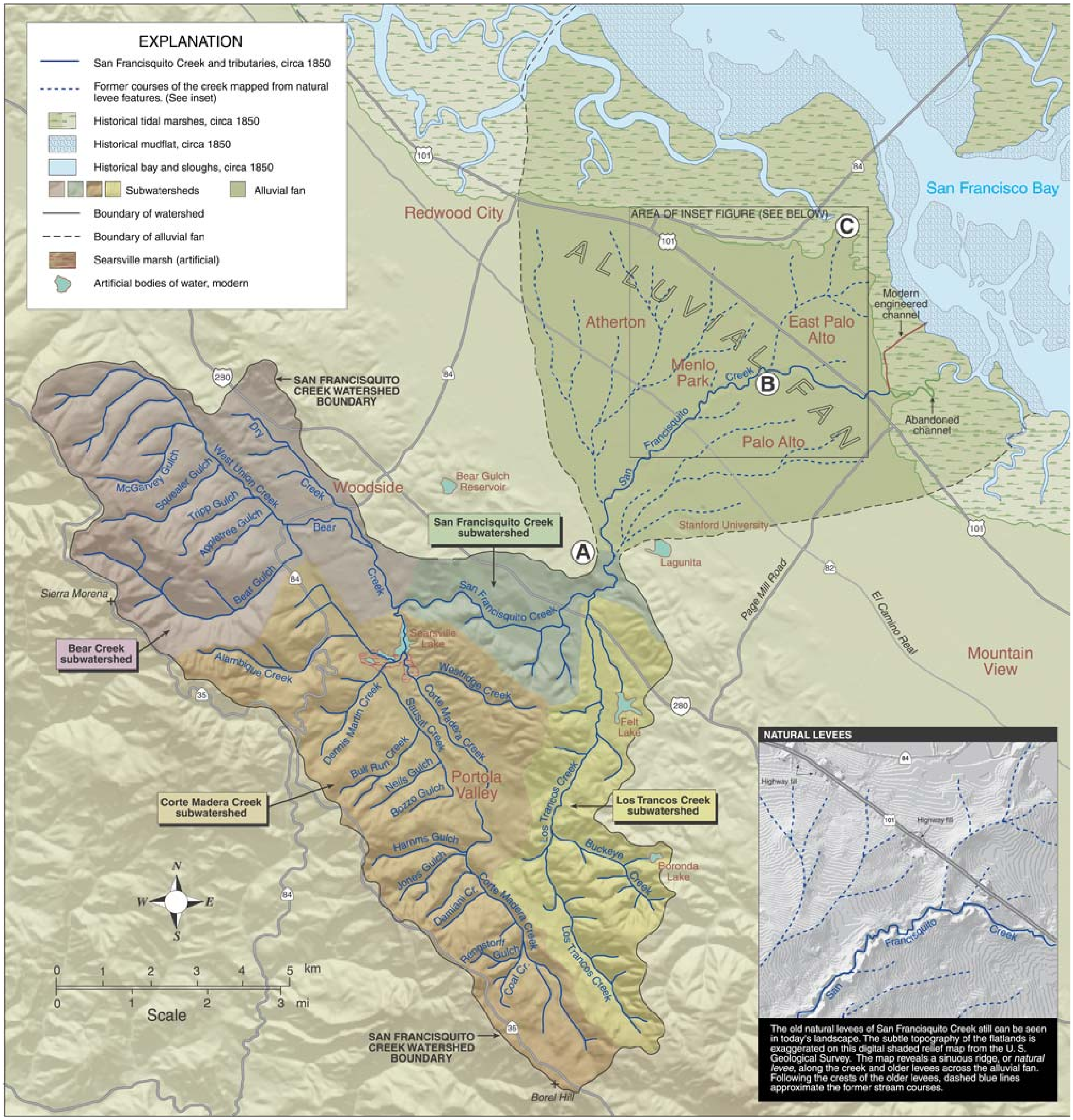

Figure 1: San Francisquito Watershed Map

4. HYDROLOGIC DATASET

To analyze the effects of the lake on downstream flows, large historical flow events that had inflow and outflow measurements for Searsville Lake were needed. Upon solicitation, Balance Hydrologics furnished pertinent stream flow data for the events that will be analyzed in this report. However, the data provided was not exhaustive for the events analyzed and missing data was estimated. Several methods were used to fill in the data gaps:

- For the 2011 and 2010 events, only one upstream tributary (Corte Madera Creek) was gaged. These events also had reliable gage adjusted radar rainfall data, and were used in the historical calibrations in the hydrologic model. Therefore, outputs from the HEC-HMS hydrologic model prepared by the 2015 San Francisquito Hydrology Study were used as tributary inflow inputs for the HEC-RAS models.

- For the 2005 event, Corte Madera Gage was the only gaged location as well. However, rainfall data was not reliable. Therefore, the remainders of the tributary inflows were determined by scaling the Corte Madera Creek hydrograph based on drainage area.

- The 2012 event had two gaged tributaries upstream of the Lake. Additionally, a third tributary had visual observations for estimated flow. For the remaining tributaries, flow was determined by scaling the hydrographs from the average of the two gaged tributaries, in the same manner as the 2005 event. However, for the tributary with visual observations, the hydrograph was modified so that the observed flow values properly fit within the rising and receding values of the scaled hydrograph.

- In 1998 and 2000, there were no gaged tributaries upstream of the Lake. Therefore, gage adjusted radar rainfall data was used in the HEC-HMS hydrologic model and the appropriate outflows were used as inputs into the 2D model.

- In 2000, there was no outflow data for Searsville Dam. The 2D model was used to determine the outflow during that time.

Four separate hydrographs were developed based on the different tributary sub-catchments to quantify the 2D model inflow. This was necessary to properly model the attenuation created by different topographic features in the 2D model, such as Portola Road and Family Farm Road.

- Alambique Creek

- Corte Madera Creek

- Dennis Martin & Sausal Creeks

- Additional sub-basin tributary to the Searsville Lake not included in the previous three

5. HYDRAULIC 2D MODEL

HEC-RAS 5.0.0 BETA, released October 2014, will be used to perform the 2D analysis. RAS 5.0 was chosen as the software of choice due to the simplicity of its 2D application, as well as its industry standard use. The October 2014 release is the final BETA release before the final release, and runs very stable with few issues.

A 2D computation mesh was created by using a *.LAS dataset from the 2006 LiDAR survey that generated a digital terrain model with 10' x 10' squares. This dataset was cleaned to remove errant reflectivity data from foliage and buildings by the survey vendor. Relevant hydraulic structures were inputted with data from Balance Hydrology's 1D HEC-RAS model[3] of Searsville that was sent to the District for review in 2014. The outfall of the entire model was modeled as a 2D Boundary Condition Line, which uses a rating curve generated from Balance Hydrology's model. This curve was double checked with recorded stage and flow data from historical events, which was also provided by Balance.

The 2D Boundary Condition Line spans six grid elements, and during simulation, five of those grid elements are wetted. Due to program limitations in the beta, water surface elevations can only be determined on a grid-by-grid basis while in the 2D domain. Conversation with Gary Brunner, lead developer at HEC, revealed that the computational scheme allows for different water surface elevations within each grid at the boundary condition line. Each grid independently uses the rating curve based on its connection at the boundary condition line. Therefore, there are slight variations in the water surface elevations, depending on grid characteristics. The five wetted grids will be average to determine a single water surface elevation, which will be used to determine flow from the rating curve.

Computational point spacing for the mesh was set at 100' x 100' and 50' x 50', depending on the detail required. A sensitivity analysis that ran the same model at a 10' x 10' mesh showed negligible output difference. The diffusive wave computational method was selected over the full dynamic solution due to the lack of potential energy losses through obstructions. A sensitivity analysis using different methods also yielded negligible difference.

To properly characterize the lake, several historical calibrations were run to determine if the model is accurate. When available, stream gage data was used as input into the model. HEC-RAS inputs from other tributaries that were not gaged were estimated, similar to the methods detailed in Section 4. A final manning's roughness coefficient of 0.1 worked well for all the historical storms. Results from the calibration and verification process are further detailed in the San Francisquito Hydrology Study.

The 2D model was the same model used in the 2015 San Francisquito Hydrology Study to characterize the effects of the Lake within the hydrologic HEC-HMS model.

[3] Sears_US_JPA_052114.prj. Balance Hydrology is Stanford University's consultant.

6. BASELINE OBSERVATIONS

A total of six historical storms were looked at by using the data as described in Section 4. Each storm event was characterized as either being a storm where Searsville Lake had significant attenuation effects (blue), or a storm where the Lake had nuanced attenuation effects (orange). The peak lag time between inflow and outflow, and the overall peak flow reduction, were parameters used to quantify attenuation. Table 1 below documents each storm and the associated attenuation.

Table 1: Historical Lake Attenuation

Historical Event	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Lag Time (hrs)	Reduced Flow (cfs)	Flow Reduction (%)
2012	2481	1553	3.25	928	37.4%
2011	794	619	3.5	175	22.0%
2010	1429	982	2	447	31.3%
2005	2478	1258	2	1,220	49.2%
2000	1486	1068	1.5	418	28.1%
1998	3023	2588	0.5	435	14.4%

From the table above, there are two events that have parameters that do not necessarily fit the mold. For 2011, there is such a small peak flow reduction, but a large lag time. For 2000, the numbers are very close to the 2010 event. However, it is suspected that the inflow and outflow values for 2000 are less reliable, since there was no gage data for the entire watershed and since all the data was being handled by models.

It is also noted that the attenuation effects of the storm do not seem to follow a trend based on the peak inflow. The 2012 and 2005 events experienced significant attenuations, while the 1998 event experienced very little.

7. ANTECEDENT CONDITIONS

It is well known that the antecedent condition of the watershed can profoundly affect runoff. To analyze this, two datasets were looked at to determine the saturation of the watershed prior to the peak rainfall events for the six storms; antecedent rainfall and baseflow conditions prior to the largest inflow.

For antecedent rainfall, gage adjusted radar rainfall data was looked at one day prior to the peak rainfall intensity for five out of the six events. The 2005 data was extremely suspect and not used. A one day look-back period was used since the gage adjusted radar rainfall data began 24 hours prior to the peak rainfall intensity.

A longer look-back period was not pursued, due to the distance of the nearest rain gage which would provide the data. The nearest rain gage station that was operational during this time frame was at Dahl Ranch. This is a District gage that is on the edge of the entire San Francisquito watershed, just to the east of the Los Trancos Creek tributary area. Due to the observed temporal variation of storms in this area, it was decided not to pursue the use of that gage.

Figure 2 shows a scatter plot of the rainfall percentage that falls during the 24-hr look-back period for the five storm events. Hour zero is the earliest point in time, while hour 23 is the time of highest rainfall intensity. From the plot, the storms in 1998 and 2000 exhibit a higher percentage of rainfall during the earlier hours, while the storms in 2010, 2011, and 2012 have the majority of the rainfall occurring during the immediate hours before the peak rainfall intensity.

Cross referencing the observations from Figure 2 with Table 1, there is a slight trend showing that more attenuation is provided when there is a smaller percentage of antecedent 24-hr rainfall. The 2011 event is an outlier, when looking at peak flow attenuation, but has very large lag time attenuation.

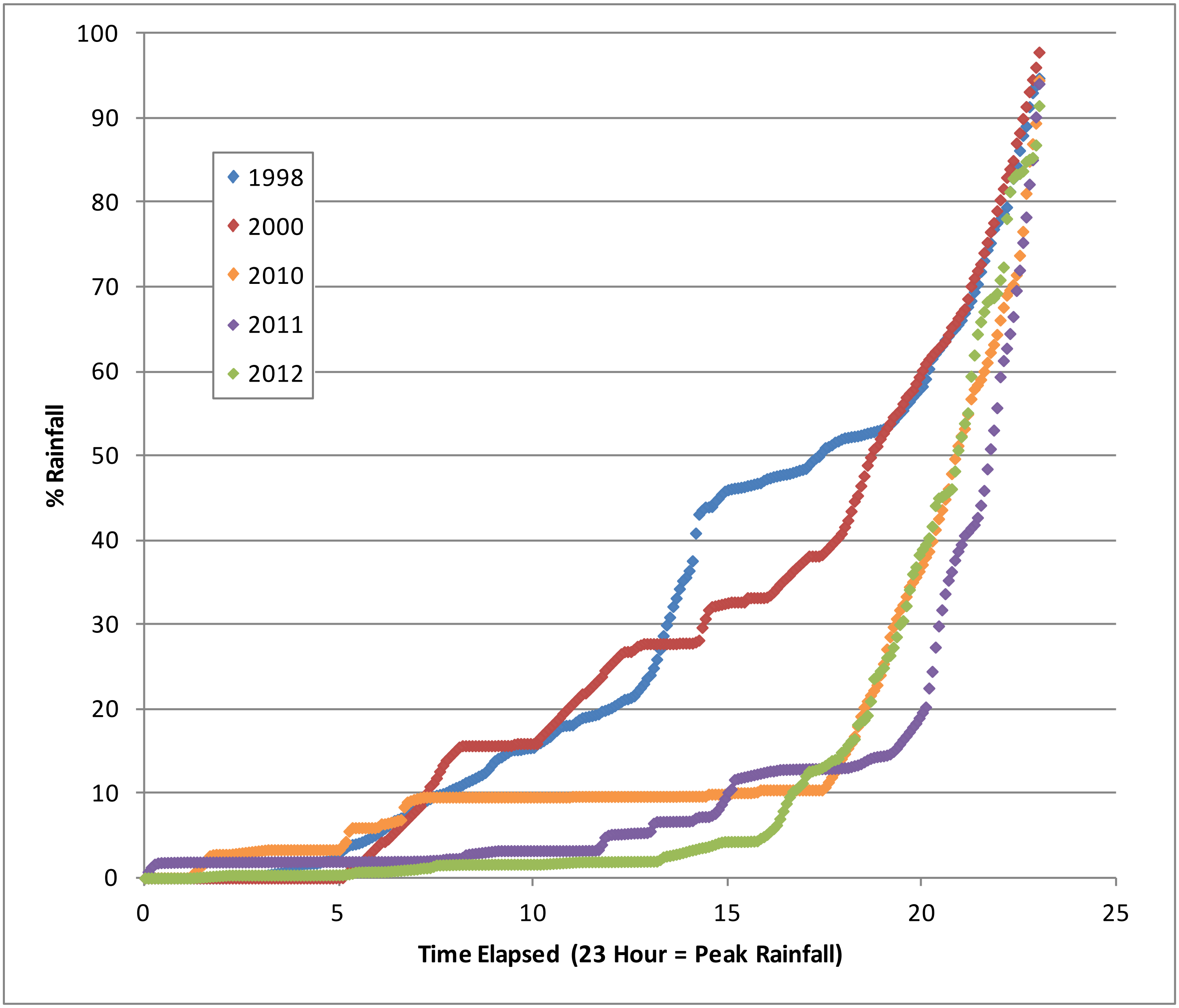

Figure 2: 24-Hr Antecedent Rainfall

The second dataset analyzed was observed baseflow prior to the largest inflow. To determine baseflow, recorded Searsville Lake outflow data was used. The prevailing baseflow was determined to be the lowest flow before the peak hydrograph recorded at Searsville Lake, marked as point B on Figure 3, which was taken from Chow et al[4]. Table 2 summarizes the recorded low flows for five of the six events, as Searsville Lake was not being recorded in 2000. The results suggest that a lower antecedent baseflow produces a larger attenuation. The resulting events are then characterized as having significant attenuation (blue) or nuanced attenuation (orange) based on the antecedent patterns. A graphical representation of the effects of prior low flow to flow reduction is in Figure 4.

Table 2: Prevailing Baseflow

Historical Event	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Lag Time (hrs)	Flow Reduction (%)	Prior Low Flow (cfs)
2012	2481	1553	3.25	37.4%	30
2011	794	619	3.5	22.0%	65
2010	1429	982	2	31.3%	35
2005	2478	1258	2	49.2%	15
2000	1486	1068	1.5	28.1%	N/A
1998	3023	2588	0.5	14.4%	70

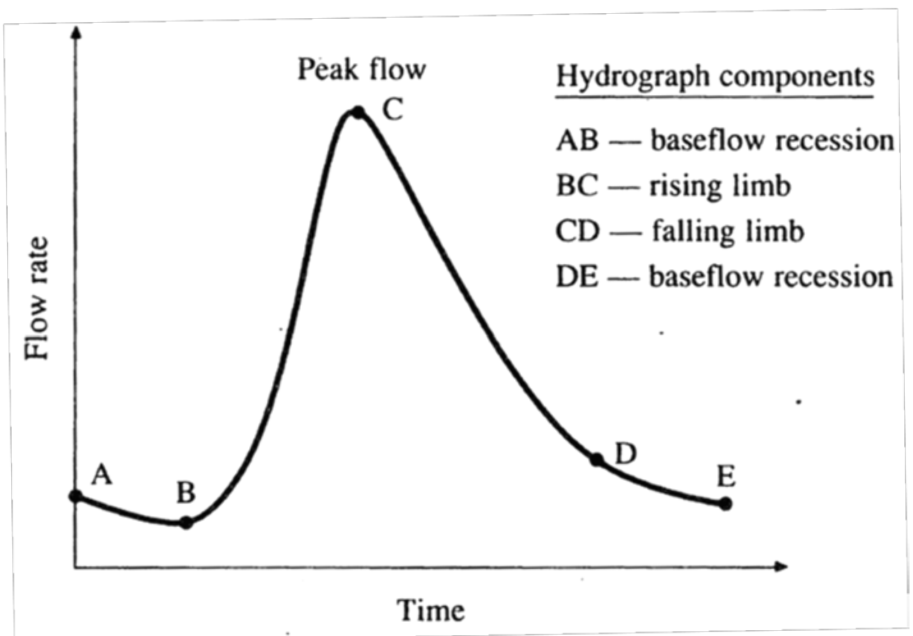

Figure 3: Baseflow Hydrograph Reference

[4] Chow, Ven Te. Maidment, David R. Mays, Larry W. Applied Hydrology. Published 1988. McGraw-Hill.

8. INFLOW VOLUME

Although a peak flow may help characterize a storm's intensity, an analysis was done to determine the relative inflow volume into the Lake during the rising limb of the hydrograph. The rising limb was used to see the utilization of storage within the Lake in attenuating the peak. Using the inflow data detailed in Section 4, inflow volume was determined for the six hours preceding the peak inflow. Six hours was observed to generally be representative of the rising limb of the hydrograph for these storm events.

The 6-hour total volume during the rising limb was then divided by the observed peak inflow. This ratio helps normalize the volume to the size of the storm, and characterizes the general shape of the inflow hydrograph. A higher ratio of volume/peak would infer a wider hydrograph, while the reverse would be true for a lower ratio. Table 3 summarizes the results from these analyses. In general, the higher volume/peak ratios have less attenuation, while the lower volume/peak ratios exhibit more attenuation. Resulting events are characterized as having significant attenuation (blue) or nuanced attenuation (orange) based the volume/peak ratio. Figure 4 summarizes the effect of 6-hr inflow volume and prior inflow volume to flow reduction.

Table 3: Inflow Volume

Historical Event	Peak Inflow (cfs)	Flow Reduction (%)	6-Hr Inflow Volume (AC-ft)	6-Hr Inflow Volume / Peak Inflow
2012	2481	37.4%	373	15.0%
2011	794	22.0%	204	25.7%
2010	1429	31.3%	246	17.2%
2005	2478	49.2%	381	15.4%
2000	1486	28.1%	439	29.5%
1998	3023	14.4%	638	21.1%

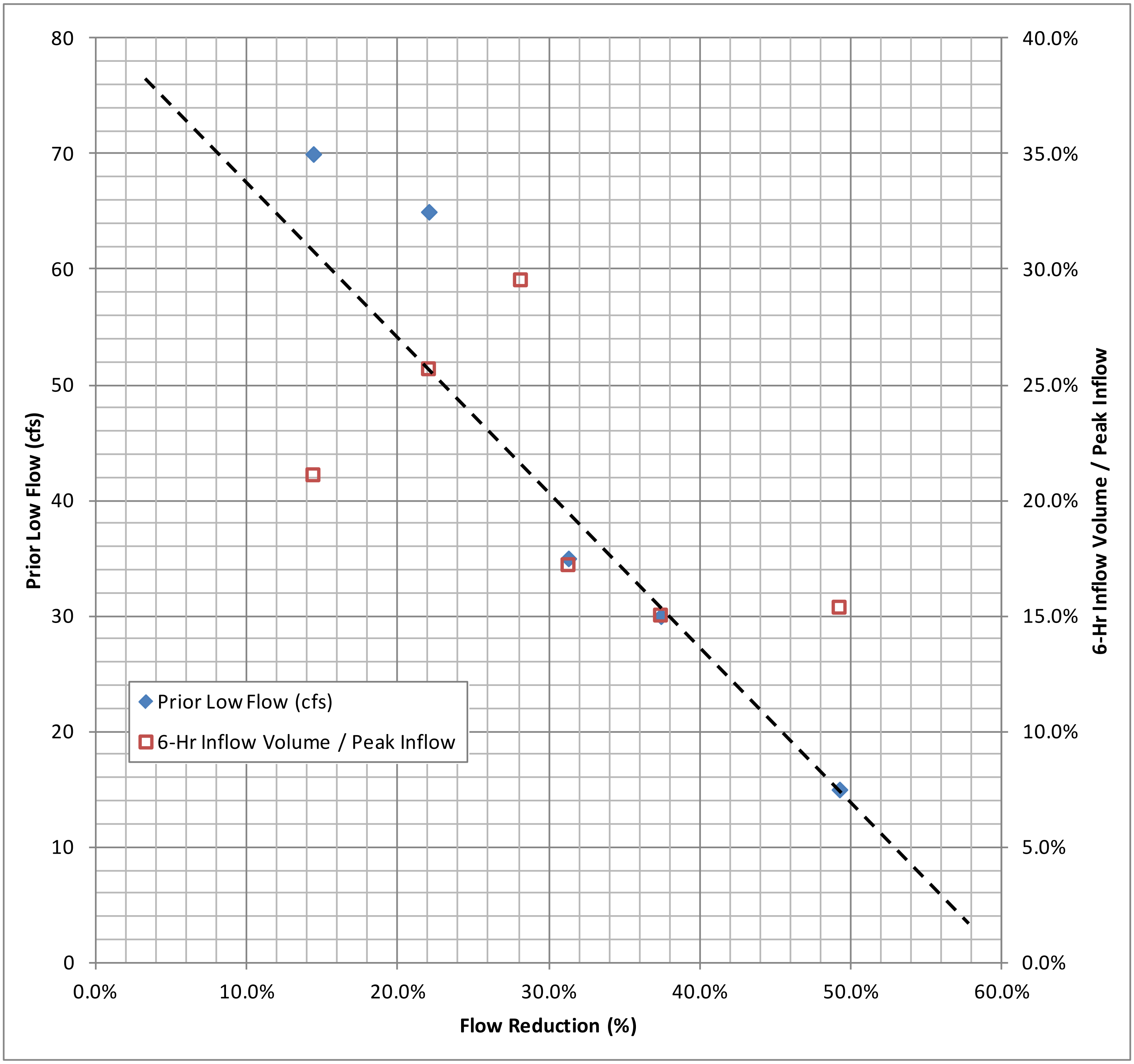

Figure 4: Effects on Flow Reduction

9. DOWNSTREAM EFFECTS

A historical case study was done on the December 2012 event to determine the impacts of Searsville Lake to the downstream reaches of San Francisquito Creek where creek capacity and flooding is an issue. The 2012 event was chosen due to the availability of stream gage data upstream of the Lake to properly estimate the amount of inflow. It is also noted that this event does have one of the highest percentages of flow reduction, and is not representative of every storm event. Due to the high flow reduction, the benefit seen in this case study will likely be on the higher end.

To perform this analysis, the recorded flow downstream will be compared with a hypothetical situation where the lake is not present. No modeling will be performed and measured data will be used. For inflow data into Searsville Lake, the methods outlined in Section 4 was used. Furthermore, two additional stream gages will be used for the study as well. The first is on Bear Creek, and the second is on Los Trancos Creek. Both these creeks join with San Francisquito Creek before entering the valley, as seen in the map in Figure 1. With Searsville, Bear, and Los Trancos, the majority of the runoff producing watershed is accounted for, and additional flows should be negligible for the purposes of this study. To determine the travel time of the flow, analyses will be performed on the recorded data, and the same value will be used for both cases. The USGS gage by the Stanford golf course will be used as the index point to determine impacts to downstream conditions.

For the observed 2012 data, the USGS gage records two peaks, as seen in Figure 5. The first can be attributed to the first Bear Creek peak (4,264cfs), along with smaller flows from Los Trancos and Searsville. Both Bear and Los Trancos peaks occur on the 23rd, at just after 3pm in the afternoon within 15 minutes of each other. This shows that travel times for both Bear and Los Trancos are similar, reaching the USGS gage at 4:30pm, giving a travel time of about 1 hour.

The second and larger peak at the USGS gage occurs at 6:45pm with a flow rate of 5,400cfs. This is attributed, for the most part, to the Searsville Lake spill (1,553cfs) combining with the second Bear Creek peak (3,275cfs). These peaks occur within half an hour, starting at 6pm. The travel time for the Bear and Searsville combined flows is about 45 minutes, slightly faster than the previous travel time. The sum hydrograph of all three of the tributaries is shown in dashed black in Figure 5.

For the hypothetical, no lake scenario, the inflow stream gage data was summed and used as the outflow for Searsville Lake. Travel distance from these stream gages toward the location of the dam was averaged to about 1 mile, which would translate into about a 15 minute travel time at a reasonable velocity of about 6 ft/s, assuming a natural channel in lieu of the lake. Therefore, the summed inflow data was lagged 15 minutes to account for travel time to the dam site. The sum of the three tributaries was then lagged 1 hour to account for the travel time to the USGS gage, which will be considered the hypothetical USGS observed data. Results can be seen in Figure 6.

The estimated peak flow for the no lake scenario is 7,351cfs, which is almost 2,000cfs higher than the observed peak flow value of 5,400cfs. This reduction is a result of a combination of both flow and time attenuation effects from the lake. The largest storm of record on San Francisquito Creek recorded a peak flow of 7,200cfs at the USGS station, which caused significant flooding in the downstream communities in 1998.

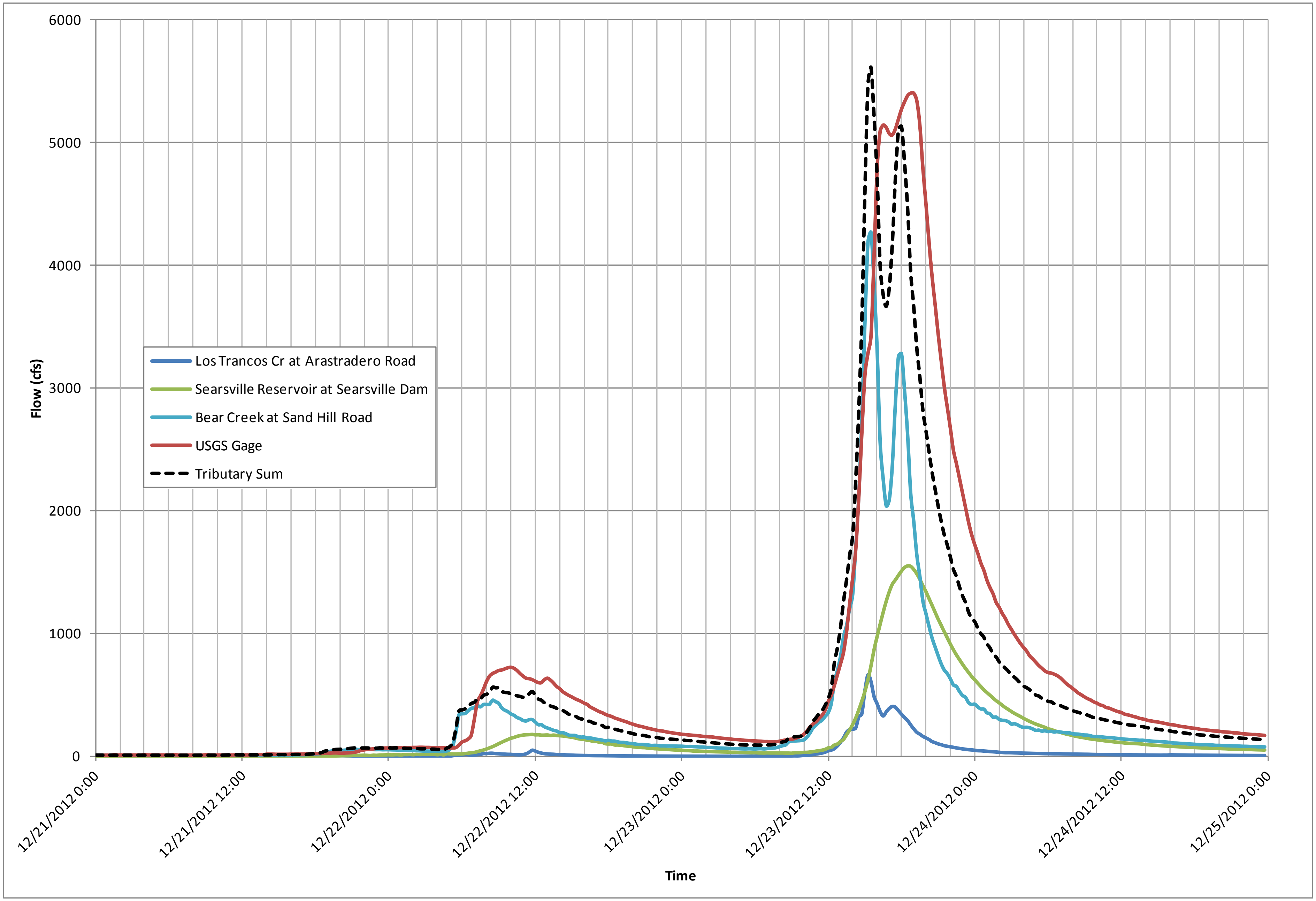

Figure 5: 2012 Observed Stream Flow

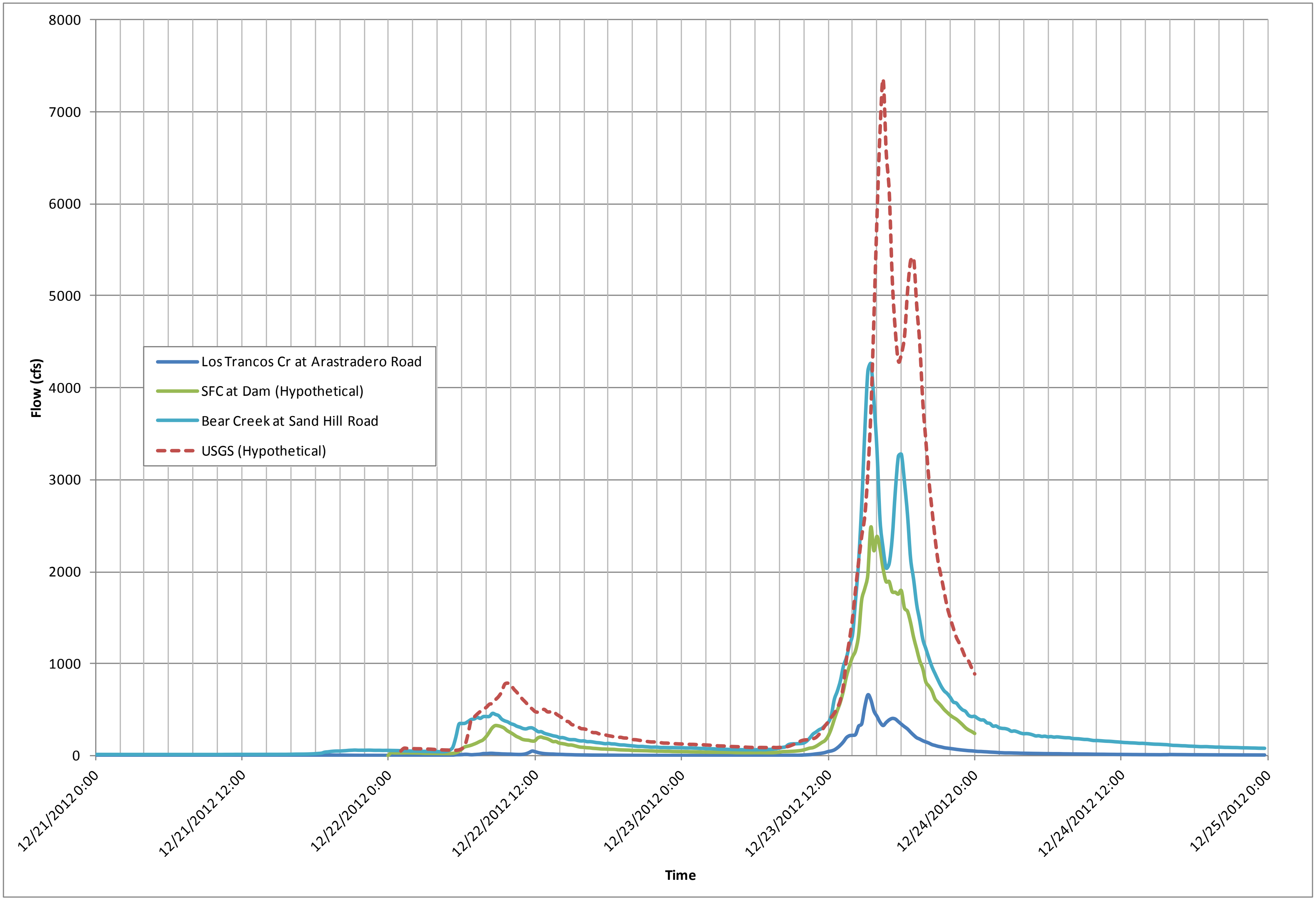

Figure 6: 2012 Hypothetical No Dam Flows

10. CONCLUSIONS

In all six events, three different parameters for each event were then analyzed to quantify the specific characteristics causing the attenuation, including antecedent rainfall, baseflow, and hydrograph shape. General conclusions from the parameters are listed below.

- When the majority (more than 80%-90%) of antecedent rainfall 24-hours before the peak intensity falls within 6 hours of the peak, there is more attenuation.

- When the baseflow prior to the peak inflow is low (less than 30cfs-40cfs), there is more attenuation.

- When the inflow volume / peak inflow is low (less than 18%-20%), meaning a thin and sharp hydrograph, there is more attenuation.

Table 4 below documents how each event performed with respect to all the parameters, and categorizes each event based on the three parameters. Events with significant attenuation are in blue, and events with nuanced attenuation are in orange, with a yes value indicating attenuation.

Table 4: Attenuation Parameter Summary

Historical Event	Flow Reduction (%)	Peak Lag Time (hrs)	24-hr Antecedent Rainfall	Prior Low Flow (cfs)	6-Hr Inflow Volume / Peak Inflow
2012	37.4%	3.25	Y	Y	Y
2011	22.0%	3.5	Y	N	N
2010	31.3%	2	Y	Y	Y
2005	49.2%	2	n/a	Y	Y
2000	28.1%	1.5	N	n/a	N
1998	14.4%	0.5	N	N	N

The results of the analysis show that Searsville Lake has available storage. Storms with the most volume concentrated in the main inflow hydrograph have the most attenuation, while storms that are spread out offer the least attenuation. In addition, the antecedent base flow conditions give a clue to the saturation of the Lake's storage system, showing that an event that occurs during high saturation will not incur much attenuation benefit. The parameters between antecedent rainfall, base flow, and hydrograph shape are likely correlated to some extent, and are probably characteristics of a slow-moving storm system.

The event in 2011 appears to be an outlier, possibly due to the significantly lower peak flow. With a maximum peak inflow to the Lake estimated at around 800cfs, it is almost half the size of the next smallest event.

The exact nature and location of the Searsville Lake storage is not known for certain, but it is hypothesized that the area behind the Lake, identified as the artificial Searsville marsh (Figure 1), is providing the storage. Once the floodplain is utilized, this area has a considerable amount of flow obstructions, as evidenced by a Manning's roughness coefficient of 0.1 in the 2D hydraulic model, and the various culverts used to convey floodwaters under road embankments.

APPENDIX B

DISTRICT'S STATEMENT

CERTIFICATION OF AGENCY TECHNICAL REVIEW
December 2015

Targeted Review

For the:

SAN FRANCISQUITO CREEK HYDROLOGY STUDY
Hydraulics, Hydrology and Geomorphology Unit
DRAFT FINAL USACE DIVISION REVIEW

Prepared by:
Jack Xu, PE Associate Civil Engineer

Under the Direction of:
Liang Xu, Ph. D, PE Engineering Unit Manager

October 2015

San Francisco District

US Army Corps
of Engineers ®

CERTIFICATION OF AGENCY TECHNICAL REVIEW

Subject: Agency Technical Review (ATR) of the **SAN FRANCISQUITO CREEK HYDROLOGY STUDY, Hydraulics, Hydrology and Geomorphology Unit, DRAFT FINAL USACE DIVISION REVIEW, October 2015**, San Francisco District.

Significant concerns and the explanation of the resolution of agency technical review comments for the subject ATR are as follows:

- None

References.

a. ATR guidance: EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW.
b. The Review Management Organization for this review was the National Flood Risk Management Planning Center of Expertise (FRM-PCX).
c. The ProjnetTM DrChecks Project and Review titles are: Project: (San Francisquito) San Francisquito Creek Flood Risk Management and Review: 2015 Hydrology ATR.
d. The ATR review report is titled: Review Management Organization: National Flood Risk Management Planning Center of Expertise, REVIEW MANAGEMENT ORGANIZATION'S AGENCY TECHNICAL REVIEW REPORT, December 2015, Targeted Review, For the: SAN FRANCISQUITO CREEK HYDROLOGY STUDY, Hydraulics, Hydrology and Geomorphology Unit, DRAFT FINAL USACE DIVISION REVIEW, Prepared by: Jack Xu, PE Associate Civil Engineer, Under the Direction of: Liang Xu, Ph. D, PE Engineering Unit Manager, October 2015, San Francisco District, and contains the ATR Completion Statement.

I certify that all comments resulting from ATR of the subject report have been closed to the satisfaction of the agency technical review team and the project delivery team.

Lyn Gillespie, P.E. Chief, Engineering and Technical Services Division CESPN-ET	Date

Review Management Organization:
National Flood Risk Management
Planning Center of Expertise

REVIEW MANAGEMENT ORGANIZATION'S AGENCY TECHNICAL REVIEW REPORT
December 2015

Targeted Review

For the:

SAN FRANCISQUITO CREEK HYDROLOGY STUDY
Hydraulics, Hydrology and Geomorphology Unit
DRAFT FINAL USACE DIVISION REVIEW

Prepared by:
Jack Xu, PE Associate Civil Engineer

Under the Direction of:
Liang Xu, Ph. D, PE Engineering Unit Manager

October 2015

San Francisco District

US Army Corps
of Engineers ®

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AGENCY TECHNICAL REVIEW REPORT

ENCLOSURE

Agency Technical Review Report

Subject: Targeted review of the **SAN FRANCISQUITO CREEK HYDROLOGY STUDY, Hydraulics, Hydrology and Geomorphology Unit, DRAFT FINAL USACE DIVISION REVIEW, October 2015**, San Francisco District.

1. Scope and Purpose of Review. This review report documents a targeted technical review of the subject report and was conducted pursuant to EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW. The review was conducted for the San Francisco District. The point of contact for the District was Patrick Sing, Project Engineer, CESPN. The ATR team (ATRT) was lead by Marc L. Masnor, CESWF-PEC-PF (Tulsa, OK). The Review Management Organization with responsibility for managing this ATR was the National Flood Risk Management Planning Center of Expertise (FRM-PCX). The review was conducted between October and November 2015.

2. References.

a. This supplement to the review report was prepared in response to EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW.
b. The review documents reside online at ProjNet™ (www.projnet.org), DrChecks Project and Review titles: Project: (San Francisquito) San Francisquito Creek Flood Risk Management and Review: 2015 Hydrology ATR.

3. Project Description. San Francisquito Creek forms the boundary of the Santa Clara Valley Water District's (SCVWD) jurisdiction to the north with San Mateo County. The watershed is approximately 45 square miles, with the majority of the watershed in the rural foothills of the San Francisco Peninsula. The Creek's watershed impacts the cities of Palo Alto, East Palo Alto, and Menlo Park. Stanford University is also a major landowner in the region and owns several reservoirs within the watershed.

San Francisquito has three main tributaries that combine to form the creek proper once it leaves the foothills and enters the urbanized valley. Bear Creek is the northernmost tributary and is unimpaired. To the south, Searsville Lake and Dam collect runoff from Alambique, Dennis Martin, Sausal, and Corte Madera Creeks. Searsville Lake offers some attenuation, but has experienced severe sedimentation over time. On the southeastern edge of the watershed, Los Trancos Creek flows unimpaired, passing Felt Lake, a diversion pond owned by Stanford. All three of these tributaries meet before traveling downstream toward the bay through urbanized neighborhoods.

The purpose of the report was to update the 2007 San Francisquito Hydrology Report by improving the following items from the old report:

- Upgrading the numerical model from HEC-1 to HEC-HMS v4.0.
- Characterizing the routing effects of Searsville Lake and dam by using a 2D hydraulic model.
- Using revised and improved methodology for design storms, loss, and Clark's hydrograph parameters (Tc & R).
- Calibrating the numerical model to historical storms.
- Performing a flood frequency analysis (FFA) on the USGS stream gage and validating the hydrologic design model to the FFA.

A hydrologic model that reflects the existing San Francisquito Creek watershed was developed. This model will be used to determine revised 1% and 10% design flows for the entire creek.

4. Review Team. The following team members met the requirements of the District and RMO for this targeted review.

ATRT Lead – Marc Masnor P.E., Civil Engineer, CESWF-PEC-PF (Tulsa, OK) – 918-669-7349, Marc.L.Masnor@usace.army.mil. Mr. Masnor is a civil works water resources planner in the Plan Formulation Section of the Southwestern Division Office (SWD) Regional Planning and Environmental Center (RPEC), headquartered in the Fort Worth District Office (CESWF) in Fort Worth, TX. He works from the Tulsa District Office (CESWT) in Tulsa, OK, 1645 S. 101st East Ave, Tulsa, OK 74128-4609. He has 37 years of experience with the Corps of Engineers, Tulsa District, Tulsa, OK.

Marc is a SWD regional technical specialist (RTS) for plan formulation and National Environmental Policy Act evaluation of flood risk management (FRM), ecosystem restoration (ECO), and water management and reallocation studies (WMRS). As a senior plan formulation specialist and regional technical specialist, he assists in the development of unique or complex formulation and analysis techniques within the framework of Corps of Engineers guidance; Federal, state, and local laws and regulations; and stakeholder interests. He has been both study manager and project manager for many Tulsa District planning studies that involved flood risk management, ecosystem restoration, comprehensive watershed studies, water supply, reservoir storage reallocation, navigation, hydropower, and chloride control. Mr. Masnor has worked in hydrology, design, project management, and civil works planning offices within the Tulsa District and has completed a wide variety of water resources studies in Kansas, Oklahoma, and Texas. Studies included the evaluation of navigation and hydropower expansion on the McClellan-Kerr Navigation system; a system of 122 small reservoirs in the Grand-Neosho Basin; chloride control evaluations in the Arkansas and Red River Basins; multiple purpose reservoirs system formulation; storage reallocation studies, regional needs studies; watershed ecosystem restoration evaluations; and several local levee, channel, detention, and buyout plans.

He currently provides support for offices within (a) the RPEC and Districts within SWD, (b) three planning centers of expertise (PCX) review management organizations (RMO) for FRM, ECO, and WMRS, and (c) multiple division office RMOs across the Corps. He has participated in or lead roughly 100 ATRs or DQCs.

(a) He supports the RPEC and the SWD as the plan formulation RTS, as an agency technical review (ATR) team member or team lead for continuing authority projects, as a district quality control (DQC) team member, and as a project delivery team (PDT) member.

(b) He supports three PCX RMOs as the ATR Team lead. In that capacity he selects and manages ATR teams to analyze pre-authorization feasibility studies conducted by Districts related to flood risk management, water management and reallocation, ecosystem restoration, and navigation. He has been the Southwestern Division Regional Manager for the FRM PCX National Manager, Eric Thaut (SPD) since 2008 through 2013. Marc participates in a national team that develops tools in support of the PCX RMOs managing body called the PCX Guild. This small team meets at the direction of the Guild to prepare supplemental review tools such as checklists, templates, and training materials for ATR and PDT teams.

(c) He also supports the Division RMOs as the ATR lead. In that capacity he selects and manages ATR teams to analyze post-authorization implementation studies including design documentation reports (DDR) and detailed project reports (DPR), and plans and specifications (P&S), generally for FRM, ECO, and WMRS.

Hydrology and Hydraulics – David Williams, CESWT – 918-669-7091, David.J.Williams@usace.army.mil. David Williams, Hydraulic Engineer, U.S.

Army Corps of Engineers, Tulsa, OK. Dr. Williams graduated Cum Laude from the University of Tulsa in 1999 with a Bachelor of Arts degree in Geology, from the University of Oklahoma in 2001 with a Master of Environmental Science, from Oklahoma State University in 2004 with a Master of Science in Environmental Engineering, and from Oklahoma State University in 2007 with a Doctor of Philosophy in Civil Engineering. He has worked for the U.S. Army Corps of Engineers for 3 years in the Tulsa District office. He currently serves as a Hydraulic Design Engineer for Tulsa District in the areas of flood modeling, flood control structure design, and climate change. Additionally, he serves as a National Hydraulic Modeling Team Lead for the USACE Modeling, Mapping, and Consequences (MC) Production Center and as a representative on the USACE Climate Change and Water Management PDT. Dr. Williams is a member of the USACE Hydrology Committee and of the USACE Extreme Storm Workgroup. He serves on a National Dam Safety Evaluation Team and has conducted several risk-based analyses in the field of Hydrology and Hydraulics. Current work includes modeling of dam break scenarios on multiple structures nationwide as well as levee certification modeling, all based on risk analysis framework. In addition to his employment with USACE, Dr. Williams is an Adjunct Professor of Civil Engineering at Oklahoma State University and a Research Associate (Geosciences) at the University of Tulsa.

5. Charge to Reviewers. A separate charge document was not developed for this targeted review. The District briefed the reviewer. The ATRT Lead's electronic meeting notice provided the location and description of review documents, review schedule, labor codes, and labor amounts. The notice also identified the District POC and provided contact information, identified the Projnet™ DrChecks project and review, and stated the requirement for four part comments.

6. Summary. The ATR was completed without issues or controversy. The ATRT finding was that the District conducted a thorough peer review. The following paragraphs summarize the status of comments.

a. Critical. None.
b. Unresolved. None.
c. Lessons Learned. None.

7. Dr. Checks Report. The Projnet™ DrChecks report of all comments is attached as Enclosure 1.

8. ATR Completion. Enclosure 2 contains the completion statement of agency technical review. A completion statement for a decision document would be signed by ATRT Lead, the District point of contact, and the RMO representative. Because this was a targeted review the completion statement is only signed by the ATRT Lead and the District point of contact. The District POC should provide a copy of the review report with both signatures for records.

____
Marc L. Masnor
CESWF-PEC-PF (Tulsa, OK)

Enclosure 1

PROJNET^{TM} DRCHECKS REPORT OF ALL COMMENTS

UNCLASSIFIED\\FOR OFFICIAL USE ONLY

Comment Report: All Comments
Project: San Francisquito Creek Flood Risk Management
Review: 2015 Hydrology ATR
Displaying 4 comments for the criteria specified in this report.

Id	Discipline	Section/Figure	Page Number	Line Number
6284017	Hydrology	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

REVIEW CONCERN

Design rainfall values.

BASIS FOR THE CONCERN

It is stated in the report (page 48) that NOAA Atlas 14 was not used to characterize the design storm as previous studies have yielded high flows. There certainly can be value in developing a site-specific analysis in lieu of using a more generalized study such as NOAA Atlas 14, but the discussion on page 48 describing why NOAA Atlas 14 is inappropriate is limited.

SIGNIFICANCE OF THE CONCERN

Medium

ACTION NEEDED TO RESOLVE THE CONCERN

At a minimum, a more complete explanation about why NOAA Atlas 14 was excluded would be helpful on page 48. For example, how do the design values published in NOAA Atlas 14 compare with the TDS design values? How do these compare with TP-40? What factors make NOAA Atlas 14 unsuitable at this location?

Submitted By: David Williams (918-669-7091). Submitted On: Oct 30 2015

1-0 Evaluation **Concurred**

Additional narrative included in section 5.2 RAINFALL DEPTH. In summary, the depths were larger and the percentage short duration/long duration depths were larger too, resulting in higher runoffs. Comparison between NOAA-14 and District TDS equations shown for all sub-basins on new Table 7. Comparison between NOAA-14 at a point rainfall gauge station (ca. 1966) with District statistical numbers done as well in new Table 8. TP-40 shows approximately 6" for 1%, 24-hr storm, and appears closer to the District TDS equations (attachment). However, the 2" contours are rough and difficult to exact.

Submitted By: Jack Xu (4086302913) Submitted On: Nov 05 2015 (Attachment: TP_40_1p_24hr.jpg)

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: David Williams (918-669-7091) Submitted On: Nov 16 2015
Current Comment Status: **Comment Closed**

6284018	Hydrology	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

REVIEW CONCERN

Use of the TDS regional equation.

BASIS FOR THE CONCERN

Without having a detailed knowledge of heavy precipitation events in this basin, it is assumed that they result from onshore flow and occur in part to the local orographic effect of the coastal range. It is also assumed that excessive precipitation results from specific types of weather patterns, e.g. the "Pineapple Express" or some other prevailing flow that brings relatively warm, moist air onshore. Do the storms that were used in the statistical analysis adequately represent the full range of plausible events?

SIGNIFICANCE OF THE CONCERN

Medium

ACTION NEEDED TO RESOLVE THE CONCERN

Please comment.

Submitted By: David Williams (918-669-7091). Submitted On: Oct 30 2015

1-0 Evaluation **For Information Only**
You are correct - all the major moisture that falls in the SFC watershed, and really most of the state for that matter, are from atmospheric river type events, aka pineapple express. There are sometimes very isolated and small convective storms, but these do not occur on the west side of our region, which is where SFC is located.

Our statistical analyses (which produce our TDS equations) rely on recorded rain gauge data that the District has operated - most of which were installed from 1960 to 1980, with an average record length of 30+ years.

Since all the major rain events are atmospheric rivers, the rain gauge data should reflect that as well.

Submitted By: Jack Xu (4086302913) Submitted On: Nov 04 2015

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: David Williams (918-669-7091) Submitted On: Nov 16 2015
Current Comment Status: **Comment Closed**

6284019 Hydrology n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

REVIEW CONCERN

Adopted design rainfall.

BASIS FOR THE CONCERN

Although the TDS equation and coefficients were provided in the report, the adopted design rainfall values were not. Discussion on page 48 would benefit from a table of values.

SIGNIFICANCE OF THE CONCERN

Medium

ACTION NEEDED TO RESOLVE THE CONCERN

Please consider adding a table of TDS design rainfall values to the report. For the sake of comparison, NOAA Atlas 14 design rainfall values would be helpful as well.

Submitted By: David Williams (918-669-7091). Submitted On: Oct 30 2015

1-0 Evaluation **Concurred**
Included new Table 7 to compare 1% 72-hr and 24-hr TDS depths to NOAA-14 depths.

Submitted By: Jack Xu (4086302913) Submitted On: Nov 05 2015

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: David Williams (918-669-7091) Submitted On: Nov 16 2015
Current Comment Status: **Comment Closed**

6284021 Hydrology n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

REVIEW CONCERN

Available storage in Searsville Lake.

BASIS FOR THE CONCERN

On page 13 of the technical memorandum, it is stated that "the exact nature and location of Searsville Lake not known for certain, but is hypothesized that the area behind the lake, identified as the artificial Searsville marsh, is providing the storage." With respect to storage behind the dam, the most critical volume for the hypothetical runoff events is the volume above the normal pool elevation since the additional runoff will be routed on top of this permanent or semi-permanent pool. Since this is the case, a detailed volume-elevation curve can be developed from the DEM, and the areas providing the most storage can be readily identified.

SIGNIFICANCE OF THE CONCERN

Medium

ACTION NEEDED TO RESOLVE THE CONCERN

Consider additional analysis (using the DEM) that will improve knowledge about available flood storage volume behind Searsville Dam. Historical relationships can be developed from topographic quadrangle maps and/or the original design memorandum from the project (if available).

Submitted By: David Williams (918-669-7091). Submitted On: Oct 30 2015

1-0 Evaluation **Concurred**

Additional analysis performed using the DEM, converting it to a TIN file and using a GIS tool to calculate volume at given elevations. Two storage areas were identified, formed by roadway embankments, and one storage area that includes the lake and the marsh upstream.

Since the technical memo is separate from the hydrology study and is already finalized, the data was not added to the technical memo. The design storm and calibration took into account the storage in the 2D model.

Submitted By: Jack Xu (4086302913) Submitted On: Nov 17 2015

1-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: David Williams (918-669-7091) Submitted On: Nov 20 2015

Current Comment Status: **Comment Closed**

Enclosure 2

COMPLETION STATEMENT OF AGENCY TECHNICAL REVIEW

COMPLETION OF AGENCY TECHNICAL REVIEW

A targeted agency technical review has been completed for the SAN FRANCISQUITO CREEK HYDROLOGY STUDY, Hydraulics, Hydrology and Geomorphology Unit, DRAFT FINAL USACE DIVISION REVIEW, October 2015, San Francisco District. The review was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW. During the review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy. The DQC process was found to be thorough. All comments resulting from the ATR have been resolved and the comments have been closed in DrChecks.

______________________________ __________________
Marc L. Masnor, P.E. Date
ATR Team Leader
CESWF-PEC-PF (Tulsa, OK)

______________________________ __________________
Patrick Sing Date
Project Engineer
CESPN-ET-EW

Targeted reviews are coordinated with the RMO but do not require signature by the RMO representative. A courtesy copy of the review report and signed completion statement should be provided to the RMO.

DISTRICT QUALITY CONTROL CERTIFICATION COMPLETION OF QUALITY CONTROL ACTIVITIES

The District Quality Control (DQC) of the 2015 hydrology study of the San Francisquito Creek watershed has been completed. A hydrologic model of the entire watershed, hydraulic model characterizing the routing effects of Searsville Dam, main report titled "San Francisquito Creek Hydrology Study, Draft Final, USACE Division Review", and supporting reference documents were reviewed. Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent in the product have been completed.

GENERAL FINDINGS

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, has been verified. This includes assumptions; methods, procedures and materials used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and the reasonableness of the results. The undersigned recommends certification of the quality control process for this product.

CERTIFICATION

Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent with the completed product.

____________________________	09 October 2015
Janice M. Lera-Chan, P.E. Chief, Water Resources Section CESPN-ET-EW	Date
____________________________	________________
Harrison S. Sutcliffe, P.E. Chief, Engineering Branch CESPN-ET-E	Date

District Quality Control (DQC) Review of the 2015 San Francisquito Hydrologic Study (SCVWD RESPONSE)

Background:

The Water Resources Section of the San Francisco District (SPN) conducted a DQC review of the 2015 hydrologic study of the San Francisquito Creek watershed in September 2015. The 2015 hydrologic study was compiled by the Santa Clara Valley Water District (SCVWD) and includes a HEC-HMS model, a HEC-RAS model, main report, and supporting documentation. SCVWD requests that this hydrologic study be adopted for use in the ongoing San Francisquito Creek General Investigations Feasibility Study. The feasibility study is being conducted by SPN with the San Francisquito Creek Joint Powers Authority (JPA) as the non-federal sponsor. SCVWD is a member of the JPA. A complete list of products included in the 2015 study is presented below.

Products Included in the 2015 Hydrologic Study for DQC Review:

- Main report titled "San Francisquito Creek Hydrology Study, Draft Final USACE DQC Review, September 2015"
- HEC-HMS model "Cal_SFO_2014.hms"
- HEC-RAS model "SearsvilleRAS5.prj"
- Fifteen reference documents for the main report

Prior Coordination Between SCVWD and Water Resources Section:

The Water Resources Section was given the opportunity to review and provide comments on the pre-final draft report in June 2015. At the time of this review, SCVWD had not yet requested a certification of their hydrologic study, so Water Resources Section's review and comments did not constitute an official DQC review. The Water Resources Section initially had comments about SCVWD's assumptions regarding the existing and future operations of Searsville Dam, and had concerns that these operations were not being accounted for in their HEC-HMS model. SCVWD attempted to address these concerns by creating Section 8 ("Future Conditions") in the pre-final draft final report, updating their HEC-HMS model to include a scenario where the lake behind the dam would be full of sediment as a future condition, and by giving a short PowerPoint presentation to Water Resources Section staff regarding the updates to both the pre-final draft report and HEC-HMS model. The Water Resources Section thanks SCVWD for the opportunity to be part of the review process of the 2015 hydrologic study before the official DQC review commenced.

DQC Comments:

Comment #1 (Submitted by: Patrick Sing)

- SCVWD communicated to Water Resources Section that one of the main reasons for conducting this 2015 hydrologic study was to account for attenuation of peak flows caused by the dam at Searsville Lake and that this attenuation was not addressed in SCVWD's 2007 hydrologic study of the San Francisquito Creek watershed. However, the main report does not include much background information of the dam itself. Background information could include (but not necessarily be limited to): original purpose of the dam, construction date of the dam, current capacity of the dam, and sedimentation rates behind the dam. The only background information provided about the dam is in Section 2.5 (page 6) of the main report regarding the square mileage of the watershed that is behind the dam. Because the attenuation of flows caused by the dam was a driving force for conducting the 2015 hydrologic study, it is recommended that additional background information of the dam be included either in Section 2.5 or Section 8.2 of the main report.

SCVWD Response to Comment #1:

- Concur. Requested background information for Searsville Dam is added to the narrative in section 2.5.

Comment #2 (Submitted by: Janice Lera-Chan)

- SCVWD compiled a technical memorandum, dated March 25, 2015, on the effect of Searsville Lake on large storm events. It is mentioned on page 8 of the main report. It is recommended that the memo either be incorporated in the main report or it be included as attachment, rather than just made as a reference. It is also recommended that a plate (i.e. figure map) be added to the main report that focuses on the Searsville Lake area that shows the roads crossings, culvert restrictions and what is referred to as wetlands/small water bodies.

SCVWD Response to Comment #2:

- Concur. The technical memorandum is added as Appendix A, in addition to being a reference. An additional figure/map was added (now Figure 2) detailing the intricacies of the upstream Searsville Lake area, including the wetlands and culvert crossings. It's worth noting that it was very difficult in finding any sort of map that showed the trails and private roads crossing the Jasper Ridge Preserve in Stanford. However, the figure should have all the pertinent information necessary to understand the operation of the upland area.

Comment #3 (Submitted by: Patrick Sing)

- Section 8.2.2 of the main report refers to a "Stanford steering committee". This is in reference to the steering committee commissioned by Stanford University to address the future of the dam at Searsville Lake. To avoid confusion with other steering committees present at Stanford University, the Water Resources Section recommends referring to this committee as the "Searsville Alternatives Study Committee". This is the same title that is used in the recommendation report that was produced by the committee in April 2015 (and is included as a reference to the main report).

SCVWD Response to Comment #3:

- Concur. Steering committee revised to Searsville Alternatives Study Committee (SASC)

Comment #4 (Submitted by: Patrick Sing)

- The Water Resources Section recommends that Section 8.2.2 of the main report be expanded to include further background information on the Searsville Alternatives Study Committee. Background information could include (but not be limited to): reason for why the committee was founded, who participates on the committee, and responsibilities of the committee.

SCVWD Response to Comment #4:

- Concur. Relevant information added to section 8.2.2, with a more clear reference to the Stanford Alternatives Study report.

Comment #5 (Submitted by: Janice Lera-Chan)

- Section 8.2.2 of the main report briefly states that a comparison was made between a scenario where Searsville Lake is filled in with sediment and a scenario where an orifice at the dam base was created and the sediment inside the lake was excavate. How much sediment would be excavated? Recommend a table showing the existing and future discharges and timing for Searsville these scenarios.

SCVWD Response to Comment #5:

- Additional language clarified the sediment filled scenario and the orifice scenario. However, the orifice details are unknown. The steering report does not specify the size, shape, or invert elevation of the "opening". Therefore, we are unable to perform any calculations. Discussion was added explaining this as well in 8.2.2.

Comment #6 (Submitted by: Patrick Sing)

- Section 2.2 of the main report notes that the Curve Number method and Clark's Unit Hydrograph was selected as the loss method and transform method in part because of its successful application to other watersheds within the boundaries of SCVWD. If possible, please provide the names of a couple of these watersheds for comparison of their sizes and shapes to the San Francisquito Creek watershed.

SCVWD Response to Comment #6:

- Added reference to the Lower Peninsula Study (2007) that was also Corps ATR'd, as well as a San Tomas/Saratoga Creek study (2013) that also used Clark's and CN method. Relative basin areas were added too. Basin sizes are within the range of San Francisquito (20-45 sq mi for the other studies). We feel Lower Peninsula Study would be a good comparison watershed since it is adjacent to San Francisquito. However, given the extensive historical calibration performed, any method would have probably been appropriate.

Comment #7 (Submitted by: Patrick Sing)

- Please provide a short explanation in Section 2.4 of the main report about why the Muskingum-Cunge method was selected as the routing method in the HEC-HMS model. Phone communication between SCVWD and Water Resources Section indicates that Muskingum-Cunge was selected because of its application to other SCVWD projects of similar nature to the San Francisquito Creek watershed - if so, the main report should include this information and further elaborate.

SCVWD Response to Comment #7:

- Muskingum-Cunge further explained. Table 19 in HEC-HMS technical reference manual shows it to be the most robust in performing routing. Other District studies that use Muskingum-Cunge are the same as the reports in Comment #6.

Points of Contact:

Name	Organization	Phone	Email
Janice Lera-Chan	SPN-Water Resources Section (Chief)	(415) 503-6743	janice.m.lera-chan@usace.army.mil
Patrick Sing	SPN-Water Resources Section (Hydraulic Engineer)	(415) 503-6950	patrick.f.sing@usace.army.mil
Patrick Howell	SPN-Project Management	(415) 503-6876	patrick.howell3@usace.army.mil
Liang Xu	SCVWD	(408) 630-2780	lxu@valleywater.org
Jack Xu	SCVWD	(408) 630-2913	jxu@valleywater.org

Appendix E

Traffic Analysis

Final Project Report

Traffic Analysis for the Upstream of Highway 101, San Francisquito Creek Flood Reduction, Ecosystem Restoration and Recreation Project

San Francisquito Creek Joint Powers Authority

October 31, 2018

TJKM

TABLE OF CONTENTS

Tables

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Appendices

PROJECT OVERVIEW

ICF requested for professional services for Traffic Analysis for San Francisquito Creek Flood Protection, Ecosystem Restoration and Recreational Project Environmental Document. As part of the project, TJKM evaluated the Pope Street/Chaucer Street Bridge and surrounding intersections for existing and bridge closure conditions during weekday a.m. and p.m. peak periods. The objective of the evaluation is to determine impact of the temporary bridge closure within the study area.

Eight study intersections were selected for the project within the study area. The intersections were evaluated under the study scenarios for the weekday a.m. and p.m. peak periods. This report summarizes the results of the analysis including level of service (LOS), delay and 95th percentile queue lengths at all study intersections.

STUDY INTERSECTIONS

The study intersections selected for the project are listed below and illustrated in **Figure 1**.

1. Willow Road/Gilbert Avenue (Signalized)[1]
2. Willow Road/Middlefield Road (Signalized)[1]
3. Middlefield Road/Woodland Avenue-Palo Alto Avenue (Two-Way Stop Control)[1]
4. Middlefield Road/Palo Alto Avenue (One-Way Stop Control)
5. Pope Street/Central Avenue (Yield Control)[1]
6. Pope Street/Woodland Avenue (All-Way Stop Control)[1]
7. Chaucer Street/Palo Alto Avenue (Two-Way Stop Control)
8. Chaucer Street/University Avenue (Signalized)
9. Woodland Avenue/University Avenue (Signalized)

Note:
[1]Intersections fall within the City of Menlo Park jurisdiction. All other intersections fall under City of Palo Alto Jurisdiction.

PROJECT SCENARIOS

The scenarios selected for the study are listed below:

1. Existing Conditions (2018)
2. Existing plus Bridge Closure Conditions

Existing Conditions (2018)

This scenario evaluates all study intersections with existing lane geometry, traffic controls and traffic volumes.

Existing plus Project Conditions

This scenario evaluates all study intersections with existing lane geometry and traffic controls. All inbound and outbound movements at the bridge along Pope Street/Chaucer Street between Pope Street/Woodland Avenue and Chaucer Street/Palo Alto Avenue are restricted to evaluate bridge closure conditions. This includes the eastbound through, northbound right-turn and southbound left-turn movements at Pope Street/Woodland Avenue and the westbound through, northbound left-turn and southbound right-turn movements at Chaucer Street/Palo Alto Avenue intersections. Based on the study area and existing traffic patterns, traffic volumes for the restricted movements were rerouted.

Mitigation Measures

This scenario evaluates potential mitigation measures to reduce impact on traffic operations during bridge closure conditions.

Project Study Area

Legend

X Study Intersections

STUDY METHODOLOGY

LEVEL OF SERVICE (LOS) ANALYSIS METHODOLOGY

LOS is a standard measure of traffic service along a roadway or at an intersection. It ranges from A to F, with LOS A being best and LOS F being worst. In very general terms, LOS A, B, and C indicate conditions where traffic can move relatively freely. LOS D describes conditions where delay is more noticeable and average travel speeds are more unstable. LOS E indicates significant delays and average travel speeds vary greatly and are unpredictable; traffic volumes are generally at, or close to, capacity. Finally, LOS F characterizes traffic flow at very slow speeds (stop-and-go) and significant delays with queuing at unsignalized intersections, which typically means traffic demand on the roadway exceeds the roadway's capacity.

The *Highway Capacity Manual (HCM), 2000 Edition* is the standard reference published by the Transportation Research Board, and contains the specific criteria and methods to be used in assessing LOS. There are several software packages that have been developed to implement HCM. In this study, Synchro Software was used to calculate the LOS at the study intersections.

Signalized intersection LOS and unsignalized all-way stop controlled LOS is based on the capacity of the intersection as a whole and average delay experienced by a driver. Unsignalized one-way and two-way stop controlled intersection LOS is defined by the average delay experienced by a driver for the minor approach worst movement or major approach critical movement. **Table 1** provides the relationship between LOS rating and delay for signalized and unsignalized intersections.

Table 1: Level of Service Thresholds Based on Intersection Delay

Level of Service	*Signalized Intersection Delay (sec)*	*Unsignalized Intersection Delay (sec)*
A	0 ≤ D ≤ 10	0 ≤ D ≤ 10
B	10 < D ≤ 20	10 < D ≤ 15
C	20 < D ≤ 35	15 < D ≤ 25
D	35 < D ≤ 55	25 < D ≤ 35
E	55 < D ≤ 80	35 < D ≤ 50
F	80 < D	50 < D

Source: Highway Capacity Manual (HCM), 2000 Edition

SIGNIFICANT IMPACT CRITERIA/LEVEL OF SERVICE STANDARDS

City of Palo Alto:

The acceptable LOS in the City of Palo Alto is to maintain a "D" or better for non-Congestion Management Program (CMP) Agency intersections and LOS E for CMP intersections. Based on the City of East Palo Alto 1999 General Plan, the acceptable LOS is also LOS D.

For facilities with an LOS E or LOS F under existing, background, or cumulative conditions before the addition of project traffic, a project is said to have a significant impact per CEQA Guidelines Section 15130 if the TIA shows that the project will cause LOS to deteriorate by the following amounts:

- Addition of the project increases the average control delay for critical movements by four (4) seconds or more, or
- Project traffic increases the Critical V/C (Volume/Capacity) value by 0.01 or more

City of Menlo Park:

Per Policy Circ-3.4 of the City of Menlo Park General Plan adopted in November 2016, the City strives to maintain level of service (LOS) D at all City-controlled signalized intersections during peak hours, except at the intersection of Ravenswood Avenue and Middlefield Road and at intersections along Willow Road from Middlefield Road to US 101.

EXISTING CONDITIONS

ROADWAY NETWORK

The existing Pope-Chaucer Bride is a 40-feet wide, two-lane bridge that connects Woodland Avenue and Palo Alto Avenue along Pope Street/Chaucer Street over the San Francisquito Creek. Surrounding land-uses near the bridge are primarily single-family residential homes with a few small businesses on Gilbert Avenue and Menalto Avenue. Key roadways within the project vicinity are described below:

University Avenue is two lane arterial street that connects from El Camino Real in the south to US 101 in the north.

Middlefield Road is a two to four lane arterial streets that connects from Willow Road in the west and University Avenue in the east within the project vicinity.

Woodland Avenue is primarily a two lane local street that connects from University Avenue to Middlefield Road.

Chaucer Street is a two lane local street that connects from Hamilton Avenue in the east to Woodland Avenue in the west.

Pope Street is a two lane local street that connects from Woodland Avenue in the east to Walnut Street in the west.

Palo Alto Avenue is a two lane local street that connects from University Avenue in the north to Middlefield Road in the south.

Gilbert Avenue a two lane collector street that connects from Willow Road in the west to Menalto Avenue in the east.

Willow Road is primarily a two lane arterial that connects from US 101 in the north to Middlefield Road in the south within the project vicinity.

Figure 2 illustrates the existing lane geometry and traffic controls at the study intersections.

DATA COLLECTION

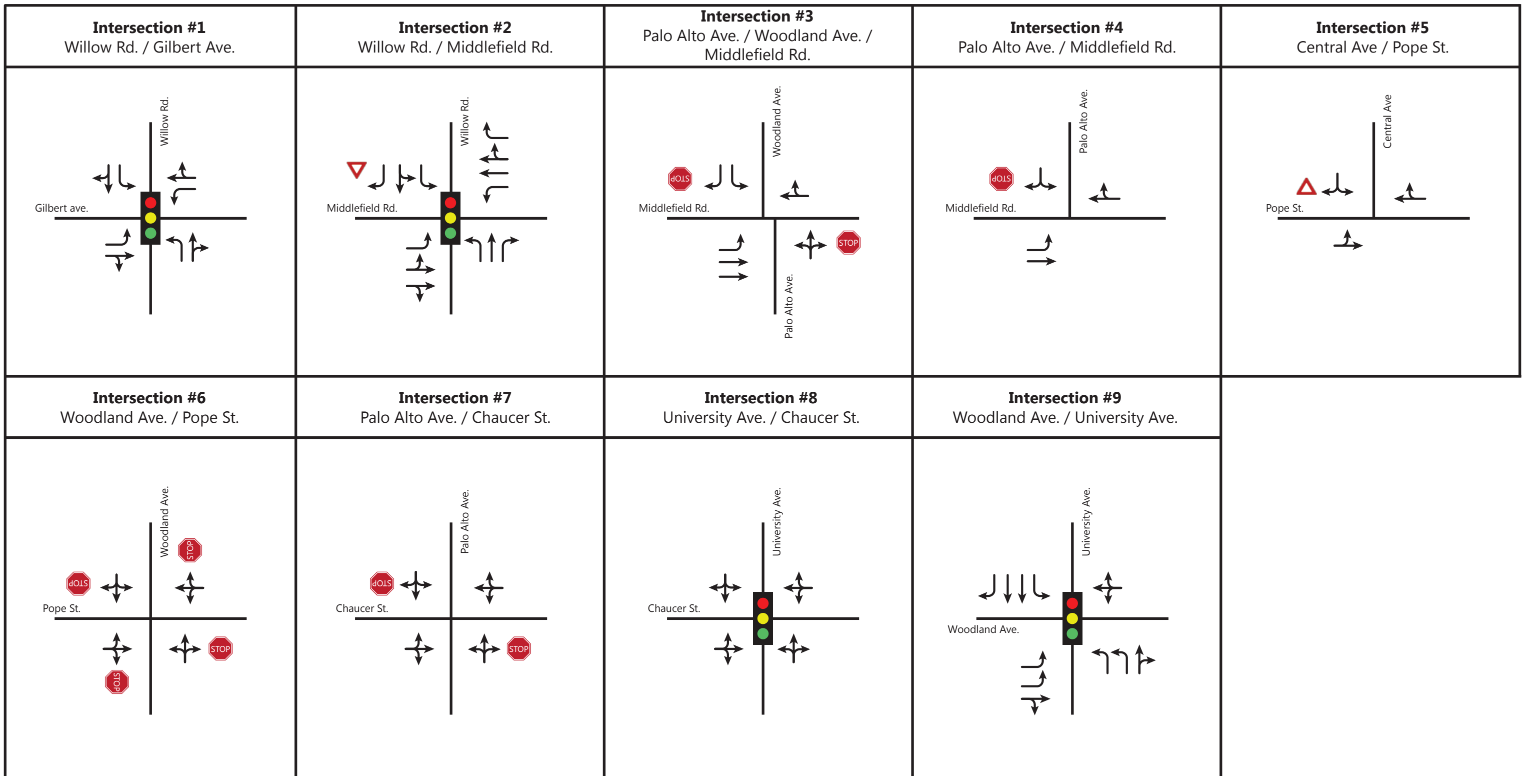
Intersection Turning Movement Counts (TMC)

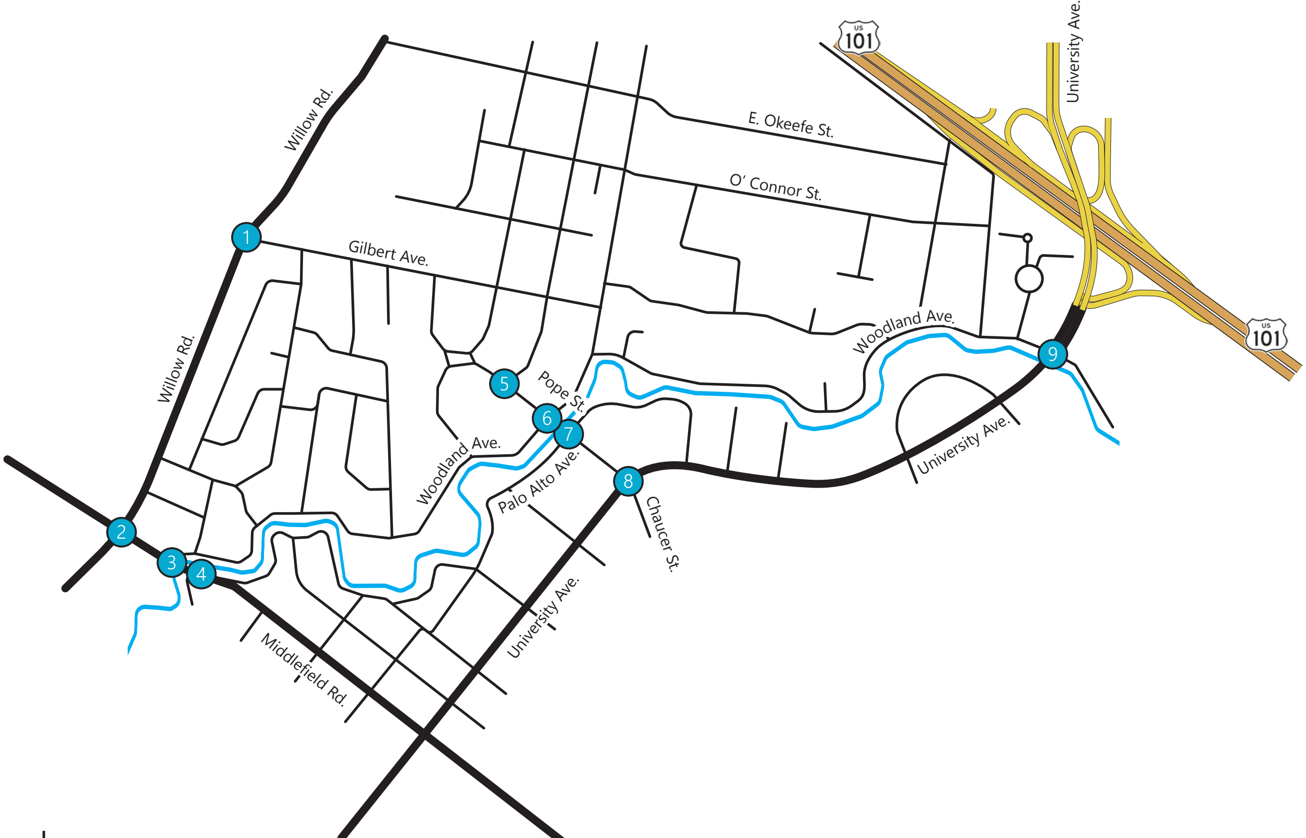
TJKM collected turning movement counts at the study intersections for vehicles, pedestrians, and bicycles on Tuesday, May 22, 2018 on a typical weekday when the schools were in session. The turning movement counts were collected for weekday a.m. (7:00 a.m. - 9:00 a.m.) and p.m. (4:00 p.m. – 6:00 p.m.) peak periods. TJKM obtained Year 2016 turning movement counts for the intersection of Woodland Avenue/University Avenue from the *Newell Bridge Replacement Project Report* dated September 21, 2016. The traffic volumes were projected for existing year 2018 per the report and utilized in this study. **Figure 3** illustrates existing vehicular traffic volumes and **Figure 4** illustrates pedestrian and bicycle volumes for all study intersections. **Appendix A** contains the vehicle, pedestrian, and bicycle counts for the study intersections.

Existing Signal Timing

TJKM obtained the existing traffic signal timing sheets and phasing diagrams for the University Avenue/Chaucer Avenue, Willow Road/Gilbert Avenue, Willow Road/Middlefield Road intersections from the City of Palo Alto and the City of Menlo Park for the purpose of this analysis.

Existing Lane Geometry and Traffic Control





Legend

X Study Intersections

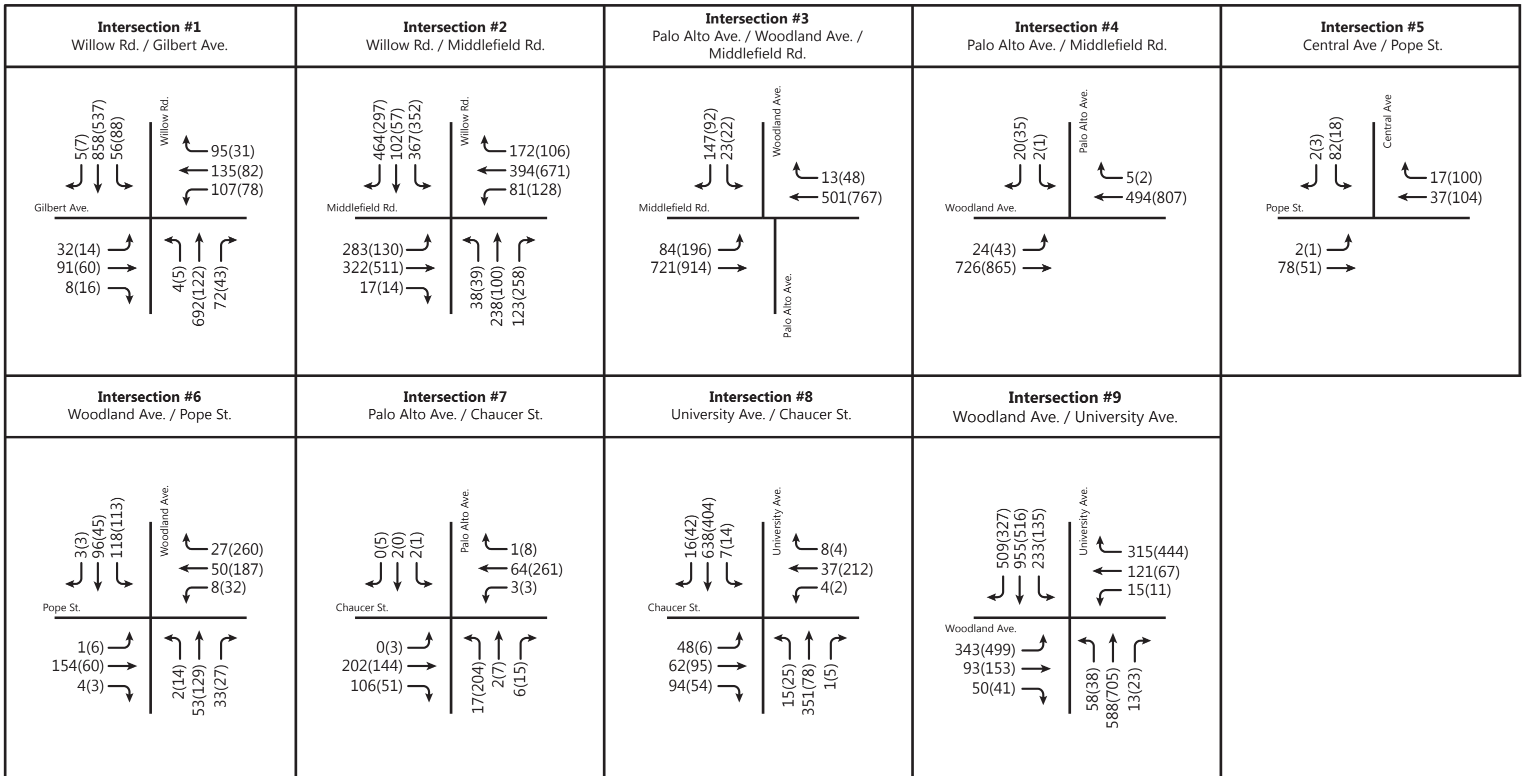
XX AM Peak Hour Volumes

(XX) PM Peak Hour Volumes

N

TJKM

Existing (2018) Traffic Volumes



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X Study Intersections

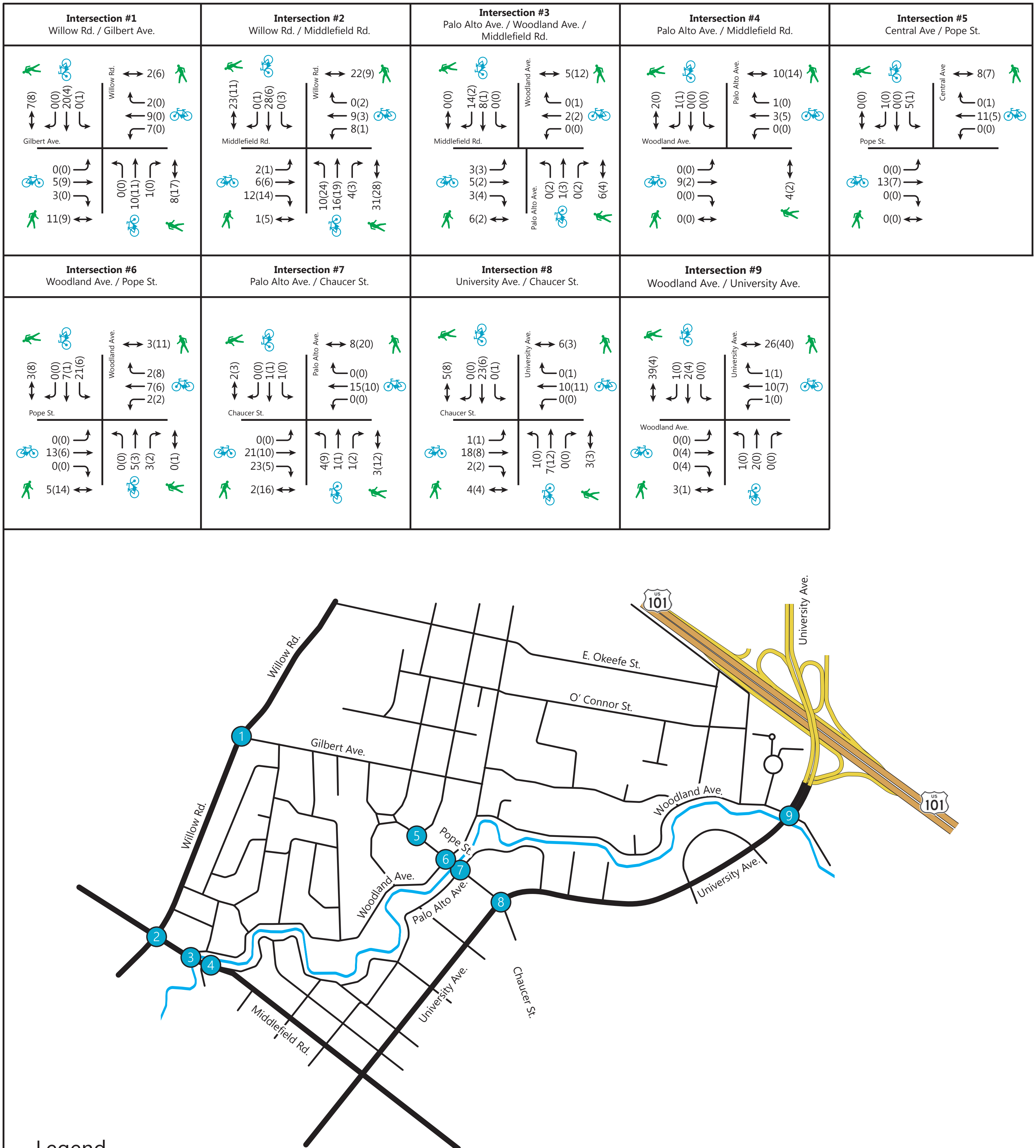
XX AM Peak Hour Volumes

(XX) PM Peak Hour Volumes

N

TJKM

Existing (2018) Pedestrian and Bicycle Volumes



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X Study Intersections

XX AM Peak Hour Volumes

(XX) PM Peak Hour Volumes

N

TJKM

EXISTING CONDITIONS (2018) LOS AND 95TH PERCENTILE QUEUE LENGTH ANALYSIS

The existing conditions (2018) scenario evaluates all study intersections with existing lane geometry, traffic controls and traffic volumes. The results of the LOS, delay and 95th percentile queue length in feet (ft.) analysis using Synchro software are summarized in **Tables 2** and **3** respectively. **Appendix B** contains Synchro reports for all study intersections.

Under the existing conditions (2018) scenario, all study intersections operate within applicable jurisdictional standards of the City of Palo Alto (LOS D or better) and the City of Menlo Park during the a.m. and p.m. peak hours with the exception of the following:

- Middlefield Road/Woodland Avenue-Palo Alto Avenue – LOS F during p.m. peak hour

Table 2: Existing Conditions LOS and Delay

#	*Study Intersections*	*Control*	*Peak Hour*	*Existing Conditions*	
				Average Delay[1] (sec)	*LOS*
1	Willow Road/Gilbert Avenue	Signalized	AM	29.4	C
			PM	15.1	B
2	Willow Road/Middlefield Road	Signalized	AM	59.7	E
			PM	52.3	D
3	Middlefield Road/Woodland Avenue-Palo Alto Avenue	Two-Way Stop	AM	17.8	C
			PM	**71.5**	**F**
4	Middlefield Road/Palo Alto Avenue	One-Way Stop	AM	12.3	B
			PM	18.4	C
5	Pope Street/Central Avenue	Yield	AM	10.0	A
			PM	10.1	B
6	Pope Street/Woodland Avenue	All-Way Stop	AM	9.4	A
			PM	16.6	C
7	Chaucer Street/Palo Alto Avenue	Two-Way Stop	AM	11.9	B
			PM	26.1	D
8	Chaucer Street/University Avenue	Signalized	AM	10.4	B
			PM	10.3	B
9	Woodland Avenue/University Avenue	Signalized	AM	39.0	D
			PM	39.3	D

Note:

[1]Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

Bold indicates unacceptable LOS.

Existing conditions queue length analysis showed several intersections having 95th percentile queue length exceeding existing storage capacity. **Table 5** summarizes 95th percentile queue lengths at the study intersections.

Table 3: Existing Conditions 95th Percentile Queue Lengths (ft.)

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions	
				A.M.	P.M.
1	Willow Road/Gilbert Avenue	EBL	55	**#90**	29
		EBTR	400	147	93
		WBL	90	**#188**	**113**
		WBTR	320	**#333**	137
		NBL	75	m3	3
		NBTR	450	363	44
		SBL	90	31	33
		SBTR	455	**497**	207
2	Willow Road/Middlefield Road	EBL	270	**#346**	210
		EBTR	1025	304	420
		WBL	120	133	**182**
		WBT	330	303	**484**
		WBR	65	175	**80**
		NBL	75	69	**80**
		NBT	1010	#360	172
		NBR	110	101	48
		SBL	150	**m307**	**330**
		SBL	250	**m315**	**331**
		SBR	65	**408**	**309**
3	Middlefield Road/Palo Alto Avenue-Woodland Avenue	EBL	50	7	34
		EBT	350	0	0
		EBT	350	0	0
		WBTR	415	0	0
		SBL	30	11	**75**
		SBR	810	33	52
4	Middlefield Road/Palo Alto Avenue	EBL	40	2	5
		EBT	505	0	0
		WBTR	655	0	0
		SBLR	630	4	14
5	Pope Street/Central Avenue	EBLT	245	0	0
		WBTR	300	0	0
		SBLR	665	10	4
6[1]	Woodland Avenue/Pope Street-Chaucer Street	EBLTR	310	60	53
		WBLTR	110	58	**124**
		NBLTR	595	45	71
		SBLTR	500	76	68

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions	
				A.M.	P.M.
7	Palo Alto Avenue/Chaucer Street	EBLTR	110	0	0
		WBLTR	470	0	0
		NBLTR	510	3	104
		SBLTR	950	2	1
8	Chaucer Street/University Avenue	EBLTR	470	165	88
		WBLTR	530	46	129
		NBLTR	505	147	46
		SBLTR	365	338	208
9	Woodland Avenue/University Avenue	EBL	580	#162	#235
		EBTR	580	126	178
		WBLTR	500	#442	#419
		NBL	160	68	53
		NBTR	536	231	283
		SBL	210	192	134
		SBT	443	326	167
		SBR	443	66	55

Note:

- 95th percentile volume exceeds capacity, queue maybe longer. Queue shown is maximum after two cycles.

m – Volume for 95th percentile queue is metered by upstream signal.

[1]Synchro does not provide queue lengths for all-way stop control intersections. Queues were obtained from SimTraffic.

Bold indicates 95th Percentile Queue Lengths higher than existing capacity.

EXISTING PLUS BRIDGE CLOSURE CONDITIONS

VEHICULAR LOS, DELAY AND 95TH PERCENTILE QUEUE LENGTH ANALYSIS

The existing plus project conditions scenario evaluates all study intersections with existing lane geometry and traffic controls. All inbound and outbound movements at the bridge along Pope Street/Chaucer Street between Pope Street/Woodland Avenue and Chaucer Street/Palo Alto Avenue are restricted to evaluate bridge closure conditions. This includes restriction of the eastbound through, northbound right-turn and southbound left-turn movements at Pope Street/Woodland Avenue and the westbound through, northbound left-turn and southbound right-turn movements at Chaucer Street/Palo Alto Avenue intersections. Based on the study area and existing traffic patterns, traffic volumes for the restricted movements were rerouted. **Figure 5** illustrates the rerouted trips under bridge closure conditions and **Figure 6** illustrates the total traffic demands under the bridge closure conditions.
Existing signal timings were maintained for signalized intersections under this scenario similar to existing conditions. The results of the LOS, delay and 95th percentile queue length in feet (ft.) analysis using Synchro software are summarized in **Tables 4** and **5** respectively. **Appendix C** contains Synchro reports for all study intersections.

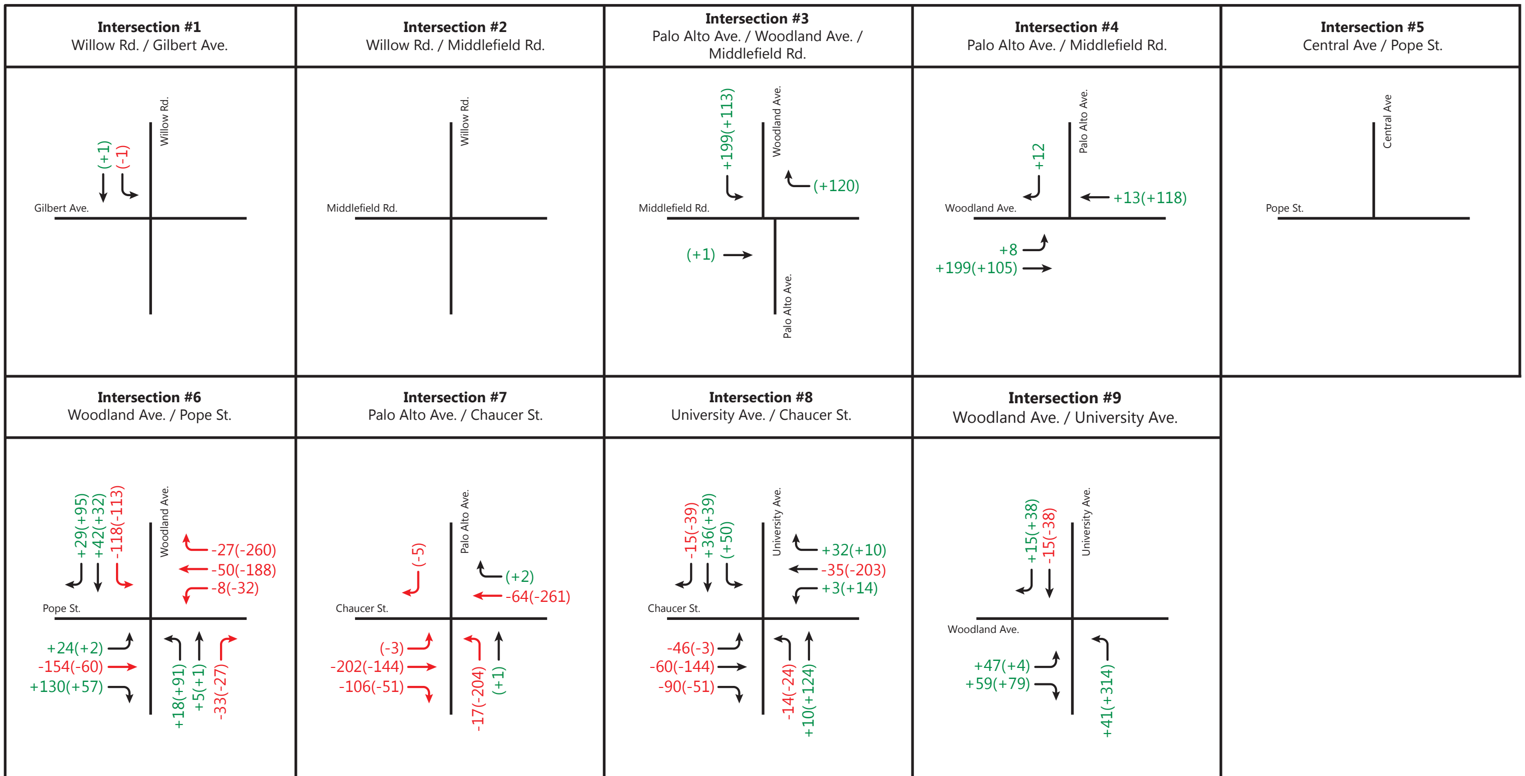
It should be noted that for the purpose of rerouting trips and maintaining reasonable volume balancing at the intersections, all intersections were evaluated with volumes for the same peak hour. The a.m. and p.m. peak hours based on the traffic counts collected are 7:45 a.m. to 8:45 a.m. and 5:00 p.m. to 6:00 p.m. respectively.

Under the existing plus bridge closure conditions scenario, all study intersections operate within applicable jurisdictional standards of the City of Palo Alto (LOS D or better) and City of Menlo Park during the a.m. and p.m. peak hours with the exception of the following:

- Middlefield Road/Woodland Avenue-Palo Alto Avenue – LOS F during a.m. and p.m. peak hours

Middlefield Road/Woodland Avenue-Palo Alto Avenue intersection operates at LOS F during the temporary bridge closure versus LOS C under existing conditions during the a.m. peak period. During the p.m. peak period, this intersection operates at LOS F, however, the delay experienced by Woodland Avenue approach is substantially higher.

Rerouted Trips During Bridge Closure



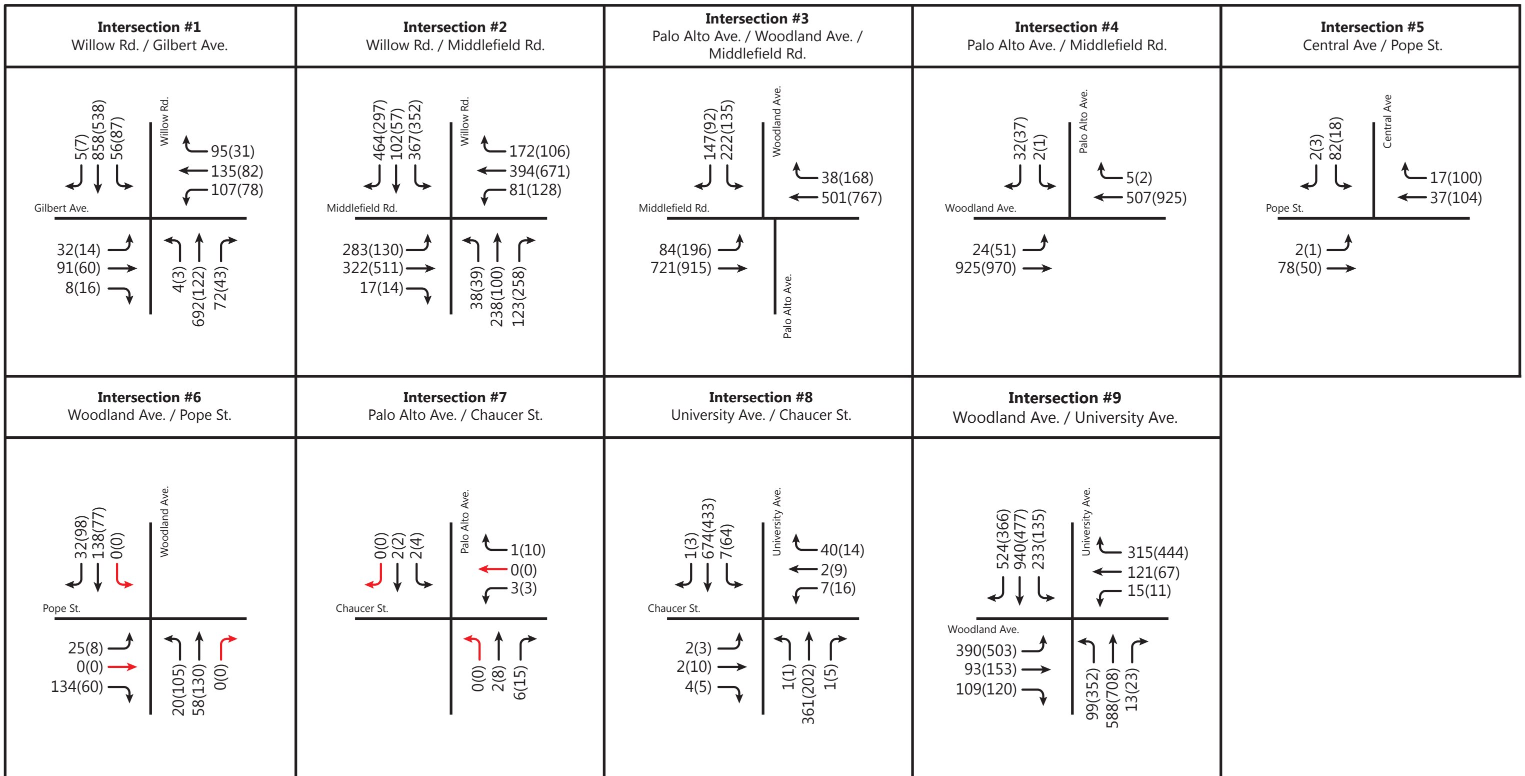
Legend

- X — Study Intersections
- XX — AM Peak Hour Volumes
- (XX) — PM Peak Hour Volumes
- +XX — Increase in Trip Volume
- -XX — Decrease in Trip Volume
- ↰ ↑ ↱ — Indicates Restricted Movement

N

TJKM

Existing plus Bridge Closure Conditions Traffic Volumes



Legend

X Study Intersections

XX AM Peak Hour Volumes

(XX) PM Peak Hour Volumes

Indicates Restricted Movement

N

TJKM

Table 4: Existing plus Project Conditions LOS and Delay

#	Study Intersections	Control	Peak Hour	Existing Conditions		Existing + Bridge Closure Conditions	
				Average Delay[1] (sec)	LOS	Average Delay[1] (sec)	LOS
1	Willow Road/Gilbert Avenue	Signalized	AM	29.4	C	29.4	C
			PM	15.1	B	15.1	B
2	Willow Road/Middlefield Road	Signalized	AM	59.7	E	59.7	E
			PM	52.3	D	52.4	D
3	Middlefield Road/Woodland Avenue-Palo Alto Avenue	Two-Way Stop	AM	17.8	C	**227.4**	**F**
			PM	**71.5**	**F**	**Err[2]**	**F**
4	Middlefield Road/Palo Alto Avenue	One-Way Stop	AM	12.3	B	12.7	B
			PM	18.4	C	21.8	C
5	Pope Street/Central Avenue	Yield	AM	10	A	10.0	A
			PM	10.1	B	10.1	B
6	Pope Street/Woodland Avenue	All-Way Stop	AM	9.4	A	8.3	A
			PM	16.6	C	9.3	A
7	Chaucer Street/Palo Alto Avenue	Two-Way Stop	AM	11.9	B	9.0	A
			PM	26.1	D	9.4	A
8	Chaucer Street/University Avenue	Signalized	AM	10.4	B	4.3	A
			PM	10.3	B	4.8	A
9	Woodland Avenue/University Avenue	Signalized	AM	39.0	D	41.5	D
			PM	39.3	D	51.9	D

Notes:

[1]Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

[2]Err indicates error in calculating delay as the volume greatly exceeds capacity.

Bold indicates unacceptable LOS.

The results of the existing plus project conditions queue length analysis was similar to existing conditions analysis at most movements and locations. The queue lengths increased at some locations because of the rerouted trips within the project area, especially at Middlefield Road/Woodland Avenue-Palo Alto Avenue intersection for the Woodland Avenue approach.

Table 5: Existing Plus Bridge Closure Conditions 95th Percentile Queue Lengths (ft.)

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions		Existing + Bridge Closure Conditions	
				A.M.	P.M.	A.M.	P.M.
1	Willow Road/Gilbert Avenue	EBL	55	#90	29	#90	29
		EBTR	400	147	93	147	93
		WBL	90	#188	113	#188	113
		WBTR	320	#333	137	#333	137
		NBL	75	m3	3	m3	3
		NBTR	450	363	44	363	44
		SBL	90	31	33	31	32
		SBTR	455	497	207	497	207
2	Willow Road/Middlefield Road	EBL	270	#346	210	#346	210
		EBTR	1025	304	420	304	420
		WBL	120	133	182	133	182
		WBT	330	303	484	303	484
		WBR	65	175	80	175	80
		NBL	75	69	80	69	80
		NBT	1010	#360	172	#360	172
		NBR	110	101	48	101	48
		SBL	150	m307	330	m307	332
		SBL	250	m315	331	m315	331
		SBR	65	408	309	408	309
3	Middlefield Road/Palo Alto Avenue-Woodland Avenue	EBL	50	7	34	7	40
		EBT	350	0	0	0	0
		EBT	350	0	0	0	0
		WBTR	415	0	0	0	0
		SBL	30	11	75	**327**	**Err[2]**
		SBR	810	33	52	34	61
4	Middlefield Road/Palo Alto Avenue	EBL	40	2	5	2	7
		EBT	505	0	0	0	0
		WBTR	655	0	0	0	0
		SBLR	630	4	14	6	19
5	Pope Street/Central Avenue	EBLT	245	0	0	0	0
		WBTR	300	0	0	0	0
		SBLR	665	10	4	10	4
6	Woodland Avenue/Pope Street-Chaucer Street	EBLTR	310	60	53	59	47
		WBLTR	110	58	124	0	0
		NBLTR	595	45	71	43	74
		SBLTR	500	76	68	67	73

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions		Existing + Bridge Closure Conditions	
				A.M.	P.M.	A.M.	P.M.
7	Palo Alto Avenue/Chaucer Street	EBLTR	110	0	0	0	0
		WBLTR	470	0	0	0	0
		NBLTR	510	3	104	1	2
		SBLTR	950	2	1	1	1
8	Chaucer Street/University Avenue	EBLTR	470	165	88	14	20
		WBLTR	530	46	129	24	31
		NBLTR	505	147	46	70	80
		SBLTR	365	338	208	174	237
9	Woodland Avenue/University Avenue	EBL	580	#162	#235	#195	#238
		EBTR	580	126	178	#194	#285
		WBLTR	500	#442	#419	#442	#419
		NBL	160	68	53	103	#431
		NBTR	536	231	283	231	284
		SBL	210	192	134	192	134
		SBT	443	326	167	329	178
		SBR	443	66	55	71	71

Notes:

- 95th percentile volume exceeds capacity, queue maybe longer. Queue shown is maximum after two cycles.

m – Volume for 95th percentile queue is metered by upstream signal.

[1]Synchro does not provide queue lengths for all-way stop control intersections. Queues were obtained from SimTraffic.

[2]Err indicates error in calculating delay as the volume greatly exceeds capacity.

Bold indicates 95th Percentile Queue Lengths higher than existing capacity.

Pedestrian and Bicycle Impacts

With full closure of the Pope St-Chaucer Street Bridge, pedestrians and bicyclists currently using the bridge would experience significant impacts with no alternate routes available within the immediate vicinity of the bridge. Under existing conditions, approximately 13 and 6 bicyclists and 5 and 14 pedestrians cross the bridge in the eastbound direction during the a.m. and p.m. peak hours respectively. Similarly, approximately 15 and 10 bicyclists and 8 and 20 pedestrians cross the bridge in the westbound direction during the a.m. and p.m. peak hours. The intersections of Woodland Avenue/Middlefield Road and Woodland Avenue/University Drive are the closest alternative routes, which are at approximately 0.6 to 0.8 mile distance from the intersection of Woodland Avenue/Pope Street and 0.6 to 0.7 mile distance from the intersection of Palo Alto Avenue/Chaucer Street.

Additionally, there are two bus stops located within close proximity of the bridge, Woodland Avenue & Woodland Court for Routes 83 and 88 and University Avenue & Chaucer Street for Routes 280, 281, 296 and 397. Pedestrians and bicyclists using transit would experience higher delays with the closure of the bridge if they were crossing the bridge to reach their preferred bus stop.

Alternate solutions to mitigate impact faced by pedestrians and bicyclists could include construction staging or constructing temporary pedestrian and bicycle access over the San Francisquito Creek.

MITIGATION MEASURES

Based on the LOS and delay analyses conducted at the eight study intersections, it was observed that under existing year (2018) conditions, all intersections operate with acceptable levels of service during the weekday a.m. and p.m. peak periods with the exception of Middlefield Road/Woodland Avenue-Palo Alto Avenue, which operates at LOS F during the p.m. peak period.

Under existing plus bridge closure conditions, Middlefield Road/Woodland Avenue-Palo Alto Avenue operates at LOS F with significantly higher delay because of the rerouted trips during both a.m. and p.m. peak periods. The 95th percentile queue length analysis conducted provided the same results.

Potential mitigation measures to alleviate the delay experienced at during the bridge closure could include the following:

1. Providing detour signs to divert traffic onto Willow Road rather than Woodland Avenue to get on to Middlefield Road. This would reduce the delay experienced at the intersection because of rerouted trips during commute hours.
2. Providing temporary traffic signal at Middlefield Road/Woodland Avenue-Palo Alto Avenue enabling the intersection to operate with acceptable LOS standards.

TJKM evaluated both options to ascertain the impact on LOS and delay at the study intersections. Under Option 1, traffic that was rerouted to Woodland Avenue/Middlefield Road was rerouted to Willow Road/Gilbert Avenue and traffic signal timings were modified to accommodate the additional traffic. Option 2 does not see any rerouting of traffic; however, traffic signal timings were modified. **Tables 6** and **7** summarize the LOS and delay and 95th percentile queue lengths respectively of the two mitigation measures. **Appendix D** contains the Synchro and SimTraffic analysis reports.

Based on the analysis conducted for the two options, the intersection of Woodland Avenue/Middlefield Road still operates with unacceptable LOS E and F during the a.m. and p.m. peak hours respectively, however, with significantly lower delay under Option 1 scenario. This intersection operates at acceptable LOS for the a.m. and p.m. peak hours under the Option 2 scenario, however, with higher queue lengths for the westbound direction during the p.m. peak period.

Table 6: Mitigation Measures LOS and Delay

#	Study Intersections	Control	Peak Hour	Existing Conditions		Existing + Bridge Closure Conditions		Mitigation Measures-Option 1		Mitigation Measures-Option 2	
				Average Delay (sec)	LOS	Average Delay (sec)	LOS	Average Delay (sec)	LOS	Average Delay (sec)	LOS
1	Willow Road/Gilbert Avenue	Signalized	AM	29.4	C	29.4	C	32.7	C	29.5	C
			PM	15.1	B	15.1	B	19.5	B	15.1	B
2	Willow Road/Middlefield Road	Signalized	AM	**59.7**	**E**	**59.7**	**E**	**58.6**	**E**	**56.2**	**E**
			PM	52.3	D	52.4	D	54.6	D	52.4	D
3	Middlefield Road/Woodland Avenue-Palo Alto Avenue	Two-Way Stop	AM	17.8	C	**227.4**	**F**	**41.1**	**E**	16.5	B
			PM	**71.5**	**F**	**Err**[2]	**F**	**942.4**	**F**	35.9	D
4	Middlefield Road/Palo Alto Avenue	One-Way Stop	AM	12.3	B	12.7	B	12.7	B	12.8	B
			PM	18.4	C	21.8	C	21.8	C	21.8	C
5	Pope Street/Central Avenue	Yield	AM	10	A	10.0	A	9.0	A	10.0	A
			PM	10.1	B	10.1	B	9.3	A	10.1	B
6	Pope Street/Woodland Avenue	All-Way Stop	AM	9.4	A	8.3	A	7.7	A	8.3	A
			PM	16.6	C	9.3	A	9.1	A	9.3	A
7	Chaucer Street/Palo Alto Avenue	Two-Way Stop	AM	11.9	B	9.0	A	9.0	A	9.0	A
			PM	26.1	D	9.4	A	9.4	A	9.4	A
8	Chaucer Street/University Avenue	Signalized	AM	10.4	B	4.3	A	4.3	A	4.3	A
			PM	10.3	B	4.8	A	4.8	A	4.8	A
9	Woodland Avenue/University Avenue	Signalized	AM	39.0	D	41.5	D	41.5	D	41.5	D
			PM	39.3	D	51.9	D	51.9	D	51.9	D

Notes:

[1]Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

[2]Err indicates error in calculating delay as the volume greatly exceeds capacity.

Bold indicates unacceptable LOS.

Table 7: Mitigation Measures 95th Percentile Queue Lengths (ft.)

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions		Existing + Bridge Closure Conditions		Mitigation Measures-Option 1		Mitigation Measures-Option 2	
				A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
1	Willow Road/Gilbert Avenue	EBL	55	#90	29	#90	29	48	26	#90	29
		EBTR	400	147	93	147	93	112	81	147	93
		WBL	90	#188	113	#188	113	378	201	#188	113
		WBTR	320	#333	137	#333	137	237	118	#333	137
		NBL	75	m3	3	m3	3	m2	4	m3	3
		NBTR	450	363	44	363	44	258	67	363	44
		SBL	90	31	33	31	32	81	47	31	32
		SBTR	455	497	207	497	207	953	302	497	207
2	Willow Road/Middlefield Road	EBL	270	#346	210	#346	210	#346	213	#346	210
		EBTR	1025	304	420	304	420	304	423	304	420
		WBL	120	133	182	133	182	133	190	m101	182
		WBT	330	303	484	303	484	303	#508	280	484
		WBR	65	175	80	175	80	175	83	135	80
		NBL	75	69	80	69	80	69	80	69	80
		NBT	1010	#360	172	#360	172	#360	172	#360	172
		NBR	110	101	48	101	48	101	48	101	48
		SBL	150	m307	330	m307	332	m307	390	m307	332
		SBL	250	m315	331	m315	331	m315	392	m315	331
		SBR	65	408	309	408	309	408	323	408	309
3	Middlefield Road/Palo Alto Avenue-Woodland Avenue	EBL	50	7	34	7	40	7	40	m62	#261
		EBT	350	0	0	0	0	0	0	59	141
		EBT	350	0	0	0	0	0	0	59	141
		WBTR	415	0	0	0	0	0	0	347	**#953**
		SBL	30	11	75	**327**	**Err[2]**	36	**198**	**154**	**146**
		SBR	810	33	52	34	61	34	61	38	25
4	Middlefield Road/Palo Alto Avenue	EBL	40	2	5	2	7	2	7	2	7
		EBT	505	0	0	0	0	0	0	0	0
		WBTR	655	0	0	0	0	0	0	0	0
		SBLR	630	4	14	6	19	6	19	6	19
5	Pope Street/Central Avenue	EBLT	245	0	0	0	0	0	0	0	0
		WBTR	300	0	0	0	0	0	0	0	0
		SBLR	665	10	4	10	4	1	1	10	4

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions		Existing + Bridge Closure Conditions		Mitigation Measures-Option 1		Mitigation Measures-Option 2	
				A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
6	Woodland Avenue/Pope Street-Chaucer Street	EBLTR	310	60	53	59	47	43	53	62	49
		WBLTR	110	58	**124**	0	0	0	0	0	0
		NBLTR	595	45	71	43	74	45	77	42	74
		SBLTR	500	76	68	67	73	61	67	67	70
7	Palo Alto Avenue/Chaucer Street	EBLTR	110	0	0	0	0	0	0	0	0
		WBLTR	470	0	0	0	0	0	0	0	0
		NBLTR	510	3	104	1	2	1	2	1	2
		SBLTR	950	2	1	1	1	1	1	1	1
8	Chaucer Street/University Avenue	EBLTR	470	165	88	14	20	14	20	14	20
		WBLTR	530	46	129	24	31	24	31	24	31
		NBLTR	505	147	46	70	80	70	80	70	80
		SBLTR	365	338	208	174	237	174	237	174	237
9	Woodland Avenue/University Avenue	EBL	580	#162	#235	#195	#238	#195	#238	#195	#238
		EBTR	580	126	178	#194	#285	#194	#285	#194	#285
		WBLTR	500	#442	#419	#442	#419	#442	#419	#442	#419
		NBL	160	68	53	103	#431	103	#431	103	#431
		NBTR	536	231	283	231	284	231	284	231	284
		SBL	210	192	134	192	134	192	134	192	134
		SBT	443	326	167	329	178	329	178	329	178
		SBR	443	66	55	71	71	71	71	71	71

Notes:

- 95th percentile volume exceeds capacity, queue maybe longer. Queue shown is maximum after two cycles.

m – Volume for 95th percentile queue is metered by upstream signal.

[1]Synchro does not provide queue lengths for all-way stop control intersections. Queues were obtained from SimTraffic.

[2]Err indicates error in calculating delay as the volume greatly exceeds capacity.

Bold indicates 95th Percentile Queue Lengths higher than existing capacity.

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CONCLUSION

Based on the LOS and delay analyses conducted at the eight study intersections, it was observed that under existing year (2018) conditions, all intersections operate with acceptable levels of service during the weekday a.m. and p.m. peak periods with the exception of Middlefield Road/Woodland Avenue-Palo Alto Avenue, which operates at LOS F during the p.m. peak period.

Under existing plus bridge closure conditions, Middlefield Road/Woodland Avenue-Palo Alto Avenue experiences significant impact as a result of the bridge closure and operates at LOS F with significantly higher delay because of the rerouted trips during both a.m. and p.m. peak periods.

TJKM evaluated two potential mitigation measures to mitigate impacts experienced at the intersection of Middlefield Road/Woodland Avenue-Palo Alto Avenue as provided below.

1. Option 1: Providing detour signs and activating real time closures on GPS navigation applications to divert traffic onto Willow Road rather than Woodland Avenue to get on to Middlefield Road. This would reduce the delay experienced at the intersection because of rerouted trips during commute hours.
2. Option 2: Providing temporary traffic signal at Middlefield Road/Woodland Avenue-Palo Alto Avenue enabling the intersection to operate with acceptable LOS standards.

Based on the analysis conducted for the two options, the intersection of Woodland Avenue/Middlefield Road still experiences significant impact and operates with unacceptable LOS E and F during the a.m. and p.m. peak hours respectively, however, with significantly lower delay under Option 1 scenario. This intersection operates at acceptable LOS for the a.m. and p.m. peak hours under the Option 2 scenario, however, with higher queue lengths for the westbound direction during the p.m. peak period.

With full closure of the Pope St-Chaucer Street Bridge, pedestrians and bicyclists currently using the bridge would experience significant impacts with no alternate routes available within the immediate vicinity of the bridge. Additionally, there are two bus stops located within close proximity of the bridge, Woodland Avenue & Woodland Court for Routes 83 and 88 and University Avenue & Chaucer Street for Routes 280, 281, 296 and 397. Pedestrians and bicyclists using transit would experience higher delays with the closure of the bridge if they were crossing the bridge to reach their preferred bus stop.

Alternate solutions to mitigate impact faced by pedestrians and bicyclists could include construction staging or constructing temporary pedestrian and bicycle access over the San Francisquito Creek. Options such as adding crosswalk flashing beacons and green bike lanes at Middlefield Road/Woodland Avenue were considered, however, they were deemed unfeasible due to impacts to traffic operations along Middlefield Road and limitations of right-of-way availability.

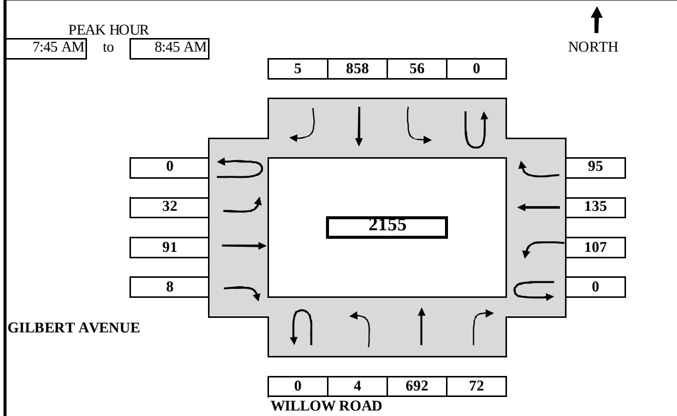
Appendix A – Traffic Counts

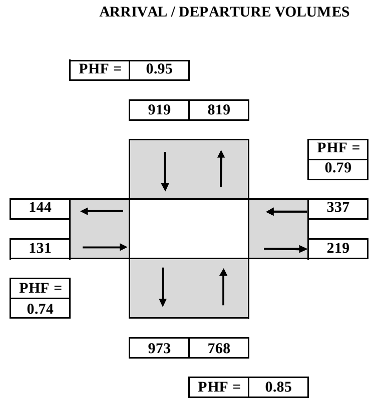
- Turning Movement Vehicles, Bicyclists and Conflicting Pedestrian Counts

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	WILLOW ROAD	SURVEY TIME:	7:00 AM	TO	9:00 AM
E-W APPROACH:	GILBERT AVENUE	JURISDICTION:	PALO ALTO	FILE:	3805030-1AM





TIME PERIOD From		To	NORTHBOUND U-TURN	LEFT	THRU	RIGHT	SOUTHBOUND U-TURN	LEFT	THRU	RIGHT	EASTBOUND U-TURN	LEFT	THRU	RIGHT	WESTBOUND U-TURN	LEFT	THRU	RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM		1	72	5		3	238	0		5	1	0		6	3	12	346
7:15 AM	to	7:30 AM		1	171	9		6	440	1		8	3	4		22	9	23	697
7:30 AM	to	7:45 AM		4	312	20		10	653	1		13	9	6		45	38	45	1156
7:45 AM	to	8:00 AM		6	451	38		21	882	2		19	22	10		74	58	68	1651
8:00 AM	to	8:15 AM		6	660	56		38	1097	3		26	42	10		95	91	92	2216
8:15 AM	to	8:30 AM		7	809	75		53	1311	4		31	73	11		125	137	122	2758
8:30 AM	to	8:45 AM		8	1004	92		66	1511	6		45	100	14		152	173	140	3311
8:45 AM	to	9:00 AM		8	1175	101		82	1711	6		49	113	19		170	196	159	3789
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	1	72	5	0	3	238	0	0	5	1	0	0	6	3	12	346
7:15 AM	to	7:30 AM	0	0	99	4	0	3	202	1	0	3	2	4	0	16	6	11	351
7:30 AM	to	7:45 AM	0	3	141	11	0	4	213	0	0	5	6	2	0	23	29	22	459
7:45 AM	to	8:00 AM	0	2	139	18	0	11	229	1	0	6	13	4	0	29	20	23	495
8:00 AM	to	8:15 AM	0	0	209	18	0	17	215	1	0	7	20	0	0	21	33	24	565
8:15 AM	to	8:30 AM	0	1	149	19	0	15	214	1	0	5	31	1	0	30	46	30	542
8:30 AM	to	8:45 AM	0	1	195	17	0	13	200	2	0	14	27	3	0	27	36	18	553
8:45 AM	to	9:00 AM	0	0	171	9	0	16	200	0	0	4	13	5	0	18	23	19	478
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	6	451	38	0	21	882	2	0	19	22	10	0	74	58	68	1651
7:15 AM	to	8:15 AM	0	5	588	51	0	35	859	3	0	21	41	10	0	89	88	80	1870
7:30 AM	to	8:30 AM	0	6	638	66	0	47	871	3	0	23	70	7	0	103	128	99	2061
7:45 AM	to	8:45 AM	0	4	692	72	0	56	858	5	0	32	91	8	0	107	135	95	2155
8:00 AM	to	9:00 AM	0	2	724	63	0	61	829	4	0	30	91	9	0	96	138	91	2138

PEAK HOUR SUMMARY

7:45 AM to 8:45 AM	NORTHBOUND NBU	NBL	NBT	NBR	SOUTHBOUND SBU	SBL	SBT	SBR	EASTBOUND EBU	EBL	EBT	EBR	WESTBOUND WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	4	692	72	0	56	858	5	0	32	91	8	0	107	135	95	2155
PHF BY MOVEMENT	0.00	0.50	0.83	0.95	0.00	0.82	0.94	0.63	0.00	0.57	0.73	0.50	0.00	0.89	0.73	0.79	OVERALL
PHF BY APPROACH	0.85				0.95				0.74				0.79				0.95
BICYCLE	11				20				8				18				57
PEDESTRIAN	10				5				3				10				28
	N-LEG				S-LEG				E-LEG				W-LEG				
PEDESTRIAN BY LEG:	2				11				8				7				28

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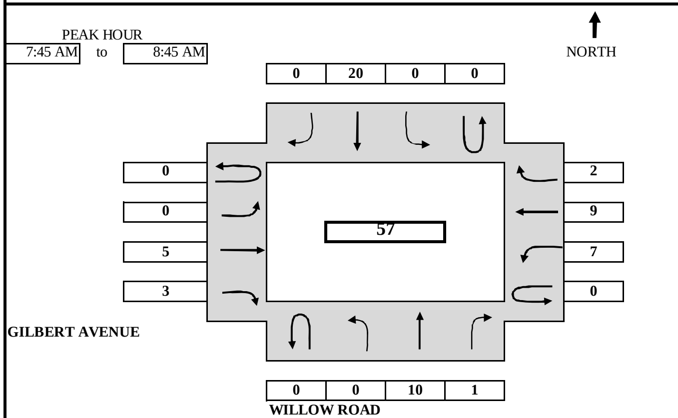
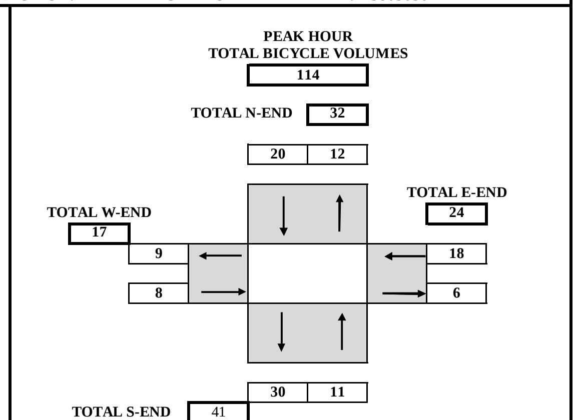
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	WILLOW ROAD	SURVEY TIME:	7:00 AM	TO	9:00 AM
E-W APPROACH:	GILBERT AVENUE	JURISDICTION:	PALO ALTO	FILE:	3805030-1AM





TIME PERIOD From		To	NORTHBOUND U-TURN	NB LEFT	NB THRU	NB RIGHT	SOUTHBOUND U-TURN	SB LEFT	SB THRU	SB RIGHT	EASTBOUND U-TURN	EB LEFT	EB THRU	EB RIGHT	WESTBOUND U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	4
7:15 AM	to	7:30 AM	0	0	2	0	0	1	5	1	0	0	1	0	0	2	1	0	13
7:30 AM	to	7:45 AM	0	0	5	0	0	1	8	1	0	0	1	0	0	3	4	1	24
7:45 AM	to	8:00 AM	0	0	5	0	0	1	18	1	0	0	1	1	0	10	5	1	43
8:00 AM	to	8:15 AM	0	0	10	0	0	1	23	1	0	0	3	2	0	10	10	2	62
8:15 AM	to	8:30 AM	0	0	12	1	0	1	24	1	0	0	6	2	0	10	12	2	71
8:30 AM	to	8:45 AM	0	0	15	1	0	1	28	1	0	0	6	3	0	10	13	3	81
8:45 AM	to	9:00 AM	0	0	20	1	0	1	30	1	0	0	6	3	0	10	15	3	90
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	4
7:15 AM	to	7:30 AM	0	0	2	0	0	1	3	0	0	0	0	0	0	2	1	0	9
7:30 AM	to	7:45 AM	0	0	3	0	0	0	3	0	0	0	0	0	0	1	3	1	11
7:45 AM	to	8:00 AM	0	0	0	0	0	0	10	0	0	0	0	1	0	7	1	0	19
8:00 AM	to	8:15 AM	0	0	5	0	0	0	5	0	0	0	2	1	0	0	5	1	19
8:15 AM	to	8:30 AM	0	0	2	1	0	0	1	0	0	0	3	0	0	0	2	0	9
8:30 AM	to	8:45 AM	0	0	3	0	0	0	4	0	0	0	0	1	0	0	1	1	10
8:45 AM	to	9:00 AM	0	0	5	0	0	0	2	0	0	0	0	0	0	0	2	0	9
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	5	0	0	1	18	1	0	0	1	1	0	10	5	1	43
7:15 AM	to	8:15 AM	0	0	10	0	0	1	21	0	0	0	2	2	0	10	10	2	58
7:30 AM	to	8:30 AM	0	0	10	1	0	0	19	0	0	0	5	2	0	8	11	2	58
7:45 AM	to	8:45 AM	0	0	10	1	0	0	20	0	0	0	5	3	0	7	9	2	57
8:00 AM	to	9:00 AM	0	0	15	1	0	0	12	0	0	0	5	2	0	0	10	2	47

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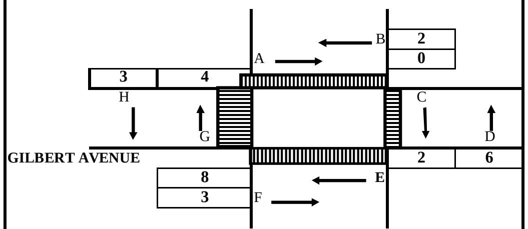
7:45 AM to 8:45 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	11	20	8	18	57

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

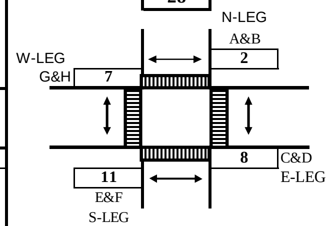
PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WILLOW ROAD**	**DAY:**	**TUESDAY**
E-W APPROACH:	**GILBERT AVENUE**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD:	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-1AM**

PEAK HOUR
07:45 AM TO 08:45 AM



LEGEND:
CROSSWALK
SIDEWALK
STOP CONTROL LINE
STOP

PEAK HOUR
TOTAL PEDESTRIAN VOLUMES
28



BY LEG:		**BY DIRECTION:**	
N-LEG	**2**	**NB**(D+G)	**10**
S-LEG	**11**	**SB**(C+H)	**5**
E-LEG	**8**	**EB**(A+F)	**3**
W-LEG	**7**	**WB**(B+E)	**10**

TIME PERIOD From		To	NORTH X-WALK A	B	EAST X-WALK C	D	SOUTH X-WALK E	F	WEST X-WALK G	H	TOTAL
SURVEY DATA											
07:00 AM	---	07:15 AM	0	0	0	0	0	1	0	0	*1*
07:15 AM	---	07:30 AM	0	0	1	0	0	1	1	2	*5*
07:30 AM	---	07:45 AM	1	1	4	0	1	1	1	6	*15*
07:45 AM	---	08:00 AM	1	1	4	0	5	1	2	7	*21*
08:00 AM	---	08:15 AM	1	3	4	2	6	1	2	8	*27*
08:15 AM	---	08:30 AM	1	3	4	5	7	2	2	9	*33*
08:30 AM	---	08:45 AM	1	3	6	6	9	4	5	9	*43*
08:45 AM	---	09:00 AM	2	4	8	7	9	6	7	10	*53*
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	0	0	0	0	0	1	0	0	*1*
07:15 AM	---	07:30 AM	0	0	1	0	0	0	1	2	*4*
07:30 AM	---	07:45 AM	1	1	3	0	1	0	0	4	*10*
07:45 AM	---	08:00 AM	0	0	0	0	4	0	1	1	*6*
08:00 AM	---	08:15 AM	0	2	0	2	1	0	0	1	*6*
08:15 AM	---	08:30 AM	0	0	0	3	1	1	0	1	*6*
08:30 AM	---	08:45 AM	0	0	2	1	2	2	3	0	*10*
08:45 AM	---	09:00 AM	1	1	2	1	0	2	2	1	*10*
HOURLY TOTALS											
07:00 AM	---	08:00 AM	1	1	4	0	5	1	2	7	*21*
07:15 AM	---	08:15 AM	1	3	4	2	6	0	2	8	*26*
07:30 AM	---	08:30 AM	1	3	3	5	7	1	1	7	*28*
07:45 AM	---	08:45 AM	0	2	2	6	8	3	4	3	*28*
08:00 AM	---	09:00 AM	1	3	4	7	4	5	5	3	*32*

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7:45 AM to 8:45 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	10	5	3	10	**28**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	2	11	8	7	**28**

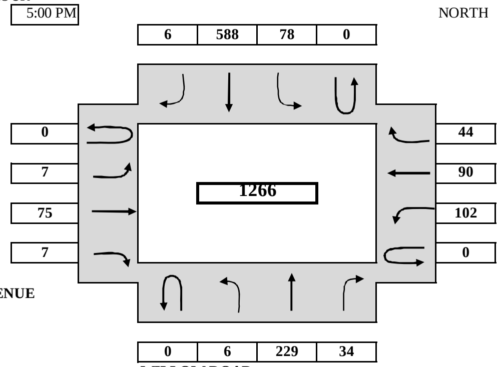
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	WILLOW ROAD	SURVEY TIME:	4:00 PM	TO	6:00 PM
E-W APPROACH:	GILBERT AVENUE	JURISDICTION:	PALO ALTO	FILE:	3805030-1PM

PEAK HOUR
4:00 PM to 5:00 PM

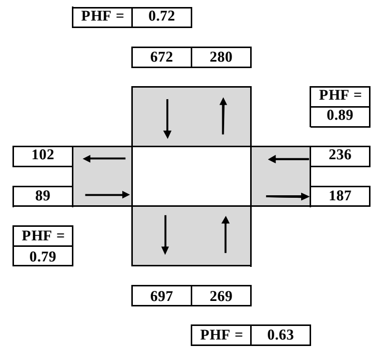
NORTH



GILBERT AVENUE

WILLOW ROAD

ARRIVAL / DEPARTURE VOLUMES



TIME From	PERIOD To		NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM		0	97	9		14	156	3		2	17	1		30	18	18	**365**
4:15 PM	to	4:30 PM		4	159	15		31	371	4		5	41	2		59	42	27	**760**
4:30 PM	to	4:45 PM		5	194	28		53	440	4		6	60	5		81	71	34	**981**
4:45 PM	to	5:00 PM		6	229	34		78	588	6		7	75	7		102	90	44	**1266**
5:00 PM	to	5:15 PM		8	267	46		104	704	7		12	90	12		124	107	54	**1535**
5:15 PM	to	5:30 PM		8	311	61		126	859	11		15	101	14		146	138	60	**1850**
5:30 PM	to	5:45 PM		9	330	63		140	992	11		19	123	20		159	156	68	**2090**
5:45 PM	to	6:00 PM		9	351	77		166	1125	13		21	135	23		180	172	75	**2347**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	97	9	0	14	156	3	0	2	17	1	0	30	18	18	**365**
4:15 PM	to	4:30 PM	0	4	62	6	0	17	215	1	0	3	24	1	0	29	24	9	**395**
4:30 PM	to	4:45 PM	0	1	35	13	0	22	69	0	0	1	19	3	0	22	29	7	**221**
4:45 PM	to	5:00 PM	0	1	35	6	0	25	148	2	0	1	15	2	0	21	19	10	**285**
5:00 PM	to	5:15 PM	0	2	38	12	0	26	116	1	0	5	15	5	0	22	17	10	**269**
5:15 PM	to	5:30 PM	0	0	44	15	0	22	155	4	0	3	11	2	0	22	31	6	**315**
5:30 PM	to	5:45 PM	0	1	19	2	0	14	133	0	0	4	22	6	0	13	18	8	**240**
5:45 PM	to	6:00 PM	0	0	21	14	0	26	133	2	0	2	12	3	0	21	16	7	**257**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	6	229	34	0	78	588	6	0	7	75	7	0	102	90	44	**1266**
4:15 PM	to	5:15 PM	0	8	170	37	0	90	548	4	0	10	73	11	0	94	89	36	**1170**
4:30 PM	to	5:30 PM	0	4	152	46	0	95	488	7	0	10	60	12	0	87	96	33	**1090**
4:45 PM	to	5:45 PM	0	4	136	35	0	87	552	7	0	13	63	15	0	78	85	34	**1109**
5:00 PM	to	6:00 PM	0	3	122	43	0	88	537	7	0	14	60	16	0	78	82	31	**1081**

PEAK HOUR SUMMARY

4:00 PM to 5:00 PM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	6	229	34	0	78	588	6	0	7	75	7	0	102	90	44	**1266**
PHF BY MOVEMENT	0.00	0.38	0.59	0.65	0.00	0.78	0.68	0.50	0.00	0.58	0.78	0.58	0.00	0.85	0.78	0.61	OVERALL
PHF BY APPROACH	NB: 0.63				SB: 0.72				EB: 0.79				WB: 0.89				0.80
BICYCLE	NB: 11				SB: 5				EB: 9				WB: 0				**25**
PEDESTRIAN	NB: 18				SB: 7				EB: 7				WB: 8				**40**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	6				9				17				8				**40**

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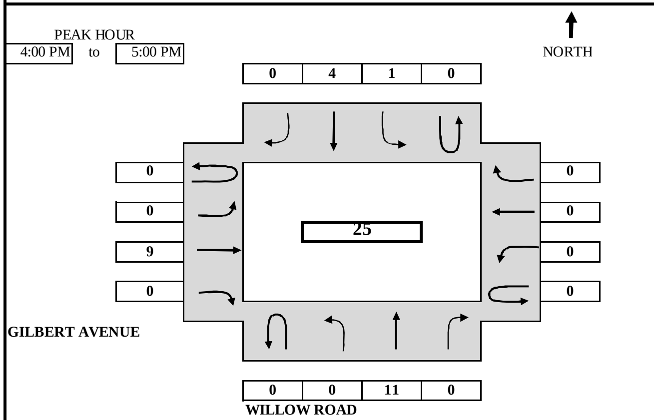
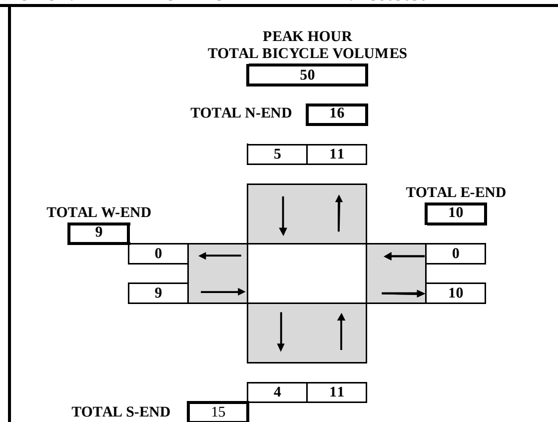
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	WILLOW ROAD	SURVEY TIME:	4:00 PM	TO	6:00 PM
E-W APPROACH:	GILBERT AVENUE	JURISDICTION:	PALO ALTO	FILE:	3805030-1PM





TIME PERIOD From		To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	4
4:15 PM	to	4:30 PM	0	0	3	0	0	0	2	0	0	0	5	0	0	0	0	0	10
4:30 PM	to	4:45 PM	0	0	10	0	0	0	3	0	0	0	6	0	0	0	0	0	19
4:45 PM	to	5:00 PM	0	0	11	0	0	1	4	0	0	0	9	0	0	0	0	0	25
5:00 PM	to	5:15 PM	0	0	14	0	0	1	7	0	0	0	11	0	0	0	0	0	33
5:15 PM	to	5:30 PM	0	0	20	0	0	1	10	0	0	0	13	0	0	0	0	0	44
5:30 PM	to	5:45 PM	0	0	22	0	0	1	12	0	0	0	15	0	0	0	0	0	50
5:45 PM	to	6:00 PM	0	0	26	0	0	3	18	0	0	0	17	1	0	1	2	0	68
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	4
4:15 PM	to	4:30 PM	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	6
4:30 PM	to	4:45 PM	0	0	7	0	0	0	1	0	0	0	1	0	0	0	0	0	9
4:45 PM	to	5:00 PM	0	0	1	0	0	1	1	0	0	0	3	0	0	0	0	0	6
5:00 PM	to	5:15 PM	0	0	3	0	0	0	3	0	0	0	2	0	0	0	0	0	8
5:15 PM	to	5:30 PM	0	0	6	0	0	0	3	0	0	0	2	0	0	0	0	0	11
5:30 PM	to	5:45 PM	0	0	2	0	0	0	2	0	0	0	2	0	0	0	0	0	6
5:45 PM	to	6:00 PM	0	0	4	0	0	2	6	0	0	0	2	1	0	1	2	0	18
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	11	0	0	1	4	0	0	0	9	0	0	0	0	0	25
4:15 PM	to	5:15 PM	0	0	13	0	0	1	5	0	0	0	10	0	0	0	0	0	29
4:30 PM	to	5:30 PM	0	0	17	0	0	1	8	0	0	0	8	0	0	0	0	0	34
4:45 PM	to	5:45 PM	0	0	12	0	0	1	9	0	0	0	9	0	0	0	0	0	31
5:00 PM	to	6:00 PM	0	0	15	0	0	2	14	0	0	0	8	1	0	1	2	0	43

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

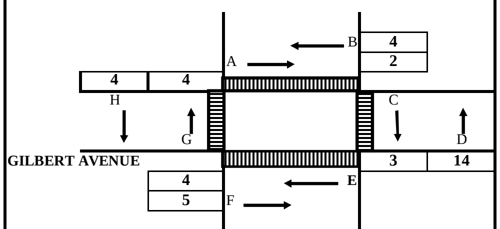
4:00 PM to 5:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	11	5	9	0	25

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

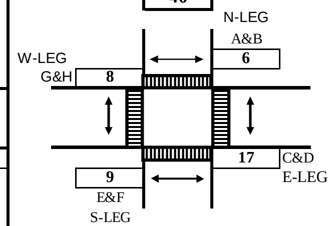
PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WILLOW ROAD**	**DAY:**	**TUESDAY**
E-W APPROACH:	**GILBERT AVENUE**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD:	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-1PM**

PEAK HOUR
04:00 PM TO 05:00 PM



LEGEND: **WILLOW ROAD**
CROSSWALK
SIDEWALK
STOP CONTROL LINE
STOP

PEAK HOUR
TOTAL PEDESTRIAN VOLUMES
40



BY LEG:	
N-LEG	6
S-LEG	9
E-LEG	17
W-LEG	8

BY DIRECTION:	
NB(D+G)	18
SB(C+H)	7
EB(A+F)	7
WB(B+E)	8

TIME PERIOD			NORTH X-WALK		EAST X-WALK		SOUTH X-WALK		WEST X-WALK		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
04:00 PM	---	04:15 PM	0	2	0	6	3	1	0	2	*14*
04:15 PM	---	04:30 PM	0	2	2	7	3	3	0	4	*21*
04:30 PM	---	04:45 PM	1	4	2	12	3	5	2	4	*33*
04:45 PM	---	05:00 PM	2	4	3	14	4	5	4	4	*40*
05:00 PM	---	05:15 PM	4	5	4	19	4	5	4	6	*51*
05:15 PM	---	05:30 PM	4	5	10	19	5	8	8	9	*68*
05:30 PM	---	05:45 PM	4	7	13	28	11	11	10	9	*93*
05:45 PM	---	06:00 PM	6	7	13	31	12	11	12	9	*101*
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	0	2	0	6	3	1	0	2	*14*
04:15 PM	---	04:30 PM	0	0	2	1	0	2	0	2	*7*
04:30 PM	---	04:45 PM	1	2	0	5	0	2	2	0	*12*
04:45 PM	---	05:00 PM	1	0	1	2	1	0	2	0	*7*
05:00 PM	---	05:15 PM	2	1	1	5	0	0	0	2	*11*
05:15 PM	---	05:30 PM	0	0	6	0	1	3	4	3	*17*
05:30 PM	---	05:45 PM	0	2	3	9	6	3	2	0	*25*
05:45 PM	---	06:00 PM	2	0	0	3	1	0	2	0	*8*
HOURLY TOTALS											
04:00 PM	---	05:00 PM	2	4	3	14	4	5	4	4	*40*
04:15 PM	---	05:15 PM	4	3	4	13	1	4	4	4	*37*
04:30 PM	---	05:30 PM	4	3	8	12	2	5	8	5	*47*
04:45 PM	---	05:45 PM	3	3	11	16	8	6	8	5	*60*
05:00 PM	---	06:00 PM	4	3	10	17	8	6	8	5	*61*

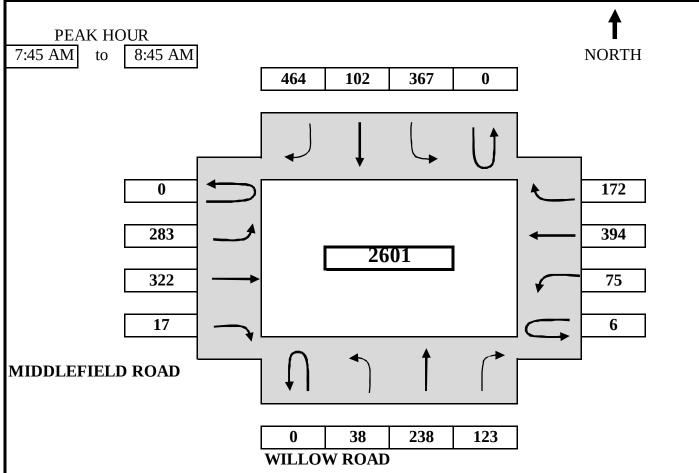
Tel : (510) 232-1271 ***Fax: (510) 232-1272***

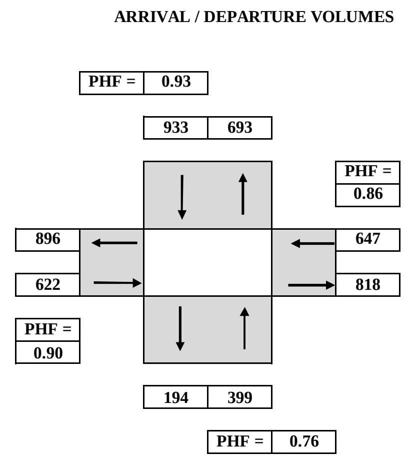
4:00 PM to 5:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	18	7	7	8	**40**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	6	9	17	8	**40**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WILLOW ROAD**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-2AM**





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM		1	20	12		100	14	122		37	43	1	0	7	45	20	**422**
7:15 AM	to	7:30 AM		2	51	27		177	27	217		82	86	1	0	19	117	46	**852**
7:30 AM	to	7:45 AM		5	92	37		266	42	351		134	148	3	1	41	217	86	**1423**
7:45 AM	to	8:00 AM		12	133	57		373	68	468		193	219	7	1	62	318	121	**2032**
8:00 AM	to	8:15 AM		19	215	100		452	93	590		274	286	10	3	82	396	170	**2690**
8:15 AM	to	8:30 AM		33	270	131		541	118	691		338	383	13	5	97	493	208	**3321**
8:30 AM	to	8:45 AM		43	330	160		633	144	815		417	470	20	7	116	611	258	**4024**
8:45 AM	to	9:00 AM		48	382	176		716	164	921		488	585	24	8	131	687	302	**4632**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	1	20	12	0	100	14	122	0	37	43	1	0	7	45	20	**422**
7:15 AM	to	7:30 AM	0	1	31	15	0	77	13	95	0	45	43	0	0	12	72	26	**430**
7:30 AM	to	7:45 AM	0	3	41	10	0	89	15	134	0	52	62	2	1	22	100	40	**571**
7:45 AM	to	8:00 AM	0	7	41	20	0	107	26	117	0	59	71	4	0	21	101	35	**609**
8:00 AM	to	8:15 AM	0	7	82	43	0	79	25	122	0	81	67	3	2	20	78	49	**658**
8:15 AM	to	8:30 AM	0	14	55	31	0	89	25	101	0	64	97	3	2	15	97	38	**631**
8:30 AM	to	8:45 AM	0	10	60	29	0	92	26	124	0	79	87	7	2	19	118	50	**703**
8:45 AM	to	9:00 AM	0	5	52	16	0	83	20	106	0	71	115	4	1	15	76	44	**608**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	12	133	57	0	373	68	468	0	193	219	7	1	62	318	121	**2032**
7:15 AM	to	8:15 AM	0	18	195	88	0	352	79	468	0	237	243	9	3	75	351	150	**2268**
7:30 AM	to	8:30 AM	0	31	219	104	0	364	91	474	0	256	297	12	5	78	376	162	**2469**
7:45 AM	to	8:45 AM	0	38	238	123	0	367	102	464	0	283	322	17	6	75	394	172	**2601**
8:00 AM	to	9:00 AM	0	36	249	119	0	343	96	453	0	295	366	17	7	69	369	181	**2600**

PEAK HOUR SUMMARY

7:45 AM to 8:45 AM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	38	238	123	0	367	102	464	0	283	322	17	6	75	394	172	**2601**
PHF BY MOVEMENT	0.00	0.68	0.73	0.72	0.00	0.86	0.98	0.94	0.00	0.87	0.83	0.61	0.75	0.89	0.83	0.86	OVERALL

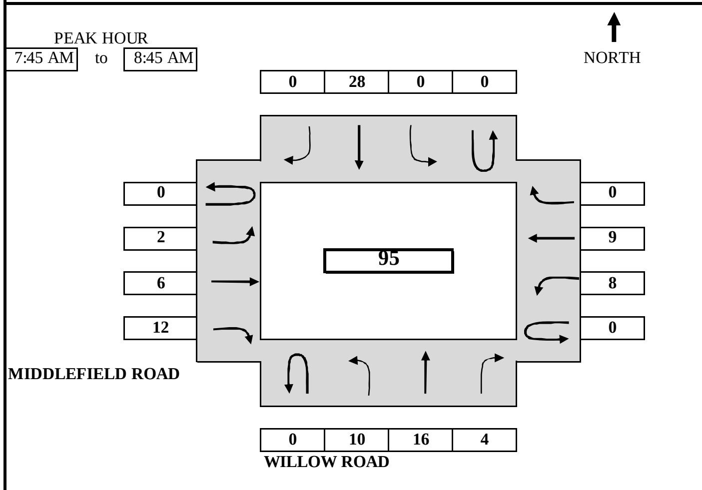
	NORTHBOUND	SOUTHBOUND	EASTBOUND	WESTBOUND	TOTAL
PHF BY APPROACH	0.76	0.93	0.90	0.86	0.92
BICYCLE	30	28	20	17	**95**
PEDESTRIAN	11	43	6	17	**77**
	N-LEG	**S-LEG**	**E-LEG**	**W-LEG**	
PEDESTRIAN BY LEG:	22	1	31	23	**77**

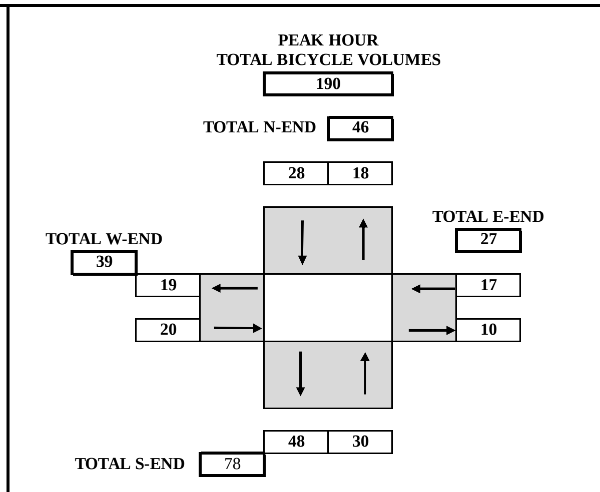
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	WILLOW ROAD	SURVEY TIME:	7:00 AM	TO	9:00 AM
E-W APPROACH:	MIDDLEFIELD ROAD	JURISDICTION:	PALO ALTO	FILE:	3805030-2AM





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	1	1	0	0	0	4	0	0	0	1	1	0	0	1	0	9
7:15 AM	to	7:30 AM	0	5	3	0	0	0	8	0	0	0	1	2	0	0	3	0	22
7:30 AM	to	7:45 AM	0	10	5	3	0	0	13	0	0	0	1	2	0	1	3	1	39
7:45 AM	to	8:00 AM	0	12	10	5	0	0	19	0	0	1	1	4	0	6	4	1	63
8:00 AM	to	8:15 AM	0	13	13	6	0	0	21	0	0	2	4	9	0	7	4	1	80
8:15 AM	to	8:30 AM	0	17	17	7	0	0	28	0	0	2	6	13	0	8	7	1	106
8:30 AM	to	8:45 AM	0	20	21	7	0	0	41	0	0	2	7	14	0	9	12	1	134
8:45 AM	to	9:00 AM	0	23	23	8	0	0	46	0	0	2	9	14	0	9	13	1	148
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	1	1	0	0	0	4	0	0	0	1	1	0	0	1	0	9
7:15 AM	to	7:30 AM	0	4	2	0	0	0	4	0	0	0	0	1	0	0	2	0	13
7:30 AM	to	7:45 AM	0	5	2	3	0	0	5	0	0	0	0	0	0	1	0	1	17
7:45 AM	to	8:00 AM	0	2	5	2	0	0	6	0	0	1	0	2	0	5	1	0	24
8:00 AM	to	8:15 AM	0	1	3	1	0	0	2	0	0	1	3	5	0	1	0	0	17
8:15 AM	to	8:30 AM	0	4	4	1	0	0	7	0	0	0	2	4	0	1	3	0	26
8:30 AM	to	8:45 AM	0	3	4	0	0	0	13	0	0	0	1	1	0	1	5	0	28
8:45 AM	to	9:00 AM	0	3	2	1	0	0	5	0	0	0	2	0	0	0	1	0	14
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	12	10	5	0	0	19	0	0	1	1	4	0	6	4	1	63
7:15 AM	to	8:15 AM	0	12	12	6	0	0	17	0	0	2	3	8	0	7	3	1	71
7:30 AM	to	8:30 AM	0	12	14	7	0	0	20	0	0	2	5	11	0	8	4	1	84
7:45 AM	to	8:45 AM	0	10	16	4	0	0	28	0	0	2	6	12	0	8	9	0	95
8:00 AM	to	9:00 AM	0	11	13	3	0	0	27	0	0	1	8	10	0	3	9	0	85

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

7:45 AM to 8:45 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	30	28	20	17	**95**

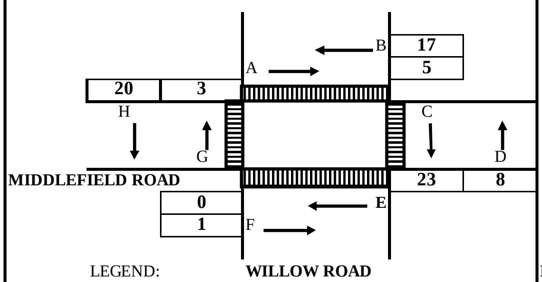
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WILLOW ROAD**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-2AM**

PEAK HOUR

07:45 AM TO 08:45 AM

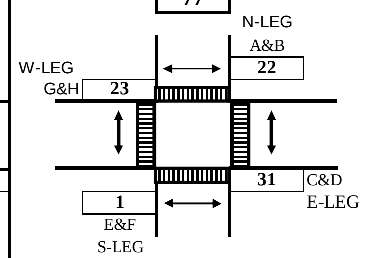


LEGEND:
- CROSSWALK
- SIDEWALK
- STOP CONTROL LINE
- STOP

PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

77



BY LEG:	
N-LEG	22
S-LEG	1
E-LEG	31
W-LEG	23

BY DIRECTION:	
NB(D+G)	11
SB(C+H)	43
EB(A+F)	6
WB(B+E)	17

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
07:00 AM	---	07:15 AM	0	0	1	0	0	1	0	0	*2*
07:15 AM	---	07:30 AM	0	0	4	2	0	2	0	1	*9*
07:30 AM	---	07:45 AM	0	0	8	2	0	2	2	1	*15*
07:45 AM	---	08:00 AM	1	8	19	2	0	2	2	16	*50*
08:00 AM	---	08:15 AM	5	9	24	4	0	2	2	16	*62*
08:15 AM	---	08:30 AM	5	15	28	7	0	3	4	19	*81*
08:30 AM	---	08:45 AM	5	17	31	10	0	3	5	21	*92*
08:45 AM	---	09:00 AM	9	19	33	16	0	3	5	23	*108*
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	0	0	1	0	0	1	0	0	*2*
07:15 AM	---	07:30 AM	0	0	3	2	0	1	0	1	*7*
07:30 AM	---	07:45 AM	0	0	4	0	0	0	2	0	*6*
07:45 AM	---	08:00 AM	1	8	11	0	0	0	0	15	*35*
08:00 AM	---	08:15 AM	4	1	5	2	0	0	0	0	*12*
08:15 AM	---	08:30 AM	0	6	4	3	0	1	2	3	*19*
08:30 AM	---	08:45 AM	0	2	3	3	0	0	1	2	*11*
08:45 AM	---	09:00 AM	4	2	2	6	0	0	0	2	*16*
HOURLY TOTALS											
07:00 AM	---	08:00 AM	1	8	19	2	0	2	2	16	*50*
07:15 AM	---	08:15 AM	5	9	23	4	0	1	2	16	*60*
07:30 AM	---	08:30 AM	5	15	24	5	0	1	4	18	*72*
07:45 AM	---	08:45 AM	5	17	23	8	0	1	3	20	*77*
08:00 AM	---	09:00 AM	8	11	14	14	0	1	3	7	*58*

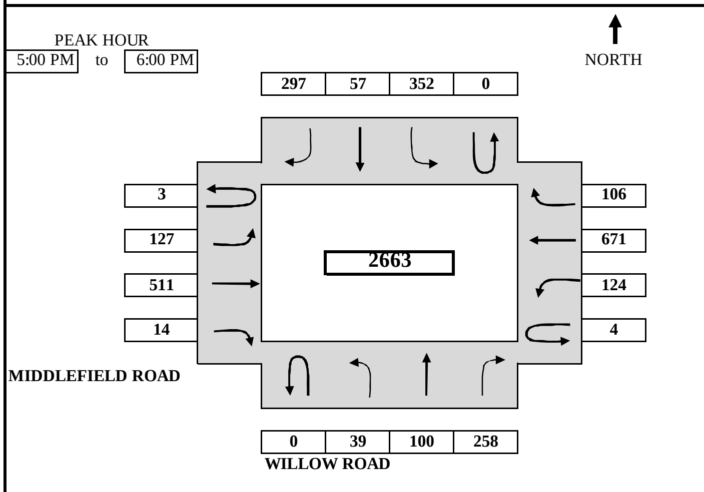
Tel : (510) 232-1271 ***Fax: (510) 232-1272***

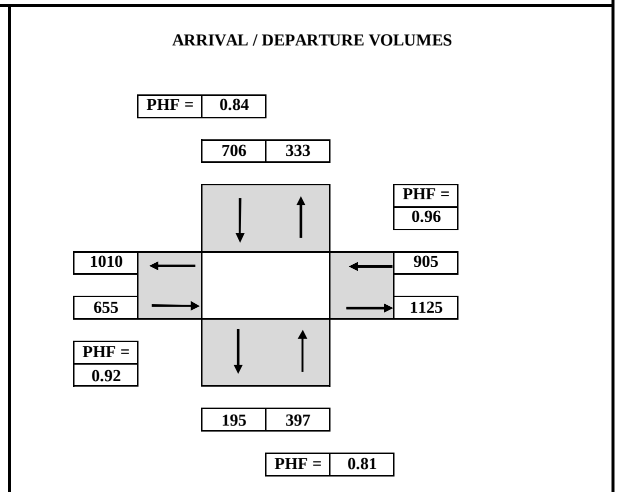
7:45 AM to 8:45 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	11	43	6	17	**77**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	22	1	31	23	**77**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	WILLOW ROAD	SURVEY TIME:	4:00 PM	TO	6:00 PM
E-W APPROACH:	MIDDLEFIELD ROAD	JURISDICTION:	PALO ALTO	FILE:	3805030-2PM





TIME From		PERIOD To	NORTHBOUND U-TURN	NB LEFT	NB THRU	NB RIGHT	SOUTHBOUND U-TURN	SB LEFT	SB THRU	SB RIGHT	EASTBOUND U-TURN	EB LEFT	EB THRU	EB RIGHT	WESTBOUND U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM		8	18	51		95	22	75	1	42	128	0	0	13	105	38	**596**
4:15 PM	to	4:30 PM		11	42	100		179	44	161	2	93	262	3	1	32	213	58	**1201**
4:30 PM	to	4:45 PM		28	58	166		251	69	232	2	133	383	6	2	54	340	73	**1797**
4:45 PM	to	5:00 PM		35	79	225		334	85	306	2	160	480	9	2	86	466	94	**2363**
5:00 PM	to	5:15 PM		42	114	306		423	101	375	2	196	620	11	5	116	629	122	**3062**
5:15 PM	to	5:30 PM		52	136	362		484	116	441	2	225	748	16	6	146	782	150	**3666**
5:30 PM	to	5:45 PM		64	164	435		591	134	526	4	259	872	18	6	179	959	176	**4387**
5:45 PM	to	6:00 PM		74	179	483		686	142	603	5	287	991	23	6	210	1137	200	**5026**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	8	18	51	0	95	22	75	1	42	128	0	0	13	105	38	**596**
4:15 PM	to	4:30 PM	0	3	24	49	0	84	22	86	1	51	134	3	1	19	108	20	**605**
4:30 PM	to	4:45 PM	0	17	16	66	0	72	25	71	0	40	121	3	1	22	127	15	**596**
4:45 PM	to	5:00 PM	0	7	21	59	0	83	16	74	0	27	97	3	0	32	126	21	**566**
5:00 PM	to	5:15 PM	0	7	35	81	0	89	16	69	0	36	140	2	3	30	163	28	**699**
5:15 PM	to	5:30 PM	0	10	22	56	0	61	15	66	0	29	128	5	1	30	153	28	**604**
5:30 PM	to	5:45 PM	0	12	28	73	0	107	18	85	2	34	124	2	0	33	177	26	**721**
5:45 PM	to	6:00 PM	0	10	15	48	0	95	8	77	1	28	119	5	0	31	178	24	**639**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	35	79	225	0	334	85	306	2	160	480	9	2	86	466	94	**2363**
4:15 PM	to	5:15 PM	0	34	96	255	0	328	79	300	1	154	492	11	5	103	524	84	**2466**
4:30 PM	to	5:30 PM	0	41	94	262	0	305	72	280	0	132	486	13	5	114	569	92	**2465**
4:45 PM	to	5:45 PM	0	36	106	269	0	340	65	294	2	126	489	12	4	125	619	103	**2590**
5:00 PM	to	6:00 PM	0	39	100	258	0	352	57	297	3	127	511	14	4	124	671	106	**2663**

PEAK HOUR SUMMARY

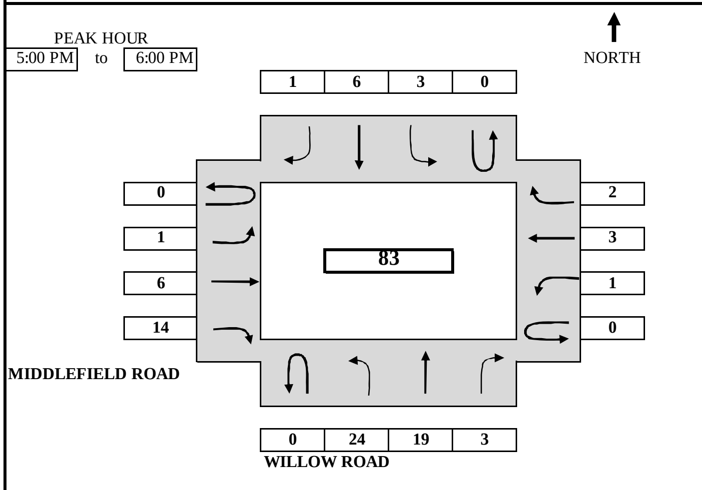
5:00 PM to 6:00 PM	NORTHBOUND NBU	NBL	NBT	NBR	SOUTHBOUND SBU	SBL	SBT	SBR	EASTBOUND EBU	EBL	EBT	EBR	WESTBOUND WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	39	100	258	0	352	57	297	3	127	511	14	4	124	671	106	**2663**
PHF BY MOVEMENT	0.00	0.81	0.71	0.80	0.00	0.82	0.79	0.87	0.38	0.88	0.91	0.70	0.33	0.94	0.94	0.95	OVERALL
PHF BY APPROACH	0.81				0.84				0.92				0.96				0.92
BICYCLE	46				10				21				6				**83**
PEDESTRIAN	16				23				9				5				**53**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	9				5				28				11				**53**

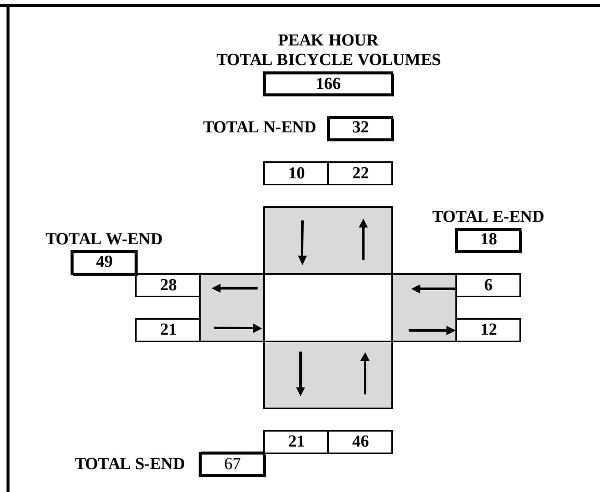
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	WILLOW ROAD	SURVEY TIME:	4:00 PM	TO	6:00 PM
E-W APPROACH:	MIDDLEFIELD ROAD	JURISDICTION:	PALO ALTO	FILE:	3805030-2PM





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	3	1	0	0	0	2	1	0	0	0	1	1	0	0	1	**10**
4:15 PM	to	4:30 PM	0	5	4	0	0	1	2	1	0	0	1	1	1	0	0	1	**17**
4:30 PM	to	4:45 PM	0	8	15	0	0	1	2	1	0	1	2	3	1	0	1	1	**36**
4:45 PM	to	5:00 PM	0	11	21	1	0	1	6	2	0	1	3	3	1	0	2	1	**53**
5:00 PM	to	5:15 PM	0	13	24	3	0	1	8	2	0	1	4	9	1	0	3	2	**71**
5:15 PM	to	5:30 PM	0	15	27	3	0	2	8	2	0	1	5	12	1	1	3	3	**83**
5:30 PM	to	5:45 PM	0	26	34	4	0	2	9	2	0	1	7	14	1	1	4	3	**108**
5:45 PM	to	6:00 PM	0	35	40	4	0	4	12	3	0	2	9	17	1	1	5	3	**136**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	3	1	0	0	0	2	1	0	0	0	1	1	0	0	1	**10**
4:15 PM	to	4:30 PM	0	2	3	0	0	1	0	0	0	0	1	0	0	0	0	0	**7**
4:30 PM	to	4:45 PM	0	3	11	0	0	0	0	0	0	1	1	2	0	0	1	0	**19**
4:45 PM	to	5:00 PM	0	3	6	1	0	0	4	1	0	0	1	0	0	0	1	0	**17**
5:00 PM	to	5:15 PM	0	2	3	2	0	0	2	0	0	0	1	6	0	0	1	1	**18**
5:15 PM	to	5:30 PM	0	2	3	0	0	1	0	0	0	0	1	3	0	1	0	1	**12**
5:30 PM	to	5:45 PM	0	11	7	1	0	0	1	0	0	0	2	2	0	0	1	0	**25**
5:45 PM	to	6:00 PM	0	9	6	0	0	2	3	1	0	1	2	3	0	0	1	0	**28**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	11	21	1	0	1	6	2	0	1	3	3	1	0	2	1	**53**
4:15 PM	to	5:15 PM	0	10	23	3	0	1	6	1	0	1	4	8	0	0	3	1	**61**
4:30 PM	to	5:30 PM	0	10	23	3	0	1	6	1	0	1	4	11	0	1	3	2	**66**
4:45 PM	to	5:45 PM	0	18	19	4	0	1	7	1	0	0	5	11	0	1	3	2	**72**
5:00 PM	to	6:00 PM	0	24	19	3	0	3	6	1	0	1	6	14	0	1	3	2	**83**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

5:00 PM to 6:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	46	10	21	6	**83**

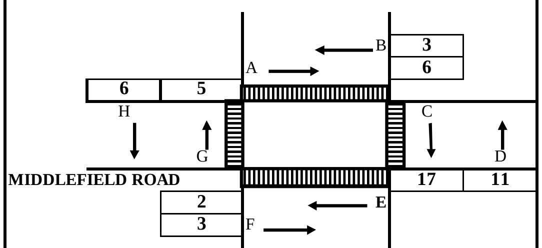
B . A . Y . M . E . T . R . I . C . S .

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WILLOW ROAD**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-2PM**

PEAK HOUR

05:00 PM TO 06:00 PM



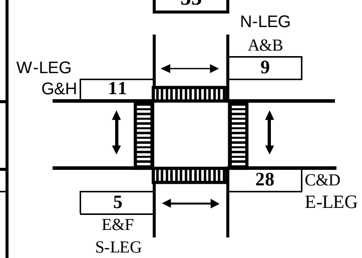
WILLOW ROAD

LEGEND:
- CROSSWALK
- SIDEWALK
- STOP CONTROL LINE
- STOP

PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

53



BY LEG:	
N-LEG	9
S-LEG	5
E-LEG	28
W-LEG	11

BY DIRECTION:	
NB(D+G)	16
SB(C+H)	23
EB(A+F)	9
WB(B+E)	5

TIME PERIOD			NORTH X-WALK		EAST X-WALK		SOUTH X-WALK		WEST X-WALK		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
04:00 PM	---	04:15 PM	1	1	0	0	0	0	1	1	*4*
04:15 PM	---	04:30 PM	2	4	1	3	1	0	1	1	*13*
04:30 PM	---	04:45 PM	2	5	2	5	1	0	2	1	*18*
04:45 PM	---	05:00 PM	3	6	4	11	4	0	3	3	*34*
05:00 PM	---	05:15 PM	4	6	8	18	5	1	4	8	*54*
05:15 PM	---	05:30 PM	5	6	16	20	5	1	4	9	*66*
05:30 PM	---	05:45 PM	6	8	20	21	5	3	7	9	*79*
05:45 PM	---	06:00 PM	9	9	21	22	6	3	8	9	*87*
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	1	1	0	0	0	0	1	1	*4*
04:15 PM	---	04:30 PM	1	3	1	3	1	0	0	0	*9*
04:30 PM	---	04:45 PM	0	1	1	2	0	0	1	0	*5*
04:45 PM	---	05:00 PM	1	1	2	6	3	0	1	2	*16*
05:00 PM	---	05:15 PM	1	0	4	7	1	1	1	5	*20*
05:15 PM	---	05:30 PM	1	0	8	2	0	0	0	1	*12*
05:30 PM	---	05:45 PM	1	2	4	1	0	2	3	0	*13*
05:45 PM	---	06:00 PM	3	1	1	1	1	0	1	0	*8*
HOURLY TOTALS											
04:00 PM	---	05:00 PM	3	6	4	11	4	0	3	3	*34*
04:15 PM	---	05:15 PM	3	5	8	18	5	1	3	7	*50*
04:30 PM	---	05:30 PM	3	2	15	17	4	1	3	8	*53*
04:45 PM	---	05:45 PM	4	3	18	16	4	3	5	8	*61*
05:00 PM	---	06:00 PM	6	3	17	11	2	3	5	6	*53*

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

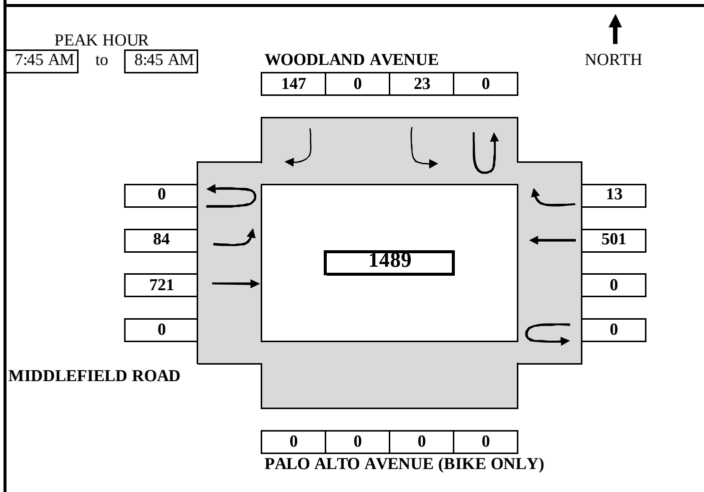
5:00 PM to 6:00 PM

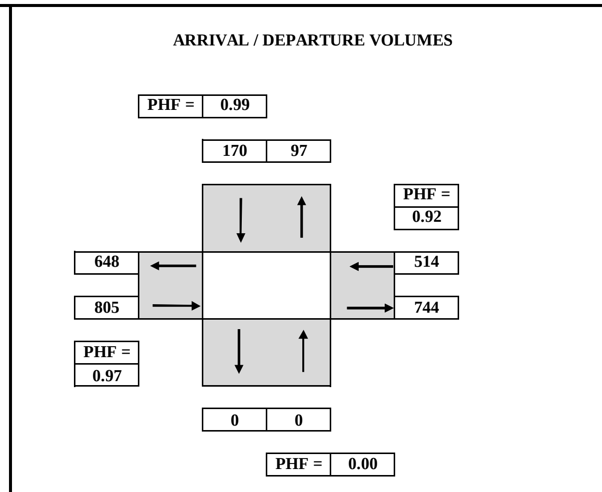
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	16	23	9	5	**53**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	9	5	28	11	**53**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE - WOODLAND AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-3AM**





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM						5		13		3	141				65	1	**228**
7:15 AM	to	7:30 AM						9		60		7	275				147	2	**500**
7:30 AM	to	7:45 AM						18		113		12	437				269	5	**854**
7:45 AM	to	8:00 AM						22		152		24	622				381	11	**1212**
8:00 AM	to	8:15 AM						30		186		51	790				506	15	**1578**
8:15 AM	to	8:30 AM						36		222		75	973				632	17	**1955**
8:30 AM	to	8:45 AM						41		260		96	1158				770	18	**2343**
8:45 AM	to	9:00 AM						45		275		115	1346				889	19	**2689**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	5	0	13	0	3	141	0	0	0	65	1	**228**
7:15 AM	to	7:30 AM	0	0	0	0	0	4	0	47	0	4	134	0	0	0	82	1	**272**
7:30 AM	to	7:45 AM	0	0	0	0	0	9	0	53	0	5	162	0	0	0	122	3	**354**
7:45 AM	to	8:00 AM	0	0	0	0	0	4	0	39	0	12	185	0	0	0	112	6	**358**
8:00 AM	to	8:15 AM	0	0	0	0	0	8	0	34	0	27	168	0	0	0	125	4	**366**
8:15 AM	to	8:30 AM	0	0	0	0	0	6	0	36	0	24	183	0	0	0	126	2	**377**
8:30 AM	to	8:45 AM	0	0	0	0	0	5	0	38	0	21	185	0	0	0	138	1	**388**
8:45 AM	to	9:00 AM	0	0	0	0	0	4	0	15	0	19	188	0	0	0	119	1	**346**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	22	0	152	0	24	622	0	0	0	381	11	**1212**
7:15 AM	to	8:15 AM	0	0	0	0	0	25	0	173	0	48	649	0	0	0	441	14	**1350**
7:30 AM	to	8:30 AM	0	0	0	0	0	27	0	162	0	68	698	0	0	0	485	15	**1455**
7:45 AM	to	8:45 AM	0	0	0	0	0	23	0	147	0	84	721	0	0	0	501	13	**1489**
8:00 AM	to	9:00 AM	0	0	0	0	0	23	0	123	0	91	724	0	0	0	508	8	**1477**

PEAK HOUR SUMMARY

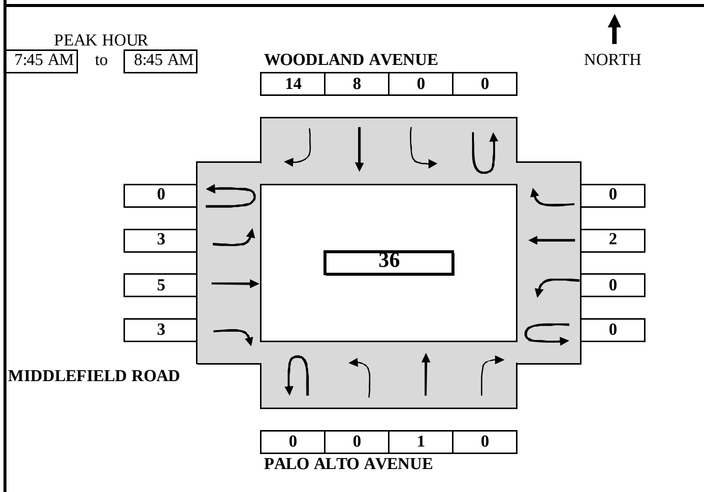
7:45 AM to 8:45 AM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	0	0	0	0	23	0	147	0	84	721	0	0	0	501	13	**1489**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.94	0.00	0.78	0.97	0.00	0.00	0.00	0.91	0.54	OVERALL
PHF BY APPROACH	0.00				0.99				0.97				0.92				0.96
BICYCLE	1				22				11				2				**36**
PEDESTRIAN	2				4				8				3				**17**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	5				6				6				0				**17**

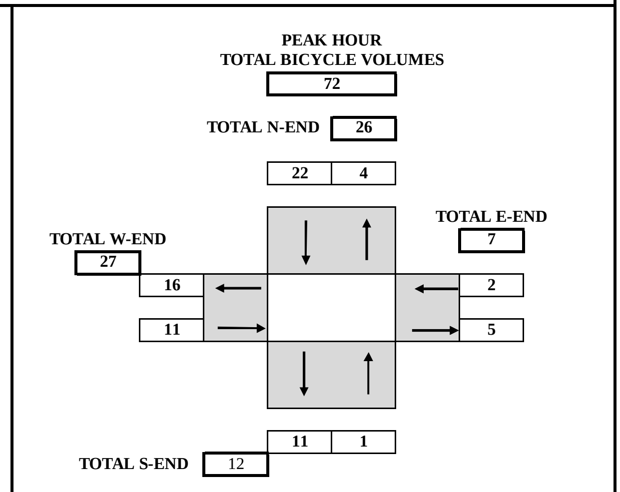
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	PALO ALTO AVENUE - WOODLAND AVENUE	SURVEY TIME:	7:00 AM	TO	9:00 AM
E-W APPROACH:	MIDDLEFIELD ROAD	JURISDICTION:	PALO ALTO	FILE:	3805030-3AM





TIME From	PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																		
7:00 AM	to 7:15 AM	0	0	2	0	0	0	1	0	0	0	1	0	0	0	1	0	**5**
7:15 AM	to 7:30 AM	0	2	3	0	0	0	2	1	0	0	2	0	0	0	1	0	**11**
7:30 AM	to 7:45 AM	0	2	3	0	0	0	5	5	0	1	4	0	0	0	2	0	**22**
7:45 AM	to 8:00 AM	0	2	3	0	0	0	7	16	0	2	5	0	0	0	3	0	**38**
8:00 AM	to 8:15 AM	0	2	3	0	0	0	11	16	0	2	8	1	0	0	3	0	**46**
8:15 AM	to 8:30 AM	0	2	3	0	0	0	12	17	0	3	9	3	0	0	4	0	**53**
8:30 AM	to 8:45 AM	0	2	4	0	0	0	13	19	0	4	9	3	0	0	4	0	**58**
8:45 AM	to 9:00 AM	0	2	4	0	0	0	14	20	0	5	10	3	0	0	5	1	**64**
TOTAL BY PERIOD																		
7:00 AM	to 7:15 AM	0	0	2	0	0	0	1	0	0	0	1	0	0	0	1	0	**5**
7:15 AM	to 7:30 AM	0	2	1	0	0	0	1	1	0	0	1	0	0	0	0	0	**6**
7:30 AM	to 7:45 AM	0	0	0	0	0	0	3	4	0	1	2	0	0	0	1	0	**11**
7:45 AM	to 8:00 AM	0	0	0	0	0	0	2	11	0	1	1	0	0	0	1	0	**16**
8:00 AM	to 8:15 AM	0	0	0	0	0	0	4	0	0	0	3	1	0	0	0	0	**8**
8:15 AM	to 8:30 AM	0	0	0	0	0	0	1	1	0	1	1	2	0	0	1	0	**7**
8:30 AM	to 8:45 AM	0	0	1	0	0	0	1	2	0	1	0	0	0	0	0	0	**5**
8:45 AM	to 9:00 AM	0	0	0	0	0	0	1	1	0	1	1	0	0	0	1	1	**6**
HOURLY TOTALS																		
7:00 AM	to 8:00 AM	0	2	3	0	0	0	7	16	0	2	5	0	0	0	3	0	**38**
7:15 AM	to 8:15 AM	0	2	1	0	0	0	10	16	0	2	7	1	0	0	2	0	**41**
7:30 AM	to 8:30 AM	0	0	0	0	0	0	10	16	0	3	7	3	0	0	3	0	**42**
7:45 AM	to 8:45 AM	0	0	1	0	0	0	8	14	0	3	5	3	0	0	2	0	**36**
8:00 AM	to 9:00 AM	0	0	1	0	0	0	7	4	0	3	5	3	0	0	2	1	**26**

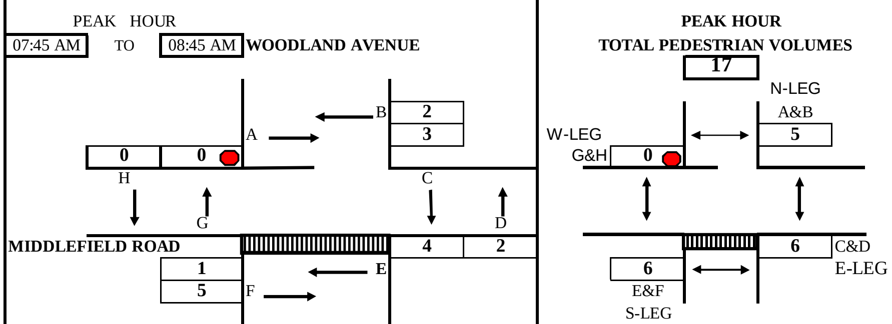
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

7:45 AM to 8:45 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	1	22	11	2	**36**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**PALO ALTO AVENUE WOODLAND AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-3AM**



LEGEND:
- CROSSWALK
- SIDEWALK
- STOP CONTROL LINE
- STOP

BY LEG:	
N-LEG	5
S-LEG	6
E-LEG	6
W-LEG	0

BY DIRECTION:	
NB(D+G)	2
SB(C+H)	4
EB(A+F)	8
WB(B+E)	3

TIME PERIOD From		To	NORTH X-WALK A	B	EAST X-WALK C	D	SOUTH X-WALK E	F	WEST X-WALK G	H	TOTAL
SURVEY DATA											
07:00 AM	---	07:15 AM	0	0	0	0	0	0	0	0	*0*
07:15 AM	---	07:30 AM	3	0	1	0	0	0	0	0	*4*
07:30 AM	---	07:45 AM	4	1	1	0	0	1	0	0	*7*
07:45 AM	---	08:00 AM	5	1	1	0	0	2	0	0	*9*
08:00 AM	---	08:15 AM	5	1	2	0	0	2	0	0	*10*
08:15 AM	---	08:30 AM	5	1	3	2	0	5	0	0	*16*
08:30 AM	---	08:45 AM	7	3	5	2	1	6	0	0	*24*
08:45 AM	---	09:00 AM	7	3	5	2	1	7	0	0	*25*
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	0	0	0	0	0	0	0	0	*0*
07:15 AM	---	07:30 AM	3	0	1	0	0	0	0	0	*4*
07:30 AM	---	07:45 AM	1	1	0	0	0	1	0	0	*3*
07:45 AM	---	08:00 AM	1	0	0	0	0	1	0	0	*2*
08:00 AM	---	08:15 AM	0	0	1	0	0	0	0	0	*1*
08:15 AM	---	08:30 AM	0	0	1	2	0	3	0	0	*6*
08:30 AM	---	08:45 AM	2	2	2	0	1	1	0	0	*8*
08:45 AM	---	09:00 AM	0	0	0	0	0	1	0	0	*1*
HOURLY TOTALS											
07:00 AM	---	08:00 AM	5	1	1	0	0	2	0	0	*9*
07:15 AM	---	08:15 AM	5	1	2	0	0	2	0	0	*10*
07:30 AM	---	08:30 AM	2	1	2	2	0	5	0	0	*12*
07:45 AM	---	08:45 AM	3	2	4	2	1	5	0	0	*17*
08:00 AM	---	09:00 AM	2	2	4	2	1	5	0	0	*16*

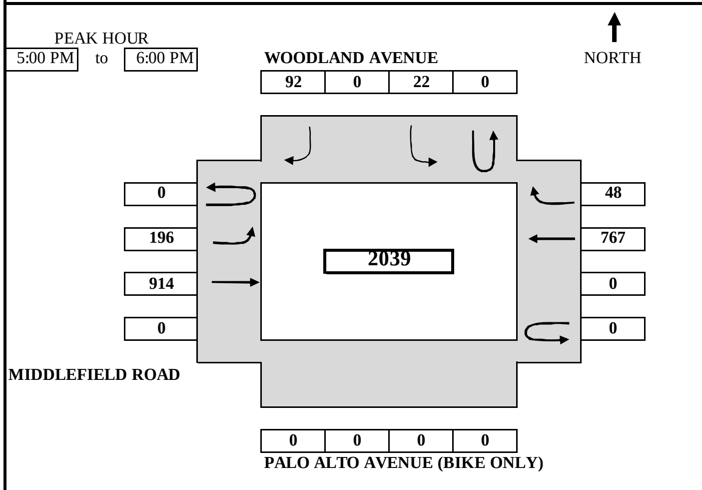
Tel : (510) 232-1271   ***Fax: (510) 232-1272***

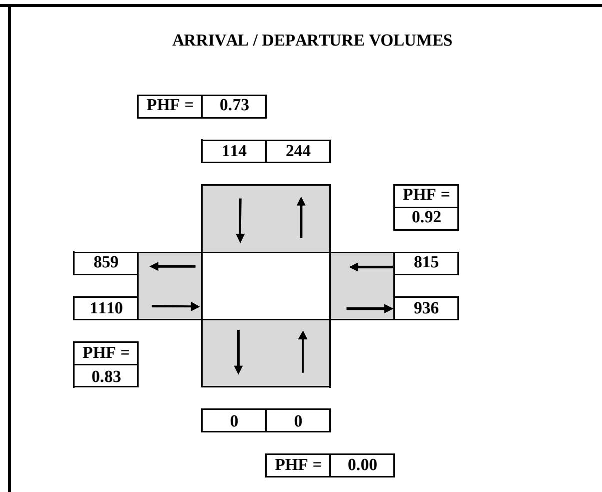
7:45 AM to 8:45 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	2	4	8	3	17
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	5	6	6	0	17

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	PALO ALTO AVENUE - WOODLAND AVENUE	SURVEY TIME:	4:00 PM	TO	6:00 PM
E-W APPROACH:	MIDDLEFIELD ROAD	JURISDICTION:	PALO ALTO	FILE:	3805030-3PM





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM						6		24		46	208				131	8	**423**
4:15 PM	to	4:30 PM						8		54		101	446				278	22	**909**
4:30 PM	to	4:45 PM						12		85		154	655				412	26	**1344**
4:45 PM	to	5:00 PM						21		125		198	823				583	37	**1787**
5:00 PM	to	5:15 PM						25		142		256	1101				777	48	**2349**
5:15 PM	to	5:30 PM						30		163		299	1314				958	56	**2820**
5:30 PM	to	5:45 PM						40		192		354	1553				1161	75	**3375**
5:45 PM	to	6:00 PM						43		217		394	1737				1350	85	**3826**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	6	0	24	0	46	208	0	0	0	131	8	**423**
4:15 PM	to	4:30 PM	0	0	0	0	0	2	0	30	0	55	238	0	0	0	147	14	**486**
4:30 PM	to	4:45 PM	0	0	0	0	0	4	0	31	0	53	209	0	0	0	134	4	**435**
4:45 PM	to	5:00 PM	0	0	0	0	0	9	0	40	0	44	168	0	0	0	171	11	**443**
5:00 PM	to	5:15 PM	0	0	0	0	0	4	0	17	0	58	278	0	0	0	194	11	**562**
5:15 PM	to	5:30 PM	0	0	0	0	0	5	0	21	0	43	213	0	0	0	181	8	**471**
5:30 PM	to	5:45 PM	0	0	0	0	0	10	0	29	0	55	239	0	0	0	203	19	**555**
5:45 PM	to	6:00 PM	0	0	0	0	0	3	0	25	0	40	184	0	0	0	189	10	**451**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	0	0	0	21	0	125	0	198	823	0	0	0	583	37	**1787**
4:15 PM	to	5:15 PM	0	0	0	0	0	19	0	118	0	210	893	0	0	0	646	40	**1926**
4:30 PM	to	5:30 PM	0	0	0	0	0	22	0	109	0	198	868	0	0	0	680	34	**1911**
4:45 PM	to	5:45 PM	0	0	0	0	0	28	0	107	0	200	898	0	0	0	749	49	**2031**
5:00 PM	to	6:00 PM	0	0	0	0	0	22	0	92	0	196	914	0	0	0	767	48	**2039**

PEAK HOUR SUMMARY

5:00 PM to 6:00 PM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	0	0	0	0	22	0	92	0	196	914	0	0	0	767	48	**2039**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.79	0.00	0.84	0.82	0.00	0.00	0.00	0.94	0.63	OVERALL
PHF BY APPROACH	0.00				0.73				0.83				0.92				0.91
BICYCLE	7				3				9				3				**22**
PEDESTRIAN	1				3				10				4				**18**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	12				2				4				0				**18**

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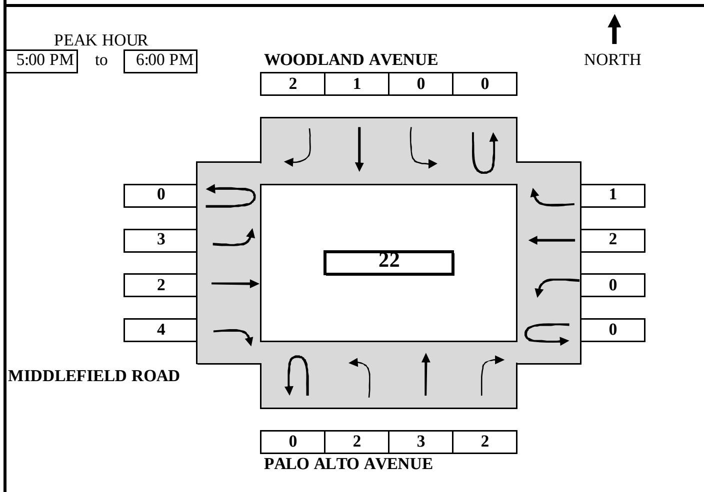
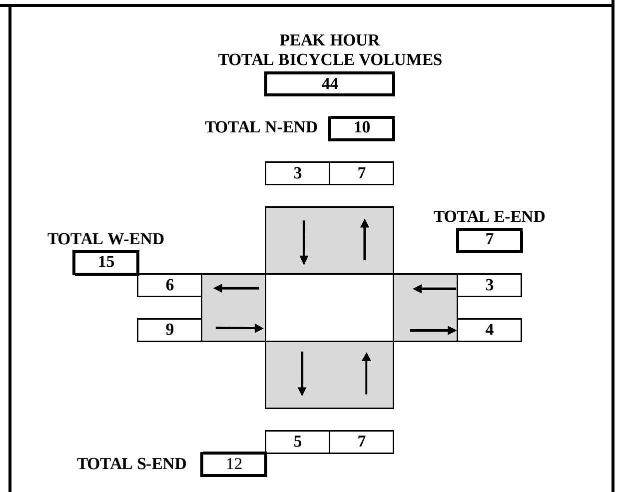
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	PALO ALTO AVENUE - WOODLAND AVENUE	SURVEY TIME:	4:00 PM	TO	6:00 PM
E-W APPROACH:	MIDDLEFIELD ROAD	JURISDICTION:	PALO ALTO	FILE:	3805030-3PM





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
4:15 PM	to	4:30 PM	0	0	1	0	0	0	0	1	0	0	2	0	0	0	1	0	5
4:30 PM	to	4:45 PM	0	1	3	0	0	0	2	1	0	0	3	0	0	0	1	0	11
4:45 PM	to	5:00 PM	0	1	3	0	0	0	2	1	0	2	3	1	0	0	2	0	15
5:00 PM	to	5:15 PM	0	2	5	1	0	0	2	1	0	4	3	2	0	0	3	1	24
5:15 PM	to	5:30 PM	0	2	5	1	0	0	2	2	0	4	4	4	0	0	3	1	28
5:30 PM	to	5:45 PM	0	2	6	2	0	0	2	2	0	5	5	4	0	0	4	1	33
5:45 PM	to	6:00 PM	0	3	6	2	0	0	3	3	0	5	5	5	0	0	4	1	37
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
4:15 PM	to	4:30 PM	0	0	1	0	0	0	0	1	0	0	2	0	0	0	0	0	4
4:30 PM	to	4:45 PM	0	1	2	0	0	0	2	0	0	0	1	0	0	0	0	0	6
4:45 PM	to	5:00 PM	0	0	0	0	0	0	0	0	0	2	0	1	0	0	1	0	4
5:00 PM	to	5:15 PM	0	1	2	1	0	0	0	0	0	2	0	1	0	0	1	1	9
5:15 PM	to	5:30 PM	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	4
5:30 PM	to	5:45 PM	0	0	1	1	0	0	0	0	0	1	1	0	0	0	1	0	5
5:45 PM	to	6:00 PM	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	4
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	1	3	0	0	0	2	1	0	2	3	1	0	0	2	0	15
4:15 PM	to	5:15 PM	0	2	5	1	0	0	2	1	0	4	3	2	0	0	2	1	23
4:30 PM	to	5:30 PM	0	2	4	1	0	0	2	1	0	4	2	4	0	0	2	1	23
4:45 PM	to	5:45 PM	0	1	3	2	0	0	0	1	0	5	2	4	0	0	3	1	22
5:00 PM	to	6:00 PM	0	2	3	2	0	0	1	2	0	3	2	4	0	0	2	1	22

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5:00 PM to 6:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	7	3	9	3	**22**

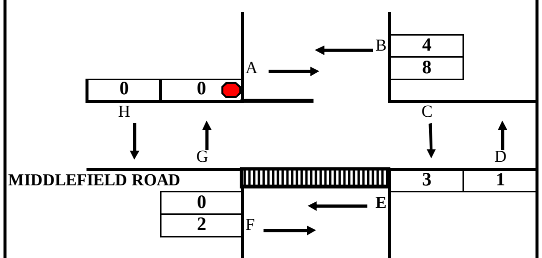
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

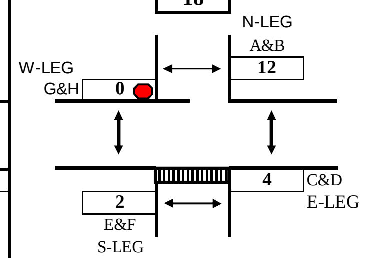
PROJECT: TRAFFIC COUNTS IN PALO ALTO		SURVEY DATE:	5/22/2018
N-S APPROACH: PALO ALTO AVENUE	WOODLAND AVENUE	DAY:	TUESDAY
E-W APPROACH: MIDDLEFIELD ROAD		JURISDICTION:	PALO ALTO
SURVEY PERIOD 4:00 PM TO 6:00 PM		FILE:	3805030-3PM

PEAK HOUR

05:00 PM TO 06:00 PM WOODLAND AVENUE



PEAK HOUR
TOTAL PEDESTRIAN VOLUMES
18



LEGEND:
CROSSWALK
SIDEWALK
STOP CONTROL LINE
STOP

BY LEG:	
N-LEG	12
S-LEG	2
E-LEG	4
W-LEG	0

BY DIRECTION:	
NB(D+G)	1
SB(C+H)	3
EB(A+F)	10
WB(B+E)	4

TIME PERIOD			NORTH X-WALK		EAST X-WALK		SOUTH X-WALK		WEST X-WALK		
From		To	A	B	C	D	E	F	G	H	TOTAL
SURVEY DATA											
04:00 PM	---	04:15 PM	0	0	1	0	0	0	0	0	*1*
04:15 PM	---	04:30 PM	0	0	3	0	0	0	0	0	*3*
04:30 PM	---	04:45 PM	0	1	3	0	0	0	0	0	*4*
04:45 PM	---	05:00 PM	0	3	3	0	0	0	0	0	*6*
05:00 PM	---	05:15 PM	2	3	4	0	0	0	0	0	*9*
05:15 PM	---	05:30 PM	5	5	4	1	0	0	0	0	*15*
05:30 PM	---	05:45 PM	7	7	6	1	0	2	0	0	*23*
05:45 PM	---	06:00 PM	8	7	6	1	0	2	0	0	*24*
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	0	0	1	0	0	0	0	0	*1*
04:15 PM	---	04:30 PM	0	0	2	0	0	0	0	0	*2*
04:30 PM	---	04:45 PM	0	1	0	0	0	0	0	0	*1*
04:45 PM	---	05:00 PM	0	2	0	0	0	0	0	0	*2*
05:00 PM	---	05:15 PM	2	0	1	0	0	0	0	0	*3*
05:15 PM	---	05:30 PM	3	2	0	1	0	0	0	0	*6*
05:30 PM	---	05:45 PM	2	2	2	0	0	2	0	0	*8*
05:45 PM	---	06:00 PM	1	0	0	0	0	0	0	0	*1*
HOURLY TOTALS											
04:00 PM	---	05:00 PM	0	3	3	0	0	0	0	0	*6*
04:15 PM	---	05:15 PM	2	3	3	0	0	0	0	0	*8*
04:30 PM	---	05:30 PM	5	5	1	1	0	0	0	0	*12*
04:45 PM	---	05:45 PM	7	6	3	1	0	2	0	0	*19*
05:00 PM	---	06:00 PM	8	4	3	1	0	2	0	0	*18*

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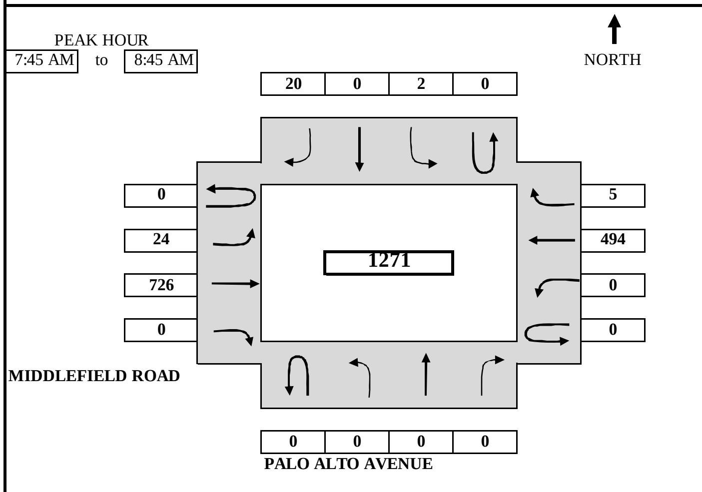
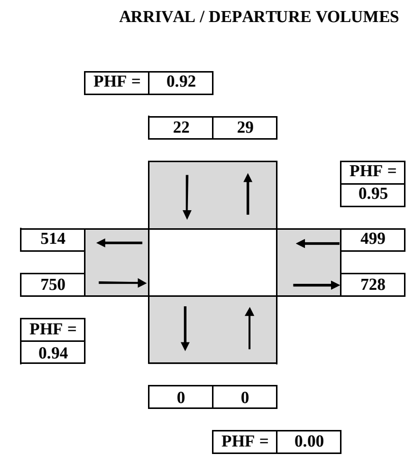
5:00 PM to 6:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	1	3	10	4	**18**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	12	2	4	0	**18**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-4AM**





TIME From	PERIOD To		NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM						1		1		1	150				62	0	**215**
7:15 AM	to	7:30 AM						1		2		3	274				135	2	**417**
7:30 AM	to	7:45 AM						1		7		4	445				260	2	**719**
7:45 AM	to	8:00 AM						2		12		8	622				370	4	**1018**
8:00 AM	to	8:15 AM						2		17		12	789				500	6	**1326**
8:15 AM	to	8:30 AM						2		22		19	981				625	6	**1655**
8:30 AM	to	8:45 AM						3		27		28	1171				754	7	**1990**
8:45 AM	to	9:00 AM						3		35		37	1322				866	8	**2271**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	1	0	1	0	1	150	0	0	0	62	0	**215**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	1	0	2	124	0	0	0	73	2	**202**
7:30 AM	to	7:45 AM	0	0	0	0	0	0	0	5	0	1	171	0	0	0	125	0	**302**
7:45 AM	to	8:00 AM	0	0	0	0	0	1	0	5	0	4	177	0	0	0	110	2	**299**
8:00 AM	to	8:15 AM	0	0	0	0	0	0	0	5	0	4	167	0	0	0	130	2	**308**
8:15 AM	to	8:30 AM	0	0	0	0	0	0	0	5	0	7	192	0	0	0	125	0	**329**
8:30 AM	to	8:45 AM	0	0	0	0	0	1	0	5	0	9	190	0	0	0	129	1	**335**
8:45 AM	to	9:00 AM	0	0	0	0	0	0	0	8	0	9	151	0	0	0	112	1	**281**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	2	0	12	0	8	622	0	0	0	370	4	**1018**
7:15 AM	to	8:15 AM	0	0	0	0	0	1	0	16	0	11	639	0	0	0	438	6	**1111**
7:30 AM	to	8:30 AM	0	0	0	0	0	1	0	20	0	16	707	0	0	0	490	4	**1238**
7:45 AM	to	8:45 AM	0	0	0	0	0	2	0	20	0	24	726	0	0	0	494	5	**1271**
8:00 AM	to	9:00 AM	0	0	0	0	0	1	0	23	0	29	700	0	0	0	496	4	**1253**

PEAK HOUR SUMMARY

7:45 AM to 8:45 AM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	0	0	0	0	2	0	20	0	24	726	0	0	0	494	5	**1271**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.50	0.00	1.00	0.00	0.67	0.95	0.00	0.00	0.00	0.95	0.63	OVERALL
PHF BY APPROACH	0.00				0.92				0.94				0.95				0.95
BICYCLE	0				1				9				4				**14**
PEDESTRIAN	4				2				4				6				**16**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	10				0				4				2				**16**

(NORTHBOUND: NBU–NBR; SOUTHBOUND: SBU–SBR; EASTBOUND: EBU–EBR; WESTBOUND: WBU–WBR)

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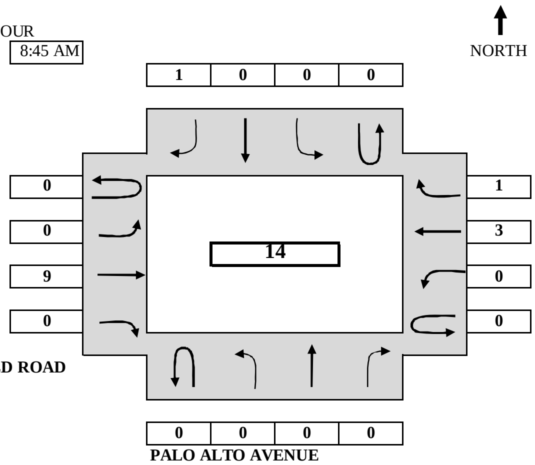
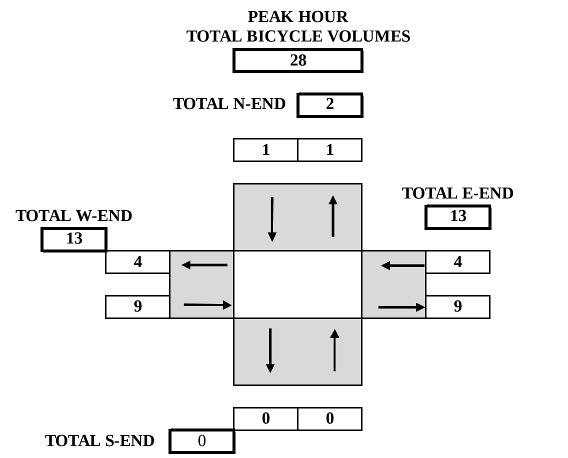
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	PALO ALTO AVENUE	SURVEY TIME:	7:00 AM	TO	9:00 AM
E-W APPROACH:	MIDDLEFIELD ROAD	JURISDICTION:	PALO ALTO	FILE:	3805030-4AM

PEAK HOUR
7:45 AM to 8:45 AM





TIME From		PERIOD To	NORTHBOUND U-TURN	NORTHBOUND LEFT	NORTHBOUND THRU	NORTHBOUND RIGHT	SOUTHBOUND U-TURN	SOUTHBOUND LEFT	SOUTHBOUND THRU	SOUTHBOUND RIGHT	EASTBOUND U-TURN	EASTBOUND LEFT	EASTBOUND THRU	EASTBOUND RIGHT	WESTBOUND U-TURN	WESTBOUND LEFT	WESTBOUND THRU	WESTBOUND RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	3
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	2	0	0	2	0	0	0	1	0	5
7:30 AM	to	7:45 AM	0	0	0	0	0	0	0	2	0	0	4	0	0	0	2	0	8
7:45 AM	to	8:00 AM	0	0	0	0	0	0	0	3	0	0	6	0	0	0	2	1	12
8:00 AM	to	8:15 AM	0	0	0	0	0	0	0	3	0	0	10	0	0	0	3	1	17
8:15 AM	to	8:30 AM	0	0	0	0	0	0	0	3	0	0	12	0	0	0	4	1	20
8:30 AM	to	8:45 AM	0	0	0	0	0	0	0	3	0	0	13	0	0	0	5	1	22
8:45 AM	to	9:00 AM	0	0	0	0	0	0	0	3	0	0	14	0	0	0	6	1	24
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	3
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2
7:30 AM	to	7:45 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	3
7:45 AM	to	8:00 AM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	1	4
8:00 AM	to	8:15 AM	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0	5
8:15 AM	to	8:30 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	3
8:30 AM	to	8:45 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	2
8:45 AM	to	9:00 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	2
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	0	0	3	0	0	6	0	0	0	2	1	12
7:15 AM	to	8:15 AM	0	0	0	0	0	0	0	2	0	0	9	0	0	0	2	1	14
7:30 AM	to	8:30 AM	0	0	0	0	0	0	0	1	0	0	10	0	0	0	3	1	15
7:45 AM	to	8:45 AM	0	0	0	0	0	0	0	1	0	0	9	0	0	0	3	1	14
8:00 AM	to	9:00 AM	0	0	0	0	0	0	0	0	0	0	8	0	0	0	4	0	12

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

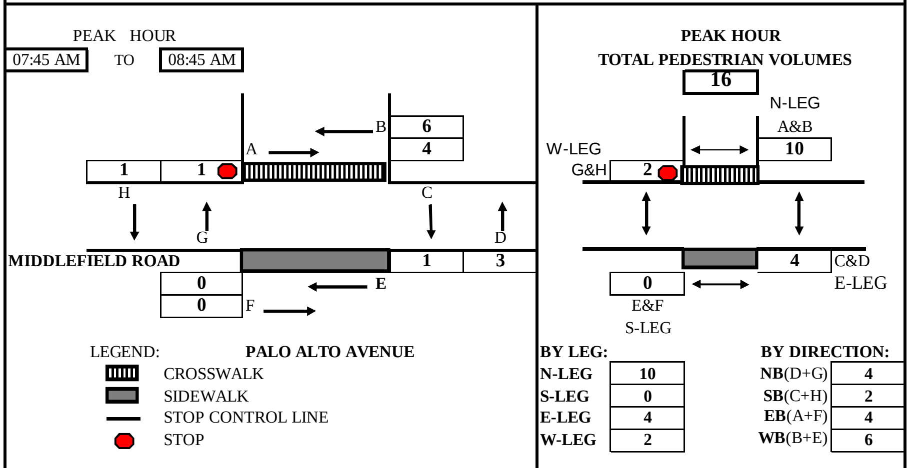
7:45 AM to 8:45 AM

APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	0	1	9	4	**14**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**PALO ALTO AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-4AM**



TIME PERIOD From		To	NORTH X-WALK A	B	EAST X-WALK C	D	SOUTH X-WALK E	F	WEST X-WALK G	H	TOTAL
SURVEY DATA											
07:00 AM	---	07:15 AM	0	0	0	0	0	0	0	0	*0*
07:15 AM	---	07:30 AM	1	0	0	1	0	0	0	0	*2*
07:30 AM	---	07:45 AM	3	1	0	1	0	0	0	0	*5*
07:45 AM	---	08:00 AM	3	2	0	2	0	0	0	0	*7*
08:00 AM	---	08:15 AM	4	2	1	3	0	0	0	0	*10*
08:15 AM	---	08:30 AM	5	5	1	3	0	0	1	1	*16*
08:30 AM	---	08:45 AM	7	7	1	4	0	0	1	1	*21*
08:45 AM	---	09:00 AM	8	8	1	4	0	0	1	1	*23*
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	0	0	0	0	0	0	0	0	*0*
07:15 AM	---	07:30 AM	1	0	0	1	0	0	0	0	*2*
07:30 AM	---	07:45 AM	2	1	0	0	0	0	0	0	*3*
07:45 AM	---	08:00 AM	0	1	0	1	0	0	0	0	*2*
08:00 AM	---	08:15 AM	1	0	1	1	0	0	0	0	*3*
08:15 AM	---	08:30 AM	1	3	0	0	0	0	1	1	*6*
08:30 AM	---	08:45 AM	2	2	0	1	0	0	0	0	*5*
08:45 AM	---	09:00 AM	1	1	0	0	0	0	0	0	*2*
HOURLY TOTALS											
07:00 AM	---	08:00 AM	3	2	0	2	0	0	0	0	*7*
07:15 AM	---	08:15 AM	4	2	1	3	0	0	0	0	*10*
07:30 AM	---	08:30 AM	4	5	1	2	0	0	1	1	*14*
07:45 AM	---	08:45 AM	4	6	1	3	0	0	1	1	*16*
08:00 AM	---	09:00 AM	5	6	1	2	0	0	1	1	*16*

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

7:45 AM to 8:45 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	4	2	4	6	**16**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	10	0	4	2	**16**

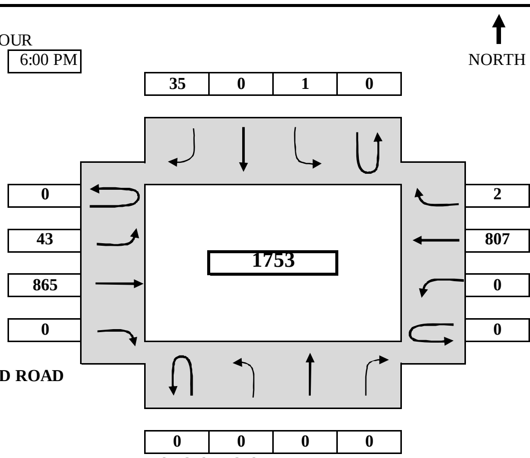
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

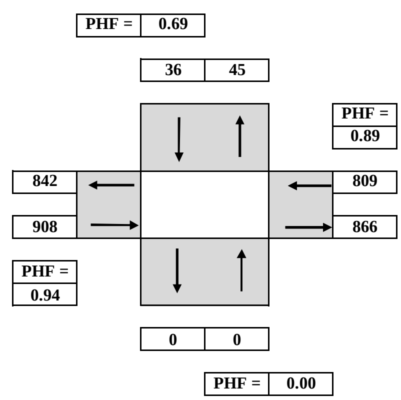
PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-4PM**

PEAK HOUR

5:00 PM to 6:00 PM



ARRIVAL / DEPARTURE VOLUMES



TIME	PERIOD		NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM						0		9		8	190				132	0	**339**
4:15 PM	to	4:30 PM						1		14		21	389				268	1	**694**
4:30 PM	to	4:45 PM						1		18		35	621				422	1	**1098**
4:45 PM	to	5:00 PM						1		27		47	835				603	1	**1514**
5:00 PM	to	5:15 PM						2		39		61	1013				773	3	**1891**
5:15 PM	to	5:30 PM						2		45		73	1239				975	3	**2337**
5:30 PM	to	5:45 PM						2		55		86	1468				1182	3	**2796**
5:45 PM	to	6:00 PM						2		62		90	1700				1410	3	**3267**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	9	0	8	190	0	0	0	132	0	**339**
4:15 PM	to	4:30 PM	0	0	0	0	0	1	0	5	0	13	199	0	0	0	136	1	**355**
4:30 PM	to	4:45 PM	0	0	0	0	0	0	0	4	0	14	232	0	0	0	154	0	**404**
4:45 PM	to	5:00 PM	0	0	0	0	0	0	0	9	0	12	214	0	0	0	181	0	**416**
5:00 PM	to	5:15 PM	0	0	0	0	0	1	0	12	0	14	178	0	0	0	170	2	**377**
5:15 PM	to	5:30 PM	0	0	0	0	0	0	0	6	0	12	226	0	0	0	202	0	**446**
5:30 PM	to	5:45 PM	0	0	0	0	0	0	0	10	0	13	229	0	0	0	207	0	**459**
5:45 PM	to	6:00 PM	0	0	0	0	0	0	0	7	0	4	232	0	0	0	228	0	**471**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	0	0	0	1	0	27	0	47	835	0	0	0	603	1	**1514**
4:15 PM	to	5:15 PM	0	0	0	0	0	2	0	30	0	53	823	0	0	0	641	3	**1552**
4:30 PM	to	5:30 PM	0	0	0	0	0	1	0	31	0	52	850	0	0	0	707	2	**1643**
4:45 PM	to	5:45 PM	0	0	0	0	0	1	0	37	0	51	847	0	0	0	760	2	**1698**
5:00 PM	to	6:00 PM	0	0	0	0	0	1	0	35	0	43	865	0	0	0	807	2	**1753**

PEAK HOUR SUMMARY

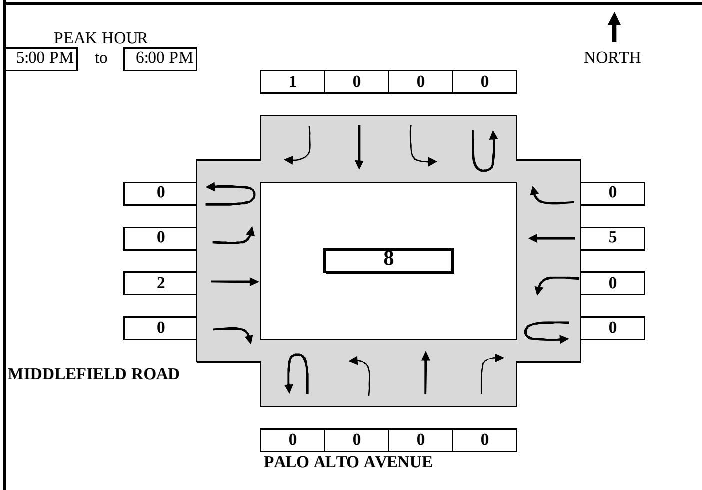
5:00 PM to 6:00 PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	0	0	0	0	1	0	35	0	43	865	0	0	0	807	2	**1753**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.73	0.00	0.77	0.93	0.00	0.00	0.00	0.88	0.25	OVERALL
PHF BY APPROACH	0.00				0.69				0.94				0.89				0.93
BICYCLE	0				1				2				5				**8**
PEDESTRIAN	2				0				6				8				**16**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	14				0				2				0				**16**

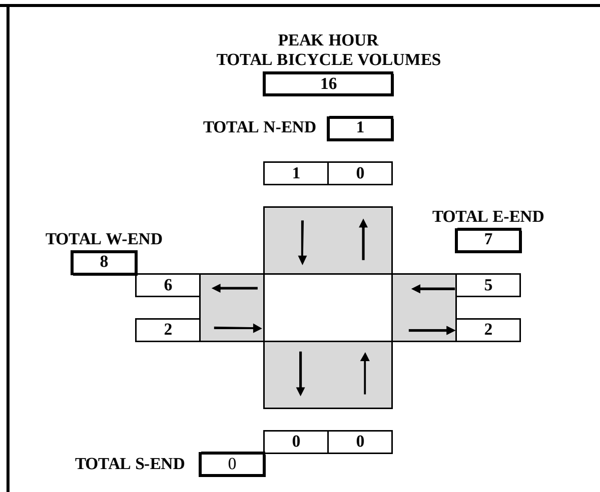
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-4PM**





TIME From	PERIOD To		NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
4:15 PM	to	4:30 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	**3**
4:30 PM	to	4:45 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	**4**
4:45 PM	to	5:00 PM	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	**6**
5:00 PM	to	5:15 PM	0	0	0	0	0	0	0	1	0	0	3	0	0	0	4	0	**8**
5:15 PM	to	5:30 PM	0	0	0	0	0	0	0	1	0	0	4	0	0	0	5	0	**10**
5:30 PM	to	5:45 PM	0	0	0	0	0	0	0	1	0	0	4	0	0	0	6	0	**11**
5:45 PM	to	6:00 PM	0	0	0	0	0	0	0	1	0	0	5	0	0	0	8	0	**14**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
4:15 PM	to	4:30 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	**2**
4:30 PM	to	4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
4:45 PM	to	5:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
5:00 PM	to	5:15 PM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	**2**
5:15 PM	to	5:30 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
5:30 PM	to	5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
5:45 PM	to	6:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	**3**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	**6**
4:15 PM	to	5:15 PM	0	0	0	0	0	0	0	1	0	0	3	0	0	0	3	0	**7**
4:30 PM	to	5:30 PM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	4	0	**7**
4:45 PM	to	5:45 PM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	4	0	**7**
5:00 PM	to	6:00 PM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	5	0	**8**

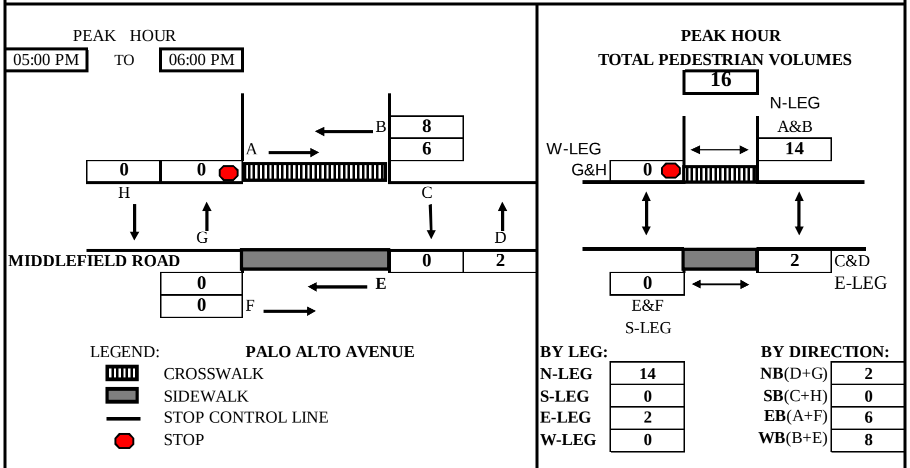
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

5:00 PM to 6:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	0	1	2	5	**8**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**PALO ALTO AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-4PM**



TIME PERIOD From		To	NORTH X-WALK A	B	EAST X-WALK C	D	SOUTH X-WALK E	F	WEST X-WALK G	H	TOTAL
SURVEY DATA											
04:00 PM	---	04:15 PM	0	2	0	0	0	0	1	0	*3*
04:15 PM	---	04:30 PM	1	3	0	0	0	0	1	0	*5*
04:30 PM	---	04:45 PM	1	3	0	0	0	0	1	0	*5*
04:45 PM	---	05:00 PM	3	4	0	1	0	0	1	2	*11*
05:00 PM	---	05:15 PM	5	6	0	3	0	0	1	2	*17*
05:15 PM	---	05:30 PM	9	7	0	3	0	0	1	2	*22*
05:30 PM	---	05:45 PM	9	11	0	3	0	0	1	2	*26*
05:45 PM	---	06:00 PM	9	12	0	3	0	0	1	2	*27*
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	0	2	0	0	0	0	1	0	*3*
04:15 PM	---	04:30 PM	1	1	0	0	0	0	0	0	*2*
04:30 PM	---	04:45 PM	0	0	0	0	0	0	0	0	*0*
04:45 PM	---	05:00 PM	2	1	0	1	0	0	0	2	*6*
05:00 PM	---	05:15 PM	2	2	0	2	0	0	0	0	*6*
05:15 PM	---	05:30 PM	4	1	0	0	0	0	0	0	*5*
05:30 PM	---	05:45 PM	0	4	0	0	0	0	0	0	*4*
05:45 PM	---	06:00 PM	0	1	0	0	0	0	0	0	*1*
HOURLY TOTALS											
04:00 PM	---	05:00 PM	3	4	0	1	0	0	1	2	*11*
04:15 PM	---	05:15 PM	5	4	0	3	0	0	0	2	*14*
04:30 PM	---	05:30 PM	8	4	0	3	0	0	0	2	*17*
04:45 PM	---	05:45 PM	8	8	0	3	0	0	0	2	*21*
05:00 PM	---	06:00 PM	6	8	0	2	0	0	0	0	*16*

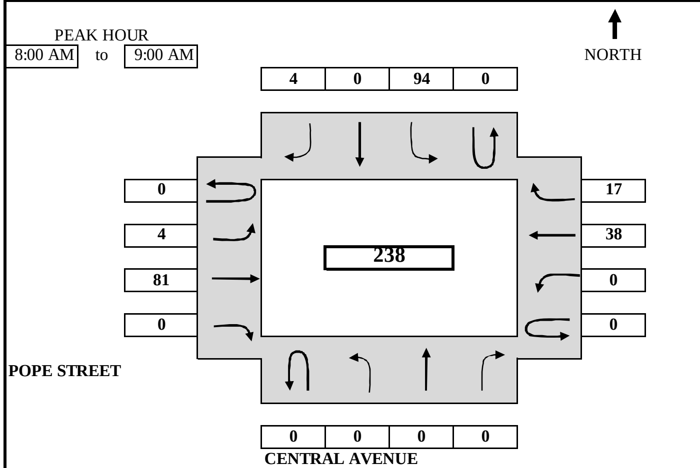
Tel : (510) 232-1271 ***Fax: (510) 232-1272***

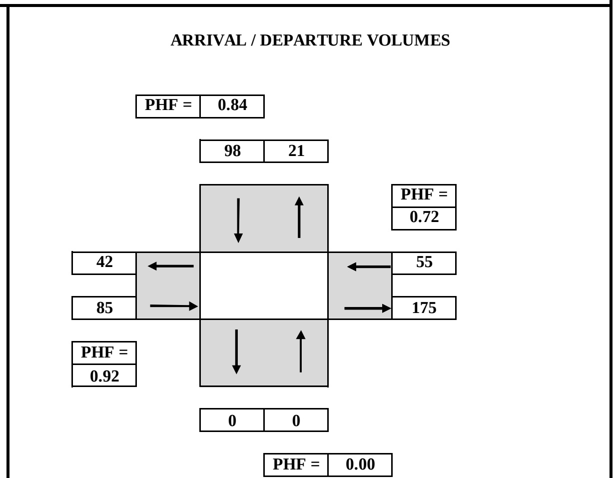
5:00 PM to 6:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	2	0	6	8	**16**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	14	0	2	0	**16**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	CENTRAL AVENUE	SURVEY TIME:	7:00 AM	TO	9:00 AM
E-W APPROACH:	POPE STREET	JURISDICTION:	PALO ALTO	FILE:	3805030-5AM





TIME From		PERIOD To	NORTHBOUND U-TURN	NB LEFT	NB THRU	NB RIGHT	SOUTHBOUND U-TURN	SB LEFT	SB THRU	SB RIGHT	EASTBOUND U-TURN	EB LEFT	EB THRU	EB RIGHT	WESTBOUND U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM						3		1		0	3				1	3	**11**
7:15 AM	to	7:30 AM						13		1		0	7				3	5	**29**
7:30 AM	to	7:45 AM						25		1		2	11				6	6	**51**
7:45 AM	to	8:00 AM						40		1		2	29				16	10	**98**
8:00 AM	to	8:15 AM						58		2		3	51				31	14	**159**
8:15 AM	to	8:30 AM						84		3		4	67				40	18	**216**
8:30 AM	to	8:45 AM						107		3		4	89				43	23	**269**
8:45 AM	to	9:00 AM						134		5		6	110				54	27	**336**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	3	0	1	0	0	3	0	0	0	1	3	**11**
7:15 AM	to	7:30 AM	0	0	0	0	0	10	0	0	0	0	4	0	0	0	2	2	**18**
7:30 AM	to	7:45 AM	0	0	0	0	0	12	0	0	0	2	4	0	0	0	3	1	**22**
7:45 AM	to	8:00 AM	0	0	0	0	0	15	0	0	0	0	18	0	0	0	10	4	**47**
8:00 AM	to	8:15 AM	0	0	0	0	0	18	0	1	0	1	22	0	0	0	15	4	**61**
8:15 AM	to	8:30 AM	0	0	0	0	0	26	0	1	0	1	16	0	0	0	9	4	**57**
8:30 AM	to	8:45 AM	0	0	0	0	0	23	0	0	0	0	22	0	0	0	3	5	**53**
8:45 AM	to	9:00 AM	0	0	0	0	0	27	0	2	0	2	21	0	0	0	11	4	**67**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	40	0	1	0	2	29	0	0	0	16	10	**98**
7:15 AM	to	8:15 AM	0	0	0	0	0	55	0	1	0	3	48	0	0	0	30	11	**148**
7:30 AM	to	8:30 AM	0	0	0	0	0	71	0	2	0	4	60	0	0	0	37	13	**187**
7:45 AM	to	8:45 AM	0	0	0	0	0	82	0	2	0	2	78	0	0	0	37	17	**218**
8:00 AM	to	9:00 AM	0	0	0	0	0	94	0	4	0	4	81	0	0	0	38	17	**238**

PEAK HOUR SUMMARY

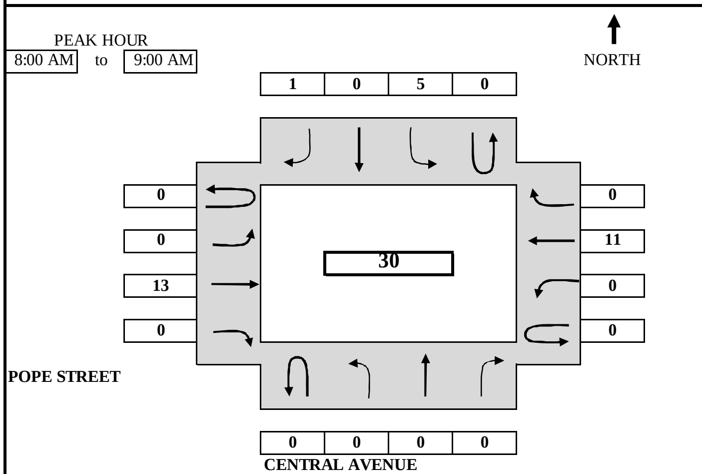
8:00 AM to 9:00 AM	NORTHBOUND NBU	NBL	NBT	NBR	SOUTHBOUND SBU	SBL	SBT	SBR	EASTBOUND EBU	EBL	EBT	EBR	WESTBOUND WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	0	0	0	0	94	0	4	0	4	81	0	0	0	38	17	**238**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.87	0.00	0.50	0.00	0.50	0.92	0.00	0.00	0.00	0.63	0.85	OVERALL
PHF BY APPROACH	0.00				0.84				0.92				0.72				0.89
BICYCLE	0				6				13				11				**30**
PEDESTRIAN	0				0				8				0				**8**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	8				0				0				0				**8**

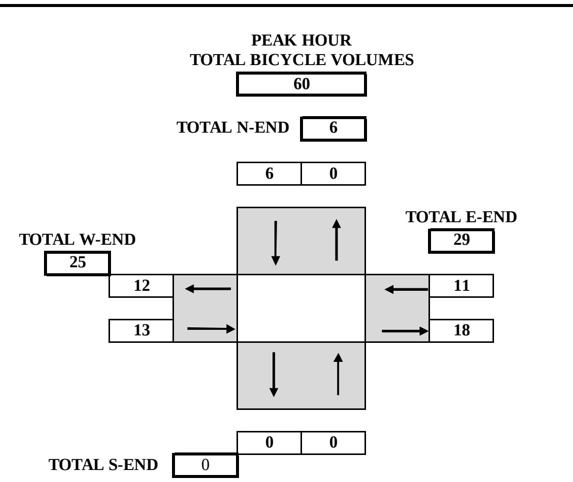
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**CENTRAL AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-5AM**





TIME From	PERIOD	To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	**5**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	0	0	0	10	0	0	0	1	0	**11**
7:30 AM	to	7:45 AM	0	0	0	0	0	1	0	0	0	0	13	0	0	0	3	0	**17**
7:45 AM	to	8:00 AM	0	0	0	0	0	2	0	0	0	0	15	0	0	0	3	0	**20**
8:00 AM	to	8:15 AM	0	0	0	0	0	3	0	0	0	0	19	0	0	0	6	0	**28**
8:15 AM	to	8:30 AM	0	0	0	0	0	5	0	0	0	0	21	0	0	0	9	0	**35**
8:30 AM	to	8:45 AM	0	0	0	0	0	6	0	1	0	0	26	0	0	0	10	0	**43**
8:45 AM	to	9:00 AM	0	0	0	0	0	7	0	1	0	0	28	0	0	0	14	0	**50**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	**5**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	0	1	0	**6**
7:30 AM	to	7:45 AM	0	0	0	0	0	1	0	0	0	0	3	0	0	0	2	0	**6**
7:45 AM	to	8:00 AM	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	**3**
8:00 AM	to	8:15 AM	0	0	0	0	0	1	0	0	0	0	4	0	0	0	3	0	**8**
8:15 AM	to	8:30 AM	0	0	0	0	0	2	0	0	0	0	2	0	0	0	3	0	**7**
8:30 AM	to	8:45 AM	0	0	0	0	0	1	0	1	0	0	5	0	0	0	1	0	**8**
8:45 AM	to	9:00 AM	0	0	0	0	0	1	0	0	0	0	2	0	0	0	4	0	**7**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	2	0	0	0	0	15	0	0	0	3	0	**20**
7:15 AM	to	8:15 AM	0	0	0	0	0	3	0	0	0	0	14	0	0	0	6	0	**23**
7:30 AM	to	8:30 AM	0	0	0	0	0	5	0	0	0	0	11	0	0	0	8	0	**24**
7:45 AM	to	8:45 AM	0	0	0	0	0	5	0	1	0	0	13	0	0	0	7	0	**26**
8:00 AM	to	9:00 AM	0	0	0	0	0	5	0	1	0	0	13	0	0	0	11	0	**30**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

8:00 AM to 9:00 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	0	6	13	11	**30**

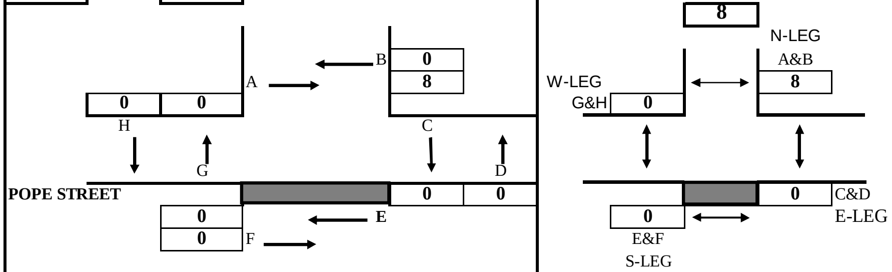
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**CENTRAL AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-5AM**

PEAK HOUR
08:00 AM TO 09:00 AM

PEAK HOUR
TOTAL PEDESTRIAN VOLUMES
8



CENTRAL AVENUE

LEGEND:
- CROSSWALK
- SIDEWALK
- STOP CONTROL LINE
- STOP

BY LEG:		**BY DIRECTION:**	
N-LEG	8	**NB**(D+G)	0
S-LEG	0	**SB**(C+H)	0
E-LEG	0	**EB**(A+F)	8
W-LEG	0	**WB**(B+E)	0

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
S U R V E Y D A T A											
07:00 AM	---	07:15 AM	0	1	0	0	0	0	0	0	*1*
07:15 AM	---	07:30 AM	1	1	0	0	0	0	0	0	*2*
07:30 AM	---	07:45 AM	1	1	0	0	0	0	0	0	*2*
07:45 AM	---	08:00 AM	1	2	0	0	0	0	0	0	*3*
08:00 AM	---	08:15 AM	1	2	0	0	0	0	0	0	*3*
08:15 AM	---	08:30 AM	4	2	0	0	0	0	0	0	*6*
08:30 AM	---	08:45 AM	5	2	0	0	0	0	0	0	*7*
08:45 AM	---	09:00 AM	9	2	0	0	0	0	0	0	*11*
T O T A L B Y P E R I O D											
07:00 AM	---	07:15 AM	0	1	0	0	0	0	0	0	*1*
07:15 AM	---	07:30 AM	1	0	0	0	0	0	0	0	*1*
07:30 AM	---	07:45 AM	0	0	0	0	0	0	0	0	*0*
07:45 AM	---	08:00 AM	0	1	0	0	0	0	0	0	*1*
08:00 AM	---	08:15 AM	0	0	0	0	0	0	0	0	*0*
08:15 AM	---	08:30 AM	3	0	0	0	0	0	0	0	*3*
08:30 AM	---	08:45 AM	1	0	0	0	0	0	0	0	*1*
08:45 AM	---	09:00 AM	4	0	0	0	0	0	0	0	*4*
H O U R L Y T O T A L S											
07:00 AM	---	08:00 AM	1	2	0	0	0	0	0	0	*3*
07:15 AM	---	08:15 AM	1	1	0	0	0	0	0	0	*2*
07:30 AM	---	08:30 AM	3	1	0	0	0	0	0	0	*4*
07:45 AM	---	08:45 AM	4	1	0	0	0	0	0	0	*5*
08:00 AM	---	09:00 AM	8	0	0	0	0	0	0	0	*8*

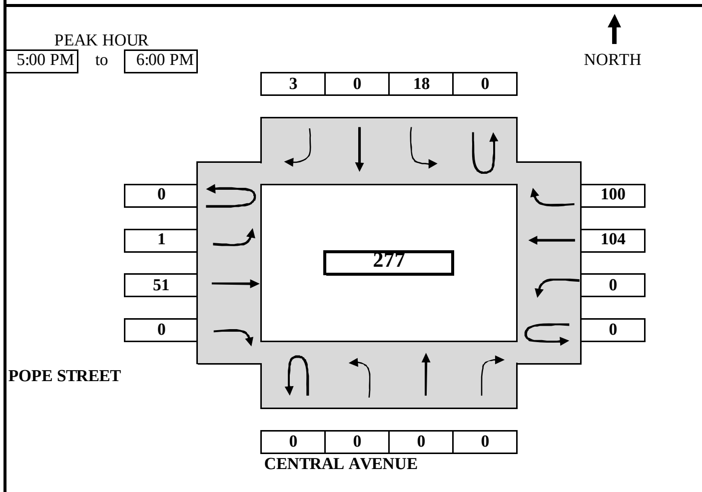
Tel : (510) 232-1271 ***Fax: (510) 232-1272***

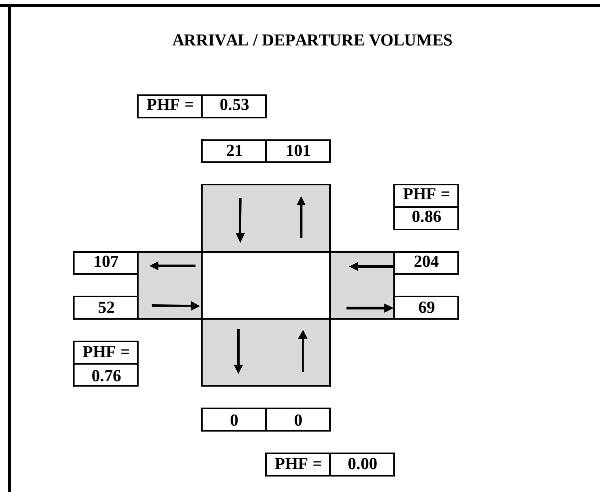
8:00 AM to 9:00 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	0	0	8	0	**8**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	8	0	0	0	**8**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**CENTRAL AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-5PM**





TIME From	PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																		
4:00 PM to	4:15 PM						7		0		0	22				14	16	**59**
4:15 PM to	4:30 PM						16		0		0	37				28	38	**119**
4:30 PM to	4:45 PM						24		1		0	47				37	50	**159**
4:45 PM to	5:00 PM						26		2		1	58				61	66	**214**
5:00 PM to	5:15 PM						34		4		1	70				84	102	**295**
5:15 PM to	5:30 PM						36		5		2	76				111	123	**353**
5:30 PM to	5:45 PM						41		5		2	92				141	150	**431**
5:45 PM to	6:00 PM						44		5		2	109				165	166	**491**
TOTAL BY PERIOD																		
4:00 PM to	4:15 PM	0	0	0	0	0	7	0	0	0	0	22	0	0	0	14	16	**59**
4:15 PM to	4:30 PM	0	0	0	0	0	9	0	0	0	0	15	0	0	0	14	22	**60**
4:30 PM to	4:45 PM	0	0	0	0	0	8	0	1	0	0	10	0	0	0	9	12	**40**
4:45 PM to	5:00 PM	0	0	0	0	0	2	0	1	0	1	11	0	0	0	24	16	**55**
5:00 PM to	5:15 PM	0	0	0	0	0	8	0	2	0	0	12	0	0	0	23	36	**81**
5:15 PM to	5:30 PM	0	0	0	0	0	2	0	1	0	1	6	0	0	0	27	21	**58**
5:30 PM to	5:45 PM	0	0	0	0	0	5	0	0	0	0	16	0	0	0	30	27	**78**
5:45 PM to	6:00 PM	0	0	0	0	0	3	0	0	0	0	17	0	0	0	24	16	**60**
HOURLY TOTALS																		
4:00 PM to	5:00 PM	0	0	0	0	0	26	0	2	0	1	58	0	0	0	61	66	**214**
4:15 PM to	5:15 PM	0	0	0	0	0	27	0	4	0	1	48	0	0	0	70	86	**236**
4:30 PM to	5:30 PM	0	0	0	0	0	20	0	5	0	2	39	0	0	0	83	85	**234**
4:45 PM to	5:45 PM	0	0	0	0	0	17	0	4	0	2	45	0	0	0	104	100	**272**
5:00 PM to	6:00 PM	0	0	0	0	0	18	0	3	0	1	51	0	0	0	104	100	**277**

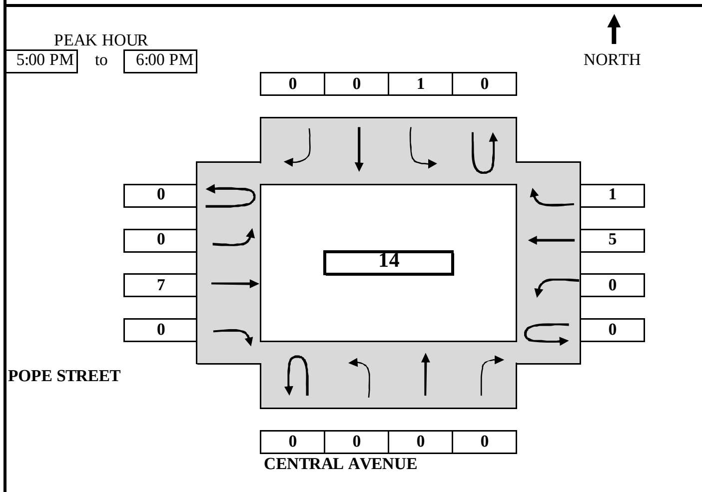
PEAK HOUR SUMMARY

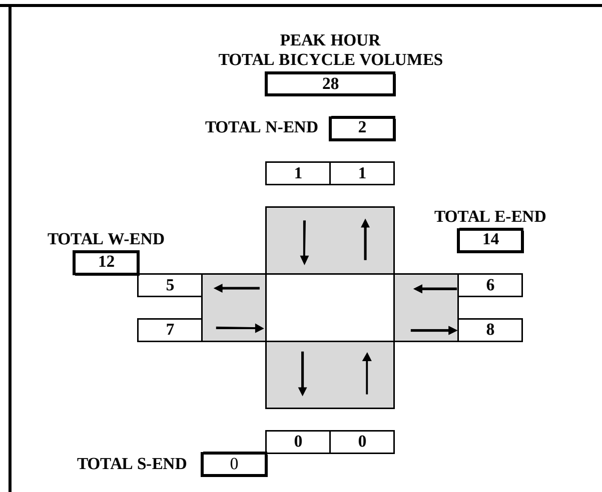
5:00 PM to 6:00 PM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	0	0	0	0	18	0	3	0	1	51	0	0	0	104	100	**277**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.38	0.00	0.25	0.75	0.00	0.00	0.00	0.87	0.69	OVERALL
PHF BY APPROACH	0.00				0.53				0.76				0.86				0.85
BICYCLE	0				1				7				6				**14**
PEDESTRIAN	0				0				2				5				**7**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	7				0				0				0				**7**

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**CENTRAL AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-5PM**





TIME From	PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																		
4:00 PM to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
4:15 PM to	4:30 PM	0	0	0	0	0	1	0	0	0	0	5	0	0	0	3	0	**9**
4:30 PM to	4:45 PM	0	0	0	0	0	1	0	0	0	0	6	0	0	0	4	1	**12**
4:45 PM to	5:00 PM	0	0	0	0	0	1	0	0	0	0	7	0	0	0	5	1	**14**
5:00 PM to	5:15 PM	0	0	0	0	0	1	0	0	0	0	8	0	0	0	6	2	**17**
5:15 PM to	5:30 PM	0	0	0	0	0	1	0	0	0	0	9	0	0	0	7	2	**19**
5:30 PM to	5:45 PM	0	0	0	0	0	2	0	0	0	0	12	0	0	0	9	2	**25**
5:45 PM to	6:00 PM	0	0	0	0	0	2	0	0	0	0	14	0	0	0	10	2	**28**
TOTAL BY PERIOD																		
4:00 PM to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
4:15 PM to	4:30 PM	0	0	0	0	0	1	0	0	0	0	5	0	0	0	3	0	**9**
4:30 PM to	4:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	**3**
4:45 PM to	5:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
5:00 PM to	5:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	**3**
5:15 PM to	5:30 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
5:30 PM to	5:45 PM	0	0	0	0	0	1	0	0	0	0	3	0	0	0	2	0	**6**
5:45 PM to	6:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	**3**
HOURLY TOTALS																		
4:00 PM to	5:00 PM	0	0	0	0	0	1	0	0	0	0	7	0	0	0	5	1	**14**
4:15 PM to	5:15 PM	0	0	0	0	0	1	0	0	0	0	8	0	0	0	6	2	**17**
4:30 PM to	5:30 PM	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	2	**10**
4:45 PM to	5:45 PM	0	0	0	0	0	1	0	0	0	0	6	0	0	0	5	1	**13**
5:00 PM to	6:00 PM	0	0	0	0	0	1	0	0	0	0	7	0	0	0	5	1	**14**

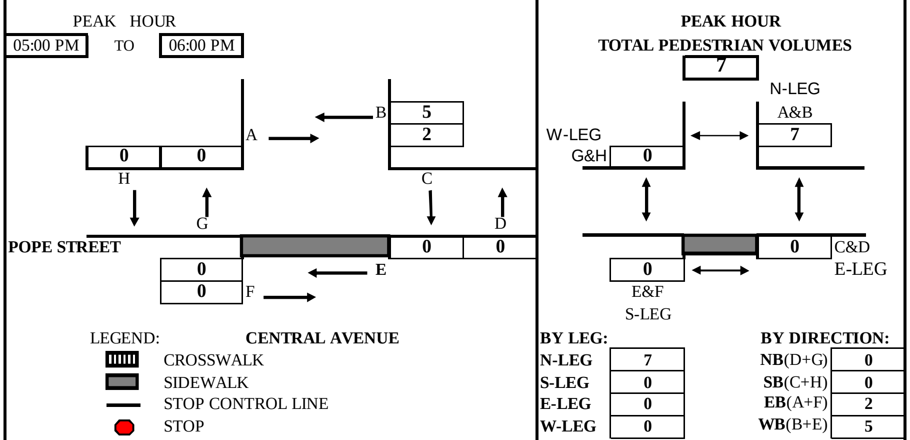
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

5:00 PM to 6:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	0	1	7	6	**14**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**CENTRAL AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-5PM**



BY LEG:		BY DIRECTION:	
N-LEG	7	NB(D+G)	0
S-LEG	0	SB(C+H)	0
E-LEG	0	EB(A+F)	2
W-LEG	0	WB(B+E)	5

TIME PERIOD From		To	NORTH X-WALK A	B	EAST X-WALK C	D	SOUTH X-WALK E	F	WEST X-WALK G	H	TOTAL
SURVEY DATA											
04:00 PM	---	04:15 PM	0	0	0	0	0	0	0	0	*0*
04:15 PM	---	04:30 PM	0	0	0	0	0	0	0	0	*0*
04:30 PM	---	04:45 PM	0	1	0	0	0	0	0	0	*1*
04:45 PM	---	05:00 PM	1	1	0	0	0	0	0	0	*2*
05:00 PM	---	05:15 PM	1	3	0	0	0	0	0	0	*4*
05:15 PM	---	05:30 PM	1	4	0	0	0	0	0	0	*5*
05:30 PM	---	05:45 PM	3	5	0	0	0	0	0	0	*8*
05:45 PM	---	06:00 PM	3	6	0	0	0	0	0	0	*9*
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	0	0	0	0	0	0	0	0	*0*
04:15 PM	---	04:30 PM	0	0	0	0	0	0	0	0	*0*
04:30 PM	---	04:45 PM	0	1	0	0	0	0	0	0	*1*
04:45 PM	---	05:00 PM	1	0	0	0	0	0	0	0	*1*
05:00 PM	---	05:15 PM	0	2	0	0	0	0	0	0	*2*
05:15 PM	---	05:30 PM	0	1	0	0	0	0	0	0	*1*
05:30 PM	---	05:45 PM	2	1	0	0	0	0	0	0	*3*
05:45 PM	---	06:00 PM	0	1	0	0	0	0	0	0	*1*
HOURLY TOTALS											
04:00 PM	---	05:00 PM	1	1	0	0	0	0	0	0	*2*
04:15 PM	---	05:15 PM	1	3	0	0	0	0	0	0	*4*
04:30 PM	---	05:30 PM	1	4	0	0	0	0	0	0	*5*
04:45 PM	---	05:45 PM	3	4	0	0	0	0	0	0	*7*
05:00 PM	---	06:00 PM	2	5	0	0	0	0	0	0	*7*

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

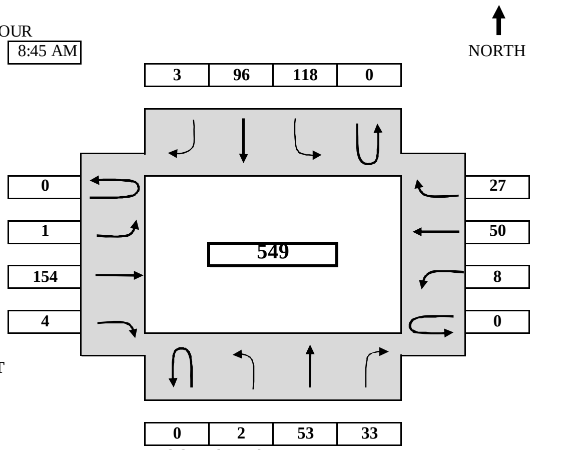
5:00 PM to 6:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	0	0	2	5	7
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	7	0	0	0	7

B.A.Y.M.E.T.R.I.C.S.

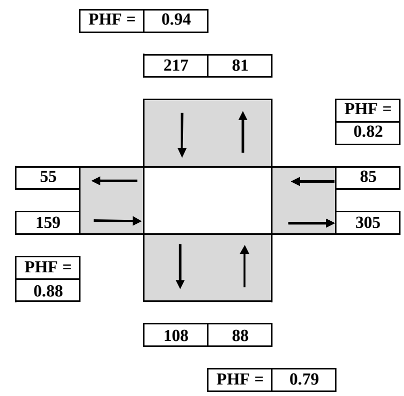
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WOODLAND AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-6AM**

PEAK HOUR
7:45 AM to 8:45 AM



ARRIVAL / DEPARTURE VOLUMES



TIME From	PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																		
7:00 AM to	7:15 AM		0	2	3		13	13	1		0	7	0		3	3	3	**48**
7:15 AM to	7:30 AM		0	2	4		42	48	1		0	20	0		4	7	11	**139**
7:30 AM to	7:45 AM		0	5	13		74	98	2		0	36	0		5	9	16	**258**
7:45 AM to	8:00 AM		0	12	22		104	124	4		0	68	0		8	22	26	**390**
8:00 AM to	8:15 AM		0	26	26		137	141	5		1	107	1		10	41	29	**524**
8:15 AM to	8:30 AM		2	42	36		170	165	5		1	145	4		11	52	39	**672**
8:30 AM to	8:45 AM		2	58	46		192	194	5		1	190	4		13	59	43	**807**
8:45 AM to	9:00 AM		2	70	60		213	206	5		1	238	5		14	74	47	**935**
TOTAL BY PERIOD																		
7:00 AM to	7:15 AM	0	0	2	3	0	13	13	1	0	0	7	0	0	3	3	3	**48**
7:15 AM to	7:30 AM	0	0	0	1	0	29	35	0	0	0	13	0	0	1	4	8	**91**
7:30 AM to	7:45 AM	0	0	3	9	0	32	50	1	0	0	16	0	0	1	2	5	**119**
7:45 AM to	8:00 AM	0	0	7	9	0	30	26	2	0	0	32	0	0	3	13	10	**132**
8:00 AM to	8:15 AM	0	0	14	4	0	33	17	1	0	1	39	1	0	2	19	3	**134**
8:15 AM to	8:30 AM	0	2	16	10	0	33	24	0	0	0	38	3	0	1	11	10	**148**
8:30 AM to	8:45 AM	0	0	16	10	0	22	29	0	0	0	45	0	0	2	7	4	**135**
8:45 AM to	9:00 AM	0	0	12	14	0	21	12	0	0	0	48	1	0	1	15	4	**128**
HOURLY TOTALS																		
7:00 AM to	8:00 AM	0	0	12	22	0	104	124	4	0	0	68	0	0	8	22	26	**390**
7:15 AM to	8:15 AM	0	0	24	23	0	124	128	4	0	1	100	1	0	7	38	26	**476**
7:30 AM to	8:30 AM	0	2	40	32	0	128	117	4	0	1	125	4	0	7	45	28	**533**
7:45 AM to	8:45 AM	0	2	53	33	0	118	96	3	0	1	154	4	0	8	50	27	**549**
8:00 AM to	9:00 AM	0	2	58	38	0	109	82	1	0	1	170	5	0	6	52	21	**545**

PEAK HOUR SUMMARY

7:45 AM to 8:45 AM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	2	53	33	0	118	96	3	0	1	154	4	0	8	50	27	**549**
PHF BY MOVEMENT	0.00	0.25	0.83	0.83	0.00	0.89	0.83	0.38	0.00	0.25	0.86	0.33	0.00	0.67	0.66	0.68	OVERALL
PHF BY APPROACH	0.79				0.94				0.88				0.82				0.93
BICYCLE	8				28				13				11				**60**
PEDESTRIAN	1				2				6				2				**11**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	3				5				0				3				**11**

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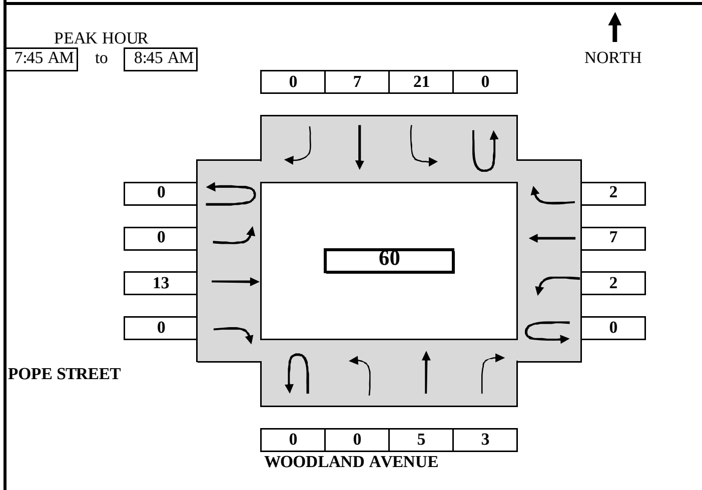
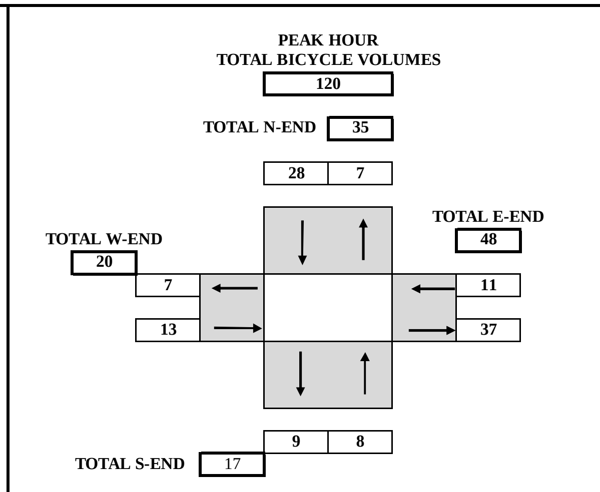
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WOODLAND AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-6AM**





TIME From		PERIOD To	NORTHBOUND U-TURN	LEFT	THRU	RIGHT	SOUTHBOUND U-TURN	LEFT	THRU	RIGHT	EASTBOUND U-TURN	LEFT	THRU	RIGHT	WESTBOUND U-TURN	LEFT	THRU	RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	1	0	3	0	0	0	0	5	0	0	0	0	0	**9**
7:15 AM	to	7:30 AM	0	0	0	2	0	6	0	0	0	0	10	0	0	0	1	0	**19**
7:30 AM	to	7:45 AM	0	0	0	3	0	8	2	0	0	0	12	1	0	3	3	1	**33**
7:45 AM	to	8:00 AM	0	0	1	3	0	11	6	0	0	0	14	1	0	4	3	1	**44**
8:00 AM	to	8:15 AM	0	0	3	4	0	18	6	0	0	0	18	1	0	4	6	2	**62**
8:15 AM	to	8:30 AM	0	0	4	4	0	20	8	0	0	0	20	1	0	4	9	2	**72**
8:30 AM	to	8:45 AM	0	0	5	6	0	29	9	0	0	0	25	1	0	5	10	3	**93**
8:45 AM	to	9:00 AM	0	0	6	8	0	38	9	0	0	0	27	1	0	7	14	5	**115**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	1	0	3	0	0	0	0	5	0	0	0	0	0	**9**
7:15 AM	to	7:30 AM	0	0	0	1	0	3	0	0	0	0	5	0	0	0	1	0	**10**
7:30 AM	to	7:45 AM	0	0	0	1	0	2	2	0	0	0	2	1	0	3	2	1	**14**
7:45 AM	to	8:00 AM	0	0	1	0	0	3	4	0	0	0	2	0	0	1	0	0	**11**
8:00 AM	to	8:15 AM	0	0	2	1	0	7	0	0	0	0	4	0	0	0	3	1	**18**
8:15 AM	to	8:30 AM	0	0	1	0	0	2	2	0	0	0	2	0	0	0	3	0	**10**
8:30 AM	to	8:45 AM	0	0	1	2	0	9	1	0	0	0	5	0	0	1	1	1	**21**
8:45 AM	to	9:00 AM	0	0	1	2	0	9	0	0	0	0	2	0	0	2	4	2	**22**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	1	3	0	11	6	0	0	0	14	1	0	4	3	1	**44**
7:15 AM	to	8:15 AM	0	0	3	3	0	15	6	0	0	0	13	1	0	4	6	2	**53**
7:30 AM	to	8:30 AM	0	0	4	2	0	14	8	0	0	0	10	1	0	4	8	2	**53**
7:45 AM	to	8:45 AM	0	0	5	3	0	21	7	0	0	0	13	0	0	2	7	2	**60**
8:00 AM	to	9:00 AM	0	0	5	5	0	27	3	0	0	0	13	0	0	3	11	4	**71**

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7:45 AM to 8:45 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	8	28	13	11	**60**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WOODLAND AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-6AM**

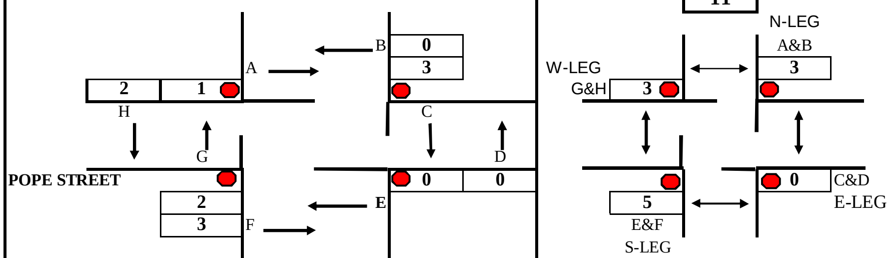
PEAK HOUR

07:45 AM TO 08:45 AM

PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

11



LEGEND:

- CROSSWALK
- SIDEWALK
- STOP CONTROL LINE
- STOP

BY LEG:		**BY DIRECTION:**	
N-LEG	3	**NB**(D+G)	1
S-LEG	5	**SB**(C+H)	2
E-LEG	0	**EB**(A+F)	6
W-LEG	3	**WB**(B+E)	2

TIME PERIOD			NORTH X-WALK		EAST X-WALK		SOUTH X-WALK		WEST X-WALK		
From		To	A	B	C	D	E	F	G	H	TOTAL
SURVEY DATA											
07:00 AM	---	07:15 AM	0	1	0	0	0	2	0	3	6
07:15 AM	---	07:30 AM	1	3	0	0	0	2	1	4	11
07:30 AM	---	07:45 AM	2	4	0	0	0	4	2	4	16
07:45 AM	---	08:00 AM	2	4	0	0	0	4	2	4	16
08:00 AM	---	08:15 AM	4	4	0	0	0	5	2	4	19
08:15 AM	---	08:30 AM	4	4	0	0	1	6	3	6	24
08:30 AM	---	08:45 AM	5	4	0	0	2	7	3	6	27
08:45 AM	---	09:00 AM	7	5	0	0	4	7	4	7	34
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	0	1	0	0	0	2	0	3	6
07:15 AM	---	07:30 AM	1	2	0	0	0	0	1	1	5
07:30 AM	---	07:45 AM	1	1	0	0	0	2	1	0	5
07:45 AM	---	08:00 AM	0	0	0	0	0	0	0	0	0
08:00 AM	---	08:15 AM	2	0	0	0	0	1	0	0	3
08:15 AM	---	08:30 AM	0	0	0	0	1	1	1	2	5
08:30 AM	---	08:45 AM	1	0	0	0	1	1	0	0	3
08:45 AM	---	09:00 AM	2	1	0	0	2	0	1	1	7
HOURLY TOTALS											
07:00 AM	---	08:00 AM	2	4	0	0	0	4	2	4	16
07:15 AM	---	08:15 AM	4	3	0	0	0	3	2	1	13
07:30 AM	---	08:30 AM	3	1	0	0	1	4	2	2	13
07:45 AM	---	08:45 AM	3	0	0	0	2	3	1	2	11
08:00 AM	---	09:00 AM	5	1	0	0	4	3	2	3	18

Tel : (510) 232-1271 *Fax: (510) 232-1272*

7:45 AM to 8:45 AM

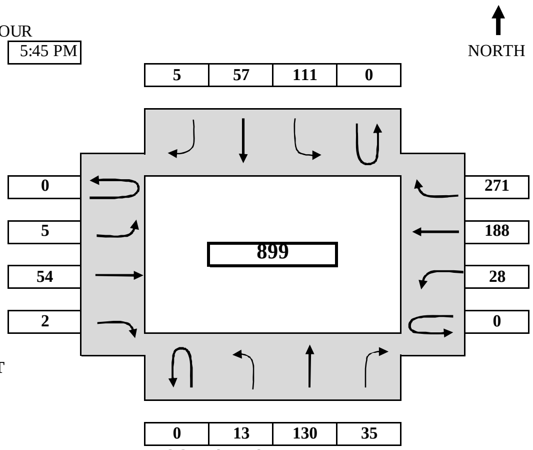
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	1	2	6	2	11
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	3	5	0	3	11

B . A . Y . M . E . T . R . I . C . S .

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	WOODLAND AVENUE	SURVEY TIME:	4:00 PM	TO	6:00 PM
E-W APPROACH:	POPE STREET	JURISDICTION:	PALO ALTO	FILE:	3805030-6PM

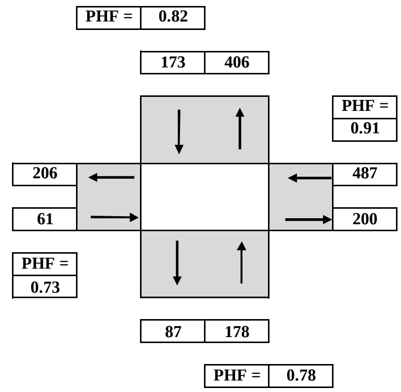
PEAK HOUR
4:45 PM to 5:45 PM



POPE STREET

WOODLAND AVENUE

ARRIVAL / DEPARTURE VOLUMES



TIME From		PERIOD To	NORTHBOUND U-TURN	NB LEFT	NB THRU	NB RIGHT	SOUTHBOUND U-TURN	SB LEFT	SB THRU	SB RIGHT	EASTBOUND U-TURN	EB LEFT	EB THRU	EB RIGHT	WESTBOUND U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM		5	42	12		25	7	1		0	27	3		3	25	44	**194**
4:15 PM	to	4:30 PM		10	80	17		59	22	1		0	50	3		8	56	91	**397**
4:30 PM	to	4:45 PM		13	121	35		80	36	2		0	68	3		14	72	139	**583**
4:45 PM	to	5:00 PM		14	149	51		104	60	4		0	81	3		18	110	197	**791**
5:00 PM	to	5:15 PM		24	186	61		123	68	4		2	99	4		26	159	274	**1030**
5:15 PM	to	5:30 PM		24	221	65		152	80	6		3	103	5		34	205	342	**1240**
5:30 PM	to	5:45 PM		26	251	70		191	93	7		5	122	5		42	260	410	**1482**
5:45 PM	to	6:00 PM		28	278	78		217	105	7		6	141	6		50	297	457	**1670**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	5	42	12	0	25	7	1	0	0	27	3	0	3	25	44	**194**
4:15 PM	to	4:30 PM	0	5	38	5	0	34	15	0	0	0	23	0	0	5	31	47	**203**
4:30 PM	to	4:45 PM	0	3	41	18	0	21	14	1	0	0	18	0	0	6	16	48	**186**
4:45 PM	to	5:00 PM	0	1	28	16	0	24	24	2	0	0	13	0	0	4	38	58	**208**
5:00 PM	to	5:15 PM	0	10	37	10	0	19	8	0	0	2	18	1	0	8	49	77	**239**
5:15 PM	to	5:30 PM	0	0	35	4	0	29	12	2	0	1	4	1	0	8	46	68	**210**
5:30 PM	to	5:45 PM	0	2	30	5	0	39	13	1	0	2	19	0	0	8	55	68	**242**
5:45 PM	to	6:00 PM	0	2	27	8	0	26	12	0	0	1	19	1	0	8	37	47	**188**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	14	149	51	0	104	60	4	0	0	81	3	0	18	110	197	**791**
4:15 PM	to	5:15 PM	0	19	144	49	0	98	61	3	0	2	72	1	0	23	134	230	**836**
4:30 PM	to	5:30 PM	0	14	141	48	0	93	58	5	0	3	53	2	0	26	149	251	**843**
4:45 PM	to	5:45 PM	0	13	130	35	0	111	57	5	0	5	54	2	0	28	188	271	**899**
5:00 PM	to	6:00 PM	0	14	129	27	0	113	45	3	0	6	60	3	0	32	187	260	**879**

PEAK HOUR SUMMARY

4:45 PM to 5:45 PM	NORTHBOUND NBU	NBL	NBT	NBR	SOUTHBOUND SBU	SBL	SBT	SBR	EASTBOUND EBU	EBL	EBT	EBR	WESTBOUND WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	13	130	35	0	111	57	5	0	5	54	2	0	28	188	271	**899**
PHF BY MOVEMENT	0.00	0.33	0.88	0.55	0.00	0.71	0.59	0.63	0.00	0.63	0.71	0.50	0.00	0.88	0.85	0.88	OVERALL
PHF BY APPROACH	0.78				0.82				0.73				0.91				0.93
BICYCLE	5				7				6				16				**34**
PEDESTRIAN	6				3				17				8				**34**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	11				14				1				8				**34**

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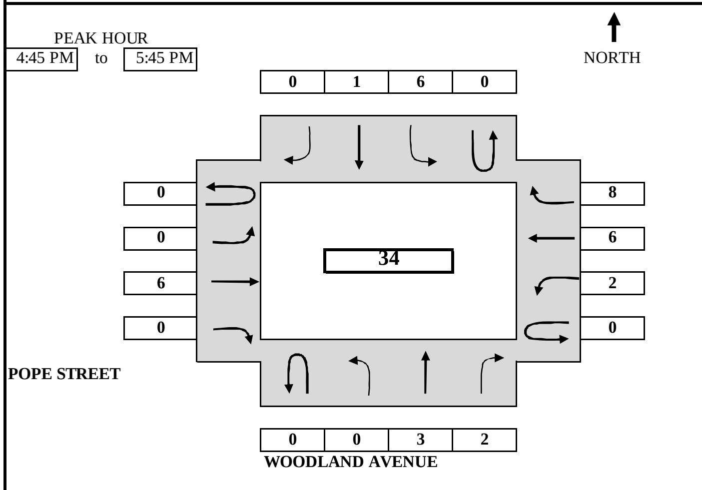
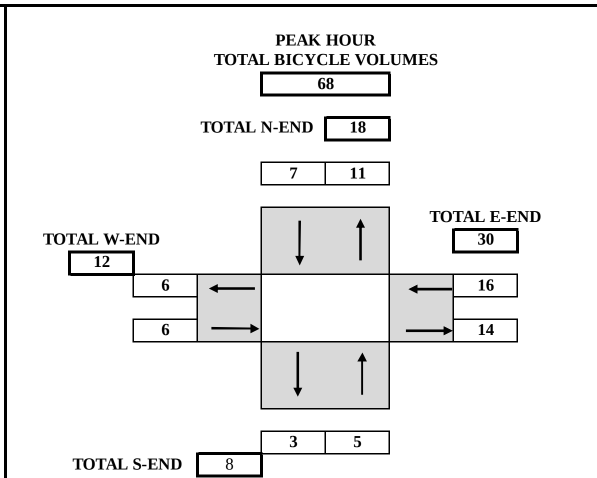
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY: TUESDAY**
N-S APPROACH:	**WOODLAND AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO 6:00 PM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE: 3805030-6PM**





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	**4**
4:15 PM	to	4:30 PM	0	0	3	0	0	1	1	0	0	0	5	0	0	0	3	3	**16**
4:30 PM	to	4:45 PM	0	0	4	0	0	3	1	0	0	0	6	0	0	0	5	4	**23**
4:45 PM	to	5:00 PM	0	0	4	1	0	7	2	0	0	0	7	0	0	1	6	5	**33**
5:00 PM	to	5:15 PM	0	0	4	1	0	7	2	0	0	0	8	0	0	2	8	7	**39**
5:15 PM	to	5:30 PM	0	0	7	2	0	8	2	0	0	0	9	0	0	2	9	10	**49**
5:30 PM	to	5:45 PM	0	0	7	2	0	9	2	0	0	0	12	0	0	2	11	12	**57**
5:45 PM	to	6:00 PM	0	0	7	2	0	10	2	0	0	0	13	1	0	4	12	17	**68**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	**4**
4:15 PM	to	4:30 PM	0	0	0	0	0	1	1	0	0	0	5	0	0	0	3	2	**12**
4:30 PM	to	4:45 PM	0	0	1	0	0	2	0	0	0	0	1	0	0	0	2	1	**7**
4:45 PM	to	5:00 PM	0	0	0	1	0	4	1	0	0	0	1	0	0	1	1	1	**10**
5:00 PM	to	5:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	2	**6**
5:15 PM	to	5:30 PM	0	0	3	1	0	1	0	0	0	0	1	0	0	0	1	3	**10**
5:30 PM	to	5:45 PM	0	0	0	0	0	1	0	0	0	0	3	0	0	0	2	2	**8**
5:45 PM	to	6:00 PM	0	0	0	0	0	1	0	0	0	0	1	1	0	2	1	5	**11**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	4	1	0	7	2	0	0	0	7	0	0	1	6	5	**33**
4:15 PM	to	5:15 PM	0	0	1	1	0	7	2	0	0	0	8	0	0	2	8	6	**35**
4:30 PM	to	5:30 PM	0	0	4	2	0	7	1	0	0	0	4	0	0	2	6	7	**33**
4:45 PM	to	5:45 PM	0	0	3	2	0	6	1	0	0	0	6	0	0	2	6	8	**34**
5:00 PM	to	6:00 PM	0	0	3	1	0	3	0	0	0	0	6	1	0	3	6	12	**35**

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4:45 PM to 5:45 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	5	7	6	16	**34**

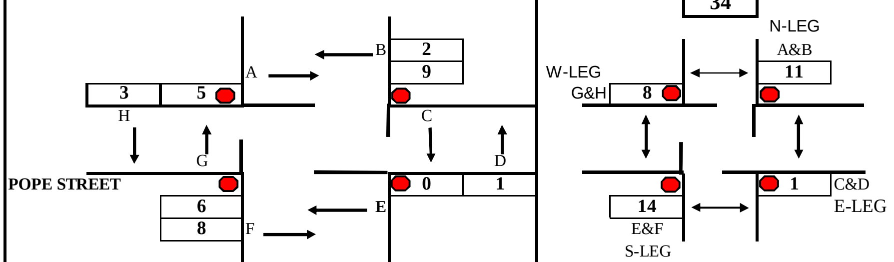
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018
N-S APPROACH:	WOODLAND AVENUE	DAY:	TUESDAY
E-W APPROACH:	POPE STREET	JURISDICTION:	PALO ALTO
SURVEY PERIOD	4:00 PM TO 6:00 PM	FILE:	3805030-6PM

PEAK HOUR
04:45 PM TO 05:45 PM

PEAK HOUR
TOTAL PEDESTRIAN VOLUMES
34



LEGEND: CROSSWALK, SIDEWALK, STOP CONTROL LINE, STOP

WOODLAND AVENUE

BY LEG:	
N-LEG	11
S-LEG	14
E-LEG	1
W-LEG	8

BY DIRECTION:	
NB(D+G)	6
SB(C+H)	3
EB(A+F)	17
WB(B+E)	8

TIME PERIOD From		To	NORTH X-WALK A	B	EAST X-WALK C	D	SOUTH X-WALK E	F	WEST X-WALK G	H	TOTAL
SURVEY DATA											
04:00 PM	---	04:15 PM	2	0	0	0	1	0	1	0	*4*
04:15 PM	---	04:30 PM	4	1	2	0	2	3	4	5	*21*
04:30 PM	---	04:45 PM	5	1	2	0	3	3	4	6	*24*
04:45 PM	---	05:00 PM	6	1	2	0	7	6	5	7	*34*
05:00 PM	---	05:15 PM	7	2	2	0	7	8	7	7	*40*
05:15 PM	---	05:30 PM	9	2	2	1	7	11	7	8	*47*
05:30 PM	---	05:45 PM	14	3	2	1	9	11	9	9	*58*
05:45 PM	---	06:00 PM	14	3	2	1	13	11	11	9	*64*
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	2	0	0	0	1	0	1	0	*4*
04:15 PM	---	04:30 PM	2	1	2	0	1	3	3	5	*17*
04:30 PM	---	04:45 PM	1	0	0	0	1	0	0	1	*3*
04:45 PM	---	05:00 PM	1	0	0	0	4	3	1	1	*10*
05:00 PM	---	05:15 PM	1	1	0	0	0	2	2	0	*6*
05:15 PM	---	05:30 PM	2	0	0	1	0	3	0	1	*7*
05:30 PM	---	05:45 PM	5	1	0	0	2	0	2	1	*11*
05:45 PM	---	06:00 PM	0	0	0	0	4	0	2	0	*6*
HOURLY TOTALS											
04:00 PM	---	05:00 PM	6	1	2	0	7	6	5	7	*34*
04:15 PM	---	05:15 PM	5	2	2	0	6	8	6	7	*36*
04:30 PM	---	05:30 PM	5	1	0	1	5	8	3	3	*26*
04:45 PM	---	05:45 PM	9	2	0	1	6	8	5	3	*34*
05:00 PM	---	06:00 PM	8	2	0	1	6	5	6	2	*30*

Tel : (510) 232-1271 *Fax: (510) 232-1272*

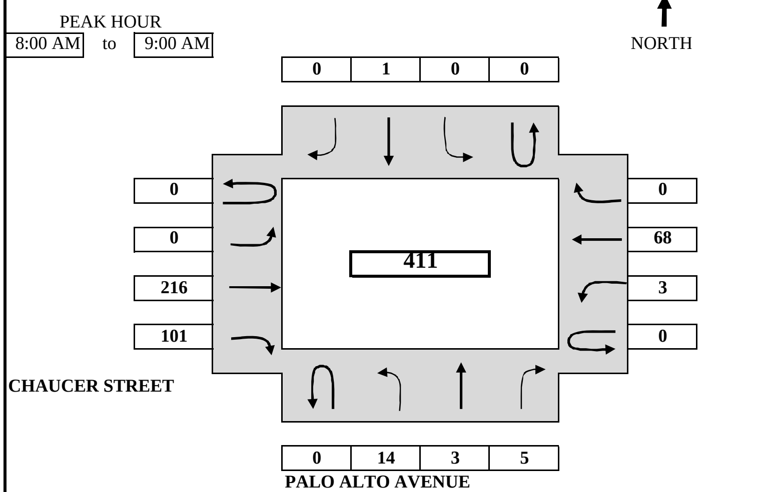
4:45 PM to 5:45 PM

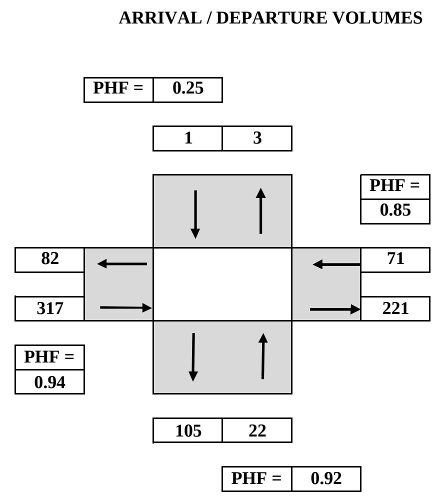
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	6	3	17	8	34
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	11	14	1	8	34

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-7AM**





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM		2	0	1		0	1	0		0	13	9		1	7	0	**34**
7:15 AM	to	7:30 AM		3	1	2		0	3	1		0	32	36		2	18	0	**98**
7:30 AM	to	7:45 AM		6	4	3		0	3	2		1	59	67		3	26	0	**174**
7:45 AM	to	8:00 AM		13	5	4		2	5	2		1	100	95		3	40	1	**271**
8:00 AM	to	8:15 AM		16	5	7		2	5	2		1	154	125		3	61	1	**382**
8:15 AM	to	8:30 AM		21	5	8		2	5	2		1	203	151		5	79	1	**483**
8:30 AM	to	8:45 AM		23	6	9		2	5	2		1	261	173		6	90	1	**579**
8:45 AM	to	9:00 AM		27	8	9		2	6	2		1	316	196		6	108	1	**682**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	2	0	1	0	0	1	0	0	0	13	9	0	1	7	0	**34**
7:15 AM	to	7:30 AM	0	1	1	1	0	0	2	1	0	0	19	27	0	1	11	0	**64**
7:30 AM	to	7:45 AM	0	3	3	1	0	0	0	1	0	1	27	31	0	1	8	0	**76**
7:45 AM	to	8:00 AM	0	7	1	1	0	2	2	0	0	0	41	28	0	0	14	1	**97**
8:00 AM	to	8:15 AM	0	3	0	3	0	0	0	0	0	0	54	30	0	0	21	0	**111**
8:15 AM	to	8:30 AM	0	5	0	1	0	0	0	0	0	0	49	26	0	2	18	0	**101**
8:30 AM	to	8:45 AM	0	2	1	1	0	0	0	0	0	0	58	22	0	1	11	0	**96**
8:45 AM	to	9:00 AM	0	4	2	0	0	0	1	0	0	0	55	23	0	0	18	0	**103**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	13	5	4	0	2	5	2	0	1	100	95	0	3	40	1	**271**
7:15 AM	to	8:15 AM	0	14	5	6	0	2	4	2	0	1	141	116	0	2	54	1	**348**
7:30 AM	to	8:30 AM	0	18	4	6	0	2	2	1	0	1	171	115	0	3	61	1	**385**
7:45 AM	to	8:45 AM	0	17	2	6	0	2	2	0	0	0	202	106	0	3	64	1	**405**
8:00 AM	to	9:00 AM	0	14	3	5	0	0	1	0	0	0	216	101	0	3	68	0	**411**

PEAK HOUR SUMMARY

8:00 AM to 9:00 AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	14	3	5	0	0	1	0	0	0	216	101	0	3	68	0	**411**
PHF BY MOVEMENT	0.00	0.70	0.38	0.42	0.00	0.00	0.25	0.00	0.00	0.00	0.93	0.84	0.00	0.38	0.81	0.00	OVERALL
PHF BY APPROACH	0.92				0.25				0.94				0.85				0.93
BICYCLE	6				2				44				15				**67**
PEDESTRIAN	3				2				7				3				**15**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	8				2				3				2				**15**

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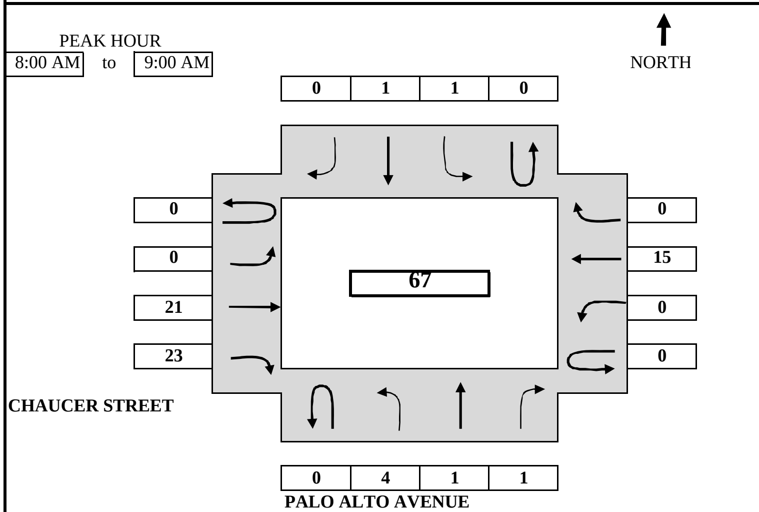
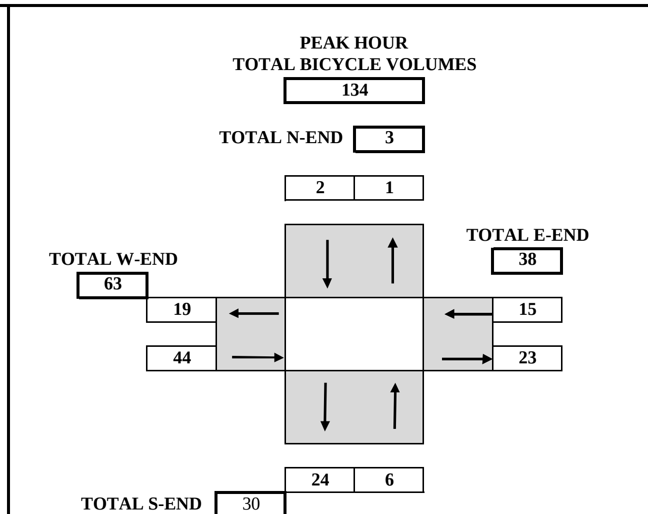
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-7AM**





TIME PERIOD From	To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																		
7:00 AM	to 7:15 AM	0	0	0	0	0	0	0	0	0	0	4	3	0	0	0	0	**7**
7:15 AM	to 7:30 AM	0	0	0	0	0	0	0	0	0	0	8	9	0	0	1	0	**18**
7:30 AM	to 7:45 AM	0	1	0	0	0	0	0	0	0	0	11	12	0	0	5	0	**29**
7:45 AM	to 8:00 AM	0	1	0	0	0	0	0	0	0	0	13	15	0	0	6	0	**35**
8:00 AM	to 8:15 AM	0	1	0	0	0	1	0	0	0	0	16	25	0	0	10	0	**53**
8:15 AM	to 8:30 AM	0	2	0	0	0	1	0	0	0	0	21	29	0	0	14	0	**67**
8:30 AM	to 8:45 AM	0	2	0	0	0	1	0	0	0	0	28	35	0	0	17	0	**83**
8:45 AM	to 9:00 AM	0	5	1	1	0	1	1	0	0	0	34	38	0	0	21	0	**102**
TOTAL BY PERIOD																		
7:00 AM	to 7:15 AM	0	0	0	0	0	0	0	0	0	0	4	3	0	0	0	0	**7**
7:15 AM	to 7:30 AM	0	0	0	0	0	0	0	0	0	0	4	6	0	0	1	0	**11**
7:30 AM	to 7:45 AM	0	1	0	0	0	0	0	0	0	0	3	3	0	0	4	0	**11**
7:45 AM	to 8:00 AM	0	0	0	0	0	0	0	0	0	0	2	3	0	0	1	0	**6**
8:00 AM	to 8:15 AM	0	0	0	0	0	1	0	0	0	0	3	10	0	0	4	0	**18**
8:15 AM	to 8:30 AM	0	1	0	0	0	0	0	0	0	0	5	4	0	0	4	0	**14**
8:30 AM	to 8:45 AM	0	0	0	0	0	0	0	0	0	0	7	6	0	0	3	0	**16**
8:45 AM	to 9:00 AM	0	3	1	1	0	0	1	0	0	0	6	3	0	0	4	0	**19**
HOURLY TOTALS																		
7:00 AM	to 8:00 AM	0	1	0	0	0	0	0	0	0	0	13	15	0	0	6	0	**35**
7:15 AM	to 8:15 AM	0	1	0	0	0	1	0	0	0	0	12	22	0	0	10	0	**46**
7:30 AM	to 8:30 AM	0	2	0	0	0	1	0	0	0	0	13	20	0	0	13	0	**49**
7:45 AM	to 8:45 AM	0	1	0	0	0	1	0	0	0	0	17	23	0	0	12	0	**54**
8:00 AM	to 9:00 AM	0	4	1	1	0	1	1	0	0	0	21	23	0	0	15	0	**67**

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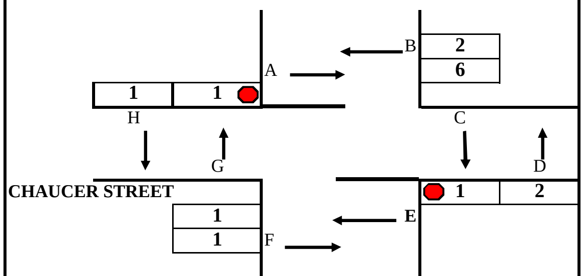
8:00 AM to 9:00 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	6	2	44	15	**67**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

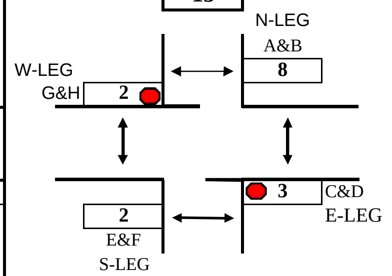
PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018
N-S APPROACH:	PALO ALTO AVENUE	DAY:	TUESDAY
E-W APPROACH:	CHAUCER STREET	JURISDICTION:	PALO ALTO
SURVEY PERIOD	7:00 AM TO 9:00 AM	FILE:	3805030-7AM

PEAK HOUR
08:00 AM TO 09:00 AM



LEGEND:
- CROSSWALK
- SIDEWALK
- STOP CONTROL LINE
- STOP

PEAK HOUR
TOTAL PEDESTRIAN VOLUMES
15



BY LEG:	
N-LEG	8
S-LEG	2
E-LEG	3
W-LEG	2

BY DIRECTION:	
NB(D+G)	3
SB(C+H)	2
EB(A+F)	7
WB(B+E)	3

TIME PERIOD From		To	NORTH X-WALK A	B	EAST X-WALK C	D	SOUTH X-WALK E	F	WEST X-WALK G	H	TOTAL
SURVEY DATA											
07:00 AM	---	07:15 AM	1	2	0	0	0	0	0	1	*4*
07:15 AM	---	07:30 AM	2	5	0	0	0	0	1	1	*9*
07:30 AM	---	07:45 AM	4	7	1	0	1	1	2	1	*17*
07:45 AM	---	08:00 AM	5	8	1	1	1	1	2	1	*20*
08:00 AM	---	08:15 AM	6	8	1	1	1	2	2	2	*23*
08:15 AM	---	08:30 AM	6	8	1	1	2	2	2	2	*24*
08:30 AM	---	08:45 AM	8	8	2	2	2	2	2	2	*28*
08:45 AM	---	09:00 AM	11	10	2	3	2	2	3	2	*35*
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	1	2	0	0	0	0	0	1	*4*
07:15 AM	---	07:30 AM	1	3	0	0	0	0	1	0	*5*
07:30 AM	---	07:45 AM	2	2	1	0	1	1	1	0	*8*
07:45 AM	---	08:00 AM	1	1	0	1	0	0	0	0	*3*
08:00 AM	---	08:15 AM	1	0	0	0	0	1	0	1	*3*
08:15 AM	---	08:30 AM	0	0	0	0	1	0	0	0	*1*
08:30 AM	---	08:45 AM	2	0	1	1	0	0	0	0	*4*
08:45 AM	---	09:00 AM	3	2	0	1	0	0	1	0	*7*
HOURLY TOTALS											
07:00 AM	---	08:00 AM	5	8	1	1	1	1	2	1	*20*
07:15 AM	---	08:15 AM	5	6	1	1	1	2	2	1	*19*
07:30 AM	---	08:30 AM	4	3	1	1	2	2	1	1	*15*
07:45 AM	---	08:45 AM	4	1	1	2	1	1	0	1	*11*
08:00 AM	---	09:00 AM	6	2	1	2	1	1	1	1	*15*

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8:00 AM to 9:00 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	3	2	7	3	**15**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	8	2	3	2	**15**

B.A.Y.M.E.T.R.I.C.S.

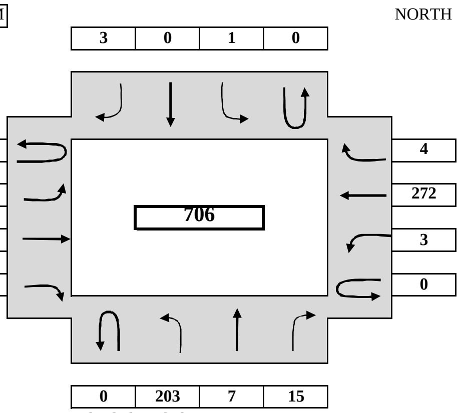
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-7PM**

PEAK HOUR

4:45 PM to 5:45 PM

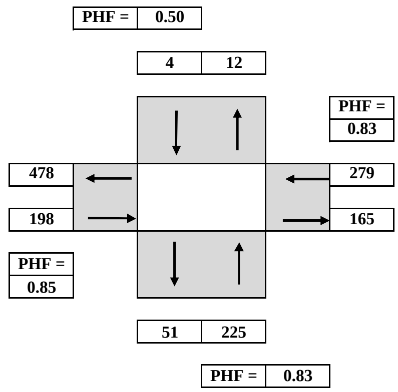
NORTH



CHAUCER STREET

PALO ALTO AVENUE

ARRIVAL / DEPARTURE VOLUMES



TIME From	PERIOD To	NORTHBOUND U-TURN	NB LEFT	NB THRU	NB RIGHT	SOUTHBOUND U-TURN	SB LEFT	SB THRU	SB RIGHT	EASTBOUND U-TURN	EB LEFT	EB THRU	EB RIGHT	WESTBOUND U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																		
4:00 PM to	4:15 PM		36	1	3		1	1	1		1	53	11	1	0	38	0	**147**
4:15 PM to	4:30 PM		63	4	5		1	2	5		1	90	33	1	0	86	1	**292**
4:30 PM to	4:45 PM		96	5	8		4	2	9		2	129	47	1	2	125	2	**432**
4:45 PM to	5:00 PM		138	6	11		5	2	9		2	171	61	1	3	187	2	**598**
5:00 PM to	5:15 PM		192	7	16		5	2	10		2	207	67	1	3	261	3	**776**
5:15 PM to	5:30 PM		254	10	19		5	2	10		3	237	78	1	4	316	4	**943**
5:30 PM to	5:45 PM		299	12	23		5	2	12		3	278	95	1	5	397	6	**1138**
5:45 PM to	6:00 PM		342	13	26		6	2	14		5	315	112	1	6	448	10	**1300**
TOTAL BY PERIOD																		
4:00 PM to	4:15 PM	0	36	1	3	0	1	1	1	0	1	53	11	1	0	38	0	**147**
4:15 PM to	4:30 PM	0	27	3	2	0	0	1	4	0	0	37	22	0	0	48	1	**145**
4:30 PM to	4:45 PM	0	33	1	3	0	3	0	4	0	1	39	14	0	2	39	1	**140**
4:45 PM to	5:00 PM	0	42	1	3	0	1	0	0	0	0	42	14	0	1	62	0	**166**
5:00 PM to	5:15 PM	0	54	1	5	0	0	0	1	0	0	36	6	0	0	74	1	**178**
5:15 PM to	5:30 PM	0	62	3	3	0	0	0	0	0	1	30	11	0	1	55	1	**167**
5:30 PM to	5:45 PM	0	45	2	4	0	0	0	2	0	0	41	17	0	1	81	2	**195**
5:45 PM to	6:00 PM	0	43	1	3	0	1	0	2	0	2	37	17	0	1	51	4	**162**
HOURLY TOTALS																		
4:00 PM to	5:00 PM	0	138	6	11	0	5	2	9	0	2	171	61	1	3	187	2	**598**
4:15 PM to	5:15 PM	0	156	6	13	0	4	1	9	0	1	154	56	0	3	223	3	**629**
4:30 PM to	5:30 PM	0	191	6	14	0	4	0	5	0	2	147	45	0	4	230	3	**651**
4:45 PM to	5:45 PM	0	203	7	15	0	1	0	3	0	1	149	48	0	3	272	4	**706**
5:00 PM to	6:00 PM	0	204	7	15	0	1	0	5	0	3	144	51	0	3	261	8	**702**

PEAK HOUR SUMMARY

4:45 PM to 5:45 PM	NORTHBOUND NBU	NBL	NBT	NBR	SOUTHBOUND SBU	SBL	SBT	SBR	EASTBOUND EBU	EBL	EBT	EBR	WESTBOUND WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	203	7	15	0	1	0	3	0	1	149	48	0	3	272	4	**706**
PHF BY MOVEMENT	0.00	0.82	0.58	0.75	0.00	0.25	0.00	0.38	0.00	0.25	0.89	0.71	0.00	0.75	0.84	0.50	OVERALL
PHF BY APPROACH	0.83				0.50				0.85				0.83				0.91
BICYCLE	12				1				15				10				**38**
PEDESTRIAN	9				6				23				13				**51**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	20				16				12				3				**51**

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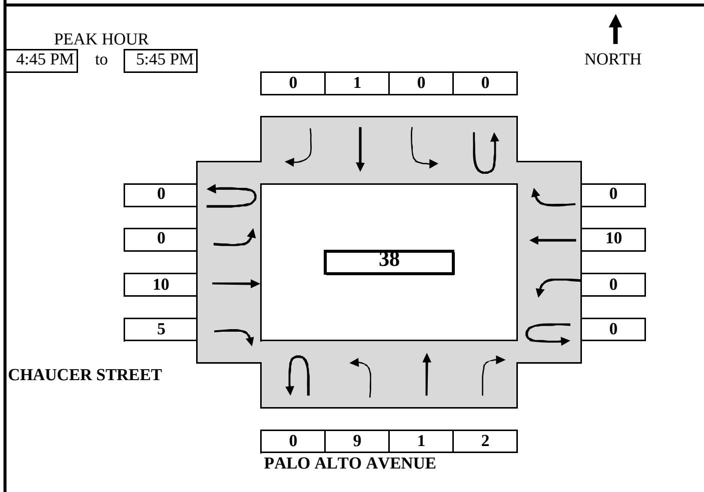
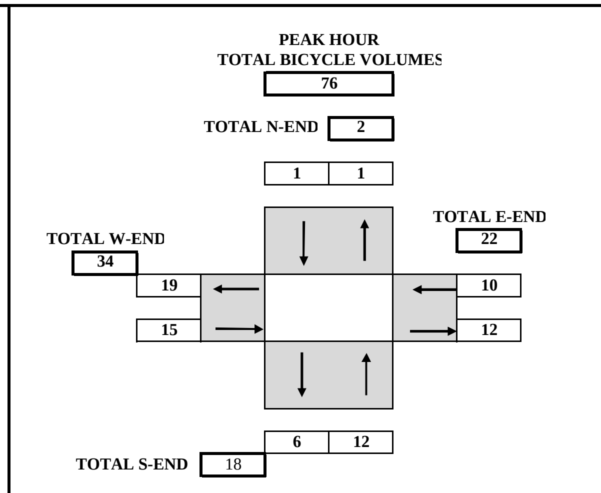
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-7PM**





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	1	0	0	0	0	0	0	0	0	1	0	0	0	5	0	**7**
4:15 PM	to	4:30 PM	0	3	0	0	0	0	0	0	0	0	6	2	0	0	7	0	**18**
4:30 PM	to	4:45 PM	0	5	0	0	0	0	0	0	0	0	7	3	0	0	8	0	**23**
4:45 PM	to	5:00 PM	0	7	0	1	0	0	0	0	0	0	12	5	0	0	11	0	**36**
5:00 PM	to	5:15 PM	0	9	1	2	0	0	1	0	0	0	13	5	0	0	13	0	**44**
5:15 PM	to	5:30 PM	0	11	1	2	0	0	1	0	0	0	16	6	0	0	15	0	**52**
5:30 PM	to	5:45 PM	0	14	1	2	0	0	1	0	0	0	17	8	0	0	18	0	**61**
5:45 PM	to	6:00 PM	0	17	1	2	0	0	1	1	0	0	19	8	0	0	23	0	**72**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	1	0	0	0	0	0	0	0	0	1	0	0	0	5	0	**7**
4:15 PM	to	4:30 PM	0	2	0	0	0	0	0	0	0	0	5	2	0	0	2	0	**11**
4:30 PM	to	4:45 PM	0	2	0	0	0	0	0	0	0	0	1	1	0	0	1	0	**5**
4:45 PM	to	5:00 PM	0	2	0	1	0	0	0	0	0	0	5	2	0	0	3	0	**13**
5:00 PM	to	5:15 PM	0	2	1	1	0	0	1	0	0	0	1	0	0	0	2	0	**8**
5:15 PM	to	5:30 PM	0	2	0	0	0	0	0	0	0	0	3	1	0	0	2	0	**8**
5:30 PM	to	5:45 PM	0	3	0	0	0	0	0	0	0	0	1	2	0	0	3	0	**9**
5:45 PM	to	6:00 PM	0	3	0	0	0	0	0	1	0	0	2	0	0	0	5	0	**11**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	7	0	1	0	0	0	0	0	0	12	5	0	0	11	0	**36**
4:15 PM	to	5:15 PM	0	8	1	2	0	0	1	0	0	0	12	5	0	0	8	0	**37**
4:30 PM	to	5:30 PM	0	8	1	2	0	0	1	0	0	0	10	4	0	0	8	0	**34**
4:45 PM	to	5:45 PM	0	9	1	2	0	0	1	0	0	0	10	5	0	0	10	0	**38**
5:00 PM	to	6:00 PM	0	10	1	1	0	0	1	1	0	0	7	3	0	0	12	0	**36**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

4:45 PM to 5:45 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	12	1	15	10	**38**

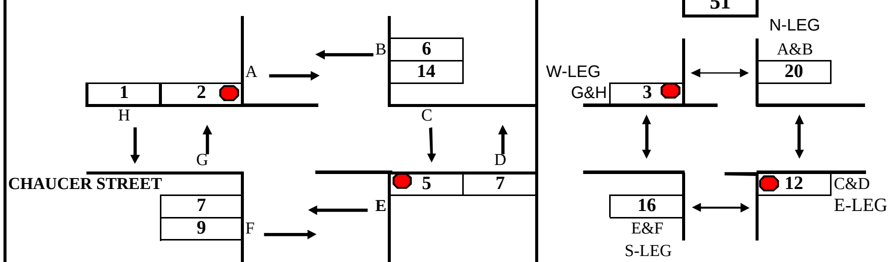
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018
N-S APPROACH:	PALO ALTO AVENUE	DAY:	TUESDAY
E-W APPROACH:	CHAUCER STREET	JURISDICTION:	PALO ALTO
SURVEY PERIOD	4:00 PM TO 6:00 PM	FILE:	3805030-7PM

PEAK HOUR
04:45 PM TO 05:45 PM

PEAK HOUR
TOTAL PEDESTRIAN VOLUMES
51



LEGEND:
- CROSSWALK
- SIDEWALK
- STOP CONTROL LINE
- STOP

BY LEG:		BY DIRECTION:	
N-LEG	20	NB(D+G)	9
S-LEG	16	SB(C+H)	6
E-LEG	12	EB(A+F)	23
W-LEG	3	WB(B+E)	13

TIME PERIOD From		To	NORTH X-WALK A	B	EAST X-WALK C	D	SOUTH X-WALK E	F	WEST X-WALK G	H	TOTAL
SURVEY DATA											
04:00 PM	---	04:15 PM	1	0	0	1	1	0	1	1	*5*
04:15 PM	---	04:30 PM	1	1	0	2	2	5	1	3	*15*
04:30 PM	---	04:45 PM	2	3	1	4	3	5	1	3	*22*
04:45 PM	---	05:00 PM	5	5	1	5	6	7	1	3	*33*
05:00 PM	---	05:15 PM	7	7	1	8	6	8	1	3	*41*
05:15 PM	---	05:30 PM	12	7	3	9	7	11	1	3	*53*
05:30 PM	---	05:45 PM	16	9	6	11	10	14	3	4	*73*
05:45 PM	---	06:00 PM	16	9	6	11	12	14	3	4	*75*
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	1	0	0	1	1	0	1	1	*5*
04:15 PM	---	04:30 PM	0	1	0	1	1	5	0	2	*10*
04:30 PM	---	04:45 PM	1	2	1	2	1	0	0	0	*7*
04:45 PM	---	05:00 PM	3	2	0	1	3	2	0	0	*11*
05:00 PM	---	05:15 PM	2	2	0	3	0	1	0	0	*8*
05:15 PM	---	05:30 PM	5	0	2	1	1	3	0	0	*12*
05:30 PM	---	05:45 PM	4	2	3	2	3	3	2	1	*20*
05:45 PM	---	06:00 PM	0	0	0	0	2	0	0	0	*2*
HOURLY TOTALS											
04:00 PM	---	05:00 PM	5	5	1	5	6	7	1	3	*33*
04:15 PM	---	05:15 PM	6	7	1	7	5	8	0	2	*36*
04:30 PM	---	05:30 PM	11	6	3	7	5	6	0	0	*38*
04:45 PM	---	05:45 PM	14	6	5	7	7	9	2	1	*51*
05:00 PM	---	06:00 PM	11	4	5	6	6	7	2	1	*42*

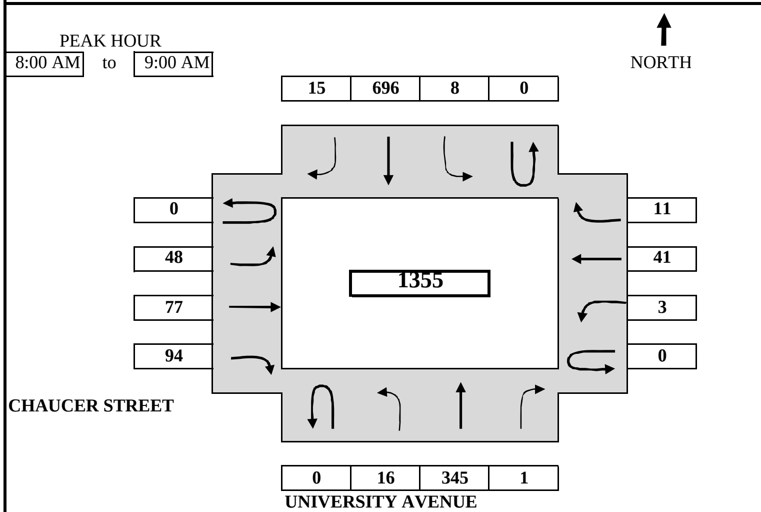
Tel : (510) 232-1271 *Fax: (510) 232-1272*

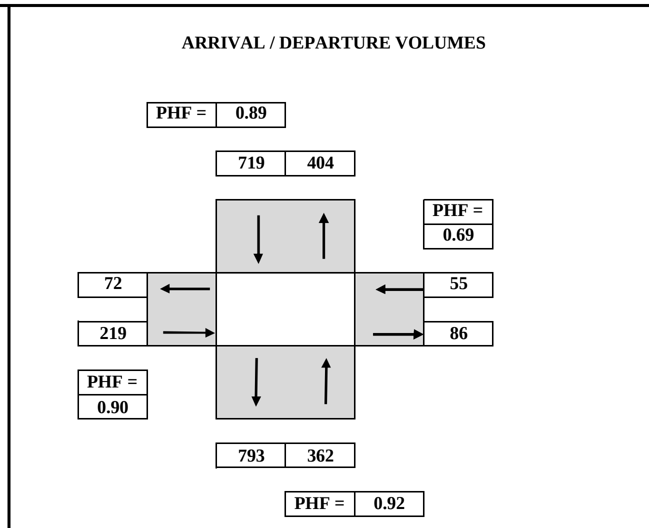
4:45 PM to 5:45 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	9	6	23	13	**51**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	20	16	12	3	**51**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**UNIVERSITY AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-8AM**





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM		3	61	0		1	163	2		4	5	6		1	3	2	**251**
7:15 AM	to	7:30 AM		4	123	0		2	323	7		6	11	16		1	7	4	**504**
7:30 AM	to	7:45 AM		6	208	0		3	467	13		12	20	31		1	9	6	**776**
7:45 AM	to	8:00 AM		9	308	0		4	603	19		26	32	51		2	16	7	**1077**
8:00 AM	to	8:15 AM		12	397	1		7	755	23		37	45	70		3	31	11	**1392**
8:15 AM	to	8:30 AM		16	480	1		9	914	27		50	65	96		5	42	13	**1718**
8:30 AM	to	8:45 AM		21	559	1		10	1105	29		60	82	125		5	46	14	**2057**
8:45 AM	to	9:00 AM		25	653	1		12	1299	34		74	109	145		5	57	18	**2432**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	3	61	0	0	1	163	2	0	4	5	6	0	1	3	2	**251**
7:15 AM	to	7:30 AM	0	1	62	0	0	1	160	5	0	2	6	10	0	0	4	2	**253**
7:30 AM	to	7:45 AM	0	2	85	0	0	1	144	6	0	6	9	15	0	0	2	2	**272**
7:45 AM	to	8:00 AM	0	3	100	0	0	1	136	6	0	14	12	20	0	1	7	1	**301**
8:00 AM	to	8:15 AM	0	3	89	1	0	3	152	4	0	11	13	19	0	1	15	4	**315**
8:15 AM	to	8:30 AM	0	4	83	0	0	2	159	4	0	13	20	26	0	2	11	2	**326**
8:30 AM	to	8:45 AM	0	5	79	0	0	1	191	2	0	10	17	29	0	0	4	1	**339**
8:45 AM	to	9:00 AM	0	4	94	0	0	2	194	5	0	14	27	20	0	0	11	4	**375**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	9	308	0	0	4	603	19	0	26	32	51	0	2	16	7	**1077**
7:15 AM	to	8:15 AM	0	9	336	1	0	6	592	21	0	33	40	64	0	2	28	9	**1141**
7:30 AM	to	8:30 AM	0	12	357	1	0	7	591	20	0	44	54	80	0	4	35	9	**1214**
7:45 AM	to	8:45 AM	0	15	351	1	0	7	638	16	0	48	62	94	0	4	37	8	**1281**
8:00 AM	to	9:00 AM	0	16	345	1	0	8	696	15	0	48	77	94	0	3	41	11	**1355**

PEAK HOUR SUMMARY

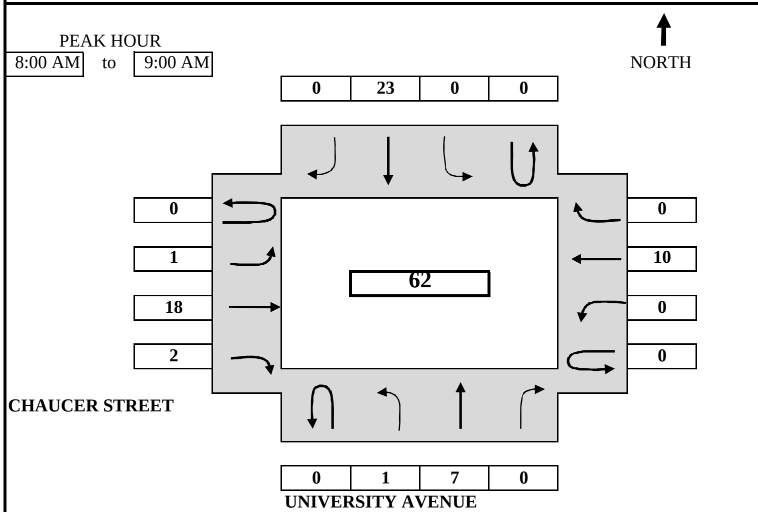
8:00 AM to 9:00 AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	16	345	1	0	8	696	15	0	48	77	94	0	3	41	11	**1355**
PHF BY MOVEMENT	0.00	0.80	0.92	0.25	0.00	0.67	0.90	0.75	0.00	0.86	0.71	0.81	0.00	0.38	0.68	0.69	OVERALL
PHF BY APPROACH	0.92				0.89				0.90				0.69				0.90
BICYCLE	8				23				21				10				**62**
PEDESTRIAN	5				3				7				3				**18**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	6				4				3				5				**18**

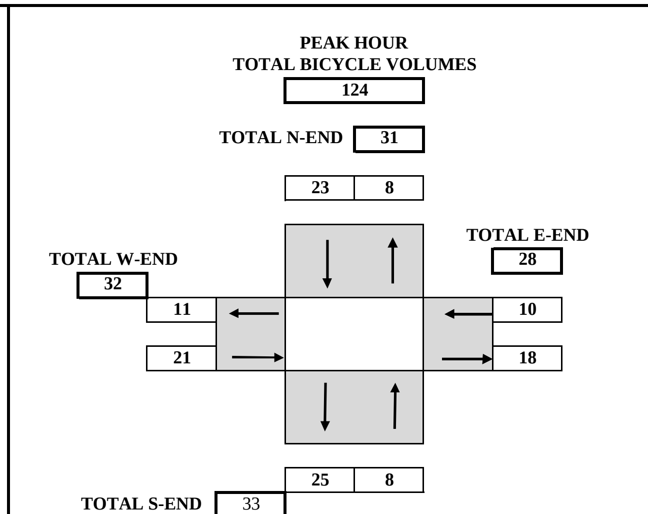
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**UNIVERSITY AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-8AM**





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	1	0	0	0	5	0	0	0	0	0	**6**
7:15 AM	to	7:30 AM	0	1	0	0	0	0	7	0	0	0	8	1	0	0	0	0	**17**
7:30 AM	to	7:45 AM	0	1	1	0	0	0	15	1	0	0	11	1	0	0	3	0	**33**
7:45 AM	to	8:00 AM	0	1	2	0	0	0	18	1	0	0	14	1	0	0	4	0	**41**
8:00 AM	to	8:15 AM	0	1	2	0	0	0	24	1	0	0	17	1	0	0	7	0	**53**
8:15 AM	to	8:30 AM	0	1	6	0	0	0	26	1	0	0	20	1	0	0	11	0	**66**
8:30 AM	to	8:45 AM	0	2	8	0	0	0	37	1	0	0	29	1	0	0	12	0	**90**
8:45 AM	to	9:00 AM	0	2	9	0	0	0	41	1	0	1	32	3	0	0	14	0	**103**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	1	0	0	0	5	0	0	0	0	0	**6**
7:15 AM	to	7:30 AM	0	1	0	0	0	0	6	0	0	0	3	1	0	0	0	0	**11**
7:30 AM	to	7:45 AM	0	0	1	0	0	0	8	1	0	0	3	0	0	0	3	0	**16**
7:45 AM	to	8:00 AM	0	0	1	0	0	0	3	0	0	0	3	0	0	0	1	0	**8**
8:00 AM	to	8:15 AM	0	0	0	0	0	0	6	0	0	0	3	0	0	0	3	0	**12**
8:15 AM	to	8:30 AM	0	0	4	0	0	0	2	0	0	0	3	0	0	0	4	0	**13**
8:30 AM	to	8:45 AM	0	1	2	0	0	0	11	0	0	0	9	0	0	0	1	0	**24**
8:45 AM	to	9:00 AM	0	0	1	0	0	0	4	0	0	1	3	2	0	0	2	0	**13**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	1	2	0	0	0	18	1	0	0	14	1	0	0	4	0	**41**
7:15 AM	to	8:15 AM	0	1	2	0	0	0	23	1	0	0	12	1	0	0	7	0	**47**
7:30 AM	to	8:30 AM	0	0	6	0	0	0	19	1	0	0	12	0	0	0	11	0	**49**
7:45 AM	to	8:45 AM	0	1	7	0	0	0	22	0	0	0	18	0	0	0	9	0	**57**
8:00 AM	to	9:00 AM	0	1	7	0	0	0	23	0	0	1	18	2	0	0	10	0	**62**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

8:00 AM to 9:00 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	8	23	21	10	**62**

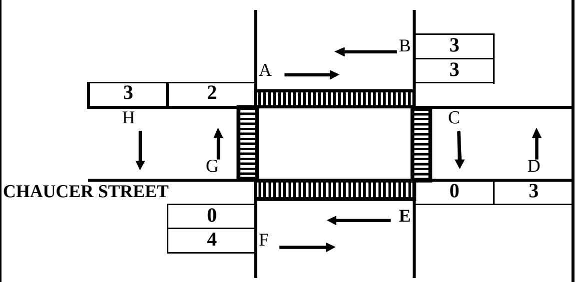
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018
N-S APPROACH:	UNIVERSITY AVENUE	DAY:	TUESDAY
E-W APPROACH:	CHAUCER STREET	JURISDICTION:	PALO ALTO
SURVEY PERIOD	7:00 AM TO 9:00 AM	FILE:	3805030-8AM

PEAK HOUR

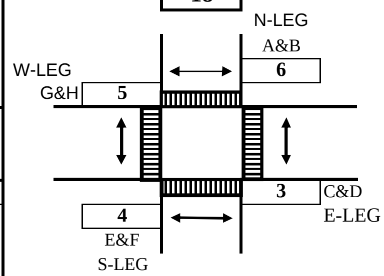
08:00 AM TO 09:00 AM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

18



LEGEND: **UNIVERSITY AVENUE**

- CROSSWALK
- SIDEWALK
- STOP CONTROL LINE
- STOP

BY LEG:	
N-LEG	6
S-LEG	4
E-LEG	3
W-LEG	5

BY DIRECTION:	
NB(D+G)	5
SB(C+H)	3
EB(A+F)	7
WB(B+E)	3

TIME PERIOD From		To	NORTH X-WALK A	B	EAST X-WALK C	D	SOUTH X-WALK E	F	WEST X-WALK G	H	TOTAL
SURVEY DATA											
07:00 AM	---	07:15 AM	2	0	3	0	0	0	0	2	*7*
07:15 AM	---	07:30 AM	3	2	3	0	0	1	0	3	*12*
07:30 AM	---	07:45 AM	3	4	4	0	0	2	2	4	*19*
07:45 AM	---	08:00 AM	3	4	4	1	1	2	2	5	*22*
08:00 AM	---	08:15 AM	4	5	4	2	1	4	2	6	*28*
08:15 AM	---	08:30 AM	4	5	4	3	1	5	3	7	*32*
08:30 AM	---	08:45 AM	4	6	4	3	1	5	3	8	*34*
08:45 AM	---	09:00 AM	6	7	4	4	1	6	4	8	*40*
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	2	0	3	0	0	0	0	2	*7*
07:15 AM	---	07:30 AM	1	2	0	0	0	1	0	1	*5*
07:30 AM	---	07:45 AM	0	2	1	0	0	1	2	1	*7*
07:45 AM	---	08:00 AM	0	0	0	1	1	0	0	1	*3*
08:00 AM	---	08:15 AM	1	1	0	1	0	2	0	1	*6*
08:15 AM	---	08:30 AM	0	0	0	1	0	1	1	1	*4*
08:30 AM	---	08:45 AM	0	1	0	0	0	0	0	1	*2*
08:45 AM	---	09:00 AM	2	1	0	1	0	1	1	0	*6*
HOURLY TOTALS											
07:00 AM	---	08:00 AM	3	4	4	1	1	2	2	5	*22*
07:15 AM	---	08:15 AM	2	5	1	2	1	4	2	4	*21*
07:30 AM	---	08:30 AM	1	3	1	3	1	4	3	4	*20*
07:45 AM	---	08:45 AM	1	2	0	3	1	3	1	4	*15*
08:00 AM	---	09:00 AM	3	3	0	3	0	4	2	3	*18*

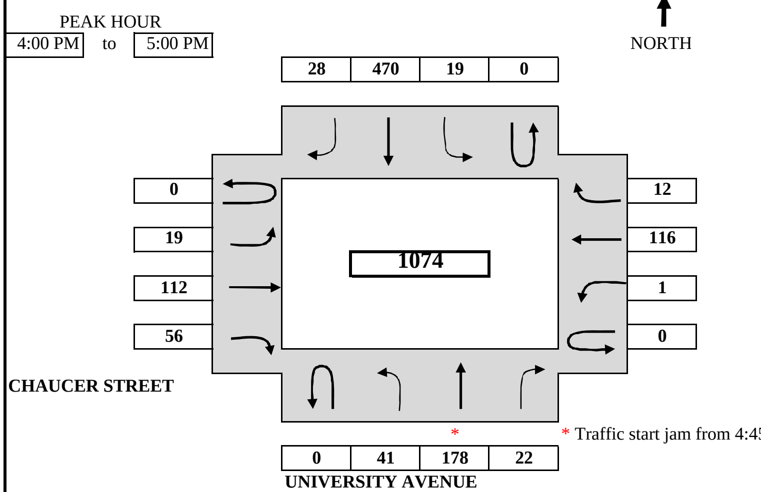
Tel : (510) 232-1271 *Fax: (510) 232-1272*

8:00 AM to 9:00 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	5	3	7	3	**18**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	6	4	3	5	**18**

B.A.Y.M.E.T.R.I.C.S.

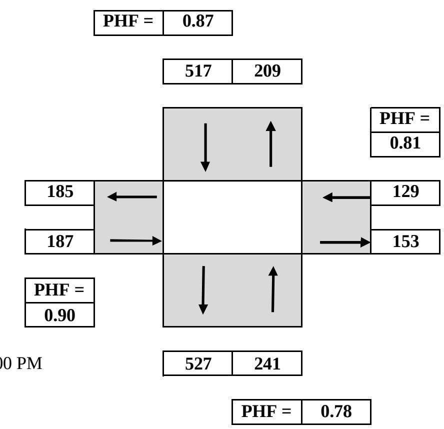
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**UNIVERSITY AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-8PM**



* Traffic start jam from 4:45 to 6:00 PM

ARRIVAL / DEPARTURE VOLUMES



TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM		7	68	2		3	140	6		9	23	20		0	25	1	**304**
4:15 PM	to	4:30 PM		22	124	4		10	218	16		14	52	34		0	54	6	**554**
4:30 PM	to	4:45 PM		32	154	15		16	349	21		18	81	48		1	80	8	**823**
4:45 PM	to	5:00 PM		41	178	22		19	470	28		19	112	56		1	116	12	**1074**
5:00 PM	to	5:15 PM		52	199	25		21	565	36		20	141	69		1	178	14	**1321**
5:15 PM	to	5:30 PM		56	212	25		25	663	41		23	153	82		3	226	14	**1523**
5:30 PM	to	5:45 PM		62	233	27		26	762	56		24	185	96		3	288	15	**1777**
5:45 PM	to	6:00 PM		66	256	27		33	874	70		25	207	110		3	328	16	**2015**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	7	68	2	0	3	140	6	0	9	23	20	0	0	25	1	**304**
4:15 PM	to	4:30 PM	0	15	56	2	0	7	78	10	0	5	29	14	0	0	29	5	**250**
4:30 PM	to	4:45 PM	0	10	30	11	0	6	131	5	0	4	29	14	0	1	26	2	**269**
4:45 PM	to	5:00 PM	0	9	24	7	0	3	121	7	0	1	31	8	0	0	36	4	**251**
5:00 PM	to	5:15 PM	0	11	21	3	0	2	95	8	0	1	29	13	0	0	62	2	**247**
5:15 PM	to	5:30 PM	0	4	13	0	0	4	98	5	0	3	12	13	0	2	48	0	**202**
5:30 PM	to	5:45 PM	0	6	21	2	0	1	99	15	0	1	32	14	0	0	62	1	**254**
5:45 PM	to	6:00 PM	0	4	23	0	0	7	112	14	0	1	22	14	0	0	40	1	**238**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	41	178	22	0	19	470	28	0	19	112	56	0	1	116	12	**1074**
4:15 PM	to	5:15 PM	0	45	131	23	0	18	425	30	0	11	118	49	0	1	153	13	**1017**
4:30 PM	to	5:30 PM	0	34	88	21	0	15	445	25	0	9	101	48	0	3	172	8	**969**
4:45 PM	to	5:45 PM	0	30	79	12	0	10	413	35	0	6	104	48	0	2	208	7	**954**
5:00 PM	to	6:00 PM	0	25	78	5	0	14	404	42	0	6	95	54	0	2	212	4	**941**

PEAK HOUR SUMMARY

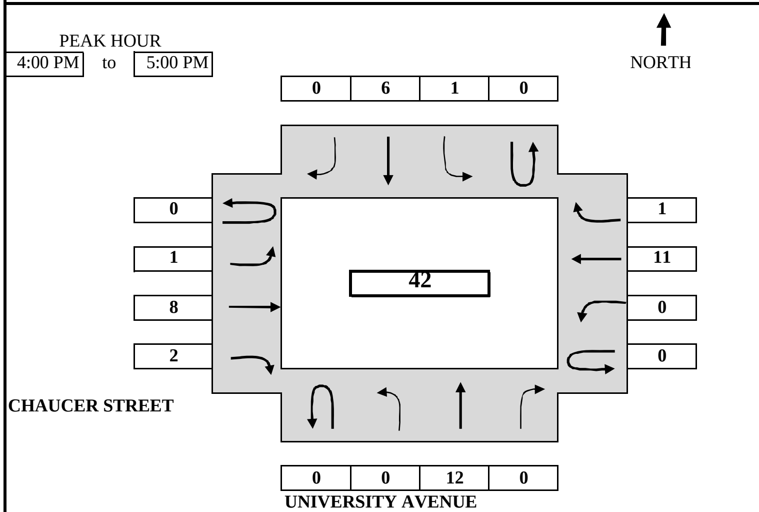
4:00 PM to 5:00 PM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	41	178	22	0	19	470	28	0	19	112	56	0	1	116	12	**1074**
PHF BY MOVEMENT	0.00	0.68	0.65	0.50	0.00	0.68	0.84	0.70	0.00	0.53	0.90	0.70	0.00	0.25	0.81	0.60	OVERALL
PHF BY APPROACH	0.78				0.87				0.90				0.81				0.88
BICYCLE	12				7				11				12				**42**
PEDESTRIAN	6				5				2				5				**18**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	3				4				3				8				**18**

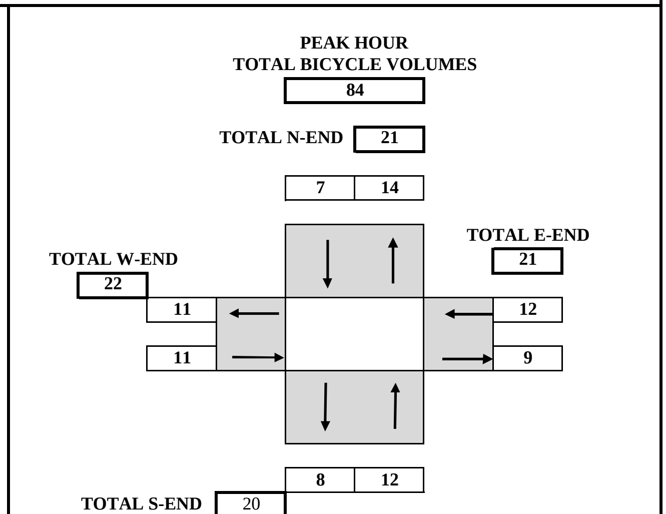
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	TRAFFIC COUNTS IN PALO ALTO	SURVEY DATE:	5/22/2018	DAY:	TUESDAY
N-S APPROACH:	UNIVERSITY AVENUE	SURVEY TIME:	4:00 PM	TO	6:00 PM
E-W APPROACH:	CHAUCER STREET	JURISDICTION:	PALO ALTO	FILE:	3805030-8PM





TIME PERIOD From		To	NORTHBOUND U-TURN	LEFT	THRU	RIGHT	SOUTHBOUND U-TURN	LEFT	THRU	RIGHT	EASTBOUND U-TURN	LEFT	THRU	RIGHT	WESTBOUND U-TURN	LEFT	THRU	RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	3	0	0	1	2	0	0	0	0	0	0	0	4	0	**10**
4:15 PM	to	4:30 PM	0	0	6	0	0	1	3	0	0	0	5	1	0	0	7	0	**23**
4:30 PM	to	4:45 PM	0	0	10	0	0	1	5	0	0	0	5	1	0	0	8	1	**31**
4:45 PM	to	5:00 PM	0	0	12	0	0	1	6	0	0	1	8	2	0	0	11	1	**42**
5:00 PM	to	5:15 PM	0	0	12	0	0	1	10	1	0	1	9	3	0	0	13	2	**52**
5:15 PM	to	5:30 PM	0	0	15	0	0	1	14	1	0	1	10	5	0	0	15	2	**64**
5:30 PM	to	5:45 PM	0	0	17	0	0	1	16	1	0	1	10	5	0	0	15	2	**68**
5:45 PM	to	6:00 PM	0	0	24	0	0	1	17	1	0	1	11	7	0	0	21	2	**85**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	3	0	0	1	2	0	0	0	0	0	0	0	4	0	**10**
4:15 PM	to	4:30 PM	0	0	3	0	0	0	1	0	0	0	5	1	0	0	3	0	**13**
4:30 PM	to	4:45 PM	0	0	4	0	0	0	2	0	0	0	0	0	0	0	1	1	**8**
4:45 PM	to	5:00 PM	0	0	2	0	0	0	1	0	0	1	3	1	0	0	3	0	**11**
5:00 PM	to	5:15 PM	0	0	0	0	0	0	4	1	0	0	1	1	0	0	2	1	**10**
5:15 PM	to	5:30 PM	0	0	3	0	0	0	4	0	0	0	1	2	0	0	2	0	**12**
5:30 PM	to	5:45 PM	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	**4**
5:45 PM	to	6:00 PM	0	0	7	0	0	0	1	0	0	0	1	2	0	0	6	0	**17**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	12	0	0	1	6	0	0	1	8	2	0	0	11	1	**42**
4:15 PM	to	5:15 PM	0	0	9	0	0	0	8	1	0	1	9	3	0	0	9	2	**42**
4:30 PM	to	5:30 PM	0	0	9	0	0	0	11	1	0	1	5	4	0	0	8	2	**41**
4:45 PM	to	5:45 PM	0	0	7	0	0	0	11	1	0	1	5	4	0	0	7	1	**37**
5:00 PM	to	6:00 PM	0	0	12	0	0	0	11	1	0	0	3	5	0	0	10	1	**43**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

4:00 PM to 5:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	12	7	11	12	**42**

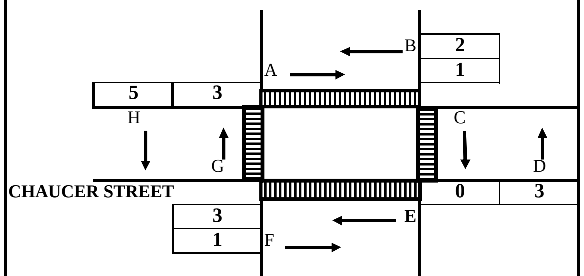
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**UNIVERSITY AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-8PM**

PEAK HOUR

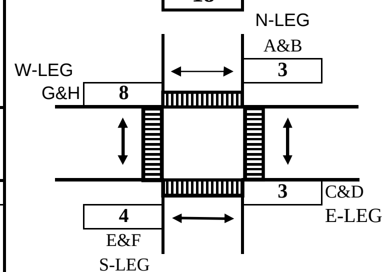
04:00 PM TO 05:00 PM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

18



LEGEND:

CROSSWALK

SIDEWALK

STOP CONTROL LINE

STOP

BY LEG:	
N-LEG	**3**
S-LEG	**4**
E-LEG	**3**
W-LEG	**8**

BY DIRECTION:	
NB(D+G)	**6**
SB(C+H)	**5**
EB(A+F)	**2**
WB(B+E)	**5**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
					SURVEY DATA						
04:00 PM	---	04:15 PM	1	1	0	1	2	0	0	0	***5***
04:15 PM	---	04:30 PM	1	2	0	2	3	0	2	0	***10***
04:30 PM	---	04:45 PM	1	2	0	3	3	1	2	1	***13***
04:45 PM	---	05:00 PM	1	2	0	3	3	1	3	5	***18***
05:00 PM	---	05:15 PM	2	3	0	3	4	2	5	11	***30***
05:15 PM	---	05:30 PM	4	4	1	3	4	2	9	12	***39***
05:30 PM	---	05:45 PM	6	6	2	12	5	3	10	14	***58***
05:45 PM	---	06:00 PM	6	6	2	15	7	3	11	16	***66***
					TOTAL BY PERIOD						
04:00 PM	---	04:15 PM	1	1	0	1	2	0	0	0	***5***
04:15 PM	---	04:30 PM	0	1	0	1	1	0	2	0	***5***
04:30 PM	---	04:45 PM	0	0	0	1	0	1	0	1	***3***
04:45 PM	---	05:00 PM	0	0	0	0	0	0	1	4	***5***
05:00 PM	---	05:15 PM	1	1	0	0	1	1	2	6	***12***
05:15 PM	---	05:30 PM	2	1	1	0	0	0	4	1	***9***
05:30 PM	---	05:45 PM	2	2	1	9	1	1	1	2	***19***
05:45 PM	---	06:00 PM	0	0	0	3	2	0	1	2	***8***
					HOURLY TOTALS						
04:00 PM	---	05:00 PM	1	2	0	3	3	1	3	5	***18***
04:15 PM	---	05:15 PM	1	2	0	2	2	2	5	11	***25***
04:30 PM	---	05:30 PM	3	2	1	1	1	2	7	12	***29***
04:45 PM	---	05:45 PM	5	4	2	9	2	2	8	13	***45***
05:00 PM	---	06:00 PM	5	4	2	12	4	2	8	11	***48***

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

4:00 PM to 5:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	6	5	2	5	**18**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	3	4	3	8	**18**

Appendix B – Existing Conditions Synchro Reports

- HCM Delay and LOS Reports
- 95th Percentile Queue Length Reports

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	134	135	291	5	899	59	908
v/c Ratio	0.86	0.42	0.79	0.92	0.01	0.64	0.17	0.64
Control Delay	150.3	57.7	90.3	89.0	6.2	13.9	6.4	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	150.3	57.7	90.3	89.0	6.2	13.9	6.4	10.9
Queue Length 50th (ft)	41	114	127	262	1	302	14	377
Queue Length 95th (ft)	#90	147	#188	#333	m3	363	31	497
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	52	336	177	330	337	1398	343	1420
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.40	0.76	0.88	0.01	0.64	0.17	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Future Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.97	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1765	1830		1721	1715		1770	1828		1770	1861	
Flt Permitted	0.16	1.00		0.53	1.00		0.24	1.00		0.24	1.00	
Satd. Flow (perm)	290	1830		969	1715		443	1828		451	1861	
Peak-hour factor, PHF	0.74	0.74	0.74	0.79	0.79	0.79	0.85	0.85	0.85	0.95	0.95	0.95
Adj. Flow (vph)	43	123	11	135	171	120	5	814	85	59	903	5
RTOR Reduction (vph)	0	2	0	0	17	0	0	2	0	0	0	0
Lane Group Flow (vph)	43	132	0	135	274	0	5	897	0	59	908	0
Confl. Peds. (#/hr)	2		11	11		2	7		8	8		7
Confl. Bikes (#/hr)			5			9			10			20
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Effective Green, g (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.76	0.76		0.76	0.76	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	50	320		169	300		338	1395		344	1420	
v/s Ratio Prot		0.07			c0.16			c0.49			0.49	
v/s Ratio Perm	0.15			0.14			0.01			0.13		
v/c Ratio	0.86	0.41		0.80	0.91		0.01	0.64		0.17	0.64	
Uniform Delay, d1	60.1	55.0		59.3	60.7		4.2	8.2		4.8	8.2	
Progression Factor	1.00	1.00		1.00	1.00		1.36	1.42		1.00	1.00	
Incremental Delay, d2	76.1	0.9		22.5	30.2		0.1	1.6		1.1	2.2	
Delay (s)	136.2	55.8		81.9	91.0		5.8	13.3		5.9	10.4	
Level of Service	F	E		F	F		A	B		A	B	
Approach Delay (s)		75.3			88.1			13.3			10.1	
Approach LOS		E			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	29.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	75.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	226	465	94	478	180	50	313	162	249	256	499
v/c Ratio	0.80	0.79	0.32	0.85	0.61	0.16	0.94	0.49	0.43	0.43	0.74
Control Delay	80.0	69.3	57.9	75.1	39.2	53.3	96.9	30.1	37.5	37.5	24.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.0	69.3	57.9	75.1	39.2	53.3	96.9	30.1	37.5	37.5	24.3
Queue Length 50th (ft)	232	237	81	249	94	42	305	63	215	222	258
Queue Length 95th (ft)	#346	304	133	303	175	69	#360	101	m307	m315	408
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	308	639	305	581	303	322	339	338	580	594	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.73	0.31	0.82	0.59	0.16	0.92	0.48	0.43	0.43	0.74

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Future Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.92	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Peak-hour factor, PHF	0.90	0.90	0.90	0.86	0.86	0.86	0.76	0.76	0.76	0.93	0.93	0.93
Adj. Flow (vph)	314	358	19	94	458	200	50	313	162	395	110	499
RTOR Reduction (vph)	0	2	0	0	2	71	0	0	73	0	0	162
Lane Group Flow (vph)	226	463	0	94	476	109	50	313	89	249	256	337
Confl. Peds. (#/hr)			1			22			31			23
Confl. Bikes (#/hr)			6			9			16			28
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Effective Green, g (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Actuated g/C Ratio	0.18	0.18		0.17	0.17	0.17	0.18	0.18	0.18	0.35	0.35	0.35
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	282	584		296	562	226	316	332	260	580	594	512
v/s Ratio Prot	c0.14	0.14		0.05	c0.14		0.03	c0.17		0.15	0.15	
v/s Ratio Perm						0.08			0.06			c0.23
v/c Ratio	0.80	0.79		0.32	0.85	0.48	0.16	0.94	0.34	0.43	0.43	0.66
Uniform Delay, d1	59.3	59.2		54.9	60.6	56.6	52.1	60.8	53.9	37.7	37.8	41.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.85
Incremental Delay, d2	15.0	7.3		0.6	11.4	1.6	0.2	34.5	0.8	1.7	1.7	4.9
Delay (s)	74.3	66.6		55.5	72.0	58.2	52.3	95.3	54.7	36.0	36.0	40.2
Level of Service	E	E		E	E	E	D	F	D	D	D	D
Approach Delay (s)		69.1			66.6			78.7			38.1	
Approach LOS		E			E			E			D	

Intersection Summary			
HCM 2000 Control Delay	59.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	84	721	0	0	501	13	0	0	0	23	0	147
Future Volume (Veh/h)	84	721	0	0	501	13	0	0	0	23	0	147
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.92	0.92	0.92	0.25	0.25	0.25	0.99	0.99	0.99
Hourly flow rate (vph)	87	743	0	0	545	14	0	0	0	23	0	148
Pedestrians					6			6			5	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					1			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.94			0.94	0.94	0.94	0.94	0.94	
vC, conflicting volume	564			749			1623	1487	384	1108	1480	557
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	564			594			1528	1383	204	979	1376	557
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	91			100			100	100	100	87	100	69
cM capacity (veh/h)	999			910			47	120	743	175	122	472

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	87	372	372	559	0	23	148
Volume Left	87	0	0	0	0	23	0
Volume Right	0	0	0	14	0	0	148
cSH	999	1700	1700	1700	1700	175	472
Volume to Capacity	0.09	0.22	0.22	0.33	0.00	0.13	0.31
Queue Length 95th (ft)	7	0	0	0	0	11	33
Control Delay (s)	8.9	0.0	0.0	0.0	0.0	28.6	16.1
Lane LOS	A				A	D	C
Approach Delay (s)	0.9			0.0	0.0	17.8	
Approach LOS					A	C	

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	726	494	5	2	20
Future Volume (Veh/h)	24	726	494	5	2	20
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.95	0.95	0.92	0.92
Hourly flow rate (vph)	26	772	520	5	2	22
Pedestrians		2	4		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.86	
vC, conflicting volume	535				1360	534
vC1, stage 1 conf vol					532	
vC2, stage 2 conf vol					828	
vCu, unblocked vol	535				1338	534
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	96
cM capacity (veh/h)	1023				347	539

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	26	772	525	24
Volume Left	26	0	0	2
Volume Right	0	0	5	22
cSH	1023	1700	1700	516
Volume to Capacity	0.03	0.45	0.31	0.05
Queue Length 95th (ft)	2	0	0	4
Control Delay (s)	8.6	0.0	0.0	12.3
Lane LOS	A			B
Approach Delay (s)	0.3		0.0	12.3
Approach LOS				B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	48.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	78	37	17	82	2
Future Volume (Veh/h)	2	78	37	17	82	2
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.72	0.72	0.84	0.84
Hourly flow rate (vph)	2	85	51	24	98	2
Pedestrians					8	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	83				160	71
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83				160	71
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				88	100
cM capacity (veh/h)	1503				824	984

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	87	75	100
Volume Left	2	0	98
Volume Right	0	24	2
cSH	1503	1700	826
Volume to Capacity	0.00	0.04	0.12
Queue Length 95th (ft)	0	0	10
Control Delay (s)	0.2	0.0	10.0
Lane LOS	A		A
Approach Delay (s)	0.2	0.0	10.0
Approach LOS			A

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	17.0%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	72	70	54	84
Average Queue (ft)	39	34	26	49
95th Queue (ft)	60	58	45	76
Link Distance (ft)	283	126	395	346
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	1	154	4	8	50	27	2	53	33	118	96	3
Future Volume (vph)	1	154	4	8	50	27	2	53	33	118	96	3
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.79	0.79	0.79	0.94	0.94	0.94
Hourly flow rate (vph)	1	175	5	10	61	33	3	67	42	126	102	3

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	181	104	112	231
Volume Left (vph)	1	10	3	126
Volume Right (vph)	5	33	42	3
Hadj (s)	0.02	-0.14	-0.19	0.14
Departure Headway (s)	4.9	4.9	4.8	4.9
Degree Utilization, x	0.25	0.14	0.15	0.31
Capacity (veh/h)	679	671	697	690
Control Delay (s)	9.5	8.7	8.6	10.1
Approach Delay (s)	9.5	8.7	8.6	10.1
Approach LOS	A	A	A	B

Intersection Summary			
Delay	9.4		
Level of Service	A		
Intersection Capacity Utilization	35.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	202	106	3	64	1	17	2	6	2	2	0
Future Volume (Veh/h)	0	202	106	3	64	1	17	2	6	2	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.85	0.85	0.85	0.92	0.92	0.92	0.25	0.25	0.25
Hourly flow rate (vph)	0	215	113	4	75	1	18	2	7	8	8	0
Pedestrians		2			3			2			8	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	84			330			363	366	276	374	422	86
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	84			330			363	366	276	374	422	86
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			97	100	99	99	98	100
cM capacity (veh/h)	1501			1227			578	556	759	565	517	964

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	328	80	27	16
Volume Left	0	4	18	8
Volume Right	113	1	7	0
cSH	1501	1227	614	540
Volume to Capacity	0.00	0.00	0.04	0.03
Queue Length 95th (ft)	0	0	3	2
Control Delay (s)	0.0	0.4	11.1	11.9
Lane LOS		A	B	B
Approach Delay (s)	0.0	0.4	11.1	11.9
Approach LOS			B	B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	28.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	226	72	399	743
v/c Ratio	0.59	0.18	0.37	0.66
Control Delay	26.3	21.4	7.2	11.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	26.3	21.4	7.2	11.3
Queue Length 50th (ft)	55	17	56	135
Queue Length 95th (ft)	165	46	147	338
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	744	819	1611	1652
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.30	0.09	0.25	0.45

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	48	62	94	4	37	8	15	351	1	7	638	16
Future Volume (vph)	48	62	94	4	37	8	15	351	1	7	638	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.98			0.99			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.94			0.98			1.00			1.00	
Flt Protected		0.99			1.00			1.00			1.00	
Satd. Flow (prot)		1681			1800			1858			1854	
Flt Permitted		0.91			0.97			0.97			1.00	
Satd. Flow (perm)		1555			1757			1802			1847	
Peak-hour factor, PHF	0.90	0.90	0.90	0.69	0.69	0.69	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	53	69	104	6	54	12	16	382	1	8	717	18
RTOR Reduction (vph)	0	34	0	0	8	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	192	0	0	64	0	0	399	0	0	742	0
Confl. Peds. (#/hr)	6		4	4		6	5		3	3		5
Confl. Bikes (#/hr)			18			10			7			23
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		13.7			13.7			36.8			36.8	
Effective Green, g (s)		13.7			13.7			36.8			36.8	
Actuated g/C Ratio		0.23			0.23			0.62			0.62	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		358			404			1114			1142	
v/s Ratio Prot												
v/s Ratio Perm		c0.12			0.04			0.22			c0.40	
v/c Ratio		0.54			0.16			0.36			0.65	
Uniform Delay, d1		20.1			18.3			5.6			7.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.5			0.2			0.3			1.4	
Delay (s)		21.7			18.5			5.8			8.7	
Level of Service		C			B			A			A	
Approach Delay (s)		21.7			18.5			5.8			8.7	
Approach LOS		C			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	59.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	373	155	490	63	653	253	1038	553
v/c Ratio	0.80	0.60	1.07	0.41	0.61	0.75	0.69	0.60
Control Delay	49.6	39.0	89.3	43.8	29.0	45.6	23.6	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.6	39.0	89.3	43.8	29.0	45.6	23.6	4.8
Queue Length 50th (ft)	100	65	~253	33	153	128	233	0
Queue Length 95th (ft)	#162	126	#442	68	231	192	326	66
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	484	266	458	249	1064	458	1498	924
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.58	1.07	0.25	0.61	0.55	0.69	0.60

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	343	93	50	15	121	315	58	588	13	233	955	509
Future Volume (vph)	343	93	50	15	121	315	58	588	13	233	955	509
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			0.99		1.00	1.00		1.00	1.00	0.90
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.95			0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1730			1668		1770	3526		1770	3539	1431
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1730			1668		1770	3526		1770	3539	1431
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	373	101	54	16	132	342	63	639	14	253	1038	553
RTOR Reduction (vph)	0	22	0	0	95	0	0	1	0	0	0	323
Lane Group Flow (vph)	373	133	0	0	395	0	63	652	0	253	1038	230
Confl. Peds. (#/hr)			39						3			26
Confl. Bikes (#/hr)			2			2						10
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	11.6	11.6			18.5		6.5	25.6		16.3	35.4	35.4
Effective Green, g (s)	11.6	11.6			18.5		6.5	25.6		16.3	35.4	35.4
Actuated g/C Ratio	0.14	0.14			0.22		0.08	0.30		0.19	0.42	0.42
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	468	236			363		135	1061		339	1473	595
v/s Ratio Prot	c0.11	0.08			c0.24		0.04	0.18		c0.14	c0.29	
v/s Ratio Perm												0.16
v/c Ratio	0.80	0.56			1.09		0.47	0.61		0.75	0.70	0.39
Uniform Delay, d1	35.6	34.3			33.2		37.6	25.5		32.4	20.5	17.3
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	8.6	1.8			72.5		0.9	2.7		7.6	2.9	1.9
Delay (s)	44.1	36.1			105.8		38.5	28.1		40.0	23.3	19.2
Level of Service	D	D			F		D	C		D	C	B
Approach Delay (s)		41.8			105.8			29.0			24.4	
Approach LOS		D			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	39.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	96	88	127	5	262	122	756
v/c Ratio	0.14	0.41	0.59	0.53	0.01	0.19	0.14	0.51
Control Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Length 50th (ft)	13	63	66	84	1	30	16	152
Queue Length 95th (ft)	29	93	113	137	3	44	33	207
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	181	340	216	341	480	1406	858	1477
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.28	0.41	0.37	0.01	0.19	0.14	0.51

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	60	16	78	82	31	3	122	43	88	537	7
Future Volume (vph)	14	60	16	78	82	31	3	122	43	88	537	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.98	1.00		0.99	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.96		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1747	1778		1733	1768		1760	1759		1717	1858	
Flt Permitted	0.53	1.00		0.64	1.00		0.33	1.00		0.60	1.00	
Satd. Flow (perm)	973	1778		1161	1768		604	1759		1080	1858	
Peak-hour factor, PHF	0.79	0.79	0.79	0.89	0.89	0.89	0.63	0.63	0.63	0.72	0.72	0.72
Adj. Flow (vph)	18	76	20	88	92	35	5	194	68	122	746	10
RTOR Reduction (vph)	0	9	0	0	12	0	0	8	0	0	0	0
Lane Group Flow (vph)	18	87	0	88	115	0	5	254	0	122	756	0
Confl. Peds. (#/hr)	6		9	9		6	8		17	17		8
Confl. Bikes (#/hr)			9						11			4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Effective Green, g (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.80	0.80		0.80	0.80	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	124	228		148	226		480	1398		858	1477	
v/s Ratio Prot		0.05			0.06			0.14			c0.41	
v/s Ratio Perm	0.02			c0.08			0.01			0.11		
v/c Ratio	0.15	0.38		0.59	0.51		0.01	0.18		0.14	0.51	
Uniform Delay, d1	46.5	47.9		49.4	48.8		2.5	2.9		2.8	4.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	1.1		6.3	1.8		0.0	0.3		0.3	1.3	
Delay (s)	47.0	49.0		55.6	50.6		2.6	3.2		3.2	5.5	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		48.7			52.6			3.2			5.2	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	127	584	133	710	99	48	123	319	243	244	354
v/c Ratio	0.36	0.79	0.28	0.78	0.23	0.19	0.45	0.66	0.68	0.67	0.81
Control Delay	54.8	62.8	46.2	56.3	16.8	59.5	63.9	13.0	63.3	62.7	47.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.8	62.8	46.2	56.3	16.8	59.5	63.9	13.0	63.3	62.7	47.0
Queue Length 50th (ft)	123	313	109	374	20	42	113	0	246	246	216
Queue Length 95th (ft)	210	420	182	484	80	80	172	48	330	331	309
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	433	907	612	1171	531	408	429	580	517	525	570
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.64	0.22	0.61	0.19	0.12	0.29	0.55	0.47	0.46	0.62

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	511	14	128	671	106	39	100	258	352	57	297
Future Volume (vph)	130	511	14	128	671	106	39	100	258	352	57	297
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	1.00	0.92	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.81	0.81	0.81	0.84	0.84	0.84
Adj. Flow (vph)	141	555	15	133	699	110	48	123	319	419	68	354
RTOR Reduction (vph)	0	1	0	0	1	55	0	0	272	0	0	114
Lane Group Flow (vph)	127	583	0	133	709	44	48	123	47	243	244	240
Confl. Peds. (#/hr)			5			9			28			11
Confl. Bikes (#/hr)			6			3			19			6
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Effective Green, g (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Actuated g/C Ratio	0.22	0.22		0.27	0.27	0.27	0.15	0.15	0.15	0.22	0.22	0.22
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	355	744		478	914	378	261	275	215	361	367	329
v/s Ratio Prot	0.08	c0.17		0.08	c0.21		0.03	c0.07		0.14	0.14	
v/s Ratio Perm						0.03			0.03			c0.16
v/c Ratio	0.36	0.78		0.28	0.78	0.12	0.18	0.45	0.22	0.67	0.66	0.73
Uniform Delay, d1	45.3	50.5		39.6	46.3	37.8	51.3	53.5	51.6	49.5	49.4	50.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	5.4		0.3	4.2	0.1	0.3	1.2	0.5	4.9	4.5	8.1
Delay (s)	45.9	55.9		39.9	50.5	37.9	51.7	54.6	52.1	54.4	53.9	58.3
Level of Service	D	E		D	D	D	D	D	D	D	D	E
Approach Delay (s)		54.1			47.7			52.7			55.9	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	52.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	137.5	Sum of lost time (s)	20.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	196	914	0	0	767	48	0	0	0	22	0	92
Future Volume (Veh/h)	196	914	0	0	767	48	0	0	0	22	0	92
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.25	0.25	0.25	0.73	0.73	0.73
Hourly flow rate (vph)	236	1101	0	0	834	52	0	0	0	30	0	126
Pedestrians					4			2			12	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.86			0.86	0.86	0.86	0.86	0.86	
vC, conflicting volume	898			1103			2561	2473	556	1898	2447	872
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	898			801			2491	2389	167	1723	2359	872
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	68			100			100	100	100	17	100	57
cM capacity (veh/h)	743			704			5	19	727	36	20	290

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	236	550	550	886	0	30	126
Volume Left	236	0	0	0	0	30	0
Volume Right	0	0	0	52	0	0	126
cSH	743	1700	1700	1700	1700	36	290
Volume to Capacity	0.32	0.32	0.32	0.52	0.00	0.83	0.43
Queue Length 95th (ft)	34	0	0	0	0	75	52
Control Delay (s)	12.1	0.0	0.0	0.0	0.0	260.5	26.6
Lane LOS	B				A	F	D
Approach Delay (s)	2.1			0.0	0.0	71.5	
Approach LOS					A	F	

Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	43	865	807	2	1	35
Future Volume (Veh/h)	43	865	807	2	1	35
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.69	0.69
Hourly flow rate (vph)	46	920	907	2	1	51
Pedestrians			2		14	
Lane Width (ft)			12.0		12.0	
Walking Speed (ft/s)			3.5		3.5	
Percent Blockage			0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.82	
vC, conflicting volume	923				1936	922
vC1, stage 1 conf vol					922	
vC2, stage 2 conf vol					1014	
vCu, unblocked vol	923				2033	922
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	94				100	84
cM capacity (veh/h)	730				233	323

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	46	920	909	52
Volume Left	46	0	0	1
Volume Right	0	0	2	51
cSH	730	1700	1700	321
Volume to Capacity	0.06	0.54	0.53	0.16
Queue Length 95th (ft)	5	0	0	14
Control Delay (s)	10.3	0.0	0.0	18.4
Lane LOS	B			C
Approach Delay (s)	0.5		0.0	18.4
Approach LOS				C

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	55.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	1	51	104	100	18	3
Future Volume (Veh/h)	1	51	104	100	18	3
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.76	0.76	0.86	0.86	0.53	0.53
Hourly flow rate (vph)	1	67	121	116	34	6
Pedestrians					7	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	244				255	186
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				255	186
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				95	99
cM capacity (veh/h)	1313				728	850

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	68	237	40
Volume Left	1	0	34
Volume Right	0	116	6
cSH	1313	1700	744
Volume to Capacity	0.00	0.14	0.05
Queue Length 95th (ft)	0	0	4
Control Delay (s)	0.1	0.0	10.1
Lane LOS	A		B
Approach Delay (s)	0.1	0.0	10.1
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	66	131	86	81
Average Queue (ft)	30	83	43	43
95th Queue (ft)	53	124	71	68
Link Distance (ft)	288	125	400	344
Upstream Blk Time (%)		1		
Queuing Penalty (veh)		3		
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	6	60	3	32	187	260	14	129	27	113	45	3
Future Volume (vph)	6	60	3	32	187	260	14	129	27	113	45	3
Peak Hour Factor	0.73	0.73	0.73	0.91	0.91	0.91	0.78	0.78	0.78	0.82	0.82	0.82
Hourly flow rate (vph)	8	82	4	35	205	286	18	165	35	138	55	4

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	94	526	218	197
Volume Left (vph)	8	35	18	138
Volume Right (vph)	4	286	35	4
Hadj (s)	0.03	-0.28	-0.05	0.16
Departure Headway (s)	6.1	5.1	6.0	6.2
Degree Utilization, x	0.16	0.74	0.36	0.34
Capacity (veh/h)	505	526	542	522
Control Delay (s)	10.3	21.2	12.3	12.3
Approach Delay (s)	10.3	21.2	12.3	12.3
Approach LOS	B	C	B	B

Intersection Summary			
Delay	16.6		
Level of Service	C		
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	144	51	3	261	8	204	7	15	1	0	5
Future Volume (Veh/h)	3	144	51	3	261	8	204	7	15	1	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.83	0.83	0.83	0.83	0.83	0.83	0.50	0.50	0.50
Hourly flow rate (vph)	4	169	60	4	314	10	246	8	18	2	0	10
Pedestrians		3			12			16			20	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			1			2			2	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked	0.94						0.94	0.94		0.94	0.94	0.94
vC, conflicting volume	344			245			563	575	227	588	600	342
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	274			245			506	519	227	533	545	272
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			42	98	98	99	100	99
cM capacity (veh/h)	1192			1301			422	417	791	391	403	707

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	233	328	272	12
Volume Left	4	4	246	2
Volume Right	60	10	18	10
cSH	1192	1301	435	623
Volume to Capacity	0.00	0.00	0.63	0.02
Queue Length 95th (ft)	0	0	104	1
Control Delay (s)	0.2	0.1	26.1	10.9
Lane LOS	A	A	D	B
Approach Delay (s)	0.2	0.1	26.1	10.9
Approach LOS			D	B

Intersection Summary			
Average Delay	8.7		
Intersection Capacity Utilization	41.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	→ EBT	← WBT	↑ NBT	↓ SBT
Lane Group Flow (vph)	173	269	138	528
v/c Ratio	0.33	0.50	0.18	0.59
Control Delay	14.1	18.3	7.5	11.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.1	18.3	7.5	11.6
Queue Length 50th (ft)	27	53	16	78
Queue Length 95th (ft)	88	129	46	208
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	1040	1105	1535	1767
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.17	0.24	0.09	0.30

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	6	95	54	2	212	4	25	78	5	14	404	42
Future Volume (vph)	6	95	54	2	212	4	25	78	5	14	404	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.99			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.95			1.00			0.99			0.99	
Flt Protected		1.00			1.00			0.99			1.00	
Satd. Flow (prot)		1751			1856			1826			1831	
Flt Permitted		0.98			1.00			0.85			0.99	
Satd. Flow (perm)		1728			1853			1579			1818	
Peak-hour factor, PHF	0.90	0.90	0.90	0.81	0.81	0.81	0.78	0.78	0.78	0.87	0.87	0.87
Adj. Flow (vph)	7	106	60	2	262	5	32	100	6	16	464	48
RTOR Reduction (vph)	0	20	0	0	1	0	0	2	0	0	5	0
Lane Group Flow (vph)	0	153	0	0	268	0	0	136	0	0	523	0
Confl. Peds. (#/hr)	3		4	4		3	8		3	3		8
Confl. Bikes (#/hr)			8			11			12			6
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		13.3			13.3			22.6			22.6	
Effective Green, g (s)		13.3			13.3			22.6			22.6	
Actuated g/C Ratio		0.30			0.30			0.50			0.50	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		511			548			794			915	
v/s Ratio Prot												
v/s Ratio Perm		0.09			c0.14			0.09			c0.29	
v/c Ratio		0.30			0.49			0.17			0.57	
Uniform Delay, d1		12.2			13.0			6.1			7.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.3			0.7			0.1			1.0	
Delay (s)		12.5			13.7			6.2			8.8	
Level of Service		B			B			A			A	
Approach Delay (s)		12.5			13.7			6.2			8.8	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	44.9	Sum of lost time (s)	9.0
Intersection Capacity Utilization	46.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	542	211	568	41	791	147	561	355
v/c Ratio	0.87	0.63	0.99	0.32	0.69	0.64	0.38	0.46
Control Delay	51.4	41.0	56.0	45.3	30.1	48.9	19.5	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.4	41.0	56.0	45.3	30.1	48.9	19.5	4.3
Queue Length 50th (ft)	154	104	~216	23	195	80	115	0
Queue Length 95th (ft)	#235	178	#419	53	283	134	167	55
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	648	346	574	334	1154	334	1487	779
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.61	0.99	0.12	0.69	0.44	0.38	0.46

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	499	153	41	11	67	444	38	705	23	135	516	327
Future Volume (vph)	499	153	41	11	67	444	38	705	23	135	516	327
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			1.00		1.00	1.00		1.00	1.00	0.86
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.97			0.89		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1776			1647		1770	3519		1770	3539	1368
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1776			1647		1770	3519		1770	3539	1368
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	542	166	45	12	73	483	41	766	25	147	561	355
RTOR Reduction (vph)	0	11	0	0	220	0	0	3	0	0	0	211
Lane Group Flow (vph)	542	200	0	0	348	0	41	788	0	147	561	144
Confl. Peds. (#/hr)			47						1			40
Confl. Bikes (#/hr)			4						4			7
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	16.4	16.4			19.4		4.6	29.4		11.8	36.6	36.6
Effective Green, g (s)	16.4	16.4			19.4		4.6	29.4		11.8	36.6	36.6
Actuated g/C Ratio	0.18	0.18			0.22		0.05	0.33		0.13	0.41	0.41
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	625	323			355		90	1149		232	1439	556
v/s Ratio Prot	c0.16	0.11			c0.21		0.02	c0.22		c0.08	0.16	
v/s Ratio Perm												0.11
v/c Ratio	0.87	0.62			0.98		0.46	0.69		0.63	0.39	0.26
Uniform Delay, d1	35.7	33.9			35.1		41.5	26.3		37.1	18.8	17.7
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	11.8	2.7			42.4		1.3	3.3		4.1	0.8	1.1
Delay (s)	47.5	36.6			77.6		42.8	29.6		41.2	19.6	18.8
Level of Service	D	D			E		D	C		D	B	B
Approach Delay (s)		44.4			77.6			30.3			22.3	
Approach LOS		D			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	39.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Appendix C – Existing Plus Bridge Closure Conditions Synchro Reports

- HCM Delay and LOS Reports
- 95th Percentile Queue Length Reports

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	134	135	291	5	899	59	908
v/c Ratio	0.86	0.42	0.79	0.92	0.01	0.64	0.17	0.64
Control Delay	150.3	57.7	90.3	89.0	6.2	13.9	6.4	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	150.3	57.7	90.3	89.0	6.2	13.9	6.4	10.9
Queue Length 50th (ft)	41	114	127	262	1	302	14	377
Queue Length 95th (ft)	#90	147	#188	#333	m3	363	31	497
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	52	336	177	330	337	1398	343	1420
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.40	0.76	0.88	0.01	0.64	0.17	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Future Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.97	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1765	1830		1721	1715		1770	1828		1770	1861	
Flt Permitted	0.16	1.00		0.53	1.00		0.24	1.00		0.24	1.00	
Satd. Flow (perm)	290	1830		969	1715		443	1828		451	1861	
Peak-hour factor, PHF	0.74	0.74	0.74	0.79	0.79	0.79	0.85	0.85	0.85	0.95	0.95	0.95
Adj. Flow (vph)	43	123	11	135	171	120	5	814	85	59	903	5
RTOR Reduction (vph)	0	2	0	0	17	0	0	2	0	0	0	0
Lane Group Flow (vph)	43	132	0	135	274	0	5	897	0	59	908	0
Confl. Peds. (#/hr)	2		11	11		2	7		8	8		7
Confl. Bikes (#/hr)			5			9			10			20
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Effective Green, g (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.76	0.76		0.76	0.76	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	50	320		169	300		338	1395		344	1420	
v/s Ratio Prot		0.07			c0.16			c0.49			0.49	
v/s Ratio Perm	0.15			0.14			0.01			0.13		
v/c Ratio	0.86	0.41		0.80	0.91		0.01	0.64		0.17	0.64	
Uniform Delay, d1	60.1	55.0		59.3	60.7		4.2	8.2		4.8	8.2	
Progression Factor	1.00	1.00		1.00	1.00		1.36	1.42		1.00	1.00	
Incremental Delay, d2	76.1	0.9		22.5	30.2		0.1	1.6		1.1	2.2	
Delay (s)	136.2	55.8		81.9	91.0		5.8	13.3		5.9	10.4	
Level of Service	F	E		F	F		A	B		A	B	
Approach Delay (s)		75.3			88.1			13.3			10.1	
Approach LOS		E			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	29.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	75.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	226	465	94	478	180	50	313	162	249	256	499
v/c Ratio	0.80	0.79	0.32	0.85	0.61	0.16	0.94	0.49	0.43	0.43	0.74
Control Delay	80.0	69.3	57.9	75.1	39.2	53.3	96.9	30.1	37.5	37.5	24.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.0	69.3	57.9	75.1	39.2	53.3	96.9	30.1	37.5	37.5	24.3
Queue Length 50th (ft)	232	237	81	249	94	42	305	63	215	222	258
Queue Length 95th (ft)	#346	304	133	303	175	69	#360	101	m307	m315	408
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	308	639	305	581	303	322	339	338	580	594	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.73	0.31	0.82	0.59	0.16	0.92	0.48	0.43	0.43	0.74

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Future Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.92	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Peak-hour factor, PHF	0.90	0.90	0.90	0.86	0.86	0.86	0.76	0.76	0.76	0.93	0.93	0.93
Adj. Flow (vph)	314	358	19	94	458	200	50	313	162	395	110	499
RTOR Reduction (vph)	0	2	0	0	2	71	0	0	73	0	0	162
Lane Group Flow (vph)	226	463	0	94	476	109	50	313	89	249	256	337
Confl. Peds. (#/hr)			1			22			31			23
Confl. Bikes (#/hr)			6			9			16			28
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Effective Green, g (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Actuated g/C Ratio	0.18	0.18		0.17	0.17	0.17	0.18	0.18	0.18	0.35	0.35	0.35
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	282	584		296	562	226	316	332	260	580	594	512
v/s Ratio Prot	c0.14	0.14		0.05	c0.14		0.03	c0.17		0.15	0.15	
v/s Ratio Perm						0.08			0.06			c0.23
v/c Ratio	0.80	0.79		0.32	0.85	0.48	0.16	0.94	0.34	0.43	0.43	0.66
Uniform Delay, d1	59.3	59.2		54.9	60.6	56.6	52.1	60.8	53.9	37.7	37.8	41.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.85
Incremental Delay, d2	15.0	7.3		0.6	11.4	1.6	0.2	34.5	0.8	1.7	1.7	4.9
Delay (s)	74.3	66.6		55.5	72.0	58.2	52.3	95.3	54.7	36.0	36.0	40.2
Level of Service	E	E		E	E	E	D	F	D	D	D	D
Approach Delay (s)		69.1			66.6			78.7			38.1	
Approach LOS		E			E			E			D	

Intersection Summary			
HCM 2000 Control Delay	59.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	84	721	0	0	501	38	0	0	0	222	0	147
Future Volume (Veh/h)	84	721	0	0	501	38	0	0	0	222	0	147
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.92	0.92	0.92	0.25	0.25	0.25	0.99	0.99	0.99
Hourly flow rate (vph)	87	743	0	0	545	41	0	0	0	224	0	148
Pedestrians					6			6			5	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					1			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.94			0.94	0.94	0.94	0.94	0.94	
vC, conflicting volume	591			749			1636	1514	384	1122	1494	570
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	591			594			1543	1412	204	993	1390	570
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	91			100			100	100	100	0	100	68
cM capacity (veh/h)	976			910			46	115	743	171	119	462

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	87	372	372	586	0	224	148
Volume Left	87	0	0	0	0	224	0
Volume Right	0	0	0	41	0	0	148
cSH	976	1700	1700	1700	1700	171	462
Volume to Capacity	0.09	0.22	0.22	0.34	0.00	1.31	0.32
Queue Length 95th (ft)	7	0	0	0	0	327	34
Control Delay (s)	9.0	0.0	0.0	0.0	0.0	227.4	16.4
Lane LOS	A				A	F	C
Approach Delay (s)	0.9			0.0	0.0	143.4	
Approach LOS					A	F	

Intersection Summary			
Average Delay	30.3		
Intersection Capacity Utilization	62.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	925	507	5	2	32
Future Volume (Veh/h)	24	925	507	5	2	32
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.95	0.95	0.92	0.92
Hourly flow rate (vph)	26	984	534	5	2	35
Pedestrians		2	4		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.86	
vC, conflicting volume	549				1586	548
vC1, stage 1 conf vol					546	
vC2, stage 2 conf vol					1040	
vCu, unblocked vol	549				1601	548
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	93
cM capacity (veh/h)	1011				276	530

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	26	984	539	37
Volume Left	26	0	0	2
Volume Right	0	0	5	35
cSH	1011	1700	1700	505
Volume to Capacity	0.03	0.58	0.32	0.07
Queue Length 95th (ft)	2	0	0	6
Control Delay (s)	8.7	0.0	0.0	12.7
Lane LOS	A			B
Approach Delay (s)	0.2		0.0	12.7
Approach LOS				B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	78	37	17	82	2
Future Volume (Veh/h)	2	78	37	17	82	2
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.72	0.72	0.84	0.84
Hourly flow rate (vph)	2	85	51	24	98	2
Pedestrians					8	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	83				160	71
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83				160	71
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				88	100
cM capacity (veh/h)	1503				824	984

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	87	75	100
Volume Left	2	0	98
Volume Right	0	24	2
cSH	1503	1700	826
Volume to Capacity	0.00	0.04	0.12
Queue Length 95th (ft)	0	0	10
Control Delay (s)	0.2	0.0	10.0
Lane LOS	A		A
Approach Delay (s)	0.2	0.0	10.0
Approach LOS			A

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	17.0%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	68	54	81
Average Queue (ft)	37	24	43
95th Queue (ft)	59	43	67
Link Distance (ft)	283	395	346
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	25	0	134	0	0	0	20	58	0	0	138	32
Future Volume (vph)	25	0	134	0	0	0	20	58	0	0	138	32
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.79	0.79	0.79	0.94	0.94	0.94
Hourly flow rate (vph)	28	0	152	0	0	0	25	73	0	0	147	34

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	180	0	98	181
Volume Left (vph)	28	0	25	0
Volume Right (vph)	152	0	0	34
Hadj (s)	-0.44	0.00	0.09	-0.08
Departure Headway (s)	4.1	4.7	4.6	4.3
Degree Utilization, x	0.20	0.00	0.12	0.22
Capacity (veh/h)	821	705	744	788
Control Delay (s)	8.1	7.7	8.2	8.5
Approach Delay (s)	8.1	0.0	8.2	8.5
Approach LOS	A	A	A	A

Intersection Summary			
Delay	8.3		
Level of Service	A		
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Future Volume (Veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.85	0.85	0.85	0.92	0.92	0.92	0.25	0.25	0.25
Hourly flow rate (vph)	0	0	0	4	0	1	0	2	7	8	8	0
Pedestrians		2			3			2			8	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	9			2			16	19	5	28	18	10
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	9			2			16	19	5	28	18	10
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	99	99	99	100
cM capacity (veh/h)	1599			1617			979	864	1073	955	865	1060

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	5	9	16
Volume Left	0	4	0	8
Volume Right	0	1	7	0
cSH	1700	1617	1018	908
Volume to Capacity	0.00	0.00	0.01	0.02
Queue Length 95th (ft)	0	0	1	1
Control Delay (s)	0.0	5.8	8.6	9.0
Lane LOS		A	A	A
Approach Delay (s)	0.0	5.8	8.6	9.0
Approach LOS			A	A

Intersection Summary			
Average Delay	8.4		
Intersection Capacity Utilization	16.6%	ICU Level of Service	A
Analysis Period (min)	15		

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	8	71	394	766
v/c Ratio	0.03	0.23	0.26	0.50
Control Delay	20.6	13.0	2.8	4.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.6	13.0	2.8	4.5
Queue Length 50th (ft)	1	3	31	81
Queue Length 95th (ft)	14	24	70	174
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	987	986	1787	1781
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.01	0.07	0.22	0.43

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Future Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.94			0.94			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.93			0.89			1.00			1.00	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1619			1546			1862			1861	
Flt Permitted		0.92			0.95			1.00			1.00	
Satd. Flow (perm)		1500			1476			1860			1855	
Peak-hour factor, PHF	0.90	0.90	0.90	0.69	0.69	0.69	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	2	2	4	10	3	58	1	392	1	8	757	1
RTOR Reduction (vph)	0	4	0	0	54	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	4	0	0	17	0	0	394	0	0	766	0
Confl. Peds. (#/hr)	6		4	4		6	5		3	3		5
Confl. Bikes (#/hr)			18			10			7			23
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		3.5			3.5			33.3			33.3	
Effective Green, g (s)		3.5			3.5			33.3			33.3	
Actuated g/C Ratio		0.08			0.08			0.73			0.73	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		114			112			1352			1348	
v/s Ratio Prot												
v/s Ratio Perm		0.00			c0.01			0.21			c0.41	
v/c Ratio		0.04			0.16			0.29			0.57	
Uniform Delay, d1		19.6			19.8			2.2			2.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.7			0.2			0.7	
Delay (s)		19.7			20.4			2.3			3.6	
Level of Service		B			C			A			A	
Approach Delay (s)		19.7			20.4			2.3			3.6	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	45.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	424	219	490	108	653	253	1022	570
v/c Ratio	0.88	0.78	1.07	0.57	0.62	0.75	0.72	0.62
Control Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Length 50th (ft)	115	84	~253	56	153	128	239	0
Queue Length 95th (ft)	#195	#194	#442	103	231	192	329	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	484	284	457	249	1051	458	1420	915
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.77	1.07	0.43	0.62	0.55	0.72	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Future Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			0.99		1.00	1.00		1.00	1.00	0.90
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.92			0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1659			1668		1770	3526		1770	3539	1431
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1659			1668		1770	3526		1770	3539	1431
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	424	101	118	16	132	342	108	639	14	253	1022	570
RTOR Reduction (vph)	0	50	0	0	95	0	0	1	0	0	0	345
Lane Group Flow (vph)	424	169	0	0	395	0	108	652	0	253	1022	225
Confl. Peds. (#/hr)			39						3			26
Confl. Bikes (#/hr)			2			2						10
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Effective Green, g (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Actuated g/C Ratio	0.14	0.14			0.22		0.10	0.30		0.19	0.39	0.39
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	480	232			363		168	1049		339	1394	563
v/s Ratio Prot	c0.12	0.10			c0.24		0.06	0.18		c0.14	c0.29	
v/s Ratio Perm												0.16
v/c Ratio	0.88	0.73			1.09		0.64	0.62		0.75	0.73	0.40
Uniform Delay, d1	35.9	35.0			33.2		37.1	25.7		32.4	21.9	18.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	16.9	9.3			72.5		6.2	2.8		7.6	3.4	2.1
Delay (s)	52.7	44.3			105.8		43.2	28.5		40.0	25.4	20.6
Level of Service	D	D			F		D	C		D	C	C
Approach Delay (s)		49.9			105.8			30.6			25.9	
Approach LOS		D			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	41.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	96	88	127	5	262	121	757
v/c Ratio	0.14	0.41	0.59	0.53	0.01	0.19	0.14	0.51
Control Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Length 50th (ft)	13	63	66	84	1	30	16	152
Queue Length 95th (ft)	29	93	113	137	3	44	32	207
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	181	340	216	341	480	1406	858	1477
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.28	0.41	0.37	0.01	0.19	0.14	0.51

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	60	16	78	82	31	3	122	43	87	538	7
Future Volume (vph)	14	60	16	78	82	31	3	122	43	87	538	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.98	1.00		0.99	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.96		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1747	1778		1733	1768		1760	1759		1717	1858	
Flt Permitted	0.53	1.00		0.64	1.00		0.33	1.00		0.60	1.00	
Satd. Flow (perm)	973	1778		1161	1768		603	1759		1080	1858	
Peak-hour factor, PHF	0.79	0.79	0.79	0.89	0.89	0.89	0.63	0.63	0.63	0.72	0.72	0.72
Adj. Flow (vph)	18	76	20	88	92	35	5	194	68	121	747	10
RTOR Reduction (vph)	0	9	0	0	12	0	0	8	0	0	0	0
Lane Group Flow (vph)	18	87	0	88	115	0	5	254	0	121	757	0
Confl. Peds. (#/hr)	6		9	9		6	8		17	17		8
Confl. Bikes (#/hr)			9						11			4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Effective Green, g (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.80	0.80		0.80	0.80	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	124	228		148	226		479	1398		858	1477	
v/s Ratio Prot		0.05			0.06			0.14			c0.41	
v/s Ratio Perm	0.02			c0.08			0.01			0.11		
v/c Ratio	0.15	0.38		0.59	0.51		0.01	0.18		0.14	0.51	
Uniform Delay, d1	46.5	47.9		49.4	48.8		2.5	2.9		2.8	4.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	1.1		6.3	1.8		0.0	0.3		0.3	1.3	
Delay (s)	47.0	49.0		55.6	50.6		2.6	3.2		3.2	5.5	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		48.7			52.6			3.2			5.2	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	127	584	133	710	99	48	123	319	244	244	354
v/c Ratio	0.36	0.79	0.28	0.78	0.23	0.19	0.45	0.66	0.68	0.67	0.81
Control Delay	54.8	62.8	46.2	56.4	16.8	59.5	63.9	13.0	63.4	62.7	46.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.8	62.8	46.2	56.4	16.8	59.5	63.9	13.0	63.4	62.7	46.9
Queue Length 50th (ft)	123	313	109	374	20	42	113	0	247	246	216
Queue Length 95th (ft)	210	420	182	484	80	80	172	48	332	331	309
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	433	907	612	1170	531	408	429	580	516	525	570
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.64	0.22	0.61	0.19	0.12	0.29	0.55	0.47	0.46	0.62

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	511	14	128	671	106	39	100	258	353	57	297
Future Volume (vph)	130	511	14	128	671	106	39	100	258	353	57	297
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	1.00	0.92	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.81	0.81	0.81	0.84	0.84	0.84
Adj. Flow (vph)	141	555	15	133	699	110	48	123	319	420	68	354
RTOR Reduction (vph)	0	1	0	0	1	55	0	0	272	0	0	114
Lane Group Flow (vph)	127	583	0	133	709	44	48	123	47	244	244	240
Confl. Peds. (#/hr)			5			9			28			11
Confl. Bikes (#/hr)			6			3			19			6
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Effective Green, g (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Actuated g/C Ratio	0.22	0.22		0.27	0.27	0.27	0.15	0.15	0.15	0.22	0.22	0.22
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	355	744		478	914	378	261	275	215	361	367	329
v/s Ratio Prot	0.08	c0.17		0.08	c0.21		0.03	c0.07		0.15	0.14	
v/s Ratio Perm						0.03			0.03			c0.16
v/c Ratio	0.36	0.78		0.28	0.78	0.12	0.18	0.45	0.22	0.68	0.66	0.73
Uniform Delay, d1	45.3	50.5		39.6	46.3	37.8	51.3	53.5	51.6	49.5	49.4	50.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	5.4		0.3	4.2	0.1	0.3	1.2	0.5	4.9	4.5	8.1
Delay (s)	45.9	55.9		39.9	50.5	37.9	51.7	54.6	52.1	54.5	53.9	58.3
Level of Service	D	E		D	D	D	D	D	D	D	D	E
Approach Delay (s)		54.1			47.7			52.7			55.9	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	52.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	137.5	Sum of lost time (s)	20.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	196	915	0	0	767	168	0	0	0	135	0	92
Future Volume (Veh/h)	196	915	0	0	767	168	0	0	0	135	0	92
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.25	0.25	0.25	0.73	0.73	0.73
Hourly flow rate (vph)	236	1102	0	0	834	183	0	0	0	185	0	126
Pedestrians					4			2			12	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.86			0.86	0.86	0.86	0.86	0.86	
vC, conflicting volume	1029			1104			2628	2605	557	1964	2514	938
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1029			802			2568	2542	168	1799	2436	938
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	64			100			100	100	100	0	100	52
cM capacity (veh/h)	663			704			4	15	727	31	17	263

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	236	551	551	1017	0	185	126
Volume Left	236	0	0	0	0	185	0
Volume Right	0	0	0	183	0	0	126
cSH	663	1700	1700	1700	1700	31	263
Volume to Capacity	0.36	0.32	0.32	0.60	0.00	6.06	0.48
Queue Length 95th (ft)	40	0	0	0	0	Err	61
Control Delay (s)	13.4	0.0	0.0	0.0	0.0	Err	30.7
Lane LOS	B				A	F	D
Approach Delay (s)	2.4			0.0	0.0	5960.4	
Approach LOS					A	F	

Intersection Summary			
Average Delay	696.5		
Intersection Capacity Utilization	84.9%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	51	970	925	2	1	37
Future Volume (Veh/h)	51	970	925	2	1	37
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.69	0.69
Hourly flow rate (vph)	54	1032	1039	2	1	54
Pedestrians			2		14	
Lane Width (ft)			12.0		12.0	
Walking Speed (ft/s)			3.5		3.5	
Percent Blockage			0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.82	
vC, conflicting volume	1055				2196	1054
vC1, stage 1 conf vol					1054	
vC2, stage 2 conf vol					1142	
vCu, unblocked vol	1055				2349	1054
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	80
cM capacity (veh/h)	651				193	271

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	54	1032	1041	55
Volume Left	54	0	0	1
Volume Right	0	0	2	54
cSH	651	1700	1700	269
Volume to Capacity	0.08	0.61	0.61	0.20
Queue Length 95th (ft)	7	0	0	19
Control Delay (s)	11.0	0.0	0.0	21.8
Lane LOS	B			C
Approach Delay (s)	0.5		0.0	21.8
Approach LOS				C

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	1	50	104	100	18	3
Future Volume (Veh/h)	1	50	104	100	18	3
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.76	0.76	0.86	0.86	0.53	0.53
Hourly flow rate (vph)	1	66	121	116	34	6
Pedestrians					7	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	244				254	186
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				254	186
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				95	99
cM capacity (veh/h)	1313				729	850

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	67	237	40
Volume Left	1	0	34
Volume Right	0	116	6
cSH	1313	1700	745
Volume to Capacity	0.00	0.14	0.05
Queue Length 95th (ft)	0	0	4
Control Delay (s)	0.1	0.0	10.1
Lane LOS	A		B
Approach Delay (s)	0.1	0.0	10.1
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	55	94	89
Average Queue (ft)	29	46	45
95th Queue (ft)	47	74	73
Link Distance (ft)	288	400	344
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	0	60	0	0	0	105	130	0	0	77	98
Future Volume (vph)	8	0	60	0	0	0	105	130	0	0	77	98
Peak Hour Factor	0.73	0.73	0.73	0.91	0.91	0.91	0.78	0.78	0.78	0.82	0.82	0.82
Hourly flow rate (vph)	11	0	82	0	0	0	135	167	0	0	94	120

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	93	0	302	214
Volume Left (vph)	11	0	135	0
Volume Right (vph)	82	0	0	120
Hadj (s)	-0.47	0.00	0.12	-0.30
Departure Headway (s)	4.6	5.2	4.5	4.2
Degree Utilization, x	0.12	0.00	0.37	0.25
Capacity (veh/h)	708	622	783	830
Control Delay (s)	8.2	8.2	10.1	8.5
Approach Delay (s)	8.2	0.0	10.1	8.5
Approach LOS	A	A	B	A

Intersection Summary			
Delay	9.3		
Level of Service	A		
Intersection Capacity Utilization	42.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Future Volume (Veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.83	0.83	0.83	0.83	0.83	0.83	0.50	0.50	0.50
Hourly flow rate (vph)	0	0	0	4	0	12	0	10	18	8	4	0
Pedestrians		3			12			16			20	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			1			2			2	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	32			16			35	56	28	69	50	29
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	32			16			35	56	28	69	50	29
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	99	98	99	100	100
cM capacity (veh/h)	1550			1577			924	805	1019	847	811	1023

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	16	28	12
Volume Left	0	4	0	8
Volume Right	0	12	18	0
cSH	1700	1577	931	835
Volume to Capacity	0.00	0.00	0.03	0.01
Queue Length 95th (ft)	0	0	2	1
Control Delay (s)	0.0	1.8	9.0	9.4
Lane LOS		A	A	A
Approach Delay (s)	0.0	1.8	9.0	9.4
Approach LOS			A	A

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	21.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	20	48	266	575
v/c Ratio	0.05	0.12	0.19	0.44
Control Delay	14.9	13.7	4.9	6.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.9	13.7	4.9	6.8
Queue Length 50th (ft)	2	5	20	56
Queue Length 95th (ft)	20	31	80	237
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	1198	1076	1761	1644
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.02	0.04	0.15	0.35

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Future Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.99			0.98			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.96			0.95			1.00			1.00	
Flt Protected		0.99			0.98			1.00			0.99	
Satd. Flow (prot)		1749			1702			1855			1849	
Flt Permitted		0.94			0.86			1.00			0.93	
Satd. Flow (perm)		1663			1487			1853			1732	
Peak-hour factor, PHF	0.90	0.90	0.90	0.81	0.81	0.81	0.78	0.78	0.78	0.87	0.87	0.87
Adj. Flow (vph)	3	11	6	20	11	17	1	259	6	74	498	3
RTOR Reduction (vph)	0	5	0	0	15	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	15	0	0	33	0	0	265	0	0	575	0
Confl. Peds. (#/hr)	3		4	4		3	8		3	3		8
Confl. Bikes (#/hr)			8			11			12			6
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		5.0			5.0			24.8			24.8	
Effective Green, g (s)		5.0			5.0			24.8			24.8	
Actuated g/C Ratio		0.13			0.13			0.64			0.64	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		214			191			1184			1107	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.02			0.14			c0.33	
v/c Ratio		0.07			0.17			0.22			0.52	
Uniform Delay, d1		14.9			15.1			2.9			3.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.4			0.1			0.5	
Delay (s)		15.0			15.5			3.1			4.3	
Level of Service		B			B			A			A	
Approach Delay (s)		15.0			15.5			3.1			4.3	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	38.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	547	296	568	383	795	147	518	398
v/c Ratio	0.87	0.87	0.99	1.11	0.69	0.64	0.56	0.61
Control Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Length 50th (ft)	156	143	~216	~258	197	80	128	0
Queue Length 95th (ft)	#238	#285	#419	#431	284	134	178	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	648	350	573	345	1155	334	1022	677
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.85	0.99	1.11	0.69	0.44	0.51	0.59

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Future Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			1.00		1.00	1.00		1.00	1.00	0.86
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.93			0.89		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1686			1647		1770	3520		1770	3539	1363
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1686			1647		1770	3520		1770	3539	1363
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	547	166	130	12	73	483	383	770	25	147	518	398
RTOR Reduction (vph)	0	32	0	0	220	0	0	3	0	0	0	293
Lane Group Flow (vph)	547	264	0	0	348	0	383	792	0	147	518	105
Confl. Peds. (#/hr)			47						1			40
Confl. Bikes (#/hr)			4						4			7
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Effective Green, g (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Actuated g/C Ratio	0.18	0.18			0.21		0.20	0.33		0.13	0.26	0.26
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	625	307			353		346	1153		232	931	358
v/s Ratio Prot	c0.16	0.16			c0.21		c0.22	c0.23		0.08	0.15	
v/s Ratio Perm												0.08
v/c Ratio	0.88	0.86			0.99		1.11	0.69		0.63	0.56	0.29
Uniform Delay, d1	35.8	35.7			35.2		36.2	26.2		37.1	28.6	26.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	12.6	20.4			43.6		80.4	3.3		4.1	2.4	2.1
Delay (s)	48.4	56.1			78.9		116.6	29.6		41.2	31.0	28.5
Level of Service	D	E			E		F	C		D	C	C
Approach Delay (s)		51.1			78.9			57.9			31.5	
Approach LOS		D			E			E			C	

Intersection Summary			
HCM 2000 Control Delay	51.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Appendix D – Mitigation Measures Synchro Reports

- HCM Delay and LOS Reports
- 95th Percentile Queue Length Reports

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	134	353	291	5	899	59	908
v/c Ratio	0.17	0.22	0.93	0.49	0.04	0.82	0.41	0.81
Control Delay	34.6	34.4	78.0	37.7	11.0	17.9	28.7	31.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.6	34.4	78.0	37.7	11.0	17.9	28.7	31.9
Queue Length 50th (ft)	28	88	319	196	1	202	31	712
Queue Length 95th (ft)	48	112	378	237	m2	258	81	953
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	284	678	418	653	138	1102	144	1118
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.20	0.84	0.45	0.04	0.82	0.41	0.81

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	91	8	279	135	95	4	692	72	56	858	5
Future Volume (vph)	32	91	8	279	135	95	4	692	72	56	858	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.97	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1764	1830		1719	1721		1770	1828		1770	1861	
Flt Permitted	0.41	1.00		0.63	1.00		0.12	1.00		0.13	1.00	
Satd. Flow (perm)	769	1830		1133	1721		230	1828		240	1861	
Peak-hour factor, PHF	0.74	0.74	0.74	0.79	0.79	0.79	0.85	0.85	0.85	0.95	0.95	0.95
Adj. Flow (vph)	43	123	11	353	171	120	5	814	85	59	903	5
RTOR Reduction (vph)	0	2	0	0	18	0	0	2	0	0	0	0
Lane Group Flow (vph)	43	132	0	353	273	0	5	897	0	59	908	0
Confl. Peds. (#/hr)	2		11	11		2	7		8	8		7
Confl. Bikes (#/hr)			5			9			10			20
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	50.6	50.6		50.6	50.6		90.2	90.2		90.2	90.2	
Effective Green, g (s)	50.6	50.6		50.6	50.6		90.2	90.2		90.2	90.2	
Actuated g/C Ratio	0.34	0.34		0.34	0.34		0.60	0.60		0.60	0.60	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	259	617		382	580		138	1099		144	1119	
v/s Ratio Prot		0.07			0.16			c0.49			0.49	
v/s Ratio Perm	0.06			c0.31			0.02			0.25		
v/c Ratio	0.17	0.21		0.92	0.47		0.04	0.82		0.41	0.81	
Uniform Delay, d1	34.9	35.5		47.9	39.2		12.2	23.4		15.8	23.3	
Progression Factor	1.00	1.00		1.00	1.00		0.72	0.50		1.00	1.00	
Incremental Delay, d2	0.3	0.2		27.6	0.6		0.3	4.8		8.4	6.4	
Delay (s)	35.2	35.7		75.5	39.8		9.1	16.6		24.2	29.7	
Level of Service	D	D		E	D		A	B		C	C	
Approach Delay (s)		35.6			59.3			16.6			29.4	
Approach LOS		D			E			B			C	

Intersection Summary			
HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	226	465	94	478	180	50	313	162	342	348	499
v/c Ratio	0.83	0.82	0.31	0.83	0.60	0.15	0.91	0.47	0.60	0.60	0.80
Control Delay	84.2	72.2	57.0	73.0	38.3	51.7	89.4	29.0	41.1	41.1	30.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.2	72.2	57.0	73.0	38.3	51.7	89.4	29.0	41.1	41.1	30.8
Queue Length 50th (ft)	234	240	81	247	93	41	300	61	260	264	169
Queue Length 95th (ft)	#371	308	131	300	173	68	340	99	m373	m380	m#467
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	290	604	318	606	313	345	363	356	572	582	623
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.77	0.30	0.79	0.58	0.14	0.86	0.46	0.60	0.60	0.80

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	283	322	17	81	394	172	38	238	123	539	102	464
Future Volume (vph)	283	322	17	81	394	172	38	238	123	539	102	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.92	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3333		1770	3360	1354	1770	1863	1459	1681	1711	1484
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3333		1770	3360	1354	1770	1863	1459	1681	1711	1484
Peak-hour factor, PHF	0.90	0.90	0.90	0.86	0.86	0.86	0.76	0.76	0.76	0.93	0.93	0.93
Adj. Flow (vph)	314	358	19	94	458	200	50	313	162	580	110	499
RTOR Reduction (vph)	0	2	0	0	2	70	0	0	73	0	0	119
Lane Group Flow (vph)	226	463	0	94	476	110	50	313	89	342	348	380
Confl. Peds. (#/hr)			1			22			31			23
Confl. Bikes (#/hr)			6			9			16			28
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	25.5	25.5		25.6	25.6	25.6	27.8	27.8	27.8	51.1	51.1	51.1
Effective Green, g (s)	25.5	25.5		25.6	25.6	25.6	27.8	27.8	27.8	51.1	51.1	51.1
Actuated g/C Ratio	0.17	0.17		0.17	0.17	0.17	0.19	0.19	0.19	0.34	0.34	0.34
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	273	566		302	573	231	328	345	270	572	582	505
v/s Ratio Prot	c0.14	0.14		0.05	c0.14		0.03	c0.17		0.20	0.20	
v/s Ratio Perm						0.08			0.06			c0.26
v/c Ratio	0.83	0.82		0.31	0.83	0.47	0.15	0.91	0.33	0.60	0.60	0.75
Uniform Delay, d1	60.1	60.0		54.5	60.1	56.1	51.2	59.8	53.0	40.9	40.9	43.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.83
Incremental Delay, d2	18.3	9.0		0.6	10.0	1.5	0.2	26.3	0.7	2.6	2.5	5.7
Delay (s)	78.4	69.0		55.1	70.1	57.7	51.4	86.1	53.8	39.2	39.1	42.1
Level of Service	E	E		E	E	E	D	F	D	D	D	D
Approach Delay (s)		72.1			65.2			72.8			40.4	
Approach LOS		E			E			E			D	

Intersection Summary			
HCM 2000 Control Delay	58.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	84	893	0	0	501	38	0	0	0	51	0	147
Future Volume (Veh/h)	84	893	0	0	501	38	0	0	0	51	0	147
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.92	0.92	0.92	0.25	0.25	0.25	0.99	0.99	0.99
Hourly flow rate (vph)	87	921	0	0	545	41	0	0	0	52	0	148
Pedestrians					6			6			5	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					1			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.92			0.92	0.92	0.92	0.92	0.92	
vC, conflicting volume	591			927			1814	1692	472	1211	1672	570
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	591			752			1715	1582	260	1060	1560	570
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	91			100			100	100	100	65	100	68
cM capacity (veh/h)	976			782			34	90	674	150	92	462

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	87	460	460	586	0	52	148
Volume Left	87	0	0	0	0	52	0
Volume Right	0	0	0	41	0	0	148
cSH	976	1700	1700	1700	1700	150	462
Volume to Capacity	0.09	0.27	0.27	0.34	0.00	0.35	0.32
Queue Length 95th (ft)	7	0	0	0	0	36	34
Control Delay (s)	9.0	0.0	0.0	0.0	0.0	41.1	16.4
Lane LOS	A				A	E	C
Approach Delay (s)	0.8			0.0	0.0	22.8	
Approach LOS					A	C	

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	48.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	925	507	5	2	32
Future Volume (Veh/h)	24	925	507	5	2	32
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.95	0.95	0.92	0.92
Hourly flow rate (vph)	26	984	534	5	2	35
Pedestrians		2	4		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.86	
vC, conflicting volume	549				1586	548
vC1, stage 1 conf vol					546	
vC2, stage 2 conf vol					1040	
vCu, unblocked vol	549				1601	548
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	93
cM capacity (veh/h)	1011				276	530

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	26	984	539	37
Volume Left	26	0	0	2
Volume Right	0	0	5	35
cSH	1011	1700	1700	505
Volume to Capacity	0.03	0.58	0.32	0.07
Queue Length 95th (ft)	2	0	0	6
Control Delay (s)	8.7	0.0	0.0	12.7
Lane LOS	A			B
Approach Delay (s)	0.2		0.0	12.7
Approach LOS				B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	12	37	17	13	2
Future Volume (Veh/h)	2	12	37	17	13	2
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.72	0.72	0.84	0.84
Hourly flow rate (vph)	2	13	51	24	15	2
Pedestrians					8	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	83				88	71
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83				88	71
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				98	100
cM capacity (veh/h)	1503				905	984

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	15	75	17
Volume Left	2	0	15
Volume Right	0	24	2
cSH	1503	1700	913
Volume to Capacity	0.00	0.04	0.02
Queue Length 95th (ft)	0	0	1
Control Delay (s)	1.0	0.0	9.0
Lane LOS	A		A
Approach Delay (s)	1.0	0.0	9.0
Approach LOS			A

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	15.7%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	47	56	72
Average Queue (ft)	18	25	39
95th Queue (ft)	43	45	61
Link Distance (ft)	283	395	346
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	25	0	4	0	0	0	20	58	0	0	96	32
Future Volume (vph)	25	0	4	0	0	0	20	58	0	0	96	32
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.79	0.79	0.79	0.94	0.94	0.94
Hourly flow rate (vph)	28	0	5	0	0	0	25	73	0	0	102	34

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	33	0	98	136
Volume Left (vph)	28	0	25	0
Volume Right (vph)	5	0	0	34
Hadj (s)	0.11	0.00	0.09	-0.12
Departure Headway (s)	4.5	4.4	4.2	4.0
Degree Utilization, x	0.04	0.00	0.11	0.15
Capacity (veh/h)	756	776	838	895
Control Delay (s)	7.7	7.4	7.7	7.7
Approach Delay (s)	7.7	0.0	7.7	7.7
Approach LOS	A	A	A	A

Intersection Summary			
Delay	7.7		
Level of Service	A		
Intersection Capacity Utilization	26.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Future Volume (Veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.85	0.85	0.85	0.92	0.92	0.92	0.25	0.25	0.25
Hourly flow rate (vph)	0	0	0	4	0	1	0	2	7	8	8	0
Pedestrians		2			3			2			8	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	9			2			16	19	5	28	18	10
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	9			2			16	19	5	28	18	10
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	99	99	99	100
cM capacity (veh/h)	1599			1617			979	864	1073	955	865	1060

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	5	9	16
Volume Left	0	4	0	8
Volume Right	0	1	7	0
cSH	1700	1617	1018	908
Volume to Capacity	0.00	0.00	0.01	0.02
Queue Length 95th (ft)	0	0	1	1
Control Delay (s)	0.0	5.8	8.6	9.0
Lane LOS		A	A	A
Approach Delay (s)	0.0	5.8	8.6	9.0
Approach LOS			A	A

Intersection Summary			
Average Delay	8.4		
Intersection Capacity Utilization	16.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	8	71	394	766
v/c Ratio	0.03	0.23	0.26	0.50
Control Delay	20.6	13.0	2.8	4.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.6	13.0	2.8	4.5
Queue Length 50th (ft)	1	3	31	81
Queue Length 95th (ft)	14	24	70	174
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	987	986	1787	1781
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.01	0.07	0.22	0.43

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Future Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.94			0.94			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.93			0.89			1.00			1.00	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1619			1546			1862			1861	
Flt Permitted		0.92			0.95			1.00			1.00	
Satd. Flow (perm)		1500			1476			1860			1855	
Peak-hour factor, PHF	0.90	0.90	0.90	0.69	0.69	0.69	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	2	2	4	10	3	58	1	392	1	8	757	1
RTOR Reduction (vph)	0	4	0	0	54	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	4	0	0	17	0	0	394	0	0	766	0
Confl. Peds. (#/hr)	6		4	4		6	5		3	3		5
Confl. Bikes (#/hr)			18			10			7			23
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		3.5			3.5			33.3			33.3	
Effective Green, g (s)		3.5			3.5			33.3			33.3	
Actuated g/C Ratio		0.08			0.08			0.73			0.73	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		114			112			1352			1348	
v/s Ratio Prot												
v/s Ratio Perm		0.00			c0.01			0.21			c0.41	
v/c Ratio		0.04			0.16			0.29			0.57	
Uniform Delay, d1		19.6			19.8			2.2			2.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.7			0.2			0.7	
Delay (s)		19.7			20.4			2.3			3.6	
Level of Service		B			C			A			A	
Approach Delay (s)		19.7			20.4			2.3			3.6	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	45.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	424	219	490	108	653	253	1022	570
v/c Ratio	0.88	0.78	1.07	0.57	0.62	0.75	0.72	0.62
Control Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Length 50th (ft)	115	84	~253	56	153	128	239	0
Queue Length 95th (ft)	#195	#194	#442	103	231	192	329	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	484	284	457	249	1051	458	1420	915
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.77	1.07	0.43	0.62	0.55	0.72	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Future Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			0.99		1.00	1.00		1.00	1.00	0.90
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.92			0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1659			1668		1770	3526		1770	3539	1431
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1659			1668		1770	3526		1770	3539	1431
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	424	101	118	16	132	342	108	639	14	253	1022	570
RTOR Reduction (vph)	0	50	0	0	95	0	0	1	0	0	0	345
Lane Group Flow (vph)	424	169	0	0	395	0	108	652	0	253	1022	225
Confl. Peds. (#/hr)			39						3			26
Confl. Bikes (#/hr)			2			2						10
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Effective Green, g (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Actuated g/C Ratio	0.14	0.14			0.22		0.10	0.30		0.19	0.39	0.39
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	480	232			363		168	1049		339	1394	563
v/s Ratio Prot	c0.12	0.10			c0.24		0.06	0.18		c0.14	c0.29	
v/s Ratio Perm												0.16
v/c Ratio	0.88	0.73			1.09		0.64	0.62		0.75	0.73	0.40
Uniform Delay, d1	35.9	35.0			33.2		37.1	25.7		32.4	21.9	18.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	16.9	9.3			72.5		6.2	2.8		7.6	3.4	2.1
Delay (s)	52.7	44.3			105.8		43.2	28.5		40.0	25.4	20.6
Level of Service	D	D			F		D	C		D	C	C
Approach Delay (s)		49.9			105.8			30.6			25.9	
Approach LOS		D			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	41.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	96	188	127	5	262	121	757
v/c Ratio	0.08	0.27	0.78	0.35	0.01	0.20	0.16	0.56
Control Delay	36.3	35.6	66.6	37.0	7.0	6.0	6.9	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.3	35.6	66.6	37.0	7.0	6.0	6.9	10.8
Queue Length 50th (ft)	12	56	140	75	1	49	25	235
Queue Length 95th (ft)	26	81	201	118	4	67	47	302
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	315	519	350	518	399	1285	777	1349
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.18	0.54	0.25	0.01	0.20	0.16	0.56

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	60	16	167	82	31	3	122	43	87	538	7
Future Volume (vph)	14	60	16	167	82	31	3	122	43	87	538	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.98	1.00		1.00	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.96		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1747	1782		1732	1768		1762	1759		1718	1858	
Flt Permitted	0.60	1.00		0.67	1.00		0.29	1.00		0.59	1.00	
Satd. Flow (perm)	1099	1782		1222	1768		547	1759		1068	1858	
Peak-hour factor, PHF	0.79	0.79	0.79	0.89	0.89	0.89	0.63	0.63	0.63	0.72	0.72	0.72
Adj. Flow (vph)	18	76	20	188	92	35	5	194	68	121	747	10
RTOR Reduction (vph)	0	9	0	0	13	0	0	8	0	0	0	0
Lane Group Flow (vph)	18	87	0	188	114	0	5	254	0	121	757	0
Confl. Peds. (#/hr)	6		9	9		6	8		17	17		8
Confl. Bikes (#/hr)			9						11			4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	23.6	23.6		23.6	23.6		87.2	87.2		87.2	87.2	
Effective Green, g (s)	23.6	23.6		23.6	23.6		87.2	87.2		87.2	87.2	
Actuated g/C Ratio	0.20	0.20		0.20	0.20		0.73	0.73		0.73	0.73	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	216	350		240	347		397	1278		776	1350	
v/s Ratio Prot		0.05			0.06			0.14			c0.41	
v/s Ratio Perm	0.02			c0.15			0.01			0.11		
v/c Ratio	0.08	0.25		0.78	0.33		0.01	0.20		0.16	0.56	
Uniform Delay, d1	39.4	40.7		45.8	41.4		4.5	5.2		5.1	7.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.4		15.3	0.6		0.1	0.3		0.4	1.7	
Delay (s)	39.5	41.1		61.1	42.0		4.6	5.6		5.5	9.2	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		40.8			53.4			5.6			8.7	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	19.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	127	584	133	710	99	48	123	319	295	299	354
v/c Ratio	0.37	0.81	0.30	0.82	0.24	0.19	0.46	0.66	0.73	0.73	0.77
Control Delay	55.9	64.9	49.3	61.4	17.8	60.2	65.0	13.2	63.8	63.6	46.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.9	64.9	49.3	61.4	17.8	60.2	65.0	13.2	63.8	63.6	46.2
Queue Length 50th (ft)	126	322	114	390	20	43	116	0	307	311	238
Queue Length 95th (ft)	213	423	190	#508	83	80	172	48	390	392	323
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	412	864	532	1017	471	385	406	565	559	567	591
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.68	0.25	0.70	0.21	0.12	0.30	0.56	0.53	0.53	0.60

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	511	14	128	671	106	39	100	258	442	57	297
Future Volume (vph)	130	511	14	128	671	106	39	100	258	442	57	297
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	1.00	0.92	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1610	3369		1770	3381	1399	1770	1863	1456	1681	1704	1532
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.96	1.00
Satd. Flow (perm)	1610	3369		1770	3381	1399	1770	1863	1456	1681	1704	1532
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.81	0.81	0.81	0.84	0.84	0.84
Adj. Flow (vph)	141	555	15	133	699	110	48	123	319	526	68	354
RTOR Reduction (vph)	0	1	0	0	1	56	0	0	273	0	0	93
Lane Group Flow (vph)	127	583	0	133	709	43	48	123	46	295	299	261
Confl. Peds. (#/hr)			5			9			28			11
Confl. Bikes (#/hr)			6			3			19			6
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	30.6	30.6		36.2	36.2	36.2	20.4	20.4	20.4	34.1	34.1	34.1
Effective Green, g (s)	30.6	30.6		36.2	36.2	36.2	20.4	20.4	20.4	34.1	34.1	34.1
Actuated g/C Ratio	0.22	0.22		0.26	0.26	0.26	0.14	0.14	0.14	0.24	0.24	0.24
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	348	729		453	866	358	255	268	210	405	411	369
v/s Ratio Prot	0.08	c0.17		0.08	c0.21		0.03	c0.07		c0.18	0.18	
v/s Ratio Perm						0.03			0.03			0.17
v/c Ratio	0.36	0.80		0.29	0.82	0.12	0.19	0.46	0.22	0.73	0.73	0.71
Uniform Delay, d1	47.1	52.5		42.3	49.5	40.3	53.2	55.4	53.4	49.3	49.3	49.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	6.3		0.4	6.1	0.2	0.4	1.2	0.5	6.4	6.3	6.1
Delay (s)	47.7	58.7		42.6	55.6	40.5	53.5	56.6	53.9	55.8	55.6	55.1
Level of Service	D	E		D	E	D	D	E	D	E	E	E
Approach Delay (s)		56.8			52.1			54.6			55.5	
Approach LOS		E			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	54.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	141.3	Sum of lost time (s)	20.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	196	1004	0	0	767	168	0	0	0	48	0	92
Future Volume (Veh/h)	196	1004	0	0	767	168	0	0	0	48	0	92
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.25	0.25	0.25	0.73	0.73	0.73
Hourly flow rate (vph)	236	1210	0	0	834	183	0	0	0	66	0	126
Pedestrians					4			2			12	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.86			0.86	0.86	0.86	0.86	0.86	
vC, conflicting volume	1029			1212			2736	2713	611	2018	2622	938
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1029			919			2692	2666	220	1858	2559	938
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	64			100			100	100	100	0	100	52
cM capacity (veh/h)	663			633			3	12	670	27	14	263

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	236	605	605	1017	0	66	126
Volume Left	236	0	0	0	0	66	0
Volume Right	0	0	0	183	0	0	126
cSH	663	1700	1700	1700	1700	27	263
Volume to Capacity	0.36	0.36	0.36	0.60	0.00	2.40	0.48
Queue Length 95th (ft)	40	0	0	0	0	198	61
Control Delay (s)	13.4	0.0	0.0	0.0	0.0	942.4	30.7
Lane LOS	B				A	F	D
Approach Delay (s)	2.2			0.0	0.0	344.1	
Approach LOS					A	F	

Intersection Summary			
Average Delay	26.1		
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	51	970	925	2	1	37
Future Volume (Veh/h)	51	970	925	2	1	37
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.69	0.69
Hourly flow rate (vph)	54	1032	1039	2	1	54
Pedestrians			2		14	
Lane Width (ft)			12.0		12.0	
Walking Speed (ft/s)			3.5		3.5	
Percent Blockage			0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.82	
vC, conflicting volume	1055				2196	1054
vC1, stage 1 conf vol					1054	
vC2, stage 2 conf vol					1142	
vCu, unblocked vol	1055				2353	1054
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	80
cM capacity (veh/h)	651				192	271

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	54	1032	1041	55
Volume Left	54	0	0	1
Volume Right	0	0	2	54
cSH	651	1700	1700	269
Volume to Capacity	0.08	0.61	0.61	0.20
Queue Length 95th (ft)	7	0	0	19
Control Delay (s)	11.0	0.0	0.0	21.8
Lane LOS	B			C
Approach Delay (s)	0.5		0.0	21.8
Approach LOS				C

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	1	1	104	100	1	3
Future Volume (Veh/h)	1	1	104	100	1	3
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.76	0.76	0.86	0.86	0.53	0.53
Hourly flow rate (vph)	1	1	121	116	2	6
Pedestrians					7	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	244				189	186
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				189	186
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	99
cM capacity (veh/h)	1313				794	850

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	2	237	8
Volume Left	1	0	2
Volume Right	0	116	6
cSH	1313	1700	836
Volume to Capacity	0.00	0.14	0.01
Queue Length 95th (ft)	0	0	1
Control Delay (s)	3.9	0.0	9.3
Lane LOS	A		A
Approach Delay (s)	3.9	0.0	9.3
Approach LOS			A

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	64	94	80
Average Queue (ft)	31	46	41
95th Queue (ft)	53	77	67
Link Distance (ft)	288	400	344
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	0	60	0	0	0	105	130	0	0	45	98
Future Volume (vph)	8	0	60	0	0	0	105	130	0	0	45	98
Peak Hour Factor	0.73	0.73	0.73	0.91	0.91	0.91	0.78	0.78	0.78	0.82	0.82	0.82
Hourly flow rate (vph)	11	0	82	0	0	0	135	167	0	0	55	120

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	93	0	302	175
Volume Left (vph)	11	0	135	0
Volume Right (vph)	82	0	0	120
Hadj (s)	-0.47	0.00	0.12	-0.38
Departure Headway (s)	4.5	5.1	4.4	4.1
Degree Utilization, x	0.12	0.00	0.37	0.20
Capacity (veh/h)	725	639	793	844
Control Delay (s)	8.1	8.1	10.0	8.1
Approach Delay (s)	8.1	0.0	10.0	8.1
Approach LOS	A	A	B	A

Intersection Summary			
Delay	9.1		
Level of Service	A		
Intersection Capacity Utilization	41.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Future Volume (Veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.83	0.83	0.83	0.83	0.83	0.83	0.50	0.50	0.50
Hourly flow rate (vph)	0	0	0	4	0	12	0	10	18	8	4	0
Pedestrians		3			12			16			20	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			1			2			2	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	32			16			35	56	28	69	50	29
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	32			16			35	56	28	69	50	29
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	99	98	99	100	100
cM capacity (veh/h)	1550			1577			924	805	1019	847	811	1023

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	16	28	12
Volume Left	0	4	0	8
Volume Right	0	12	18	0
cSH	1700	1577	931	835
Volume to Capacity	0.00	0.00	0.03	0.01
Queue Length 95th (ft)	0	0	2	1
Control Delay (s)	0.0	1.8	9.0	9.4
Lane LOS		A	A	A
Approach Delay (s)	0.0	1.8	9.0	9.4
Approach LOS			A	A

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	21.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	20	48	266	575
v/c Ratio	0.05	0.12	0.19	0.44
Control Delay	14.9	13.7	4.9	6.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.9	13.7	4.9	6.8
Queue Length 50th (ft)	2	5	20	56
Queue Length 95th (ft)	20	31	80	237
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	1198	1076	1761	1644
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.02	0.04	0.15	0.35

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Future Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.99			0.98			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.96			0.95			1.00			1.00	
Flt Protected		0.99			0.98			1.00			0.99	
Satd. Flow (prot)		1749			1702			1855			1849	
Flt Permitted		0.94			0.86			1.00			0.93	
Satd. Flow (perm)		1663			1487			1853			1732	
Peak-hour factor, PHF	0.90	0.90	0.90	0.81	0.81	0.81	0.78	0.78	0.78	0.87	0.87	0.87
Adj. Flow (vph)	3	11	6	20	11	17	1	259	6	74	498	3
RTOR Reduction (vph)	0	5	0	0	15	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	15	0	0	33	0	0	265	0	0	575	0
Confl. Peds. (#/hr)	3		4	4		3	8		3	3		8
Confl. Bikes (#/hr)			8			11			12			6
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		5.0			5.0			24.8			24.8	
Effective Green, g (s)		5.0			5.0			24.8			24.8	
Actuated g/C Ratio		0.13			0.13			0.64			0.64	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		214			191			1184			1107	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.02			0.14			c0.33	
v/c Ratio		0.07			0.17			0.22			0.52	
Uniform Delay, d1		14.9			15.1			2.9			3.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.4			0.1			0.5	
Delay (s)		15.0			15.5			3.1			4.3	
Level of Service		B			B			A			A	
Approach Delay (s)		15.0			15.5			3.1			4.3	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	38.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	547	296	568	383	795	147	518	398
v/c Ratio	0.87	0.87	0.99	1.11	0.69	0.64	0.56	0.61
Control Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Length 50th (ft)	156	143	~216	~258	197	80	128	0
Queue Length 95th (ft)	#238	#285	#419	#431	284	134	178	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	648	350	573	345	1155	334	1022	677
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.85	0.99	1.11	0.69	0.44	0.51	0.59

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Future Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			1.00		1.00	1.00		1.00	1.00	0.86
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.93			0.89		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1686			1647		1770	3520		1770	3539	1363
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1686			1647		1770	3520		1770	3539	1363
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	547	166	130	12	73	483	383	770	25	147	518	398
RTOR Reduction (vph)	0	32	0	0	220	0	0	3	0	0	0	293
Lane Group Flow (vph)	547	264	0	0	348	0	383	792	0	147	518	105
Confl. Peds. (#/hr)			47						1			40
Confl. Bikes (#/hr)			4						4			7
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Effective Green, g (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Actuated g/C Ratio	0.18	0.18			0.21		0.20	0.33		0.13	0.26	0.26
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	625	307			353		346	1153		232	931	358
v/s Ratio Prot	c0.16	0.16			c0.21		c0.22	c0.23		0.08	0.15	
v/s Ratio Perm												0.08
v/c Ratio	0.88	0.86			0.99		1.11	0.69		0.63	0.56	0.29
Uniform Delay, d1	35.8	35.7			35.2		36.2	26.2		37.1	28.6	26.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	12.6	20.4			43.6		80.4	3.3		4.1	2.4	2.1
Delay (s)	48.4	56.1			78.9		116.6	29.6		41.2	31.0	28.5
Level of Service	D	E			E		F	C		D	C	C
Approach Delay (s)		51.1			78.9			57.9			31.5	
Approach LOS		D			E			E			C	

Intersection Summary			
HCM 2000 Control Delay	51.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	134	135	291	5	899	59	908
v/c Ratio	0.86	0.42	0.79	0.92	0.01	0.64	0.17	0.64
Control Delay	150.3	57.7	90.3	89.0	6.5	14.2	6.4	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	150.3	57.7	90.3	89.0	6.5	14.2	6.4	10.9
Queue Length 50th (ft)	41	114	127	262	1	310	14	377
Queue Length 95th (ft)	#90	147	#188	#333	m3	363	31	497
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	52	336	177	330	337	1398	343	1420
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.40	0.76	0.88	0.01	0.64	0.17	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Future Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.97	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1765	1830		1721	1715		1770	1828		1770	1861	
Flt Permitted	0.16	1.00		0.53	1.00		0.24	1.00		0.24	1.00	
Satd. Flow (perm)	290	1830		969	1715		443	1828		451	1861	
Peak-hour factor, PHF	0.74	0.74	0.74	0.79	0.79	0.79	0.85	0.85	0.85	0.95	0.95	0.95
Adj. Flow (vph)	43	123	11	135	171	120	5	814	85	59	903	5
RTOR Reduction (vph)	0	2	0	0	17	0	0	2	0	0	0	0
Lane Group Flow (vph)	43	132	0	135	274	0	5	897	0	59	908	0
Confl. Peds. (#/hr)	2		11	11		2	7		8	8		7
Confl. Bikes (#/hr)			5			9			10			20
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Effective Green, g (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.76	0.76		0.76	0.76	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	50	320		169	300		338	1395		344	1420	
v/s Ratio Prot		0.07			c0.16			c0.49			0.49	
v/s Ratio Perm	0.15			0.14			0.01			0.13		
v/c Ratio	0.86	0.41		0.80	0.91		0.01	0.64		0.17	0.64	
Uniform Delay, d1	60.1	55.0		59.3	60.7		4.2	8.2		4.8	8.2	
Progression Factor	1.00	1.00		1.00	1.00		1.37	1.45		1.00	1.00	
Incremental Delay, d2	76.1	0.9		22.5	30.2		0.1	1.6		1.1	2.2	
Delay (s)	136.2	55.8		81.9	91.0		5.9	13.6		5.9	10.4	
Level of Service	F	E		F	F		A	B		A	B	
Approach Delay (s)		75.3			88.1			13.5			10.1	
Approach LOS		E			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	29.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	75.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	226	465	94	478	180	50	313	162	249	256	499
v/c Ratio	0.80	0.79	0.32	0.85	0.61	0.16	0.94	0.49	0.43	0.43	0.74
Control Delay	80.0	69.3	45.8	61.3	30.1	53.3	96.9	30.1	37.5	37.5	24.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.0	69.3	45.8	61.3	30.1	53.3	96.9	30.1	37.5	37.5	24.3
Queue Length 50th (ft)	232	237	63	241	70	42	305	63	215	222	258
Queue Length 95th (ft)	#346	304	m101	280	135	69	#360	101	m307	m315	408
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	308	639	305	581	303	322	339	338	580	594	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.73	0.31	0.82	0.59	0.16	0.92	0.48	0.43	0.43	0.74

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Future Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.92	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Peak-hour factor, PHF	0.90	0.90	0.90	0.86	0.86	0.86	0.76	0.76	0.76	0.93	0.93	0.93
Adj. Flow (vph)	314	358	19	94	458	200	50	313	162	395	110	499
RTOR Reduction (vph)	0	2	0	0	2	71	0	0	73	0	0	162
Lane Group Flow (vph)	226	463	0	94	476	109	50	313	89	249	256	337
Confl. Peds. (#/hr)			1			22			31			23
Confl. Bikes (#/hr)			6			9			16			28
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Effective Green, g (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Actuated g/C Ratio	0.18	0.18		0.17	0.17	0.17	0.18	0.18	0.18	0.35	0.35	0.35
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	282	584		296	562	226	316	332	260	580	594	512
v/s Ratio Prot	c0.14	0.14		0.05	c0.14		0.03	c0.17		0.15	0.15	
v/s Ratio Perm						0.08			0.06			c0.23
v/c Ratio	0.80	0.79		0.32	0.85	0.48	0.16	0.94	0.34	0.43	0.43	0.66
Uniform Delay, d1	59.3	59.2		54.9	60.6	56.6	52.1	60.8	53.9	37.7	37.8	41.6
Progression Factor	1.00	1.00		0.79	0.80	0.75	1.00	1.00	1.00	0.91	0.91	0.85
Incremental Delay, d2	15.0	7.3		0.5	9.7	1.4	0.2	34.5	0.8	1.7	1.7	4.9
Delay (s)	74.3	66.6		43.8	58.4	43.5	52.3	95.3	54.7	36.0	36.0	40.2
Level of Service	E	E		D	E	D	D	F	D	D	D	D
Approach Delay (s)		69.1			53.0			78.7			38.1	
Approach LOS		E			D			E			D	

Intersection Summary			
HCM 2000 Control Delay	56.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	87	743	586	224	148
v/c Ratio	0.52	0.36	0.70	0.53	0.26
Control Delay	48.1	4.4	23.2	27.5	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	48.1	4.4	23.2	27.5	5.1
Queue Length 50th (ft)	39	40	221	86	0
Queue Length 95th (ft)	m62	59	347	154	38
Internal Link Dist (ft)		318	197		
Turn Bay Length (ft)	50			30	
Base Capacity (vph)	177	2052	836	420	570
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.49	0.36	0.70	0.53	0.26

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	84	721	0	0	501	38	0	0	0	222	0	147
Future Volume (vph)	84	721	0	0	501	38	0	0	0	222	0	147
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5					4.5		4.5
Lane Util. Factor	1.00	0.95			1.00					1.00		1.00
Frpb, ped/bikes	1.00	1.00			1.00					1.00		0.98
Flpb, ped/bikes	1.00	1.00			1.00					0.99		1.00
Frt	1.00	1.00			0.99					1.00		0.85
Flt Protected	0.95	1.00			1.00					0.95		1.00
Satd. Flow (prot)	1770	3539			1841					1756		1555
Flt Permitted	0.95	1.00			1.00					0.76		1.00
Satd. Flow (perm)	1770	3539			1841					1400		1555
Peak-hour factor, PHF	0.97	0.97	0.97	0.92	0.92	0.92	0.25	0.25	0.25	0.99	0.99	0.99
Adj. Flow (vph)	87	743	0	0	545	41	0	0	0	224	0	148
RTOR Reduction (vph)	0	0	0	0	3	0	0	0	0	0	0	104
Lane Group Flow (vph)	87	743	0	0	583	0	0	0	0	224	0	44
Confl. Peds. (#/hr)	5		6	6		5			6	6		
Confl. Bikes (#/hr)			5			2			1			8
Turn Type	Prot	NA			NA					Perm		Perm
Protected Phases	7	4			8			2				
Permitted Phases							2			6		6
Actuated Green, G (s)	6.0	43.5			33.0					22.5		22.5
Effective Green, g (s)	6.0	43.5			33.0					22.5		22.5
Actuated g/C Ratio	0.08	0.58			0.44					0.30		0.30
Clearance Time (s)	4.5	4.5			4.5					4.5		4.5
Vehicle Extension (s)	3.0	3.0			3.0					3.0		3.0
Lane Grp Cap (vph)	141	2052			810					420		466
v/s Ratio Prot	c0.05	0.21			c0.32							
v/s Ratio Perm										c0.16		0.03
v/c Ratio	0.62	0.36			0.72					0.53		0.10
Uniform Delay, d1	33.4	8.4			17.2					21.9		18.9
Progression Factor	1.20	0.48			1.00					1.00		1.00
Incremental Delay, d2	6.6	0.4			5.5					4.8		0.4
Delay (s)	46.6	4.4			22.7					26.7		19.3
Level of Service	D	A			C					C		B
Approach Delay (s)		8.8			22.7			0.0			23.7	
Approach LOS		A			C			A			C	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	925	507	5	2	32
Future Volume (Veh/h)	24	925	507	5	2	32
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.95	0.95	0.92	0.92
Hourly flow rate (vph)	26	984	534	5	2	35
Pedestrians		2	4		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		494				
pX, platoon unblocked					0.71	
vC, conflicting volume	549				1586	548
vC1, stage 1 conf vol					546	
vC2, stage 2 conf vol					1040	
vCu, unblocked vol	549				1622	548
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	93
cM capacity (veh/h)	1011				258	530

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	26	984	539	37
Volume Left	26	0	0	2
Volume Right	0	0	5	35
cSH	1011	1700	1700	501
Volume to Capacity	0.03	0.58	0.32	0.07
Queue Length 95th (ft)	2	0	0	6
Control Delay (s)	8.7	0.0	0.0	12.8
Lane LOS	A			B
Approach Delay (s)	0.2		0.0	12.8
Approach LOS				B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	78	37	17	82	2
Future Volume (Veh/h)	2	78	37	17	82	2
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.72	0.72	0.84	0.84
Hourly flow rate (vph)	2	85	51	24	98	2
Pedestrians					8	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	83				160	71
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83				160	71
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				88	100
cM capacity (veh/h)	1503				824	984

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	87	75	100
Volume Left	2	0	98
Volume Right	0	24	2
cSH	1503	1700	826
Volume to Capacity	0.00	0.04	0.12
Queue Length 95th (ft)	0	0	10
Control Delay (s)	0.2	0.0	10.0
Lane LOS	A		A
Approach Delay (s)	0.2	0.0	10.0
Approach LOS			A

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	17.0%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	77	50	77
Average Queue (ft)	38	25	43
95th Queue (ft)	62	42	67
Link Distance (ft)	283	395	346
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	25	0	134	0	0	0	20	58	0	0	138	32
Future Volume (vph)	25	0	134	0	0	0	20	58	0	0	138	32
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.79	0.79	0.79	0.94	0.94	0.94
Hourly flow rate (vph)	28	0	152	0	0	0	25	73	0	0	147	34

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	180	0	98	181
Volume Left (vph)	28	0	25	0
Volume Right (vph)	152	0	0	34
Hadj (s)	-0.44	0.00	0.09	-0.08
Departure Headway (s)	4.1	4.7	4.6	4.3
Degree Utilization, x	0.20	0.00	0.12	0.22
Capacity (veh/h)	821	705	744	788
Control Delay (s)	8.1	7.7	8.2	8.5
Approach Delay (s)	8.1	0.0	8.2	8.5
Approach LOS	A	A	A	A

Intersection Summary			
Delay	8.3		
Level of Service	A		
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Future Volume (Veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.85	0.85	0.85	0.92	0.92	0.92	0.25	0.25	0.25
Hourly flow rate (vph)	0	0	0	4	0	1	0	2	7	8	8	0
Pedestrians		2			3			2			8	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	9			2			16	19	5	28	18	10
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	9			2			16	19	5	28	18	10
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	99	99	99	100
cM capacity (veh/h)	1599			1617			979	864	1073	955	865	1060

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	5	9	16
Volume Left	0	4	0	8
Volume Right	0	1	7	0
cSH	1700	1617	1018	908
Volume to Capacity	0.00	0.00	0.01	0.02
Queue Length 95th (ft)	0	0	1	1
Control Delay (s)	0.0	5.8	8.6	9.0
Lane LOS		A	A	A
Approach Delay (s)	0.0	5.8	8.6	9.0
Approach LOS			A	A

Intersection Summary			
Average Delay	8.4		
Intersection Capacity Utilization	16.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	8	71	394	766
v/c Ratio	0.03	0.23	0.26	0.50
Control Delay	20.6	13.0	2.8	4.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.6	13.0	2.8	4.5
Queue Length 50th (ft)	1	3	31	81
Queue Length 95th (ft)	14	24	70	174
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	987	986	1787	1781
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.01	0.07	0.22	0.43

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Future Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.94			0.94			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.93			0.89			1.00			1.00	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1619			1546			1862			1861	
Flt Permitted		0.92			0.95			1.00			1.00	
Satd. Flow (perm)		1500			1476			1860			1855	
Peak-hour factor, PHF	0.90	0.90	0.90	0.69	0.69	0.69	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	2	2	4	10	3	58	1	392	1	8	757	1
RTOR Reduction (vph)	0	4	0	0	54	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	4	0	0	17	0	0	394	0	0	766	0
Confl. Peds. (#/hr)	6		4	4		6	5		3	3		5
Confl. Bikes (#/hr)			18			10			7			23
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		3.5			3.5			33.3			33.3	
Effective Green, g (s)		3.5			3.5			33.3			33.3	
Actuated g/C Ratio		0.08			0.08			0.73			0.73	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		114			112			1352			1348	
v/s Ratio Prot												
v/s Ratio Perm		0.00			c0.01			0.21			c0.41	
v/c Ratio		0.04			0.16			0.29			0.57	
Uniform Delay, d1		19.6			19.8			2.2			2.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.7			0.2			0.7	
Delay (s)		19.7			20.4			2.3			3.6	
Level of Service		B			C			A			A	
Approach Delay (s)		19.7			20.4			2.3			3.6	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	45.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	424	219	490	108	653	253	1022	570
v/c Ratio	0.88	0.78	1.07	0.57	0.62	0.75	0.72	0.62
Control Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Length 50th (ft)	115	84	~253	56	153	128	239	0
Queue Length 95th (ft)	#195	#194	#442	103	231	192	329	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	484	284	457	249	1051	458	1420	915
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.77	1.07	0.43	0.62	0.55	0.72	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Future Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			0.99		1.00	1.00		1.00	1.00	0.90
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.92			0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1659			1668		1770	3526		1770	3539	1431
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1659			1668		1770	3526		1770	3539	1431
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	424	101	118	16	132	342	108	639	14	253	1022	570
RTOR Reduction (vph)	0	50	0	0	95	0	0	1	0	0	0	345
Lane Group Flow (vph)	424	169	0	0	395	0	108	652	0	253	1022	225
Confl. Peds. (#/hr)			39						3			26
Confl. Bikes (#/hr)			2			2						10
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Effective Green, g (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Actuated g/C Ratio	0.14	0.14			0.22		0.10	0.30		0.19	0.39	0.39
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	480	232			363		168	1049		339	1394	563
v/s Ratio Prot	c0.12	0.10			c0.24		0.06	0.18		c0.14	c0.29	
v/s Ratio Perm												0.16
v/c Ratio	0.88	0.73			1.09		0.64	0.62		0.75	0.73	0.40
Uniform Delay, d1	35.9	35.0			33.2		37.1	25.7		32.4	21.9	18.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	16.9	9.3			72.5		6.2	2.8		7.6	3.4	2.1
Delay (s)	52.7	44.3			105.8		43.2	28.5		40.0	25.4	20.6
Level of Service	D	D			F		D	C		D	C	C
Approach Delay (s)		49.9			105.8			30.6			25.9	
Approach LOS		D			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	41.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	96	88	127	5	262	121	757
v/c Ratio	0.14	0.41	0.59	0.53	0.01	0.19	0.14	0.51
Control Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Length 50th (ft)	13	63	66	84	1	30	16	152
Queue Length 95th (ft)	29	93	113	137	3	44	32	207
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	181	340	216	341	480	1406	858	1477
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.28	0.41	0.37	0.01	0.19	0.14	0.51

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	60	16	78	82	31	3	122	43	87	538	7
Future Volume (vph)	14	60	16	78	82	31	3	122	43	87	538	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.98	1.00		0.99	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.96		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1747	1778		1733	1768		1760	1759		1717	1858	
Flt Permitted	0.53	1.00		0.64	1.00		0.33	1.00		0.60	1.00	
Satd. Flow (perm)	973	1778		1161	1768		603	1759		1080	1858	
Peak-hour factor, PHF	0.79	0.79	0.79	0.89	0.89	0.89	0.63	0.63	0.63	0.72	0.72	0.72
Adj. Flow (vph)	18	76	20	88	92	35	5	194	68	121	747	10
RTOR Reduction (vph)	0	9	0	0	12	0	0	8	0	0	0	0
Lane Group Flow (vph)	18	87	0	88	115	0	5	254	0	121	757	0
Confl. Peds. (#/hr)	6		9	9		6	8		17	17		8
Confl. Bikes (#/hr)			9						11			4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Effective Green, g (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.80	0.80		0.80	0.80	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	124	228		148	226		479	1398		858	1477	
v/s Ratio Prot		0.05			0.06			0.14			c0.41	
v/s Ratio Perm	0.02			c0.08			0.01			0.11		
v/c Ratio	0.15	0.38		0.59	0.51		0.01	0.18		0.14	0.51	
Uniform Delay, d1	46.5	47.9		49.4	48.8		2.5	2.9		2.8	4.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	1.1		6.3	1.8		0.0	0.3		0.3	1.3	
Delay (s)	47.0	49.0		55.6	50.6		2.6	3.2		3.2	5.5	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		48.7			52.6			3.2			5.2	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	127	584	133	710	99	48	123	319	244	244	354
v/c Ratio	0.36	0.79	0.28	0.78	0.23	0.19	0.45	0.66	0.68	0.67	0.81
Control Delay	54.8	62.8	46.2	56.4	16.8	59.5	63.9	13.0	63.4	62.7	46.9
Queue Delay	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.8	62.8	46.2	57.6	16.8	59.5	63.9	13.0	63.4	62.7	46.9
Queue Length 50th (ft)	123	313	109	374	20	42	113	0	247	246	216
Queue Length 95th (ft)	210	420	182	484	80	80	172	48	332	331	309
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	433	907	612	1170	531	408	429	580	516	525	570
Starvation Cap Reductn	0	0	0	247	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.64	0.22	0.77	0.19	0.12	0.29	0.55	0.47	0.46	0.62

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	511	14	128	671	106	39	100	258	353	57	297
Future Volume (vph)	130	511	14	128	671	106	39	100	258	353	57	297
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	1.00	0.92	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.81	0.81	0.81	0.84	0.84	0.84
Adj. Flow (vph)	141	555	15	133	699	110	48	123	319	420	68	354
RTOR Reduction (vph)	0	1	0	0	1	55	0	0	272	0	0	114
Lane Group Flow (vph)	127	583	0	133	709	44	48	123	47	244	244	240
Confl. Peds. (#/hr)			5			9			28			11
Confl. Bikes (#/hr)			6			3			19			6
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Effective Green, g (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Actuated g/C Ratio	0.22	0.22		0.27	0.27	0.27	0.15	0.15	0.15	0.22	0.22	0.22
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	355	744		478	914	378	261	275	215	361	367	329
v/s Ratio Prot	0.08	c0.17		0.08	c0.21		0.03	c0.07		0.15	0.14	
v/s Ratio Perm						0.03			0.03			c0.16
v/c Ratio	0.36	0.78		0.28	0.78	0.12	0.18	0.45	0.22	0.68	0.66	0.73
Uniform Delay, d1	45.3	50.5		39.6	46.3	37.8	51.3	53.5	51.6	49.5	49.4	50.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	5.4		0.3	4.2	0.1	0.3	1.2	0.5	4.9	4.5	8.1
Delay (s)	45.9	55.9		39.9	50.5	37.9	51.7	54.6	52.1	54.5	53.9	58.3
Level of Service	D	E		D	D	D	D	D	D	D	D	E
Approach Delay (s)		54.1			47.7			52.7			55.9	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	52.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	137.5	Sum of lost time (s)	20.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	236	1102	1017	185	126
v/c Ratio	0.91	0.42	1.03	0.79	0.34
Control Delay	80.7	5.6	58.8	62.7	9.3
Queue Delay	0.0	0.9	0.0	0.0	0.0
Total Delay	80.7	6.5	58.8	62.7	9.3
Queue Length 50th (ft)	151	126	~705	111	0
Queue Length 95th (ft)	#261	141	#953	146	25
Internal Link Dist (ft)		318	197		
Turn Bay Length (ft)	50			30	
Base Capacity (vph)	259	2617	992	267	400
Starvation Cap Reductn	0	1127	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.91	0.74	1.03	0.69	0.32

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	196	915	0	0	767	168	0	0	0	135	0	92
Future Volume (vph)	196	915	0	0	767	168	0	0	0	135	0	92
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5					4.5		4.5
Lane Util. Factor	1.00	0.95			1.00					1.00		1.00
Frpb, ped/bikes	1.00	1.00			0.99					1.00		0.99
Flpb, ped/bikes	1.00	1.00			1.00					0.99		1.00
Frt	1.00	1.00			0.98					1.00		0.85
Flt Protected	0.95	1.00			1.00					0.95		1.00
Satd. Flow (prot)	1770	3539			1800					1758		1562
Flt Permitted	0.95	1.00			1.00					0.76		1.00
Satd. Flow (perm)	1770	3539			1800					1401		1562
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.25	0.25	0.25	0.73	0.73	0.73
Adj. Flow (vph)	236	1102	0	0	834	183	0	0	0	185	0	126
RTOR Reduction (vph)	0	0	0	0	8	0	0	0	0	0	0	105
Lane Group Flow (vph)	236	1102	0	0	1009	0	0	0	0	185	0	21
Confl. Peds. (#/hr)	12		2	2		12			4	4		
Confl. Bikes (#/hr)			2			2			3			1
Turn Type	Prot	NA			NA					Perm		Perm
Protected Phases	7	4			8			2				
Permitted Phases							2			6		6
Actuated Green, G (s)	14.3	72.4			53.6					16.5		16.5
Effective Green, g (s)	14.3	72.4			53.6					16.5		16.5
Actuated g/C Ratio	0.15	0.74			0.55					0.17		0.17
Clearance Time (s)	4.5	4.5			4.5					4.5		4.5
Vehicle Extension (s)	3.0	3.0			3.0					3.0		3.0
Lane Grp Cap (vph)	258	2617			985					236		263
v/s Ratio Prot	c0.13	0.31			c0.56							
v/s Ratio Perm										c0.13		0.01
v/c Ratio	0.91	0.42			1.02					0.78		0.08
Uniform Delay, d1	41.2	4.8			22.2					39.0		34.3
Progression Factor	1.00	1.00			1.00					1.00		1.00
Incremental Delay, d2	34.0	0.1			35.1					15.6		0.1
Delay (s)	75.2	4.9			57.3					54.5		34.4
Level of Service	E	A			E					D		C
Approach Delay (s)		17.3			57.3			0.0			46.4	
Approach LOS		B			E			A			D	

Intersection Summary			
HCM 2000 Control Delay	35.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	97.9	Sum of lost time (s)	13.5
Intersection Capacity Utilization	85.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	51	970	925	2	1	37
Future Volume (Veh/h)	51	970	925	2	1	37
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.69	0.69
Hourly flow rate (vph)	54	1032	1039	2	1	54
Pedestrians			2		14	
Lane Width (ft)			12.0		12.0	
Walking Speed (ft/s)			3.5		3.5	
Percent Blockage			0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		494				
pX, platoon unblocked					0.73	
vC, conflicting volume	1055				2196	1054
vC1, stage 1 conf vol					1054	
vC2, stage 2 conf vol					1142	
vCu, unblocked vol	1055				2458	1054
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	80
cM capacity (veh/h)	651				184	271

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	54	1032	1041	55
Volume Left	54	0	0	1
Volume Right	0	0	2	54
cSH	651	1700	1700	269
Volume to Capacity	0.08	0.61	0.61	0.20
Queue Length 95th (ft)	7	0	0	19
Control Delay (s)	11.0	0.0	0.0	21.8
Lane LOS	B			C
Approach Delay (s)	0.5		0.0	21.8
Approach LOS				C

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	1	50	104	100	18	3
Future Volume (Veh/h)	1	50	104	100	18	3
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.76	0.76	0.86	0.86	0.53	0.53
Hourly flow rate (vph)	1	66	121	116	34	6
Pedestrians					7	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	244				254	186
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				254	186
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				95	99
cM capacity (veh/h)	1313				729	850

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	67	237	40
Volume Left	1	0	34
Volume Right	0	116	6
cSH	1313	1700	745
Volume to Capacity	0.00	0.14	0.05
Queue Length 95th (ft)	0	0	4
Control Delay (s)	0.1	0.0	10.1
Lane LOS	A		B
Approach Delay (s)	0.1	0.0	10.1
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	55	92	85
Average Queue (ft)	30	46	44
95th Queue (ft)	49	74	70
Link Distance (ft)	288	400	344
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	0	60	0	0	0	105	130	0	0	77	98
Future Volume (vph)	8	0	60	0	0	0	105	130	0	0	77	98
Peak Hour Factor	0.73	0.73	0.73	0.91	0.91	0.91	0.78	0.78	0.78	0.82	0.82	0.82
Hourly flow rate (vph)	11	0	82	0	0	0	135	167	0	0	94	120

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	93	0	302	214
Volume Left (vph)	11	0	135	0
Volume Right (vph)	82	0	0	120
Hadj (s)	-0.47	0.00	0.12	-0.30
Departure Headway (s)	4.6	5.2	4.5	4.2
Degree Utilization, x	0.12	0.00	0.37	0.25
Capacity (veh/h)	708	622	783	830
Control Delay (s)	8.2	8.2	10.1	8.5
Approach Delay (s)	8.2	0.0	10.1	8.5
Approach LOS	A	A	B	A

Intersection Summary			
Delay	9.3		
Level of Service	A		
Intersection Capacity Utilization	42.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Future Volume (Veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.83	0.83	0.83	0.83	0.83	0.83	0.50	0.50	0.50
Hourly flow rate (vph)	0	0	0	4	0	12	0	10	18	8	4	0
Pedestrians		3			12			16			20	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			1			2			2	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	32			16			35	56	28	69	50	29
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	32			16			35	56	28	69	50	29
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	99	98	99	100	100
cM capacity (veh/h)	1550			1577			924	805	1019	847	811	1023

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	16	28	12
Volume Left	0	4	0	8
Volume Right	0	12	18	0
cSH	1700	1577	931	835
Volume to Capacity	0.00	0.00	0.03	0.01
Queue Length 95th (ft)	0	0	2	1
Control Delay (s)	0.0	1.8	9.0	9.4
Lane LOS		A	A	A
Approach Delay (s)	0.0	1.8	9.0	9.4
Approach LOS			A	A

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	21.5%	ICU Level of Service	A
Analysis Period (min)	15		

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	20	48	266	575
v/c Ratio	0.05	0.12	0.19	0.44
Control Delay	14.9	13.7	4.9	6.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.9	13.7	4.9	6.8
Queue Length 50th (ft)	2	5	20	56
Queue Length 95th (ft)	20	31	80	237
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	1198	1076	1761	1644
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.02	0.04	0.15	0.35

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Future Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.99			0.98			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.96			0.95			1.00			1.00	
Flt Protected		0.99			0.98			1.00			0.99	
Satd. Flow (prot)		1749			1702			1855			1849	
Flt Permitted		0.94			0.86			1.00			0.93	
Satd. Flow (perm)		1663			1487			1853			1732	
Peak-hour factor, PHF	0.90	0.90	0.90	0.81	0.81	0.81	0.78	0.78	0.78	0.87	0.87	0.87
Adj. Flow (vph)	3	11	6	20	11	17	1	259	6	74	498	3
RTOR Reduction (vph)	0	5	0	0	15	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	15	0	0	33	0	0	265	0	0	575	0
Confl. Peds. (#/hr)	3		4	4		3	8		3	3		8
Confl. Bikes (#/hr)			8			11			12			6
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		5.0			5.0			24.8			24.8	
Effective Green, g (s)		5.0			5.0			24.8			24.8	
Actuated g/C Ratio		0.13			0.13			0.64			0.64	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		214			191			1184			1107	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.02			0.14			c0.33	
v/c Ratio		0.07			0.17			0.22			0.52	
Uniform Delay, d1		14.9			15.1			2.9			3.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.4			0.1			0.5	
Delay (s)		15.0			15.5			3.1			4.3	
Level of Service		B			B			A			A	
Approach Delay (s)		15.0			15.5			3.1			4.3	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	38.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	547	296	568	383	795	147	518	398
v/c Ratio	0.87	0.87	0.99	1.11	0.69	0.64	0.56	0.61
Control Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Length 50th (ft)	156	143	~216	~258	197	80	128	0
Queue Length 95th (ft)	#238	#285	#419	#431	284	134	178	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	648	350	573	345	1155	334	1022	677
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.85	0.99	1.11	0.69	0.44	0.51	0.59

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Future Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			1.00		1.00	1.00		1.00	1.00	0.86
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.93			0.89		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1686			1647		1770	3520		1770	3539	1363
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1686			1647		1770	3520		1770	3539	1363
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	547	166	130	12	73	483	383	770	25	147	518	398
RTOR Reduction (vph)	0	32	0	0	220	0	0	3	0	0	0	293
Lane Group Flow (vph)	547	264	0	0	348	0	383	792	0	147	518	105
Confl. Peds. (#/hr)			47						1			40
Confl. Bikes (#/hr)			4						4			7
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Effective Green, g (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Actuated g/C Ratio	0.18	0.18			0.21		0.20	0.33		0.13	0.26	0.26
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	625	307			353		346	1153		232	931	358
v/s Ratio Prot	c0.16	0.16			c0.21		c0.22	c0.23		0.08	0.15	
v/s Ratio Perm												0.08
v/c Ratio	0.88	0.86			0.99		1.11	0.69		0.63	0.56	0.29
Uniform Delay, d1	35.8	35.7			35.2		36.2	26.2		37.1	28.6	26.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	12.6	20.4			43.6		80.4	3.3		4.1	2.4	2.1
Delay (s)	48.4	56.1			78.9		116.6	29.6		41.2	31.0	28.5
Level of Service	D	E			E		F	C		D	C	C
Approach Delay (s)		51.1			78.9			57.9			31.5	
Approach LOS		D			E			E			C	

Intersection Summary			
HCM 2000 Control Delay	51.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group