FLOOD INSURANCE STUDY

VOLUME 1 OF 2

SAN MATEO COUNTY CALIFORNIA

AND INCORPORATED AREAS

Community Name	Community Number
ATHERTON, TOWN OF [1]	060312
BELMONT, CITY OF	065016
BRISBANE, CITY OF	060314
BURLINGAME, CITY OF	065019
COLMA, TOWN OF	060316
DALY CITY, CITY OF	060317
EAST PALO ALTO, CITY OF	060708
FOSTER CITY, CITY OF	060318
HALF MOON BAY, CITY OF	060319
HILLSBOROUGH, TOWN OF	060320
MENLO PARK, CITY OF	060321
MILLBRAE, CITY OF	065045
PACIFICA, CITY OF	060323
PORTOLA VALLEY, TOWN OF	065052
REDWOOD CITY, CITY OF	060325
SAN BRUNO, CITY OF	060326
SAN CARLOS, CITY OF	060327
SAN MATEO COUNTY (UNINCORPORATED AREAS)	060311
SAN MATEO, CITY OF	060328
SOUTH SAN FRANCISCO, CITY OF	065062
WOODSIDE, TOWN OF	060330

[1] No Special Flood Hazard Areas Identified

PRELIMINARY
8/13/2015

REVISED
Month Day, Year

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06081CV001C

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

Selected Flood Insurance Rate Map (FIRM) panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone(s)	New Zone
Al through A30	AE
B	X
C	X

This FIS report was revised on Month xx, 201x. Users should refer to Section 10.0, Revision Descriptions, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this FIS report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.

Initial Countywide FIS Effective Date: October 16, 2012

First Revised Countywide FIS Date: July 16, 2015

Second Revised Countywide FIS Date: Month xx, 201x

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FLOOD INSURANCE STUDY

SAN MATEO COUNTY, CALIFORNIA, AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of San Mateo County, California, including: the Cities of Belmont, Brisbane, Burlingame, Daly City, East Palo Alto, Foster City, Half Moon Bay, Menlo Park, Millbrae, Pacifica, Redwood City, San Bruno, San Carlos, San Mateo, and South San Francisco; the Towns of Atherton, Colma, Hillsborough, Portola Valley, and Woodside; and the unincorporated areas of San Mateo County (hereinafter referred to collectively as San Mateo County).

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by San Mateo County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that as of the effective date of this study the Town of Atherton and the City of San Bruno have no mapped Special Flood Hazard Areas (SFHA) identified. This does not preclude future determinations of SFHAs that could be necessitated by changed conditions affecting the community (e.g. the annexation of new lands) or the availability of new scientific or technical data about flood hazards.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include all jurisdictions within San Mateo County in a countywide FIS. The authority and acknowledgments prior to this countywide FIS were compiled from the previously identified FIS reports for flood prone jurisdictions within San Mateo County and are shown below:

Burlingame, City of: The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, Tudor Engineering Company, for the Federal Insurance Administration (FIA, now a division of FEMA), under Contract No. H-4608. This work, which was completed in July 1980, covered all significant flooding sources affecting the City of Burlingame.

East Palo Alto, City of: The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, as reported in the FIS for San Mateo County (Reference 1).

This study was revised on August 23, 1999, to incorporate the effects of a more detailed hydraulic analysis of the main channel and overflow areas of San Francisquito Creek in the City of East Palo Alto. The more detailed hydraulic analysis of San Francisquito Creek extends from the Bayshore Freeway to the corporate boundary of the City of Menlo Park. The more detailed hydraulic analysis of the overflow areas is along Willow Road between Alberni Street and the Bayshore Freeway. The hydraulic analysis for the restudy was prepared by Ensign & Buckley, for FEMA, under Contract No. EMW-90-C-3133.

Half Moon Bay, City of: The coastal analyses for this study were performed by Ott Water Engineers, Inc., for FEMA, under Contract No. EMW-83-C-1175. This work was completed in August 1984.

Hillsborough, Town of: The hydrologic and hydraulic analyses for this study were performed by Ensign & Buckley, for FEMA, under Contract No. EMW-94-C-4572. This work was completed in February 1998.

Menlo Park, City of: The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, for FIA, under Contract No. H-4608. This work, which was completed in October 1979, covered all significant flooding sources affecting the City of Menlo Park.

This study was revised on April 21, 1999, to incorporate the effects of a more detailed hydraulic analysis of the main channel and overflow areas of San Francisquito Creek in the City of Menlo Park. The more detailed hydraulic analysis of San Francisquito Creek extends from the corporate boundary of the City of East Palo Alto to the railroad. The more detailed hydraulic analysis of the overflow areas is along the Bayshore Freeway, Middlefield Road, Pope Street, and Willow Road.

The hydraulic analysis for the restudy was prepared by Ensign & Buckley, for FEMA, under Contract No. EMW-90-C-3133.

Millbrae, City of: The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, Tudor Engineering Company, for FIA, under Contract No. H- 4608. This work, which was completed in July 1980, covered all significant flooding sources affecting the City of Millbrae.

Pacifica, City of: The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, for FEMA, under Contract No. H-4608. That work was completed in November 1979.

The costal analyses for the revised study were performed by Ott Water Engineers, Inc., for FEMA, under Contract No. EMW-83-C-1175. This work was completed in August 1984.

Portola Valley, Town of: The hydrologic and hydraulic analyses for this study were performed by the U.S. Department of Agriculture, Soil Conservation Service (now known as the Natural Resources Conservation Service (NRCS)), for FIA, under Inter-Agency Agreement NO. IAA-H-16-72, Project Order No. 2. This work, which was completed in March 1975, covered all significant flooding sources affecting the Town of Portola Valley.

Redwood City, City of: The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, for FEMA, under Contract No. H-4608. This work, which was completed in October 1979, covered all significant flooding sources affecting the City of Redwood City.

San Carlos, City of: The hydrologic and hydraulic analyses for this study were performed by the U.S. Geological Survey (USGS), Water Resources Division, California District, for FIA, under Inter-Agency Agreement No. IAA-H-3-73, Project Order No. 8. This work, which was completed in June 1976, covered all flooding sources affecting the City of San Carlos.

San Mateo, City of: The hydrologic and hydraulic analyses for this study were performed by Ensign & Buckley, for FEMA, under Contract No. EMW-94-C-4572. This work was completed in February 1998.

South San Francisco, City of: The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, for FIA, under Contract No. H-4608. This work, which was completed in July 1980, covered all significant flooding sources affecting the City of South San Francisco.

Woodside, Town of: The hydrologic and hydraulic analyses for this study were performed by the USGS, Water Resources Division, California District, for FIA, under Inter-Agency Agreement No. IAA-H-3-73, Project Order No. 8. This work, which was completed in April 1974, covered all flooding sources affecting the Town of Woodside.

San Mateo County: The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, for FEMA, under Contract No. H-4608. This work was completed in December 1980.

The coastal analyses for the revised study were performed by Ott Water Engineers, Inc., for FEMA, under Contract EMW-83-C-1175. This work was completed in August 1984.

There are no previous FIS or FIRMs for the Town of Atherton and the City of San Bruno, and no previous FIS for the Cities of Belmont, Brisbane, Colma, Daly City and Foster City; therefore, the previous authority and acknowledgement information for these communities is not included in this FIS.

First Time Countywide FIS, October 16, 2012

For this first time countywide FIS, MAP IX-Mainland compiled the existing data to convert the previous San Mateo County FIS into digital format. MAP IX- Mainland completed this work under contract number EMF-2003-CO-0047, in February of 2005.

Some behind levee analyses for de-accredited levees in the Cities of Burlingame, Foster City, Pacifica, Redwood City, San Carlos, San Mateo and South San Francisco; and the Town of Colma; were performed by Nolte Engineering Company, for FEMA. This work was completed in June 2007. Some behind levee analyses for de-accredited levees in the Cities of Belmont, Burlingame, Redwood City, San Carlos and South San Francisco; and the Town of Colma; were also performed by MAP-IX Mainland, for FEMA, under Contract No. EMF- 2003-CO-0047. This work was completed in October and November 2007. These behind levee analyses were incorporated into the FIRMs by MAP-IX Mainland, for FEMA, under Contract No. EMF-2003-CO-0047. This work was completed in April 2008.

Levee accreditation and subsequent revisions to special flood hazard areas for the Cities of Redwood City, San Carlos and the unincorporated areas of San Mateo County were conducted by MAP-IX Mainland under Contract No. EMF-2003- CO-0047. This work was completed in August 2010. Levee accreditation and subsequent revision to special flood hazard areas for the City of San Mateo were conducted by BakerAECOM in February 2012. This information was incorporated into the FIRM in February 2012 by MAP-IX Mainland.

Base map information shown on select FIRM panels was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). This information was photogrammetrically compiled at a scale of 1:24,000 from aerial photography dated 2005.

The projection used in the preparation of those maps was Universal Transverse Mercator (UTM) Zone 10N. The horizontal datum was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zone used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

An initial Consultation Coordination Officer (CCO) meeting (also occasionally referred to as the Scoping meeting) is held with representatives of the communities, FEMA, and the study contractors to explain the nature and purpose of the FIS and to identify the streams to be studied by detailed methods. A final CCO (often referred to as the Preliminary DFIRM Community Coordination, or PDCC, meeting) is held with representatives of the communities, FEMA, and the study contractors to review the results of the study.

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held previously for San Mateo County and the incorporated communities within its boundaries are shown in Table 1, "Initial and Final CCO Meetings.

Table 1: Initial and Final CCO Meeting Dates

Community Name	Initial CCO Date	Final CCO Date
Belmont, City of	[1]	[1]
Brisbane, City of	[1]	[1]
Burlingame, City of	July 28, 1977	November 13, 1979
Colma, Town of	[1]	[1]
Daly City, City of	[1]	[1]
East Palo Alto, City of	June 28, 1983[2] August 18, 1990	November 1, 1983 [1]
Foster City, City of	[1]	[1]

[1]*Data not available*

Table 1: Initial and Final CCO Meeting Dates (continued)

Community Name	Initial CCO Date	Final CCO Date
Half Moon Bay, City of	June 1985	[1]
Hillsborough, Town of	[1]	September 30, 1998
Menlo Park, City of	August 4, 1977 August 19, 1990	August 28, 1979 [1]
Millbrae, City of	July 28, 1977	August 28, 1979
Pacifica, City of	July 1977 May 1983	August 19, 1979 [1]
Portola Valley, Town of	[1]	July 13, 1977
Redwood City, City of	August 4, 1977	November 20, 1979
San Carlos, City of	[1]	April 18, 1975
San Mateo, City of	[1]	October 20, 1998
San Mateo County (Unincorporated Areas)	August 4, 1977 May 1983	May 21, 1982 [1]
South San Francisco, City of	July 28, 1977	August 29, 1979
Woodside, Town of	[1]	August 15, 1977

[1]*Data not available*

For the first time countywide revision, the final CCO meeting took place on May 13, 2008. This meeting was attended by representatives of FEMA, the community, and the study contractor.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of San Mateo County, California. All or portions of the flooding sources listed in Table 2 "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Published Separately).

Table 2: Flooding Sources Studied by Detailed Methods

Brittan Creek	Pescadero Creek
Calera Creek	Pulgas Creek
Colma Creek	San Gregorio Creek
Cordilleras Creek	San Mateo Creek
Corte Madera Creek	San Vicente Creek
Denniston Creek	Sausal Creek
El Granada Creek	West Union Creek
Harbor Industrial District Channel	Woodhams Creek
La Honda Creek	16th Avenue Drainage Channel
Laurel Creek	19th Avenue Drainage Channel
Montara Creek	

*Flooding source with new or revised analyses incorporated as part of the current study update

Tidal flooding from San Francisco Bay was studied in the original study utilizing detailed tidal elevations. This revised study includes a detailed study of coastal flooding from the Pacific Ocean at two reaches. The first reach, henceforth referred to as Miramar Beach, begins approximately 1,300 feet north of the mouth of Arroyo de en Medio and extends south along the coast approximately 2,800 feet. The second reach, henceforth referred to as Martins Beach, extends south along the coast approximately 1,100 feet. Coastal flooding from the Pacific Ocean was studied in detail along a coastal reach that begins approximately 1,300 feet north of the mouth of Arroyo de en Medio and extends south approximately 2,800 feet.

The Pacific Ocean coast, from the southern boundary of Sharp Park State Beach at Clarendon Road, extending north approximately 5,000 feet; and the Pacific Ocean coast, beginning approximately 1,000 feet west of the mouth of San Pedro Creek and extending east, then northeast, approximately 4,400 feet

Detailed methods were also used to analyze tidal inundation from San Francisco Bay along the bayfront area within Burlingham, East Palo Alto, Millbrea & Menlo Park. Tidal inundation from San Francisco Bay along the Redwood City bay front and the Redwood Shores development was also studied by detailed methods. Detailed methods were also used to analyze tidal inundation in San Carlos.

The upper reach of Corte Madera Creek, outside the detailed study portion, and the unnamed tributary near the northern corporate boundary have no houses in their floodplains. The floodplain associated with Los Trancos Creek drainage has very few houses in San Mateo County that are subject to inundation. Sausal Creek drainage includes one small portion in this area (the west side of Portola Road north of Westridge Drive) that is subject to inundation because the stormdrains and culverts do not have an adequate capacity. Flood hazards in these areas were studied by approximate methods.

The flooding caused by the overflow of Redwood Creek from Alameda de las Pulgas to El Camino Real, from Stulsaft Branch to the confluence with Jefferson Branch, and from Jefferson Branch to the confluence with Redwood Creek was studied by approximate methods.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

All or portions of numerous flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the communities. All or portions of the flooding sources listed in Table 3, “Flooding Sources Studied by Approximate Methods,” were studied by approximate methods.

Table 3: Flooding Sources Studied by Approximate Methods

Alpine Creek	Bear Gulch Creek	Calera Creek
Ano Nuevo Creek	Belmont Creek	Cascade Creek
Apanolio Creek	Belmont Slough	Central Lake
Arroyo de los Frijoles	Bogess Creek	Chandler Gulch
Arroyo Leon	Bradley Creek	Clear Creek
Atherton Creek	Burlingame Channel	Colma Creek
Bean Hollow Lakes	Butano Creek	Cordilleras Creek
Corinda Los Trancos Creek	Lake Lucerne	Purisima Creek
Corte Madera Creek	Little Butano Creek	Redwood Creek
Coyote Creek	Los Trancos Creek	Rockaway Creek
Denniston Creek	Madonna Creek	San Francisquito Creek
Easton Creek	McCormick Creek	San Gregorio Creek
El Corte de Madera Creek	Middle Fork San Pedro Creek	San Pedro Creek
Elliot Creek	Milagra Creek	San Vicente Creek
Finney Creek	Millbrae Creek	Sanchez Creek
Frenchmans Creek	Mills Creek	Searsville lake
Gazos Creek	O’Neil Slough	Sharp Park Creek
Green Hills Creek	Palmer Gulch	Tahana Gulch
Green Oaks Creek	Pescadero Creek	Tunitas Creek
Hamms Gulch	Pilarcitos Creek	Yankee Jim Gulch
Harrington Creek	Pomponio Creek	
Honsinger Creek		

This countywide FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Change – LOMC), as shown in Table 4, "Letters of Map Change (LOMC)."

Table 4: Letters of Map Change (LOMC)

Community	Case Number	Flooding Source(s)	Effective Date	Type
City of San Carlos	91-09-136P	Pulgas Creek	February 27, 1992	LOMR
City of Belmont City of Redwood	95-09-327P	Belmont Creek	April 21, 1995	LOMR
City of San Carlos	97-09-942P	Pulgas Creek	November 12, 1997	LOMR
City of Belmont	99-09-247P	Belmont Creek	July 15, 1999	LOMR
City of East Palo Alto	00-09-132P	San Francisquito Creek	August 16, 2000	LOMR
City of East Palo Alto	02-09-1426P	Unnamed Ponding Area	October 15, 2002	LOMR
City of Belmont	02-09-1273P	Belmont Creek	November 6, 2002	LOMR
San Mateo County	03-09-0179P	Pescadero Creek	January 31, 2003	LOMR
City of Belmont	04-09-0057P	Belmont Creek	January 13, 2004	LOMR
Town of Hillsborough	04-09-1334P	San Mateo Creek	April 25, 2006	LOMR
City of Brisbane	06-09-BB44P	Guadalupe Valley Drain	July 31, 2006	LOMR
City of East Palo Alto	07-09-1554P	San Francisquito Creek	August 23, 2007	LOMR
City of San Carlos	11-09-1259P	Brittan Creek, Pulgas Creek	February 13, 2012	LOMR
Redwood City	12-09-0320P	Belmont Slough	July 16, 2012	LOMR

2.2 Community Description

San Mateo County is located on the western coast of California, immediately south of the City of San Francisco. It is bounded to the south by Santa Clara and Santa Cruz Counties, to the east by San Francisco Bay and Alameda County, and to the west by the Pacific Ocean.

San Mateo County was formed in 1856 through an act of legislature designed to end corruption in San Francisco. The act combined the governments of the City and County of San Francisco and took 90 percent of the landmass of San Francisco County to form the new county, San Mateo. In 1868, the Pescadero area was annexed from Santa Cruz County to complete the boundaries now in effect, which encloses an area of 553 square miles.

Commerce and commuters came with the construction of the railroad in 1863. While only the wealthy were attracted at first, after the 1906 San Francisco earthquake and fire, refugees in large numbers came in search of inexpensive land on which to rebuild

(Reference 2).

Residential development, with some commercial and light industrial areas, predominates on the eastern side of the county along San Francisco Bay, while agricultural land with some limited residential development predominates on the western side of the county, along the Pacific Ocean. The Santa Cruz Mountain Range, running along the central axis of the county, separates the ocean from the bay. There are vast amounts of undeveloped land or parkland in the mountains and on the ocean side of San Mateo County; however, the potential for growth has been controlled both by the limited access to city jobs provided by poor roads over mountains and by recent coastal control legislation.

There are eight basic landforms in San Mateo County: ocean beach, coastal terrace, coastal foothills, mountains, upper valley, bayside foothills, bayside plains, and bayside marsh and mud flats. Elevations range from sea level to a maximum elevation of 2,572 feet.

In the San Francisco area, earthquakes of destructive magnitude can be expected to develop primarily from movement along two major faults. One of these faults, the San Andreas, extends the length of San Mateo County and forms the upper valley between the mountains and the bayside foothills.

Soils vary with the landform, but are generally moderately to poorly drained. They are derived primarily from the friable, easily eroded, sedimentary formations common on the Oceanside of the San Andreas Fault, or from the Franciscan Formation's mélange of contorted sandstones, cherts, shales, and metavolcanic rocks on the bayside.

Vegetation along the coastal terrace is predominantly agricultural; typically, crops are artichokes, brussel sprouts, and field and hothouse cut flowers. The foothill valleys of both Oceanside and bayside areas foster Arroyo Willow, Bigleaf Maple, Oregon Ash, and California Laurel, which give way to numerous species of oak on the drier slopes. At higher elevations, the mountains are heavily wooded, primarily with Douglas Fir and Coastal Redwood. The native vegetation of the bayside plains area has mostly been displaced by development, but some Coast Live Oak, California Buckeye, and California Laurel have remained. Some of the more common plants found on the marshlands are the Salt Grass, Pickleweed, and California Cord Grass (Reference 3).

Residential, commercial, and industrial development fully occupies the poorly defined riverine floodplains on the bayside of the county. This development continues to spread onto the tidal floodplain of San Francisco Bay. On the Oceanside, with the exception of the old Town of Pescadero, which is located wholly in the floodplain, most development is limited to a few isolated residential buildings.

Along the Pacific coast, Miramar Beach forms the western boundary of the unincorporated community of Miramar. The town and beach are located along the northeastern shore of Half Moon Bay. Surrounding communities are the unincorporated community of El Granada to the northwest and the City of Half Moon Bay to the southeast. The terrain slopes gently upward from sea level to 40 feet. The community is bisected by the Arroyo de en Medio. Miramar is largely located above the floodplain. A low cliff separates the beach from the Town of Miramar. Most of the land held in private ownership has been developed. No new development is proposed at this time. Miramar Beach is exposed to ocean and storm influences from all directions. Wave damage caused by high water levels and storm events has occurred in the past.

Martins Beach is a small community located approximately 30 miles south of San Francisco. The beach, like Miramar Beach, is exposed to ocean hazards from all directions. Beachfront properties are almost exclusively residential. A row of approximately 12 homes skirts the lowest terrace level. One additional row of homes parallels the slope above. Storm events have resulted in complete losses to some of the beachfront properties (Reference 4).

On the bayside of the county, the development on the alluvial plains has encroached on the natural drainages up to the channel banks. Most natural channels that remain have been lined and routed into stormdrains. Runoff that exceeds the capacity of these stormdrains and channels flows eastward toward the bay along the streets and poorly defined remnants of watercourses. Streams on the oceanside of the county have not been subjected to urban development, and there are no improvements along them other than bridges and culverts. Overflow from these streams is generally confined to natural valleys.

Dry, mild summers and moist, cool winters characterize the climate. The mean monthly temperature ranges in August from 58 degrees Fahrenheit to 65 degrees Fahrenheit from the Oceanside to the bayside, while the January mean is near 50 degrees Fahrenheit on both sides. Precipitation averages from 24 inches to 20 inches for Oceanside and bayside, respectively, with approximately 90 percent of the precipitation during the 6-month period from November through April (Reference 5).

2.3 Principal Flood Problems

A summary of the principal flood problems in San Mateo County and Incorporated areas is presented below.

San Mateo County (Unincorporated Areas)

Past records and hydraulic analysis indicate that flooding will be predominately shallow along streams on the bayside of San Mateo County. Spills from the respective channels flow independently through the urbanized areas, usually following the streets, and result in flood depths of less than 1 foot. Occasionally, railroad or highway embankments form barriers, resulting in deeper ponding or sheetflow flooding. Flooding on the oceanside of the county is predominately confined to well-defined riverine valleys, with flood surface extending uniformly across the floodplain.

Major floods have occurred in February 1940, December 1955, April 1958, and January 1973. State and Federal Disasters caused by flooding were also declared in San Mateo County in January 1982, February 1986, February 1995, February 1998, December 2005, March 2006 and most recently January 2008.

The 1955 flood had an estimated recurrence interval of 25 years based on the flow records of San Francisquito Creek and Pescadero Creek. In December 1955, all streams discharging into San Francisco Bay along the eastern side of San Mateo County overflowed their banks, causing inundation of residential and agricultural areas. Flood conditions created by heavy rains were further aggravated by the high tides that prevailed immediately after the main flood peak (Reference 3).

Flooding also occurred on January 16-18, 1973 which caused a 1-percent annual chance tide in San Francisco Bay following a 5-year rainfall runoff event in several streams.

The February 1998 flood event caused record flooding in San Mateo County. Throughout the San Francisco Bay Area this flood event was responsible for 17 deaths as well as $75 million in damages in San Mateo County. The San Francisquito Creek watershed and the Pescadero - Butano Creeks watersheds were particularly hard hit by this flooding event.

<u>Colma Creek:</u> The Daly City stormdrain terminates in a junction structure near the intersection of F Street and El Camino Real. Because the downstream stormdrain has only one-half the waterway area of the upstream stormdrain, the excess flow is forced from the stormdrain through a side channel into the Colma Mobile Home Park on the northwestern side of the intersection, where it ponds.

<u>San Bruno, Crystal Springs, and Lomita Channels:</u> The shallow flooding zones between the Bayshore Freeway and the mainline of the railroad are the result of overland flows from San Bruno Channel and Crystal Springs Channel. These flows merge behind the railroad embankment and eventually cross the railroad tracks as independent flows. Approximately 220 cubic feet per second (cfs) flow into the area north and west of the Crystal Springs Channel and are then pumped into the channel at a rate of approximately 35 cfs. (The Crystal Springs Channel itself has a capacity of 200 cfs and is adequate for the flows reaching it.)

Approximately 740 cfs flow into the area south of the Crystal Springs Channel and west of the Bayshore Freeway. This flow moves southward until it reaches Lomita Channel, where it is then pumped into the Millbrae (High Line) Canal and flows to San Francisco Bay.

The Crystal Springs Channel (200-cfs flow) and the Belle Air stormdrain (750-cfs flow) merge at San Bruno Avenue and flow northeasterly to San Francisco Bay in the San Bruno Channel (1,000-cfs flow), The shallow flooding zone adjacent to the San Bruno Channel is caused by local runoff.

<u>Belmont Creek and Holly Street Channel:</u> Overflows from Belmont Creek in the City of Belmont flow generally toward San Francisco Bay, This overland flow can follow a myriad of routes, and the entire area on the bayside of the railroad tracks is subject to shallow flooding. At the railroad, the overland flow is split and the greater part is diverted to the east. Additional overflow occurs near Harbor Street and Old County Road at a

railroad loading spur. The Bayshore Freeway and Holly Street off-ramp form a barrier to the easterly flow, causing shallow ponding in the Industrial Way area. This ponding has been greatly reduced by recently completed drainage projects.

San Francisquito Creek: San Francisquito Creek overflows at two locations within the City of Menlo Park. The overflow travels eastward toward the bay along streets leading away from the creek channel. At the Bayshore Freeway, this shallow flooding crosses into the county area and continues to flow toward the bay. There are no other spills from San Francisquito Creek into the county area. However, tidal flooding from the bay during the 1-percent annual chance flood can possibly overtop the levee system in the City of East Palo Alto and cause flooding in the residential area adjacent to San Francisquito Creek. Flooding has resulted in this area as a result of inadequate or nonexistent storm water facilities causing local storm waters to be trapped in the area. More information about flooding along this creek is described sections for the Cities of East Palo Alto and Menlo Park below.

Montara, San Vicente, Denniston, and El Granada Creeks: Montara Creek is generally confined to its channel, with overtopping occurring at most culvert crossings. The culvert at Harte Street is heavily silted, forcing the water out of the channel and over the road; a few residences are affected in the process. The embankment at State Highway 1 forms a dam, resulting in deep flooding; however, no existing structures are affected.

San Vicente Creek overflows to the north at Etheldore Street, causing shallow flooding through several existing structures adjacent to State Highway 1 before the overflow returns to the channel along Cypress Avenue. Additional flooding occurs near the ocean front because of inadequate culvert capacity.

Denniston Creek is contained within a well-defined channel until it reaches State Highway 1, where limited culvert capacity results in shallow overflow and ponding southward behind the highway to a low point near Sonora Avenue, where it flows overland to the ocean. The channel through the developed part of Princeton is overgrown and culverts are of limited capacity; however, the resulting flooding is minimal.

El Granada Creek consists of a very shallow channel through the most developed oceanside area of the county. In numerous places, undersized culverts have been placed in the channel, causing general flooding of roads and residences in the vicinity of the creek. This flooding is contained by the remnants of the natural floodplain through the community.

Woodhams, La Honda, Alpine, and San Gregorio Creeks: All creeks in the La Honda community follow in well-defined and often steep channels. Flooding occurs across various stream terraces that are adjacent to culverts or channel restrictions.

On San Gregorio Creek, a combination of meandering channel and numerous private bridges creates similar terrace flooding situations.

Pescadero and Butano Creeks: Pescadero and Butano Creeks are located in a classic river valley formed by the joining of two large drainages. Each creek has a well-defined channel that meanders through a broad floodplain bounded by hills on either side of the valley. This broad floodplain has little gradient and, therefore, is inundated by overflows from Pescadero Creek and the joining flows of Butano Creek. Most of the Town of Pescadero is built in this floodplain and is inundated during floods. The U.S. Army Corps of Engineers (USACE) estimated the cost of damage in Pescadero caused by the December 1955 flooding of roads, bridges, and 15 homes to have been $352,000, including rescue and emergency efforts (Reference 6).

The 1998 Flood event brought record floods to this watershed. Over 6 inches of rain fell over two days and a peak flow of 10,600 cfs at the USGS gage on Pescadero Creek. High water marks taken after the flood show a flood elevation of 14.6 feet just downstream of the Pescadero Creek Road bridge.

Pacific Ocean: Flooding from the Pacific Ocean at Miramar and Martins Beaches is typically associated with the simultaneous occurrence of very high tides, large waves, and storm swells during the winter. As a result, ocean-front development has not been compatible with the natural instability of the shoreline and the intense winter weather.

Tsunami (sea waves generated from oceanic earthquakes, submarine landslides, and volcanic eruptions) create some of the most destructive natural water waves. As tsunami waves approach shallow coastal waters, wave refraction, shoaling, and bay resonance amplify the wave heights.

Storm centers from the southwest produce the type of storm pattern most commonly responsible for the majority of the serious coastal flooding. The strong winds and high tides that create storm surges are also accompanied by heavy rains. In some instances, high tides back up riverflows, which cause flooding at the river mouths.

The most severe storms to hit the California coast occurred in 1978 and 1983, when high water levels were accompanied by very large storm waves.

In January 1978, a series of storms emanated from a more southerly direction than normal; consequently, some of the better-protected beaches were also damaged. Jetties and breakwater barriers in the area were overtopped and in some cases undermined. Direct wave damage occurred to many beachfront homes. Accelerated erosion coupled with saturated ground conditions and rain weakened the foundations of homes located on the top of beach bluffs. Seawalls and temporary barriers failed to protect beach front properties from the ravages of the 1978 storms.

The winter of 1983 brought an extremely unusual series of high tides, storm surges, and storm waves (Reference 4) which caused considerable damage along the northern California coast. More information about Pacific Ocean flooding is described in the sections for the Cities of Half Moon Bay and Pacifica below.

City of Burlingame

Rainfall is the principal cause of flooding in Burlingame. A storm of significant magnitude occurred on January 16 through 18, 1973. As measured at the Colma Creek stream gage 5 miles to the north, the resulting flood had a recurrence interval of approximately 15 years. Major storms also occurred in 1955, 1958, 1967, 1971, and 2002.

Stream segments above El Camino Real consist of natural channels, partially improved channels, and various culverts. Most of these are inadequate for conveying a 1-percent annual chance flood event. Major flood damage has not occurred because streets parallel to the streams prevent surface flows from entering them. When the streamflows encounter an undersized culvert, the overflow proceeds along the almost-level cross streets to the steeper parallel streets leading to El Camino Real.

From El Camino Real to the railroad, the streams, with the exception of Mills Creek, have been obliterated by development and the flows have been routed through underground stormdrains. Because of the low topographic relief and an abundance of streets able to carry floodflows, 1-percent annual chance flooding throughout this area is predominantly shallow. The railroad embankment causes ponding in the vicinity of Grove Avenue and California Drive and in the vicinity of Sanchez Avenue and California Drive.

From the railroad to U.S. Highway 101 (the Bayshore Freeway), Mills Creek and Easton Creek are carried in improved channels into which much of the local drainage must be pumped. The other study streams continue to San Francisco Bay in underground stormdrains. None of these facilities is adequate to convey the 1- percent annual chance flood event. Except for the primary stormdrains that extend beyond the Bayshore Freeway, flooding sources become unidentifiable below the railroad embankment, mingling, spreading, and ponding over a large area.

High Tides in San Francisco Bay can cause flooding between the Crown Plaza Hotel and the northbound US Highway 101 off-ramp. During the 1973 storm, bay tides approached the estimated 1-percent annual chance tidal level. This produced shallow flooding along Bayshore Highway between Mills Creek and El Portal Canal. To the south, existing levees along San Francisco Bay and Burlingame Lagoon protected that area from up to 7 feet of flooding.

City of East Palo Alto

Flooding within the City of East Palo Alto is caused by heavy rainfall which generally occurs during winter and early spring and by high tides associated with storms.

Major floods have occurred in February 1940, December 1955, April 1958, January 1967, January 1973, February 1986, 1989 and most recently February 1998. The 1955 flood had an estimated recurrence interval of 25 years.

In December 1955, San Francisquito Creek overtopped its banks at two locations west of East Palo Alto in the adjacent City of Menlo Park. The perched nature of the creek does not allow spilled water to flow back into the channel. As floodwaters rise above the banks, they flow northward and eastward towards San Francisco Bay. This shallow flooding inundates a portion of East Palo Alto from the Bayshore Freeway northward past the corporate limits near Alberni Street.

The flooding in January 1973 was primarily caused by high tides in San Francisco Bay, concurrent with a 5-year storm. The maximum tide level was estimated to have a 1-percent annual chance recurrence interval. The tides inundated vast areas of low relief along the bayfront and submerged streets in the University Village area.

1-percent annual chance floodflow in San Francisquito Creek is contained in the channel in East Palo Alto. However, tidal flooding from the bay circumvents the incomplete levee system near the bay and causes flooding in the residential area adjacent to San Francisquito Creek on the east side of the city.

The 1989 flood event placed Bell Street Park underwater.

On February 2-3, 1998, San Francisquito Creek overbanked at numerous locations in San Mateo and Santa Clara Counties, which lead to widespread flooding in the Cities of East Palo Alto, Palo Alto and Menlo Park. Approximately 1,700 homes were damaged at a cost of $28 million. The flowrate at the USGS streamflow station near the Stanford golf course was estimated by the USGS to be between 6,500 cfs and 8,000 cfs. This is the highest flowrate ever recorded at that station since its installation in the 1930s. The previous historic record was 5,560 cfs in 1955. Commuting and transportation were severely limited due to the closure of the Bayshore Freeway (US Highway 101) and other major arteries. USGS records indicate that this flood was a 2-percent annual chance flood.

City of Half Moon Bay

Flooding from the Pacific Ocean at Half Moon Bay is typically associated with the simultaneous occurrence of very high tides, large waves, and storm swells during the winter. As a result, ocean-front development has not been compatible with the natural instability of the shoreline and the intense winter weather.

Tsunami (sea waves generated from oceanic earthquakes, submarine landslides, and volcanic eruptions) create some of the most destructive natural water waves. As tsunami waves approach shallow coastal waters, wave refraction, shoaling, and bay resonance amplify the wave heights.

Storm centers from the southwest produce the type of storm pattern most commonly responsible for the majority of the serious coastal flooding. The strong winds and high tides that create storm surges are also accompanied by heavy rains. In some instances, high tides back up riverflows, which causes flooding at the river mouths.

The most severe storms to hit the California coast occurred in 1978 and 1983, when high water levels were accompanied by very large storm waves.

In January 1978, a series of storms emanated from a more southerly direction than normal; consequently, some of the better protected beaches were also damaged. Jetties and breakwater barriers in the area were overtopped and in some cases undermined. Direct wave damage occurred to many beach-front homes. Accelerated erosion coupled with saturated ground conditions and rain weakened the foundations of homes located on the top of beach bluffs. Seawalls and temporary barriers failed to protect beach-front properties from the ravages of the 1978 storms.

Town of Hillsborough

The past history of flooding on San Mateo Creek indicates that flooding generally occurs during the winter or early spring.

Major floods occurred in February 1940, December 1955, April 1958, and January 1973. The 1955 flood was the largest recorded for the periods 1930 to 1941 and 1950 to 1991 based on the flow records of San Francisquito Creek, located 5 miles south of the City of San Mateo (Reference 7).

Hydraulic analyses indicate that during a 1-percent annual chance flood event, San Mateo Creek will overflow its channel in the vicinity of El Camino Real and that this spill would flow through yards and streets, resulting in shallow flooding with average depths of less than 1 foot. This flooding would collect behind the San Mateo levees before being pumped back into the bay. The analyses also indicate that San Mateo Creek will overflow its channel in the vicinity of Highway 101, resulting in flooding of the area lying east of the freeway.

City of Menlo Park

Flooding within Menlo Park is caused by heavy rainfall which generally occurs during the winter and early spring and by high tides associated with storms.

Major floods, since the development of the city, have occurred in February 1940, December 1955, April 1958, January 1967, January 1973 and most recently in February 1998.

The 1955 flood has an estimated recurrence interval of 25 years. During this flood, San Francisquito Creek overtopped its hanks at Middlefield Road and Pope Street, causing evacuation of residents along the creek. The perched nature of the creek does not allow spilled water to flow back into the channel. As floodwaters rise above the hanks, they will flow away from the channel and toward the bay through Menlo Park and the City of East Palo Alto.

The flooding in January 1973 was primarily caused by high tides in San Francisco Bay, concurrent with a 5-year storm. The maximum tide level was estimated to have a 1-percent annual chance recurrence interval. The tides inundated vast areas of low relief along the bay front that are not protected by levees and along Haven Avenue where existing levees were overtopped.

Flooding due to rainfall in the areas of low relief close to the bay is aggravated by high tides which back up the storm-drain network and drainage of storm runoff. Many of the houses in these areas are built with the first floor slab on grade; thus, flooding with depths of less than I foot can enter these houses. The majority of Atherton Creek within Menlo Park is underground and therefore, flooding has been limited to broad shallow street flow and local ponding. This is due to extensive flooding and resulting flow reduction that occurs upstream of the corporate limits.

City of Millbrae

Rainfall is the principal cause of flooding in Millbrae. During the storm of January 1973, as measured at the Colma Creek stream gage 4 miles to the north, the resulting flood had a recurrence interval of approximately 15 years. Major storms also occurred in 1956, 1958, 1967, and 1971. The most recent storm of significance occurred during the winter 1998, causing flooding around the Westin and Clarion hotels and landslides in the areas of Sleepy Hollow, Clearfield and Morningside.

Because of floodplain encroachment, there are various areas in Millbrae which have historically been subjected to local flooding, including Helen Drive west of Laurel Avenue and Landing Lane. El Camino Real is generally subject to flooding wherever it crosses a historic stream channel. In the absence of well- defined drainage channels, these areas of local flooding are the areas which are most severely affected by a major rainfall event.

During such an event, when local storm-drain capacities are exceeded, floodflows make their way toward San Francisco Bay by various overland routes. However, the embankment of the railroad forms an effective barrier to this eastward movement of water, In the vicinity of Landing Lane, a high railroad embankment and inadequate culverts cause appreciable flooding. During the 1-percent annual chance flood event, this ponding behind the railroad embankment would provide enough storage to reduce significantly the downstream ponding where Lomita Channel (Lornita Creek) is pumped into Millbrae (High Line) Canal. This pump/storage relationship at Millbrae Canal would be extremely sensitive to any future upstream improvements to relieve the flooding situation at Landing Lane. Also important would be any change in the pump/storage relationship caused by encroachment upon the undeveloped area adjacent to Lomita Channel upstream of the pump station. Development upon this storage area could substantially reduce its effectiveness.

Assuming that the existing stormdrains operate properly, the flooding from a major storm would be shallow and localized for the remaining areas of Millbrae.

There is no indication that San Francisco Bay caused significant tidal flooding problems within the City of Millbrae. The 1973 storm resulted in elevations approaching the estimated 1-percent annual chance tidal level.

City of Pacifica

Flooding in Pacifica may be caused by unusually heavy or prolonged rainfall, tsunami, storm surge, and high tides.

In October 1972, San Pedro Creek overflowed, causing an estimated 40 acre-feet of ponding, with depths of up to 4 feet in the Linda Mar area of Pacifica (Reference 8). This storm had an estimated recurrence interval of 15 years. The Linda Mar sump area is a residential area extending northward from the vicinity of Linda Mar Boulevard, and is adjacent to State Highway 1.

Flooding along Pacifica's coast is typically associated with the simultaneous occurrence of very high tides, large waves, and storm swells during the winter. As a result, oceanfront development has not been compatible with the natural instability of the shoreline and the intense winter weather conditions.

Tsunami (sea waves generated from oceanic earthquakes, submarine landslides, and volcanic eruptions) create some of the most destructive natural water waves. As tsunami waves approach shallow coastal waters, wave refraction, shoaling, and bay resonance amplify the wave heights.

Storm centers from the southwest produce the type of storm pattern most commonly responsible for the majority of the serious coastal flooding. The strong winds and high tides that create storm surges are also accompanied by heavy rains. In some instances, high tides back up riverflows, which causes flooding at the river mouths.

The most severe storms to hit the California coast occurred in 1978 and 1983, when high-water levels were accompanied by very large storm waves.

In January 1978, a series of storms emanated from a more southerly direction than normally occurs; consequently, some of the better-protected beaches were also damaged. Storm incidents occurred throughout the study area.

Jetties and breakwater barriers were overtopped and in some cases undermined. Direct wave damage occurred to many beachfront homes, especially in the more populated beachfront areas. Accelerated erosion coupled with saturated ground conditions and rain weakened the foundations of homes on the top of beach bluffs in Pacifica. Seawalls and temporary barriers failed to protect beachfront properties from the ravages of the 1978 storms.

The winter of 1983 brought a very unusual series of high tides, storm surges, and storm waves (Reference 4).

Town of Portola Valley

Corte Madera Creek drainage through the central portion of Portola Valley presents the greatest potential for flooding of residences.

In addition, Sausal Creek drainage includes one small portion, west of Portola Road and north of Westridge Drive, which is subject to inundation because the stormdrains and culverts do not have an adequate capacity.

City of Redwood City

The history of flooding on the streams in Redwood City indicates that flooding generally occurs during the winter or early spring. The greatest flooding occurs when a large frontal storm coincides with an extreme high tide.

The major floods, since development, have occurred in February 1940, December 1955, April 1958, and January 1973. The 1955 flood was the largest recorded since 1851 with an estimated recurrence interval of 25 years, based on the flow records of San Francisquito Creek, located 4 miles south of the city.

Redwood Creek overflowed its banks during the 1940, 1955, and 1958 floods, causing evacuation of some residents and inundation of and damage to many downtown businesses. The most critical overflow point is at Middlefield Road where the creek enters an underground culvert. This culvert is subject to backwater effects from high tides, thus reducing its ability to carry peak storm runoff. The overflow waters sheetflow through the central downtown area, following streets and ponding in low points.

Cordilleras Creek has experienced varying degrees of flooding during storms, due mostly to debris- clogged culverts. The most severe problem along Cordilleras Creek is the limited capacity of El Camino Real and railroad culverts. Water overflowing at these culverts is diverted behind the railroad embankment into the adjacent areas of San Carlos and Redwood City.

Flooding from Atherton Creek is limited to broad shallow street flow and local ponding. This is due to extensive flooding and resulting flow reduction that occurs upstream of the corporate limits. Much of this area of low relief just south of Bayshore Freeway and bounded by the Woodside Road and Marsh Road interchanges has experienced historic shallow flooding due to local drainage problems during storms occurring simultaneously with high tides. The bayfront area of Redwood City is subject to flooding northeast of Bayshore Freeway during extreme high tides. This occurred during January 1973, when an estimated 1-percent annual chance tide concurrent with a 5-year storm inundated the numerous trailer parks in that area up to 4 feet deep.

The Redwood Shores development, located in northeastern Redwood City, is surrounded by a perimeter levee system. The crest of some levee reaches adjacent to areas not yet developed are at, or a few tenths of a foot lower than, the 1- percent annual chance tide elevation. This would cause the tide to overflow these reaches during the peak of the 1-percent annual chance tide. However, due to the short duration of that crest, flooding would be limited and shallow, provided that the levees themselves do not fail from the overtopping.

Many other areas within Redwood City have experienced local flooding problems due to inadequate stormdrains or ponding in local depressions. These problems are common to the flat areas of the city, which lack a natural drainage slope. These areas were not studied.

City of San Carlos

In recent years, flooding in the City of San Carlos has been reported during the general flood periods of 1955, 1958, 1962, and 1972, particularly during periods of high tides on San Francisco Bay. Old County Road in the vicinity of Pulgas Creek, and areas between Old County Road and Bayshore Freeway, adjacent to Pulgas Creek and Cordilleras Creek, are among areas inundated in past years. East of the railroad, flooding has occurred in the San Carlos business are a along El Camino Real between Pulgas Creek and Cordilleras Creek. The upper reaches of Pulgas Creek between Fay Street and the corporate limits have been inundated in past years. Other isolated areas of flooding have been reported, particularly along Brittan Creek; but it appears to have been caused by debris blockages at culvert entrances. No documented history of flooding in San Carlos has been found in the literature search, and the flooding described was based on reports from city officials and local residents.

Flooding can occur in San Carlos due to the estimated 1-percent annual chance flood and 0.2-percent annual chance flood discharges. Flooding within San Carlos may be considered to be of three types.

1. Overflow of stream channels with the overflow returning to the channel at some downstream point. This occurs most generally in the southwestern part of the community, where gradients are relatively steep.

2. Overflow of stream channels with the flood waters not returning to the channel, but following unpredictable routes and constituting sheetflow moving in the direction of the bay. Such sheetflow occurs most frequently in the more highly developed residential, commercial, and industrial areas which lie somewhat lower, and have lesser gradients, than the areas subject to flooding of the first type.

3. Ponding of flood waters behind road embankments (railroad and Bayshore Freeway) where openings are inadequate for the extreme floods, and where gradients are likely to be so slight, at elevations near sea level, that flowageways cannot be provided.

Except for the last of these types, overbank flooding comes about because of encroachment on the channel or, in some reaches, because of restrictions such as channel confinement or inadequate bridge openings.

Along Cordilleras Creek from Bayshore Freeway to Industrial Road, inundation of adjacent areas will be caused by ponding of flood waters to the southwest of Bayshore Freeway. The ponding in turn is caused both by overflows from Cordilleras and Pulgas Creeks and the limited capacity of the Bayshore Freeway culverts during periods of high tides in San Francisco Bay. Southwest of Industrial Road, to the area where the creek leaves the study area, no flooding is expected to occur within the corporate limits. Cordilleras Creek waters passing through the railroad culvert can exceed the capacity of the adjacent Old County Road culvert , leave the channel, and flow (sheetflow) to the ponding area southwest of Bayshore Freeway. West, of the railroad, the estimated 1-percent annual chance flood discharge can exceed the capacity of the El Camino Real culvert; a major portion of the resulting floodwaters would flow northwest (sheetflow) to a ponding area southwest of the railroad. Ponding in this area is caused by overflow waters from Brittan and Pulgas Creeks and the limited flowageways through the railroad. The estimated 0.2-percent annual chance flood discharge can exceed the channel capacity of Cordilleras Creek at a point approximately 400 feet southwest of El Camino Real, with the overflow going to the same ponding area. Upstream (southwest) of this overflow point to the corporate limits, Cordilleras Creek will contain all discharges considered.

The Brittan Creek channel joins Pulgas Creek immediately northeast of Old County Road near Brittan Avenue. From this confluence to the railroad, flooding is in the form of sheetflow when the 1-percent annual chance and 0.2-percent annual chance ponding elevations (southwest of the railroad) exceed the top of the railroad embankment. Southwest of the railroad, Brittan Creek parallels El Camino Real to a point near Howard Avenue where it turns southwest and crosses El Camino Real. Throughout this reach of the creek, excess waters from Pulgas, Brittan, and Cordilleras Creeks pond behind the railroad. Southwest of the ponded area to a point near Elm Street , flooding in the form of sheetflow occurs adjacent t o Brittan Creek when estimated study discharges exceed the capacity of the Elm Street culverts, with floodwaters flowing to the ponding area. No flooding will occur from Elm Street to a point approximately 700 feet northeast of Cordilleras Avenue. However, from this point to immediately southwest of Cordilleras Avenue, flooding can be expected from the estimated 0.2-percent annual chance flood discharge. From Cordilleras Avenue to a point 600 feet to the southwest, flooding can be expected from both the estimated 1-percent annual chance and 0.2-percent annual chance flood discharges. All reaches of Brittan Creek southwest of this point will contain all discharges considered.

A substantial portion of the upper Brittan Creek flows are diverted near Milano Way to a recently completed stormdrain along Brittan Avenue. The drain was also designed to intercept flows from that portion of .the drainage basin lying northeast of Milano Way and northwest of Brittan Avenue (Reference 9). It is estimated that, in the vicinity of Brittan Avenue and Cedar Street, the accumulated inflows can exceed the capacity of the stormdrain; excess waters would flow overland to the ponding area near the railroad. The topography in this overflow area prevents excess waters from flowing to the Brittan Creek channel.

Tidal flooding from the estimated 1-percent annual chance and 0.2-percent annual chance tides in San Francisco Bay will occur along Pulgas Creek northeast of Bayshore Freeway. To the southwest of Bayshore Freeway, the previously described ponding area extends along Pulgas Creek to a point approximately 400 feet southwest of Industrial Road. From this point t o the railroad, and then northwest to Commercial Street, flooding in the form of sheetflow can occur, the causative factors being overflow at the railroad from the ponding area to the southwest, waters passing through the railroad culverts overflowing the culverts parallel to and under Old County Road, and the improved Pulgas Creek channel to the east. Southwest of the railroad to the area of Laurel Street and Arroyo Avenue, flooding can occur due t o the general ponding area created by overflows from Pulgas, Brittan, and Cordilleras Creeks. Pulgas Creek is confined to stormdrains under Arroyo Avenue. The original drain extends up to Walnut Street and joins the channel to the northwest while the more recent drain (1974) extends to Elm Street and then joins the open portion of the channel. With the addition of the new drain, flooding from the study discharges is not expected to occur along that portion of the channel from Arroyo Avenue to Chestnut Street. Along Pulgas Creek, south of Chestnut Street to the area approximately 200 feet west of Cedar Street, overbank flooding in the form of sheetflow can occur. Channel constriction by the Cedar Street culvert and topography along the south bank create this condition. Flooding is not expected to occur from here to a point 350 feet east of Cordilleras Avenue. However, to the west and near Alameda de Las Pulgas, flooding in the form of sheetflow can be expected along the right bank (south side) of the creek. The flooding begins at both the Cordilleras Avenue and Alameda de Las Pulgas culverts when estimated flood discharges exceed the capacities of these culverts. Upstream (west) of this area, estimated discharges will be contained within the channel to an area approximately 150 feet downstream (northeast) of Fay Avenue. From this point to the corporate limits, on both Pulgas Creek and Devonshire Branch, the channels have been confined in conduits to facilitate residential development. The conduits cannot pass the estimated 1-percent annual chance and 0.2-percent annual chance flood discharges, and flooding of adjacent residential properties will occur.

No flooding is expected along that reach of the Harbor Industrial District Channel east of Bayshore Freeway. North of Holly Street and west of Bayshore Freeway ponding will occur as a result of the inability of the Harbor Industrial District Channel culvert under Bayshore Freeway to pass the larger floodflows.

City of San Mateo

The past history of flooding on San Mateo Creek indicates that flooding generally occurs during the winter or early spring.

Major floods occurred in February 1940, December 1955, April '1958, and January 1973. The 1955 flood was the largest recorded for the periods 1930 to1941 and 1950 to 1991 based on the flow records of San Francisquito Creek, located 5 miles south of the City of San Mateo (Reference 7).

Hydraulic analyses indicate that during a 1-percent annual chance flood event, San Mateo Creek will overflow its channel in the vicinity of El Camino Real and that this spill would flow through yards and streets, resulting in shallow flooding with average depths of less than 1 foot. This flooding would collect behind the San Mateo levees before being pumped back into the bay. The analyses also indicate that San Mateo Creek will overflow its channel in the vicinity of Highway 101, resulting in flooding of the area lying east of the freeway.

City of South San Francisco

Rainfall is the principal cause of flooding in South San Francisco, The most significant flooding occurred on October 11, 1972, and January 16 and 18, 1973. The 1972 flood inundated an area of approximately 230 acres and resulted in $3,083,000 in damages (Reference 10). The floods of 1973 inundated an area of approximately 180 acres and caused $1,176,000 in damages (Reference 10). The discharges associated with these floods were 2540 cubic feet per second (cfs), 2810 cfs, and 2460 cfs (Reference 10). These discharges correspond to an estimated recurrence interval of 10 to 20 years

Flooding also occurred in 1955, 1958, and 1971.

Colma Creek has historically been a source of flooding in South San Francisco. The western portion of the Colma Creek basin is composed of easily erodible marine sediments containing a high percentage of sand (Reference 11). Because of the higher stream velocities in the upper segments of Colma Creek, these sediments are transported to within 2 miles of the outlet at San Francisco Bay. It is in this area that the stream gradient diminishes, tidal flow becomes noticeable, and the heavier sand is deposited in the channel. Inadequate channel size, further reduced by sediment deposition, has resulted insignificant flood damage in the lower portion of Colma Creek.

The only riverine flooding situation exists on Colma Creek between Hickey Boulevard Branch and the upstream corporate limits. Where Hickey Boulevard Branch joins Colma Creek, the channel has adequate capacity and makes an S- turn across the floodplain. This allows the channel to intercept most of the overbank flow, except where prevented by the channel levee. Approximately 1600 feet downstream from this point, a railroad culvert forces any flows in excess of 1500 cfs from the channel. These flows remain separated from the channel by levees or flashboards until they reach the vicinity of Oak Avenue and Mission Road. For a short distance (approximately 200 feet) in the vicinity of Oak Avenue and Mission Road, some of the overbank flow would re-enter the channel. However, from this point to Orange Avenue, the overbank and channel flows remain essentially separate and independent.

At Orange Avenue, a large steel waterline under the bridge reduces its capacity to approximately 1700 cfs causing the channel overflow at this -point to join the separated overbank flow. The combined flow then crosses Orange Avenue, with flooding primarily on the north side of Colma Creek. Between Orange Avenue and Spruce Avenue, the overbank flow gradually returns to the channel. Total interception is prevented by the levee effect of the road along the channel bank.

The channel between Spruce Avenue and Linden Avenue is not adequate for the 1-percent annual chance flood event, and because of a 3-foot-high concrete floodwall on either side of the channel, a separated flow condition exists.

A short distance below Linden Avenue the main line of the railroad crosses Colma Creek. The culvert under the railroad is not adequate, and the railroad embankment traps the overflow, causing ponding over a wide area.

Between the railroad embankment and the Produce Avenue Bridge, the channel overflows toward the south. This flow joins the flow over the railroad tracks forming an area of wide, shallow flooding. This flow is prevented from returning to the creek by floodways along the channel or the general topography of the area, until it reaches a point downstream of Utah Avenue.

Flooding in South San Francisco is aggravated by the existing channel floodwalls and levees, which, although built to protect the floodplain area from lesser floods, would prevent the 1-percent annual chance overbank flows from re-entering the channel.

Town of Woodside

Ninety percent of the annual rainfall falls between November and April. Due to this seasonal concentration of rainfall, excess water causes flooding and ponding behind culverts.

Drainage problems occur during heavy rainfall. In 1955, and again in 1957, some areas in Palo Alto, to the south, had to be evacuated.

Many stream crossings are simply roadfill over culverts which can act as temporary dams during major runoff events. Except in those areas immediately upstream from restrictive bridges and culverts, there is little overbank flow.

The only manmade feature with an appreciable effect on the passage of floodflows through Woodside is Searsville Lake, even though the lake is actually outside of and downstream from the corporate limits of the community. Searsville Lake is formed by a dam on Corte Madera Creek. During high flows, the lake level rises to flood a delta area in Woodside, south of the intersection of Mountain Home Road and Sand Hill Road. Corte Madera, Sausal, Martin, and Alambique Creeks converge in the delta area after leaving their steeper and more distinct upstream channels where they are less susceptible to overbank flooding. In low areas of Alambique Creek and Corte Madera Creek, sheetflow, or shallow, unpredictable overbank sheet flooding occurs.

Cities of Belmont, Brisbane, Daly City, Foster City and San Bruno and the Towns of Atherton and Colma

No other flooding problems beyond those described previously are known for these communities.

2.4 Flood Protection Measures

San Mateo County (Unincorporated Areas)

Flood protection measures on the streams draining into San Francisco Bay are generally limited to channel lining; bridge, culvert, and levee construction; and bank and erosion protection. These improvements are usually not adequate to contain 1-percent annual chance floodflows. The drainage basins of Colma Creek, and San Bruno Channel are classified as special flood-control districts for tax and improvement purposes.

The San Francisquito Creek Joint Powers Authority (SFC-JPA) brings together the Cities of East Palo Alto, Palo Alto and Menlo Park with the San Mateo County Flood Control District and the Santa Clara Valley Water District. The SFC-JPA is in watershed management for the San Francisquito Creek Watershed; including planning flood control measures. In 2011 the SFC-JPA has begun capital improvement projects for the lower reach of San Francisquito Creek between US Highway 101 and San Francisco Bay.

A drainage project being completed in Redwood City on the bayside of the Bayshore Freeway/Holly Street interchange will also reduce flooding in the upstream county area along Industrial Way. Improvements will consist of enlarged culverts under the Bayshore Freeway and enlarged and extended channels draining into a pump-controlled flood detention basin, This project has been designed to handle 1-percent annual chance flood flows.

Levees have been constructed for various other areas along the bayfront, Many of these levees, originally built to form salt evaporation ponds, are still privately owned and of questionable strength. Others, including those in the City of East Palo Alto, have incomplete perimeters and/or inadequate heights. Nevertheless, these levees would reduce the depth and extent of flooding during a 1-percent annual chance tide.

Since the storm and floods of the winter of 1981-1982, a program has been undertaken to remove debris and other possible obstructions to flow in Pescadero, Butano, and Gazos Creeks. No flood protection measures have been taken for any of the other Oceanside streams.

Boulder riprap was installed along Miramar Beach in 1983. Its utility in preventing flood damage to beachfront homes is not known. A timber bulkhead was constructed to protect the beach terrace in front of three homes at Martins Beach. The date of construction is unknown; however, this bulkhead appears to have been effective flood protection during recent storms (Reference 4).

City of Burlingame

The improvements in Burlingame consist of various closed conduits and improved earth or concrete- lined channels. In addition, there are three pumping stations which aid in draining some of the low-lying areas. The area southwest of the Bayshore Freeway between Broadway and El Portal Canal is served by two pump stations. One is on Marsten Road pumping into Easton Creek, and the other is on Rollins Road pumping into El Portal Canal. A third pump station is on Cowan Road and pumps into El Portal Canal. It serves the area between the Bayshore Freeway and San Francisco Bay, from El Portal Canal to Mills Creek.

El Portal Canal is a concrete-lined leveed channel. While the levees increase its capacity, they also prevent local inflow; thus, the only flows to reach it either are pumped in or arrive through stormdrains from upstream areas. The channel is adequate for these flows.

Some minor floodplain management is in effect within the City of Burlingame.

City of East Palo Alto

An incomplete system of levees has been built along the bayfront, but there are numerous low points and openings where tides can over top or bypass the levees. Nevertheless, these levees would reduce the depth and extent of flooding during a 1-percent annual chance tide.

Along San Francisquito Creek, a levee built of compacted soil and bay mud extends from San Francisco Bay upstream to a point adjacent to the intersection of Jasmine Way and Daphne Way, This levee is under the jurisdiction of the San Mateo Flood Control District. Upstream of the levee, improvements have been made to the channel at various places. These improvements include channel widening, riprap, and a concrete wall which supports the creek bank between Bayshore Freeway and Newell Street. All of these improvements failed during the 1998 flood event.

The City of East Palo Alto has joined the SFC-JPA to help manage the San Francisquito Creek watershed. The City has also joined the Community Rating System and has a rating of “8”. The City of East Palo Alto is also improving storm drains throughout the City to reduce the risk of flooding.

City of Foster City

A levee system protects Foster City from high tides in San Francisco Bay and was accredited by FEMA as providing protection against the 1-percent annual chance flood in July 2007. This system ties into San Francisco Bay levee system in the City of San Mateo which was accredited by FEMA a as providing protection against the 1-percent annual chance flood in early 2012.

City of Half Moon Bay

Boulder riprap was installed along the coastal study area in 1983. Its utility in preventing flood damage to beach-front homes is not known (Reference 4).

Town of Hillsborough

Flood-protection measures along San Mateo Creek consist mainly of cleaning and improving the creek channel.

City of Menlo Park

San Mateo and Santa Clara counties have combined efforts to accomplish improvements along San Francisquito Creek. Berms were constructed at Middlefield Road and Pope Street to increase the available headwater for these crossings, and to stabilize and increase the height of the banks along the creek. These improvements, however, have no effect on the 1-percent annual chance and 0.2-percent annual chance floodflows.

An incomplete system of levees has been built along the bayfront, but there are numerous low points and openings where tides can overtop or bypass the levees. These structures do not affect the 1-percent annual chance and 0.2-percent annual chance floodflows.

There are no flood control structures along Atherton Creek within Menlo Park. San Mateo County has a flood control zone for the entire San Francisquito Creek drainage basin. The county has jurisdiction over the city in terms of maintenance and channel improvement. Menlo Park itself enforces no floodplain management.

<u>City of Millbrae</u>

Millbrae (High Line) Canal and El Portal Canal are lined channels extending from San Francisco Bay to the main line of the railroad. Both of these canals are capable of carrying the volume of runoff that reaches them from the existing stormdrain systems. Since they are both leveed canals, runoff from adjacent areas must be pumped into them. These two channels are the only drainage outlets for Millbrae.

Lomita Channel is an improved earth channel which extends from the main line of the railroad and terminates at Millbrae (High Line) Canal and U.S. Highway 101 (Bayshore Freeway). It functions as a pumped storage outlet for Lornita Creek.

The areas upstream of these channels depend upon underground stormdrains for flood protection. These stormdrains, constructed over the years to relieve local drainage problems, serve to mitigate to a large degree the flooding from major rainfall events.

There is no floodplain management in effect within the City of Millbrae.

<u>City of Pacifica</u>

The flood protection measures in Pacifica consist of the stormdrain in Oddstad Boulevard, upstream of Terra Nova Boulevard, and pumps for the Linda Mar sump area, which can discharge 160 cubic feet per second (cfs) of the shallow flooding from San Pedro Creek.

Calera Creek was recently realigned and flooding was confined to the new channel.

Flood protection measures taken along the Pacific coast have proven ineffective in preventing erosion (Reference 4).

<u>Town of Portola Valley</u>

There are no flood protection measures in existence which would affect flooding in the Town of Portola Valley.

City of Redwood City

A major stormdrain and channel improvement project in Redwood City was undertaken in 1967 on Redwood Creek and selected tributaries. This work consisted of extending and enlarging the stormdrain network, adding pumping stations, and concrete-lining the creek channels. No work was done to improve the numerous bridges and culverts along the streams. The improvements were designed to handle a 30-year storm. However, as they serve to concentrate runoff water, they could aggravate flooding when the design capacity is exceeded.

No improvements have been made on Cordilleras Creek or the bayfront levees.

The Redwood Shores development has a system of perimeter levees. These levees were accredited by FEMA in January 2008 as providing protection against the 1-percent annual chance flood. This levee system also ties into the levee system that protects the San Carlos airport.

City of San Carlos

All areas east of the Bayshore Freeway, with the exception of a small area along the right bank of Pulgas Creek immediately east of the freeway, are protected from tidal flooding by levees and by pumps located at the San Carlos Airport. This levee system was accredited by FEMA in January 2008 as providing protection against the 1-percent annual chance flood. The pumping station on Pulgas Creek at Industrial Road removes floodwaters from street conduits in the area; however, it cannot relieve flooding from the more extreme events.

A major stormdrain under Brittan Avenue (Reference 9) diverts a part of the Brittan Creek flow at Milano Way and conveys it back to Brittan Creek about 1.5 miles downstream at El Camino Real. The stormdrain was also intended to intercept storm runoff from that part of the drainage area north of Brittan Avenue.

A similar storm drain has been constructed from the intersection of Pulgas Creek and Elm Street to El Camino Real. An additional conduit parallels the existing Pulgas Creek conduit along Old County Road. Culverts have been constructed at the Old County Road and Industrial Road crossings on Pulgas Creek. These improvements, plus channel cleaning and levee improvements along the reach of Pulgas Creek between Old County Road and Industrial Road, are intended to reduce flooding from the estimated 30-year flood. The effect of these improvements on larger floods was included in the computations used in this study and in determining the area and depth of flooding shown on the rate maps.

City of San Mateo

Flood-protection measures along San Mateo Creek consist mainly of cleaning and improving the creek channel. The City of San Mateo has constructed a levee system that runs along the bay front horn the mouth of San Mateo Creek to Coyote Point

Park. Another levee extends from Coyote Point west to Highway 101. Levees extend from the San Francisco Bay to Norfolk Street along both banks of San Mateo Creek. A levee is not required along the bay east of San Mateo Creek as the ground is high.

The levees along the south bank of San Mateo Creek were accredited by as providing protection against the 1-percent annual chance flood in early 2012. Levees along the San Francisco Bay were accredited as providing protection against the 1-percent annual chance flood in early 2012. This levee system ties into the levee system which protects the City of Foster City. The Foster City levee system was accredited by FEMA as providing protection against the 1-percent annual chance flood in July 2007.

City of South San Francisco

A number of improvements have been made on Colma Creek by the San Mateo County Flood Control District. These improvements have been designed to accommodate a 50-year event with an adequate amount of freeboard. However, during a 1-percent annual chance flood event, flooding would still occur as a result of the remaining inadequate structures and channel capacities.

The bridges at Utah Avenue and Produce Avenue have been improved along with the channels from Utah Avenue to U.S. Highway 101 (the Bayshore Freeway), Spruce Avenue to Orange Avenue, and from Twelve Mile Creek to the vicinity of Oak Street and Mission Road.

Underground stormdrains have been constructed by the City of South San Francisco on the Spruce Branch of Colma Creek.

Town of Woodside

No flood protection works are currently in place that affects the area of this neither study, nor are there plans for such works to be built in the near future.

Cities of San Belmont, Brisbane, Daly City, San Bruno; and the Towns of Atherton, and Colma

There are no known principal flood protection measures within these communities.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude, which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood, which equals or exceeds the 1-percent annual chance flood in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

Flood hazards along the northern California coast may be generated by swell waves from offshore storms, by wind waves from landfalling storms, or by tsunami. The degree of hazard depends on the water-surface elevation of the astronomical tide at the time of wave or tsunami occurrence. To evaluate the flood hazards at Miramar and Martins Beaches, detailed engineering studies separately defined the runup magnitude and frequency of astronomical tide plus swell waves arriving from both northwesterly and southwesterly directions, the runup magnitude and frequency of tide plus wind waves arriving from both northwesterly and southwesterly directions, and the magnitude and frequency of tide plus tsunami. These magnitude and frequency relations were statistically combined to provide a comprehensive evaluation of the coastal flood hazard from the Pacific Ocean.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community. For each community within San Mateo County that had a previously printed FIS report, the hydrologic analyses described in those reports have been compiled and are summarized below.

Peak discharge-drainage area relationships for the streams studied by detailed methods for all communities in San Mateo County are shown in Table 5, "Summary of Discharges."

Table 5: Summary of Discharges

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent	2-percent	1-percent	0.2-percent
16th AVENUE DRAINAGE CHANNEL					
At Southern Pacific Railroad Crossing	--[4]	--[4]	--[4]	490	--[4]
At Highway 101	--[4]	--[4]	--[4]	800	--[4]
19th AVENUE DRAINAGE CHANNEL					
At South Pacific Railroad Crossing	--[4]	--[4]	--[4]	1,310	--[4]
At Delaware Street	--[4]	--[4]	--[4]	1,330	--[4]
At Bermuda Drive	--[4]	--[4]	--[4]	1,450	--[4]
At Highway 101	--[4]	--[4]	--[4]	1,500	--[4]
ATHERTON CREEK					
At railroad	5.0	350[1]	350[1]	350[1,2]	350[3]
BELMONT CREEK					
At El Camino Real	2.5	570	1,000	1,200	1,400
At U.S. Highway 101	2.8	660	1,200	1,400	1,600
COLMA CREEK					
At F Street	1.7	800	1,200	1,400	1,600
Below Hickey Boulevard Tributary	6.0	1,700	2,900	3,400	4,100
At U.S. Geological Survey Gage in Orange Park	10.9	2,400	4,100	4,700	5,700
Below Spruce Branch	12.7	2,500	4,400	5,000	6,100
At San Francisco Bay	16.0	2,900	5,100	5,800	7,000

[1]Capacity of Atherton Creek box culvert

[2]1,750 cubic feet per second spilled upstream of study area during the 1-percent annual chance flood event

[3]170 cubic feet per second spilled to Redwood City during the 1-percent annual chance flood event

[4]Data not available

Table 5: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second)			
		10-percent	2-percent	1-percent	0.2-percent
CORDILLERAS CREEK					
At Alameda de las Pulgas	2.6	400	730	890	1,300
At Stanford Lane	3.1	460	900	1,120	1,700
At El Camino Real	3.3	470	940	1,170	1,800
At Old County Road	3.3	470	620[2]	680[1,2]	1,190[2]
At Bayshore Freeway	3.6	525	700[3]	850[3]	1,490[3]
DENNISTON CREEK					
At Reservoir	3.2	700	1,200	1,400	1,800
Near Sheltercove Drive	3.8	780	1,300	1,600	2,000
At Half Moon Bay	4.0	800	1,400	1,600	2,100
EASTON CREEK					
At railroad	0.79	260	410	470	540
EL GRANADA CREEK					
At Reservoir	0.5	160	250	290	370
At Half Moon Bay	0.6	190	300	340	440
HOLLY STREET CHANNEL					
At U.S. Highway 101	0.40	240	370[4]	420[4]	420[4]
INDUSTRIAL BRANCH					
At Colma Creek	1.5	490	720	800	970

[1]170 cubic feet per second spilled to Redwood City during the 1-percent annual chance flood event

[2]Flows reduced due to overflow into San Carlos and Redwood City

[3]Flows reduced due to upstream spill

[4]Values do not include overland flow from Belmont Creek

Table 5: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent	2-percent	1-percent	0.2-percent
LA HONDA CREEK					
Upstream of confluence with Woodhams Creek	10.0	1,800	3,100	3,600	4,800
Downstream of confluence with Woodhams Creek	10.9	1,900	3,300	3,800	5,200
At confluence with San Gregorio Creek	11.8	2,100	3,500	4,200	5,500
LAUREL CREEK					
At Alameda de las Pulgas	--[1]	--[1]	--[1]	970	--[1]
At Otay	--[1]	--[1]	--[1]	1,130	--[1]
At George Hall School	--[1]	--[1]	--[1]	1,420	--[1]
At Highway 101	--[1]	--[1]	--[1]	1,950	--[1]
LOMITA CHANNEL					
At railroad[2]					
MILLS CREEK					
At railroad	0.52	190	290	330	370
MILLS CREEK & EASTON CREEK					
At U.S. Highway 101[3]	2.46	750	840	840	840
MONTARA CREEK					
At Riviera Street	0.80	220	360	420	560
At Harte Street	1.30	310	530	620	830
At Pacific Ocean	1.70	380	640	760	1,000

[1]Data not available

[2]Inflow to low area west of track, 1-percent annual chance outflow is 170 cubic feet per second

[3]Flows limited by culvert capacity, ponding, and pump capacity

Table 5: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent	2-percent	1-percent	0.2-percent
NAVIGABLE SLOUGH					
At Colma Creek	0.4	200	270	300	300
PESCADERO CREEK					
At Pescadero Road east of town	53.3	7,700	13,900	16,700	20,000
At Pacific Ocean	81.3	11,000	20,000	24,000	29,000
RALSTON CREEK & BURLINGAME CREEK					
At railroad	1.65	500	800	930	1,100
REDWOOD CREEK					
At El Camino Real	5.2	1,200	2,100	2,500	3,200
At Broadway	8.8	1,800	3,200	3,800	4,800
At Bayshore Freeway	9.3	1,900	3,300	4,000	5,000
SANCHEZ CREEK					
At railroad	1.65	500	800	930	1,100
SANCHEZ CREEK, RALSTON CREEK, & BURLINGAME CREEK					
At U.S. Highway 101[1]	4.65	1,100	1,600	1,600	1,600
SAN FRANCISQUITO CREEK					
At El Camino Real	40.6	4,350	7,050	8,280	9,850[2]
Upstream of Middlefield Road	41.6	4,350	7,100	8,330	--[3]
Downstream of Middlefield Road	41.6	--[3]	--[3]	6,965	--[3]
Downstream of Pope Street	41.6	--[3]	--[3]	6,250	--[3]

[1]Flows limited by culvert capacity, ponding, and pump capacity

[2]Value reflects spills from the channel into Palo Alto

[3]Data not available

Table 5: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second)			
		10-percent	2-percent	1-percent	0.2-percent
SAN FRANCISQUITO CREEK (continued)					
At U.S. Highway 101	41.7	4,400	6,020[1]	6,060[1]	6,300[1]
SAN FRANCISQUITO CREEK - OVERFLOW					
At Middlefield Road	--[2]	--[2]	--[2]	640	--[2]
At Pope Street	--[2]	--[2]	--[2]	730	--[2]
Combined Middlefield Road and Pope Street Overflows	--[2]	--[2]	--[2]	1,154	--[2]
South of U.S. Highway 101	--[2]	--[2]	--[2]	1,154	--[2]
North of U.S Highway 101	--[2]	--[2]	--[2]	570	--[2]
SAN GREGORIO CREEK					
At upstream Limit of Study	9.3	1,800	3,000	3,500	4,500
Upstream of confluence with La Honda Creek	9.5	1,800	3,000	3,600	4,600
Downstream of confluence with La Honda Creek	21.3	3,300	4,800	6,900	9,300
Downstream of State Highway 84	21.8	3,400	6,000	7,100	9,400
At downstream Limit of Study	22.4	3,500	6,100	7,200	9,700
SAN MATEO CREEK					
At mouth (City of San Mateo)	--[2]	--[2]	--[2]	1,017[1]	--[2]
At downstream side of South Humboldt Street & East Third Avenue	--[2]	--[2]	--[2]	1,493[1]	--[2]
Approximately 400 feet downstream of Crystal Springs Road	33.3	--[2]	--[2]	2,124	--[2]

[1]Flows reduced to upstream spill

[2]Data not available

Table 5: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent	2-percent	1-percent	0.2-percent
SAN VINCENTE CREEK					
At upper Study Limit	1.4	340	570	660	880
At Etheldore Street	1.7	400	670	780	1,000
At Pacific Ocean	1.9	430	720	840	1,100
SPRUCE BRANCH					
At Colma Creek	1.5	540	770	810	830
WOODHAMS CREEK					
At Esmeralda Terrace	0.7	220	340	390	480
At confluence with La Honda Creek	0.9	270	520	480	600

Previous Community Analyses

City of Burlingame

These analyses were based primarily on a regional regression analysis originally developed by the Santa Clara Valley Water District (SCVWD) (Reference 12) and adapted and tested by Tudor Engineering Company for applicability in San Mateo and other Pacific coast counties. The original analysis was based on the annual floodflows recorded at 20 stream gaging stations, 2 of which were in San Mateo County. The test was based on records (Reference 13) from 15 additional stream gages, 8 of which were in San Mateo County. Peak discharge frequency relations at these stations were determined in accordance with U.S. Water Resources Council procedures (Reference 14).

There are no gages on any of the streams within the City of Burlingame. Therefore, the regional relationships developed at other gaging stations were transferred to the ungaged basins in Burlingame by means of the statistically derived regression equations. The significant basin characteristics relating to flood peaks were drainage area and mean annual precipitation (Reference 15).

Floodflow potential within Burlingame has been increased by the effect of urban development. The amount of increase applied to the initial flood estimates was based on the ratio of urban to rural floodflows as developed for the San Francisco Bay region (Reference 16) for various recurrence intervals. The significant urban characteristics affecting the peak were the portion of the basin developed and the portion served by improved major drainage channels.

The upper portion of Sanchez Creek within the Town of Hillsborough is controlled by two small reservoirs which make their approximately 0.46-square- mile drainage area effectively noncontributory to the flood peak.

The 1-percent annual chance floodflows on the streams were routed through the ponding created behind the railroad embankment and behind the Bayshore Freeway to determine the elevation of the impounded water.

City of East Palo Alto

A stream-gaging station (U.S. Geological Survey No. 11-1645) is located on San Francisquito Creek (1930-1941, 1951-1978) approximately 2 miles upstream of El Camino Real. Log-Pearson Type I11 frequency analyses (Reference 14) were performed on the gage flood-peak records. A frequency analysis was been published in the FIS for the adjacent City of Palo Alto (Reference 17).

Potential frequency-discharge rates downstream of the San Francisquito gage were determined by combining and routing hydrographs from the intervening urban subbasins (Reference 17). Because of the perched nature of the San Francisquito channel, floodflows in excess of channel capacity spill over the banks and tend to flow away from the channel. They find independent overland routes to the bay, thus reducing channel flow. Such spills during the 1-percent annual chance flood will occur at Middlefield Road and Pope Street. The overland flow into Menlo Park at these points was determined to be 525 and 210 cubic feet per second (cfs), respectively.

Sufficient length of record was available at San Francisquito Creek (29 years) to make reliable estimates of the flood frequency. These estimates were found to be in agreement with estimates based primarily on a regional regression analysis originally developed by the SCVWD (Reference 12) and adapted and tested by Tudor Engineering Company for applicability in San Mateo and other Pacific coast counties. The gage-based estimates also matched well with the published estimates of FEMA (Reference 17) and the USACE (References 6 and 18).

Floodflow potential on the bay side of San Mateo County has been increased by the effects of urban development. The amount of increase applied to the initial flood estimates was based on the ratio of urban to rural floodflows as developed for the San Francisco Bay region (Reference 16) for various recurrence intervals. The significant urban characteristics affecting the peak were the percentage of the basin developed and the percentage served by improved major drainage channels. In urban areas, the flows are the total of separate flows that may pass near a given location in stormdrains, channels, or streets.

The restudied overflow discharges from San Francisquito Creek were calculated using split-flow routines in the USACE HEC-2 computer program (Reference 19). Discharges for the main channel of San Francisquito Creek were obtained from the Flood Insurance Study for the City of East Palo Alto dated March 19, 1984 (Reference 20); however, the split-flow analysis resulted in revised overflow discharges and revised discharges along the main channel downstream of the overflow areas.

City of Half Moon Bay

The historic FIS for the City of Half Moon Bay dated June 3, 1986 (Reference 21) does not list any hydrologic analysis.

Town of Hillsborough

The USACE (USACE) HEC-1 computer program (Reference 22) was used to estimate the 1-percent annual chance flood discharges along San Mateo Creek.

Rainfall data used in the analysis were taken from the U. S. Geological Survey (USGS) open-file report entitled "Mean Annual Precipitation Depth-Duration- Frequency Data for the San Francisco Bay Region, California" (Reference 23). Due to the reservoir storage in the San Mateo Creek watershed, a long-duration storm is required to compute peak flows. 10-day storm duration was selected for this study to allow for the computation of the entire flow hydrograph. NRCS curve-number (CN) methodology was used to compute infiltration losses. The soil type and vegetation cover were obtained from a soil survey of San Mateo County (Reference 24). The vegetation cover density was estimated from aerial photographs and field visits. The CNs were estimated for each subbasin based on the soil types, cover, and vegetation density. The estimated 24-hour CNs were adjusted to 10-day CNs using NRCS procedures outlined in NRCS Technical Release No. 6, "Earth

Dams and Reservoirs" (Reference 25). The ground cover for the area below Lower Crystal Springs Dam was estimated using NRCS procedures for urbanized areas.

In 1965, the USACE prepared unit hydrographs for the subbasins of the San Mateo Creek watershed (Reference 26). The USACE reported that stream characteristics, length of longest watercourse, distance to the center of the contributing area, and overall stream slope were correlated with the time required for the S-curve hydrograph to reach 50 percent of ultimate discharge on small adjacent streams. An average dimensionless S-curve hydrograph was used to derive unit hydrographs for selected index points. The USACE reported that the unit hydrographs for the subbasins above Lower Crystal Springs Dam were computed by combining unit hydrographs for the subareas of those subbasins. The USACE had to compute unit hydrographs for the subareas within the subbasins because parts of the subbasins are covered with reservoirs and the subareas drain to the reservoirs through short, steep channels. The length of channel and channel slope cannot, therefore, be computed for the subbasin as a whole. Consequently, the USACE computed basin lag times from subarea channel lengths and slopes. Unit hydrographs for the subareas were computed and combined to obtain a single unit hydrograph for each subbasin. The USACE-computed unit hydrographs were used in this study.

The Muskingum-Cunge routing option of HEC-1 was used for channels where detailed topographic information is not available. Channel lengths, widths, and slopes were estimated from USGS quadrangle maps. Modified-Puls routing was used for the lower portion of the watershed, where detailed topographic information was available.

The HEC-1 reservoir routing procedure was used to route flows through the Lower Crystal Springs Dam spillway. Area-elevation-storage relationships were obtained from the Water Supply Division of the San Francisco Water Department. To comply with FEMA guidelines, the reservoir was assumed to be full at the start of the 1-percent annual chance storm.

<u>City of Menlo Park</u>

A stream-gaging station is located on San Francisquito Creek (1930-1941, 1951- 1978) approximately 2 miles upstream of El Camino Real. Log-Pearson Type I11 frequency analyses (Reference 14) were performed on the gage flood-peak records. A frequency analysis has been published in the FIS for the adjacent City of Palo Alto (Reference 17). The study contractor reviewed and concurred with that analysis and has adopted the applicable discharges for this study. Analyses were also performed by the SCVWD (Reference 27), the USACE (Reference 18), and Stanford University (Reference 28). These studies were used as references and for comparison in determining discharges along San Francisquito Creek.

Potential frequency-discharge rates downstream of the San Francisquito gage were determined by combining and routing hydrographs from the intervening urban subbasins (Reference 17). Because of the perched nature of the San Francisquito channel, floodflows in excess of channel capacity spill over the hanks and tend to flow away from the channel. They find independent overland routes to the bay, thus reducing channel flow. Such spills during the 1-percent annual chance flood will occur at Middlefield Road and Pope Street. The overland flow into Menlo Park at these mints was determined to be 525 and 210 cubic feet per second (cfs), respectively.

The restudied overflow discharges from San Francisquito Creek were calculated using split-flow routines in the USACE HEC-2 computer program (Reference 19). Discharges for the main channel of San Francisquito Creek were obtained from the Flood Insurance Study for the City of Menlo Park dated February 4, 1981 (Reference 29); however, the split-flow analysis resulted in revised overflow discharges and revised discharges along the main channel downstream of the overflow areas.

City of Millbrae

These analyses were based primarily on a regional regression analysis originally developed by the SCVWD (Reference 12) and adapted and tested by Tudor Engineering Company for applicability in San Mateo and other Pacific coast counties. The original analysis was based on the annual floodflows recorded at 20 stream gaging stations, 2 of which were in San Mateo County. The test was based on records (Reference 13) from 15 additional stream gages, 8 of which were in San Mateo County. Peak discharge-frequency relations at these stations were determined in accordance with U.S. Water Resources Council procedures (Reference 14).

There are no gages on any of the streams within the City of Millbrae. Therefore, the regional relationships developed at other gaging stations were transferred to the ungaged basins in Millbrae by means of the statistically derived regression equations. The significant basin characteristics relating to flood peaks were drainage area and mean annual precipitation (Reference 15).

Floodflow potential within Millbrae has been increased by the effects of urban development. The amount of increase applied to the initial flood estimates was based on the ratio of urban to rural floodflows as developed for the San Francisco Bay region (Reference 16) for various recurrence intervals. The significant urban characteristics affecting the peak were the portion of the basin developed and the portion served by improved major drainage channels.

The 1-percent annual chance flood on Lomita Creek were routed through the ponding created behind the railroad embankment and behind the Bayshore Freeway to determine the elevation of the impounded water. Routing reduced the outflow under the railroad to 170 cubic feet per second (cfs). The ponding area behind Bayshore Freeway collects flows from both Lomita and Green Hills Creeks; outflow is limited to the 240 cfs pump capacity.

City of Pacifica

The hydrologic analyses were based primarily on a regional regression analysis originally developed by the SCVWD (Reference 12) and adapted and tested by the study contractor for applicability in San Mateo and other Pacific coast counties. The original analysis was based on the annual floodflows recorded at 20 stream-gaging stations, 2 of which were in

San Mateo County. The test was based on records (Reference 13) from 15 additional stream gages, 8 of which were in San Mateo County. Peak discharge-frequency relations at these stations were determined in accordance with U.S. Water Resources Council procedures (Reference 14).

There are no gages on any of the streams within Pacifica. Therefore, the regional relationships developed at other gaging stations were transferred to the ungaged basins in Pacifica by means of the statistically derived regression equations. The significant basin characteristics related to flood peaks were drainage area and mean annual precipitation (Reference 15). Where flooding potential is aggravated by the effects of existing urban development, the floodflow estimates were adjusted upward on the basis of the portions of the basin that were developed and that were served by improved major drainage channels. No allowance has been made for the possible hydrologic impact of planned, but as yet unconstructed, developments.

The USACE previously estimated floodflows on San Pedro Creek and its tributaries (Reference 30). A comparison of 1-percent annual chance flood estimates with the regional estimates showed excellent agreement on the urbanized North Fork San Pedro Creek and approximately 20 percent lower values than those of the regional estimate at other points in this basin. As the USACE estimates are well within the standard error of estimate of the regional estimates, they have been accepted for the purposes of this study.

Flood estimates on all other drainage basins in Pacifica are based on the regional analysis.

Town of Portola Valley

The NRCS Design Hydrograph Method (Reference 31) was used to determine peak discharges for the stream studied in Portola Valley. An isohyetal map of mean annual precipitation was obtained from the USACE.

City of Redwood City

These analyses were based primarily on a regional regression analysis originally developed by the Santa Clara County Water District (Reference 12) and adapted and tested by the study contractor for applicability in San Mateo and other Pacific coast counties. The original analysis was based on the annual floodflows recorded a t 20 stream gaging stations, 2 of which were in San Mateo County. The test was based on records (Reference 13) from 15 additional stream gages, 8 of which were in San Mateo County. Peak discharge-frequency relations at these stations were determined in accordance with U.S. Water Resources Council procedures (Reference 14).

A U.S. Geological Survey stream-gaging station (No. 11-1628.00), located on the upper reach of Redwood Creek west of the corporate limits, has operated since 1960 (Reference 13). A frequency analysis was made of the flood peak record. The gage is one of the two San Mateo County gages used in developing the original regression equations. However, the results were not directly applied to the study reach on lower Redwood Creek due to the vastly different character of the highly urbanized intervening drainage and the resulting modification to the hydrologic response. Therefore, the regional relationships developed at this and other gaging stations were transferred t o the lower reaches of Redwood Creek and the ungaged basins in Redwood City by means of the statistically derived regression equations. The significant basin characteristics relating to flood peaks were drainage area and mean annual precipitation (Reference 16).

Floodflow potential within Redwood City has been increased by the effects of urban development. The amount of increase applied to the initial flood estimates was based on the ratio of urban to rural floodflows as developed for the San Francisco Bay region (Reference 16) for various recurrence intervals . The significant urban characteristics affecting the peak were the portion of the basin developed and the portion served by improved major drainage channels.

Floodflows for Cordilleras Creek were based on concurrence with the City of San Carlos FIS (Reference 32).

City of San Carlos

In an open-file report (Reference 16), S. E. Rantz, Hydrologist, U.S. Geological Survey, derived flood-frequency relationships on the basis of streamflow records. Peak discharges were computed for several recurrence intervals up to 50 years by fitting the Log-Pearson Type III distribution (Reference 33) to observed annual peak flows, and correlating the peak discharges with climatologic and topographic parameters. According to Rantz, the most significant parameters were the drainage area and the mean annual precipitation. The five regional relations, derived by multiple regression analysis, were of the form

$$Q_T = KA^aP^b$$

where: Q_T = Peak discharge (in cubic feet per second) for a recurrence interval of T years

A =Drainage area (in square miles)

P = Mean annual precipitation (in inches)

K, a, and b = Constants

Estimates of discharge for the 2-, 5, 10-, 25-, and 50-year floods were computed, by application of these regional relations, for 21 sites in the City of San Carlos. Estimates of the 1-percent annual chance and 0.2-percent annual chance floods at these sites were then obtained by logarithmic extrapolation. The discharge values for the 10-percent, 2-percent, 1-percent, and 0.2-percent annual chance floods were adjusted for the effects of urbanization using methods described by Rantz.

A 3-hour inflow period was used in combination with discharges for the 10- percent, 2-percent, 1-percent, and 0.2-percent annual chance floods to estimate the volume of storm water that might constitute inflow to the ponding areas west of the railroad and Bayshore Freeway. This inflow, together with the computed outflow through culverts and over the railroad embankment (for the ponding area west of the embankment), were used to determine the ponded elevation for each flood event. The calculated pond elevations were used in conjunction with available topographic data to determine areas of inundation.

The effect of high tides on the discharge capacity of streams was analyzed by imposing the annual maximum tide at San Carlos (5.1 feet m.s.1.) on the streams and routing the floodflows. The simultaneous occurrence of a 1-percent annual chance flood or 0.2-percent annual chance tidal extreme and a 1-percent annual chance floodflow or 0.2-percent annual chance floodflow is highly improbable and was not considered.

City of San Mateo

The USACE (USACE) HEC-1 computer program (Reference 22) was used to estimate the 1-percent annual chance flood discharges along San Mateo Creek.

Rainfall data used in the analysis were taken from the U.S. Geological Survey (USGS) open-file report entitled "Mean Annual Precipitation Depth-Duration- Frequency Data for the San Francisco Bay Region, California" (Reference 23). Due to the reservoir storage in the San Mate0 Creek watershed, a long-duration storm is required to compute peak flows. 10-day storm duration was selected for this study to allow for the computation of the entire flow hydrograph. NRCS curve-number (CN) methodology was used to compute infiltration losses. The soil type and vegetation cover were obtained from a soil survey of San Mateo County (Reference 24). The vegetation cover density was estimated from aerial photographs and field visits. The CNs were estimated for each subbasin based on the soil types, cover, and vegetation density. The estimated 24-hour CNs were adjusted to 10-day CNs using NRCS procedures outlined in NRCS Technical Release No. 6, "Earth Dams and Reservoirs" (Reference 25). The lake water surfaces for the subbasins above Crystal Springs Dam were assumed to be impervious. The ground cover for the area below Lower Crystal Springs Dam was estimated using NRCS procedures for urbanized areas.

In 1965, the USACE prepared unit hydrographs for the subbasins of the San Mateo Creek watershed (Reference 26). The USACE reported that stream characteristics, length of longest watercourse, distance to the center of the contributing area, and overall stream slope were correlated with the time required for the S-curve hydrograph to reach 50 percent of ultimate discharge on small adjacent streams. An average dimensionless S-curve hydrograph was used to derive unit hydrographs for selected index points. The USACE reported that the unit hydrographs for the subbasins above Lover Crystal Springs Dam were computed by combining unit hydrographs for the subareas of those subbasins. The USACE had to compute unit hydrographs for the subareas within the subbasins because parts of the subbasins are covered with reservoirs and the subareas drain to the reservoirs through short, steep channels. The length of channel and channel slope cannot, therefore, be computed for the subbasin as a whole. Consequently, the USACE computed basin lag times from subarea channel lengths and slopes. Unit hydrographs for the subareas were computed and combined to obtain a single unit hydrograph for each subbasin. The USACE-computed unit hydrographs were used in this study.

The Muskingum-Cunge routing option of HEC-1 was used for channels where detailed topographic information is not available. Channel lengths, widths, and slopes were estimated from USGS quadrangle maps. Modified-Puls routing was used for the lower portion of the watershed, where detailed topographic information was available. The HEC-I reservoir routing procedure was used to route flows through the Lower Crystal Springs Dam spillway. Area-elevation- storage relationships were obtained from the Water Supply Division of the San Francisco Water Department. To comply with FEMA guidelines, the reservoir was assumed to be full at the start of the 1-percent annual chance storm.

<u>City of South San Francisco</u>

These analyses were based primarily on a regional regression analysis originally developed by the SCVWD (Reference 12) and adapted and tested by the study contractor for applicability in San Mateo and other Pacific coast counties. The original analysis was based on the annual floodflows recorded at 20 stream gaging stations, 2 of which were in San Mateo County. The test was based on records (Reference 13) from 15 additional stream gages, 8 of which were in San Mateo County, including the Colma Creek gage. Peak discharge-frequency relations at these stations were determined in accordance with U.S. Water Resources Council procedures (Reference 14).

A U.S. Geological Survey stream gaging station located on Colma Creek in Orange Park has operated since 1964 (Reference 13). Although a frequency analysis was made of the flood peak record, the results were not directly applied due to the shortness of record and the rapidly changing basin hydrologic response brought about by urbanization. A gaging station was also operated on Spruce Branch for 4 years.

The regional relationships developed at other gaging stations were transferred to the Colma Creek basin by means of the statistically derived regression equations. The significant basin characteristics relating to flood peaks were drainage area and mean annual precipitation (Reference 15).

Floodflow potential within South San Francisco has been increased by the effects of urban development. The amount of increase applied to the initial flood estimates was based on the ratio of urban to rural floodflows as developed for the San Francisco Bay region (Reference 16) for various recurrence intervals. The significant urban characteristics affecting the peak were the portion of the basin developed and the portion served by improved major drainage channels.

The USACE has previously estimated floodflows on Colma Creek (Reference 11). A comparison of the 2-percent and 1-percent annual chance estimates of the USACE for the anticipated future urban conditions with the study contractor’s present-day regional estimates showed excellent agreement at the stream gage site in Orange Park. Elsewhere in the basin, the USACE estimates were within the standard error of estimate of the regional estimates. As the USACE estimates are also the basis of ongoing design and construction of channel facilities, the USACE 2-percent and 1-percent annual chance flood discharges were adopted for the purpose of this FIS.

At the railroad track on both lower Colma Creek and Spruce Branch, 1-percent annual chance flood hydrographs were developed and routed through the local floodplain storage to obtain the depth of ponding and distribution of outflow.

Town of Woodside

The peak flow rates for given recurrence intervals were computed by the flood-frequency analysis method of S. E. Rantz (Reference 16), which was developed for the San Francisco Bay area. Rantz's method relates peak flow to both drainage area and mean annual basin-wide precipitation with exponents and constants determined in the bay area for recurrence intervals of 2, 5, 10, 25, and 50 years. Flows for 1-percent annual chance and 0.2-percent annual chance recurrence intervals were determined by logarithmic extrapolation of the flood-frequency curve.

San Mateo County (Unincorporated Areas)

These analyses were based primarily on a regional regression analysis originally developed by the SCVWD (Reference 12) and adapted and tested by Tudor Engineering Company for applicability in San Mateo and other Pacific coast counties. The original analysis was based on the annual floodflows recorded at 20 stream-gaging stations, 2 of which were in San Mateo County. The test was based on data (Reference 13) from 15 additional stream gages with records of 10 to 29 years, 8 of which were in San Mateo County. Peak discharge-frequency relations at these stations were determined in accordance with U.S. Water Resources Council procedures (Reference 14). No stream gage was located within the detailed study area; however, USGS gages on Pescadero Creek (No. 11-1625), Butano Creek (No. 11-1625.4), and San Francisquito Creek (No. 11- 1645), located 2 to 4 miles upstream of the respective study reaches, and on San Gregorio Creek (No. 11-1625.7), located 4 miles below the La Honda study site, were among the gages used in developing and testing the regional regression analysis. Sufficient lengths of record were available for San Francisquito (29 years) and Pescadero Creeks (24 years) to make reliable estimates of their flood frequencies. These estimates were found to be in agreement with regional estimates and with published estimates (References 6, 17, and 18). For the remaining streams, the regional relationships developed at other gaging stations were transferred to the ungaged reaches or basins in San Mateo County by means of statistically derived regression equations. The significant basin characteristics relating to flood peaks were drainage area and mean annual precipitation (Reference 15).

Floodflow potential on the bayside of San Mateo County has been increased by the effects of urban development. The amount of increase applied to the initial flood estimates was based on the ratio of urban to rural floodflows as developed for the San Francisco Bay region (Reference 16) for various recurrence intervals. The significant urban characteristics affecting the peak were the percentage of the basin developed and the percentage served by improved major drainage channels. In urban areas, the flows are the total of separate flows that may pass near a given location in stormdrains, channels, or streets.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

All bridges, culverts, and hydraulically significant features were field-checked to verify elevation data and define the structural geometry.

The hydraulic analysis for this revision was based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Published Separately).

The values used for the channel and overbank areas are shown on Table 6, "Manning's "n" Values".

Table 6: Manning's "n" Values

Community Name	Channel	Overbank
City of Burlingame	0.019 – 0.050	0.020 – 0.080
City of East Palo Alto	0.015 – 0.080	0.12 – 0.14
Town of Hillsborough	0.035 – 0.055	0.020 – 0.100
City of Menlo Park	0.015 – 0.080	0.12 – 0.14
City of Millbrae	0.019 – 0.050	0.020 – 0.080
City of Pacifica	0.027 – 0.110	0.020 – 0.100
City of Redwood City	0.014 – 0.050	0.020 – 0.100
City of San Mateo	0.035 – 0.055	0.020 -0.100
City of South San Francisco	0.015 – 0.035	0.040 – 0.100
San Mateo County (Unincorporated Areas)	0.019 – 0.050	0.020 – 0.100

For each community within San Mateo County that had a previously printed FIS report, the hydraulic analyses described in those reports have been compiled and are summarized below.

Previous Community Analyses

City of Burlingame

For manmade prismatic channels, elevations and capacity were computed by using a direct step-backwater computer program (Reference 34).

Cross sections for backwater analyses were located short distances upstream and downstream of hydraulically significant features in order to establish the backwater effect of such features.

Aerial photogrammetry was used to obtain topographic mapping of the study area with contour intervals of 2 feet and a horizontal scale of 1":4,800' (Reference 35). Digitized cross sections were obtained from the mapper at preselected locations. Field measurements were used to supplement the available data.

Roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of field inspection of floodplain areas. The values used for the channels varied between 0.019 and 0.050; values for the overbanks varied between 0.020 and 0.080.

The starting water-surface elevation for El Portal Canal and Burlingame Lagoon was the mean higher high water level of 3.5 feet as determined for the tides in San Francisco Bay (Reference 36).

Where overbank flooding is shallow and hydraulically independent of the adjacent stream channel, channel flood profiles are inapplicable. Where applicable, the extent of shallow overbank flooding was determined by normal- depth calculations, street flow capacity (Reference 37), field inspection, topographic maps (Reference 34), and engineering judgment.

The extent of flooding in ponded areas was determined by a hydrograph storage/routing procedure.

Manning's equation was used to determine the capacity of closed conduit stormdrains and for normal-depth calculations of shallow flooding areas.

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 38). Bridges, culverts, and other significant hydraulic features were field checked to verify elevation data and define the structural geometry.

City of East Palo Alto

Water-surface elevations for San Francisquito Creek were computed by George S. Nolte & Associates (Reference 17) using the USACE HEC-2 step-backwater computer program (Reference 19), supplemented by hand calculations where required.

Aerial photogrammetry was used to obtain topographic maps of the study areas at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35). Field measurements were used to supplement the available data.

Roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of field inspection of the study areas. The values used for the channel ranged from 0.015 to 0.080, values for the overbanks ranged from 0.018 to 0.080 (Reference 17).

Starting water-surface elevation for San Francisquito Creek was set at the Mean Higher High Water tidal level in San Francisco Bay.

The extent of overbank flooding was determined by using existing topographic information (Reference 35), street capacity, normal-depth calculations, and by field inspection. Shallow overbank flooding results from flow leaving San Francisquito Creek at Pope Street in Menlo Park. Since the overbank flooding is shallow and hydraulically independent of the adjacent stream channel, flood profiles are inappropriate and are not included in this study.

The restudied detailed hydraulic analysis for San Francisquito Creek and the overflow areas used the USACE HEC-2 computer program. Starting water- surface elevations were determined using the slope-area (normal-depth) method. Channel and overflow cross sections were obtained from topographic mapping (References 39 and 40), supplemented with field-surveyed elevations. Modifications to existing cross-section information were based on SCVWD as- built drawings (Reference 41) and field surveys. In the overbank area, the 1- percent annual chance flood boundary has been delineated using a topographic map at a scale of 1”:2,400’, with a contour interval of 1 foot (Reference 42). Approximate flood plain boundaries have been delineated in the overbank area up to the extent of the San Francisquito Creek overflow flooding in February 1998. Roughness coefficients (Manning’s “n” values) ranged from 0.02 to 0.06 in the channel and from 0.12 to 0.14 in the overbank areas. The 1-percent annual chance flood plain boundaries for the overflow areas were delineated using elevations computed at each cross section; between cross sections, the boundaries were interpolated using topographic mapping (References 35, 39, and 40).

City of Half Moon Bay

The historic FIS for the City of Half Moon Bay dated June 3, 1986 (Reference 21) does not list any hydraulic analysis.

Town of Hillsborough

Water-surface elevations for San Mateo Creek were computed using the USACE HEC-2 computer program (Reference 43).

All culverts and bridges were analyzed using the USACE HEC-2 computer program, except the long culvert under Mills Hospital, located in the City of San Mateo that extends from approximately 6,740 feet to approximately 8,585 feet above the mouth of San Mateo Creek, which was analyzed manually. The rating curve developed for this culvert was then included in the HEC-2 analyses. The long culvert consists of a mixture of different underground structures, including box and arch culverts and covered channels with vertical walls.

Aerial photogrammetry was used to develop topographic mapping at a scale of 1”:200’, with a contour interval of 2 feet, along San Mateo Creek (Reference 44).

Surveyed cross sections, culverts, and bridge dimensions were taken from available data and supplemented by field measurements where necessary.

Roughness coefficients (Manning's “n” values) used in the hydraulic computations were assigned on the basis of field inspections. The values used for the channel and overbank areas ranged from 0.035 to 0.055 and 0.020 to 0.100, respectively. A value of 0.100 was used for shallow flooding areas due to the area being almost completely urbanized.

The starting water-surface elevation for San Mateo Creek is the mean higher high water-surface elevation for the San Francisco Bay at the mouth of San Mateo Creek in the City of San Maw. This value was taken from the USACE report entitled “San Francisco Bay, Tidal Stage vs. Frequency Study” (Reference 45). This report summarizes the results of a tidal stage-frequency restudy of the San Francisco Bay. The tidal data, as well as other tidal parameters presented in the report, reflect only still water conditions. The report does not consider the effects of wave height or runup on the 1-percent annual chance water-surface elevations.

City of Menlo Park

Water-surface elevations for that portion of San Francisquito Creek shared by both the Cities of Palo Alto and Menlo Park from Bayshore Freeway to El Camino Real were computed by George S. Nolte & Associates (Reference 17) using the USACE HEC-2 step-backwater computer program (Reference 19), supplemented by hand calculations where required. The study contractor reviewed and concurred with that analysis. Special in-house computer programs were used to analyze Atherton Creek (References 34 and 38).

Aerial photogrammetry was used to obtain topographic maps of the study areas at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35). Digitized cross sections were obtained at pre-selected locations. Field measurements were used to supplement this data. Cross sections for backwater analyses were located short distances upstream and downstream of bridges and other hydraulically significant features in order to establish the backwater effect of such features.

Roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of field inspection of the study areas. The values used for the channels ranged from 0.015 to 0.080; values for the overbanks ranged from 0.018 to 0.080 (Reference 17).

Starting water-surface elevations for San Francisquito Creek and Atherton Creek were based on the slope-area method.

The 1-percent annual chance floodflows along San Francisquito Creek and Atherton Creek are either contained within the channel or the overbank flooding is shallow and hydraulically independent of the adjacent stream channel; therefore, channel flood profiles are inappropriate and are not included in this study. The extent of overbank flooding was determined by using existing topographic information (Reference 35), street capacity, normal-depth calculations, and by field inspection.

The revised detailed hydraulic analysis for San Francisquito Creek and the overflow areas used the USACE HEC-2 computer program. Starting water- surface elevations were determined using the slope-area (normal-depth) method. Channel and overflow cross sections were obtained from topographic mapping (References 39 and 40), supplemented with field-surveyed elevations. Modifications to existing cross-section information were based on SCVWD as- built drawings (Reference 41) and field surveys. In the overbank area, the 1- percent annual chance flood boundary has been delineated using a topographic map at a scale of 1”:2,400’, with a contour interval of 1 foot (Reference 42). Roughness coefficients (Manning’s “n” values) ranged from 0.02 to 0.06 in the channel and from 0.12 to 0.14 in the overbank areas. The 1-percent annual chance flood plain boundaries for the overflow areas were delineated using elevations computed at each cross section; between cross sections, the boundaries were interpolated using topographic mapping (References 35, 39, and 40). The hydraulic analysis for this study was based on unobstructed flow. The flood elevations are considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

No flood profile exists for the San Francisquito Creek study area.

<u>City of Millbrae</u>

Water-surface elevations and capacities of natural channels were computed using the USACE HEC-2 step-backwater computer program (Reference 19), supplemented by hand calculations and special computer programs developed by the study contractor, where required (Reference 38). For manmade prismatic channels, elevations and capacities were computed by using a direct step- backwater computer program (Reference 34).

Aerial photogrammetry was used to obtain topographic mapping of the study areas with contour intervals of 2 feet and a horizontal scale of 1”:4,800’ (Reference 35). Digitized cross sections were obtained from the mapper at pre- selected locations. Field measurements were used to supplement the available data.

Cross sections for backwater analyses were located short distances upstream and downstream of hydraulically significant features in order to establish the backwater effect of such features.

Roughness factors (Manning's “n”) used in the hydraulic computations were assigned on the basis of field inspection of floodplain areas. The values used for the channels varied between 0.019 and 0.050; values for the overbanks varied between 0.020 and 0.080.

Starting water-surface elevations for El Portal Canal and Millbrae (High Line) Canal were calculated using the mean higher high water of 3.5 feet for the tides in San Francisco Bay. For Lomita Channel, a starting water-surface elevation was obtained by using the ponding elevation (4 feet) of the shallow flooding area adjacent to the lower portion of the canal.

Where overbank flooding is shallow and hydraulically independent of the adjacent stream channel, channel flood profiles are inapplicable. The extent of such overbank flooding was determined by normal-depth street flow calculations as outlined by U.S. Department of Transportation Circular 12 (Reference 37), field inspection, topographic maps (Reference 35), and engineering judgment.

The extent of flooding in ponded areas was determined by a hydrograph storage/routing procedure.

Manning's equation was used to determine the capacity of closed conduit stormdrains and for normal-depth calculations of shallow flooding areas.

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 38).

City of Pacifica

Water-surface elevations were computed using the USACE HEC-2 step- backwater computer program (Reference 19), supplemented, where required, by hand calculations and special computer programs developed by the study contractor.

Cross sections for backwater analyses were located short distances upstream and downstream of hydraulically significant features in order to establish the backwater effect of such features.

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 38).

Aerial photogrammetry was used to obtain topographic mapping of the study areas (Reference 35). Digitized cross sections were obtained at pre-selected locations. Field measurements and as-built drawings were used to supplement these data (Reference 46).

Where overbank flooding is shallow and hydraulically independent of the adjacent stream channel, channel flood profiles are inapplicable. The extent of such overbank flooding was determined by normal-depth, street-flow calculations as outlined by U.S. Department of Transportation Circular 12 (Reference 37). Flood-routing methods were used to determine the 1-percent annual chance flood elevation in the Linda Mar sump area.

Roughness factors (Manning's “n”) used in the hydraulic computations were assigned on the basis of field inspection of the study areas. The values used for the channels varied between 0.027 and 0.110; values for the overbanks varied between 0.020 and 0.110.

The starting water-surface elevation at the Pacific Ocean outfall of the streams was the tidal mean higher high-water elevation of 2.8 feet.

During the 1-percent annual chance flood event, local shallow flooding can be expected at several locations along San Pedro Creek. This would occur as the culvert capacities at Peralta Road and Adobe Road were exceeded. The channel capacity drops from 1,900 cfs downstream of Peralta Road to 600 cfs in the vicinity of the Linda Mar Shopping Center. Any runoff in excess of 600 cfs will leave the channel and flow northward into the sump area, where, once the pump capacities (160 cfs) are exceeded, ponding occurs. The ponded depth increases until the flows are forced over State Highway 1. During the 1-percent annual chance flood event, this ponding is expected to reach an elevation of 11 feet. Even though some locations will experience depths in excess of 4 feet, the average depth of the entire area will be between 1 and 3 feet (Reference 30). Local shallow flooding is also anticipated on the North Fork San Pedro Creek when the storm-drain capacities are exceeded. These flows are contained within Oddstad Boulevard until they reach the shopping center at the corner of Oddstad Boulevard and Terra Nova Boulevard. Here, the flows will lose velocity, but will have room to spread and, therefore, remain shallow.

During the 1-percent annual chance flood event, local shallow flooding from Rockaway Creek would be experienced because of inadequate culverts. This would occur at Oddstad Way, Buel Avenue, and State Highway 1.

The lower reaches of Calera Creek will be subject to widespread shallow flooding during the 1-percent annual chance flood event. This is caused by inadequate culverts; small, brush-choked channels; and overbank areas with low topographic relief. Inadequate culverts and overgrown channels will produce some local shallow flooding in the upstream reaches.

The lower reaches of Sharp Park Creek will be subject to shallow flooding during the 1-percent annual chance flood event, when channel capacities will be exceeded. Excess discharge will flow into Laguna Salada, a tidal pond that drains into the Pacific Ocean.

Shallow flooding from Milagra Creek can be expected in the reach east of State Highway 1 during the 1-percent annual chance flood. This is caused by an inadequate culvert at Edgemar Avenue. The shallow flows will proceed westward until they are intercepted by State Highway 1, where they will pond in a low area of the highway.

Town of Portola Valley

Valley and channel cross sections were made at key points along Corte Madera Creek, and culvert sizes and elevations were determined. Water-surface elevations were then computed through the use of the Portland WSP Computer Program (Reference 47).

The portion of Corte Madera Creek upstream from Alpine Road, the unnamed tributary to Corte Madera Creek, Los Trancos Creek, and Sausal Creek, were not studied in detail because of the lack of current or planned development along those streams. The 1-percent annual chance flood for those streams was approximated based on regional rainfall-runoff estimates, topographic features, and normal depth calculations.

City of Redwood City

Where overbank flooding is shallow and hydraulically independent of the adjacent stream channel, channel flood profiles are inapplicable. The extent of such overbank flooding was determined by using normal-depth sheetflow calculations as outlined by U.S. Department of Transportation Circular 12 (Reference 37), field inspection, topographic maps (Reference 35), and engineering judgment. Water-surface elevations and capacity of natural channels were computed using the USACE HEC-2 step-backwater computer program (Reference 19), supplemented by hand calculations and special computer programs developed by the study contractor, where required (Reference 38). For manmade prismatic channels, water-surface elevations and capacities were computed by using a direct step-backwater computer program (Reference 34).

The results of the foregoing- backwater analyses indicated that all riverine 1- percent annual chance flood discharges occurring upstream of the 1-percent annual chance tide level either were contained in the channel or resulted in shallow, independent overbank flooding. Therefore, channel flow profiles were inappropriate and were not produced.

Manning's equation was used to determine the capacity of closed conduit stormdrains and for normal-depth calculations of shallow flooding areas.

Cross sections for backwater analyses were located short distances upstream and downstream of hydraulically significant features in order to establish the backwater effect of such features.

Most culverts were analyzed using a separate computer program, developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 35).

Aerial photogrammetry was used to obtain topographic mapping of the study areas with a contour interval of 2 feet and a horizontal scale of 1”:4,800’ (Reference 35). Digitized cross sections were obtained from the mapper at pre- selected locations. Field measurements were used to supplement the available data.

Roughness factors (Manning's “n”) used in the hydraulic computations were assigned on the basis of field inspection of floodplain areas. The values used for the channels varied between 0.014 and 0.050; values for the overbanks varied between 0.020 and 0.100.

Starting water-surface elevations for Cordilleras and Redwood Creeks were calculated using the Mean Higher High Water elevation of 4.0 feet for the tides in San Francisco Bay.

Starting water-surface elevations for Atherton Creek were calculated by slope- area method.

In the study areas subject to tidal flooding, numbered insurance zones have been assigned on the basis of detailed tidal water-surface data; no wave studies were performed.

For the area upstream of El Camino Real, the depths of shallow flooding areas were determined using discharges computed for areas downstream of El Camino Real, historic flooding information, field investigation, and topographic maps (Reference 48).

City of San Carlos

Longitudinal profiles for the stream channels and for the 10-percent, 2-percent, 1-percent, and 0.2-percent annual chance floods were developed from culvert surveys using Computer Program A526, Culvert Analysis (Reference 49) and from hydraulic computations of 63 stream channel cross sections utilizing Computer Program C649, Backwater Analysis (Reference 50). The profiles represent estimated water-surface elevations for specific flood events. In some cases, spillage over roadways shown on the profiles is due to the limited capacity of culverts to discharge streamflows. However, the streamflows immediately upstream and downstream of the culverts are contained within the channel limits. Adjacent land areas are not subject to flooding from the estimated discharges in these cases. Also, overbank flows may not return to the channel but may move overland to ponding areas. In these instances, additional cross sections and topographic data were used to estimate the extent of flow paths and ponding areas.

City of San Mateo

Water-surface elevations for San Mateo Creek upstream of East 3rd Avenue were computed using the USACE HEC-2 computer program (Reference 43), water- surface elevations downstream of East 3rd Avenue were computed using the USACE HEC-RAS computer program.

All culverts and bridges were analyzed using the USACE HEC-2 and HEC-RAS computer programs except the long culvert under Mills Hospital that extends from approximately 6,740 feet to approximately 8,585 feet above the mouth of San Mateo Creek, which was analyzed manually. The rating curve developed for this culvert was then included in the HEC-2 analyses. The long culvert consists of a mixture of different underground structures, including box and arch culverts and covered channels with vertical walls.

Aerial photogrammetry was used to develop topographic mapping at a scale of 1”:200’, with a contour interval of 2 feet, along San Mateo Creek (Reference 44). Surveyed cross sections, adverts, and bridge dimensions were taken from available data and supplemented by field measurements where necessary.

Roughness coefficients (Manning's “n” values) used in the hydraulic computations were assigned on the basis of field inspections. The values used for the channel and overbank areas ranged from 0.035 to 0.055 and 0.020 to 0.100, respectively. A value of 0.100 was used for shallow flooding areas due to the area being almost completely urbanized.

The starting water-surface elevation for San Mateo Creek is the mean higher high water-surface elevation for the San Francisco Bay at the mouth of San Mateo Creek. This value was taken from the USACE report entitled “San Francisco Bay, Tidal Stage vs. Frequency Study” (Reference 45). This report summarizes the results of a tidal stage-frequency restudy of the San Francisco Bay. The tidal data, as well as other tidal parameters presented in the report, reflect only still water conditions. The report does not consider the effects of wave height or runup on the 1-percent annual chance water-surface elevations. Based on this report, the 1- percent annual chance water-surface elevation for the San Francisco Bay in the City of San Mateo is 10 feet, which is shown on the FIRM.

<u>City of South San Francisco</u>

Water-surface elevations for stream reaches where riverine flooding occurs were computed using the USACE HEC-2 step-backwater computer program (Reference 19).

Cross sections for backwater analysis were located short distances upstream and downstream of hydraulically significant features in order to establish the backwater effect of such features.

Aerial photogrammetry was used to obtain topographic mapping of the study areas with contour intervals of 2 feet and a horizontal scale of 1”:4,800’ (Reference 35). Digitized cross sections were obtained from the mapper at pre- selected locations. Field measurements were used to supplement the available data.

Roughness factors (Manning's “n”) used in the hydraulic computations were assigned on the basis of field inspection of floodplain areas. The values used for the channels varied between 0.015 and 0.035; values for the overbanks varied between 0.040 and 0.100.

The starting water-surface elevation for channels entering San Francisco Bay, concurrent with floods of the selected recurrence intervals, was set at the tidal mean higher high water level of 3.5 feet.

Where overbank flooding is shallow and hydraulically independent of the adjacent stream channel, channel flood profiles are inapplicable. Where applicable, the extent of overbank flooding was determined by normal-depth calculations, street flow capacity calculations (Reference 37), field inspection, topographic maps (Reference 35), and engineering judgment.

The extent of flooding in ponded areas was determined by a hydrograph storage/routing procedure.

Manning's equation was used to determine the capacity of closed conduit stormdrains and for normal-depth calculations of shallow flooding areas.

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 38).

Town of Woodside

Water-surface elevations of floods of the selected recurrence intervals were computed by slope conveyance methods and through the use of U.S. Geological Survey computer program A526 (Reference 51).

Cross sections for the backwater analyses for all streams studied in detail were field surveyed and were located at close intervals above and below bridges and culverts to compute the significant backwater effects of these structures.

Roughness factors (Manning’s “n”) for these computations were assigned on the basis of field inspection of floodplain areas.

San Mateo County (Unincorporated Areas)

Water-surface elevations and the capacities of natural channels were computed using the USACE HEC-2 step-backwater computer program (Reference 19), supplemented by hand calculations and special computer programs developed by the study contractor for the original study (Reference 38). For manmade prismatic channels, elevations and capacities were computed using the direct step- backwater computer program (Reference 34).

Aerial photogrammetry was used to obtain topographic mapping of the study areas at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35). Digitized cross sections were obtained from the mapper at pre-selected locations. Field measurements were used to supplement the available data. In the La Honda area, forest cover was too dense to use aerial photogrammetry. Therefore, cross sections were obtained by field survey and located on topographic maps enlarged to a scale of 1”:24,000’, with a contour interval of 40 feet (Reference 52).

Cross sections for backwater analyses were located short distances upstream and downstream of hydraulically significant features in order to establish the backwater effect of such features.

Most culverts were analyzed using a separate computer program developed by the study contractor for the original study that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 38).

Roughness factors (Manning's “n”) used in the hydraulic computations were assigned on the basis of field inspection of floodplain areas, The values used for the channels varied between 0.019 and 0.050; values for the overbanks varied between 0.020 and 0.100.

Starting water-surface elevation for reaches extending into tidal areas was set at the Mean Higher High Water tidal level. In the San Francisco Bay area, this value ranged from 3.6 feet at the San Francisco International Airport to 4.2 feet at the Palo Alto Yacht Harbor. On the Pacific Ocean, an elevation of 2.6 feet was used for the entire coastside of the county. In nontidal reaches, starting water-surface elevations were determined by normal-depth analysis.

Shallow flooding occurs between Bayshore Freeway and the mainline of the railroad from overland flows from San Bruno and Crystal Springs Channels.

Shallow flooding from Lomita Channel also occurs between Bayshore Freeway and the railroad.

Belmont Creek and Holly Street Channel cause 1-percent annual chance shallow flooding of less than 1.0 foot deep between the railroad and Bayshore Freeway (U. S. Highway 101).

Shallow flooding from Denniston Creek occurs from the intersection of California and Harvard Avenues to the shoreline and along Somora Avenue and Cabrillo Highway between Denniston Creek and the intersection of Presidad and Sonora Avenues south to the shoreline.

Shallow flooding occurs along El Granada Creek south of Avenue Alhambra.

Where overbank flooding is shallow and hydraulically independent of the adjacent stream channel, channel flood profiles are inapplicable. The extent of such overbank flooding was determined using appropriate methods. For San Bruno, Crystal Springs, and Holly Street Channels and Belmont Creek, the 1- percent annual chance flooding is contained in the channel in the unincorporated areas of San Mateo County.

Manning's equation was used to determine the capacity of closed conduit stormdrains and for normal-depth calculations of shallow flooding areas.

Approximate flooding shown on Flood-Prone Area and Flood Hazard Boundary Maps (References 53 and 54, respectively) was checked for reasonableness for Arroyo de en Medio; Arroyo de los Frijoles; and Parisima, Lobitos, Lower San Gregorio, Upper Pescadero, Upper Butano, Little Butano, and Green Oaks Creeks. Approximate studies for Guadelupe Valley Drain and Tunitas Creek were determined using normal-depth calculations based on field inspection and topographic maps (References 55 and 56).

First Time Countywide FIS, October 12, 2012

City of Pacifica

Pacifica submitted a revised study for Calera Creek in April 2011. This study realigned the existing channel (Reference 57).

Levee Hazard Analysis

Some flood hazard information presented in prior FIRMs and in prior FIS reports for San Mateo County and its incorporated communities was based on flood protection provided by levees. Based on the information available and the mapping standards of the National Flood Insurance Program at the time that the prior FISs and FIRMs were prepared, FEMA accredited the levees as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year. For FEMA to continue to accredit the identified levees with providing protection from the base flood, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

On August 22, 2005, FEMA issued Procedure Memorandum No. 34 - Interim Guidance for Studies Including Levees. The purpose of the memorandum was to help clarify the responsibility of community officials or other parties seeking recognition of a levee by providing information identified during a study/mapping project. Often, documentation regarding levee design, accreditation, and the impacts on flood hazard mapping is outdated or missing altogether. To remedy this, Procedure Memorandum No. 34 provides interim guidance on procedures to minimize delays in near-term studies/mapping projects, to help our mapping partners properly assess how to handle levee mapping issues.

While 44 CFR Section 65.10 documentation is being compiled, the release of more up-to-date FIRM panels for other parts of a community or county may be delayed. To minimize the impact of the levee recognition and certification process, FEMA issued Procedure Memorandum No. 43 - Guidelines for Identifying Provisionally Accredited Levees on March 16, 2007. These guidelines will allow issuance of preliminary and effective versions of FIRMs while the levee owners or communities are compiling the full documentation required to show compliance with 44 CFR Section 65.10. The guidelines also explain that preliminary FIRMs can be issued while providing the communities and levee owners with a specified timeframe to correct any maintenance deficiencies associated with a levee and to show compliance with 44 CFR Section 65.10.

FEMA contacted the communities within San Mateo County to obtain data required under 44 CFR 65.10 to continue to show the levees as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year.

FEMA understood that it may take time to acquire and/or assemble the documentation necessary to fully comply with 44 CFR 65.10. Therefore, FEMA put forth a process to provide the communities with additional time to submit all the necessary documentation. For a community to avail itself of the additional time, it had to sign an agreement with

FEMA. Levees for which such agreements were signed are shown on the final effective FIRM as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year and labeled as a Provisionally Accredited Levee (PAL). Communities have two years from the date of FEMA's initial coordination to submit to FEMA final accreditation data for all PALs. Following receipt of final accreditation data, FEMA will revise the FIS and FIRM as warranted.

FEMA coordinated with the U.S. Army Corps of Engineers, the local communities, and other organizations to compile a list of levees that exist within San Mateo County. Table 7, "List of Structures Requiring Flood Hazard Revisions" lists all levees shown on the FIRM, to include PALs, for which corresponding flood hazard revisions were made.

Approximate analyses of "behind levee" flooding were conducted for all the levees in Table 7 to indicate the extent of the "behind levee" floodplains. The methodology used in these analyses is discussed below.

The approximate levee analysis was conducted using information from existing hydraulic models (where applicable) and USGS topographic maps.

The extent of the 1-percent-annual-chance flood in the event of levee failure was determined. Normal-depth calculations were used to estimate the base flood elevation if detailed topographic or representative cross section information was available. The remaining base flood elevations were estimated from effective FIRM maps. The 1-percent-annual-chance floodplain boundary followed the contour line representing the estimated base flood elevation. Topographic features such as highways, railroads, and high ground were used to refine approximate floodplain boundary limits. The 1-pecent annual chance peak flow and floodplain widths and depth (assumed at 1 foot) were used to ensure the floodplain boundary was not overly conservative.

Several levees within San Mateo County and its incorporated communities meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems." Table 8, "List of Certified and Accredited Levees" lists all levees shown on the FIRM that meet the requirements of 44 CFR 65.10 and have been determined to provide protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year.

Table 7: List of Structures Requiring Flood Hazard Revisions

Levee Inventory ID	Community	Flood Source	Latitude/ Longitude (Begin, End Points)	FIRM panel(s)	USACE Levee
P2433	City of Belmont	Belmont Slough	-122.267, 37.524; -122.266, 37.524	06081C0169G	No
P2434	City of Belmont	Belmont Creek	-122.265, 37.522; -122.264, 37.523	06081C0169G	No
P1915	City of San Mateo	San Mateo Creek	-122.311, 37.573; -122.307, 37.574	06081C0158G	No
P242	City of San Mateo	San Francisco Bay	-122.318, 37.586; -122.317, 37.584	06081C0154G	No
P2034	City of South San Francisco	San Francisco Bay	-122.391, 37.64; -122.39, 37.642	06081C0044F	No

Table 8: List of Certified and Accredited Levees

Levee Inventory ID	Community	Flood Source	Latitude/ Longitude (Begin, End Points)	FIRM panel(s)	USACE Levee
P771	City of Foster City	San Francisco Bay	-122.288, 37.571; -122.277, 37.535	06081C0158G, 06081C0159G, 06081C0167G, 06081C0178F, 06081C0186F	No
P1918b	City of Redwood City	Belmont Slough	-122.26, 37.53; -122.26, 37.532	06081C0167G, 06081C0169G	No
P3000a	City of Redwood City	San Francisco Bay	-122.233, 37.536; -122.227, 37.544	06081C0186F	No
P3000c	City of Redwood City	San Francisco Bay	-122.229, 37.548; -122.243, 37.549	06081C0186F	No
P3000d	City of Redwood City	San Francisco Bay	-122.227, 37.544; -122.229, 37.548	06081C0186F	No
P3000e	City of Redwood City	San Francisco Bay	-122.249, 37.541; -122.259, 37.539	06081C0167G, 06081C0186G	No
P3001a	City of Redwood City	Steinberger Slough	-122.248, 37.519; -122.233, 37.537	06081C0186F, 06081C0188F	No
P3007a	City of Redwood City, City of San Carlos	Steinberger Slough	-122.248, 37.519; -122.249, 37.516	06081C0188F	No

Table 8: List of Certified and Accredited Levees (continued)

Levee Inventory ID	Community	Flood Source	Latitude/ Longitude (Begin, End Points)	FIRM panel(s)	USACE Levee
P1992	City of San Carlos	Pulgas Creek	-122.247, 37.506; -122.246, 37.509	06081C0188F	No
P3006	City of San Carlos	Steinberger Slough	-122.249, 37.516; -122.246, 37.509	06081C0188F	No
P1916	City of San Mateo	O'Neill Slough	-122.277, 37.535; -122.277, 37.534	06081C0167G	No
P2024	City of San Mateo	O'Neill Slough	-122.277, 37.533; -122.277, 37.534	06081C0167G	No
P2430	City of San Mateo	San Mateo Creek	-122.308, 37.574; -122.306, 37.574	06081C0158E	No
P2980	City of San Mateo	San Mateo Creek	-122.306, 37.574; -122.305, 37.575	06081C0158G	No
P2981	City of San Mateo	San Mateo Creek	-122.306, 37.574; -122.305, 37.575	06081C0158G	No
P2983	City of San Mateo	Marina Lagoon	-122.294, 37.57; -122.294, 37.569	06081C0158G	No
P770	City of San Mateo	San Francisco Bay	-122.297, 37.573; -122.296, 37.571	06081C0158G	No

Table 8: List of Certified and Accredited Levees (continued)

Levee Inventory ID	Community	Flood Source	Latitude/ Longitude (Begin, End Points)	FIRM panel(s)	USACE Levee
P778	City of San Mateo	San Mateo Creek	-122.311, 37.572; -122.313, 37.571	06081C0158G	No
1139	City of San Mateo	San Francisco Bay	-122.292, 37.571; -122.293, 37.571	06081C0158G	No

Check with your local community to obtain more information, such as the estimated level of protection provided by levees (which may exceed the 1-percent annual chance level) and Emergency Action Plan on the levee systems shown as providing protection in San Mateo County. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and flood-proofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/businee/nfip/index.shtm.

3.3 Coastal Hazard Analysis

The hydraulic characteristics of coastal flood sources were analyzed to provide estimates of flood elevations for selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown in the coastal data tables and flood profiles provided in the FIS report.

Elevations for floods of the selected recurrence intervals on the Pacific Ocean and the San Francisco Bay are shown in Table 9, "Summary of Stillwater Elevations." Table 10, “Transect Locations,” provides a listing of the transect locations, and Figure 1 presents a sample transect.

Table 9: Summary of Stillwater Elevations

	Elevation (feet NAVD88)*			
Flooding Source and Location	**10-percent Annual Chance**	**2-percent Annual Chance**	**1-percent Annual Chance**	**0.2-percent Annual Chance**
SAN FRANCISCO BAY				
At South San Francisco	8.9	9.2	9.3	9.6
At Millbrae	9.0	9.5	9.6	9.9
At Burlingame	9.2	9.6	9.7	10.0
At Redwood Shores	9.3	9.6	9.7	10.0
At Redwood Creek	9.0	9.4	9.5	9.8
At Marsh Road/Bayshore Freeway Interchange (East Redwood City)	9.5[4]	9.7[4]	10.2[3]	10.2[4]
At Willow Road	[1]	[1]	10.3	[1]
10,030 feet south of Dumbarton Bridge	[1]	[1]	10.4	[1]
At San Francisquito Creek	9.8[3]	10.0[3]	10.4[5]	10.5[3]
PACIFIC OCEAN				
Sharp Park State Beach	7.6	8.0	8.0	8.4
San Pedro Valley	7.6	8.0	8.0	8.4
Miramar Beach (at Arroyo de en Medio) [2]	7.4	7.4	7.8	8.0
Martins Beach	7.4	7.7	7.8	8.0
Central Lagoon [7,8] Entire lagoon	[1]	[1]	1.9	[1]
Marina Lagoon [7] Entire lagoon	[1]	[1]	2.4	[1]
Redwood Shores Lagoon [6,7] Entire lagoon	[1]	[1]	2.8	[1]

* Rounded to the nearest tenth of a foot

[1] Data not available

[2] Taken from City of Half Moon Bay FIS dated June 3, 1986 (Reference 21)

[3] Taken from City of Menlo Park FIS revised April 21, 1999 (Reference 58)

[4] Taken from San Mateo (Unincorporated Areas) FIS dated August 5, 1986 (Reference 59)

[5] Taken from East Palo Alto FIS revised August 23, 1999 (Reference 60)

[6] Mapped as Zone A on FIRM panels

[7] 1%Annual Chance Flood Discharge Contained in Lagoon notes have been added to the FIRM panels

[8] Elevation is rounded to 2 feet on FIRM panels

Table 10: Transect Locations

Study Area	Transect Number	Location
Sharp Park State Beach	1	Between the coastline and Palmetto Avenue along Paloma Avenue
San Pedro Valley	2	From the coastline, southeast 615 feet to the cyclone fence
Miramar Beach (Arroyo de en Medio)	3	From the coastline, east and upslope 650 feet along Medio Avenue
Martins Beach	4	From the coastline, east and upslope 450 feet to the main access road

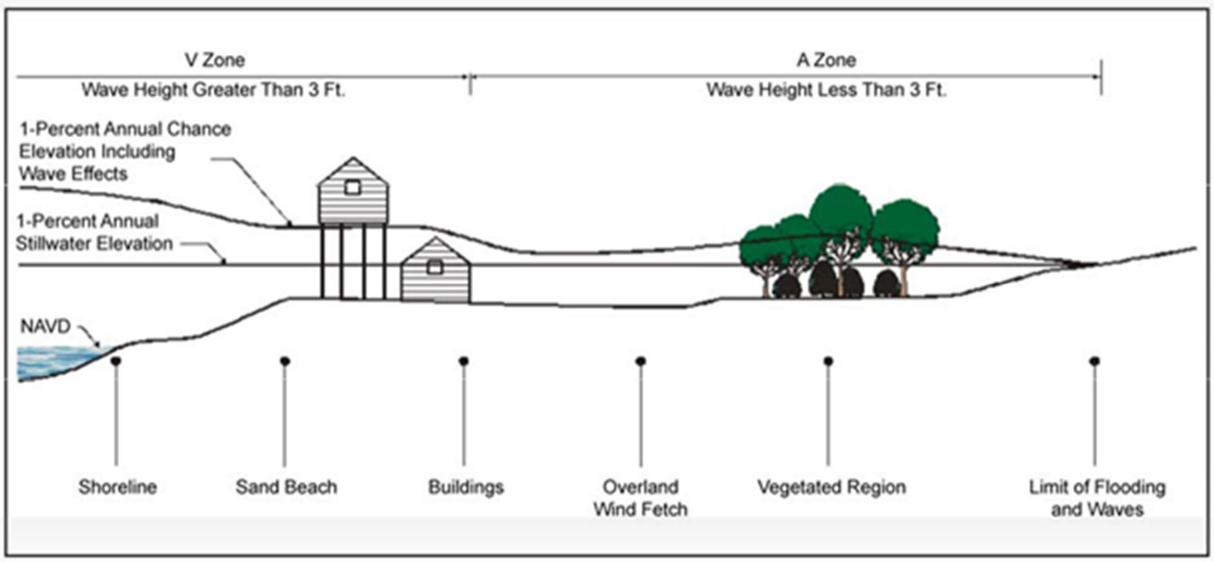

Figure 1: Typical Transect Schematic

For each community within San Mateo County that had a previously printed FIS report, the Coastal Hazard analyses described in those reports have been compiled and are summarized below.

Previous Community Analyses

City of Half Moon Bay

Analyses were carried out to establish the peak elevation-frequency relationships for the flooding source studied in detail.

Swell-wave and wind-wave frequency and magnitude components were determined by a two-step process. The first step defined a Stillwater elevation that included effects of astronomical tide, storm surge, and wave setup. The second step determined wave runup above Stillwater elevation onto the beach.

Storm surge is the superelevation of the water level above the astronomical tide elevation caused by the low barometric pressure and wind stresses of a storm.

Storm surge was evaluated only for definition of the wind-wave component of landfalling storms. Setup is an additional superelevation of the water-surface produced by wave action, and the magnitude of wave setup varies with wave characteristics, bathymetry, and beach profile. Because wave setup varies with the characteristics of the waves, different Stillwater elevations and magnitude relations were defined for wind waves from the northwest, wind waves from the southwest, swell waves from the northwest, and swell waves from the southwest. Wave runup is the maximum elevation of a wave breaking onto a beach and varies with wave characteristics, bathymetry, and beach profile.

The storm surge at the City of Half Moon Bay was defined by a two-dimensional, finite-element computer model (Reference 61). Applicability of the model had been tested by using long-term climatic records for San Francisco (Reference 62) to synthesize a long-term record of storm surge hydrographs for San Francisco Bay. The close comparison of synthesized data with available tidal records confirmed the usability of the model for California storm conditions. For Half Moon Bay the model synthesized a record of storm surges from both the northwest and southwest quadrants based on windspeed, wind direction, and barometric pressure data, from 1955 to 1983, determined from North American Surface Weather Maps (Reference 63).

The effect of storm surge was combined with astronomical tide and wave setup to define the Stillwater elevation needed to evaluate the wind-wave runup. Characteristics of astronomical tide could be reliably defined from previous studies (Reference 64) and were convoluted with storm surge (Reference 65). The magnitude of wind-wave setup was calculated by an iterative process coupled with the wave runup calculations.

Runup of wind waves was evaluated by first determining the deepwater wave conditions from both the southwest and northwest quadrants using the 1955-to- 1983 climatic data and methods described in Reference 65. A wave tracking model (Reference 4) then transformed the deep water waves as they traveled toward the shoreline on the basis of bathymetry and beach profiles. Beach transects along the coast provided a generalized representation of the beach profiles that control the magnitude of wave runup. In coastal-study areas, beach transects were oriented perpendicular to the shoreline and were strategically located along the shore to represent reaches with similar characteristics. Data were primarily obtained from offshore bathymetry maps supplemented with 1978 USACE survey data (Reference 66). The wave runup along sloping sandy beaches was computed by Hunt's method (Reference 67); at obstructions, it was computed by Stoa's method (Reference 68).

City of Pacifica

Swell-wave and wind-wave frequency and magnitude components were determined by a two-step process. The first step defined a Stillwater elevation that included effects of astronomical tide, storm surge, and wave setup, The second step determined wave runup above Stillwater elevation onto the beach.

Storm surge is the superelevation of the water level above the astronomical tide elevation caused by the low barometric pressure and wind stresses of a storm. Storm surge was evaluated only for definition of the wind-wave component of landfalling storms. Setup is an additional superelevation of the water-surface produced by wave action, and the magnitude of wave setup varies with wave characteristics, bathymetry, and beach profile. Because wave setup varies with the characteristics of the waves, different Stillwater elevations and magnitude relations were defined for wind waves from the northwest, wind waves from the southwest, swell waves from the northwest, and swell waves from the southwest. Wave runup is the maximum elevation of a wave breaking onto a beach and varies with wave characteristics, bathymetry, and beach profile.

The storm surge at Pacifica was defined by a two-dimensional, finite-element computer model (Reference 61). Applicability of the model had been tested by using long-term climatic records for San Francisco (Reference 62) to synthesize a long-term record of storm surge hydrographs for San Francisco Bay. The close comparison of synthesized data with available tidal records confirmed the usability of the model for California storm conditions. For Pacifica, the model synthesized a record of storm surges from both the northwest and southwest quadrants based on windspeed, wind direction, and barometric pressure data, from 1955 to 1983, determined from North American Surface Weather Maps (Reference 63).

The effects of storm surge were combined with astronomical tide and wave setup to define the Stillwater elevation needed to evaluate the wind-wave runup. Characteristics of astronomical tide at Pacifica could be reliably defined from previous studies (Reference 64) and were convoluted with storm surge (Reference 65). The magnitude of wind-wave setup was calculated by an iterative process coupled with the wave runup calculations.

Runup of wind waves was evaluated by first determining the deepwater wave conditions from both the southwest and northwest quadrants using the 1955-1983 data and methods described in Reference 65. A wave-tracking model (Reference 69) then transformed the deepwater waves, as they traveled toward the shoreline, on the basis of bathymetry and beach profiles. Beach transects along the coast provided a generalized representation of the beach profiles that control the magnitude of wave runup. In coastal-study areas, beach transects were oriented perpendicular to the shoreline and were strategically located along the shore to represent reaches with similar characteristics. Data were primarily obtained from offshore bathymetry maps supplemented with 1978 USACE survey data (Reference 66). The wave runup along sloping sandy beaches was computed by Hunt's method (Reference 67); at obstructions, it was computed by Stoa's method (Reference 68).

The elevation-probability distribution for swell waves followed a similar development. Stillwater was defined only from wave setup convoluted with astronomical tide. The frequency of offshore wave height and wave period from the northwest and southwest quadrants were determined from available data (Reference 70) and routed shoreward with the wave tracking model. The runup elevation at each beach transect was calculated using Hunt's and Stoa's methods.

Tsunami plus astronomical tide elevations having 1-percent and 0.2-percent annual chance recurrence intervals have been published (References 71, 72, and 73), and for this analysis, the complete magnitude-frequency relationship was defined from supporting data for those earlier studies.

The joint probability of wind waves from the northwest and southwest quadrants, swell waves from the northwest and southwest quadrants, and of tsunami was defined on the assumption that the events are independent.

San Mateo County (Unincorporated Areas)

Swell-wave and wind-wave frequency and magnitude components were determined by a two-step process. The first step defined a Stillwater elevation that included effects of astronomical tide, storm surge, and wave setup. The second step determined wave runup above Stillwater elevation onto the beach.

Storm surge is the superelevation of the water level above the astronomical tide elevation caused by the low barometric pressure and wind stresses of a storm. Storm surge was evaluated only for definition of the wind-wave component of landfalling storms. Setup is an additional superelevation of the water-surface produced by wave action, and the magnitude of wave setup varies with wave characteristics, bathymetry, and beach profile. Because wave setup varies with the characteristics of the waves, different Stillwater elevations and magnitude relations were defined for wind waves from the northwest, wind waves from the southwest, swell waves from the northwest, and swell waves from the southwest. Wave runup is the maximum elevation of a wave breaking onto a beach and varies with wave characteristics, bathymetry, and beach profile.

The storm surge in San Mateo County (Unincorporated Areas) along the Pacific Coast was defined by a two-dimensional, finite-element computer model (Reference 61). Applicability of the model had been tested by using long-term climatic records for San Francisco (Reference 62) to synthesize a long-term record of storm surge hydrographs for San Francisco Bay. The close comparison of synthesized data with available tidal records confirmed the usability of the model for California storm conditions. For San Mateo County, the model synthesized a record of storm surges from both the northwest and southwest quadrants based on windspeed, wind direction, and barometric pressure data, from 1955 to 1983, determined from North American Surface Weather Maps (Reference 63).

The effect of storm surge was combined with astronomical tide and wave setup to define the Stillwater elevation needed to evaluate the wind-wave runup. Characteristics of astronomical tide could be reliably defined from previous studies (Reference 64) and were convoluted with storm surge (Reference 64). The magnitude of windwave setup was calculated by an iterative process coupled with the wave-runup calculations.

Runup of wind waves was evaluated by first determining the deepwater wave conditions from both the southwest and northwest quadrants using the 1955-1983 climatic data and methods described in Reference 65. A wave tracking model (Reference 69) then transformed the deepwater waves as they traveled toward the shoreline on the basis of bathymetry and beach profiles. Beach transects along the coast provided a generalized representation of the beach profiles that control the magnitude of wave runup. In coastal-study areas, beach transects were oriented perpendicular to the shoreline and were strategically located along the shore to represent reaches with similar characteristics. Data were primarily obtained from offshore bathymetry maps supplemented with 1978 USACE survey data (Reference 66). Table 10, "Transect Locations," provides a listing of the transect locations, and Figure 1 presents a sample transect. The wave runup along sloping sandy beaches was computed by Hunt's method (Reference 67); at obstructions, it was computed by Stoa's method (Reference 68).

The elevation-probability distribution for swell waves followed a similar development. Stillwater was defined only from wave setup convoluted with astronomical tide. The frequency of offshore wave height and wave period from the northwest and southwest quadrants were determined from available data (Reference 70) and routed shoreward with the wave tracking model. The runup elevation at each beach transect was calculated using Hunt's and Stoa's methods.

Tsunami plus astronomical tide elevations having 1-percent and 0.2-percent annual chance recurrence intervals have been published (References 71, 72, and 73), and for this analysis, the complete magnitude-frequency relationship was defined from supporting data for those earlier studies.

The joint probability of wind waves from the northwest and southwest quadrants, swell waves from the northwest and southwest quadrants, and of tsunami was defined on the assumption that the events are independent.

<u>Cities of Burlingame, Millbrae, Redwood City, and South San Francisco</u>

Elevations of tidal floods of the selected recurrence intervals were obtained by correlating the existing U.S. Coast and Geodetic Survey data (Reference 36) from various gaging stations within San Francisco Bay and interpolating between stations. The effects of tsunami-induced flooding (Reference 74) were considered and found to be less severe than the effects of tidal flooding in this area of the bay.

<u>Cities of East Palo Alto, and Menlo Park</u>

Originally the elevations of tidal floods of the selected recurrence intervals were obtained by correlating the existing U.S. Coast and Geodetic Survey data (Reference 36) from various gaging stations within San Francisco Bay and interpolating between stations. The effects of tsunami-induced flooding (Reference 74) were considered and found to be less severe than the effects of tidal flooding in this area of the bay.

Tidal elevations in the San Francisco Bay were revsied by the The USACE report entitled "San Francisco Bay, Tidal Stage vs. Frequency Study" (Reference 45), summarizes the results of a tidal stage-frequency restudy of the San Francisco Bay. This report does not consider the effects of wave height or runup on the 1- percent annual chance flood water-surface elevation.

City of San Carlos

Tidal elevation-frequency data for the City of San Carlos were obtained from a frequency curve of observed annual maximum tides at San Francisco (Ft. Point), prepared by the USACE and transferred to the San Carlos area on the basis of data compiled by the U.S. Coast and Geodetic Survey (Reference 75). For this study, an elevation of 7.0 feet (above Mean Sea Level (msl)) was used for the base-tidal (1-percent annual chance) elevation; and an elevation of 7.5 feet (above msl) was adopted for the 0.2-percent annual chance tidal elevation. Tidal velocities are minimal.

Some agencies have in their reports referred tidal elevations to Mean Lower Low Water (MLLW). MLLW at San Carlos is about 4 feet below m.s.l., and therefore the 1-percent annual chance high tide elevation of 7.0 feet would be about 11.0 feet above MLLW.

Cities of Brisbane, Daly City, Foster City, Redwood City, and San Mateo

Coastal Hazards for these communities as shown on the FIRMs can be taken from the historic FIS for the adjacent communities listed above.

3.4 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in base flood elevations across the corporate limits between the communities.

The conversion factor from NGVD29 to NAVD88 was +2.75 feet for all streams and Stillwater elevations in San Mateo County.

As noted above, the elevations shown in the FIS report and on the FIRM for San Mateo County are referenced to NAVD88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD29 by applying a standard conversion factor.

The Base Flood Elevations shown on the FIRM represent whole-foot rounded values. For example, a Base Flood Elevation of 102.4 will appear as 102 on the FIRM and 102.6 will appear as 103. Therefore, users that wish to convert the elevations in this FIS to NGVD29 should apply the stated conversion factor(s) to elevations shown on the Flood Profiles and supporting data tables in the FIS report.

For additional information regarding conversion between the NGVD29 and NAVD88, visit the National Geodetic Survey website at http://www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the TSDN associated with the FIS report and FIRM for this county. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-percent, 2- percent, 1-percent, and 0.2-percent annual chance flood elevations; delineations of the 1- percent and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1-percent and 0.2-percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were originally interpolated using topographic maps at a scale and a contour interval as shown on Table 11, “Topographic Map Information.”

Table 11: Topographic Map Information

Community	Scale	Contour Interval (feet)	Reference
Town of Atherton[1]			
City of Belmont[1]			
City of Brisbane[1]			
City of Burlingame	1" : 4,800'	2	38
Town of Coma[1]			
City of Daly City[1]			
City of East Palo Alto	1" : 4,800' (original) 1" : 2,400' (restudy)	2 1	38 45
City of Foster City		1	76
City of Half Moon Bay	1" : 4,800'	4	63
Town of Hillsborough	1" : 200'	2	47
City of Menlo Park	1" : 4,800' (original) 1" : 2,400' (restudy)	2 1	38 45
City of Millbrae	1" : 4,800'	2	38
City of Pacifica	1" : 4,800' 1" : 4,800'	2 4	38 1
Town of Portola Valley	1" : 200' 1" : 24,000'	10 20	73 74
City of Redwood City	1" : 4,800'	2	38
City of South San Francisco	1" : 4,800'	2	38
City of San Bruno[1]			
City of San Carlos	1" : 500'	1-10	[1]
City of San Mateo	1" : 200' 1" : 400'	2 [1]	47 76
Town of Woodside	1" : 4,800' 1" : 24,000'	1 10	78 79
San Mateo County (Unincorporated Areas)	1" : 4,800' 1" : 24,000' 1" : 4,800' 1": 24,000'	2 40 4 25 & 40	38 53 71 56-57

[1]Data not available

The 1-percent and 0.2-percent annual chance floodplain boundaries are shown on the FIRM (Published Separately). On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, V and VE), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1-percent and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM (Published Separately).

Flood boundaries for creeks studied by approximate methods were established according to the professional judgment of engineers familiar with the region taking into account flood elevations estimated from available data, existing hydrologic and hydraulic analyses, correlations with similar streams, and field observations.

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

For each community within San Mateo County that had a previously printed FIS report, the floodplain boundaries described in those reports have been compiled and are summarized below.

Previous Community Analyses

<u>City of Burlingame</u>

For each stream studied in detail, the boundaries of the 1-percent annual chance flood have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

For stream channels designated as “Zone A Contained in Channel,” the 1-percent annual chance flood boundaries are based on the existing channel alignment and right-of-way.

For those areas subject to shallow flooding, boundaries of the 1-percent annual chance flood were delineated using the appropriate elevations and depths and topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

Flood boundaries for those areas subject to tidal flooding were delineated using the appropriate elevations, engineering judgment, and topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

City of East Palo Alto

For each stream studied in detail, the 1-percent annual chance and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

For stream channels designated as “Zone A Contained in Channel,” the 1-percent annual chance flood boundaries are based on the existing channel alignment and right-of-way.

Shallow flood boundaries were delineated using the appropriate depths, topographic maps (Reference 35), and field inspection.

Tidal flooding boundaries were delineated using topographic maps (Reference 35) in conjunction with previously determined elevations and historic flood information from the 1973 flood.

City of Half Moon Bay

For the Pacific Ocean reach studied in detail, the 1-percent annual chance and 0.2-percent annual chance floodplain boundaries have been delineated using a topographic map at a scale of 1”:4,800’, with a contour interval of 4 feet, developed from an aerial photograph (Reference 77).

Town of Hillsborough

For each stream studied by detailed methods, the 1-percent annual chance and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1”:200’, with a contour interval of 2 feet (Reference 44).

City of Menlo Park

For each stream studied in detail, the boundaries of the 1-percent annual chance and 0.2-percent annual chance floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

For stream channels designated as “Zone A Contained in Channel”, the 1-percent annual chance flood boundaries are based on the existing channel alignment and right-of-way.

Shallow flood boundaries were delineated using the appropriate depths, topographic maps (Reference 35), and by field inspection.

Tidal flooding boundaries were delineated using topographic maps (Reference 35) in conjunction with previously determined elevations and historic flood information from the 1973 flood.

City of Millbrae

For each stream studied in detail, the boundaries of the 1-percent annual chance flood have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1":4,800', with a contour interval of 2 feet (Reference 35).

For stream channels designated as "Zone A Contained in Channel," the 1-percent annual chance flood boundaries are based on the existing channel alignment and right-of-way.

For those areas subject to shallow flooding, boundaries of the 1-percent annual chance flood were delineated using the appropriate elevations and depths and topographic maps at a scale of 1":4,800', with a contour interval of 2 feet (Reference 35).

Flood boundaries for those areas subject to tidal flooding were delineated using the appropriate elevations, engineering judgment, and topographic maps at a scale of 1":4,800', with a contour interval of 2 feet (Reference 35).

City of Pacifica

For each stream studied in detail, the 1-percent annual chance and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of l":4,800', with a contour interval of 2 feet (Reference 78). Detailed-study reaches along the Pacific coast were delineated using topographic maps at a scale of 1":4,800', with a contour interval of 4 feet, developed from aerial photographs.

Shallow floodplain boundaries were delineated using the appropriate depths and topographic maps mentioned above.

Approximate 1-percent annual chance floodplain boundaries in some portions of the study area were taken directly from the previous Flood Insurance Rate Map (Reference 79).

For stream channels designated as "Zone A Contained in Channel," the 1-percent annual chance floodplain boundaries are based on existing channel alignment and right-of -way.

Town of Portola Valley

For each stream studied in detail, the boundaries of the 1-percent annual chance and 0.2-percent annual chance floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at scale of 1":200', with a contour interval of 10 feet (Reference 80).

For streams studied by approximate methods, the boundaries of the 1-percent annual chance flood were delineated on U.S. Geological Survey Quadrangle Maps at a scale of 1":24,000', with a contour interval of 20 feet (Reference 81), or taken from a U.S. Geological Survey Flood-Prone Area Map (Reference 82). Approximate boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map (FHBM).

City of Redwood City

For each stream studied in detail, the boundaries of the 1-percent annual chance and 0.2-percent annual chance floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

Tidal flood boundaries were delineated using appropriate elevations and topographic maps (Reference 48).

Portions of Redwood Creek were designated as “Zone A Contained in Channel.” The 1-percent annual chance flood boundaries were based on the existing channels.

Shallow flood boundaries were delineated using the appropriate depths and topographic maps (Reference 35). The 0.2-percent annual chance flood boundaries were not determined where shallow flooding conditions prevail.

Areas studied by approximate methods were delineated using the determined elevations and topographic maps (Reference 48).

In accordance with FEMA guidelines, approximate floodplains less than 200 feet wide were determined to be areas of minimal flood hazard and have not been delineated.

City of San Carlos

For each stream studied in detail, the boundaries of the 1-percent annual chance flood and the 0.2-percent annual chance flood have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps. Topographic maps used were contained in a storm drainage report on Brittan Creek (Reference 9) and a survey report on streams in San Mateo County (Reference 75). These and unpublished county maps were supplemented by topographic field surveys at a horizontal scale of 1”:500’, and varied contour intervals ranging from 1 foot to 10 feet.

City of San Mateo

For each stream studied by detailed methods, the 1-percent annual chance and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1”:200’, with a contour interval of 2 feet (Reference 44).

In the vicinity of the San Francisco Bay, topographic mapping at a scale of 1”:400’ (Reference 83) was used to supplement the 1”:200’ contour mapping (Reference 44). South of State Highway 92, in the vicinity of Marina Lagoon, floodplain boundaries were delineated using manhole elevations provided by the City of San Mateo Department of Public Works (Reference 84).

City of South San Francisco

For each stream studied in detail, the boundaries of the 1-percent annual chance and 0.2-percent annual chance floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

For stream channels designated as “Zone A Contained in Channel,” the 1-percent annual chance flood boundaries are based on the existing channel alignment and right-of-way.

For those areas subject to shallow flooding, boundaries of the 1-percent annual chance flood were delineated using the appropriate elevations and depths and topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

Flood boundaries for those areas subject to tidal flooding were delineated using the appropriate elevations, engineering judgment, and topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

Town of Woodside

For each stream studied in detail, the boundaries of the 1-percent annual chance and 0.2-percent annual chance floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps a t scale of 1”:4,800’ (Reference 85) and U.S. Geological Survey topographic maps at a scale of 1”:24,000’, with a contour interval of 10 feet (Reference 86).

San Mateo County (Unincorporated Areas)

For each stream studied in detail, except La Honda, Woodhams, San Gregorio, and Alpine Creeks, the 1-percent annual chance and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1”:4,800’, with a contour interval of 2 feet (Reference 35).

For La Honda, Woodhams, San Gregorio, and Alpine Creeks, the 1-percent annual chance and 0.2-percent annual chance floodplain boundaries were delineated using flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1”:24,000’, enlarged to 1”:4,800’, with a contour interval of 40 feet (Reference 52).

For the Pacific Ocean, detailed floodplain boundaries were delineated using topographic maps at a scale of 1”:4,800’, with a contour interval of 4 feet, developed from aerial photographs (Reference 77).

Boundaries for shallow flooding areas were delineated using the appropriate depths and topographic maps mentioned previously (Reference 35).

Approximate floodplain boundaries for Guadelupe Valley Drain and Tunitas Creek were delineated using topographic maps at a scale of 1”:24,000’, with contour intervals of 25 and 40 feet (References 55 and 56). Approximate boundaries in some portions of the study area were taken directly from the FHBM.

First Time countywide FIS, October 16, 2012

City of Foster City and San Mateo

Floodplain boundaries within the City of Foster City and City of San Mateo were revised based on the behind levee analysis and subsequent levee accreditation. These boundaries were revised based on 1 ft contour maps supplied by Foster City, dated 2008 (Reference 76).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1- percent annual chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections. The computed floodways are shown on the revised FIRM (Published Separately). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

As shown on the FIRM (Published Separately), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 1-percent annual chance flood boundaries are close together, only the floodway boundary has been shown.

Cross sections for stream floodways studied in detail are presented on Table 12, “Floodway Data Table.”

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD 88)	WITHOUT FLOODWAY (FEET NAVD 88)	WITH FLOODWAY (FEET NAVD 88)	INCREASE (FEET)
La Honda Creek								
A	100	74	481	8.7	327.8	326.1[2]	326.1	0.0
B	270	67	528	8.0	327.8	327.0[2]	327.0	0.0
C	390	43	318	13.2	327.8	327.2[2]	327.2	0.0
D	790	44	324	13.0	330.6	330.6[2]	331.4	0.8
E	1,440	67	448	9.4	337.0	337.0	337.9	0.9
F	1,850	50	299	14.0	344.9	344.9	344.9	0.0
G	2,300	56	312	13.5	352.5	352.5	352.5	0.0
H	2,670	55	376	11.2	361.6	361.6	361.7	0.1
I	3,060	49	356	11.8	365.1	365.1	365.1	0.0
J	3,910	89	362	11.6	376.0	376.0	376.0	0.0
K	4,400	195	535	7.8	383.4	383.4	383.4	0.0
L	4,700	237	1,363	3.1	393.5	393.5	393.5	0.0
M	4,940	206	1,402	3.0	393.6	393.6	393.6	0.0
N	5,980	49	298	14.1	416.7	416.7	416.7	0.0
O	6,770	69	302	11.9	436.3	436.3	436.3	0.0
P	7,590	28	229	15.7	449.6	449.6	449.6	0.0

[1] Feet above confluence with San Gregorio Creek
[2] Elevations computed without consideration of backwater

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY
SAN MATEO COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

LA HONDA CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD 88)	WITHOUT FLOODWAY (FEET NAVD 88)	WITH FLOODWAY (FEET NAVD 88)	INCREASE (FEET)
Pescadero Creek								
A	197	261	3,265	7.4	17.3	17.3	17.4	0.1
B	1,705	1,999	22,137	1.1	17.8	17.8	18.4	0.6
C	3,115	2,933	32,014	0.7	17.9	17.9	18.5	0.6
D	4,344	3,316	35,043	0.7	17.9	17.9	18.5	0.6
E	5,465	2,739	28,014	0.9	17.9	17.9	18.5	0.6
F	6,321	1,831	17,109	1.4	17.9	17.9	18.5	0.6
G	7,938	2,138	15,446	1.6	17.9	17.9	18.5	0.6
H	8,940	1,201	3,141	5.3	18.0	18.0	18.6	0.6
I	10,722	850	2,566	6.5	23.8	23.8	24.8	1.0
J	12,017	545	2,122	7.9	30.9	30.9	30.9	0.0
K	13,599	1,217	5,534	3.0	35.2	35.2	35.6	0.4
L	14,545	675	1,924	8.7	36.7	36.7	37.4	0.7
M	15,710	191	1,892	8.8	39.8	39.8	39.8	0.0
N	16,948	165	2,773	6.0	44.9	44.9	44.9	0.0
O	17,645	185	2,440	6.8	45.3	45.3	45.4	0.1
P	19,338	562	3,571	4.7	47.6	47.6	48.1	0.5
Q	20,368	394	2,624	6.4	49.6	49.6	49.8	0.2
R	21,004	315	2,573	6.5	51.3	51.3	51.3	0.0
S	21,140	278	2,024	8.3	51.3	51.3	51.6	0.3
T	21,933	190	1,848	9.0	53.7	53.7	53.7	0.0
U	22,461	344	3,466	4.8	54.7	54.7	55.3	0.6

[1] Feet above mouth

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN MATEO COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

PESCADERO CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD 88)	WITHOUT FLOODWAY (FEET NAVD 88)	WITH FLOODWAY (FEET NAVD 88)	INCREASE (FEET)
San Gregorio Creek								
A	50,000	70	505	14.3	233.9	233.9	233.9	0.0
B	50,450	75	555	13.0	241.6	241.6	241.6	0.0
C	50,830	59	477	15.1	245.8	245.8	246.0	0.2
D	51,670	101	869	8.3	253.2	253.2	253.6	0.4
E	52,070	164	1,444	5.0	254.6	254.6	255.5	0.9
F	52,290	144	1,782	4.0	255.8	255.8	256.7	0.9
G	52,420	114	1,048	6.9	255.5	255.5	256.5	1.0
H	52,720	360	1,425	5.1	256.6	256.6	257.1	0.5
I	52,980	362	2,522	2.9	259.9	259.9	259.9	0.0
J	53,450	72	483	14.9	263.6	263.6	263.6	0.0
K	53,960	50	430	16.7	269.1	269.1	269.1	0.0
L	54,430	45	482	14.9	275.1	275.1	275.8	0.7
M	54,830	73	952	7.6	281.3	281.3	281.5	0.2
N	56,150	59	528	13.5	291.8	291.8	292.7	0.9
O	56,300	68	536	13.2	293.5	293.5	294.3	0.8
P	56,500	65	550	12.9	296.8	296.8	296.8	0.0
Q	56,820	54	435	16.3	300.6	300.6	300.6	0.0
R	57,230	141	911	7.8	306.8	306.8	306.9	0.1
S	57,510	137	680	10.4	310.8	310.8	310.9	0.1
T	58,340	113	618	11.5	318.7	318.7	318.7	0.0
U	58,940	63	584	12.1	323.8	323.8	323.9	0.1
V	59,240	86	603	11.8	326.2	326.2	326.4	0.2
W	59,530	65	603	6.0	329.1	329.1	329.3	0.2
X	59,960	86	338	10.7	338.2	338.2	338.2	0.0
Y	60,400	40	305	11.8	342.5	342.5	342.6	0.1
Z	61,210	40	377	9.5	348.8	348.8	348.9	0.1
AA	62,380	72	307	11.5	373.9	373.9	373.9	0.0

[1] Feet above mouth

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN MATEO COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

SAN GREGORIO CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD 88)	WITHOUT FLOODWAY (FEET NAVD 88)	WITH FLOODWAY (FEET NAVD 88)	INCREASE (FEET)
San Mateo Creek								
A-D[2]								
E[3]								
F	10,890[1]	67	603	3.5	34.9	34.9	35.2	0.3
G	11,970[1]	36	322	6.6	37.1	37.1	37.3	0.2
H	13,165[1]	72	602	3.5	44.5	44.5	44.7	0.2
I	14,260[1]	37	302	7.0	47.3	47.3	47.5	0.2
J	15,070[1]	43	342	6.2	50.3	50.3	50.8	0.5
K	15,810[1]	41	321	6.7	53.2	53.2	53.9	0.7
L	16,580[1]	36	238	8.9	57.6	57.6	57.7	0.1
M	17,185[1]	68	426	5.0	63.2	63.2	63.2	0.0
Sausal Creek								
A	0[4]	247	460	3.3	351.7	351.7	352.7	1.0
B	1,110[4]	302	800	1.9	352.9	352.9	353.9	1.0
C	1,920[4]	92	211	7.1	358.2	358.2	359.2	1.0
D	2,720[4]	73	195	4.8	369.5	369.5	370.4	0.9
E	3,600[4]	64	183	5.1	378.4	378.4	379.4	1.0

[1] Feet above mouth
[2] No floodway determined
[3] Data not available
[4] Feet above Limit of Detailed Study at Family Farm Road

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY
SAN MATEO COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

SAN MATEO CREEK – SAUSAL CREEK

The area between the floodway and 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2, "Floodway Schematic."

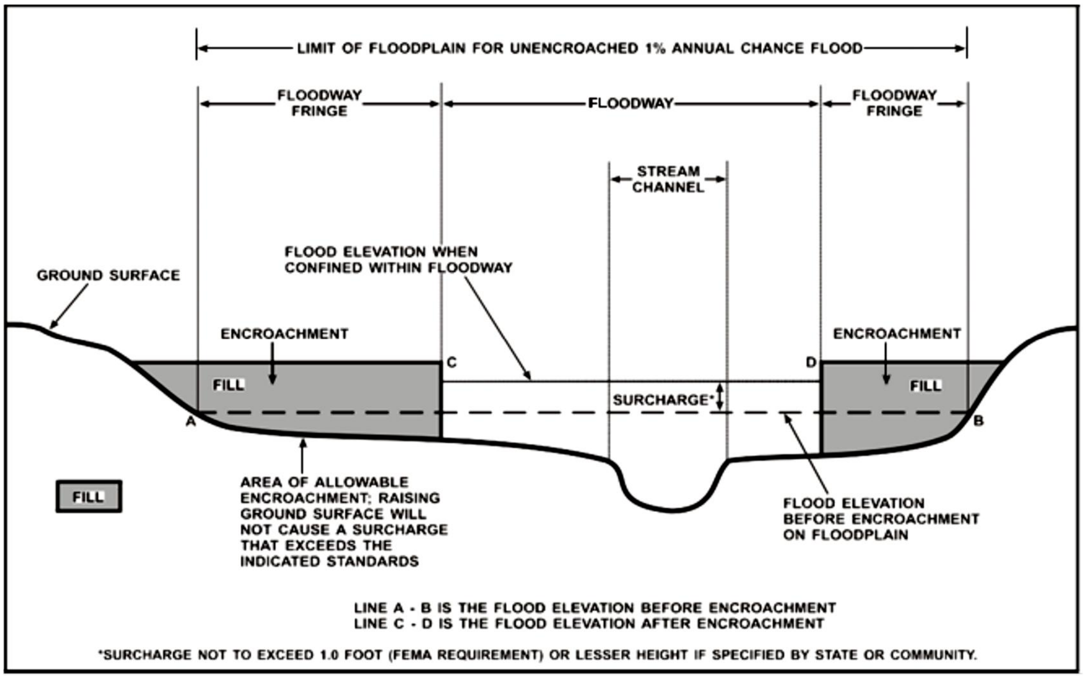

Figure 2: Floodway Schematic

For each community within San Mateo County that had a previously printed FIS report, the floodways described in those reports have been compiled and are summarized below.

Previous Community Analyses

City of Burlingame

Because development in most of the study area either extends to the banks of the streams or has obliterated the natural channels completely, no floodways were computed for this FIS.

City of East Palo Alto

No floodway was computed for San Francisquito Creek because the 1-percent annual chance flood is contained in the channel. Floodways are inappropriate for areas inundated by tidal flooding and sheetflow; therefore, no floodways are presented in this study.

City of Menlo Park

Floodway determination along San Francisquito Creek and Atherton Creek is inapplicable due to the extensive development up to the channel banks. Floodways are inappropriate for areas inundated by tidal flooding and sheetflow; therefore, no floodways are presented in this study.

City of Millbrae

Because development in most of the study area either extends to the banks of the streams or has obliterated the natural channels completely, no floodways were computed for this FIS.

City of Pacifica

Since development in most of the study area already extends to the banks of the stream, no floodways were determined. In addition, floodway determination would be inappropriate for ponded areas such as the Linda Mar sump area on San Pedro Creek, and in areas subject to tidal flooding.

City of Redwood City

Development in most of the study area either extends to the banks of the streams or has replaced them with storm sewers. Therefore, there is little option for floodway planning, and no floodways were determined.

City of San Mateo

No floodways were computed for San Mateo Creek from its mouth to just upstream of North El Camino Real because of numerous splits that occur along this reach.

City of South San Francisco

Because development in most of the study area already extends to the banks of the streams, no floodways were computed for this FIS.

Town of Woodside

The county engineer and the study contractor coordinated floodway determinations for Woodside. It was decided that a floodway would be determined only for Sausal Creek because this area is developed.

San Mateo County (Unincorporated Areas)

Floodways were only determined on La Honda, San Gregorio, and Alpine Creeks, and Pescadero Creek near the communities of La Honda and Pescadero. The results of the floodway computations were tabulated at selected cross sections for each stream segment for which a floodway was computed.

Development in much of the county either extends to the banks of the streams, or the streams have been replaced by storm sewers. Floodways on these streams would serve no purpose and, therefore, were not determined.

Cities of Belmont, Brisbane, Daly City, Foster City, Half Moon Bay, San Bruno, and San Carlos; and the Towns of Atherton, Colma, Hillsborough, and Portola Valley

Floodways have not yet been determined for these communities.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1- percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1- percent annual chance shallow flooding (usually sheetflow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2- percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, and areas of 1-percent annual chance flooding where average depths are less than 1 foot, areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent annual chance flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of San Mateo County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each incorporated community with identified flood hazard areas and the unincorporated areas of the county. Historical map dates relating to pre-countywide maps prepared for each community are presented in Table 13, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Atherton, Town of [1]	None	None	October 16, 2012	n/a
Belmont, City of	July 19, 1974	August 20, 1976	March 9, 1982	July 16, 2015
Brisbane, City of	May 24, 1974	October 10, 1975	March 29, 1983	n/a
Burlingame, City of	June 28, 1974	August 29, 1975 March 4, 1977	September 16, 1981	July 16, 2015
Colma, Town of	October 16, 2012	None	October 16, 2012	n/a
Daly City, City of	October 16, 2012	None	October 16, 2012	n/a
East Palo Alto, City of	September 19, 1984	None	September 19, 1984	August 23, 1999
Foster City, City of	June 14, 1974	December 12, 1975	January 7, 1977	January 19, 1995 July 16, 2015
Half Moon Bay, City of	March 1, 1974	None	June 3, 1986	n/a
Hillsborough, Town of	October 6, 1999	None	October 6, 1999	July 16, 2015
Menlo Park, City of	June 14, 1974	August 8, 1975 February 13, 1979	February 4, 1981	February 19, 1987
Millbrae, City of	July 19, 1974	December 5, 1975	September 30, 1981	n/a
Pacifica, City of	June 28, 1974	December 5, 1975 September 26, 1978	February 4, 1981	February 19, 1987

[1]NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN MATEO COUNTY, CA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Portola Valley, Town of	September 28, 1973	February 13, 1976	October 17, 1978	November 13, 1979 September 22, 1981
Redwood, City of	June 28, 1974	January 2, 1976	May 17, 1982	July 16, 2015
San Bruno, City of	None	None	October 12, 2012	n/a
San Carlos, City of	June 28, 1974	August 8, 1975	September 1, 1977	August 21, 1979 July 16, 2015
San Mateo, County of	November 1, 1974	April 15, 1977	July 5, 1984	August 5, 1986 July 16, 2015
San Mateo, City of	October 19, 2001	None	October 19, 2001	July 16, 2015
South San Francisco, City of	January 10, 1975	January 17, 1978	September 2, 1981	n/a
Woodside, Town of	June 14, 1974	April 9, 1976	November 15, 1979	n/a

[1]NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN MATEO COUNTY, CA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within San Mateo County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within San Mateo County.

In addition the City of Foster City commissioned a report on the levees and the effects of levee deaccreditation in that community (Reference 87).

This is a multi-volume FIS. Each volume may be revised separately, in which case it supersedes the previously printed volume. Users should refer to the Table of Contents in Volume 1 for the current effective date of each volume; volumes bearing these dates contain the most up-to-date flood hazard data.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this FIS can be obtained by contacting:

FEMA, Federal Insurance and Mitigation Division 1111
Broadway, Suite 1200
Oakland, California 94607-4052.

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