FLOOD INSURANCE STUDY

VOLUME 1 OF 3

SONOMA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

Community Name	Community Number
CLOVERDALE, CITY OF	060376
COTATI, CITY OF	060377
HEALDSBURG, CITY OF	060378
PETALUMA, CITY OF	060379
ROHNERT PARK, CITY OF	060380
SANTA ROSA, CITY OF	060381
SEBASTOPOL, CITY OF	060382
SONOMA, CITY OF	060383
SONOMA COUNTY (UNINCORPORATED AREAS)	060375
WINDSOR, TOWN OF	060761

PRELIMINARY
FEBRUARY 23, 2015

REVISED
Month Day, Year

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06097CV001E

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 (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: December 2, 2008

First Revised Countywide FIS Date: October 16, 2012

Second Revised Countywide FIS Date: February 19, 2014

Third Revised Countywide FIS Date: <date>

Fourth Revised Countywide FIS Date: <date>

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FLOOD INSURANCE STUDY

SONOMA 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 Sonoma County, California, including: the Cities of Cloverdale, Cotati, Healdsburg, Petaluma, Rohnert Park, Santa Rosa, Sebastopol, Sonoma, the unincorporated areas of Sonoma County and the Town of Windsor (hereinafter referred to collectively as Sonoma County). The Two Rock Ranch Station Military Reservation and the U.S. Naval Reservation are shown as part of the unincorporated areas of Sonoma 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 Sonoma 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.

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.

The Digital Flood Insurance Rate Map (DFIRM) and FIS Report for this countywide study have been produced in digital format. Flood hazard information was converted to meet the Federal Emergency Management Agency (FEMA) DFIRM database specifications and geographic information standards and is provided in a digital format so that it can be incorporated into a local Geographic Information System and be accessed more easily by the community.

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 the unincorporated areas of, and incorporated communities within, Sonoma County in a countywide format. Information on the authority

and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Cloverdale, City of: the hydrologic and hydraulic analyses from the FIS report dated July 16, 1996, for the Russian River, were performed by the U.S. Army Corps of Engineers (USACE), as determined for the FIS for Sonoma County, California (FEMA, 1981).

Cotati, City of: the hydrologic and hydraulic analyses from the FIS report dated December 5, 1996, were prepared by Ensign & Buckley Consulting Engineers, the study contractor, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-90-3133. This study was completed in September 1995. The hydrologic analyses performed by the USACE for the effective FIS dated October 1979 (FEMA, 1980) were also used for this study.

Healdsburg, City of: the hydrologic and hydraulic analyses from the FIS report dated September 1979, were performed by the USACE, Sacramento District, for the Federal Insurance Administration (FIA), under Inter-Agency Agreement Nos. IAA-H-7-76 and IAA-H10-77, Project Order Nos. 31 and 4, respectively. That work was completed in October 1977.

The hydrologic and hydraulic analyses for the September 6, 2006, restudy were performed by Northwest Hydraulic Consultants for FEMA, under Contract No. EMW-90-C-9133, Project Order No. 50260. That work was completed in December 2002.

Petaluma, City of: the hydrologic and hydraulic analyses from the original FIS report, which was completed in July 1978, were performed by the USACE, San Francisco District, for the FIA, under Inter-Agency Agreement Nos. IAA-H-7-76 and IAA-H-10-77, Project Order Nos. 31 and 4, respectively.

The hydrologic and hydraulic analyses from the revised FIS report dated September 29, 1989, were performed by the USACE, San Francisco District, for FEMA, under Inter-Agency Agreement No. IAA-EMW-85-E-1822, Project Order No. 1, Amendment No. 11. That work was completed in April 1987.

This FIS was revised on February 19, 2014 to account for studies performed by WEST Consultants, Inc., on Petaluma River, Willow Brook, Corona Creek, Capri Creek, Lynch Creek, Washington Creek, East Washington Creek, Adobe Creek, located within the of City of Petaluma. Additional details on this revision can be found in Section 10.

Rohnert Park, City of: the hydrologic and hydraulic analyses from the FIS report dated December 1, 1980, were performed by the USACE, San Francisco District, for the FIA, under Inter-Agency Agreement Nos. IAA-H-7-76 and IAA-H-10-77, Project Order Nos. 30 and 4, respectively. That work was completed in November 1977.

Santa Rosa, City of: the hydrologic and hydraulic analyses from the FIS report dated February 3, 1981, were performed by the USACE, Jacksonville District, for the FIA, under Inter-Agency Agreement No. IAA-H-7-76, Project Order No. 25 and Inter-Agency Agreement No. IAA-H-10-77, Project Order No. 4 and Amendment No. 8. That work was completed in July 1979.

This FIS was revised on October 16, 2012 to account for studies performed by Nolte Associates, Inc., on Colgan Creek, Naval Creek, and Roseland Creek located within the City of Santa Rosa. Additional details on this revision can be found in Section 10.

Sebastopol, City of: the hydrologic and hydraulic analyses from the original FIS report which was completed in October, 1978, were prepared by Dames & Moore, for the FIA, under Contract No. H-3952, using the hydrologic and hydraulic analyses developed by the USACE. That work, which was completed in October, 1978, covered all significant flooding sources affecting the City of Sebastopol.

The hydrologic and hydraulic analyses from the FIS report dated September 28, 1990, were performed by the USACE, for FEMA, under Inter-Agency Agreement No. EMW-84-E-1506, Project Order No. 1, Amendments 12, 12a, and 12c. That work was completed in May 1988.

Sonoma, City of: the hydrologic and hydraulic analyses from the FIS report dated June 5, 1997, were performed by the USACE, San Francisco District, for the FIA, under Inter-Agency Agreement Nos. IAA-H-7-76 and IAA-H-10-77, Project Order Nos. 31 and 4, respectively. That work was completed in July 1977.

Sonoma County (Unincorporated Areas): the hydrologic and hydraulic analyses from the original FIS report, which was completed in October, 1977, were performed by the USACE for FEMA, under Inter-Agency Agreement Nos. IAA-H-19-74, IAA-H-16-75, IAA-H-76, and IAA-H-10- 77; Project Order Nos. 18, 6, 13 (Amendment 2), and 3 (Amendment 1), respectively.

Detailed analyses of Salmon Creek and Bodega Harbor were performed by Ott Water Engineers, Inc., for FEMA, under Contract No. EMW-83-C1175. That work was completed in August, 1984.

The hydrologic and hydraulic analyses from the FIS report revision dated June 19, 1997, were performed by the USACE, for FEMA, under Inter-Agency Agreement No. EMW-84-E-1506, Project Order No. 1, Amendments 12, 12a, and 12c.

This study was revised on October 18, 1995, to provide flood hazard information based on a new hydraulic analysis of a reach of the Russian River. The study was performed by Ensign & Buckley Consulting Engineers, under Contract No. EMW90-C-9133.

This study was revised on July 16, 1996, to modify the 100-year (1-percent annual chance) floodplain boundary delineations and add BFE boundaries along Cloverdale Creek. The revised hydrologic and hydraulic analyses were performed by Ensign & Buckley Consulting Engineers.

This study was revised on June 5, 1997, to incorporate new and revised data for Fryer Creek from Leveroni Road to approximately 300 feet upstream of Fifth Street West. The Sonoma County Water Agency (SCWA) was contacted for hydrologic data. The hydraulic analysis used in this revision was performed by Ensign & Buckley Consulting Engineers, under Contract No. EMW90-3133.

This study was revised on June 19, 1997, to incorporate new and revised data for Fryer Creek from Leveroni Road to approximately 300 feet upstream of Fifth Street West. The Sonoma County Water Agency (SCWA) was contacted for hydrologic data. The hydraulic analysis used in this revision was performed by Ensign & Buckley Consulting Engineers, under Contract No. EMW90-3133.

This FIS was revised on October 16, 2012 to account for studies performed by Nolte Associates, Inc., on Colgan Creek, Naval Creek, and Roseland Creek, located within unincorporated areas of Sonoma County. Additional details on this revision can be found in Section 10.

Windsor, Town of: flood hazard information for the Town of Windsor has been previously reflected on the FIS and FIRM for the unincorporated areas of Sonoma County.

For this revision to the countywide FIS report, detailed coastal analyses were conducted for the Sonoma County San Francisco Bay (San Pablo Bay) shoreline north of the Richmond-San Rafael Bridge. The work was performed by Northwest Hydraulic Consultants for FEMA under Contract No. HSFEHQ-09-D-0368.

On selected FIRM panels, planimetric base map information was provided in digital format. These files were compiled at scales of 1:1,200, 1:2,400, and 1:4,800. Additional

information was derived from U.S. Geological Survey (USGS) Digital Line Graphs. Additional information may have been derived from other sources. Users of this FIRM should be aware that minor adjustments may have been made to specific base map features. For this revision, base map information was derived from Coastal California LiDAR and Digital Imagery dated 2011. USDA NAIP 2012 imagery is used in areas not covered by the Coastal California imagery.

The coordinate system used for the production of this FIRM is State Plane California II FIPS 0402 Feet, North American Datum of 1983 (NAD 83), Geodetic Reference System (GRS) 1980 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the State Plane projection, NAD 83. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

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 for Sonoma County and the incorporated communities within its boundaries are shown in Table 1, "Initial and Final CCO Meetings."

On October 31, 2007, the final CCO meeting for Sonoma County countywide DFIRM and FIS was held. Attending the meeting were representatives of FEMA Region IX, MAPIX-Mainland (the study contractor), Sonoma County, Cities of Cotati, Healdsburg, Petaluma, Santa Rosa, Sebastopol and Windsor.

For the October 16, 2012 revision, the final CCO meeting was held on May 25, 2011. All issues identified during this meeting have been addressed.

For the February 19, 2014 revision, the final CCO meeting was held on June 4, 2012.

For this revision, the initial CCO meeting was held on <date>. Attending the meeting were representatives of <attendees>. The final CCO meeting was held on <date>. Attending the meeting were representatives of <attendees>. All issued identified during this meeting have been addressed.

Table 1: Initial and Final CCO Meetings

Community	For FIS Dated	Initial CCO Date	Final CCO Date
Cloverdale, City of	July 16, 1996	June 15, 1990	June 23, 1995
Cotati, City of	December 5, 1996	August 11, 1992	*
Healdsburg, City of	September 1979	*	August 21, 1978
	September 6, 2006	October 23, 2001	*
Petaluma, City of	February 15, 1980	January 19, 1976	December 13, 1978
	September 29, 1989	September 27, 1984	March 19, 1987
		October 18, 2001	
		August 19, 2006	
		September 9, 2006	
Rohnert Park, City of	December 1, 1980	January 16, 1976	November 9, 1978
Santa Rosa, City of	February 3, 1981	September 1, 1976	September 23 and 24, 1980
Sebastopol, City of	June 18, 1980	*	May 21, 1979
	September 28, 1990	*	December 7, 1989
Sonoma, City of	January 17, 1979	January 19, 1976	September 28, 1977
	June 5, 1997	August 11, 1992	June 6, 1996
Sonoma County	January 20, 1982	December 26, 1974	March 1, 1979
	*	February 1, 1984	December 4, 1989
	October 18, 1995	August 2, 1990	October 28, 1994
	June 19, 1997	August 11, 1992	July 3, 1996
	September 6, 2006	*	June 23, 2005
	*	*	October 31, 2007
	October 16, 2012	*	May 25, 2011
	February 19, 2014	*	June 4, 2012
	<third revision date>	<date>	<date>
	<fourth revision date>	<date>	<date>
Windsor, Town of	*	*	*

*Data not available

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Sonoma 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 (Exhibit 2).

Table 2: Flooding Sources Studied by Detailed Methods

Adobe Creek	Hulbert Creek Tributary	Roseland Creek
Airport Creek	Hunter Creek	Russian River
Arroyo Seco	Kelly Creek	Russian River Split Flow
Austin Creek	Kizer Creek	Salmon Creek
Bloomfield Creek	Laguna de Santa Rosa	San Pablo Bay
Bodega Harbor	Liberty Creek	Santa Rosa Flood Control
Cameron Creek	Lichau Creek	Channel
Capri Creek	Lynch Creek	Schell Creek
Champlin Creek	Marin Creek	Sonoma Creek
Cloverdale Creek	Mark West Creek	Spring Creek
Colgan Creek	McBrown Creek	Starr Creek
Corona Creek	Moorland Creek	Thompson Creek
Cotati Creek	Mount Hood Creek	Todd Creek
Dry Creek	Nathanson Creek	Todd Creek (East Fork)
Dutch Bill Creek	Naval Creek	Todd Creek Tributary 1
East Austin Creek	Naval Creek Tributary 1	Todd Creek Tributary 1
East Washington Creek	Naval Creek Tributary 2	Washington Creek
East Windsor Creek	North Kenwood Creek	Wiggins Creek
Fife Creek	Petaluma River	Willow Brook
Fowler Creek	Pocket Canyon	Wilson Creek
Fryer Creek	Pool Creek	Windsor Creek
Fulton Creek	Pruitt Creek	Woolsey Creek
Gibson Creek	Redwood Creek	
Hulbert Creek	Rodgers Creek	

This FIS also incorporates the determinations of letters issued by FEMA resulting in map

changes (Letter of Map Revision [LOMR], as shown in Table 3, "Letters of Map Change."

Table 3: Letters of Map Change

Community	Flooding Source(s)/Project Identifier	Date Issued	Type
Petaluma, City of	Petaluma River, Washington Creek/ Petaluma River Floodwall - A99 Request	June 20, 2014	LOMR

The February 2, 2014 revision of the countywide FIS superseded six LOMRs. Determinations on Adobe Creek (99-09-220P & 96-09-930P), Capri Creek (199105408FIA), Corona Creek (97-09-429P), Petaluma River (97-09-832P) and Willow Brook (199535736MBJ) were superseded by the new detailed analyses that include updated methodology (hydraulics and hydrology), topography, bridge and channel improvements, and calibration to the December 2005 storm event.

The following LOMRs were not incorporated in the February 2, 2014 Physical Map Revision since they are outside the panels affected by the Petaluma River restudy: 09-09-1491P, 09-09-2125P, 09-09-2169P, 10-09-1737P, and 12-09-1872P. These unincorporated LOMRs remain effective.

The following LOMRs were not incorporated in this Physical Map Revision since they are outside the panels affected by the Petaluma River restudy: 09-09-1491P, 09-09-2125P, 09-09-2169P, 10-09-1737P, 12-09-1872P, and 14-09-0616P. These unincorporated LOMRs remain effective.

Floods caused by the overflow of Foss Creek results in shallow flooding. Foss Creek had originally been studied by detailed methods, but, due to the lack of reliable data, predicted floodflows were found to be inaccurate.

Copeland Creek, Hinebaugh Creek, Crane Creek, Five Creek, Coleman Creek, and Baumgardner Creek have been either improved or diverted to improved channels within the City of Rohnert Park so that they carry the 1-percent annual chance flood; therefore, no detailed studies were made along their channels. Approximate analyses extending to the points at which the flows become contained in the improved channels within the City of Rohnert Park were, therefore, conducted on each of these watercourses. In addition, an area of detailed study on Laguna de Santa Rosa was developed by the City of Rohnert Park in coordination with Sonoma County Water Agency.

The Russian River was studied using detailed methods from approximately 5,500 feet upstream to approximately 22,000 feet upstream of State Highway 128.

The SCWA is conducting Master Flood Control and Drainage Planning Studies for the Fryer Creek watershed area. A hydrologic study has also been conducted by a private consultant for the Madera Park Development, located adjacent to Fryer Creek, immediately upstream of Leveroni Road. However, the SCWA Master Plan Hydrologic Study was used as the basis for this study so that the study would be consistent with others

in Sonoma County. The Madera Park Study was not adopted.

Cloverdale Creek was studied from approximately 1,000 feet downstream of northbound U.S. Highway 101 to approximately 100 feet upstream of Portofino Way.

The September 1979 FIS for the City of Healdsburg was revised to provide flood hazard information based on a new hydraulic analysis of a reach on the Russian River from the confluence with Dry Creek to the USGS Gage near the City of Healdsburg, gage no. 11464000. This restudy covers approximately 3 miles of detailed study reach consisting of areas primarily within the corporate and extraterritorial limits of the City of Healdsburg, but also affecting Sonoma County.

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 Sonoma County.

2.2 Community Description

Sonoma County, established in February 1850 as one of the original 27 counties of California, borders the Pacific Ocean north of San Francisco Bay. The county extends approximately 50 miles from northwest to southeast along the Pacific Coast and has a width of approximately 40 miles from the coast inland to the crest of the Coast Range.

Sonoma County was colonized by both the Spanish and the Russians. By 1841, all of the Russian colonists had departed Sonoma County, leaving the Spanish in possession.

On June 14, 1846, in an operation known as the Bear Flag Revolt, Captain John C. Fremont of the U.S. Army, along with a group of 33 men, took possession of the fortified stronghold at Sonoma and hoisted the Bear Flag. On July 9, 1846, the Bear Flag was lowered and the Stars and Stripes were raised by Lieutenant Joseph Warren Revere, the grandson of Paul Revere.

The county seat was located in the Town of Sonoma from 1850 to 1854; since 1854, it has been in Santa Rosa. The principal industries in Sonoma County are agricultural. Development in the county consists of residential subdivision, small businesses, schools, and shopping centers.

The 1980 population of Sonoma County was 299,681, an increase of 94,796 since 1970. In 1980, 133,232 people lived in the unincorporated areas of Sonoma County. According to the 2000 Census, the population of Sonoma County was 458,614. The increase in population from 1990 to 2000 was 18.1 percent. According to the 2010 Census, the population of Sonoma County was 483,878.

More than one-half of Sonoma County's 1,579 square miles is devoted to agricultural

activities. A specious rural environment prevails in the county.

The climate of Sonoma County is Mediterranean. Along the coast, temperatures remain cool throughout the summer and seldom drop below 22 degrees Fahrenheit (°F) in the winter. Inland, there is a wider temperature range, with high readings occasionally exceeding 100°F and lows sometimes falling below 32°F.

The average annual precipitation ranges from less than 20 inches in the extreme southeastern corner to from 30 to 40 inches over much of the central part of the county. In the mountains in the northwestern portion of the county, total precipitation increases to more than 70 inches at some points. In the northeast, precipitation increases to more than 80 inches. Most precipitation occurs from November to April, and the summers are dry. The growing season is approximately 207 days long, and killing frosts are rare.

Elevations in Sonoma County range from sea level along the western edge and in the southeast to 3,000 to 4,000 feet along much of the eastern county limits. The northwestern corner of the county, between the coast and the Russian River, is mountainous, with elevations ranging from sea level to approximately 2,000 feet. East of the Russian River, elevations increase again; Mt. St. Helena, on the eastern border, reaches a crest of 4,344 feet.

The Russian River flows southward into the county and then turns westerly toward the ocean. Sonoma Creek drains into San Pablo Bay through the Sonoma Valley in the southeastern corner of the county. The Petaluma River drains most of the southwestern part of the county, which is relatively flat farmland near sea level, into San Pablo Bay.

Soils in the county can be described as follows: sandstone of the Franciscan group appears at the surface for the greater part of the county; Pliocene sediments occur in the southern part; Pliocene Sonoma volcanics cover a large area in the eastern half of the county.

The unincorporated community of Salmon Creek is located along the southern shore of Salmon Creek, 2,400 feet upstream of its confluence with the Pacific Ocean. A sand spit has formed along the creek delta, which normally protects the community from direct coastal flooding. However, Salmon Creek flow is backed up by the sand spit in unusual events.

Bodega Bay is an unincorporated community at the head of Bodega Harbor. Commercial fishing facilities and recreational boat moorings occupy sites adjacent to the harbor. Numerous residences and businesses border the Bodega Harbor floodplain within the community of Bodega Bay. Bodega Harbor is one of the few well-protected harbors along the northern California coast. Bodega Head and Doran County Park protect Bodega Harbor from direct exposure to normal peak ocean surges and high tides. Storm waves have overtopped the dunes during high tide (Ott Water Engineers, Inc., 1984).

2.3 Principal Flood Problems

The principal watercourses in Sonoma County are the Petaluma River, Russian River, Sonoma Creek, and their tributaries.

The flood conditions on the Russian River were the subject of two previous FISs (U.S. Department of Housing and Urban Development, 1970; U.S. Department of Housing and Urban Development, 1971). The information developed in those studies was reevaluated for the June 19, 1997, study.

Flooding in the Sonoma Creek basin is the result of intense, short-period rainfall occurring within a longer duration storm. The concentration period of the basin is less than 6 hours. Above the reclaimed tidal area, flooding is of relatively short duration. Tidal action in San Pablo Bay has a variable effect on flood conditions in the floodplain adjacent to the bay, both in respect to area inundated and duration of flooding.

Characteristic floods in the Petaluma River basin are normally of short duration, lasting 3 or 4 hours. Floods may develop within 24 hours after the beginning of a flood-producing storm and will normally recede within 1 day after the end of the storm. Tributaries rise rapidly so that flooding begins a few hours after occurrence of heavy rainfall. Flooding, mainly in the form of sheetflows, can occur along the entire reach of the Petaluma River. Most flooding is caused by inadequate channel capacity and poor drainage in areas close to the river.

Characteristic floods in the Russian River basin are normally of short duration, lasting 3 or 4 days. They are the flash-flood type and develop within 24 to 48 hours after the beginning of a flood-producing storm. They normally recede within 3 days after the end of the storm. Tributaries rise so rapidly that flooding occurs as early as 4 hours after a heavy rainfall begins.

The largest flood of record in the lower reaches of the Russian River occurred during the period of February 14-18, 1986, when a peak discharge of 102,000 cubic feet per second (cfs) was recorded by the U.S. Geological Survey (USGS) near the community of Guerneville. The flood is documented in USAC post-flood reports (USACE, June 1987; USACE, January 1987).

Flood peaks for the Petaluma and Russian River basins generally occur between December and March, although records show that they have occurred as early as November and as late as April.

Flooding conditions on the minor streams of Sonoma County are similar to those found in the three major basins.

The principal flooding problems are caused by inadequate channel capacity to carry off large flows from short-duration storms of high intensity. Many inadequate bridges and culverts add to the flood problem.

Numerous small streams and ditches are directed into Laguna de Santa Rosa, which

becomes the main drainageway of the Santa Rosa Plain. The capacity of Laguna de Santa Rosa west of U.S. Highway 101 is sufficient to pass the 1- percent annual chance flood. The flood hazard generally occurs in the flatter areas in the northeast section of the City of Cotati. The flow of out-of-bank floodwaters is extremely slow and often impounded by streets and roads. Debris accumulating at culvert entrances further impedes the flow, resulting in increased ponding.

Due to continued efforts by the SCWA to upgrade hydraulic structures and channel improvements, localized flooding along Cotati Creek has been significantly reduced.

The principal flooding problems are caused by debris restricting flows on Foss Creek.

The natural storage area of Denman Flat in the northwestern part of the city, where Willow Brook and several other streams come together to form the Petaluma River, acts as a detention basin and helps to reduce downstream peak discharges. Significant flooding occurs in this natural storage area and to the area east of Denman Flat between Highway 101 and the Northwestern Pacific Railroad line when flows in excess of the Willow Brook channel capacity escape as sheetflow to the southeast.

Widespread flooding from the Petaluma River can occur in the reach between Denman Flat and the confluence of Lynch Creek, and is generally shallow but can reach depths of 3-4' in lower areas. Significantly deep flooding can occur in the urbanized reach between the Lynch Creek confluence and the Lakeville Street bridge. Improvements undertaken in partnership with the Corps of Engineers have afforded flood protection for the urbanized reach between the Lynch Creek confluence and the Lakeville Street bridge. Flooding is reduced in depth downstream of Lakeville Street and is fairly well contained in the Petaluma River channel below the D Street bridge except for some localized flooding mostly contained within the streets in the downtown area.

The largest flood of record in the City of Petaluma occurred during the period January 3-5, 1982, and caused an estimated 28 million dollars in damages. The flood is documented in a USACE post-flood report (USACE, 1983). An extract of this report reads:

> During the January 1982 storm, flooding occurred over a 50+ block area on both sides of the river through the City of Petaluma. Most of the 500 homes and the 100 commercial-industrial establishments in this area incurred flood damage. In many cases, water depth reached two to three feet inside the structure. The most severely hit area appears to be along Jess Avenue where most homes had four to five feet inside. Payran Street was also an area of major damage in which flooding reached over three feet inside the structure.

Approximately one million dollars in flood damages occurred in the urbanized reach of the Petaluma River between the confluence of Lynch Creek and the Lakeville Street bridge during the flood of February 14-17, 1986. On February 15, an article in the San Francisco Chronicle was headlined “Petaluma Takes to the Boats” and goes on to read:

> Yesterday, most of the townsfolk put their experience to use and took their lumps like troupers. The relatively few newcomers in the hardest-hit Linda Del Mar subdivision, where the water depth in the street reached five feet, "absolutely panicked," according to a veteran of the 1982 deluge.
>
> At 4 a.m., a flood alert was posted for the city of 40,000 people. By dawn, a team of police officers, firefighters and volunteers was knocking on doors in Petaluma's flood prone flatlands.
>
> About 400 homes were evacuated in the Linda Del Mar subdivision and several trailer parks west and east of U.S. 101. Those who could not drive over the flooded roads were removed by bus and, later, by boat.

Significant out-of-bank flow from Willow Brook Creek has caused sheet flows that adversely affect a large area of the northeast quadrant of the City of Petaluma. Land along Lynch Creek and Adobe Creek are particularly affected.

Unchanneled and channel flows from the east enter the City of Rohnert Park and can cause minor flooding prior to entering improved channels through the city.

Historical records verify that Spring Creek has consistently overflowed, causing ponding and sheet flow problems every few years.

Ponding of the lower reaches of Laguna de Santa Rosa due to backwater from the Russian River is the principal flooding problem in the City of Sebastopol.

In the City of Sonoma, existing interior drainage is inadequate, and the flood problems are accentuated by encroachment of residential developments upon the floodplain, as evidenced by consistent sheet flow problems in the city park area and nearby streets.

Within the City of Sonoma, Sonoma Creek is contained in the channel.

Along the upstream reaches of Nathanson Creek, the limited channel is perched, with resultant floods acting as sheet flow on the east side of Broadway Street (State Route 12). A small area of ponding exits between Broadway Street and the lower reach of Nathanson Creek.

In the City of Sonoma, Fryer Creek and surrounding streets have had consistent flooding problems due to inadequate channel capacity. The lower reach of Fryer Creek has an improved concrete channel, and full consideration was given to the channel capacity. The channel has been newly converted to a closed-conduit storm drain between Fourth Street West and Andrieux Street. A new culvert has also been constructed at Leveroni Road.

2.4 Flood Protection Measures

No projects are being maintained or operated by the USACE in the Sonoma Creek basin. However, from time to time, under the authority of Public Law 99, 84th

Congress, or Public Law 875, 81st Congress, emergency channel restoration and levee repairs are carried out following floods.

Sonoma Creek was studied by the USACE for possible flood control measures. The USACE found that channel improvements were not economically justified (USACE, 1963).

Although intended for navigation, limited flood control protection is provided by the USACE in their routine maintenance dredging of the Petaluma River from its mouth to the Washington Street bridge just upstream of the Turning Basin in the City of Petaluma. The USACE has studied the possibility of providing comprehensive flood control for the Petaluma River, however, these studies have concluded that flood control measures were not economically justified for the unincorporated areas of Sonoma County, along the Petaluma River.

Perimeter drainage ditches, which were created as borrow areas for levee materials, serve to drain surface waters and maintain suitable ground-water levels. Several small dam structures, for water storage and soil conservation, were constructed on various tributaries. During construction and realignment of U.S. Highway 101 in 1958, the California Division of Highways, in cooperation with Sonoma County, improved approximately 7,200 feet of channel on the Petaluma River and Willow Brook by channel clearing and enlargement.

Starting in 1956, the USACE has installed flexible channel bank protective works to stabilize eroding banks, maintain channel alignment, and improve flow conditions at 91 sites along the Russian River as well as along the Petaluma River. Channel improvements have been constructed on Adobe Creek, East Washington Creek, Bloomfield Creek, Capri Creek, Corona Creek, Kelly Creek, Laguna de Santa Rosa and its tributaries, Lynch Creek, North Corona Channel, Thompson Creek, Washington Creek, Willow Brook, and Windsor Creek.

The USACE constructed the Coyote Dam and Lake Mendocino Project northeast of Ukiah, in Mendocino County, and the Warm Springs Dam and Lake Sonoma Project in Sonoma County. As a result of these projects, flooding in Guerneville during the flood of record in February 1986 was reduced 4 feet (USACE, January 1987). In addition to the existing Federal Projects, a number of local protection works have been constructed by non-Federal entities on the Russian River system.

The maximum stage on Laguna de Santa Rosa has a high correlation with the maximum stage on the Russian River downstream from its confluence with Laguna de Santa Rosa. As a result of completion of the Warm Springs Dam on Dry Creek, the 1-percent annual chance flood stage on Laguna de Santa Rosa has been reduced to elevation 75 feet above National Geodetic Vertical Datum.

The Santa Rosa Flood Control Channel conveys the 1-percent annual chance flood for a portion of its length before it reaches the City of Santa Rosa.

As a result of the Warm Springs Dam and Lake Sonoma Project, 1-percent annual chance flooding on Dry Creek downstream of the dam has been eliminated.

In the community of Bodega Bay, Bay Flat Road, which approaches the edge of the Bodega Harbor, has been provided with rockshore protection. The road that skirts Bodega Harbor has been fully riprapped to a 4- to 6-foot height above the road elevation (Ott Water Engineers, Inc., 1984).

In the vicinity of the City of Cloverdale, levees have been constructed along the Russian River. The levees provide protection from minor flooding only, and do not protect against a flood of 1-percent annual chance magnitude.

In 1970, the SCWA performed channel improvements on Laguna de Santa Rosa west of U.S. Highway 101. Some channel improvements were made in conjunction with the upgrading of U.S. Highway 101 to freeway standards. A drainage master plan was developed by the SCWA based on the ultimate development of the watershed.

The SCWA has completed additional flood-protection measures of Cotati Creek and on Laguna de Santa Rosa near the confluence with Cotati Creek.

The modifications consist of channel excavation, retaining walls, and bridge and culvert replacements along Cotati Creek between the confluence with Laguna de Santa Rosa and the Old Redwood Highway crossing over Cotati Creek. In addition, the SCWA has constructed a project on Cotati Creek from Old Redwood Highway to approximately 400 feet upstream of Cypress Avenue. This project includes the following elements:

- Channel excavation
- Retaining walls
- Modifications to existing bridges and culverts
- Channel-slope protection, including: rock riprap, sacked concrete, interlocking pre-cast concrete modules, and cellular concrete mat
- A reinforced-concrete-block bypass structure, approximately 1,000 feet long that diverts more than 50 percent of the flow from the channel at the upstream end of the project and returns it at Valpairso Avenue. The channel and bypass structure together can accommodate the 1-percent annual chance flow.

The supporting calculations and hydrology, along with design details, are available to developers and others interested in the City of Cotati.

No flood protection measures have been undertaken by Federal or State agencies. Channel work has been accomplished to a minor degree by local interests. The SCWA has conducted an investigation of alternate methods of flow diversion for Foss Creek to reduce flooding in the downstream areas.

Local interests have constructed approximately 35 miles of levees along the lower portion of the Petaluma River and its tributaries below Highway 101, principally to reclaim marshy areas for agricultural purposes. The City of Petaluma has constructed levees to protect wastewater treatment facilities and dredge spoil areas downstream of Highway 101.

According to the Sonoma County Hazard Mitigation Plan, "Between 1997 and 2008, the USACE and the City of Petaluma have completed nearly $40 million in improvements on the Petaluma River Flood Control project which involved construction of a flood control channel and flood walls, replacement of bridges that cause flow constrictions, and re-vegetation of channel banks, designed to provide residents of the Payran area with protection from the 100-year flood." (Sonoma County, 2011)

Channel improvements to tributary streams of the Petaluma River constructed by the SCWA include North Corona Channel, Capri Creek, Corona Creek, Lynch Creek, Washington Creek, East Washington Creek, and Adobe Creek. Bypass storm drains have been constructed on Kelly Creek and Thompson Creek by the SCWA and should provide protection from the 1-percent annual chance flood event on Thompson Creek and Kelly Creeks. The SCWA has also provided large-scale pump protection for the East Court area located in the southeast part of the city between the fairgrounds and Lakeville Street. During construction and realignment of U.S. Highway 101 in 1958, the California Division of Highways, in cooperation with the SCWA, improved approximately 7,200 feet of the channels on the Petaluma River and Willow Brook by channel clearing and widening.

The Denman Flat area in the northwestern part of the City of Petaluma acts as a detention basin. The City of Petaluma General Plan 2025 prohibits new construction in "existing areas subject to periodic surface water inundation and containment, within the Corona and Denman Reaches (Lynch Creek confluence with the Petaluma River upstream to the Old Redwood Highway over-crossing of Willow Brook Creek)", that would compromise the protection afforded by the Petaluma River Flood Control Project. (City of Petaluma, 2008)

No flood protection measures exist in the City of Rohnert Park except for channel segments within the community that have been improved to contain the 1-percent annual chance flood.

Most channels that pass through the City of Santa Rosa have been improved, either by the U.S. Soil Conservation Service or the SCWA, to contain the 1-percent annual chance flood.

The SCWA has performed channel realignment and culvert replacement and has constructed a flow diversion structure that has relieved most of the flooding problems on Spring Creek.

As a result of completion in 1983 of the Warm Springs Dam on Dry Creek (a major

tributary of the Russian River), the 1-percent annual chance flood stage on Laguna de Santa Rosa was reduced from 79 feet to 78 feet above NAVD 88.

Sonoma Creek was studied by the USACE, San Francisco District, for possible flood control measures. The study found that channel improvements were not economically justified (USACE, 1963).

The SCWA performed channel improvements on Fryer Creek, from upstream of Leveroni Road to just above Andrieux Street, which have relieved most of the flooding problems in that reach of the creek.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, 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 100-year flood (1-percent chance of annual exceedence) 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 county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding sources studied in detail affecting the county.

Precountywide Analyses

For the unincorporated areas of Sonoma County and each community within Sonoma County that had a previously printed FIS report, the hydrologic analyses described in those reports have been compiled and are summarized below.

For the City of Cloverdale, from 1911 to 1913, the U.S. Geological Survey (USGS) maintained stream gaging stations to record flows on the East Fork of the Russian River near Ukiah and on the Russian River at Ukiah and at Geyserville. Eleven stations are now being operated in the Russian River basin by the USGS. Peak discharges at stream gaging stations were used to the greatest possible extent as bases for determining flood discharge-frequency relationships. Where there was no existing record and a flood discharge-frequency relationship was needed, these data were evaluated synthetically.

For the July 16, 1996, study, a hydrologic analysis was performed to determine the 100-year flood peak discharges along Cloverdale Creek. The SCWA computer program "Rational Method Hydrology" was used for the hydrologic analysis.

In the City of Cotati, no stream gaging stations are located on any of the streams, nor were there any National Weather Service rain gages located within the basin, even though there are several nearby. Normal annual precipitation (NAP) for the subject basin was developed from NAP maps prepared for the nearby Russian River basin and the Petaluma River by the USACE (USACE, Normal Precipitation Maps, Russian River and Petaluma River).

NAP of the study area is approximately 24 inches. Data collected at the Petaluma Fire Station No. 2 rain gage are representative of the study area and were used during this study. The station, which is located between the Petaluma River and U.S. Highway 101, has been in existence since 1944. Short-duration rainfall-frequency data developed by the California State Department of Water Resources (California State Department of Water Resources, Bulletin 195) were used in this study.

Unit hydrographs were derived for six subbasins of Laguna de Santa Rosa. The unit hydrographs were developed using the San Francisco District-wide S-curve hydrograph, and the following lag relationship:

$$\text{Lag} = 24n \frac{LL_{ca}^{0.38}}{S^{0.5}}$$

where Lag = Time from the start of runoff to the point where 50 percent of the ultimate discharge reaches the downstream end of the basin (in hours)

n = Basin average roughness coefficient (dimensionless)

L = Length of primary watercourse (in miles)

L_{ca} = Distance from the centroid of the basin to the downstream end of the basin measured along the primary watercourse (in miles)

S = Average slope of primary watercourse (in feet per mile)

Because no stream gaging stations exist on the subject streams, it was necessary to develop peak discharge-frequency data by applying rainfall of a given frequency to the derived unit graphs and assuming that the peak discharge of the resulting hydrograph has the same frequency as the applied rainfall. To ensure that each study area had ample time to respond to runoff-producing rainfall, critical 1- and 6- hour rainfall amounts were incorporated into a 6-hour storm for each event studied. The rainfall was distributed randomly, first within the critical 1-hour period, then within the remaining 5-hour period.

Using this method, 10-, 2-, and 1-percent chance storms were developed and applied to the developed unit hydrographs. Loss rates used in these computations were based on studies

done for similar areas, with the lower loss rates used in the urbanized area. Base flow was held constant for the various frequency events on each basin, but varied from 1 to 6 cfs per square mile between basins. The hydrographs derived for each of the subbasins were combined to produce discharge hydrographs at the index stations needed for hydraulic analyses. No channel routings were performed, but hydrograph combining on Laguna de Santa Rosa was adjusted to correct for estimated travel times between index stations. The peak discharges computed at index stations were then used to compute peak discharge-frequency curve statistics at the index stations, assuming a regional skew of -0.3.

No hydrologic analyses were conducted as a part of the study of the City of Healdsburg because the required data on the Russian River and Dry Creek, including flood elevations, were previously developed in the Flood Insurance Study of the unincorporated areas of Sonoma County.

For the September 6, 2006, revision for the City of Healdsburg, the quantities for the 10-, 2-, 1-, and 0.2-percent annual chance flood events developed in the FIS, dated October 18, 1995, for the unincorporated areas of Sonoma County were verified in the restudy by using the peak flows of the USGS gage near the City of Healdsburg, gage no. 11464000. In addition, a frequency analysis was prepared using the USGS PEAKFQ computer program, which was used to calculate water-surface profiles.

For the City of Petaluma, the USACE installed and operated a stream gage on the Petaluma River approximately 1,000 feet downstream of the old Corona Road bridge crossing of the river during the period from 1941 to 1946. In 1948, the USGS operated and maintained the gage and kept records until 1963, when data collection was discontinued and the gage was removed.

The approach taken for development of approximate hydrology for the City of Rohnert Park was to determine the 1-percent chance event peak discharge for as many streams as possible in Sonoma County, then to use the technique of multiple regression analysis in determining the most reliable estimate of the 1-percent chance peak discharge for any given area in Sonoma County.

Three National Weather Service rain gages near the Russian River basin were used during the study of the City of Santa Rosa; the rain gages are in Santa Rosa, Graton, and Sebastopol. No stream gaging station exists in either the Matanzas Creek or Spring Creek basins; therefore, discharge-frequency relationships were developed by means of synthetic analyses using loss rates determined from hydrologically similar basins. The nearby USGS stream gaging station at Santa Rosa Creek near Santa Rosa, for which records are available from 1959 to 1970, was not used to develop hydrologic parameters because of dissimilar basin characteristics, notably the difference in forest cover, which would materially affect basin lag and loss rate characteristics.

Unit hydrographs, which represent the response of each subbasin to runoff-producing rainfall, were derived from a USACE district-wide S-curve hydrograph and other physical parameters.

Because of the lack of stream gaging data on Matanzas Creek and Spring Creek, discharge-frequency relationships were developed from peak discharges calculated by using synthetic unit hydrographs and hyetographs developed from 3-day statistical rainfall data. Daily precipitation amounts used to calculate the peak discharge for selected flood frequencies were based on statistical rainfall data developed by the California Department of Water Resources for the Santa Rosa rain gage, which has 22 years of record. The Santa Rosa rainfall data were correlated with data from the Graton rain gage, which has 76 years of record. After extending the rainfall statistics of the Santa Rosa gage, the Santa Rosa rainfall data were corrected for the normal annual precipitation of each subbasin. Because of the proximity of the Santa Rosa rain gage to both the Matanzas Creek and Spring Creek basins, the correction for local normal annual precipitation was less than 5 percent. Statistical rainfall data from the Sebastopol rain gage were used to develop hypothetical short-duration precipitation for use in the study. A critical 6-hour period of precipitation, developed from 28 years of recorded rainfall data at the Sebastopol rain gage, was included within the 72-hour storm period for the 10-, 2-, 1-, and 0.2-percent annual chance storm events.

Hydrologic data stations in and near the study area of the City of Sonoma are limited. Four weather stations are maintained by the National Weather Service in the vicinity of the study area; the stations are Calistoga, Atlas Road Dutra, Sonoma, and St. Helena. The station at Atlas Road Dutra includes a recording rain gage; but, due to its proximity and elevation, it does not reflect a representative rainfall distribution for the Sonoma Creek basin. Three USGS stream gaging stations are located in and around the Sonoma Creek basin; the gaging stations are Sonoma Creek basin at Agua Caliente, Sonoma Creek near Kenwood, and Napa River near St. Helena.

Annual maximum peak discharges were analyzed using techniques presented in U.S. Water Resources Council Bulletin 17 (U.S. Water Resources Council, 1976). Statistics developed by an analysis of the 20-year period of record included a large negative skew coefficient. In order to validate the statistics which had been derived from the short period of record, statistical data from a hydrologically similar basin nearby were used. The USGS station on the Napa River near St. Helena is the most hydrologically similar of the gaging stations nearby. The Napa River near St. Helena station, which collects data from an 81.4-square mile drainage area, has been in continuous operation since 1939. Peak discharges at this station were statistically analyzed and used to develop extended statistics for Sonoma County at Agua Caliente. Streamflow at the confluence of the two streams was determined by combining hydrographs of the two streams. Values of the 10-, 2-, 1-, and 0.2- percent annual chance peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data.

In the June 5, 1997, study, the 1-percent annual chance peak discharge for Fryer Creek was determined using a hydrologic model provided by the SCWA (Sonoma County Water Agency, 1994). This model was prepared by the SCWA based on planned full future development of the watershed area. The model uses the SCWA Rational Method Hydrology HYDRO Program (Sonoma County Water Agency, Rational Method Hydrology, HYDRO Version 2.0). The SCWA model was based on the following:

1. Watershed area and slope were determined from USGS quadrangle maps (U.S. Department of the Interior, 1951) and available storm-drain plans.

2. Land uses were based on adopted land-use plans (City of Sonoma, 1992 General Plan Revision, December 1992).

3. Runoff-coefficient and watershed-roughness values were based on SCWA criteria (Sonoma County Water Agency, 1983) and land-use conditions.

4. Precipitation was determined by the HYDRO program based on calculated times of concentration and SCWA-developed precipitation-frequency-duration relationships.

To develop the discharges used in this study for Fryer Creek, the SCWA HYDRO model runoff coefficients were modified to reflect existing land-use conditions. The land use was determined based on available existing land-use mapping provided by the City of Sonoma (City of Sonoma, Existing Land Use Map, December 1992) and field reconnaissance. The runoff coefficients were estimated based on SCWA criteria (Sonoma County Water Agency, Rational Method Hydrology, HYDRO Version 2.0).

In the unincorporated areas of Sonoma County, there are three USGS stream-gaging stations in and around the Sonoma Creek basin. The gaging stations are on Sonoma Creek at Agua Caliente, Sonoma Creek near Kenwood, and Napa River near St. Helena. Streamflow data have been collected for Sonoma Creek at the Agua Caliente stream-gaging station since 1955; prior to 1966, it was published as Boyes Hot Springs.

Statistics developed by an analysis of the period of record at the Agua Caliente stream-gaging station included a large negative skew coefficient. To validate the statistics that were derived from the short period of record, statistical data from a hydrologically similar basin nearby were used. The USGS gaging station on the Napa River near St. Helena is the most similar hydrologically of the gaging stations nearby (U.S. Department of the Interior, 1939-Present). The Napa River near St. Helena gage, which collects data from an 81.4-square-mile drainage area, has been in continuous operation since 1939. Peak discharges measured at the Napa River gage were statistically analyzed and were used to develop extended statistics for Sonoma Creek at Agua Caliente. Values of the 10-, 2-, 1-, and 0.2-percent annual chance peak discharges were obtained from a log-Pearson Type III distribution (U.S. Water Resources Council, 1976) of annual peak-flow data.

The USACE installed and operated a stream gage on the Petaluma River from 1941 to 1946. This gage was located approximately 1,000 feet downstream of the Corono Road crossing of the river. In 1948, the USGS relocated the gage upstream at a point 70 feet downstream of the Corona Road bridge. The USGS operated, maintained, and kept records for the gage until 1963, when data collection was discontinued and the gage was removed. Because of the short period of record and the considered unreliability of the data, the frequency data developed were tempered by correlation with records from nearby streams having similar characteristics and by synthetic evaluations (USACE, March 1973).

From 1911 to 1913, the USGS maintained stream-gaging stations to record flows on the East Fork Russian River near Ukiah and on the Russian River at Ukiah and at Geyserville.

Diversions from the Eel River basin, through Potter Valley Powerhouse, have been measured by the Pacific Gas and Electric Company and its predecessor since 1922. The USGS operates 13 stations in the Russian River basin. Peak discharges at stream-gaging stations were used to the greatest possible extent as bases for determining flood discharge-frequency relationships. Where there was no existing record and a flood discharge-frequency relationship was needed, these data were evaluated synthetically (USACE, February 1973; USACE, 1984). Peak discharge-frequency relationships for the Russian River below Dry Creek were taken from the hydrology analysis for the USACE's Warm Springs Dam and Lake Sonoma Project (USACE, 1967).

Peak discharge-frequency relationships for Mark West Creek, Windsor Creek, and Laguna Creek Basins, and Bloomfield Creek were provided by the Sonoma County Water Agency.

The approach taken for development of approximate-type hydrology for this study was to determine the 1-percent annual chance peak discharge for as many streams as possible in Sonoma County, then to use the technique of multiple regression analysis in determining the most reliable estimate of the 1-percent annual chance peak discharge for any given area in Sonoma County.

For the June 19, 1997, revision, the 1-percent annual chance peak discharge for Fryer Creek was determined using a hydrologic model provided by the SCWA (Sonoma County Water Agency, 1994). This model was prepared by the SCWA based on planned full future development of the watershed area. The model uses the SCWA Rational Method Hydrology HYDRO Program (Sonoma County Water Agency, Rational Method Hydrology, HYDRO Version 2.0). The SCWA model was based on the following:

1. Watershed area and slope were determined from USGS quadrangle maps (U.S. Department of the Interior, 1951) and available storm-drain plans.

2. Land uses were based on adopted land-use plans (City of Sonoma, 1992 General Plan Revision, December 1992).

3. Runoff-coefficient and watershed-roughness values were based on SCWA criteria (Sonoma County Water Agency, 1983) and land-use conditions.

4. Precipitation was determined by the HYDRO program based on calculated times of concentration and SCWA-developed precipitation-frequency-duration relationships.

To develop the discharges used in this study for Fryer Creek, the SCWA HYDRO model runoff coefficients were modified to reflect existing land-use conditions. The land use was determined based on available existing land-use mapping provided by the City of Sonoma (City of Sonoma, Existing Land Use Map, December 1992) and field reconnaissance. The runoff coefficients were estimated based on SCWA criteria (Sonoma County Water Agency, Rational Method Hydrology, HYDRO Version 2.0).

A hydrologic analysis was performed to determine the 1-percent annual chance flood peak discharges along Cloverdale Creek. The SCWA computer program "Rational Method

Hydrology" (Sonoma County Water Agency, Rational Method Hydrology) was used for the hydrologic analysis.

In the City of Cloverdale, Cloverdale Creek was studied from approximately 1,000 feet downstream of northbound U.S. Highway 101 to approximately 100 feet upstream of Portofino Way.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 4, "Summary of Discharges."

Table 4: 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
ADOBE CREEK					
Above Petaluma River	5.05	1,410	2,033	2,226	2,417
Upstream of Ely Road	4.53	1,383	2,084	2,364	2,993
Upstream of confluence of Adobe Creek Diversion Channel	4.21	1,084	1,290	1,342	1,372
AIRPORT CREEK					
Upstream of confluence of Windsor Creek	2.84	943	1,262	1,379	1,678
Upstream of confluence of Redwood Creek	0.99	425	562	617	745
ARROYO SECO					
At Cross Section B	7.10	1,250	1,910	2,140	2,660
At Cross Section W	3.49	725	1,070	1,200	1,470
AUSTIN CREEK					
Upstream of confluence of Russian River	63.23	14,900	22,100	24,600	30,400
Upstream of confluence of East Austin Creek	30.50	8,500	12,400	13,500	16,600
BLOOMFIELD CREEK					
Upstream of confluence of Estero Americano	3.51	1,000	1,300	1,444	1,720
CAMERON CREEK					
Upstream of confluence of Fulton Creek	1.49	266	345	377	460
CAPRI CREEK					
At Southern Pacific Railroad	0.99	247	303	345	393
At Maria Drive	0.88	324	466	546	685
At Sonoma Mountain	0.47	276	410	463	583
CHAMPLIN CREEK					
At Cross Section B	2.08	325	520	585	725
At Cross Section J	1.24	195	315	350	435

Table 4: 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
CLOVERDALE CREEK					
At confluence of Russian River	1.8	*	*	835	*
COLGAN CREEK					
At Mouth	7.77	1,220	1,780	2,019	2,504
At Stony Point Road	4.70	1,011	1,340	1,444	1,931
At Bellevue Avenue	3.81	777	1,017	1,102	1,312
At Hearn Avenue	2.73	673	867	908	1,003
At Highway 101	2.32	558	787	787	787
At Petaluma Hill Road	0.97	157	252	304	452
CORONA CREEK					
Downstream of confluence with Capri Creek	3.09	576	736	765	908
At Highway 101	1.71	525	592	610	635
At Ely Road	1.25	462	662	727	825
COTATI CREEK					
Upstream of confluence of Laguna de Santa Rosa	1.1	210	360	405	*
Upstream of Hillview Drive	1.0	210	360	440	610
Upstream of Water Avenue	0.5	110	180	220	310
DRY CREEK					
Upstream of confluence with Russian River	217	12,500	18,000	21,000	25,000
Upstream of confluence of Mill Creek	193	8,700	13,000	15,000	18,000
Upstream of confluence of Pena Creek	137	6,200	6,500	6,900	8,800
Upstream of confluence of Dutcher Creek (Warm Springs Dam Outflow)	130	6,000	6,000	6,000	7,400

*Data Not Available

Table 4: 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
DUTCH BILL CREEK					
Upstream of confluence with Russian River	12.47	2,100	3,400	4,200	5,900
Upstream of confluence of Tyrone Creek	11.06	1,900	3,200	3,900	5,600
Downstream of confluence of Duvoul Creek	7.87	1,500	2,500	3,000	4,400
Upstream of confluence of Duvoul Creek	6.56	1,250	2,080	2,500	3,670
EAST AUSTIN CREEK					
Upstream of confluence with Austin Creek	31.89	7,400	11,000	12,300	15,300
EAST WASHINGTON CREEK					
Above Washington Creek	2.29	515	635	671	692
At Ely Road	2.10	479	599	636	710
EAST WINDSOR CREEK					
Upstream of confluence with Windsor Creek	2.71	929	1,223	1,339	1,616
At Highway 101	1.84	669	879	963	1,173
At Lakewood Drive	0.70	218	286	313	377
FIFE CREEK					
Upstream of confluence with Russian River	6.81	1,600	2,400	2,800	3,900
Downstream of confluence of Sweetwater Creek	5.54	1,400	2,100	2,400	3,400
Upstream of confluence of Sweetwater Creek	2.67	700	1,100	1,300	1,800
FOWLER CREEK					
At Cross Section C	19.39	9,590[1]	11,200[2]	11,450[1]	12,210
At Cross Section J	19.39	2,340[2]	5,800[3]	6,570[3]	10,070[3]
At Cross Section O	19.39	2,340[2]	4,660[3]	5,420[3]	8,920[3]
At Cross Section R	19.38	2,340[2]	3,880[3]	4,160[2]	6,490[3]

[1]Combined flow Fowler Creek and overflow of Sonoma Creek
[2]Combined flow Fowler and Rodgers Creeks
[3]Combined flow Fowler and Rodgers Creeks and overflow of Sonoma Creek

Table 4: 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
FOWLER CREEK (continued)					
At Cross Section AB	10.26	1,500	2,400	2,580	3,310
FRYER CREEK					
At Leveroni Road	2.04	*	*	846	*
At confluence of West Fork Fryer Creek	1.81	*	*	818	*
At confluence of East Fork Fryer Creek	0.94	*	*	407	*
At Andrieux Street	0.89	*	*	395	*
North of Andrieux Street	0.86	*	*	380	*
North of Napa Street	0.78	*	*	360	*
North of Church Street	0.76	*	*	350	*
North of Spain Street	0.72	*	*	340	*
West of Fifth Street West	0.23	*	*	130	*
North of San Joaquin Drive	0.19	*	*	110	*
FULTON CREEK					
Upstream of confluence with Mark West Creek	4.15	592	800	892	1,060
GIBSON CREEK					
Upstream of confluence with Marin Creek	0.60	185	240	265	322
HUNTER CREEK					
Upstream of confluence with Todd Creek	1.01	320	463	524	663

*Data Not Available

Table 4: 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
HULBERT CREEK					
Upstream of confluence with Russian River	8.01	3,300	4,420	4,860	5,830
Downstream of confluence of Mission Creek	6.87	2,910	3,890	4,270	5,120
Upstream of confluence of Mission Creek	5.31	2,170	2,910	3,200	3,840
HULBERT CREEK TRIBUTARY					
Upstream of confluence with Hulbert Creek	1.56	650	900	1,010	1,240
KELLY CREEK					
Above Thompson Creek	0.90	210	325	380	520
KIZER CREEK					
Upstream of confluence with Petaluma Creek	1.33	322	420	462	555
At Middle Two Rock Road	0.46	170	220	245	290
LAGUNA DE SANTA ROSA					
Upstream of confluence with Mark West Creek	170.0	21,100	30,300	35,100	44,900
Downstream of confluence of Santa Rosa Flood Control Channel	166.0	16,800	23,900	28,000	35,700
Upstream of confluence of Santa Rosa Flood Control Channel	87.4	14,000	20,100	23,300	30,800
Upstream of confluence of Irwin Creek	*	13,200	19,100	22,000	29,200
Upstream of confluence of Gravenstein Creek	*	12,300	18,000	20,500	27,200
Upstream of confluence of Pleasant Hill Creek	*	11,600	16,900	19,300	25,600
Upstream of confluence of Roseland Creek	*	10,800	15,800	18,000	23,900
Upstream of confluence of Blucher Creek	*	9,570	14,000	15,950	21,200
Upstream of confluence of Colgan Creek	*	7,710	11,200	12,850	17,100

*Data Not Available

Table 4: 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
LAGUNA DE SANTA ROSA (contd.)					
At Stony Point Road	*	7,170	10,400	11,950	15,900
Downstream of confluence of Hinebaugh Creek	*	5,550	7,900	9,250	12,000
Upstream of confluence of Hinebaugh Creek	*	2,280	3,250	3,800	5,000
Upstream of confluence with Copeland Creek	*	977	1,410	1,630	2,120
At U.S. Highway 101	3.8	720	1,250	1,500	2,100
Upstream of confluence of Cotati Creek	1.6	320	540	660	930
LIBERTY CREEK					
Upstream of confluence with Marin Creek	3.14	490	640	710	820
At Pepper Road	0.96	180	240	260	320
LICHAU CREEK					
Upstream of confluence with Willow Brook	9.35	1,738	2,310	2,543	3,140
Upstream of confluence of Penngrove Creek	7.12	1,480	1,970	2,160	2,700
Upstream of confluence of Meacham Creek	5.87	1,280	1,700	1,870	2,300
Upstream of confluence of Highlands Creek	4.41	1,030	1,390	1,510	1,890
LYNCH CREEK					
At Highway 101	4.19	902	1,269	1,323	1,440
At Sonoma Mountain	3.77	890	1,643	1,994	2,739
MARIN CREEK					
Upstream of confluence with Petaluma River	11.37	1,829	2,400	2,659	3,200
Upstream of confluence of Wiggins Creek	5.86	1,040	1,360	1,510	1,815
Upstream of confluence of Wilson Creek	3.69	684	906	988	1,209
Upstream of confluence of Gibson Creek	1.23	310	410	450	548

*Data Not Available

Table 4: 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
MARK WEST CREEK					
Upstream of confluence with Russian River	254.0	32,885	46,481	52,700	68,563
Upstream of confluence of Windsor Creek	227.0[1]	29,602	42,248	47,900	62,318
Upstream of confluence of Laguna de Santa Rosa	52.1	8,172	11,000	12,085	15,000
Downstream of confluence of Wikiup Creek	43.6	8,340	11,300	12,430	15,500
Downstream of confluence of Leslie Creek	34.4	8,260	11,100	12,300	15,500
Upstream of confluence of Leslie Creek	31.3	7,530	10,100	11,200	14,000
MCBROWN CREEK					
Upstream of confluence with Wiggins Creek	0.64	175	228	251	305
MOORLAND CREEK					
Just upstream of confluence with Todd Creek	0.31	119	168	189	237
MOUNT HOOD CREEK					
At Cross Section A	6.14	1,430	2,090	2,330	2,850
At Cross Section C & M	1.18	270	390	440	540
At Cross Section D	3.39	1,100	1,390	1,490	1,765
At Cross Section E	1.65	375	520	565	665
NATHANSON CREEK					
At Cross Section A	9.51	1,760[2]	2,470[2]	2,780[2]	3,450[2]
At Cross Section G	7.64	1,480	2,070	2,320	2,870
At Cross Section O	4.83	835	1,260	1,410	1,750
At Napa Road	4.66	835	1,250	1,400	1,740
At MacArthur Street	4.61	835	1,240	1,390	1,700

[1]Estimated

[2]Combined flow Nathanson and Schell Creeks

Table 4: 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
NATHANSON CREEK (Contd.)					
At Fourth Street East	4.53	840	1,220	1,370	1,670
At Cross Section BZ	3.58	835	1,220	1,360	1,650
At Lovall Valley Road	3.04	710	1,030	1,150	1,400
NAVAL CREEK					
At Mouth	2.40	297	462	555	813
At Llano Road	1.79	269	424	509	748
NAVAL CREEK TRIBUTARY 1					
Approximately 700 feet downstream of South Wright Road	0.05	56	90	103	133
NAVAL CREEK TRIBUTARY 2					
Upstream of confluence with Naval Creek	0.45	317	466	527	665
NORTH KENWOOD CREEK					
At Mervin Avenue	1.37	310	440	490	600
At Cross Section F	*	290	460	460	565
At Cross Section G	0.94	180	230	250	300
At Chateau St. Jean	0.50	140	200	220	270
PETALUMA RIVER					
Downstream of confluence with Adobe Creek	58.93	8,672	11,034	11,910	15,044
At Highway 101 bridge	50.8	6,675	9,149	10,494	13,694
Downstream of confluence of Washington Creek	44.55	5,758	8,459	9,757	13,056

*Data Not Available

Table 4: 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
PETALUMA RIVER (Contd.)					
Downstream of confluence of Lynch Creek	39.55	5,246	7,492	8,671	11,563
Downstream of confluence of Capri Creek	34.60	4,653	6,583	7,728	10,523
Downstream of confluence of Willow Brook	29.31	3,587	4,825	5,360	6,733
Upstream of confluence of Willow Brook	14.97	1,701	2,947	3,529	4,801
POCKET CANYON					
Upstream of confluence with Russian River	6.56	1,790	2,650	3,050	3,880
Downstream of confluence of Mays Canyon	5.06	1,390	2,050	2,360	2,990
Downstream of confluence of Oregon Canyon	2.42	840	1,230	1,400	1,780
Upstream of confluence of Oregon Canyon	1.75	580	850	970	1,230
POOL CREEK					
Upstream of confluence with Windsor Creek	10.3	2,283	2,970[1]	3,258[1]	3,815[1]
Upstream of confluence of Pruitt Creek	4.91	1,358	1,874[1]	1,906[1]	2,165[1]
At Highway 101	3.75	1,152	1,520[1]	1,677[1]	2,030[1]
At Chalk Hill Road	1.67	684	895	987	1,200[1]
PRUITT CREEK					
Upstream of confluence with Pool Creek	3.99	925[1]	1,210[1]	1,311[1]	1,540[1]
At Shiloh Road (upstream crossing)	2.36	876[1]	1,146[1]	1,240[1]	1,455[1]
At Faught Road	1.94	535	618	767	930
REDWOOD CREEK					
Upstream of confluence with Airport Creek	1.12	490	640	715	880
At NWPER	0.30	115	150	160	205

[1]Reduced flows due to upstream losses

Table 4: 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
RODGERS CREEK					
At Cross Section F	19.38	2,340[1]	5,820[2]	6,570[2]	10,000[2]
At Cross Section K	19.38	2,340[1]	4,660[2]	5,420[2]	8,920[2]
At Cross Section N	19.38	2,340[1]	3,880[2]	4,160[2]	6,490[2]
At Cross Section O	6.69	815	1,400	1,490	1,910
At Cross Section S	3.55	435	740	790	1,030
At Cross Section T	3.14	385	655	700	910
ROSELAND CREEK					
At Mouth	3.91	622	944	1,106	1,537
At Fresno Avenue	2.16	527	781	917	1,294
At Stony Point Road	1.28	254	383	452	648
At Burbank Avenue	0.54	171	249	290	406
RUSSIAN RIVER					
At Pacific Ocean	1,485	76,000	102,000	114,000	135,000
Upstream of Duncan Mills	1,460	75,000	100,000	112,000	133,000
Upstream of confluence of Austin Creek	1,390	74,000	98,000	107,000	131,000
Upstream of Summerhome Gage	1,340	73,000	97,000	106,000	130,000
Downstream of confluence of Mark West Creek	1,295	67,000	92,000	97,000[3]	126,000[3]
Upstream of confluence of Mark West Creek	1,041	60,000	88,000	103,000	140,000
Upstream of confluence of Dry Creek	795	56,000	79,000	90,000	129,000
Upstream of confluence of Brooks Creek	777	55,000	78,000	88,000	127,000

[1]Combined flow Fowler and Rodgers Creek

[2]Combined flow Fowler and Rodgers Creeks and overflow of Sonoma Creek

[3]Discharges reduced due to storage effects of Mark West Creek floodplain

Table 4: 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
RUSSIAN RIVER (continued)					
Upstream of confluence of Maacama Canal	707	51,000	73,000	82,000	115,000
Upstream of confluence of Sausal Creek	686	50,000	71,000	81,000	111,000
Upstream of confluence of Lytton Creek	678	50,000	70,000	80,000	110,000
Upstream of confluence of Miller Creek	654	48,000	68,000	79,000	106,000
Upstream of confluence of Gill Creek	642	47,000	67,000	76,000	105,000
Upstream of confluence of Big Sulphur Creek	520	46,000	58,000	73,000	100,000
Upstream of confluence of Oat Valley Creek	502	40,000	56,000	64,000	85,000
RUSSIAN RIVER SPLIT FLOW					
At Healdsburg Avenue	*	*	215	640	9,140
SALMON CREEK					
Upstream of Bodega Bay	*	*	*	*	*
SANTA ROSA FLOOD CONTROL CHANNEL					
Downstream of Guerneville Road	[2]	21,000	30,300	35,100	44,000
Upstream of confluence of Laguna de Santa Rosa	78.6	9,900	14,500	16,500	22,000
Upstream of confluence of Channel No. 3	[1]	9,120	13,500	15,200	19,000
SCHELL CREEK					
At Cross Section A	20.07	2,710	4,300	4,880	6,140
At Cross Section B	18.83	2,650	4,180	4,730	5,940
At Cross Section K	11.38	1,830	2,610	2,950	3,680
At Southern Pacific Railroad	9.51	1,750	2,470	2,780	3,450

*Data Not Available

[1]Discharges reduced due to storage effects of Mark West Creek floodplain

[2]Not Determined

Table 4: 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
SCHELL CREEK (continued)					
At Cross Section X	9.51	1,750	4,400[1]	5,190[1]	8,100[1]
At Cross Section AC	9.51	1,750	2,470	2,780	3,450
At Cross Section AI	9.51	1,750[2]	2,470[2]	2,780[2]	3,450[1]
At Cross Section AO	1.25	205	325	365	455
SONOMA CREEK					
At State Route 121	90.88	10,590	17,200	18,500	24,200
At Watmaugh Road	71.50	9,820	15,500	16,700	21,500
At Cross Section AL	67.89	9,720	15,200	16,400	21,000
At Cross Section BB	58.20	9,280	14,500	15,600	20,000
At Cross Section BL	56.01	9,050	14,100	15,000	19,200
At Madrone Road	48.17	7,900	12,200	13,100	16,800
At Harney Road	46.83	7,770	12,000	12,800	16,400
At Cross Section BY	45.51	7,640	11,700	12,500	16,000
At Cross Section BZ	31.29	5,790	8,780	9,420	11,900
At Cross Section CG	29.09	5,500	8,320	8,950	11,300
At Cross Section CL	27.27	5,270	7,960	8,550	10,800
At Cross Section CN	20.67	4,260	6,400	6,890	8,620
At Cross Section CY	16.88	3,860	5,505	5,930	7,385
At Cross Section DD	14.38	3,295	4,910	5,300	6,575
At Cross Section DF	7.99	2,015	2,985	3,220	3,995

[1]Combined flow Schell Creek and overflow of Sonoma Creek

[2]Combined flow Nathanson and Schell Creeks

Table 4: 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
SPRING CREEK					
Upstream of confluence with Matanzas Creek	5.30	700	1,170	1,350	1,730
At Franquette Avenue	4.80	580	970	1,120	1,440
Upstream of Yulupa Avenue	4.30	400	660	770	990
Upstream of confluence of Sierra Creek	3.20	220	360	420	540
Downstream of Summerfield Road	2.80	120	200	230	300
STARR CREEK					
Upstream of confluence with Windsor Creek	3.64	771	1,010	1,122	1,340
Upstream of confluence of Gumview Creek	2.08	494	650	717	870
At Windsor Road	0.87	236	310	341	415
Upstream of confluence of Wilson Creek	0.23	80	102	115	135
THOMPSON CREEK					
At F Street Outfall	2.68	490	790	960	1,290
Above Kelly Creek	1.60	305	510	600	830
TODD CREEK					
Approximately 900 feet downstream of Miller Road	0.54	217	304	340	423
Just downstream of confluence with TODD CREEK TRIBUTARY 2	1.10	409	582	653	824
Just upstream of Delores Lane	1.53	609	877	989	1,250
Just downstream of E Robles Avenue	2.10	819	1,174	1,323	1,667
Just upstream of the confluence with Hunter Creek	2.71	1,250	1,415	1,434	1,448
Just downstream of the confluence with Moorland Creek	4.23	1,414	1,650	1,697	1,776
Approximate 2,000 feet downstream of Scenic Avenue	4.33	1,448	1,695	1,748	1,836

Table 4: 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
TODD CREEK EAST FORK					
Just upstream of confluence with Todd Creek	0.56	210	297	333	417
TODD CREEK TRIBUTARY 1					
Just upstream of the confluence with Todd Creek	0.12	56	79	89	111
TODD CREEK TRIBUTARY 2					
Just upstream of the confluence with Todd Creek	0.41	154	222	250	316
WASHINGTON CREEK					
At Holly Band Lane	2.40	1,249	1,558	1,611	2,161
Downstream of Maria Drive	2.10	682	941	984	1,110
WIGGINS CREEK					
Upstream of confluence with Marin Creek	5.38	1,073	1,405	1,559	1,910
Upstream of confluence of Kizer Creek	3.12	768	1,010	1,108	1,385
Upstream of confluence of McBrown Creek	1.72	508	660	730	875
At King Road	1.44	438	570	627	755
WILLOW BROOK					
At Ely Road	13.94	5,749	8,291	9,372	11,656
Upstream of confluence of Lichau Creek	13.60	5,691	8,230	9,292	11,541
WILSON CREEK					
Upstream of confluence with Marin Creek	1.78	413	537	596	715
At Petaluma Valley Ford Road	1.33	365	470	525	630
Upstream of confluence of Stark Creek	0.67	205	270	295	355

Table 4: 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
WINDSOR CREEK					
Upstream of confluence with Mark West Creek	26.9	5,148	6,860	7,571	9,290
Upstream of confluence of Airport Creek	21.0	4,377	5,896	6,436	7,942
Upstream of confluence of Pool Creek	10.9	2,472	3,280	3,632	4,497
Upstream of confluence of Starr Creek	6.94	1,854	2,461	2,723	3,346
Upstream of confluence of East Windsor Creek	3.80	964	1,293	1,415	1,747
At Brooks Road	2.63	850	1,120	1,240	1,530
WOOLSEY CREEK					
Upstream of confluence with Mark West Creek	1.78	210	290	319	405

The stillwater elevations for coastal and tide-controlled areas on the Pacific Coast have been determined for the 10-, 2-, 1-, and 0.2-percent annual chance floods for the flooding sources studied by detailed methods and are summarized in Table 5, "Summary of Stillwater Elevations, Open Pacific Coast."

Table 5: Summary of Stillwater Elevations, Open Pacific Coast

	ELEVATION (feet NAVD[1])			
Flooding Source and Location	**10-percent**	**2-percent**	**1-percent**	**0.2-percent**
BODEGA HARBOR				
At Spud Point	7.9	8.3	8.4	8.7
PACIFIC OCEAN				
At Russian River Entrance	8.7	9.3	9.5	9.8

[1]North American Vertical Datum of 1988

Table 5a, "Summary of Stillwater Elevations, Sheltered Waters" summarizes the stillwater elevations for the 10-, 2-, 1-, and 0.2-percent annual chance floods for the flooding sources studied by detailed methods for San Pablo Bay.

Table 5a: Summary of Stillwater Elevations, San Pablo Bay

	ELEVATION (feet NAVD[1])			
Transect Number	**10-percent**	**2-percent**	**1-percent**	**0.2-percent**
B001	8.4	9.9	10.6	10.9
B002	8.4	9.8	10.6	10.9
B003	9.0	10.6	11.5	11.7
B004	9.2	11.0	11.8	12.1
B005	9.1	10.9	11.7	12.0
B006	9.1	10.8	11.6	11.8
B007	9.1	10.9	11.7	12.0
B008	9.3	11.1	11.9	12.2
B009	9.5	11.1	12.1	12.4
B010	9.3	11.1	11.9	12.2
B011	13.7	15.1	15.6	16.5
B012	11.9	12.7	12.9	13.3
B013	11.8	12.6	12.8	13.3
B014	9.4	11.1	12.0	12.4

Table 5a: Summary of Stillwater Elevations, Sheltered Waters, continued

	ELEVATION (feet NAVD[1])			
Transect Number	**10-percent**	**2-percent**	**1-percent**	**0.2-percent**
B015	15.7	16.9	17.2	11.3
B016	9.4	11.1	12.0	11.3
B017	9.2	11.0	11.9	11.3
B018	9.2	11.0	11.9	11.3
B019	9.2	10.9	11.8	11.3
B020	9.2	10.9	11.8	11.3
B021	9.3	10.9	12.1	12.7
B022	9.0	10.1	12.2	11.7

[1]North American Vertical Datum of 1988

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source 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.

Cross sections were determined from topographic maps and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. All topographic mapping used to determine cross sections is referenced in Section 4.1.

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 was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2).

The hydraulic analyses for this FIS were 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.

Precountywide Analyses

Each incorporated community within, and the unincorporated areas of, Sonoma County, has a previously printed FIS report. The hydraulic analyses described in those reports have been compiled and are summarized below.

In the City of Cloverdale, starting water-surface elevations for the Russian River were taken from those developed during past studies. For the July 16, 1996, study, water-surface elevations of the 1-percent annual chance flood peak discharge were computed using the 1990 version of the USACE HEC-2 computer program.

Water-surface elevations of the 1-percent annual chance flood peak discharge were computed using the 1990 version of the USACE HEC-2 computer program (USACE, 1990).

Cross-section data were obtained from field surveys, site grading plans and spot elevations. The starting water-surface elevation was computed using the slope-area method. Locations of selected cross sections used in the HEC-2 analysis are shown on the Flood Profiles. The computed profile is based on unobstructed flow. A floodway analysis was not performed along Cloverdale Creek.

For the City of Cotati, the downstream starting water-surface elevation for Cotati Creek was based on the HEC-2 slope/area method, with the model starting at the confluence with Laguna de Santa Rosa. The model for Laguna de Santa Rosa was started approximately 500 feet downstream of East Cotati Avenue using the water-surface elevation from the effective FIS for the City of Cotati.

Supercritical flow conditions can occur in some channel reaches. Where this happens, subcritical analyses were conducted to determine the water-surface profiles for these reaches.

Split-flow routines were used to determine discharges for overbank flow paths that are hydraulically separated from the main channel. A weir coefficient of 2.6 was used. The split-flow analysis indicated that approximately 35 cfs from Cotati Creek will overflow the main channel upstream of Hillview Avenue, and will flow onto West Sierra Avenue. Due to the site topography, this overflow will result in shallow street flooding and will not return to Cotati Creek within the study area. The street flow along West Sierra Avenue has a depth of less than 1 foot.

The Cotati Creek reinforced-concrete-box bypass structure was analyzed by performing a multiple-discharge analysis to develop an inlet water-surface elevation versus discharge rating for this structure. This rating was used to perform a split-flow analysis for the creek. It was determined that the bypass would divert 250 cfs from the creek during a 1-percent annual chance flood event. The discharge in the creek between the ends of the bypass was reduced from 440 to 190 cfs to account for the breakout of the flow through the bypass. This discharge was used for the floodplain and floodway determination in the main channel reach.

No hydraulic analyses were conducted as a part of the study for the City of Healdsburg because the required data on the Russian River and Dry Creek, including flood elevations, were previously developed in the Flood Insurance Study of the unincorporated areas of Sonoma County.

Channel roughness, Manning's "n" values, were established based on field observations and USACE and USGS guidelines (Chow, V. T., 1959; U.S. Department of the Interior, 1987).

In accordance with USACE guidelines, contraction and expansion coefficients of 0.1 and 0.3 were used for open-channel sections. Contraction coefficients at bridges ranged from 0.3 to 0.5, depending on configuration. Contraction coefficients of 0.5 were used at bridges. HEC-2 special bridge and culvert routines were used to model the existing road crossings.

For the September 6, 2006, revision for the City of Healdsburg, water-surface elevations for the 10-, 2-, 1-, and 0.2-percent annual chance recurrence intervals were developed along the Russian River using the standard step-backwater computer program HEC-RAS 3.0.1.

Cross-section data for the Russian River through the City of Healdsburg were obtained from field surveys, topographic maps, and bridge drawings. Aerial and ground surveys were conducted using a horizontal datum of the North American Datum of 1983.

Cross sections were located at the Healdsburg Avenue Bridge and the Southern Pacific Railroad Bridge. Cross sections were also located upstream and downstream of the Healdsburg Veterans' Memorial Beach Dam, an in-stream low head dam. Flood hazard delineations were mapped on topographic maps derived from aerial photogrammetry. The topographic maps were created at 1"=200' scale with a contour interval of 2 feet within the City of Healdsburg. The contour interval outside the City of Healdsburg city limits ranges from 1.0 foot to 5 feet.

Starting water-surface elevations were based on the effective Flood Profiles shown in the Sonoma County FIS report.

Upstream of the Southern Pacific Railroad Bridge, high water marks were used to calibrate composite roughness coefficients. In areas where high water marks were not available, roughness coefficients were estimated using engineering judgment.

Split flow analyses were conducted for the 1- and 0.2-percent annual chance flood events using HEC-RAS 3.0.1. During the 1-percent annual chance flood event, flows overtopping the left bank near river station 178+400 flow southeasterly away from the river and become hydraulically disconnected from the river. In the 0.2- percent annual chance flood event, flows begin to break out near 180+500 and become hydraulically disconnected from the river. The 1-percent annual chance and a portion of the 0.2-percent annual chance flood event flows reenter the channel at river station 174+100. Approximate methods were used to delineate the 0.2- percent annual chance flood hazard boundary southeast of the split flow channel. Flood hazard delineations for the remainder of the peak 0.2-percent annual chance discharge not conveyed in the main Russian River channel and in the split flow channel modeled using HEC-RAS 3.0.1 were calculated using approximate methods. The approximate methods were performed by calculating flow splits using roads and railroad tracks as weirs. The 0.2-percent annual chance event

flood hazard boundary outside of the modeled reaches was delineated using the water-surface elevation calculated from the weir-flow calculations.

Floodways for this study were computed on the basis of equal conveyance reduction from each side of the floodplain. In areas where the 1-percent annual chance floodplain was confined to the main channel, the floodway was defined by the 1-percent annual chance floodplain. Flows that overtopped the channel bank during the 1-percent annual chance flood event between 178+400 and 174+100, and were conveyed through the split flow reach, were contained within the channel in the floodway analysis. Within this area, the floodway data table values of "without floodway" base flood water-surface elevations are taken from the floodway model. The results of these computations are tabulated at selected cross sections for each segment for which a floodway was computed. In areas where the 1-percent annual chance peak discharge is conveyed entirely within the channel floodways were established between the tops of the channel banks.

Starting water-surface elevations for the Petaluma River at the downstream corporate limits in the City of Petaluma were determined from a HEC-2 study performed by the SCWA. For streams tributary to the Petaluma River, starting elevations were based on coincident flows at confluences.

Tidal elevations for the 10-, 2-, 1-, and 0.2-percent annual chance tidal floods used in this study were developed by Northwest Hydraulic Consultants (NHC, 2013). These elevations do not reflect wind setup or wave action and are referred to as stillwater elevations.

Ponding areas in the northwestern portion of the City of Petaluma are generally referred to as Denman Flat, a large natural storage area whose capacity greatly reduces the potential flood hazard downstream. The elevation is generally controlled by the ground elevation itself with the Old Redwood Highway and U.S. Highway 101 contributing to the containment of ponding.

Cross-sectional data for Laguna de Santa Rosa was supplied by the City of Rohnert Park in coordination with the SCWA. Water-surface profiles were developed using a HEC-2 computer step-backwater model (USACE, August 1979). Profiles were determined for the 10-, 2-, 1-, and 0.2-percent annual chance floods.

Elevations for streams studied by approximate analysis were determined by log interpolation of contours on topographic maps using hand calculations and estimated discharges. Depths were determined to be approximately 1 foot along Hinebaugh Creek, Coleman Creek, and Baumgardner Creek.

For the study of the City of Santa Rosa, cross-section data for all streams studied by detailed methods, with the exception of improved sections of Mount Hood Creek, were obtained by field surveys. Cross-section data for the improved sections of Mount Hood Creek were taken from design plans (Brelje and Race, 1977). Cross sections were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures.

The water-surface elevation computations for Spring and Mount Hood Creeks were started at normal depth and computed by using the slope/area method.

As a result of the analyses performed for Mount Hood Creek, it was determined that the 1- and 0.2-percent annual chance flows would be contained in the channel for those portions of the creek within the city. For this reason, no profiles, zone data, or floodway data have been presented in this report, and no 1-percent, 0.2- percent, or floodway delineations are shown on the FIRM or Flood Boundary and Floodway Map (FBFM).

Water-surface profiles for Spring Creek were developed using the USACE HEC-2 step-backwater computer model (USACE, August 1979). Profiles were determined for the 10-, 2-, 1-, and 0.2-percent annual chance floods.

The study contractor determined that the flooding on Santa Rosa Creek would be contained within the channel.

The USACE hydraulic analysis of Laguna de Santa Rosa extended from its confluence with Mark West Creek (which flows into the Russian River) upstream to the City of Cotati. This analysis was performed without consideration of backwater effects from the Russian River. However, this hydraulic analysis showed that the water-surface elevations ion the reach that affect the City of Sebastopol were approximately 6 feet lower than the backwater elevations from the Russian River developed during a hydrologic investigation of Warm Springs Dam on Dry Creek (a major tributary of the Russian River upstream of Laguna de Santa Rosa) for the Sonoma County FIS (FEMA, Sonoma County, California). From this investigation, the USACE determined that Laguna de Santa Rosa will pond in the vicinity of the City of Sebastopol due to flooding of the Russian River during a 1- percent annual chance event. Because the backwater elevation of the Russian River is higher than the base flood elevation of Laguna de Santa Rosa in this area, the Russian River backwater is the controlling flooding source. The base flood elevation presented in this FIS and on the FIRM (78 feet NAVD 88 from reservoir routing methods) reflects flooding from the Russian River.

Starting water-surface elevations for Laguna de Santa Rosa and Atascadero Creek were based on coincident flows at confluences. Starting water-surface elevations for the Russian River were based on previous studies.

Elevations for floods of the selected recurrence interval in the Pacific Ocean, San Pablo Bay, and Bodega Harbor are shown in Table 5, “Summary of Stillwater Elevations.”

For the City of Sonoma, June 5, 1997, revision, and the June 19, 1997, revision of the unincorporated areas of Sonoma County, water-surface elevations were computed through the use of the USACE HEC-2 computer program (USACE, 1985). The following parameters were used:

1. Channel and overbank cross sections were determined from field-surveyed channel sections and topographic maps and construction drawings provided by the City of Sonoma (Aero Cartographics, 1984; John J. Bonnoitt Associates, July 1994; John J. Bonnoitt Associates, November 1994).

2. The Manning's "n" roughness values were established based on field observations and USACE and USGS guidelines (Chow, V. T., 1959; U.S. Department of the Interior, 1987). The roughness values varied between 0.015 and 0.050 for the channel and between 0.020 and 0.200 for the overbank areas.

3. The downstream starting water-surface elevation for Fryer Creek was based on the HEC-2 slope/area method, with the model started approximately 1,000 feet downstream of the study limit of Leveroni Road.

4. Supercritical flow conditions can occur in some channel reaches. In accordance with FEMA guidelines, subcritical analyses were conducted to determine base flood elevations for all stream reaches.

5. The analyses indicate that backwater caused by the West MacArthur Street culvert results in a significant upstream flood-hazard area. Due to topographic conditions, the left-bank overflow will split from the channel downstream of MacArthur Street. This divided overflow area was analyzed by a separate HEC-2 model. Approximately 300 cfs are initially divided from the Fryer Creek channel. Portions of the overflow will return to the channel at several locations between West MacArthur and Lubeck Streets, after which the full discharge will pass through and over Leveroni Road. The average calculated depth for this overflow is less than 1 foot.

6. The backwater caused by the West MacArthur Street culvert also limits the capacity of the Andrieux Street/Fourth Street West conduit, resulting in approximately 80 cfs overtopping that will flow south down Fourth Street West. Approximately 40 cfs will return to the channel.

7. The closed conduit north of the upstream end of the open channel was analyzed by approximate methods. The capacity of the system drain was based on the existing conduit sizes (City of Sonoma, Existing Storm Drain Map) and assuming the drain slope is approximately the same as the ground, as estimated from the City of Sonoma topographic mapping (Aero Cartographics, 1984).

A roughness value of 0.013 was used for the existing concrete storm drain. The discharge in excess of the conduit capacity was assumed to result in shallow flooding along the conduit alignment. The depths were estimated by manual normal-depth calculations, and were determined to be less than 1 foot.

A floodway for Fryer Creek has not been defined between Todd Avenue and West MacArthur Street because it was determined that the overflow originating at West MacArthur Street cannot be contained within the channel flood limits without resulting in a water-surface rise of more than 1 foot.

In the unincorporated areas of Sonoma County, water-surface elevations of floods of the selected recurrence intervals were computed through use of the USACE HEC-2 step-backwater computer program.

Cross-section data for streams studied in detail in the county were obtained from existing topographic maps, channel improvement plans, or bridge drawings, or they were field surveyed. Cross sections were located at close intervals above and below bridges and culverts to compute any significant backwater effects of these structures.

Starting water-surface elevations for Sonoma Creek and the Petaluma River were set by tidal elevation. The starting water-surface elevations for the Russian River were taken from previous studies.

Flood elevations for the 10-, 2-, 1-, and 0.2-percent annual chance recurrence intervals for coastal areas adjacent to San Pablo Bay were based on a statistical analysis of tide gage information (U.S. Department of Commerce, 1980). The tide gage infrastructure was obtained from the National Oceanic and Atmospheric Administration for the period of time from 1855 through 1983. The elevations computed by the analysis represent the rise in bay elevation due to the effects of local storm surge coupled with astronomical tide. The elevations in San Pablo Bay do not include the effects of wind-driven waves or associated wave runup.

Starting water-surface elevations for San Pablo Bay, concurrent with 10-, 2-, 1-, and 0.2-percent annual chance flood events on streams studied, were all set at mean higher high water.

The effects of tsunami-induced flooding were considered, based on previous studies, to be insignificant in the northern end of San Francisco Bay.

The hydraulics of flooding at Salmon Creek was initially attributed to the occurrence of high ocean-water levels that would back up the streamflow. Field surveys and hydraulic analyses established that the spit was formed by wave action and that its elevation exceeded the maximum ocean stillwater level plus wave setup. Tsunami-induced flooding would not affect Salmon Creek because a sand spit protects the study area.

The maximum water-surface elevation at Salmon Creek was determined by treating the blocking sand spit as a broad-crested weir during flood events on the stream. The sand spit at the mouth of Salmon Creek is assumed to back up flooding from Salmon Creek just before breaching. Actual ocean levels at the time of breach have no influence on water-surface elevations from Salmon Creek. The water level so produced was consistent with local observations and was used in the delineation of the flood zone (Ott Water Engineers, Inc., 1984).

Storm-generated components of the coastal flood hazard at Bodega Harbor were evaluated by a three-step analysis. The first step determined the magnitude and frequency of storm surge or the super-elevation of the water level above astronomical tide that is caused by low barometric pressure and by wind stresses. The second step convoluted storm-surge probabilities with astronomical tide characteristics to define the stillwater elevation and frequency relation. Finally, wave impacts were defined and added to stillwater elevations.

The storm surge on Bodega Harbor was defined by a two-dimensional, finite-element computer model (James R. Pagenkopf, 1976). Applicability of the model had been tested using long-term climatic records for San Francisco to synthesize a long-term record of storm-surge hydrographs for San Francisco Bay. The close match of the synthesized data to available long-term tidal records confirmed the usability of the model for California conditions. For Bodega Harbor, the model synthesized a record, from 1955 to 1983, of storm-surge data on windspeed, wind direction, and barometric pressure as determined from North American Surface Weather Maps (U.S. Department of Commerce, 1955-1983). The frequency and magnitude of storm surges were defined from the synthesized storm-surge record.

Astronomical tide elevations can be defined precisely for Bodega Harbor from previous studies (U.S. Department of Commerce, 1945-1983). These tide characteristics were convoluted with the storm-surge magnitude and frequency to define the magnitude and frequency of stillwater elevations—the water-surface elevation with no wave impacts.

Because of inlet constrictions, Bodega Harbor was assumed to be sheltered from the influence of offshore storm-generated waves, but the magnitudes of locally generated wind waves were investigated using methods from the Shore Protection Manual (USACE, 1977). Based on wind magnitude and frequency data, measured fetch lengths, and beach profiles (Ott Water Engineers, Inc., 1984), the wave heights were found to be generally greater than 3 feet and therefore produced runup above the stillwater elevation. Hence, wave action has a significant effect on the flood hazard from Bodega Harbor. Transects along the Bodega Harbor shoreline provided a generalized representation of the beach profiles that control the magnitude of wave runup. In coastal-study areas, beach transects are oriented perpendicular to the shoreline and are 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 (USACE, 1978). Table 6, “Transect Locations,” lists the transect locations, and Figure 1, “Transect Location Map,” presents a sample transect. Tsunami plus astronomical tide elevations having 1- and 0.2-percent annual chance recurrence intervals have been defined for the northern California coastal areas in previous studies (USACE, December 1978; USACE, 1974; USACE, 1979). Study of the Bodega Harbor inlet conveyance capacity determined that tsunami waves could have only an insignificant impact on the flood hazard in this area.

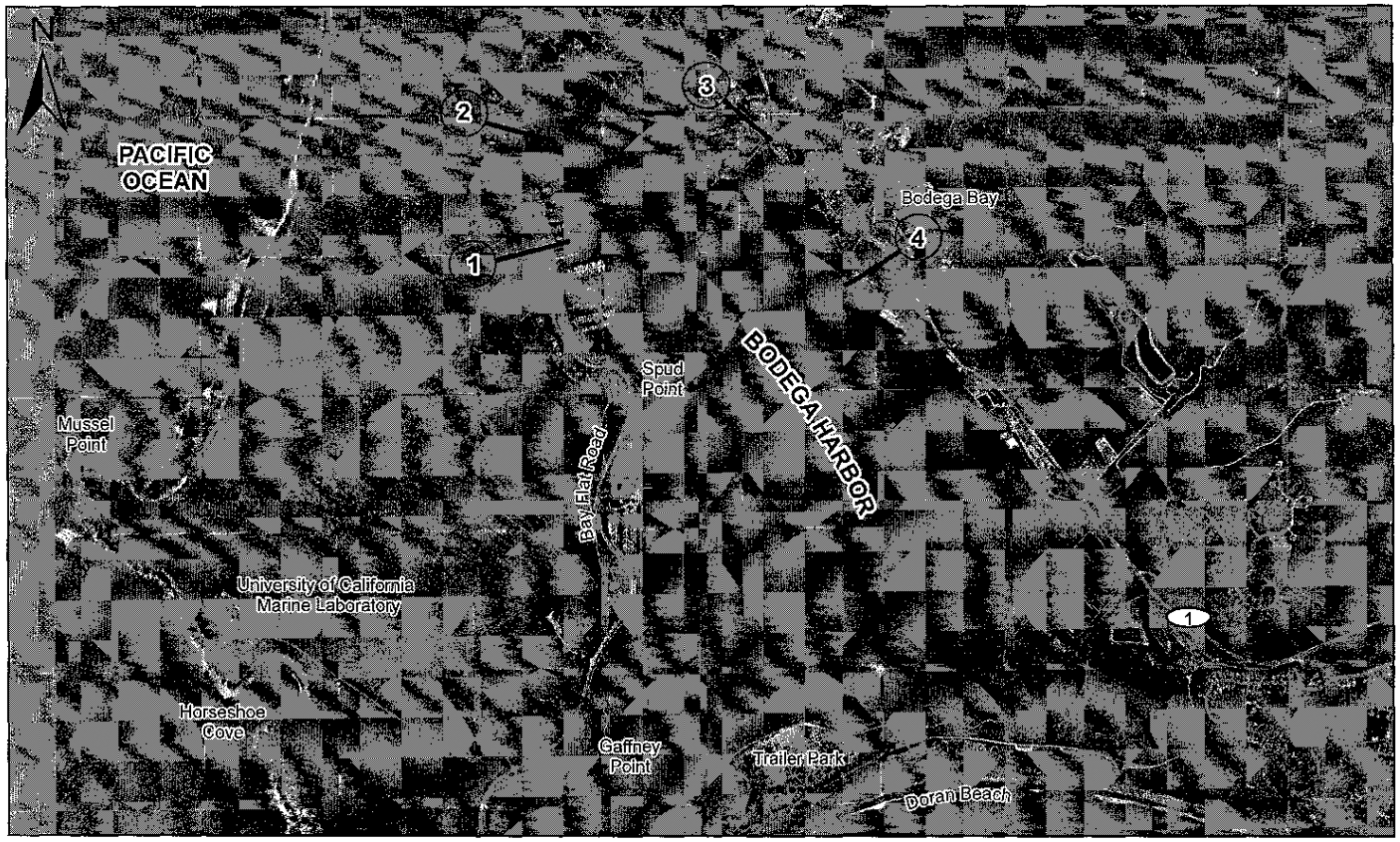

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA AND INCORPORATED AREAS

0 1,000 2,000 4,000 6,000 8,000 Feet

TRANSECT LOCATION MAP, OPEN PACIFIC COAST

Table 6: Transect Locations

Study Area	Transect Number	Location
Bodega Harbor	1	From the water's edge, south of the Bodega Boatworks and west to Old Bay Flat Road
	2	From the coastline, along Bay Flat Road and northwest to Westshore Road
	3	From the water's edge at the mouth of drainage, north along Eastshore Road
	4	From the shoreline at FAMFISHCO parking lot, east across State Highway 1

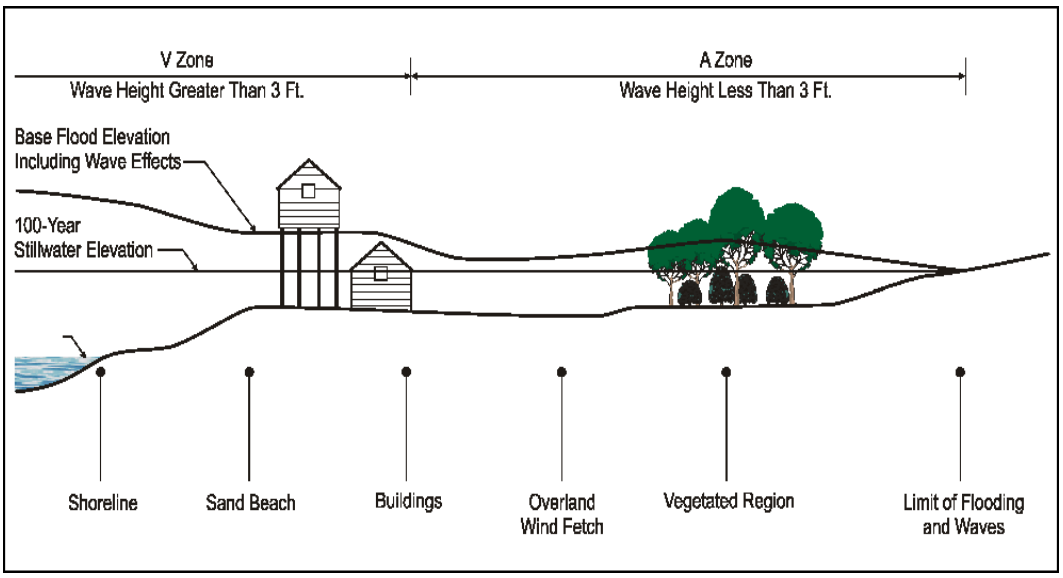

Figure 2: Transect Schematic

For the October 18, 1995 revision in the unincorporated areas of Sonoma County, the Russian River was studied using detailed methods from approximately 5,500 feet upstream to approximately 22,000 feet downstream of State Highway 128.

The 1% chance annual flood peak discharges along the studied reach of the Russian River were adopted from the April 1991 Flood Insurance Study for Sonoma County, California.

Cross-section data for the study reach were field surveyed. Water-surface elevations for the 1% chance annual flood were computed through the use of the USACE HEC-2 computer program. The starting water-surface elevation was adopted for the April 1991 FIS at a cross section upstream of Highway 128, approximately 5,200 feet downstream of the study reach.

A levee on the west overbank is not recognized as providing 1-percent annual chance protection in this study. Therefore, in accordance with FEMA criteria, the levee was evaluated for conditions reflecting with and without the levee.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 7, "Manning's "n" Values."

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Table 7: Manning's "n" Values

Flooding Source	Main Channel	Overbank Area	Bridge and Culvert Structures
Adobe Creek	0.020 – 0.045	0.020 – 0.070	
Arroyo Seco	0.035 – 0.050	0.040 – 0.050	0.030
Airport Creek	0.035 – 0.080	0.040 – 0.055	0.017 – 0.070
Austin Creek	0.030 – 0.060	0.070 – 0.080	
Bloomfield Creek	0.014 – 0.045	0.040 – 0.060	0.014 – 0.020
Cameron Creek	0.065	0.055	0.024 – 0.030
Capri Creek	0.020 – 0.100	0.020 – 0.093	
Champlin Creek	0.030 – 0.040	0.040 – 0.050	0.030
Cloverdale Creek	0.020 – 0.100	0.015 – 0.100	
Colgan Creek	0.030 – 0.100	0.020 – 0.120	0.015
Corona Creek	0.020 – 0.045	0.035-0.040	
Dutch Bill Creek	0.060	0.090 – 0.100	
Dry Creek	0.032	0.080	
East Austin Creek	0.040	0.080	
East Washington Creek	0.020 – 0.040	0.020 – 0.100	
East Windsor Creek	0.024 – 0.070	0.035 – 0.040	0.019 – 0.045
Fife Creek	0.060	0.100	
Fulton Creek	0.020 – 0.070	0.035 – 0.045	0.014 – 0.025
Gibson Creek	0.035 – 0.070	0.045	0.020 – 0.050

Table 7: Manning's "n" Values, continued

Flooding Source	Main Channel	Overbank Area	Bridge and Culvert Structures
Hulbert Creek	0.040 – 0.090	0.100	0.014
Hulbert Creek Tributary	0.055	0.100	0.014
Hunter Creek	0.035	0.040 – 0.060	
Kelly Creek	0.020 – 0.070	0.050	
Kizer Creek	0.045 – 0.100	0.050 – 0.090	0.020 – 0.025
Laguna de Santa Rose	0.035 – 0.055	0.035 – 0.070	0.020 – 0.080
Lakeville Street to Section Q	0.015	0.050	
Liberty Creek	0.035 – 0.050	0.050 – 0.070	0.020 – 0.030
Lichau Creek	0.035 – 0.065	0.035 – 0.095	0.020 – 0.055
Lynch Creek	0.030 – 0.100	0.030 – 0.100	
Mark West Creek	0.035 – 0.070	0.035 – 0.120	0.018 – 0.050
Marin Creek	0.035 – 0.070	0.050 – 0.060	0.017 – 0.030
McBrown Creek	0.040 – 0.100	0.050 – 0.100	0.020 – 0.025
Moorland Creek			
Mount Hood Creek	0.030 – 0.040	0.050 – 0.050	0.014
Nathanson Creek	0.025 – 0.050	0.040 – 0.100	0.020 – 0.040
Naval Creek	0.035 – 0.050	0.020 – 0.040	0.015 – 0.024
Naval Creek Tributary 1	0.035	0.04	
Naval Creek Tributary 2	0.035	0.04	
North Kenwood Creek	0.040 – 0.050	0.050 – 0.100	0.020 – 0.030
Petaluma River	0.025 – 0.055	0.025 – 0.070	
Pocket Canyon	0.040 – 0.090	0.070 – 0.120	0.014
Pool Creek	0.017 – 0.100	0.030 – 0.075	0.020 – 0.060
Redwood Creek	0.014 – 0.085	0.035 – 0.065	0.014 – 0.050
Roseland Creek	0.035 – 0.070	0.012 – 0.120	0.015 – 0.024
Russian River	0.020 – 0.080	0.050 – 0.160	

Table 7: Manning's "n" Values, continued

Flooding Source	Main Channel	Overbank Area	Bridge and Culvert Structures
Santa Rosa Flood Control Channel	0.035	0.035	0.020 – 0.035
Schell Creek	0.035 – 0.040	0.040 – 0.060	0.030 – 0.040
Sonoma Creek	0.040 – 0.055	0.060 – 0.100	0.020 – 0.040
Spring Creek	0.050 – 0.080	0.100 – 0.140	0.014
Stark Creek	0.014 – 0.050	0.070	0.030
Starr Creek	0.017 – 0.085	0.040 – 0.075	0.013 – 0.045
Thompson Creek	0.014 – 0.005	0.040 – 0.012	
Todd Creek	0.03 – 0.045	0.040 – 0.080	
Todd Creek (East Fork)	0.04	0.045	
Todd Creek Tributary 1	0.035 – 0.040	0.040 – 0.045	
Todd Creek Tributary 2	0.035	0.04	
Washington Creek	0.030 – 0.045	0.030-0.055	
Wiggins Creek	0.040 – 0.070	0.050 – 0.060	0.017 – 0.060
Willow Brook	0.020 – 0.070	0.020 – 0.045	
Wilson Creek	0.035 – 0.070	0.050	0.020 – 0.050
Windsor Creek	0.015 – 0.095	0.035 – 0.065	0.017 – 0.020

Behind Levee Analysis

Some flood hazard information presented in prior FIRMs and in prior FIS reports for Sonoma 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 (NFIP) 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 annual 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 documentation related to 44 CFR 65.10 is being compiled, the release of a more up-to-date FIRM 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 allow issuance of the FIS and FIRM while levee owners or communities compile full documentation required to show compliance with 44 CFR 65.10. The guidelines also explain that a FIRM 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 65.10.

FEMA contacted the communities within Sonoma 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 annual 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 annual 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 local communities, the USACE, and other organizations to compile a list of levees that exist within Sonoma County. Table 8 lists all levees shown on the FIRM, to include PALs, for which corresponding flood hazard revisions were made.

Table 8: List of Levees

Community	Flood Source	Levee Inventory Identification Number	USACE Levee
City of Petaluma	Petaluma River	165 and 168	No
Sonoma County (Unincorporated Areas)	Santa Rosa Flood Control Channel	40 and 149	No
Sonoma County (Unincorporated Areas)	Abramson Creek	152 and 154	No

Sonoma County (Unincorporated Areas)	Russian River	87, 144 and 145	No
Sonoma County (Unincorporated Areas)	Santa Rosa Flood Control Channel	156 and 162	No

Approximate analyses of "behind levee" flooding were conducted for all the levees in Table 8 to indicate the extent of the "behind levee" floodplains. The methodology used in these analyses is discussed below.

Levees 40 and 149 are located along Santa Rosa Flood Control Channel, levees 152, and 154 are located along Abramson Creek. Levees 156 and 162 are located along an unnamed tributary to the Santa Rosa Flood Control Channel. Based upon the FIS and topographic information from the USGS, an approximate area of 1-percent annual chance flooding in the event of failure of the levees was determined based on engineering judgment and designated as such as no accreditation data were provided.

Levees 165 and 168 are located along the Petaluma River. Based upon the FIS and topographic information from the USGS, areas of flooding in the event of failure of the levees were determined. These floodplains were consistent with the adjacent flood hazards, which dominate flooding in the area, and were designated consistently with those hazards as such no accreditation data were provided.

Levees 87, 144, and 145 are located along Russian River. Based upon the FIS, topographic information from the USGS, and a hydraulic analysis of 1-percent annual chance water-surface elevations in the area prepared using the USACE HEC-RAS model, an area of approximate flooding in the event of failure of the levees was determined and designated as such as no accreditation data were provided.

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 (NGVD 29). With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between the communities.

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration,

Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

The riverine vertical datum conversion factors are shown in the tabulation below:

Stream	Conversion Factor (ft)
Adobe Creek	2.71
Airport Creek	2.83
Arroyo Seco	2.65
Austin Creek	2.91

Stream	Conversion Factor (ft)
Bloomfield Creek	2.77
Cameron Creek	2.82
Capri Creek	2.70
Champlin Creek	2.70
Colgan Creek	2.81
Corona Creek	2.71
Cotati Creek	2.74
Dry Creek	2.87
Dutch Bill Creek	2.92
East Austin Creek	2.92
East Washington Creek	2.71
East Windsor Creek	2.84
Fife Creek	2.91
Fowler Creek	2.65
Fryer Creek	2.69
Fulton Creek	2.82
Gibson Creek	2.71
Hulbert Creek	2.90
Hulbert Creek Tributary	2.91
Kelly Creek	2.71
Kizer Creek	2.71
Laguna de Santa Rosa	2.78
Liberty Creek	2.73
Lichau Creek	2.73
Lynch Creek	2.71
Marin Creek	2.71
Mark West Creek	2.86
McBrown Creek	2.72

Mount Hood Creek	2.84
Nathanson Creek	2.67
Naval Creek	2.79
North Kenwood Creek	2.81
Petaluma River	2.71
Pocket Canyon	2.88
Pool Creek	2.84
Pruitt Creek	2.84
Redwood Creek	2.83
Stream	Conversion Factor (ft)
Rodgers Creek	2.66
Roseland Creek	2.80
Russian River	2.86
Santa Rosa Flood Control Channel	2.81
Schell Creek	2.63
Sonoma Creek	2.69
Spring Creek	2.82
Starr Creek	2.84
Thompson Creek	2.71
Washington Creek	2.71
Wiggins Creek	2.72
Willow Brook	2.72
Wilson Creek	2.71
Windsor Creek	2.84
Woolsey Creek	2.82

The non-riverine vertical datum conversion factors are shown in the tabulation below:

Flooding Source and Location	1-percent Annual Chance Elevation (NGVD 29)	Conversion Factor (ft)	1-percent Annual Chance Elevation (NAVD 88)
PACIFIC OCEAN			
At Russian River Entrance	6.6	2.86	9.5
BODEGA HARBOR			
At Spud Point	5.6	2.77	8.4

Additional non-riverine vertical datum conversion factors are shown in the tabulation below (only whole-foot NGVD 29 elevations available):

Flooding Source and Location	1-percent Annual Chance Elevation (NGVD 29)	Conversion Factor[1]	1-percent Annual Chance Elevation (NAVD 88)
BODEGA HARBOR			
At the east coast of the Harbor, from Windy Road to west of Smith Brothers Road	11	2.77	14

1All non-riverine conversions are based on whole-foot values from the FIRM

Flooding Source and Location	1-percent Annual Chance Elevation (NGVD 29)	Conversion Factor[1]	1-percent Annual Chance Elevation (NAVD 88)
BODEGA HARBOR, (continued)			
Along the Harbor north coast	12	2.77	15
At the coast of the Harbor, right located south of Bayflat Road and west of Eastshore Road	6	2.77	9
At the northeast coast of the Harbor, south of Eastshore Road and north of Windy Lane	12	2.77	15
North of West Side Regional Park, along the Harbor west coast	11	2.77	14
MARK WEST CREED, LAGUNA DE SANTA ROSA, SANTA ROSA FLOOD CONTROL CHANNEL, WINDSOR CREEK, WOOLSEY CREEK	75	2.86	78
PONDING			
Along Broadway vicinity Nathanson Creek	62	2.86	65
RUSSIAN RIVER TRIBUTARIES			
At the intersection of Willow and Wood Roads	61	2.86	64
SALMON CREEK			

West of Highway 1 and north of Bean Avenue	11	2.77	14

[1]All non-riverine conversions are based on whole-foot values from the FIRM

Coastal Analyses for the <date> Revision to this FIS

For San Francisco Bay, storm surge, swell-wave and wind-waves were modeled at a regional scale using numerical models to deterministically predict water levels and wave conditions in the bay (DHI, 2011). Coastal flooding hazards were then evaluated with one-dimensional (1D) transect-based models. The MIKE 21 Flow Model (HD) and MIKE 21 Spectral Wave (SW) model developed by DHI Water & Environment were used for the regional surge and wave modeling. The hydrodynamic model included the effects of tide, storm surge, and riverine discharge. The wave modeling was performed in two separate models, one for locally developing wind-waves and one for Pacific Ocean swell propagating into San Francisco Bay through the Golden Gate. The models synthesized water level and wave condition information for the 31 year period from 1973 to 2004. The frequency and magnitude of storm surge and wave heights was derived statistically from the synthesized 31 year record.

Water level and wave information from the regional hydrodynamic and wave models was used as input to the 1D flood hazard analyses. Wave setup, runup, overtopping, and overland wave propagation were analyzed at representative transects. Transects are shown on the FIRM panels and depicted in the San Pablo Bay Transect Location Map (Figure 3). Transect profile elevations were based on the National Oceanic and Atmospheric Administration (NOAA) 2010 Northern San Francisco Bay Area LiDAR, collected February to April, 2010. Bathymetric information was derived from USACE dredging surveys and NOAA/National Ocean Service (NOS) Geophysical Data System (GEODAS) bathymetric data. In areas where the two datasets overlapped, the USACE data was given priority.

Overland wave propagation modeling, using FEMA's Wave Height Analysis for Flood Insurance Studies (WHAFIS) model, Version 4 (FEMA, 1988; Divoky, 2007), was performed for transects with gently sloping profiles where the prevailing ground is inundated by the stillwater flood level alone. WHAFIS solves the wave action conservation equation and incorporates wind-generated wave growth and dissipation by marsh grasses, rigid vegetation, and buildings. Site specific vegetation roughness and drag parameters were developed by NHC for application to San Francisco Bay.

Wave runup was calculated for transects with coastal armoring or steeply sloping ground profiles in the vicinity of the flooded shoreline. Runup was calculated using one of three methods, depending on shoreline characteristics. The Direct Integration Method (FEMA, 2005) was used to calculate runup for transects with natural, gently sloping ($m < 0.125$) profiles. The Technical Advisory Committee for Water Retaining Structures (TAW) (van der Meer 2002) method was used for shorelines with shore protection structures and steeply sloping ($m \geq 0.125$) natural shorelines. The Shore Protection Manual (SPM) method (USACE 1984) was used to calculate wave runup on vertical walls. The total

runup elevation is also referred to as the total water level (TWL). Annual TWL maxima were selected from the 31 years (1973-2003) of hindcast data, and the generalized extreme value (GEV) distribution was employed to determine the 1-percent-annual-chance TWL from the annual maxima at each transect. Wave overtopping was evaluated for transects where the runup elevation exceeded the structure or bluff crest. Table 9, "Transect Data Table," provides a listing of the transect locations.

Table 9: Transect Data Table, San Pablo Bay

Transect	XY Coordinates (Feet, SP CA III FIPS 0403 HARN)		Stillwater Elevation (feet NAVD 88)[1]				Zone	BFE
			10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
B001	6419948.9	1803047.5	8.4	9.9	10.6	10.9	VE	11
B002	6420050.5	1803043.3	8.4	9.8	10.6	10.9	VE	11
B003	6421806.5	1803125.3	9.0	10.6	11.5	11.7	VE	12
B004	6423728.9	1803783.5	9.2	11.0	11.8	12.1	VE	12
B005	6425426.2	1804021.0	9.1	10.9	11.7	12.0	VE	12
B006	6427428.7	1804175.8	9.1	10.8	11.6	11.8	VE	12
B007	6429359.9	1804481.2	9.1	10.9	11.7	12.0	VE	12
B008	6431106.9	1804954.0	9.3	11.1	11.9	12.2	VE	12
B009	6432016.2	1804852.5	9.5	11.1	12.1	12.4	VE	12
B010	6433615.0	1804601.3	9.3	11.1	11.9	12.2	VE	12
B011	6434971.3	1804973.6	13.7	15.1	15.6	16.5	VE	16[2]
B012	6435778.1	1805963.6	11.9	12.7	12.9	13.3	VE	13[2]
B013	6436340.6	1806215.1	11.8	12.6	12.8	13.3	VE	13[2]
B014	6437961.0	1807244.5	9.4	11.1	12.0	12.4	VE	12
B015	6439127.2	1808196.4	15.7	16.9	17.2	17.8	VE	17[2]
B016	6441643.1	1809472.3	9.4	11.1	12.0	12.4	VE	12
B017	6442353.5	1809767.2	9.2	11.0	11.9	12.2	VE	12
B018	6443611.2	1810363.1	9.2	11.0	11.9	12.2	VE	12
B019	6445082.6	1811093.6	9.2	10.9	11.8	12.1	VE	12
B020	6446641.8	1812347.0	9.2	10.9	11.8	12.1	VE	12
B021[3]	6447743.8	1814317.7	9.3	10.9	12.1	12.7	N/A	13
B022[3]	6448392.7	1814126.3	9.0	10.1	12.2	11.7	N/A	12

[1]North American Vertical Datum of 1988

[2]Wave runup elevation

[3]Transects B021 and B022 originate in Solano County. No BFE is designated at the start of transects for Sonoma County

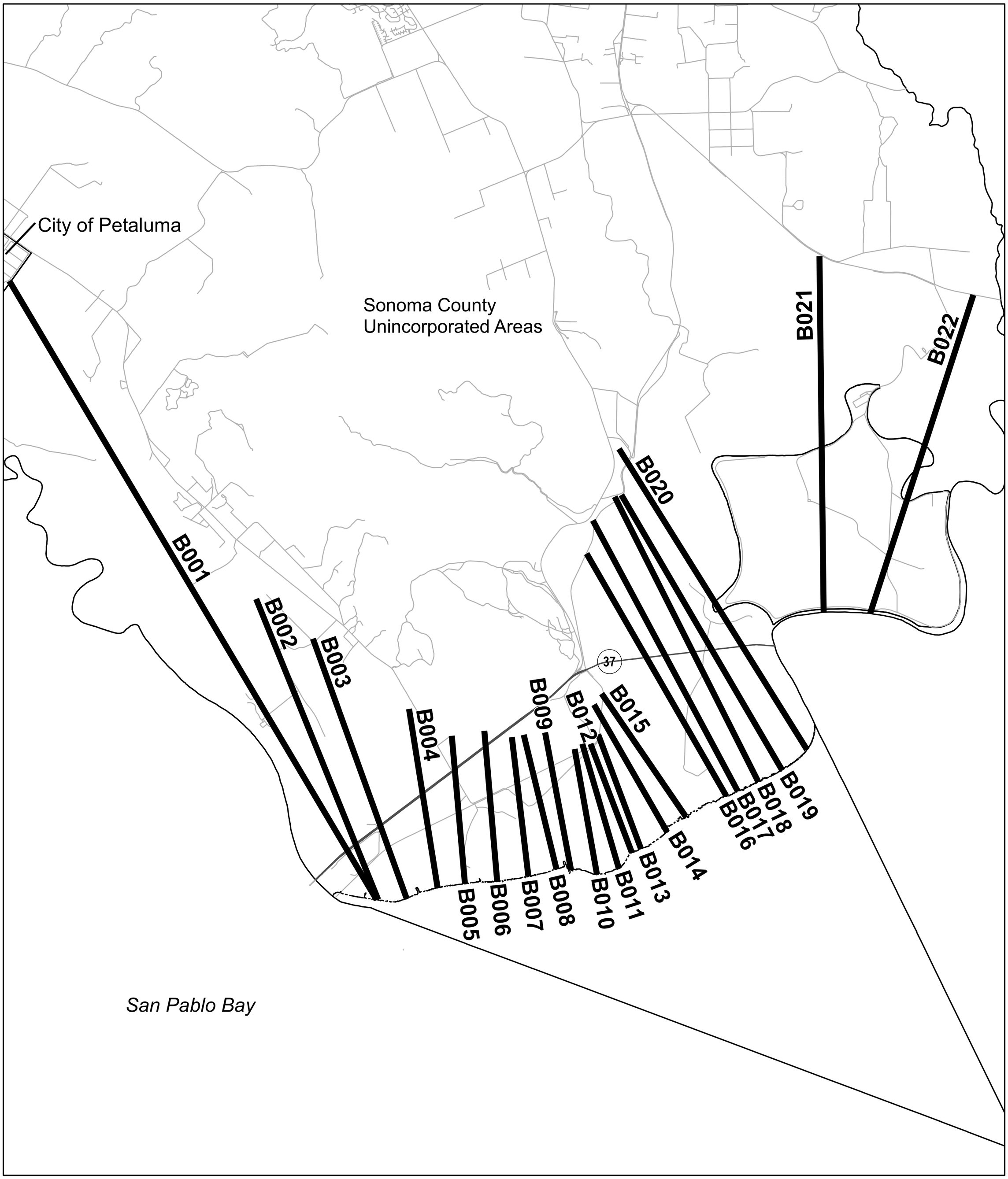

FIGURE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CALIFORNIA AND INCORPORATED AREAS

0 0.5 1 2 3 Miles

N

TRANSECT LOCATION MAP, SAN PABLO BAY

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-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1- 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 (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the county. For the streams studied in detail, the 100- and 500-year 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 scales varying from 1:600 to 1:24,000, with contour intervals of 2 to 40 feet.

Floodplain boundaries for Bodega Harbor and Salmon Creek were delineated using topographic maps at a scale of 1:4,800, with a contour interval of 4 feet, developed from aerial photographs (Ott Water Engineers, Inc., 1983). Approximate floodplain boundaries were delineated using the same topographic maps.

Floodplain boundaries behind the levees in the southern part of the city were delineated by the USACE, San Francisco District, assuming that the levees along the Russian River in the vicinity of Cloverdale offered only minor protection from floods of less than a 1-percent annual chance magnitude.

Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:240 and 1:24,000, with contour intervals of 2 and 5 feet, respectively (Sonoma County Water Agency, June 14, 1990; Sonoma County Water Agency, June 27, 1990; U.S. Department of the Interior, 1954). The FIRM was prepared using a 1"=500' scale photo enlargement of the USGS quadrangle map as the base map.

Flood boundaries for Laguna de Santa Rosa were developed on the basis of field investigation done by the City of Rohnert Park in coordination with the SCWA.

Flood boundaries for Sonoma Creek have not been shown because the flooding is contained within the channel for the entire area within the corporate limits of the City of Sonoma.

For the flooding sources studied by approximate methods, the boundaries of the 1-percent annual chance floodplains were delineated using topographic maps taken from the

previously printed FIS reports, FHBMs, and/or FIRMs for all of the incorporated and unincorporated jurisdictions within Sonoma County.

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- 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 (Exhibit 2).

For this revision to the FIS, new flood zones were developed and mapped for the updated San Francisco Bay coastal hazard analysis described in Section 3.2. Detailed flood hazard boundaries along San Francisco Bay were delineated using the NOAA 2010 Northern San Francisco Bay Area LiDAR, collected February to April (NOAA, 1960 - 2007).

Areas inundated by stillwater flooding with minimal wave hazard effects were mapped as Zone AE and the flood hazard boundary is located at the point where the ground elevation equals the BFE Stillwater elevation. In areas subject to wave runup, the flood hazard boundary is located at the point where the ground elevation equals the runup elevation, or where overtopping occurs, the boundary is located at the inland extent of overtopping. The Base Flood Elevation (BFE) in these areas is rounded to the nearest whole-foot, though the boundary is mapped using precision to the tenth of a foot. Inundation flooding is mapped inland to the point where it meets continuous high ground or encounters flooding from another flooding source. Salt marsh berms and non certified agricultural berms are not considered barriers to flood inundation regardless of height or continuity.

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 FIS are presented to local agencies as minimum standards 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 (Table 10). The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

On Dutch Bill Creek from cross section AT to cross section BG, the floodway boundary should be considered coincident with the channel boundaries.

From State Route 121 to San Pablo Bay, floodflows generally are a series of diked or cutoff ponding areas that fill up and spill over into adjacent ponding or diked areas; therefore, a floodway determination is not appropriate in these areas.

Because the overflow of Sonoma Creek above State Route 121 causes sheetflow to the adjacent streams, it is impossible to apply the equal conveyance reduction techniques, as required in FEMA guidelines; therefore, no floodways were computed on the following creeks: Sonoma Creek, from Station 51,380 to 59,500; Fowler Creek, from Station 000 to 7,800; Rodgers Creek, from Station 000 to 7,610; and Schell Creek, from Station 8,200 to 10,020.

Above Station 59,500 on Sonoma Creek, the floodway is contained in the channel; therefore, the top of bank should be considered the floodway limit.

Because of the significant loss of flows separating to the southeast in the reach between Old Redwood Highway and Ely Road, no floodway for Willow Brook was determined for this reach (Stations 3,500 to 4,900).

For the reach of Mark West Creek between Stations 5,344 and 8,749, the south creek bank is significantly higher than the adjacent overbank (a perched stream); consequently, no floodway was determined for this reach.

The floodway for Dry Creek in Sonoma County is contained within the channel for its entire length; therefore, the top of the bank should be considered the floodway limit.

Since only shallow flooding on Corona Creek would be expected during the 1- percent annual chance flood event, a floodway was not deemed practical; consequently, a floodway was not determined.

Because of the variability of the stream course of Liberty Creek from Station 3,000 to Station 5,200, no floodway was defined in this reach. Upstream of Station 5,200, the floodway is contained in the channel; therefore, the top of the bank should be considered the floodway limit.

For the reach of Laguna de Santa Rosa from Stony Point Road to the confluence with Hinebaugh Creek, from Station 62,800 to Station 65,600, no floodway was determined because water spilling from the three canals in this reach prevented such a determination.

For the reach of Bloomfield Creek downstream of cross section “A”, the south creek bank is significantly higher than the overbank (a perched stream); consequently, no floodway was determined for this reach.

At the north end of the City of Petaluma, a number of small streams, including Willow Brook, converge to form the Petaluma River. The area, referred to as Denman Flat, is a meadowland for the majority of the year. Runoff from heavy rains collects in this area, and escapes slowly, reducing peak flows and their resulting flood hazard in Petaluma. A floodway was not developed for the Denman Flat area. However, the role that area plays in reducing flood hazards should be carefully analyzed before encroachment into the area is allowed.

The floodway for Laguna de Santa Rosa was computed on the basis of equal-conveyance reduction from each side of the floodplain.

Due to the nature of flooding in the City of Sebastopol, a floodway was not computed.

Along Nathanson Creek, the overflow areas above MacArthur Street are subject to shallow flooding of less than 1 foot in depth. These floodflows are generally confined to street areas because the immediate overbank area that parallels the channel contains homes and businesses. In determining the flood elevations of the 1-percent annual chance event, streetflows were analyzed separately from the main channel flow with adjustments made in discharge quantities in the channel proper. Selection of a floodway that would cause a rise in water surface of 1 foot would cause serious flooding conditions, with hazard to life and property. There would be some logic in calling a major street a floodway, but little in making street areas a floodway fringe and occupied areas part of the floodway. In many instances, where overbank areas are subject to inundation of 1 foot or less, the potential flood damage would be increased by 100 percent or more by the application of the floodway concept.

Floodways were not computed for Sonoma Creek, as the 1-percent annual chance flow was contained in the channel or, as with parts of Fryer Creek, only shallow overland flow was produced.

A floodway has not been defined between Todd Avenue and West MacArthur Street because it was determined that the overflow originating at West MacArthur Street cannot be contained within the channel flood limits without resulting in a water-surface rise of more than 1 foot for Fryer Creek.

A floodway analysis was not performed along Cloverdale Creek.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 10, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Airport Creek								
A	1,521[2]	78	407	3.4	81.2	81.2	82.1	0.9
B	2,159[2]	71	302	4.5	83.2	83.2	84.0	0.8
C	2 894[2]	229	487	2.8	84.9	84.9	85.9	1.0
D	3,621[2]	120	415	3.3	86.7	86.7	87.1	0.4
E	4,340[2]	104	409	2.3	88.9	88.9	89.9	1.0
F[1]	4,966[2]	60	340	2.8	90.2	90.2	91.0	0.8
G[1]	5,634[2]	48	316	3.0	92.3	92.3	93.0	0.7
H[1]	6,709[2]	48	306	4.1	95.3	95.3	96.2	0.9
I	7,652[2]	49	337	3.8	97.6	97.6	98.5	0.9
J	8,294[2]	90	348	1.8	97.9	97.9	98.9	1.0
K[1]	9,094[2]	46	182	3.4	99.7	99.7	100.6	0.9
L	9,494[2]	42	160	3.9	100.6	100.6	101.5	0.9
M	9,994[2]	75	289	2.1	103.0	103.0	104.0	1.0
Arroyo Seco								
A	600[3]	40	248	8.7	16.5	16.5	17.5	1.0
B	1,200[3]	155	483	4.4	19.1	19.1	20.1	1.0
C	1,970[3]	69	330	6.5	21.0	21.0	22.0	1.0
D	2,800[3]	49	284	7.5	24.2	24.2	25.2	1.0
E	3,400[3]	122	464	4.6	27.2	27.2	28.2	1.0
F	4,000[3]	106	408	5.2	28.8	28.8	29.8	1.0
G	4,600[3]	73	413	5.2	30.5	30.5	31.5	1.0
H	5,200[3]	48	336	6.4	32.5	32.5	33.5	1.0
I	5,770[3]	80	378	5.7	35.1	35.1	36.1	1.0
J	6,620[3]	52	432	5.0	38.0	38.0	39.0	1.0
K	7,550[3]	27	286	7.5	42.2	42.2	43.2	1.0

[1] Flow contained in channel
[2] Feet above confluence with Windsor Creek
[3] Feet above confluence with Schell Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

AIRPORT CREEK – ARROYO SECO

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Arroyo Seco (continued)								
L[1]	8,300	42	182	11.8	47.7	47.7	47.7	0.0
M	8,900	75	515	4.2	52.9	52.9	53.9	1.0
N	9,400	26	180	11.9	54.5	54.5	55.5	1.0
O[1]	9,920	49	345	6.2	60.1	60.1	60.7	0.6
P	10,500	276	1,145	1.9	65.5	65.5	66.5	1.0
Q[1]	11,460	44	353	6.1	66.5	66.5	67.5	1.0
R	12,000	55	357	6.0	68.8	68.8	69.8	1.0
S	12,680	39	287	7.5	72.9	72.9	73.9	1.0
T[1]	13,700	41	144	8.3	78.2	78.2	78.4	0.2
U	14,250	52	296	4.0	82.7	82.7	83.7	1.0
V	15,103	24	162	7.4	88.4	88.4	89.4	1.0
W[1]	15,940	27	132	9.1	92.7	92.7	92.7	0.0
X	16,400	152	532	2.2	99.3	99.3	100.3	1.0
Y	17,000	57	258	4.6	100.2	100.2	101.2	1.0
Z[1]	17,580	56	189	6.3	105.0	105.0	105.0	0.0
AA	18,220	86	420	2.8	107.9	107.9	108.9	1.0
AB	18,660	26	239	5.0	112.9	112.9	113.9	1.0
AC	19,175	47	250	4.8	115.1	115.1	116.0	0.9
AD[1]	19,918	18	93	12.9	124.9	124.9	124.9	0.0

[1] Flow contained in channel
[2] Feet above confluence with Schell Creek

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Austin Creek								
A	150	250[3]	2,849	8.6	37.9	22.1[4]	23.1	1.0
B[1]	1,900	238	2,240	11.0	37.9	26.7[4]	26.8	0.1
C[1]	1,950	247	2,594	9.5	37.9	27.6[4]	27.7	0.1
D[1]	2,650	307	3,999	6.2	37.9	29.6[4]	30.2	0.6
E[1]	4,300	300	3,561	6.9	37.9	31.1[4]	31.5	0.4
F[1]	5,600	239	2,008	12.3	37.9	32.7[4]	32.9	0.2
G[1]	7,600	187	2,425	10.1	39.8	39.8	39.8	0.0
H[1]	9,150	366	3,352	7.3	46.0	46.0	46.5	0.5
I[1]	10,950	237	4,196	5.9	50.0	50.0	50.7	0.7
J[1]	12,650	149	2,058	12.0	51.9	51.9	52.8	0.9
K[1]	14,100	256	3,399	7.9	56.3	56.3	56.8	0.5
L[1]	15,650	215	2,644	9.3	57.4	57.4	58.0	0.6
M[1]	16,700	144	1,709	14.4	59.0	59.0	59.3	0.3
N[1]	18,000	173	2,363	10.4	64.0	64.0	64.0	0.0
O[1]	20,400	186	2,711	9.1	66.9	66.9	67.9	1.0
P	20,485	322	3,482	7.1	71.1	71.1	72.1	1.0
Q	20,900	465	5,328	4.6	72.3	72.3	73.1	0.8
R	21,650	461	4,857	5.1	72.9	72.9	73.6	0.7
S	21,750	234	3,325	4.1	73.3	73.3	73.8	0.5
T	22,000	181	3,021	4.5	73.3	73.3	73.8	0.5
U[1]	23,400	182	1,902	7.1	73.6	73.6	74.3	0.7
V[1]	23,750	208	2,603	5.2	75.8	75.8	76.2	0.4
W[1]	23,900	207	2,694	5.0	78.2	78.2	78.6	0.4
X[1]	24,700	160	2,095	6.4	79.5	79.5	79.9	0.4
Y[1]	25,900	118	1,698	8.0	82.7	82.7	83.1	0.4
Z	27,000	240	2,749	4.9	85.4	85.4	86.2	0.8

[1] Flow contained in channel
[2] Feet above confluence with Russian River
[3] Width given without consideration of influence of Russian River
[4] Elevation computed without consideration of backwater

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

AUSTIN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Austin Creek (continued)								
AA[1]	27,600[2]	133	1,540	8.8	86.7	86.7	87.6	0.9
AB[1]	29,400[2]	126	1,824	7.4	92.4	92.4	93.1	0.7
AC[1]	30,700[2]	107	1,357	10.0	94.6	94.6	95.1	0.5
AD[1]	31,700[2]	119	1,367	9.9	97.2	97.2	98.1	0.9
AE[1]	32,300[2]	148	1,731	7.8	99.7	99.7	100.4	0.7
AF[1]	32,332[2]	148	2,537	5.3	105.1	105.1	105.8	0.7
AG[1]	32,900[2]	99	1,586	8.5	105.2	105.2	105.9	0.7
AH[1]	33,750[2]	145	1,854	7.3	106.4	106.4	107.3	0.9
AI[1]	35,250[2]	164	1,291	10.5	108.2	108.2	108.7	0.5
AJ[1]	35,800[2]	84	781	17.3	112.8	112.8	112.8	0.0
AK[1]	35,870[2]	153	1,405	9.6	115.9	115.9	116.4	0.5
AL[1]	36,400[2]	201	2,416	5.6	117.7	117.7	118.0	0.3
AM[1]	37,100[2]	173	1,718	7.9	117.9	117.9	118.1	0.2
AN[1]	38,000[2]	122	1,264	10.7	118.9	118.9	119.1	0.2
AO[1]	38,100[2]	123	1,307	10.3	119.3	119.3	119.4	0.1
AP[1]	38,168[2]	68	975	13.8	124.2	124.2	124.2	0.0
AQ[1]	39,100[2]	159	1,499	9.0	126.7	126.7	126.7	0.0
Bloomfield Creek								
A	1,188[3]	250	340	4.2	52.8	52.8	53.8	1.0
B	1,936[3]	220	551	2.6	54.9	54.9	55.4	0.5
C	2,492[3]	240	435	3.3	55.4	55.4	56.3	0.9
D	3,611[3]	60	416	3.3	65.1	65.1	65.8	0.7
E	3,921[3]	69	352	3.9	65.2	65.2	66.1	1.0

[1] Flow contained in channel
[2] Feet above confluence with Russian River
[3] Feet above Valley Ford Road

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

AUSTIN CREEK – BLOOMFIELD CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cameron Creek								
A[1]	283[2]	25	130	2.9	91.2	91.2	92.2	1.0
B	899[2]	151	397	1.0	93.9	93.9	94.8	0.9
C	1,498[2]	80	175	2.2	94.3	94.3	95.3	1.0
D	2,178[2]	55	148	2.5	97.6	97.6	98.5	0.9
E	2,680[2]	34	166	2.2	101.5	101.5	102.5	1.0
F	3,321[2]	23	104	2.8	102.3	102.3	103.3	1.0
G	3,826[2]	23	104	2.8	106.1	106.1	107.1	1.0
H	4,207[2]	50	253	1.2	107.7	107.7	107.8	0.1
I	4,827[2]	61	234	1.3	107.7	107.7	107.8	0.1
J	5,399[2]	54	130	2.3	108.1	108.1	108.6	0.5
K	6,029[2]	34	97	2.9	109.3	109.3	110.3	1.0
L	6,645[2]	62	135	2.1	111.8	111.8	112.8	1.0
Champlin Creek								
A[1]	0[3]	78	358	4.2	45.4	45.4	45.4	0.0
B[1]	660[3]	39	93	6.3	46.9	46.9	47.6	0.7
C[1]	1,525[3]	23	77	7.6	56.4	56.4	56.4	0.0
D[1]	2,169[3]	12	61	9.6	64.0	64.0	64.9	0.9
E[1]	2,700[3]	57	86	6.8	70.0	70.0	70.0	0.0
F1	3,300[3]	33	70	8.3	77.3	77.3	77.3	0.0
G	*		*		*	*	*	*
H	*	*	*	*	*	*	*	*
I[1]	5,900[3]	15	33	17.6	107.5	107.5	108.0	0.5
J[1]	6,450[3]	14	26	13.3	136.5	136.5	136.5	0.0
K[1]	7,000[3]	17	40	8.7	147.6	147.6	148.3	0.7

[1] Flow contained in channel
[2] Feet above confluence with Fulton Creek
[3] Feet above confluence with Rodgers Creek
* Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

CAMERON CREEK – CHAMPLIN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Colgan Creek								
A	311	105	564	4.3	79.8	76.4[2]	77.4[2]	1.0
B	1,077	79	516	4.7	79.8	77.5[2]	78.1[2]	0.6
C	2,410	94	471	4.4	79.8	78.6[2]	79.3[2]	0.7
D	2,701	87	597	3.3	79.8	79.8[2]	80.1[2]	0.3
E	3,348	99	576	3.0	80.1	80.1	80.7	0.6
F	3,971	98	508	3.4	80.7	80.7	81.2	0.5
G	4,867	87	434	3.9	82.4	82.4	82.6	0.2
H	5,306	91	453	3.7	83.0	83.0	83.3	0.3
I	6,182	114	515	3.3	84.2	84.2	84.4	0.2
J	6,870	89	439	3.2	84.9	84.9	85.0	0.1
K	8,216	103	401	4.5	86.6	86.6	86.8	0.2
L	8,837	113	427	4.4	87.7	87.7	88.2	0.5
M	9,782	109	407	4.6	89.2	89.2	90.2	1.0
N	10,795	100	512	3.8	91.4	91.4	92.3	0.9
O	11,736	93	450	4.2	92.7	92.7	93.3	0.6
P	12,393	55	396	4.6	93.7	93.7	94.3	0.6
Q	12,676	105	457	4.5	94.6	94.6	95.1	0.5
R	12,939	101	480	4.1	95.0	95.0	95.4	0.4
S	13,161	155	500	4.4	95.5	95.5	95.8	0.3
T	13,578	202	786	2.4	96.5	96.5	97.5	1.0
U	13,875	156	616	3.1	96.7	96.7	97.6	0.9
V	14,439	54	354	5.1	97.3	97.3	98.1	0.8
W	14,988	52	364	4.5	98.3	98.3	99.0	0.7
X	15,894	52	324	4.7	99.7	99.7	100.3	0.6
Y	16,185	54	292	5.0	100.4	100.4	100.8	0.4
Z	16,569	53	289	5.0	101.4	101.4	101.6	0.2

[1] Feet above confluence with Laguna de Santa Rosa
[2] Elevations computed without consideration of backwater effects from Laguna de Santa Rosa

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

COLGAN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Colgan Creek (continued)								
AA	17,246	55	316	4.7	102.8	102.8	103.0	0.2
AB	18,137	53	279	3.4	104.6	104.6	104.7	0.1
AC	18,682	50	260	4.1	105.2	105.2	105.3	0.1
AD	18,993	129	487	2.1	106.4	106.4	106.5	0.1
AE	19,477	45	223	4.0	107.5	107.5	107.5	0.0
AF	19,865	47	244	3.8	108.6	108.6	108.6	0.0
AG	20,258	52	261	6.0	110.1	110.1	110.1	0.0
AH	21,239	48	224	3.9	111.8	111.8	111.8	0.0
AI	21,896	45	189	3.4	112.9	112.9	112.9	0.0
AJ	22,318	40	160	3.8	113.4	113.4	113.4	0.0
AK	22,726	45	176	3.4	114.4	114.4	114.4	0.0
AL	23,115	43	185	3.3	115.5	115.5	115.5	0.0
AM	23,995	56	293	4.4	119.3	119.3	119.6	0.3
AN	24,276	54	314	3.8	120.5	120.5	121.1	0.6
AO	25,144	63	388	3.2	124.2	124.2	124.5	0.3
AP	25,905	29	190	6.1	127.8	127.8	128.2	0.4
AQ	26,363	43	257	4.6	128.5	128.5	128.9	0.4
AR	26,931	49	356	3.0	133.6	133.6	133.8	0.2
AS	27,281	42	263	3.5	133.9	133.9	134.0	0.1
AT	27,429	40	166	6.1	134.9	134.9	135.0	0.1
AU	28,236	41	180	5.3	138.3	138.3	138.4	0.1
AV	28,426	38	179	5.2	139.7	139.7	139.7	0.0
AW	28,756	38	227	4.7	140.3	140.3	140.8	0.5
AX	29,166	37	184	5.5	141.2	141.2	141.8	0.6
AY	29,332	39	208	4.8	142.1	142.1	142.5	0.4
AZ	29,719	39	182	5.5	143.4	143.4	143.7	0.3

[1] Feet above confluence with Laguna de Santa Rosa

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Colgan Creek (continued)								
BA	30,016	21	153	5.2	144.5	144.5	145.1	0.6
BB	30,276	37	199	4.4	145.5	145.5	146.3	0.8
BC	30,550	21	150	5.3	146.8	146.8	147.5	0.7
BD	30,756	20	152	5.2	147.3	147.3	147.9	0.6
BE	31,355	21	154	6.2	149.0	149.0	149.6	0.6
BF	31,648	20	163	5.0	150.3	150.3	150.9	0.6
BG	32,356	54	166	2.1	151.4	151.4	151.8	0.4
BH	33,033	49	105	3.1	155.0	155.0	155.0	0.0
BI	33,475	48	93	3.5	156.1	156.1	156.1	0.0
BJ	34,096	42	81	4.0	160.0	160.0	160.0	0.0
BK	34,326	35	74	4.4	161.5	161.5	161.5	0.0
BL	34,677	29	87	3.5	165.5	165.5	165.5	0.0
BM	35,162	40	98	3.1	169.9	169.9	169.9	0.0
BN	35,593	76	138	2.2	174.0	174.0	174.0	0.0
BO	36,159	37	96	3.2	179.4	179.4	179.4	0.0
BP	36,643	41	77	4.1	188.3	188.3	188.3	0.0
BQ	37,279	64	86	3.8	197.6	197.6	197.6	0.0
BR	38,000	17	34	8.0	211.1	211.1	211.1	0.0
BS	38,720	36	57	4.8	232.1	232.1	232.1	0.0
BT	39,716	16	34	8.1	254.7	254.7	254.7	0.0
BU	40,155	20	48	5.2	268.5	268.5	268.5	0.0
BV	41,111	13	28	8.3	302.8	302.8	302.8	0.0

[1] Feet above confluence with Laguna de Santa Rosa

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cotati Creek								
A	981	20	60	7.3	109.6	109.6	110.3	0.7
B	1,091	20	72	6.1	110.9	110.9	111.0	0.1
C	1,168	16	61	7.3	111.2	111.2	111.4	0.2
D	1,350	16	66	6.7	112.4	112.4	112.6	0.2
E	1,449	16	63	6.9	112.5	112.5	112.8	0.3
F	1,510	25	84	5.2	113.3	113.3	113.5	0.2
G	1,760	26	103	4.3	114.7	114.7	114.9	0.2
H	2,172	26	92	4.8	116.4	116.4	116.6	0.2
I	2,261	23	76	2.3	118.0	118.0	118.3	0.3
J	2,526	9	49	3.6	119.2	119.2	119.6	0.4
K	2,707	17	62	2.8	119.9	119.9	120.3	0.4
L	2,799	14	24	7.4	121.1	121.1	121.3	0.2
M	2,905	13	44	3.9	122.3	122.3	122.6	0.3
N	3,011	20	60	2.9	123.0	123.0	123.5	0.5
O	3,236	19	77	5.7	124.0	124.0	124.6	0.6
P	3,278	32	109	4.0	127.5	127.5	128.3	0.8
Q	3,371	26	101	4.4	128.8	128.8	129.4	0.6
R	3,539	20	89	5.0	129.9	129.9	130.5	0.6
S	3,659	26	89	4.9	131.0	131.0	131.4	0.4
T	3,725	20	93	4.7	132.1	132.1	132.4	0.3
U	3,816	24	107	4.1	133.0	133.0	133.4	0.4
V	4,117	17	29	7.5	134.9	134.9	134.9	0.0
W	5,167	28	59	3.8	150.8	150.8	150.8	0.0

[1] Feet above confluence with Laguna de Santa Rosa

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Dry Creek[1]								
A	1,530	423	4,834	4.3	84.2	81.1[3]	82.0	0.9
B	5,380	292	2,622	5.7	84.2	83.9[3]	84.2	0.3
C	13,380	304	2,297	6.5	94.5	94.5	94.5	0.0
D	16,145	385	3,101	4.5	99.5	99.5	99.5	0.0
E	17,345	406	1,917	7.4	100.7	100.7	100.7	0.0
F	18,545	451	2,723	5.2	103.6	103.6	103.8	0.2
G	19,403	289	2,266	6.2	105.3	105.3	105.5	0.2
H	20,545	718	3,094	4.6	108.3	108.3	108.4	0.1
I	22,590	322	2,018	6.4	112.5	112.5	112.6	0.1
J	29,625	148	1,511	8.6	127.9	127.9	127.9	0.0
K	33,420	158	1,638	7.3	134.5	134.5	134.5	0.0
L	39,160	217	1,524	7.2	143.5	143.5	144.0	0.5
M	46,720	134	1,135	9.7	159.7	159.7	159.7	0.0
N	50,460	317	1,610	6.8	165.9	165.9	166.6	0.7
O	55,170	140	1,864	5.9	177.5	177.5	177.8	0.3
P	59,550	116	878	7.9	182.7	182.7	182.7	0.0
Q	64,160	125	657	9.1	191.2	191.2	191.4	0.2
R	67,810	180	1,182	5.1	200.7	200.7	201.4	0.7
S	68,010	175	1,140	5.3	201.0	201.0	201.6	0.6

[1] Flow in channel
[2] Feet above confluence with Russian River
[3] Elevation computed without consideration of backwater

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

DRY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Dutch Bill Creek								
A*								
B	853	65	705	6.0	47.4	47.4	48.4	1.0
C	1,484	74	621	6.8	47.4	47.4	48.4	1.0
D	2,668	59	666	6.3	47.4	47.4	48.4	1.0
E	3,768	110	928	4.5	47.4	47.4	48.4	1.0
F	5,123	70	673	6.2	47.4	47.4	48.4	1.0
G	5,680	59	641	6.5	47.4	47.4	48.4	1.0
H	5,980	106	929	4.5	47.4	47.4	48.4	1.0
I	7,120	90	803	5.2	47.4	47.4	48.4	1.0
J	7,620	100	709	5.9	47.4	47.4	48.4	1.0
K	7,900	160	1,025	4.1	48.5	48.5	49.5	1.0
L	8,350	200	1,298	3.2	49.8	49.8	50.8	1.0
M*								
N[1]	9,810	112	858	4.9	56.0	56.0	56.1	0.1
O[1]	10,910	176	573	5.4	60.9	60.9	60.9	0.0
P[1]	11,910	116	764	5.1	67.3	67.3	67.3	0.0
Q[1]	13,110	91	630	6.2	71.9	71.9	72.0	0.1
R[1]	13,813	88	560	7.0	76.2	76.2	76.2	0.0
S[1]	14,210	145	712	5.5	78.2	78.2	78.3	0.1
T[1]	15,010	197	885	4.4	82.7	82.7	82.8	0.0
U[1]	15,910	180	734	5.3	87.7	87.7	87.7	0.0
V-AI*								

[1] Flow contained in channel
[2] Feet above confluence with Russian River
* Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

DUTCH BILL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
East Austin Creek								
A	400[2]	109	1,612	7.6	72.7	72.7	73.6	0.9
B	2,100[2]	173	2,176	5.7	75.0	75.0	75.9	0.9
C	3,800[2]	134	1,523	8.1	76.7	76.7	77.7	1.0
D[1]	6,300[2]	165	1,969	6.2	81.4	81.4	82.0	0.6
East Windsor Creek								
A	0[3]	127	535	2.5	95.3	95.3	96.3	1.0
B[1]	670[3]	51	253	5.3	97.4	97.4	98.3	0.9
C	1,583[3]	70	273	4.9	101.3	101.3	101.3	0.0
D[1]	2,215[3]	49	242	4.0	102.8	102.8	103.1	0.3
E[1]	2,515[3]	61	263	3.7	103.7	103.7	104.0	0.3
F[1]	3,115[3]	53	264	3.7	106.7	106.7	106.7	0.0
G[1]	3,857[3]	10	100	9.6	108.8	108.8	108.8	0.0
H[1]	4,384[3]	16	155	6.2	112.3	112.3	112.3	0.0
I[1]	4,798[3]	35	165	4.9	114.7	114.7	114.7	0.0
J[1]	5,402[3]	35	193	3.1	119.6	119.6	119.7	0.1
K[1]	5,976[3]	32	216	2.8	123.6	123.6	123.9	0.3
L[1]	6,881[3]	32	92	3.4	125.7	125.7	125.7	0.0
M[1]	7,652[3]	31	71	3.9	131.3	131.3	131.3	0.0
N[1]	8,137[3]	68	102	2.4	136.0	136.0	136.0	0.0
O[1]	8,779[3]	25	46	3.9	140.4	140.4	141.2	0.8
P[1]	9,379[3]	24	40	3.8	145.2	145.2	145.3	0.1

[1] Flow contained in channel
[2] Feet above confluence with Austin Creek
[3] Feet above confluence with Windsor Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

EAST AUSTIN CREEK – EAST WINDSOR CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Fife Creek								
A	1,750	97	382	7.3	59.4	59.4	60.4	1.0
B	1,960	112	797	3.5	59.4	59.4	60.4	1.0
C	2,340	141	912	3.1	59.4	59.4	60.4	1.0
D	2,630	107	679	4.1	59.4	59.4	60.4	1.0
E	2,805	85	506	5.5	59.4	59.4	60.4	1.0
F	2,985	101	658	4.3	59.4	59.4	60.4	1.0
G	3,285	166	1,023	2.7	59.4	59.4	60.4	1.0
H	3,388	54	281	10.0	59.4	59.4	60.4	1.0
I	3,500	51	402	7.0	59.4	59.4	60.4	1.0
J	3,610	191	1,184	2.4	59.4	59.4	60.4	1.0
K	3,810	270	2,205	1.3	59.4	59.4	60.4	1.0
L	4,110	222	1,395	2.0	59.4	59.4	60.4	1.0
M	4,310	188	979	2.9	59.4	59.4	60.4	1.0
N	4,540	237	1,144	2.4	59.4	59.4	60.4	1.0
O	4,825	167	643	4.4	59.4	59.4	60.4	1.0
P	5,185	61	365	7.7	59.4	59.4	60.4	1.0
Q	5,550	212	976	2.9	66.1	66.1	67.1	1.0
R	6,000	70	291	9.6	67.8	67.8	68.0	0.2
S	6,200	111	532	5.3	70.2	70.2	71.2	1.0
T	6,650	136	607	4.6	73.1	73.1	74.1	1.0
U	7,000	80	403	6.9	75.0	75.0	76.0	1.0
V	7,255	96	597	4.7	77.4	77.4	78.1	0.7
W	7,455	75	441	6.3	78.1	78.1	78.9	0.8[2]
X	7,655	161	831	3.4	79.5	79.5	80.1	0.6
Y	7,955	51	377	7.4	80.2	80.2	81.1	0.9[2]
Z	8,140	98	671	4.2	82.1	82.1	82.5	0.4[2]

[1] Feet above confluence with Russian River
[2] Encroached to width of channel

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

FIFE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Fife Creek (continued)								
AA	8,340	51	378	7.4	82.5	82.5	82.9	0.4[2]
AB	8,490	106	594	4.7	84.2	84.2	84.4	0.2[2]
AC	8,690	50	338	8.3	85.0	85.0	85.2	0.2[2]
AD	9,015	95	406	5.9	87.0	87.0	87.4	0.4[2]
AE	9,275	57	416	5.8	87.5	87.5	88.2	0.7[2]
AF	9,555	78	563	4.3	89.5	89.5	90.0	0.5[2]
AG	9,815	42	347	6.9	90.3	90.3	91.0	0.7[2]
AH	10,015	48	353	6.8	91.5	91.5	92.1	0.6[2]
AI	10,285	40	292	8.2	93.4	93.4	94.0	0.6[2]
AJ	10,500	47	415	5.8	96.8	96.8	97.0	0.2[2]
AK	10,830	148	768	3.1	98.6	98.6	99.1	0.5
AL	11,090	100	317	4.1	101.2	101.2	101.2	0.0
AM	11,360	65	345	3.8	102.0	102.0	102.0	0.0[2]

[1] Feet above confluence with Russian River
[2] Encroached to width of channel

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

FIFE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Fowler Creek								
A-R*								
S	8,370[2]	382	692	4.0	33.8	33.8	33.8	0.0
U	9,100[2]	360	995	2.8	34.7	34.7	35.5	0.8
V	10,200[2]	115	442	6.2	37.3	37.3	38.3	1.0
X	11,300[2]	85	439	6.3	40.1	40.1	41.1	1.0
Z[1]	12,280[2]	74	4,497	5.5	42.8	42.8	43.1	0.3
AA[1]	13,000[2]	47	334	8.2	44.1	44.1	44.2	0.1
AB[1]	13,690[2]	145	565	4.9	46.2	46.2	46.2	0.0
Fryer Creek								
A	4,985[3]	101	413	2.0	58.5	58.5	59.4	0.9
B	5,230[3]	109	352	2.4	58.5	58.5	59.4	0.9
C	5,345[3]	127	342	2.5	58.6	58.6	59.5	0.9
D	8,335[3]	47	281	2.9	68.7	68.7	68.7	0.0
E	8,440[3]	56	294	1.4	68.8	68.8	68.9	0.1
F	8,550[3]	53	275	1.5	68.8	68.8	68.9	0.1
G	8,720[3]	23	141	2.9	69.4	69.4	69.7	0.3
H	8,855[3]	41	244	1.7	69.5	69.5	69.9	0.4
I	9,025[3]	39	226	1.8	69.5	69.5	69.9	0.4
J	9,230[3]	44	247	1.6	69.6	69.6	70.0	0.4
K	9,940[3]	43	265	1.4	71.3	71.3	71.7	0.4
L	10,025[3]	23	95	4.0	71.1	71.1	71.5	0.4
M	10,165[3]	19	56	6.8	71.5	71.5	71.8	0.3
N	10,335[3]	20	68	5.6	73.1	73.1	73.2	0.1
O	10,600[3]	23	72	5.3	74.3	74.3	74.9	0.6
P	10,735[3]	17	65	5.9	75.6	75.6	75.8	0.2
Q	10,860[3]	19	85	4.5	76.3	76.3	76.6	0.3
R	10,970[3]	13	55	6.9	76.1	76.1	77.0	0.9

[1] Flow in channel
[2] Feet above confluence with Sonoma Creek
[3] Feet above confluence with Nathanson Creek
* Floodway not determined

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

FOWLER CREEK – FRYER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Fulton Creek								
A[1]	2,339	33	124	7.2	81.3	81.3	82.1	0.8
B[1]	3,026	38	215	4.1	84.3	84.3	84.8	0.5
C[1]	3,668	39	232	3.8	85.5	85.5	86.2	0.7
D[1]	4,297	70	246	3.6	86.4	86.4	87.3	0.9
E[1]	4,752	65	201	4.4	87.4	87.4	88.3	0.9
F[1]	5,427	129	514	1.7	89.2	89.2	90.2	1.0
G[1]	6,048	113	339	2.6	89.6	89.6	90.6	1.0
H[1]	6,532	86	277	3.2	90.4	90.4	91.3	0.9
I[1]	6,874	76	173	3.1	91.2	91.2	92.4	1.0
J[1]	7,500	92	233	2.3	92.5	92.5	93.5	1.0
K[1]	7,884	59	155	3.5	93.3	93.3	94.2	0.9
L[1]	8,474	49	129	4.2	95.9	95.9	96.8	0.9
M	8,973	152	301	1.8	97.8	97.8	98.8	1.0
N	9,704	69	190	2.7	100.4	100.4	101.4	1.0
O	10,365	90	185	2.8	103.5	103.5	104.5	1.0
P	11,009	135	213	2.4	105.8	105.8	106.5	0.7
Q	11,674	155	245	2.1	107.5	107.5	108.5	1.0
R[1]	12,586	104	285	1.7	110.7	110.7	111.2	0.5
S[1]	13,218	64	186	2.7	112.1	112.1	112.3	0.2
T[1]	13,684	98	249	2.0	113.1	113.1	113.4	0.3
U[1]	14,374	52	176	2.6	117.4	117.4	118.2	0.8
V[1]	14,950	40	149	3.1	119.4	119.4	119.9	0.5
W[1]	15,676	42	131	3.4	121.7	121.7	122.1	0.4
X[1]	16,335	26	97	3.2	123.2	123.2	123.9	0.7
Y[1]	16,938	52	144	2.2	124.6	124.6	125.4	0.8
Z[1]	17,530	36	114	2.8	127.5	127.5	128.3	0.8
AA[1]	18,044	39	92	3.4	129.4	129.4	130.2	0.8
AB[1]	18,489	13	52	5.9	132.8	132.8	132.8	0.0

[1] Flow contained in channel
[2] Feet above confluence with Mark West Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

FULTON CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Gibson Creek								
A[1]	241[2]	20	70	3.8	79.6	79.6	79.6	0.0
B[1]	727[2]	17	45	5.9	88.1	88.1	88.6	0.5
C[1]	1,307[2]	18	40	6.7	95.3	95.3	95.3	0.0
D[1]	1,796[2]	15	34	7.8	101.5	101.5	101.5	0.0
E[1]	2,217[2]	15	59	4.5	104.8	104.8	104.8	0.0
F[1]	2,477[2]	11	30	8.9	109.6	109.6	109.6	0.0
Hulbert Creek								
A[1]	800[3]	112	1,163	4.2	57.4	43.84	42.8	1.0
B[1]	1,520[3]	83	891	5.5	57.4	44.04	44.7	0.7
C[1]	2,550[3]	87	711	6.8	57.4	47.24	47.5	0.3
D[1]	3,660[3]	77	567	8.6	57.4	53.84	53.8	0.0
E	4,580[3]	113	666	7.3	60.0	60.0	60.4	0.4
F	5,090[3]	95	780	6.2	62.3	62.3	63.2	0.9
G[1]	5,720[3]	59	399	12.2	65.8	65.8	65.9	0.1
H[1]	6,320[3]	92	765	5.8	71.7	71.7	71.7	0.0
I[1]	6,620[3]	90	643	6.8	73.2	73.2	73.3	0.1
J	6,950[3]	72	760	5.8	79.3	79.3	80.0	0.7
K[1]	7,570[3]	48	473	9.3	81.0	81.0	81.9	0.9
L[1]	7,780[3]	58	612	7.2	82.8	82.8	83.6	0.8
M	8,200[3]	68	507	8.7	84.7	84.7	85.6	0.9
N[1]	8,700[3]	94	676	6.5	88.7	88.7	89.7	1.0
O[1]	9,170[3]	68	467	9.4	91.9	91.9	92.5	0.6
P[1]	9,700[3]	63	517	8.5	96.1	96.1	96.9	0.8
Q[1]	10,230[3]	156	787	4.1	101.1	101.1	102.0	0.9
R[1]	10,670[3]	68	510	6.3	102.8	102.8	103.2	0.4
S[1]	11,200[3]	41	320	10.0	105.7	105.7	106.1	0.4
T[1]	11,820[3]	39	360	8.9	112.3	112.3	112.5	0.2

[1] Flow contained in channel
[2] Feet above confluence with Marin Creek
[3] Feet above confluence with Russian River
[4] Elevations computed without considerations of backwater

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

GIBSON CREEK – HULBERT CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION FEET (NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Hulbert Creek Tributary								
A	375[2]	70	170	5.9	107.2	107.2	107.4	0.2
B	440[2]	67	467	2.2	108.4	108.4	109.4	1.0
C[1]	875[2]	23	89	11.3	111.2	111.2	111.2	0.0
Hunter Creek								
A	455[3]	119	357	0.7	101.7	101.7	101.7	0.0
B	1,582[3]	42	153	1.6	101.8	101.8	101.8	0.0
C	4,293[3]	43	43	5.7	109.7	109.7	109.7	0.0
D	4,893[3]	25	54	4.6	114.3	114.3	114.3	0.0
E	5,255[3]	20	44	5.6	116.8	116.8	116.8	0.0
F	6,055[3]	23	35	7.1	125.3	125.3	125.3	0.0
G	7,087[3]	65	85	6.2	149.1	149.1	150.1	1.0
H	8,090[3]	31	64	8.2	180.7	180.7	180.7	0.0
I	8,160[3]	31	67	7.8	185.0	185.0	185.6	0.6
J	8,455[3]	38	77	6.8	199.5	199.5	199.5	0.0
K	9,855[3]	19	55	9.6	322.91	322.9	323.10	0.2

[1] Flow contained in channel
[2] Feet above confluence with Hulbert Creek
[3] Feet above confluence with Todd Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SONOMA COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

HULBERT CREEK TRIBUTARY – HUNTER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION FEET (NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Kizer Creek								
A	11,173	40	112	4.1	55.7	55.7	56.1	0.4
B[2]	21,753	34	114	4.0	59.9	59.9	60.6	0.7
C[2]	28,823	38	134	3.4	63.8	63.8	63.9	0.1
D[2]	35,083	100	47	8.7	67.6	67.6	67.6	0.0
E[2]	40,463	111	60	6.1	76.9	76.9	77.0	0.1
F[2]	49,763	17	59	4.4	85.4	85.4	85.4	0.0
G[2]	56,593	12	34	7.5	102.3	102.3	102.3	0.0
H	62,183	20	74	3.5	114.4	114.4	114.4	0.0
I[2]	66,053	24	37	6.6	127.2	127.2	127.2	0.0

[1] Feet above confluence with Wiggins Creek
[2] Flow contained in channel

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SONOMA COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

KIZER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Laguna de Santa Rosa								
A	45,800	700	3,656	4.8	77.9	77.9	78.9	1.0
B	46,690	1,126	2,801	5.7	79.4	79.4	80.2	0.8
C	47,240	1,105	8,585	1.7	80.0	80.0	81.0	1.0
D	48,230	678	5,561	2.3	80.1	80.1	81.1	1.0
E[2]	48,910	270	2,953	4.4	80.2	80.2	81.2	1.0
F[2]	49,720	225	2,428	5.3	80.7	80.7	81.6	0.9
G[2]	50,500	243	2,711	4.7	81.6	81.6	82.3	0.7
H[2]	51,060	265	2,143	6.0	81.9	81.9	82.5	0.6
I	51,500	201	1,828	6.8	82.7	82.7	83.1	0.4
J	52,040	402	2,506	5.0	84.1	84.1	84.9	0.8
K	52,650	374	2,843	4.4	85.1	85.1	86.0	0.9
L	53,430	971	6,740	1.9	86.8	86.8	87.7	0.9
M	54,370	804	4,526	2.8	86.9	86.9	87.8	0.9
N	55,440	290	2,293	5.5	87.4	87.4	88.3	0.9
O	56,460	692	4,471	2.8	88.2	88.2	89.2	1.0
P	57,500	1,578	8,628	1.4	88.5	88.5	89.5	1.0
Q	58,000	1,600	8,845	1.4	88.6	88.6	89.6	1.0
R	58,920	748	4,299	2.8	88.7	88.7	89.7	1.0
S	59,900	801	3,690	3.2	89.1	89.1	90.1	1.0
T	60,850	1,154	3,614	3.3	89.6	89.6	90.6	1.0
U	61,690	1,190	5,559	2.1	90.3	90.3	91.3	1.0
V[2]	62,762	152	1,782	6.7	90.7	90.7	91.7	1.0
W[2]-AA[2]	*	*	*	*	*	*	*	*

[1] Feet above confluence with Mark West Creek
[2] Flow contained in channel
* Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

LAGUNA DE SANTA ROSA

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Laguna de Santa Rosa (continued)								
AB	69,717	68	284	5.3	91.7	91.7	91.7	0.0
AC	70,717	65	338	4.4	93.8	93.8	93.8	0.0
AD	71,217	82	457	3.3	94.5	94.5	94.5	0.0
AE	71,717	56	321	4.7	95.0	95.0	95.0	0.0
AF	72,217	68	425	3.5	95.7	95.7	95.7	0.0
AG	72,717	76	488	3.1	96.1	96.1	96.1	0.0
AH	73,027	75	485	3.1	96.3	96.3	96.3	0.0
AI	73,698	19	123	12.2	100.4	100.4	100.4	0.0
AJ	74,217	74	571	2.6	102.8	102.8	102.8	0.0
AK	74,727	70	491	3.1	102.9	102.9	102.9	0.0
AL	75,252	73	476	3.2	103.2	103.2	103.2	0.0
AM	75,717	50	*	*	103.5	103.5	104.0	0.5
AN	76,157	45	252	*	104.3	104.3	104.8	0.5
AO	76,667	54	311	4.8	105.5	105.5	105.9	0.4
AP	77,179	57	294	5.1	106.6	106.3	106.6	0.3
AQ	77,532	57	281	5.3	107.2	107.0	107.2	0.2
AR	77,887	80	414	3.6	108.9	108.9	109.7	0.8
AS	78,042	150	537	2.8	109.2	109.2	110.0	0.8
AT	78,192	55	337	4.5	109.5	109.5	110.2	0.7
AU	78,412	55	363	1.8	109.8	109.8	110.5	0.9
AV	78,562	50	314	2.1	109.8	109.8	110.5	0.9
AW	78,887	100	427	1.5	109.9	109.9	110.7	0.8
AX	79,342	75	306	2.2	110.1	110.1	110.9	0.8
AY	79,477	50	289	2.3	110.3	110.3	111.3	1.0
AZ	79,752	82	459	1.4	110.5	110.5	111.4	0.9
BA	80,442	67	307	2.1	110.8	110.8	113.6	0.8

[1] Feet above confluence with Mark West Creek
[2] Flow contained in channel
* Data not available

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Liberty Creek								
A[1]	6,160	26	38	6.9	58.3	58.3	58.6	0.3
B[1]	8,135	63	78	3.1	74.8	74.8	74.8	0.0
C[1]	10,444	24	61	3.5	99.6	99.6	99.6	0.0
D[1]	12,115	12	18	7.1	136.7	136.7	136.7	0.0

[1] Flow contained in channel
[2] Feet above confluence with Mann Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

LIBERTY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lichau Creek								
A	0	127	757	3.4	50.2	49.8[3]	50.8	1.0
B[1]	190	48	394	6.5	50.2	50.0[3]	50.9	0.9
C[1]	1,010	61	494	5.1	52.3	52.3	53.2	0.9
D[1]	1,618	60	385	6.6	54.2	54.2	54.7	0.5
E[1]	1,938	38	265	8.7	55.1	55.1	55.3	0.2
F	2,678	67	329	7.0	57.3	57.3	57.7	0.4
G	3,160	226	718	3.1	59.0	59.0	59.8	0.8
H	3,563	112	389	5.8	60.0	60.0	60.7	0.7
I	4,105	228	706	3.2	61.9	61.9	62.8	0.9
J	4,554	114	328	6.8	63.7	63.7	64.1	0.4
K	5,029	121	491	4.6	66.6	66.6	67.1	0.5
L	5,499	194	841	2.7	69.1	69.1	70.1	1.0
M	5,756	158	857	2.5	71.0	71.0	72.0	1.0
N	6,065	192	941	2.3	71.4	71.4	72.4	1.0
O	6,605	111	454	4.8	72.7	72.7	73.6	0.9
P	6,887	311	1,056	2.0	73.7	73.7	74.7	1.0
Q[1]	7,299	21	185	11.7	74.9	74.9	75.5	0.6
R	7,575	74	470	4.6	78.2	78.2	78.8	0.6
S	7,984	140	774	2.8	78.5	78.5	79.5	1.0
T	8,314	149	653	3.3	79.0	79.0	79.9	0.9
U[1]	8,718	46	319	6.8	80.1	80.1	81.0	0.9
V	9,226	103	323	6.7	84.0	84.0	84.7	0.7
W	9,708	102	474	4.4	86.7	86.7	87.7	1.0
X	10,172	116	510	4.1	88.8	88.8	89.7	0.9
Y[1]	10,799	36	269	6.9	90.9	90.9	91.8	0.9
Z[1]	11,340	29	277	6.7	94.0	94.0	94.9	0.9
AA[1]	11,776	39	308	6.1	95.6	95.6	96.6	1.0
AB[1]	12,171	53	356	4.2	97.5	97.5	98.3	0.8

[1] Flow contained in channel
[2] Feet above confluence with Willow Brook
[3] Elevation computed without consideration of backwater effects from Willow Brook

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

LICHAU CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[4]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lynch Creek								
A-L[1]								
M-Q[2]								
R	9,458	155	322	4.9	95.6	95.6	95.8	0.2
S[3]	9,987	148	330	4.8	100.9	100.9	101.6	0.7
T[3]	10,698	106	368	4.3	108.6	108.6	108.6	0.0
U[3]	11,273	27	154	10.2	117.5	117.5	117.5	0.0
V[3]	11,794	51	193	8.1	121.8	121.8	122.6	0.8
Marin Creek								
A[3]	4,020	741	3,238	0.5	40.5	40.5	41.5	1.0
B[3]	5,720	1,023	1,882	0.8	41.1	41.1	41.8	0.7
C	6,770	122	342	2.9	43.5	43.5	44.1	0.6
D	7,840	115	320	3.1	45.1	45.1	46.0	0.9
E	8,463	138	420	2.4	46.1	46.1	47.1	1.0
F	9,451	112	399	2.5	48.8	48.8	49.6	0.8
G	10,294	132	300	3.1	50.4	50.4	51.1	0.7
H	11,213	74	243	3.8	53.3	53.3	54.1	0.8
I	12,159	65	316	2.9	57.6	57.6	58.3	0.7
J	13,227	52	178	5.1	58.3	58.3	59.2	0.9
K[3]	14,266	25	145	6.0	62.7	62.7	63.5	0.8
L	15,226	169	425	2.0	68.8	68.8	69.8	1.0
M[3]	16,124	22	156	4.3	74.3	74.3	74.9	0.6

[1] No floodway determined
[2] Flow and floodway contained in channel
[3] Flow contained in channel
[4] Feet above confluence with Petaluma River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

LYNCH CREEK – MARIN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Marin Creek (continued)								
N	17,425[2]	26	99	4.5	83.1	83.1	83.2	0.1
O[1]	18,160[2]	27	124	3.5	93.4	93.4	94.3	0.9
P	18,919[2]	66	158	2.6	102.3	102.3	103.3	1.0
Q[1]	19,397[2]	29	102	4.0	105.9	105.9	106.0	0.1
R[1]	20,410[2]	27	118	3.0	122.2	122.2	122.4	0.2
S	21,268[2]	21	45	7.9	133.7	133.7	133.8	0.1
T	21,610[2]	36	130	2.7	140.7	140.7	141.1	0.4
Mark West Creek								
A[1]	50,266[3]	113	1,522	7.9	114.7	114.7	115.4	0.7
B[1]	51,166[3]	140	1,928	6.3	116.4	116.4	116.9	0.5
C	52,666[3]	118	1,037	11.7	119.5	119.5	119.8	0.3
D	54,966[3]	140	1,370	8.8	126.7	126.7	126.8	0.1
E[1]	57,216[3]	104	1,401	8.6	135.1	135.1	136.0	0.9
F[1]	60,319[3]	192	2,572	4.7	145.0	145.0	145.4	0.4
G[1]	62,840[3]	267	2,590	4.7	149.7	149.7	149.8	0.1
H[1]	65,507[3]	125	1,405	8.8	159.3	159.3	159.4	0.1
I[1]	67,608[3]	156	1,887	6.6	167.9	167.9	168.5	0.6
J	69,439[3]	180	1,679	7.4	174.4	174.4	175.2	0.8
K[1]	72,139[3]	247	2,755	4.8	191.0	191.0	191.4	0.4
L[1]	77,769[3]	182	1,785	6.9	224.1	224.1	224.1	0.0
M[1]	80,639[3]	113	1,023	12.0	257.6	257.6	257.6	0.0
N[1]	84,659[3]	90	1,264	9.7	332.3	332.3	333.0	0.7
O[1]	88,439[3]	82	737	16.7	396.8	396.8	396.8	0.0
P[1]	92,839[3]	99	1,283	9.6	426.5	426.5	426.5	0.0
Q[1]	96,559[3]	86	1,114	10.1	442.6	442.6	442.7	0.1

[1] Flow contained in channel
[2] Feet above confluence with Petaluma River
[3] Feet above confluence with Russian River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

MARIN CREEK – MARK WEST CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION FEET (NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
McBrown Creek								
A	7,00[2]	28	69	3.6	67.0	67.0	68.0	1.0
B[1]	14,02[2]	20	53	4.7	72.6	72.6	72.8	0.2
C[1]	19,68[2]	22	45	5.5	77.5	77.5	77.5	0.0
D[1]	25,29[2]	23	63	3.0	86.9	86.9	87.0	0.1
Moorland Creek								
A	7[3]	155	1,152	0.2	98.1	98.1	98.1	0.0
B	334[3]	20	181	1.5	98.5	98.5	98.5	0.0
C	2,307[3]	8	37	5.1	99.6	99.6	99.6	0.0
D	2,803[3]	8	41	4.6	101.2	101.2	101.4	0.1
E	4,488[3]	40	73	2.6	103.9	103.9	104.0	0.0
Mount Hood Creek								
A[1]	9,00[4]	43	236	9.9	427.6	427.6	427.6	0.0
B[1]	16,00[4]	23	156	9.6	432.3	432.3	432.9	0.6
C	25,00[4]	69	203	7.3	435.7	435.7	436.2	0.5
D	33,50[4]	109	359	4.2	439.0	439.0	439.9	0.9
E[1]	42,95[4]	22	72	7.9	449.1	449.1	449.3	0.2
F[1]	53,35[4]	28	80	7.1	458.7	458.7	458.9	0.2
G[1]	60,80[4]	32	101	5.6	466.1	466.1	466.8	0.7
H[1]	67,95[4]	17	61	9.3	474.5	474.5	475.0	0.5
I	74,65[4]	39	107	5.3	480.5	480.5	480.7	0.2
J	79,25[4]	33	69	8.2	487.6	487.6	487.6	0.0
K[1]	83,20[4]	35	72	8.2	496.4	496.4	497.2	0.8
L[1]	95,00[4]	10	46	12.2	523.9	523.9	523.9	0.0

[1] Flow contained in channel
[2] Feet above confluence with Wiggins Creek
[3] Feet above confluence with Todd Creek
[4] Feet above confluence with Sonoma Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SONOMA COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

MCBROWN CREEK – MOUNT HOOD CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Nathanson Creek								
A	0	329	1,364	2.0	24.5	23.9[3]	24.9	1.0
C	902	378	975	2.8	24.9	24.9	25.5	0.6
D	1,500	395	1,111	2.5	26.0	26.0	26.6	0.6
F	2,040	540	1,364	2.0	26.7	26.7	27.2	0.5
G	2,400	651	1,403	2.0	27.2	27.2	27.6	0.4
J	3,026	277	701	3.3	32.5	32.5	33.5	1.0
L[1]	3,600	53	345	6.7	33.9	33.9	34.5	0.6
N[1]	4,240	47	314	7.4	37.4	37.4	37.4	0.0
O[1]	4,635	71	496	4.6	39.0	39.0	39.0	0.0
Q[1]	5,200	54	221	6.4	43.2	43.2	43.2	0.0
R[1]	5,700	59	344	4.1	44.6	44.6	44.6	0.0
T	6,510	35	129	10.9	47.5	47.5	47.5	0.0
V	7,255	64	290	4.8	52.6	52.6	53.6	1.0
Z	7,635	163	675	2.1	55.1	55.1	56.1	1.0
AA	8,200	50	286	4.9	55.7	55.7	56.7	1.0
AB	8,500	38	214	6.5	56.9	56.9	57.9	1.0
AC	8,800	174	436	3.2	58.0	58.0	59.0	1.0
AD	9,000	41	236	5.9	58.7	58.7	59.7	1.0
AE	9,500	172	357	3.9	60.2	60.2	61.2	1.0
AF	9,700	61	270	5.1	61.4	61.4	62.4	1.0
AG	10,085	60	245	5.7	63.3	63.3	64.3	1.0
AH	10,565	41	247	5.6	65.7	65.7	66.7	1.0
AI	10,900	37	203	6.8	67.7	67.7	68.7	1.0
BV	18,369	23	143	7.0	106.5	106.5	107.5	1.0
BZ	19,129	36	226	6.0	111.3	111.3	112.3	1.0
CE[1]	20,262	33	110	10.4	118.3	118.3	118.3	0.0
CI[1]	21,119	32	121	9.5	126.4	126.4	126.4	0.0
CM[1]	21,919	44	106	10.8	136.3	136.3	136.3	0.0

[1] Flow contained in channel
[2] Feet above confluence with Schell Creek
[3] Elevation computed without consideration of backwater effects from Schell Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

NATHANSON CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION FEET (NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Naval Creek								
A	333	74	152	3.9	77.8	66.5[2]	67.2[2]	0.7
B	1,079	70	247	2.4	77.8	68.1[2]	68.9[2]	0.8
C	1,559	65	286	2.0	77.8	68.3[2]	69.3[2]	1.0
D	2,067	63	180	3.2	77.8	68.9[2]	69.6[2]	0.7
E	2,792	110	338	1.6	77.8	70.4[2]	70.9[2]	0.5
F	3,552	231	550	1.1	77.8	70.6[2]	71.3[2]	0.7
G	4,076	70	235	1.7	77.8	70.9[2]	71.4[2]	0.5
H	4,723	70	250	2.2	77.8	71.3[2]	71.8[2]	0.5
I	5,057	70	236	2.4	77.8	71.5[2]	72.0[2]	0.5
J	5,540	282	474	1.2	77.8	71.9[2]	72.4[2]	0.5
K	6,206	53	69	2.7	77.8	72.9[2]	72.9[2]	0.0
L	6,970	263	322	1.4	77.8	74.2[2]	74.2[2]	0.0
M	7,520	288	319	1.7	77.8	75.0[2]	75.1[2]	0.1
N	8,706	70	207	2.6	77.8	77.8[2]	77.9[2]	0.1
O	9,024	70	183	2.3	78.5	78.5	78.6	0.1
P	9,521	70	178	2.2	79.2	79.2	79.3	0.1
Q	10,014	70	201	1.9	79.9	79.9	80.2	0.3
R	10,826	86	173	2.2	80.3	80.3	80.8	0.5
S	11,708	70	180	2.1	81.7	81.7	82.1	0.4
T	12,163	70	147	2.5	82.2	82.2	82.8	0.6
U	12,696	70	200	1.9	84.0	84.0	84.6	0.6
V	13,907	85	179	2.0	86.4	86.4	86.7	0.3
W	14,395	70	131	2.8	87.2	87.2	87.4	0.2
X	15,146	49	94	0.7	88.3	88.3	88.3	0.0
Y	15,692	23	33	2.0	88.4	88.4	88.4	0.0

1 Feet above confluence with Laguna de Santa Rosa

2 Elevations computed without consideration of backwater effects from Laguna de Santa Rosa

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SONOMA COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

NAVAL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION FEET (NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Naval Creek (Continued)								
Z	16,464	32	43	1.5	90.5	90.5	90.5	0.0
AA	16,959	32	39	1.7	91.3	91.3	91.3	0.0
AB	17,318	29	26	2.5	92.1	92.1	92.1	0.0
AC	17,838	61	60	1.1	93.3	93.3	93.3	0.0
AD	18,325	81	140	0.6	95.5	95.5	96.1	0.6
AE	18,821	36	53	1.3	95.6	95.6	96.1	0.5
AF	19,650	52	57	1.4	96.1	96.1	96.5	0.4

1 Feet above confluence with Laguna de Santa Rosa

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION FEET (NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Naval Creek Tributary 1								
A	103[1]	17	36	2.8	91.7	91.7	92.4	0.7
B	629[1]	14	30	3.5	93.1	93.1	93.6	0.5
Naval Creek Tributary 2								
A	211[2]	104	180	2.9	88.2	88.2	88.4	0.2
B	319[2]	130	249	2.1	88.4	88.4	88.7	0.3
C	365[2]	130	337	1.6	89.6	89.6	90.0	0.4
D	1,142[2]	49	120	4.4	89.9	89.9	90.4	0.5
E	2,074[2]	65	156	2.7	92.1	92.1	92.4	0.3
F	2,098[2]	65	194	2.2	92.5	92.5	93.1	0.6
G	2,441[2]	128	413	1.0	92.8	92.8	93.4	0.6
H	2,478[2]	128	249	1.7	93.8	93.8	94.0	0.2
I	3,119[2]	199	180	2.4	95.1	95.1	95.6	0.5
J	3,922[2]	29	73	5.8	96.8	96.8	97.3	0.5
K	4,711[2]	142	177	2.4	98.5	98.5	99.1	0.6

[1] Feet above confluence with Naval Creek Tributary 2

[2] Feet above confluence with Naval Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SONOMA COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

NAVAL CREEK TRIBUTARY 1 - NAVAL CREEK TRIBUTARY 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
North Kenwood Creek								
A	300	150	135	3.6	403.5	403.5	403.7	0.2
B	668	280	472	1.0	404.5	404.5	405.2	0.7
C	1,071	187	265	1.8	407.2	407.2	408.2	1.0
D	1,400	244	180	2.7	410.0	410.0	411.0	1.0
E[2]	1,695	33	79	6.0	412.4	412.4	413.2	0.8
F[2]	2,169	30	115	4.0	416.1	416.1	417.1	1.0
G	2,514	142	497	0.5	418.9	418.9	419.5	0.6

[1] Feet above confluence with Sonoma Creek
[2] Flow contained in channel

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

NORTH KENWOOD CREEK

FLOODING SOURCE			FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
NODES	LINKS	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Petaluma River									
A		66706				10.0	9.2[2]	9.2	0.0
	A-B		205	10479	4.8				
B		68147				10.0	9.2[2]	9.2	0.0
	B-C		203	10340	4.6				
C		69139				10.0	9.2[2]	9.4	0.2
	C-D		198	10342	4.7				
D		69586				10.0	9.2[2]	9.5	0.3
	D-E		201	10329	4.6				
E		70479				10.0	9.2[2]	9.7	0.5
	E-F		177	10000	4.5				
F		72071				10.0	9.6[2]	10.1	0.5
	F-G		171	9980	4.6				
G		72788				10.1	10.1	10.5	0.4
	G-H		473	9977	1.6				
H		73290				10.1	10.1	10.5	0.4
	H-I		165	9984	5.8				
I		73480				10.1	10.1	10.5	0.4
	I-J		124	9857	6.6				
J		75211				11.3	11.3	11.8	0.5
	J-K		130	9830	8.2				
K		76396				12.8	12.8	13.4	0.6
	K-L		135	9831	8.1				
L		76996				14.2	14.2	14.9	0.7

[1] Feet above confluence with Pacific Ocean

[2] Elevation computed without consideration of backwater effects from Pacific Ocean

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

PETALUMA RIVER

FLOODING SOURCE			FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
NODES	LINKS	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Petaluma River, continued									
	L-M		142	9757	7.3				
M		77667				15.6	15.6	16.3	0.7
	M-N		160	7764	6.1				
N		79975				20.0	20.0	20.5	0.5
	N-O		190	7729	4.1				
O		81222				22.0	22.0	22.6	0.6
	O-P		150	7704	4.5				
P		82522				23.4	23.4	23.8	0.4
	P-Q		185	7728	5.5				
Q		82947				24.0	24.0	24.2	0.2
	Q-R		266	6826	4.6				
R		84920				25.9	25.9	26.3	0.4
	R-S		327	6871	5.1				
S		85556				26.4	26.4	27.3	0.9
	S-T		310	6460	4.5				
T		86156				28.0	28.0	28.2	0.2
	T-U		303	6502	4.5				
U		86669				28.4	28.4	28.9	0.5
	U-V		237	6406	4.1				
V		87502				30.0	30.0	30.4	0.4
	V-W		283	5318	3.0				
W		88030				30.4	30.4	30.7	0.3

[1] Feet above confluence with Pacific Ocean

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

PETALUMA RIVER

FLOODING SOURCE			FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
NODES	LINKS	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Petaluma River, continued									
	W-X		326	5284	3.0				
X		88601				30.6	30.6	30.9	0.3
	X-Y		221	5278	4.4				
Y		89103				31.1	31.1	31.7	0.6
	Y-Z		230	1602	4.0				
Z		91667				34.4	34.4	34.6	0.2
	Z-AA		456	5385	4.5				
AA		91985				34.5	34.5	35.0	0.5
	AA-AB		497	5400	6.6				
AB		92479				35.4	35.4	35.7	0.3
	AB-AC		577	5367	3.5				
AC		93460				37.8	37.8	38.0	0.2
	AC-AD		257	5360	4.1				
AD		94717				39.3	39.3	39.4	0.1

[1] Feet above confluence with Pacific Ocean

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

PETALUMA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pocket Canyon								
A[1]	390	101	1,794	1.7	50.6	50.6	51.6	1.0
B	1,100	408	4,358	0.7	50.9	50.9	51.9	1.0
C	1,900	467	7,630	0.3	50.9	50.9	51.9	1.0
D	2,745	556	8,801	0.3	51.0	51.0	52.0	1.0
E	3,315	453	6,036	0.4	51.0	51.0	52.0	1.0
F	4,135	387	3,544	0.7	51.0	51.0	52.0	1.0
G	4,745	244	1,345	1.8	51.1	51.1	52.1	1.0
H	5,845	238	1,076	2.2	52.6	52.6	53.6	1.0
I[1]	6,640	35	181	13.0	57.0	57.0	57.0	0.0
J	7,630	97	601	3.9	65.0	65.0	65.8	0.5
K	8,440	160	617	3.8	67.6	67.6	68.4	0.8
L	9,160	218	541	4.4	72.1	72.1	72.9	0.8
M	9,900	37	268	8.8	78.6	78.6	79.4	0.8
N	10,345	167	787	2.6	82.0	82.0	83.0	1.0
O	11,245	156	530	3.8	85.2	85.2	86.0	0.8
P	11,970	175	679	3.0	88.8	88.8	89.7	0.9
Q	12,600	231	795	2.6	93.2	93.2	94.1	0.9
R	13,190	159	389	5.2	95.8	95.8	96.2	0.4
S	14,145	155	650	3.1	104.3	104.3	105.1	0.8
T[1]	14,810	37	234	7.9	106.9	106.9	107.4	0.5
U[1]	15,360	49	395	4.7	114.3	114.3	114.3	0.0
V[1]	15,665	29	179	10.3	114.3	114.3	114.9	0.6
W	16,615	67	515	3.6	122.9	122.9	123.6	0.7
X	17,100	54	335	5.5	128.3	128.3	129.2	0.9
Y	17,290	83	514	3.6	134.0	134.0	134.1	0.1
Z	17,935	62	319	5.8	135.5	135.5	136.0	0.5

[1] Flow contained in channel
[2] Feet above confluence with the Russian River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

POCKET CANYON

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pocket Canyon (continued)								
AA	18,350	388	1,411	1.3	139.3	139.3	140.1	0.8
AB	18,895	70	214	8.6	140.9	140.9	140.9	0.0
AC	19,700	70	281	6.5	150.2	150.2	151.1	0.9
AD	20,535	132	506	2.8	157.0	157.0	157.7	0.7
AE[1]	20,880	24	166	5.8	159.0	159.0	159.3	0.3
AF[1]	21,430	26	137	7.1	163.3	163.3	163.3	0.0
AG[1]	22,015	31	140	6.9	169.5	169.5	169.5	0.0
AH[1]	22,530	30	134	7.2	175.1	175.1	175.2	0.1
AI	23,095	57	205	4.7	181.5	181.5	181.5	0.0
AJ	23,575	28	106	9.2	186.0	186.0	186.6	0.6
AK	24,420	140	184	3.9	197.8	197.8	198.1	0.3
AL	24,940	124	135	5.2	203.5	203.5	203.5	0.0
AM[1]	25,535	24	96	7.4	213.0	213.0	213.2	0.2
AN	26,555	36	95	4.3	226.5	226.5	226.5	0.0
AO	27,200	20	59	7.0	233.4	233.4	233.5	0.1
AP	27,740	16	44	6.3	244.1	244.1	244.1	0.0

[1] Flow contained in channel
[2] Feet above confluence with the Russian River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

POCKET CANYON

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pool Creek								
A	1,820	402	1,376	2.4	79.4	79.4	80.4	1.0
B	2,206	402	1,391	2.3	79.8	79.8	80.8	1.0
C	2,506	364	1,349	2.4	80.1	80.1	81.1	1.0
D	3,306	305	810	4.0	81.7	81.7	82.7	1.0
E	3,728	370	819	4.0	83.3	83.3	84.3	1.0
F	4,223	443	1,526	2.1	84.5	84.5	85.4	0.9
G	4,876	289	1,018	3.2	85.6	85.6	86.6	1.0
H	5,237	307	1,468	2.2	88.1	88.1	88.3	0.2
I	5,915	191	616	5.3	88.4	88.4	88.6	0.2
J	6,346	325	820	3.9	89.4	89.4	90.4	1.0
K	7,000	358	1,091	3.0	90.8	90.8	91.8	1.0
L	7,620	225	520	6.3	92.7	92.7	93.3	0.6
M	8,220	225	498	6.5	94.3	94.3	95.2	0.9
N	8,820	250	707	4.6	95.5	95.5	96.4	0.9
O	9,420	81	450	7.2	97.7	97.7	98.5	0.8
P	10,020	151	557	5.9	100.2	100.2	101.0	0.8
Q[1]	10,715	40	287	6.6	104.0	104.0	104.8	0.8
R	11,677	90	319	5.0	107.9	107.9	108.2	0.3
S[1]	12,253	27	170	9.0	109.7	109.7	110.0	0.3
T[1]	13,071	44	268	5.7	113.1	113.1	113.9	0.8
U[1]	13,631	60	339	4.5	115.5	115.5	115.8	0.3
V[1]	14,231	65	365	4.2	118.8	118.8	119.3	0.5
W[1]	14,831	70	417	3.7	121.8	121.8	122.1	0.3
X[1]	15,150	83	331	4.6	124.0	124.0	124.4	0.4
Y[1]	15,747	71	351	4.4	129.4	129.4	129.4	0.0
Z[1]	16,482	65	386	4.0	135.1	135.1	135.0	0.0

[1] Flow contained in channel
[2] Feet above confluence with Windsor Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

POOL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pool Creek (continued)								
AA[1]	16,976[2]	98	565	2.7	137.5	137.5	137.5	0.0
AB[1]	17,787[2]	58	360	4.2	144.0	144.0	144.0	0.0
AC[1]	18,307[2]	52	464	3.3	147.3	147.3	147.3	0.0
AD[1]	19,045[2]	69	495	3.4	153.0	153.0	153.4	0.4
AE[1]	19,774[2]	60	328	5.1	157.4	157.4	157.6	0.2
AF[1]	20,272[2]	138	601	2.8	159.9	159.9	160.4	0.5
AG[1]	20,872[2]	78	323	5.2	165.1	165.1	165.1	0.0
AH	21,531[2]	43	150	11.2	171.4	171.4	171.5	0.1
Pruitt Creek								
A	400[3]	49	349	3.8	104.6	104.6	105.6	1.0
B	751[3]	18	127	9.7	106.3	106.3	106.3	0.0
C	1,142[3]	54	210	5.9	108.5	108.5	108.7	0.2
D	1,511[3]	80	367	3.4	110.9	110.9	111.6	0.7
E1	2,174[3]	34	213	5.5	111.5	111.5	112.3	0.8
F1	2,484[3]	25	135	8.7	111.9	111.9	112.6	0.7
G	2,901[3]	26	200	5.9	114.2	114.2	114.3	0.1
H1	3,463[3]	42	249	4.6	116.3	116.3	116.6	0.3
I	3,774[3]	52	242	4.8	117.2	117.2	117.5	0.3
J	4,716[3]	42	215	5.8	119.5	119.5	119.9	0.4
K	5,344[3]	92	312	4.0	120.7	120.7	121.7	1.0
L-Q*								
R	8,749[3]	248	655	1.9	132.7	132.7	133.7	1.0
S	9,151[3]	106	221	4.3	135.4	135.4	136.0	0.6
T	9,441[3]	100	255	3.8	137.4	137.4	138.4	1.0

[1] Flow contained in channel
[2] Feet above confluence with Windsor Creek
[3] Feet above confluence with Pool Creek
[*] Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

POOL CREEK – PRUITT CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pruitt Creek (continued)								
U	9,761	98	200	4.8	140.1	140.1	140.9	0.8
V[1]	10,371	75	207	4.6	144.9	144.9	144.9	0.0
W[1]	10,944	45	197	4.9	149.7	149.7	149.7	0.0
X[1]	11,511	41	145	6.1	154.5	154.5	154.5	0.0
Y[1]	11,891	31	128	6.9	158.6	158.6	158.7	0.1
Z[1]	12,532	60	161	4.9	166.5	166.5	166.5	0.0
AA[1]	13,092	44	156	5.1	175.6	175.6	175.6	0.0
AB[1]	13,516	60	114	6.9	179.9	179.9	180.3	0.4
AC[1]	13,869	57	197	4.0	184.1	184.1	184.6	0.5
AD[1]	14,269	37	101	7.6	189.2	189.2	189.7	0.5

[1] Flow contained in channel
[2] Feet above confluence with Pool Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

PRUITT CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Redwood Creek								
A[1]	470[2]	41	215	3.3	99.5	99.5	100.5	1.0
B[1]	1,215[2]	85	463	0.9	102.9	102.9	103.5	0.6
C[1]	2,080[2]	79	340	1.3	103.1	103.1	103.6	0.5
D[1]	2,770[2]	53	150	2.8	103.9	103.9	104.2	0.3
E[1]	3,548[2]	50	221	1.8	105.5	105.5	105.6	0.1
F[1]	4,317[2]	63	228	1.7	109.6	109.6	109.6	0.0
G	5,027[2]	55	72	5.5	111.5	111.5	111.6	0.1
H	5,556[2]	23	45	8.6	115.1	115.1	115.4	0.3
I	6,072[2]	64	244	1.4	116.2	116.2	117.2	1.0
J[1]	6,982[2]	62	241	1.4	117.2	117.2	117.6	0.4
K[1]	7,582[2]	25	62	2.7	118.7	118.7	119.5	0.8
Rodgers Creek								
A-N*								
O	8,550[3]	378	1,232	1.4	33.0	33.0	34.0	1.0
P	9,360[3]	101	2,229	6.5	33.6	33.6	34.6	1.0
R	10,350[3]	372	400	3.7	38.6	38.6	38.6	0.0
S	11,375[3]	81	454	3.3	45.5	45.5	46.5	1.0
T	12,800[3]	37	122	5.7	53.2	53.2	54.2	1.0
U	13,500[3]	35	104	6.7	59.9	59.9	60.2	0.3
V	14,200[3]	80	220	3.2	67.6	67.6	68.6	1.0
W[1]	14,625[3]	47	154	4.5	71.2	71.2	71.2	0.0
X[1]	15,500[3]	27	74	9.4	84.6	84.6	84.6	0.0

[1] Flow contained in channel
[2] Feet above confluence with Airport Creek
[3] Feet above confluence with Fowler Creek
* Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

REDWOOD CREEK – RODGERS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Roseland Creek								
A	491	190	983	1.3	77.8	75.2[2]	75.5[2]	0.3
B	1,375	211	336	36.	77.8	75.3[2]	75.7[2]	0.4
C	1,836	203	692	1.9	77.8	75.6[2]	76.0[2]	0.4
D	2,362	192	727	1.8	77.8	75.8[2]	76.2[2]	0.4
E	2,750	200	654	1.9	77.8	75.9[2]	76.3[2]	0.4
F	3,210	200	536	2.4	77.8	76.1[2]	76.6[2]	0.5
G	3,662	322	668	2.4	77.8	76.5[2]	76.8[2]	0.3
H	4,242	200	385	3.2	77.8	77.4[2]	77.6[2]	0.2
I	4,790	179	389	3.2	78.7	78.7	78.7	0.0
J	5,028	180	280	4.9	79.3	79.3	79.3	0.0
K	5,425	180	490	2.5	80.5	80.5	80.7	0.2
L	5,856	175	423	3.5	81.1	81.1	81.2	0.1
M	6,263	170	555	2.4	81.7	81.7	81.8	0.1
N	6,767	150	412	3.3	82.0	82.0	82.2	0.2
O	7,021	134	405	3.4	82.3	82.3	82.5	0.2
P	7,539	132	496	2.6	82.9	82.9	83.0	0.1
Q	7,914	130	575	2.2	84.0	84.0	84.1	0.1
R	8,167	118	544	2.2	84.1	84.1	84.2	0.1

[1] Feet above confluence with Laguna de Santa Rosa
[2] Elevations computed without consideration of backwater effects from Laguna de Santa Rosa

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

ROSELAND CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Roseland Creek (continued)								
S	8,619	11	480	2.5	84.3	84.3	84.4	0.1
T	8,920	107	445	2.7	84.5	84.5	84.6	0.1
U	9,480	95	394	3.0	85.0	85.0	85.1	0.1
V	10,025	86	340	3.7	85.5	85.5	85.5	0.0
W	10,660	90	347	3.7	86.4	86.4	86.4	0.0
X	11,174	90	323	4.0	87.0	87.0	87.0	0.0
Y	11,458	93	344	3.8	87.5	87.5	87.5	0.0
Z	12,297	91	310	4.3	88.6	88.6	88.6	0.0
AA	12,790	87	290	4.5	89.4	89.4	89.4	0.0
AB	13,462	86	296	4.4	90.5	90.5	90.5	0.0
AC	13,734	74	259	5.1	90.9	90.9	90.9	0.0
AD	14,760	81	294	4.3	92.9	92.9	92.9	0.0
AE	15,625	59	279	4.1	94.2	94.2	94.2	0.0
AF	15,889	91	393	2.9	94.6	94.6	94.6	0.0
AG	16,326	70	257	4.5	94.9	94.9	94.9	0.0
AH	16,784	89	340	3.5	96.8	96.8	96.8	0.0
AI	17,168	88	323	3.9	97.3	97.3	97.3	0.0
AJ	17,926	54	268	4.3	98.3	98.3	98.3	0.0

[1] Feet above confluence with Laguna de Santa Rosa

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Roseland Creek (continued)								
AK	18,979	71	372	3.2	99.7	99.7	99.7	0.0
AL	19,833	60	322	3.6	100.7	100.7	100.7	0.0
AM	20,318	80	392	2.7	101.2	101.2	101.2	0.0
AN	21,076	67	270	3.9	101.8	101.8	101.9	0.1
AO	21,661	70	340	2.9	102.5	102.5	102.7	0.2
AP	22,631	65	275	3.6	104.3	104.3	104.4	0.1
AQ	23,611	53	210	4.9	107.7	107.7	107.7	0.0
AR	24,583	36	185	5.3	110.3	110.3	110.5	0.2
AS	25,512	79	430	1.5	115.9	115.9	116.0	0.1
AT	25,894	66	264	2.5	115.9	115.9	116.1	0.2
AU	26,177	61	234	2.3	116.1	116.1	116.3	0.2
AV	26,843	63	210	2.6	116.8	116.8	116.9	0.1
AW	27,061	58	181	2.9	117.0	117.0	117.1	0.1
AX	27,709	54	140	3.1	118.2	118.2	118.2	0.0
AY	27,945	62	177	2.4	118.8	118.8	118.8	0.0
AZ	28,267	44	126	3.4	119.5	119.5	119.5	0.0
BA	28,541	45	130	3.2	120.7	120.7	120.7	0.0
BB	28,981	34	228	1.8	124.8	124.8	125.4	0.6

[1] Feet above confluence with Laguna de Santa Rosa

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Roseland Creek (continued)								
BC	29,092	25	149	2.8	124.9	124.9	125.4	0.5
BD	29,512	48	225	1.6	127.0	127.0	127.6	0.6
BE	29,987	43	55	6.5	129.6	129.6	129.6	0.0
BF	30,224	30	81	4.1	131.2	131.2	131.6	0.4
BG	30,614	44	171	1.9	132.5	132.5	133.3	0.8
BH	30,890	38	156	2.0	133.0	133.0	133.6	0.6
BI	31,109	35	126	2.6	133.2	133.2	133.7	0.5
BJ	31,339	42	149	2.2	134.6	134.6	134.9	0.3
BK	31,844	55	221	0.9	136.3	136.3	136.7	0.4
BL	32,304	45	123	1.9	136.7	136.7	137.0	0.3
BM	32,870	55	154	1.2	138.8	138.8	138.8	0.0
BN	33,152	51	219	0.8	141.5	141.5	141.8	0.3
BO	33,619	27	62	3.3	141.5	141.5	141.8	0.3

[1] Feet above confluence with Laguna de Santa Rosa

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Russian River								
A	1,550	789	21,394	5.3	15.4	15.4	16.4	1.0
B	5,550	750	21,378	5.3	16.3	16.3	17.3	1.0
C	11,250	720	18,922	6.0	19.3	19.3	20.3	1.0
D	14,300	1,120	23,463	4.9	21.5	21.5	22.5	1.0
E	16,600	796	17,919	6.4	21.9	21.9	22.9	1.0
F	22,450	684	13,246	8.5	24.0	24.0	24.9	0.9
G	28,300	625	16,763	6.7	27.3	27.3	28.0	0.7
H	33,100	545	13,882	8.1	30.3	30.3	31.0	0.7
I	33,600	1,169	19,699	5.7	31.5	31.5	32.3	0.8
J	36,700	800	15,867	7.1	35.0	35.0	35.8	0.8
K	38,700	1,260	24,983	4.5	37.0	37.0	37.7	0.7
L	41,450	550	14,167	7.6	37.9	37.9	38.9	1.0
M	43,750	422	13,043	8.2	39.1	39.1	40.0	0.9
N	48,400	344	11,282	9.5	41.7	41.7	42.5	0.8
O	52,750	446	15,976	6.7	45.8	45.8	46.5	0.8
P	54,396	773	25,866	4.1	47.3	47.3	48.1	0.8
Q	56,000	475	14,410	7.4	47.6	47.6	48.2	0.6
R	57,500	566	16,652	6.4	48.3	48.3	49.1	0.8
S	60,200	670	20,691	5.1	49.4	49.4	50.2	0.8
T	62,500	445	13,633	7.8	49.7	49.7	50.4	0.7
U	66,000	427	13,526	7.9	51.2	51.2	52.2	1.0
V	68,000	498	13,366	8.0	52.0	52.0	52.9	0.9
W	70,170	643	19,386	5.5	53.8	53.8	54.8	1.0
X	72,950	438	12,295	8.7	54.6	54.6	55.6	1.0
Y	75,820	394	13,920	7.7	56.9	56.9	57.7	0.8
Z	77,700	388	12,749	8.4	57.8	57.8	58.6	0.8

[1] Feet above confluence with Pacific Ocean

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

RUSSIAN RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Russian River (continued)								
AA	81,530	1,017	28,127	3.8	61.7	61.7	62.6	0.9
AB	84,500	546	17,516	6.1	62.2	62.2	63.2	1.0
AC	87,800	695	26,230	4.0	63.0	63.0	64.0	1.0
AD	91,070	488	17,516	6.1	62.2	62.2	63.2	1.0
AE	93,470	989	23,558	4.5	64.4	64.4	65.4	1.0
AF	96,250	721	21,727	4.9	65.5	65.5	66.5	1.0
AG	97,950	758	23,022	4.6	66.0	66.0	67.0	1.0
AH	99,800	754	26,601	4.0	66.7	66.7	67.7	1.0
AI	102,600	666	22,703	4.7	67.7	67.7	68.7	1.0
AJ	104,500	351	14,391	7.4	68.1	68.1	69.1	1.0
AK	108,200	1,077	21,066	5.0	70.1	70.1	71.1	1.0
AL	110,100	487	20,852	5.1	71.3	71.3	72.3	1.0
AM	113,200	541	22,599	4.7	72.0	72.0	73.0	1.0
AN	114,234	836	17,576	6.0	72.7	72.7	73.7	1.0
AO	119,140	1,757	51,938	2.0	75.7	75.7	76.7	1.0
AP	120,140	1,523	46,972	2.1	75.9	75.9	76.9	1.0
AQ	125,770	2,093	59,496	1.6	76.6	76.6	77.6	1.0
AR	132,000	900	23,028	4.5	77.6	77.6	78.6	1.0
AS	133,000	730	24,890	4.1	78.0	78.0	79.0	1.0
AT	138,150	2,643	50,719	1.8	78.8	78.8	79.8	1.0
AU	142,200	2,256	46,818	2.2	78.9	78.9	79.9	1.0
AV	146,550	3,295	68,304	1.5	79.2	79.2	80.2	1.0
AW	149,750	3,518	60,632	1.7	79.2	79.2	80.2	1.0
AX	153,150	3,550	37,237	2.0	79.3	79.3	80.3	1.0
AY	156,500	1,924	21,157	4.9	79.6	79.6	80.6	1.0
AZ	164,500	493	10,363	9.9	82.2	82.2	83.2	1.0

[1] Feet above confluence with Pacific Ocean

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Russian River (continued)								
BA	168,075	757	15,749	6.5	86.4	86.4	87.2	0.8
BB	170,969	699	13,414	7.7	89.4	89.4	90.1	0.7
BC	172,903	621[2]	13,034	6.9	92.5	92.5	93.0	0.5
BD	174,137	439	9,475	9.5	93.4	93.4	93.8	0.4
BE	176,254	430	7,390	12.2	99.1	99.1	99.2	0.1
BF	178,375	474	10,066	8.9	102.3	102.3	102.4	0.1
BG	180,438	370	8,579	10.5	104.9	104.9	105.7	0.8
BH	182,484	340	7,959	11.3	106.8	106.8	107.6	0.8
BI	183,510	180	5,427	16.6	110.1	110.1	110.9	0.8
BJ	185,910	310	8,977	10.0	115.8	115.8	116.8	1.0
BK	189,110	360	10,727	8.4	120.5	120.5	121.5	1.0
BL	190,710	360	10,769	8.4	122.3	122.3	123.3	1.0
BM	195,660	820	15,299	5.9	133.6	133.6	134.6	1.0
BN	199,510	800	12,832	7.0	136.8	136.8	137.8	1.0
BO	205,610	400	9,059	9.9	140.4	140.4	141.4	1.0
BP	214,960	440	7,878	11.4	146.5	146.5	147.5	1.0
BQ	217,110	564	14,557	6.1	152.8	152.8	153.6	0.8
BR	218,110	560	15,253	5.8	154.3	154.3	155.2	0.9
BS	219,810	500	10,539	7.8	156.1	156.1	157.0	0.9
BT	223,260	400	11,146	7.4	162.0	162.0	162.9	0.9
BU	228,610	1,500	27,771	3.0	169.3	169.3	170.3	1.0
BV	233,410	1,290	22,738	3.6	174.0	174.0	175.0	1.0
BW	237,460	670	14,493	5.5	177.9	177.9	178.9	1.0
BX	239,360	810	15,631	5.1	180.3	180.3	181.3	1.0
BY	240,410	1,420	22,065	3.6	181.3	181.3	182.3	1.0
BZ	240,610	1,430	22,268	3.6	181.4	181.4	182.4	1.0

[1] Feet above confluence with Pacific Ocean
[2] Width/width within corporate limit

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Russian River (continued)								
CA	245,110	3,140	40,575	2.0	182.7	182.7	183.7	1.0
CB	248,960	5,585	45,658	1.8	184.1	184.1	185.1	1.0
CC	255,460	1,040	15,065	5.3	191.4	191.4	192.0	0.6
CD	260,190	2,800	23,136	3.5	202.0	202.0	203.0	1.0
CE	269,080	2,200	23,021	3.4	215.8	215.8	216.8	1.0
CF	276,090	2,590	31,635	2.4	230.9	230.9	231.9	1.0
CG	278,990	2,930	41,296	1.8	237.8	237.8	238.8	1.0
CH	285,040	1,380	18,276	4.2	248.9	248.9	249.9	1.0
CI	293,540	929	16,168	4.7	267.5	267.5	268.5	1.0
CJ	298,940	2,236	30,435	2.5	275.1	275.1	276.0	0.9
CK	305,440	870	6,427	11.8	285.1	285.1	285.3	0.2
CL	308,440	644	7,286	10.4	293.9	293.9	293.9	0.0
CM	311,440	820	5,235	14.5	303.2	303.2	303.2	0.0
CN	312,640	470	6,041	12.6	305.6	305.6	306.6	1.0
CO	315,640	380	7,414	10.3	311.8	311.8	312.3	0.5
CP	320,240	180	4,337	14.8	328.1	328.1	328.3	0.2
CQ	320,790	260	7,108	9.0	331.0	331.0	332.0	1.0
CR	321,590	400	7,371	8.7	332.3	332.3	333.2	0.9
CS	329,390	250	5,551	11.5	347.6	347.6	348.6	1.0

[1] Feet above confluence with Pacific Ocean

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Santa Rosa Flood Control Channel								
A[1]	11,845[2]	175	2,156	7.0	79.1	79.1	79.6	0.5
B[1]	12,645[2]	176	2,177	7.0	80.0	80.0	80.4	0.4
C[1]	13,290[2]	176	2,112	7.2	80.8	80.8	81.1	0.3
D[1]	14,845[2]	144	1,641	9.3	82.7	82.7	82.9	0.2
E[1]	15,945[2]	139	1,490	10.2	85.0	85.0	85.1	0.1
F[1]	16,445[2]	128	1,475	9.7	86.4	86.4	86.5	0.1
G[1]	17,329[2]	136	1,403	10.2	88.6	88.6	88.6	0.0
Schell Creek								
A	2,200[3]	504	2,549	1.9	11.0	11.0	12.0	1.0
C	2,600[3]	328	1,562	3.0	11.2	11.2	12.2	1.0
D	2,800[3]	300	1,270	3.7	11.3	11.3	12.3	1.0
F	3,134[3]	345	2,008	2.3	12.5	12.5	13.5	1.0
H	3,588[3]	256	1,636	2.9	14.4	14.4	15.4	1.0
J	4,100[3]	198	1,041	4.5	14.6	14.6	15.6	1.0
K	4,360[3]	112	779	6.1	14.8	14.8	15.8	1.0
L	4,850[3]	118	662	4.4	16.0	16.0	17.0	1.0
M	5,165[3]	175	1,157	2.5	16.5	16.5	17.5	1.0
N	5,515[3]	338	1,773	1.7	16.7	16.7	17.7	1.0
P	6,550[3]	530	2,597	1.1	16.8	16.8	17.8	1.0
T	7,300[3]	456	1,819	1.5	17.8	17.8	18.8	1.0
V	7,916[3]	68	405	6.9	18.9	18.9	19.9	1.0
W*								
AC	10,760[3]	275	1,471	1.9	23.0	23.0	24.0	1.0
AG	11,550[3]	277	1,353	2.0	23.3	23.3	24.3	1.0
AH*								
AI	11,910[3]	329	1,364	2.0	23.8	23.8	24.8	1.0

[1] Flow contained in channel
[2] Feet above confluence with Russian River
[3] Feet above Tide Gates
* Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

SANTA ROSA FLOOD CONTROL CHANNEL – SCHELL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Schell Creek (continued)								
AJ*								
AK	12,510[2]	378	975	2.8	24.8	24.8	25.4	0.6
AL	13,000[2]	395	1,111	2.5	25.9	25.9	26.5	0.6
AN	13,550[2]	540	1,364	2.0	26.6	26.6	27.1	0.5
AO	13,950[2]	651	1,403	2.0	27.1	27.1	27.5	0.4
AQ	14,571[2]	23	61	6.0	28.5	28.5	29.5	1.0
AR	15,000[2]	81	178	2.0	30.6	30.6	31.6	1.0
AS	15,500[2]	19	66	5.5	32.3	32.3	33.3	1.0
AV	16,200[2]	24	84	4.3	39.4	39.4	40.4	1.0
AW	17,000[2]	88	129	2.8	42.2	42.2	43.2	1.0
AX	17,800[2]	157	302	1.2	45.6	45.6	46.6	1.0
AY	18,381[2]	33	91	4.0	48.2	48.2	48.2	0.0
Sonoma Creek								
A-W*								
X[1]	59,500[3]	187	2,181	7.6	34.4	34.4	34.4	0.0
Y[1]	60,000[3]	120	1,554	10.7	35.0	35.0	35.0	0.0
Z[1]	60,500[3]	91	1,364	12.2	35.9	35.9	36.2	0.3
AA[1]	61,000[3]	92	1,443	11.5	38.1	38.1	38.2	0.1
AB[1]	61,500[3]	111	1,858	9.0	39.7	39.7	40.2	0.5
AC[1]	62,500[3]	120	2,043	8.2	41.0	41.0	41.9	0.9
AD[1]	63,500[3]	94	1,509	11.0	41.7	41.7	42.6	0.9
AE[1]	64,500[3]	215	2,559	6.5	45.9	45.9	45.9	0.0
AF[1]	65,500[3]	160	2,053	8.1	47.0	47.0	47.0	0.0
AG[1]	66,500[3]	190	2,057	8.1	48.7	48.7	48.8	0.1
AH[1]	67,500[3]	182	2,126	7.8	50.6	50.6	50.6	0.0
AI[1]	68,500[3]	150	1,899	8.8	53.4	53.4	53.4	0.0
AJ[1]	69,600[3]	150	2,164	7.7	57.7	57.7	57.7	0.0

[1] Flow contained in channel
[2] Feet above tide gates
[3] Feet above State Route 37
* Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

SCHELL CREEK – SONOMA CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION[1]	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sonoma Creek (continued)								
AK	70,500	117	1,662	10.0	59.0	59.0	59.0	0.0
AL	71,500	133	1,884	8.8	61.1	61.1	61.1	0.0
AM	72,500	118	1,251	13.1	63.0	63.0	63.0	0.0
AN	73,500	128	2,112	7.7	68.9	68.9	69.1	0.2
AO	74,500	150	2,099	7.8	70.2	70.2	70.5	0.3
AP	75,500	145	2,035	8.0	72.1	72.1	72.3	0.2
AQ	76,500	67	923	17.7	73.0	73.0	73.1	0.1
AR	77,500	143	2,381	6.9	80.8	80.8	81.4	0.6
AS	78,500	183	2,094	7.8	81.3	81.3	81.9	0.6
AT	79,500	184	2,407	6.8	83.3	83.3	83.7	0.4
AU	80,500	140	1,417	11.5	84.2	84.2	84.5	0.3
AV	81,500	296	2,325	7.0	88.4	88.4	88.5	0.1
AW	82,500	132	1,666	9.8	92.5	92.5	92.7	0.2
AX	83,500	133	1,524	10.7	96.6	96.6	96.7	0.1
AY	84,500	234	2,495	6.6	99.8	99.8	99.8	0.0
AZ	85,500	208	1,643	10.0	103.6	103.6	103.6	0.0
BA	86,500	201	1,692	9.7	111.1	111.1	111.1	0.0
BB	87,500	151	2,270	7.2	115.4	115.4	115.9	0.5
BC	88,500	157	1,869	8.3	117.9	117.9	118.2	0.3
BD	89,768	240	2,387	6.5	121.8	121.8	121.8	0.0
BE	90,768	108	1,312	11.9	124.1	124.1	124.1	0.0
BF	91,425	157	1,730	9.0	127.7	127.7	127.8	0.1
BG	92,295	83	1,046	14.9	130.3	130.3	130.4	0.1
BH	93,295	111	1,670	9.3	135.9	135.9	135.9	0.0
BI	94,755	235	2,736	5.7	140.7	140.7	140.7	0.0
BJ	95,655	204	1,765	8.8	141.3	141.3	141.4	0.1
BK	96,610	271	2,147	7.3	145.8	145.8	145.8	0.0

[1] Flow contained in channel
[2] Feet above State Route 37

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

SONOMA CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION[1]	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sonoma Creek (continued)								
BL	97,610	194	2,055	7.3	151.8	151.8	151.8	0.0
BM	98,510	116	1,399	10.8	157.0	157.0	157.0	0.0
BN	99,510	188	1,652	9.1	160.8	160.8	160.8	0.0
BO	100,364	107	1,235	10.6	167.3	167.3	167.3	0.0
BP	101,762	129	1,325	9.9	172.4	172.4	172.4	0.0
BQ	102,292	139	1,130	11.6	174.5	174.5	174.5	0.0
BR	103,402	115	843	15.6	178.4	178.4	178.4	0.0
BS	104,492	118	1,268	10.1	186.7	186.7	186.7	0.0
BT	105,555	126	1,161	11.0	192.0	192.0	192.0	0.0
BU	106,460	207	1,182	10.8	196.4	196.4	196.5	0.1
BV	107,355	102	1,043	12.3	204.3	204.3	205.3	1.0
BW	108,335	105	1,382	10.5	211.2	211.2	211.2	0.0
BX	109,345	138	1,372	9.2	215.1	215.1	215.2	0.1
BY	110,395	72	808	15.5	220.0	220.0	220.4	0.4
BZ	111,675	183	1,273	7.4	228.8	228.8	229.1	0.3
CA	112,627	85	617	15.3	233.9	233.9	233.9	0.0
CB	113,527	90	623	15.1	240.7	240.7	240.7	0.0
CC	114,527	159	1,117	8.4	248.3	248.3	249.0	0.7
CD	115,347	130	911	10.3	257.2	257.2	257.5	0.3
CE	116,721	89	857	11.0	265.8	265.8	265.9	0.1
CF	117,713	110	1,111	8.5	274.4	274.4	274.4	0.0
CG	118,593	78	701	12.8	279.5	279.5	279.7	0.2
CH	119,373	80	857	10.2	284.6	284.6	284.7	0.1
CI	120,645	145	1,472	5.9	293.1	293.1	293.8	0.7
CJ	121,655	123	1,049	8.3	296.6	296.6	296.9	0.3
CK	122,402	100	846	10.3	300.3	300.3	300.4	0.1
CL	123,355	95	1,055	8.1	307.7	307.7	307.8	0.1
CM	124,346	64	866	9.9	311.8	311.8	312.3	0.5

[1] Flow contained in channel
[2] Feet above State Route 37

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

SONOMA CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sonoma Creek (continued)								
CN[1]	125,394	71	742	9.3	315.7	315.7	316.1	0.4
CO[1]	126,540	72	617	10.9	324.1	324.1	324.1	0.0
CP[1]	127,455	62	694	9.6	332.5	332.5	332.5	0.0
CQ[1]	128,525	50	576	11.6	339.7	339.7	340.0	0.3
CR[1]	129,531	67	696	9.6	344.4	344.4	344.7	0.3
CS[1]	130,579	72	545	12.3	347.9	347.9	348.6	0.7
CT[1]	131,500	85	717	9.3	357.6	357.6	357.8	0.2
CU[1]	132,537	100	768	8.7	361.6	361.6	362.1	0.5
CV[1]	133,470	60	703	9.5	367.8	367.8	367.9	0.1
CW[1]	134,671	45	439	15.3	376.7	376.7	377.2	0.5
CX[1]	135,583	58	742	9.0	389.6	389.6	389.7	0.1
CY[1]	136,493	71	617	9.6	392.4	392.4	392.7	0.3
CZ[1]	137,418	71	617	9.6	396.0	396.0	396.3	0.3
DA[1]	138,545	94	872	6.8	403.1	403.1	403.1	0.0
DB[1]	139,645	70	562	10.5	406.4	406.4	406.7	0.3
DC[1]	141,040	66	416	14.3	413.1	413.1	413.2	0.1
DD	142,200	213	1,019	5.2	425.9	425.9	426.2	0.3
DE	142,400	87	851	6.2	426.3	426.3	427.1	0.8
DF	143,900	260	1,084	3.0	428.0	428.0	429.0	1.0
DG	144,630	246	510	6.3	430.0	430.0	430.5	0.5
DH	145,120	88	343	9.4	433.4	433.4	433.5	0.1
DI[1]	146,350	86	418	7.7	439.5	439.5	440.0	0.5
DJ[1]	147,459	79	478	6.7	446.6	446.6	447.6	1.0
DK[1]	148,597	61	354	9.1	454.9	454.9	455.5	0.6
DL[1]	149,382	47	247	13.1	463.2	463.2	463.2	0.0
DM[1]	150,540	57	230	14.0	474.6	474.6	475.0	0.4
DN[1]	151,529	35	223	14.4	490.1	490.1	490.1	0.0
DO[1]	152,477	88	250	12.9	503.7	503.7	503.7	0.0

[1] Flow contained in channel
[2] Feet above State Route 37

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Spring Creek								
A	3,090	29	245	5.5	189.0	189.0	189.5	0.5
B	3,220	37	264	5.1	189.3	189.3	189.9	0.6
C	3,570	43	237	5.7	190.0	190.0	190.5	0.5

[1] Feet above confluence with Matanzas Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

SPRING CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Starr Creek								
A	296	45	286	3.9	81.1	81.1	82.1	1.0
B	780	130	405	2.8	82.8	82.8	83.7	0.9
C	1,324	167	434	2.5	83.7	83.7	84.7	1.0
D	1,774	66	260	4.2	85.0	85.0	85.9	0.9
E	2,114	157	621	1.7	87.3	87.3	88.1	0.8
F	2,489	86	343	3.1	87.6	87.6	88.4	0.8
G	3,150	60	291	3.7	89.8	89.8	90.7	0.9
H[1]	3,560	39	237	3.0	91.9	91.9	92.6	0.7
I	3,990	25	133	5.4	92.9	92.9	93.7	0.8
J	4,507	29	184	3.9	96.1	96.1	97.0	0.9
K	4,912	41	207	3.4	97.4	97.4	98.3	0.9
L	5,278	34	185	3.8	99.0	99.0	100.0	1.0
M[1]	5,789	38	230	3.0	101.2	101.2	102.1	0.9
N[1]	6,328	31	147	4.8	103.2	103.2	103.5	0.3
O	6,703	28	166	3.8	105.6	105.6	105.7	0.1
P	7,278	33	197	3.2	107.0	107.0	107.6	0.6
Q	7,818	43	212	1.6	110.5	110.5	110.6	0.1
R[1]	8,299	12	43	7.8	110.7	110.7	110.8	0.1
S[1]	9,075	33	109	3.1	114.4	114.4	114.5	0.1
T[1]	9,495	33	91	3.7	115.1	115.1	115.2	0.1
U	10,112	66	327	0.5	121.1	121.1	122.1	1.0
V	10,419	30	112	3.0	121.0	121.0	122.0	1.0
W[1]	10,706	10	54	6.3	121.5	121.5	122.5	1.0
X[1]	11,036	10	68	4.9	123.7	123.7	124.7	1.0
Y[1]	11,526	23	98	3.4	124.8	124.8	125.6	0.8
Z	11,917	25	58	5.4	128.4	128.4	129.2	0.8
AA	12,393	64	194	1.6	131.2	131.2	132.2	1.0

[1] Flow contained in channel
[2] Feet above confluence with Windsor Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

STARR CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION FEET (NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Todd Creek								
A	336	48	380	4.5	93.8	93.8	93.8	0.0
B	1,999	69	483	3.5	95.3	95.3	95.3	0.0
C	2,100	82	721	3.0	97.0	97.0	97.0	0.0
D	3,689	70	512	3.4	97.8	97.8	97.8	0.0
E	4,158	71	370	3.9	98.1	98.1	98.1	0.0
F	4,375	49	391	3.7	98.4	98.4	98.4	0.0
G	4,613	93	522	2.8	99.9	99.9	99.9	0.0
H	5,717	168	617	2.3	101.6	101.6	101.6	0.0
I	6,131	55	317	4.2	101.7	101.7	101.7	0.0
J	7,721	53	335	4.0	104.2	104.2	104.3	0.0
K	7,806	62	407	3.3	106.0	106.0	106.3	0.3
L	7,978	58	345	3.8	106.1	106.1	106.4	0.3
M	8,071	125	474	2.8	106.7	106.7	107.4	0.7
N	8,758	115	361	3.7	107.1	107.1	108.1	1.0
O	10,661	815	727	1.4	111.3	111.3	112.2	0.9
P	10,729	826	717	1.4	111.4	111.4	112.3	0.9
Q	11,348	64	209	3.1	112.0	112.0	112.6	0.6
R	11,758	78	148	4.4	115.5	115.5	115.9	0.4
S	12,758	51	114	5.7	118.5	118.5	119.4	0.9
T	13,366	150	287	1.4	120.2	120.2	121.1	0.9
U	13,606	59	73	4.7	121.1	121.1	121.3	0.2
V	14,685	100	166	2.1	125.2	125.2	126.0	0.8
W	15,192	113	265	1.3	128.8	128.8	129.4	0.6
X	15,419	70	85	3.1	129.0	129.0	129.6	0.6
Y	15,758	49	62	4.2	130.5	130.5	131.1	0.6

[1] Feet above Pacific Northwest Railroad

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SONOMA COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

TODD CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION FEET (NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Todd Creek (Continued)								
Z	16,554[1]	17	40	6.5	136.4	136.4	136.9	0.5
AA	16,728[1]	18	55	4.8	141.4	141.4	141.4	0.0
AB	16,973[1]	41	88	3.0	146.7	146.7	147.5	0.8
AC	17,912[1]	11	29	9.0	173.5	173.5	174.1	0.6
Todd Creek Tributary 1								
A	208[2]	11	14	6.3	132.2	132.2	132.2	0.0
B	1,101[2]	12	14	6.2	152.9	152.9	152.9	0.0
C	1,301[2]	14	15	5.9	163.5	163.5	163.5	0.0
D	1,488[2]	38	52	1.7	171.6	171.6	171.6	0.0

[1] Feet above Pacific Northwest Railroad

[2] Feet above confluence with Todd Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SONOMA COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

TODD CREEK - TODD CREEK TRIBUTARY 1

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION FEET (NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Todd Creek Tributary 2								
A	400	299	177	1.4	120.6	120.6	121.1	0.5
B	1,400	35	41	6.1	129.1	129.1	129.2	0.1
C	2,000	13	29	8.6	138.1	138.1	138.1	0.0
D	2,102	93	73	3.7	143.0	143.0	143.0	0.0
E	2,320	100	59	4.3	148.3	148.3	148.6	0.3
F	2,877	13	30	8.4	169.3	169.3	169.3	0.0

[1] Feet above confluence with Todd Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY
SONOMA COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

TODD CREEK TRIBUTARY 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Wiggins Creek								
A	2,710	285	1,056	1.5	40.7	40.7	41.7	1.0
B	3,940	178	526	3.0	42.2	42.2	43.2	1.0
C	5,140	144	406	3.8	44.7	44.7	45.7	1.0
D	5,940	300	623	2.5	47.4	47.4	48.0	0.6
E	6,740	283	799	2.0	49.2	49.2	50.1	0.9
F	7,722	378	1,233	1.3	53.2	53.2	53.5	0.3
G	8,480	162	349	3.2	53.8	53.8	54.5	0.7
H[1]	9,368	56	263	4.0	57.4	57.4	58.3	0.9
I[1]	9,987	40	179	5.9	59.3	59.3	59.7	0.4
J[1]	10,602	44	216	3.4	61.7	61.7	62.0	0.3
K[1]	11,316	30	147	5.0	64.0	64.0	64.4	0.4
L[1]	11,958	40	106	6.9	69.1	69.1	69.1	0.0
M	12,640	83	150	4.9	77.2	77.2	78.0	0.8
N[1]	13,099	22	91	6.9	79.3	79.3	79.9	0.6
O[1]	13,751	27	94	6.7	83.3	83.3	83.5	0.2
P[1]	14,567	25	89	7.1	87.8	87.8	87.8	0.0

[1] Flow contained in channel
[2] Feet above confluence with Marin Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

WIGGINS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[3]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Willow Brook								
A-E[1]								
F	5,500	120	434	3.7	50.2	50.2	51.1	0.9
G	6,436	111	479	3.4	52.9	52.9	53.9	1.0
H	7,468	61	281	5.8	57.9	57.9	58.8	0.9
I	8,539	48	310	5.3	64.8	64.8	65.8	1.0
J	9,539	54	217	7.5	67.6	67.6	68.6	1.0
K[2]	10,483	47	248	6.1	72.8	72.8	72.8	0.0
L[2]	11,683	64	290	5.2	79.7	79.7	79.7	0.0
M[2]	12,570	132	790	1.9	90.8	90.8	90.8	0.0

[1] No floodway determined
[2] Flow contained in channel
[3] Feet above confluence with Petaluma River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

WILLOW BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Wilson Creek								
A	4,291	117	176	3.4	48.0	48.0	49.0	1.0
B	5,091	120	214	2.8	50.8	50.8	51.8	1.0
C	5,519	78	268	2.2	54.5	54.5	54.7	0.2
D	6,588	114	209	2.9	55.7	55.7	56.6	0.9
E	7,241	61	134	4.4	57.7	57.7	58.6	0.9
F	7,746	243	566	1.1	61.4	61.4	62.1	0.7
G[1]	8,581	49	135	4.2	65.7	65.7	65.8	0.1
H[1]	9,198	18	62	9.0	69.5	69.5	69.5	0.0
I[1]	9,720	35	158	3.3	76.9	76.9	76.9	0.0
J[1]	10,266	29	115	4.6	78.3	78.3	78.4	0.1
K[1]	10,964	26	93	5.7	85.5	85.5	85.5	0.0
L[1]	11,614	27	120	3.8	95.7	95.7	95.7	0.0
M[1]	12,239	26	81	5.7	99.4	99.4	99.4	0.0
N[1]	12,863	34	61	4.8	109.7	109.7	109.7	0.0
O[1]	13,467	18	36	8.1	121.5	121.5	121.5	0.0

[1] Flow contained in channel
[2] Feet above confluence with Mann Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

WILSON CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Windsor Creek								
A	14,312	411	1,853	2.0	80.3	80.3	81.3	1.0
B	15,142	377	1,543	2.4	80.6	80.6	81.6	1.0
C	15,802	376	1,303	2.8	80.9	80.9	81.9	1.0
D[1]	16,380	79	507	5.4	82.1	82.1	82.5	0.4
E[1]	17,042	78	538	5.1	83.3	83.3	83.7	0.4
F-H*								
I	19,969	516	1,475	1.8	91.3	91.3	92.3	1.0
J	20,569	281	621	4.2	92.0	92.0	92.9	0.9
K	21,015	250	635	4.2	94.0	94.0	94.9	0.9
L	21,643	48	294	4.8	97.2	97.2	97.6	0.4
M[1]	22,243	51	310	4.6	99.2	99.2	99.4	0.2
N[1]	22,735	57	310	4.6	101.7	101.7	101.7	0.0
O[1]	23,356	67	303	4.4	103.5	103.5	103.8	0.3
P[1]	23,957	86	429	3.1	105.7	105.7	105.9	0.2
Q[1]	24,639	47	225	5.9	108.2	108.2	108.2	0.0
R[1]	25,339	47	228	5.9	111.4	111.4	111.4	0.0
S[1]	25,686	36	346	3.7	113.4	113.4	113.5	0.1
T[1]	26,221	20	136	9.5	113.4	113.4	113.4	0.0
U[1]	26,841	48	260	4.9	119.7	119.7	119.7	0.0
V[1]	27,457	41	217	5.8	123.7	123.7	123.7	0.0
W[1]	28,327	45	258	4.9	127.8	127.8	128.4	0.6
X[1]	29,017	72	429	2.9	138.0	138.0	138.0	0.0
Y[1]	29,534	33	239	5.3	139.0	139.0	139.4	0.4
Z[1]	30,206	36	260	4.8	141.3	141.3	141.6	0.3
AA[1]	30,938	35	209	6.0	144.0	144.0	144.1	0.1
AB[1]	31,489	57	297	4.2	152.3	152.3	152.5	0.2
AC[1]	32,016	32	180	7.0	154.2	154.2	155.1	0.9
AD[1]	32,434	35	254	4.9	158.8	158.2	159.0	0.2

[1] Flow contained in channel
[2] Feet above confluence with Mark West Creek
* Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

WINDSOR CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Windsor Creek (continued)								
AE[1]	32,905	60	229	5.4	161.9	161.9	161.9	0.0
AF[1]	33,487	56	437	2.8	167.5	167.5	167.8	0.3
AG[1]	34,087	62	336	3.7	168.5	168.5	169.0	0.5
AH[1]	34,701	73	407	3.1	173.7	173.7	173.7	0.0
AI[1]	35,416	40	257	4.8	178.9	178.9	179.6	0.7
AJ[1]	36,132	35	226	5.5	184.3	184.3	184.3	0.0
AK[1]	36,662	34	238	5.2	188.1	188.1	188.8	0.7
AL[1]	36,981	27	158	7.9	192.4	192.4	192.4	0.0
Woolsey Creek								
A	1,253	219	1,658	0.2	78.8	76.2[3]	76.7	0.5
B[1]	2,082	274	1,641	0.2	80.7	76.3[3]	76.8	0.5
C[1]	2,875	41	103	3.0	80.8	76.5[3]	77.0	0.5
D	3,573	8	42	7.4	80.8	79.6[3]	80.1	0.5
E	4,027	38	156	2.0	83.4	83.4	84.1	0.7
F[1]	4,564	21	106	2.9	85.1	85.1	86.0	0.9
G[1]	5,219	17	89	3.3	87.8	87.8	88.3	0.5
H[1]	6,023	18	64	4.7	97.0	97.0	97.0	0.0
I	6,952	51	259	1.2	103.5	103.5	104.3	0.8
J	7,585	36	129	2.3	104.2	104.2	105.1	0.9
K	8,153	35	127	2.4	106.7	106.7	107.5	0.8
L	8,819	30	239	0.9	114.0	114.0	115.1	1.1
M	9,521	44	195	1.1	114.0	114.0	114.2	0.2
N[1]	10,157	19	92	2.4	114.6	114.6	114.8	0.2

[1] Flow contained in channel
[2] Feet above confluence with Mark West Creek
[3] Elevations computed without consideration of backwater

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

WINDSOR CREEK – WOOLSEY 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 4.

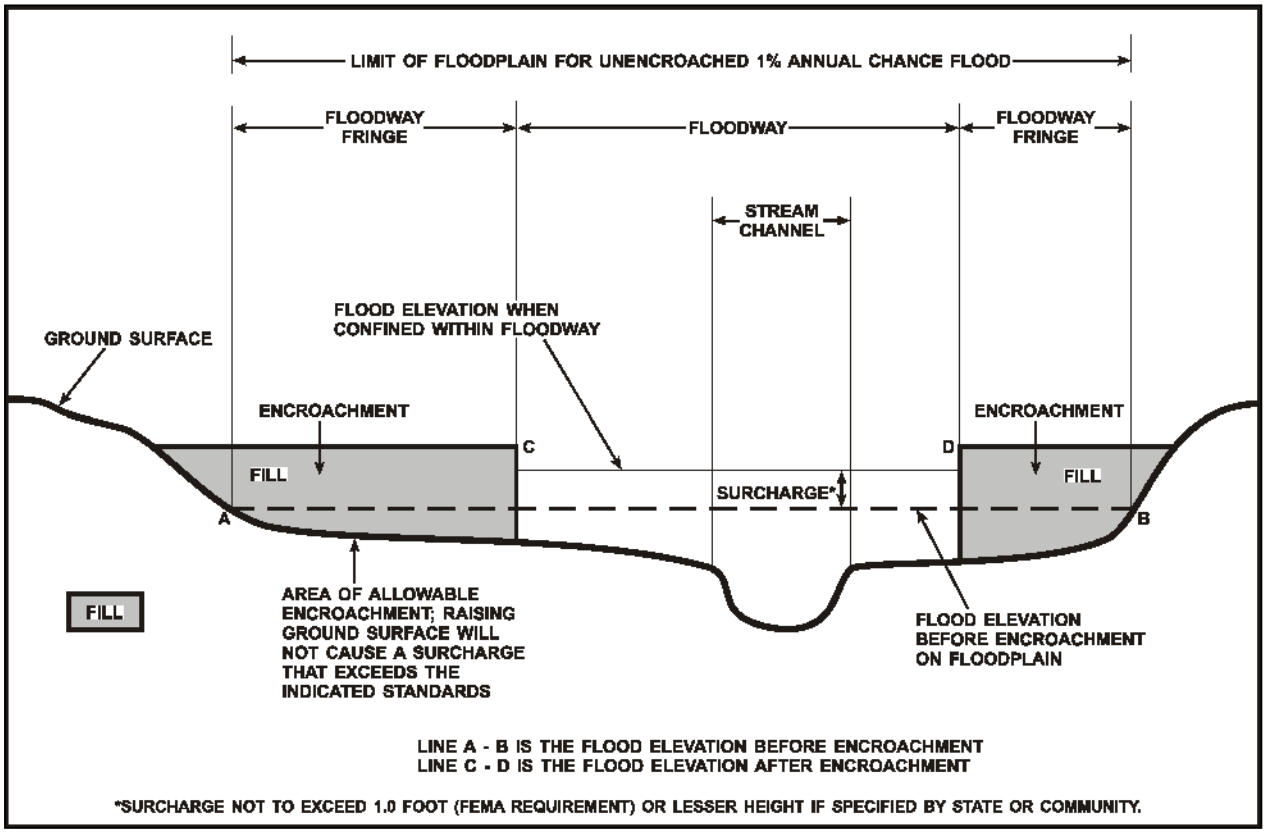

Figure 4: Floodway Schematic

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 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 sheet flow 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 AR

Area of special flood hazard formerly protected from the 1-percent annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1-percent annual chance or greater flood event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths 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 to 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-percent 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 Sonoma County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community are presented in Table 10, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Cloverdale, City of	February 22, 1974	February 6, 1976	September 27, 1985	July 16, 1996
Cotati, City of	November 22, 1974	July 30, 1976 February 14, 1978	April 15, 1980	December 5, 1996
Healdsburg, City of	March 1, 1974	April 16, 1976	March 4, 1980	October 18, 1983 September 6, 2006
Petaluma, City of	March 8, 1974	November 28, 1975	February 15, 1980	September 29, 1989 <date>
Rohnert Park, City of	November 29, 1974	November 5, 1976	June 1, 1981	None
Santa Rosa, City of	July 26, 1974	November 15, 1977	August 3, 1981	None
Sebastopol, City of	March 8, 1974	September 26, 1975	June 18, 1980	September 28, 1990
Sonoma, City of	February 22, 1974	January 30, 1976 September 17, 1976	January 17, 1979	June 5, 1997 <date>
Sonoma County (Unincorporated Areas)	June 19, 1970	None	January 20, 1982	August 5, 1986 April 2, 1991 October 18, 1995 June 19, 1997 September 6, 2006
Windsor, Town of	June 19, 1970	None	January 20, 1982	None

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Sonoma 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 Sonoma County.

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, 111 Broadway, Suite 1200, Oakland, California 94607-4052.

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10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository.

10.1 First Revision

This study was revised on October 16, 2012, to include a detailed hydrologic and hydraulic study on Colgan Creek, Roseland Creek, and Naval Creek. This study was performed by Nolte Associates, Inc. (the study contractor) under Contract No. EMF.2003-CO-0044 Task Order No. 10. The study was completed in October 2009.

The Naval Creek study reach is approximately 2.4 miles long, has an approximately 0.2 percent longitudinal slope, and is vegetated for its entire length. Just west of Lloyd Avenue there is a significant confluence point that accounts for approximately 20 percent of the overall watershed area. The entire watershed is approximately 2.4 square miles with a majority of the land use being agricultural with some low-density residential in the upstream areas. Naval Creek was also studied an additional 1.4 miles upstream of the limit of study. This additional study reach will be included in future revisions.

The Roseland Creek study reach is approximately 6.4 miles long as it traverses through the 3.9 square mile watershed. The upstream portion of the creek is within the City of Santa Rosa with land use generally consisting of residential, commercial, and industrial. The creek is unimproved from its headwaters to Burbank Avenue. Downstream of Burbank Avenue, the creek is vegetated and has a slope between 0.2 and 0.6 percent. As Roseland Creek travels through the Santa Rosa Plain, it is fed by small, natural tributaries and has slopes between 0.1 and 0.2 percent. Mean annual precipitation for the entire watershed is approximately 30 inches.

The Colgan Creek study reach is approximately 9.0 miles in length from its headwaters to its confluence with Laguna de Santa Rosa. The watershed is approximately 7.8 square miles and is divided into mountainous terrain east of the City of Santa Rosa, urbanized areas, and the Santa Rosa Plain in the downstream portion. The headwaters of the watershed are characterized by steep slopes (greater than 10 percent) and heavy vegetation. As the creek flows through the City of Santa Rosa, there are interspersed reaches of concrete and vegetated channel sections. Land use through this portion of the watershed is mainly classified as single- and multi-family residential in addition to commercial and industrial. The downstream portion of the watershed (Santa Rosa Plain) consists mainly of agricultural and grassland areas with sporadic single-family residences. The terrain is flat with the average slope of the creek between 0.1 and 0.2 percent. Two large unnamed tributaries contribute flow to Colgan Creek near its downstream termination point. Approximately one square mile of drainage area contributes to each of these two unnamed tributaries.

Hydrologic Analyses

Hydrologic analyses were performed to establish peak discharge-frequency relationships for Colgan, Roseland, and Naval Creeks. Specifically, peak discharge values for the 10-, 50-, 100-, and 500-year recurrence intervals were developed as part of the "Hydrology Study for Colgan, Roseland, and Naval Creeks," prepared by Nolte Associates, Inc. Flood hydrographs and peak discharge values for the aforementioned flood events were performed using the US Army Corps of Engineers (USACE) HEC-HMS, version 3.1.0 computer modeling program.

Precipitation data for the 10-, 50-, 100-, and 500-year, 24-hour storms were developed using Plate B-2 of the Sonoma County Water Agency Flood Control Design Criteria Manual. The Natural Resource Conservation Service (NRCS) Type 1A synthetic rainfall pattern was used to distribute these precipitation totals. Land use was determined by reviewing orthophotography and existing land use GIS shape files provided by the City of Santa Rosa. Hydrologic soil types for Sonoma County were obtained from the NRCS website. Composite curve numbers (CN) were calculated based on land use and soil type and applied to each sub-basin to account for precipitation losses within the watershed. Sub-basin hydrographs were created using an S-graph developed by the USACE San Francisco District in the 1960s. Lag times for these hydrographs were calculated from the USACE equation that includes variables such as length of watercourse, slope, and roughness coefficient. The Muskingum-Cunge 8-point method was used to route and attenuate the hydrographs through the study reaches.

High water marks from the 2005 New Year's Eve historical storm event were recorded by the City of Santa Rosa at various locations along Colgan and Roseland Creeks. The City of Santa Rosa provided digital files that illustrated the high water mark locations and elevations for the 2005 flooding event. By inputting precipitation data from local rain gages for this storm event into the HEC-HMS model, peak flow rates were generated. To calibrate the HEC-HMS model parameters, hydraulic models were run using these flow rates to generate water surface elevations that were compared to the observed high water mark elevations.

Of the three studied streams, only Colgan Creek contained stream gages that possessed historical flow data. Unfortunately, these two USGS gages (No. 11465690 and No. 11465700) do not contain enough recorded years of peak stream flow data to allow for a flood frequency analyses. As such, USGS regional regression equations were used to validate the 100-year flows generated by the HEC-HMS model.

Hydraulic Analyses

Aerial photogrammetry was used to develop 1-foot contour interval topographic data for the study areas. Field surveys within the channel area at each cross section define the true ground profile (i.e. below the water level). Field survey points were incorporated into the overall terrain model prior to generation of the contour data. This topographical information was used to develop the hydraulic models and base mapping for the delineation of the 100-year and 500-year floodplains and floodway. Hydraulic analyses were performed using the USACE HEC-RAS Version 3.1.3 (May 2005) computer

modeling program. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Channel roughness coefficients (Manning's "n") used in the hydraulic computations were determined by engineering judgment and field reconnaissance in addition to being validated and calibrated using the 2005 New Year's Eve storm high water marks. In general, the channel roughness coefficients for Colgan and Roseland Creek ranged from 0.035 to 0.070. Roughness coefficients for Naval Creek were between 0.035 and 0.05.

In the undeveloped overbank areas, roughness coefficients for Colgan, Roseland, and Naval Creeks were 0.035 to 0.04 as the land was principally agricultural fields. In the urbanized areas characterized by single-family residences and commercial/industrial uses, roughness coefficients were calculated using equation 12 of "A Method for Adjusting Values of Manning's Roughness Coefficient for Flooded Urban Areas" by H.R. Hejl, Jr. Roughness values were calculated to be approximately 0.11 to 0.12 for the urbanized areas.

Starting water-surface elevations for Colgan, Roseland, and Naval Creeks were computed using the slope-area method.

Naval Creek

From its headwaters to Llano Road, the 100-year discharge is contained within a well defined vegetated channel. Downstream of Llano Road, there are two split flow locations along the left overbank of Naval Creek. These split flow reaches are short in length (approximately 1,430 feet for upstream split and 540 feet, respectively) and eventually join back with the main channel. Flow values for the main channel and split flow were determined by balancing energy grade elevations at the upstream split flow locations.

Downstream of Llano Road, flooding elevations are controlled by flooding from Laguna de Santa Rosa.

Roseland Creek

The 100-year flow for Roseland Creek is channelized for a majority of its length. Similar to Naval Creek, this portion of Roseland Creek is inundated by flooding from Laguna de Santa Rosa. A comparison of base flood elevations shows that Laguna de Santa Rosa is approximately two to three feet higher than Roseland Creek base flood elevations. Land use in this area is also agricultural without any affected structures.

Colgan Creek

The 100-year flow is contained within the vegetated channel section of Colgan Creek from its upstream limits to the culvert just south of Colgan Avenue (approximately 9,800 feet of channel length). As flow travels downstream from this location to the Highway 101 culvert crossing, the channel geometry changes to an approximately 20-foot by 7-foot rectangular concrete section. The reduced conveyance area of the channel, undersized Highway 101 culvert crossing, and two significant hydrologic inflow locations combine to create flooding issues upstream of the Highway 101 culvert.

Along the right overbank, upstream from the Highway 101 crossing, Santa Rosa Avenue and Baker Avenue prevent flow from spilling in a northerly direction. Along the left overbank, the topography slopes away from the main channel towards the south. As a result, the flooding created by the backwater conditions at the Highway 101 culvert releases to the south. Hydraulic calculations revealed that approximately 787 cfs is conveyed through the Highway 101 culvert; forcing approximately 165 cfs and 552 cfs for the 100- year and 500-year storms, respectively, to flow in a southerly direction (parallel to Highway 101).

The spill exiting the main channel will travel southerly through a mainly commercial/industrial area and will not reconfluence with Colgan Creek. A separate HEC-RAS model was created to evaluate spill flooding limits and it was determined that average hydraulic flooding depths for the 100-year storm is generally less than 1.0 feet.

A split flow occurs approximately 860 feet downstream of Victoria Drive along the main channel. Downstream from this split, main channel conveyance is reduced due to significant vegetation creating a backwater that forces flood flows to spill into the right overbank area. Energy grade elevations were balanced between the split flow and the main channel to determine the quantity of flow leaving the main channel. Results from these calculations revealed that 10-, 50-, 100-, and 500-year split flow values are approximately 248 cfs, 452 cfs, 526 cfs, and 722 cfs. The 100-year flooding is shallow with average depths less than 1-foot as it travels southwesterly through a mainly undeveloped open space. The split flow eventually rejoins Colgan Creek near Burgess Drive.

Bellevue Avenue largely contains the 100-year flows along the main channel between the Burgess Drive and Dutton Meadow crossings. However, at several locations along this specific reach, Bellevue Avenue is overtopped by the 100-year storm event. Spill flows exiting the main channel travel southeasterly approximately 2,300 feet before re-entering the main channel of Colgan Creek. Discharge values for the spill were determined by reducing flow in the main channel such that the main channel water surface elevations were approximately equal to the split elevations. Flows were reduced at the upstream most cross-sections in this manner. The 10-, 50-, 100-, and 500-year spill values were calculated to be approximately 49 cfs, 377 cfs, 512 cfs, and 884 cfs, respectively. This split flow is considered to be shallow flooding since average 100-year hydraulic depths are less than 1.0 feet.

The last split flow for Colgan Creek occurs approximately 3,700 feet upstream of Walker Avenue. In this location, flow splits from the main channel before it confluences approximately 2,000 feet downstream. Flow values for the main channel and split flow were determined by balancing energy grade elevations at the upstream split flow locations.

Floodplain and Floodway Mapping

This study provided 100-year, 500-year, and floodway boundaries for Naval, Roseland, and Colgan Creeks. Additionally, the determination of base flood elevations for all Zone AE designations is included. Floodplain limits were delineated using one-foot interval topography at a scale of 1:50.

Naval and Roseland Creeks feature 100-year and 500-year floodplain boundaries that correspond to Zone AE and Zone X special flood hazard areas, respectively. The floodplain boundaries for both creeks are generally contained within well defined vegetated channel areas.

The 100-year and 500-year floodplains for Colgan Creek are contained within the vegetated channel in the upstream portion of the reach. Upstream from the Highway 101 crossing, the spill that occurs to the south as a result of backwater effects from the culvert produces 100-year shallow flooding depths less than 1.0 feet. This area has been mapped as a Zone X with the downstream limit at Yolanda Avenue. Mapping limits were terminated at this location due to Yolanda Avenue being elevated, very shallow 100-year flooding depths (less than 0.5 feet), and local drainage being unaccounted for. Similarly, the split flow areas downstream from Victoria Drive and between Burgess Drive and Dutton Meadow produce 100- year shallow flooding less than 1.0 feet in depth and are also mapped as a Zone X.

The floodways calculated for Colgan, Roseland, and Naval Creeks were based upon equal conveyance reduction from each side of the floodplain. Between cross-sections, the floodway widths were interpolated. In some instances where lined channel reaches contain the 100-year discharge, the floodplain and floodway boundaries are coincident. An example of such a location is along Roseland Creek between Ludwig Avenue and Llano Road.

10.2 Second Revision

This study was revised on February 19, 2014, to include updated hydrologic and hydraulic analysis, and updated topography on Petaluma River, Willow Brook, Corona Creek, Capri Creek, Lynch Creek, Washington Creek, East Washington Creek, and Adobe Creek. This study was performed by WEST Consultants, Inc. under Contract No. HSFEHQ-09-D-0368 Task Order: HSFE09-10-J-0003. The study was completed in April 2011.

The primary reason for the map revision is the construction of the U.S. Army Corps Engineers Petaluma River Floodwall Control Project (USACE Project), which consists of channel improvements, bridge improvements, and construction of a floodwall in the vicinity of Lynch and Washington Creeks. Secondary reasons include updated methodology (hydraulics and hydrology), updated topography, a detailed evaluation of Willow Brook Breakout flow paths, and recent calibration to the New Year's Storm of December 31, 2005.

The Adobe Creek study reach is approximately 2.1 miles long from Petaluma River to the tie-in point upstream of Casa Grande Road (south crossing).

The Capri Creek is approximately 1.4 miles long and is the entire reach.

The Corona Creek study reach is approximately 1.6 miles long, from Petaluma river/Capri Creek to Riesling Road.

The East Washington Creek study reach is approximately 1.1 miles long from Washington Creek to the tie-in point in the Culvert under the Petaluma Airport.

The Lynch Creek study reach is approximately 1.6 miles long from Petaluma River to the tie-in point downstream of Noriel Lane (which does not cross Lynch).

The Petaluma River study reach is approximately 6.6 miles long, from Adobe Creek to Marin Creek.

The Washington Creek study reach is approximately 1.4 miles long from Petaluma River to the tie-in point downstream of Sonoma Mountain Parkway.

The Willow Brook study reach is approximately 0.8 miles long, from Petaluma River to Ely Road.

The Kelly Creek and Thompson Creek flooding sources within the City of Petaluma are not being revised because flooding is still essentially contained in channel.

The North Corona Channel (a ditch along the north side of Corona Road) is being removed as a flooding source in this revision because the majority of flooding in the North Corona Channel area originates from Willow Brook breaking out of bank. Therefore, the floodplain in vicinity of the North Corona Channel will be mapped

as part of the Willow Brook breakout (Zone AE). The North Corona Channel also receives flows from a roadside ditch along Corona Road upstream of the Southern Pacific Railroad. This flow contribution is accounted for in the model.

Data Sources

The City of Petaluma provided 2-foot contour data for the entire City as well as topographic data developed using photogrammetric methods based on data points in two separate layers "ridge points" which were typically found in the lowest and highest areas and "scan points" which were typically evenly spaced in areas that were relatively flat. Areas outside the City coverage were processed using USGS 7.5 minute quadrangle topography with a 10 to 20 foot contour interval. Other elevation data sources included surveyed stream cross section data by Meridian Surveying Engineering Inc. throughout the City, stream cross section survey by Questa Engineering in the Denman Reach (upstream of Corona Road). And stream cross section survey by Prunuske Chatham Inc. for portions of Lynch and Capri Creeks. Additional grading and AutoCAD files were provided by BKF, Inc., and Steven J. Lafranchi & Associates, Inc. All of the above geographic data were combined into a ground surface grid in ArcGIS. Data was provided in the North American Vertical Datum of 1988 (NAVD 88), and the USGS topography was converted to this datum. All cross section data in the XP-SWMM model is based on the North American Vertical Datum of 1988 (NAVD 88). Data sources provided in the National Geodetic Vertical Datum of 1929 (NGVD 29) were converted to NAVD 88 by adding 2.7 feet. This conversion factor was determined using the National Geodetic Survey VERTCON utility (Milbert, 1999).

The City of Petaluma also provided backup data including an inventory of photographs, field notes, and ArcView shapefile describing the watershed basins and soil characteristics, and a Microsoft Access database.

Hydrologic Analyses

Hydrologic analyses were performed to establish peak discharge-frequency relationships for City of Petaluma. Specifically, peak discharge values for the 10-, 50-, 100-, and 500-year recurrence intervals were developed as part of the Study prepared by WEST Consultants, Inc. Flood hydrographs and peak discharge values for the aforementioned flood events were performed using XP-SWMM.

XP-SWMM is a one-dimensional (1D) link-node model capable of modeling surface flow of natural streams/rivers, pipes/culverts, and weirs. The City's XPSWMM model consists mostly of surface water elements. There are two modules of the City's XP-SWMM model – the runoff module which transforms rainfall to runoff at representative nodes corresponding to subbasin concentration points, and the hydraulics module which routes the flow from one node to another by solving the full dynamic wave equation. Model output includes flow hydrographs at all model links and stage hydrographs at all model nodes. These hydrographs are useful in evaluating model results and calibrating to measured stream gage data.

XP-SWMM version May 2010 was used with a 1025 node license. The new version of XP-SWMM called xpstorm was used. This version is identical to XPSWMM except that it does not include the sanitary or water quality modules, which are not part of this study. All references to "XP-SWMM" can be assumed to be interchangeable with "xpstorm".

Hydrologic data in the XP-SWMM model runoff module include rainfall data, catchment geometric characteristics (area, slope, length, impervious percentage), and data specific to the runoff transformation method including Soil Conservation Service (SCS) curve number, time of concentration, initial abstraction and the shape factor. Catchment data in the city of Petaluma model were evaluated with the SCS method for all subbasins.

The SCS curve numbers represent the pervious surface curve numbers. In the urban areas of the City, SCS curve numbers for land classifications "residential" and "mixed urban" were composited based on the impervious percentage of each urban area multiplied by a curve number of 98 and the remainder of the area multiplied by a curve number for open space in good condition. Impervious percentages were not entered directly in XP-SWMM because they have already been accounted for in the formulation of urban curve numbers described above.

The watershed feeding the upper Petaluma River have high quantities of clay and the entire region commonly experiences back-to-back storms that result in saturated antecedent moisture conditions. SCS curve numbers for the Denman Flat, Lichau Creek, and Willow Brook watersheds were increased from antecedent moisture conditions (AMC) II to AMC III to account for the saturated conditions preceding the calibration event.

Precipitation data for the 10-, 50-, 100-, and 500-year, 24-hour storms were originally developed by the Corps of Engineers based on statistical analysis of the Petaluma Fire Station precipitation gage from 1944 through 1986, as presented in the Corps of Engineers 1990 Hydrologic Engineering Office Report. WEST extended this frequency analysis to include the full 95 years of record of the gage (through 2008). Daily precipitation data for

the 95 years of record were reviewed and the water year maximum (Oct 1 – Sept. 30) was included in the frequency analysis. Two additional changes were implemented at the request of FEMA for a more conservative rainfall estimate.

1. Each annual daily maximum rainfall value was multiplied by 1.14 to account for the interval correction between daily rainfall totals (midnight to midnight) and the annual maximum 24-hour period. The factor of 1.14 was recommended by James Goodridge, State Climatologist, retired, as an interval correction factor for this area of California, in place of the default value of 1.13.

2. The 1982 storm depth was increased from the daily gage total of 3.69 inches to the 15-minute gage 24-hour total of 6.40 inches.

Hydraulic Analyses

The XP-SWMM hydraulic data are input to model links. Natural cross section data for links include upstream and downstream elevations (which can be different than node elevations), station-elevation cross section data, left and right bank stations, and Manning's n values and reach length for left and right overbanks and the main channel.

Cross section data is applied differently in XP-SWMM than model such as the Corps of Engineers' HEC-RAS. In XP-SWMM, elevation data from surveyed cross sections is only used to define the cross section shape. This is because cross sections are defined as a reach in XP-SWMM, instead of single location as is the case with HEC-RAS. The elevation of cross section inverts at the upstream and downstream ends of the reach are established by XP-SWMM based on the upstream and downstream elevations entered for the reach, so the cross section inverts for the reach used by XP-SWMM can be different than the invert coded in the cross section shape data. The reach slope is computed internally by XP-SWMM as ((upstream elevation)-(downstream elevation)) / length.

Cross section data in the City's XP-SWMM model were generated from the project ground surface grid and were cut perpendicular to the direction of flow, utilizing survey cross section data where available. For the majority of Petaluma River and Willow Brook, model nodes were defined at locations approximately half way between the surveyed cross sections. The elevations of the nodes were determined by interpolating values along the invert profiles of the survey cross section data. This was an important step because the slope of the cross section reach is defined between nodes and not by the elevations defining the cross section shape.

Bridges were modeled in XP-SWMM using a "User –defined" conduit. The geometry of the cross section at the upstream face of each bridge was evaluated in a side calculation to produce the "User-defined" relationship between depth, area, wetted perimeter, and top width. The areas of piers were subtracted from the available flow area and the low chord elevation of the bridge was modeled by setting the top width of higher elevations to zero and fixing the area for higher elevations to a constant value. If overtopping of the bridge deck was expected, another conduit was added to account for any flow over or around the bridge deck.

Adobe Creek

Adobe Creek is on the southeast side of the City. There is a bypass overflow channel that was included in the model between the north and south Casa Grande Road culverts along the east side of Casa Grande Road. Other potential breakout

flow locations include the north end of Del Oro Circle and Casa Verde Circle. Links were added to XP-SWMM to evaluate flooding depths along these two potential breakout flow paths.

Capri Creek

Capri Creek is located northwest of Lynch Creek. The model reach extends from upstream of Lennox Drive down to the confluence with Corona Creek upstream of Highway 101. A breakout is possible for the 50-, 100-, and 500-year events just upstream of McDowell Boulevard in the left overbank, and for the 500-year event in the right overbank.

Corona Creek

Corona Creek is located northwest of Capri Creek and the model reach extends from approximately 3,000 feet upstream of Riesling Road to the confluence with Capri Creek at Highway 101.

Model results for the 100-year flood indicate a flow direction from the east side of Highway 101 to the west side (Petaluma River side) during peak flow conditions.

There are several locations where breakout flow could occur along Corona Creek. A breakout with depths greater than one foot is possible between Telford Lane and Andover Way for the 100- and 500- year events in the right overbank. Downstream of the Southern Pacific Railroad overflows are possible for the 50-, 100-, and 500- year events to the left into the Petaluma Estates Mobile Home Park and to the right into the Youngstown Senior Mobile home Park.

East Washington Creek

East Washington Creek study reach is from north end of the golf course, under the Petaluma Airport to the confluence with Washington Creek between McDowell Boulevard and Maria Drive. The available storage for the golf course upstream of the airport was entered as a stepwise linear storage relationship. Some of the links also convey flow from the left overbank breakout from the left overbank breakout from Washington Creek at McDowell Boulevard.

Lynch Creek

Lynch Creek is located northwest of Washington Creek. The model reach extends from the north end of the golf course to the confluence with Petaluma River. There are several areas where breakout flow could occur along Lynch Creek. The most upstream breakout is in the vicinity of the golf course. Breakout flow to the golf course occurs for all modeled events (10-, 50-, 100-, and 500-year events). The next four downstream breakouts occur at Sonoma Mountain Parkway, Sheila Street Court, Flanigan Way, and Maria Drive. The

next breakout downstream occurs adjacent to Luchessi Park Lake. This breakout occurred during the New Year's Flood and, in addition, the pond itself overflowed into McDowell Boulevard and across the street into the Plaza North Shopping Center parking lot. The available storage for Luchessi Park Lake was entered as a stepwise linear storage relationship. Links were added to the model to evaluate flooding depth along the potential flow paths – some of these links also convey flow from the left overbank breakouts from Washington Creek.

Petaluma River

The model reach of the Petaluma River extends from the confluence of Liberty and Wiggins Creeks to the City limit downstream of the Adobe Creek confluence near the City limit. Several additional model elements were added to extend the model upstream to include the Liberty, Marin, Wiggins, and Wilson Creek watersheds for hydrologic purposes. The best available topography upstream of the confluence of the Petaluma River and Liberty and Wiggins Creek is USGS 7.5-minute topography at a 10-foot contour interval. Therefore, model cross sections and slopes in this area may not accurately describe the actual stream characteristics.

When the flood peak arrives there is some detention volume available in the Benson and Hummel properties as water overtops Stony Point Road into the Benson property. This detention effect significantly reduces the peak flow rate of the Petaluma River.

The upstream end of the recent USACE project creates a lateral constriction to direct flow away from nearby housing without flooding areas upstream.

The downstream boundary condition for the XP-SWMM model is the Mean Higher High Water (MHHW) tide condition equal to 6.53 feet NAVD.

Washington Creek

Washington Creek is northwest of Adobe Creek and includes a tributary, East Washington Creek. The study reach includes the north end of the Rooster Run Golf Course to the confluence with Petaluma River.

There are some areas of breakout flow that could occur along Washington Creek. The most upstream breakout is located between Sparrow and Songbird Streets in the right overbank for the 100- and 500-year events. A portion of this breakout flow returns to the channel downstream of Ely Road. The next downstream breakout occurs at Rene and Lauren Streets in the right overbank for the 500-year event only, followed by Maria Drive in the right overbank for the 500-year event only. Downstream of East Washington Creek the next breakout is at McDowell Boulevard to the right and left overbanks for the 100- and 500-year events between McDowell and Highway 101. The last breakout for Washington Creek is located at Madison Avenue in the right and left overbanks for both the 100- and 500-year events.

Willow Brook

The Willow Brook model extends from Ely Road to the confluence with Petaluma River. There are several locations where breakout flow occurs downstream of Ely Road. The model was revised to evaluate overflows in the Willow Brook Breakout Area and Old Redwood Highway.

The North Corona Channel (a ditch along the north side of Corona Road) is being removed as a flooding source in this revision because the majority of flooding in the North Corona Channel area originates from Willow Brook breaking out of bank. Therefore, the floodplain in the vicinity of the North Corona Channel will be mapped as part of the Willow Brook breakout (Zone AE). The North Corona Channel also receives flow from a roadside ditch along Corona Road upstream of the Southern Pacific Railroad. This flow contribution is accounted for in the model.

Floodway Revisions

The Petaluma River floodway was revised along the entire floodway length to reflect better topography, to avoid maximum surcharges greater than one foot, and to represent equal conveyance reduction. Floodway revisions followed the FEMA guidelines for performing a floodway analysis using SWMM utilizing HEC-RAS, version 4.1 to calculate the equal conveyance reduction using the peak flow and water surface elevations occurring at a the time of the peak flow from the XPSWMM model. HEC-RAS was not used to calculate water surface elevations, only the equal conveyance reduction per FEMA guidelines. The water surface elevation occurring at the time of the peak flow from the XP-SWMM model was entered at each cross section in HEC-RAS, and a discharge was entered in HEC-RAS so the model would run. The equal conveyance option was selected in HEC-RAS along with a target surcharge at each cross section. The value of the surcharge in HECRAS was adjusted in multiple iterations involving both HEC-RAS and XP-SWMM to yield floodway stations resulting in a surcharge of less than one foot in XPSWMM at the time of the peak flow for each reach.

In addition to the above changes, the floodway was extended upstream of the Willow Brook confluence to the confluence with Liberty and Marin Creeks. The left floodway was widened beyond the left end of cross section because the area between Stony Point Road and Highway 101 is a key detention area.

Downstream of the constriction weir the floodway boundary was not based on equal conveyance reduction because the flow is essentially contained in channel.

Between the constriction weir and Payran Avenue, the floodway is confined to the main channel for consistency with upstream and downstream reaches. Downstream of Payran Avenue to Highway 101 the floodway is coincident with the 100-year floodplain boundary.

10.3 Third Revision

The <date> revision was initiated as a Physical Map Revision (PMR) submitted to FEMA by BakerAECOM for FEMA under Standard Ops Task Order HSFE09-10-J-0002 for Contract No. HSFEHQ-09-D-0368.

This revision involved updating the coastal mapping along the San Francisco Bay shoreline for Marin County. The PMR study area impacts the following 28 printed PMR panels: 0982, 1001, 1002, 1003, 1004, 1008, 1012, 1016, 1017, 1019, 1029, 1031, 1032, 1033, 1034, 1037, 1038, 1039, 1041, 1042, 1043, 1044, 1053, 1061, 1062, 1101, 1102, and 1106.

Detailed flood hazard boundaries were delineated using the National Oceanic and Atmospheric Administration (NOAA) 2010 Northern San Francisco Bay Area LiDAR, collected in February to April, 2010 (NOAA, 2010). The 1% and 0.2% annual chance floodplain elevations were mapped on the NOAA 2010 LiDAR Terrain. Other water bodies not studied on the PMR panels were redelineated based on effective information.

There are several streams not studied for this PMR that fall on the 28 PMR panels that are independent of the North San Francisco Bay, yet flow into its waters. These streams were reviewed for consistency with a 1-Foot resolution DEM created from the 2010 NOAA LiDAR. Portions of Sonoma Creek, Petaluma River, and Adobe Creek from the October 16, 2012 DFIRM were redelineated.

The remaining areas affected by this coastal hazard study have been updated. No significant tie-in issues were encountered in this PMR. The 2010 NOAA LiDAR aided in tie-in adjustment of the flood hazard areas. The location of the transition point from backwater to headwater control on the flood profiles was used as the basis for placement of the zone break between the riverine & coastal AE zones.

10.4 Fourth Revision

This study was revised on <date>, to include a detailed hydrologic and hydraulic study on Todd Creek, Moreland Creek, Hunter Creek, Todd Creek East Fork, Todd Creek Tributary 1, Todd Creek Tributary 2, Naval Creek Tributary 1, and Naval Creek Tributary 2. This study was performed by BakerAECOM. (the study contractor) under Contract No. HSFEHQ-09-D-0368 Task Order HSFE09-09-J-0001. The study was completed in August 2014.

The streams studied by detailed methods in the study for Sonoma County include the following: approximately 3.5 river miles of Todd Creek; from approximately 1700 feet upstream of Petaluma Hill road downstream to approximately 100 feet upstream of Northwestern Pacific Railroad; approximately 1.9 river miles of Hunter Creek; from approximately 1,900 feet upstream of Petaluma Hill Road downstream to the confluence with Todd Creek; approximately 0.9 river miles of Moorland Creek; from approximately 2,000 feet upstream of Todd Road downstream to the confluence with Todd Creek; approximately 1.2 river miles of Hunter Creek; from approximately 800 feet upstream of Petaluma Hill Road downstream to the confluence with Todd Creek; approximately 0.6 river miles of Todd Creek Tributary 1; from approximately 150 feet upstream of Petaluma

Hill Road downstream to the confluence with Todd Creek; approximately 0.5 river miles of Todd Creek Tributary 2; from approximately 100 feet upstream of Petaluma Hill Road downstream to the confluence with Todd Creek; approximately 0.9 river miles of Naval Creek Tributary 1 and 0.6 river miles of Naval Creek Tributary 2; for Tributary 1 from approximately 2,200 feet upstream of South Wright Road downstream to the confluence with Naval Creek and for Tributary 2 from the downstream side of South Wright Road downstream to Merced Avenue.

Hydrologic Analyses

For the study of detailed flooding sources, hydrologic analyses were carried using HEC-HMS model to establish peak discharges having recurrence intervals of 10, 50, 100, and 500 years. No stream gages were available for the streams being studied.

Precipitation was estimated using a synthetic storm distribution with 24-hour duration. Synthetic precipitation depths were obtained from the NOAA Atlas 14 Volume 6 Version 2.0 for California (Reference 10). The precipitation depths were distributed based on the NRCS 24-hour, Type 1A distribution. The SCS Curve Number method was used to reflect precipitation loss.). An S-graph, a dimensionless form of a unit hydrograph, developed in the 1960s by the San Francisco District was used was used for the rainfall runoff in the HEC-HMS modeling. Lag parameters were based on the method by the Los Angeles District of the Corps of Engineers shown in the U.S. Bureau of Reclamation "Flood Hydrology Manual." Hydrograph routing was performed with the Muskingum-Cunge method. The computational methods and techniques used are acceptable procedures for hydrologic analyses and produced results considered reasonable for Sonoma County. No unexpected finds were encountered in carrying out the hydrologic analyses for this Flood Insurance Study.

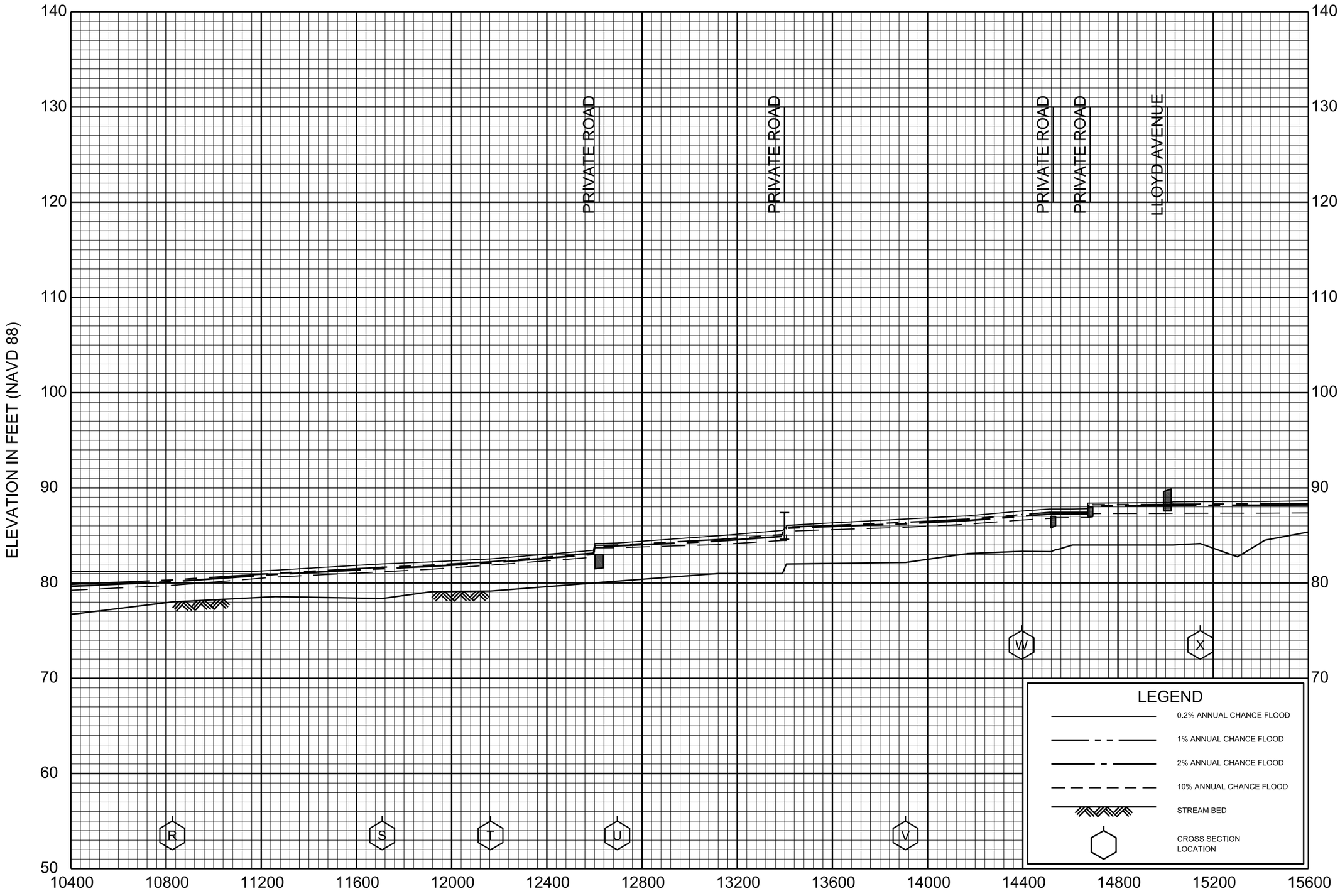
Hydraulic Analyses

The study for Todd Creek, Todd Creek Tributary 1, Todd Creek Tributary 2, Todd Creek (East Fork), Hunter Creek, Moorland Creek, Naval Creek Tributary 1, and Naval Creek Tributary 2 utilized the USACE HEC-RAS Version 4.1 hydraulic model to determine water surface elevations. The hydraulic model revealed open channel capacity issues on Todd Creek upstream of Santa Rosa Avenue. The hydraulic model revealed open channel capacity issues on Hunter Creek approximately 1,000 feet downstream of Petaluma Hill Road. It was determined that the capacity of Todd Creek East Fork is exceeded in two locations along the study reach. In both cases along Todd Creek East Fork, the diverted flow exceeds the channel banks and is regained downstream.

Composite Manning's 'n' roughness values for channel and overbank were evaluated using aerial imagery and site photographs using guidelines established by Ven Te Chow, 1959. The channel 'n' value range was 0.03 to 0.045 and the overbank 'n' value range was 0.04 to 0.08. These values are shown in Table 6.

Floodplain and Floodway Mapping

Detailed floodplain boundaries for the <date> study used the City of Santa Rosa digital terrain data processed by BakerAECOM. All bridge, culvert, and concrete channel geometries were measured in the field in December 2011 and July 2012 by the City of Santa Rosa. All elevations within the <date> study are referenced to the NAVD 88 vertical datum with no conversions necessary.



FLOOD PROFILES

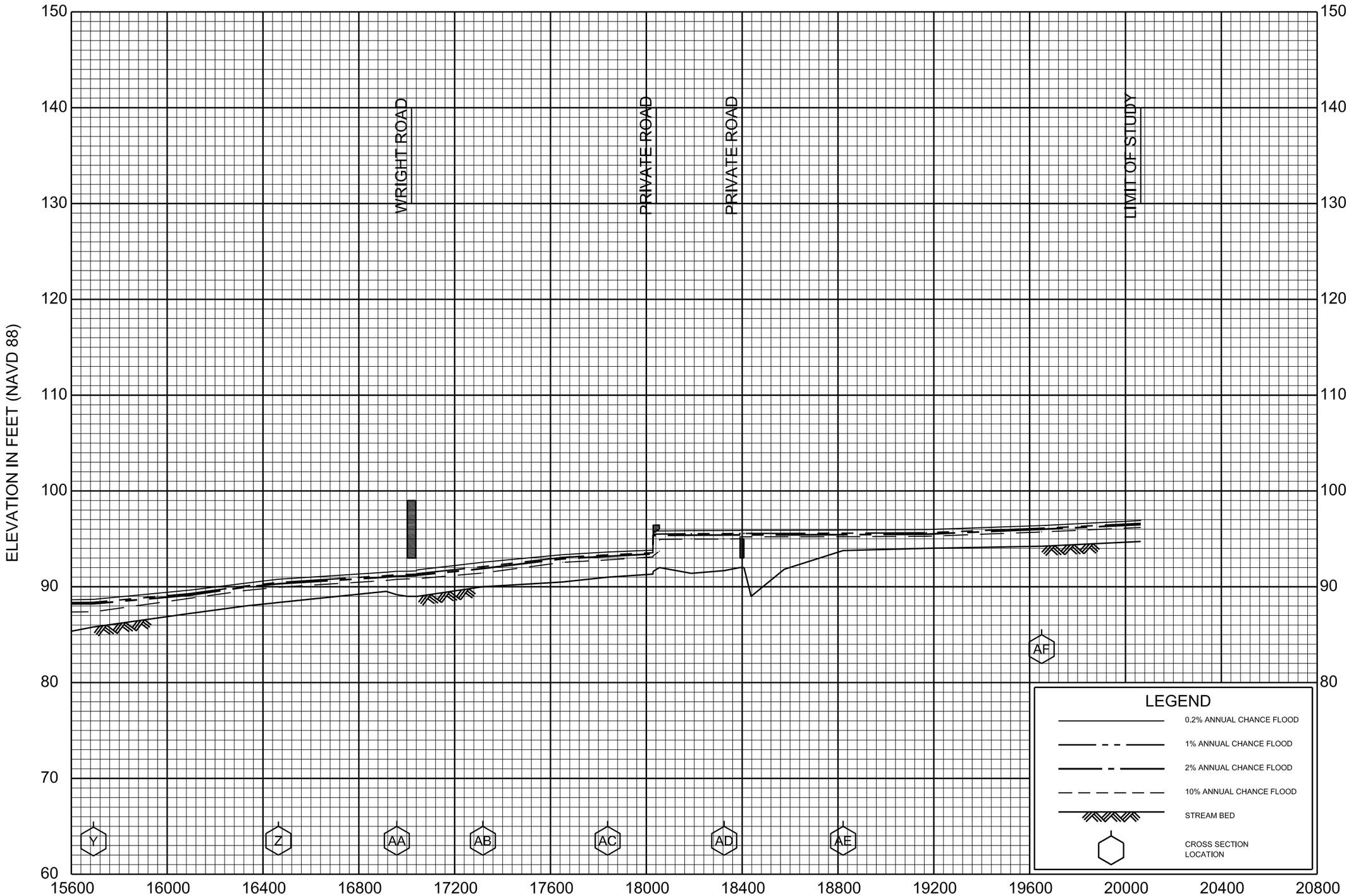
NAVAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND UNINCORPORATED AREAS

192P



FLOOD PROFILES

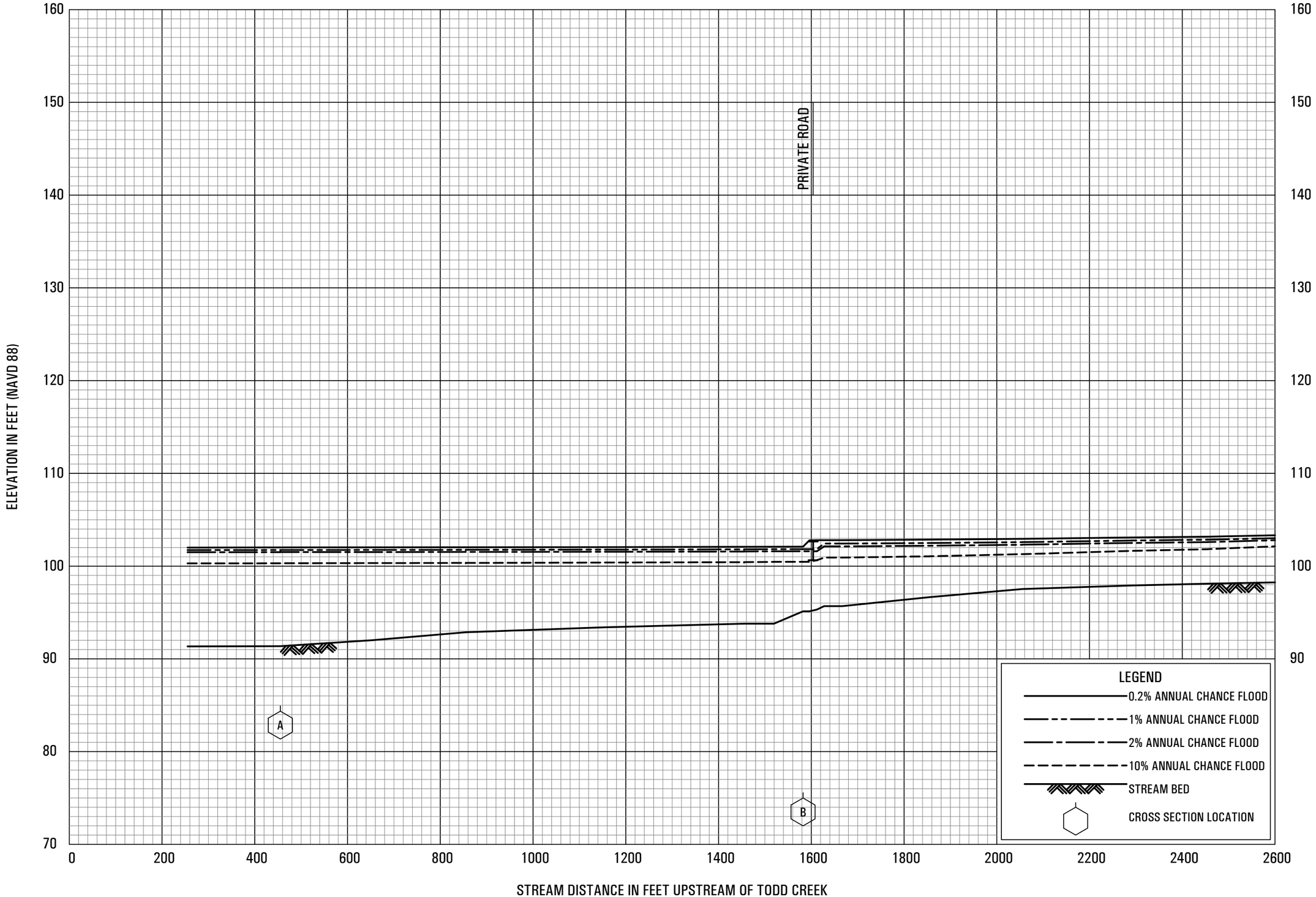
NAVAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND UNINCORPORATED AREAS

192P(a)



FLOOD PROFILES

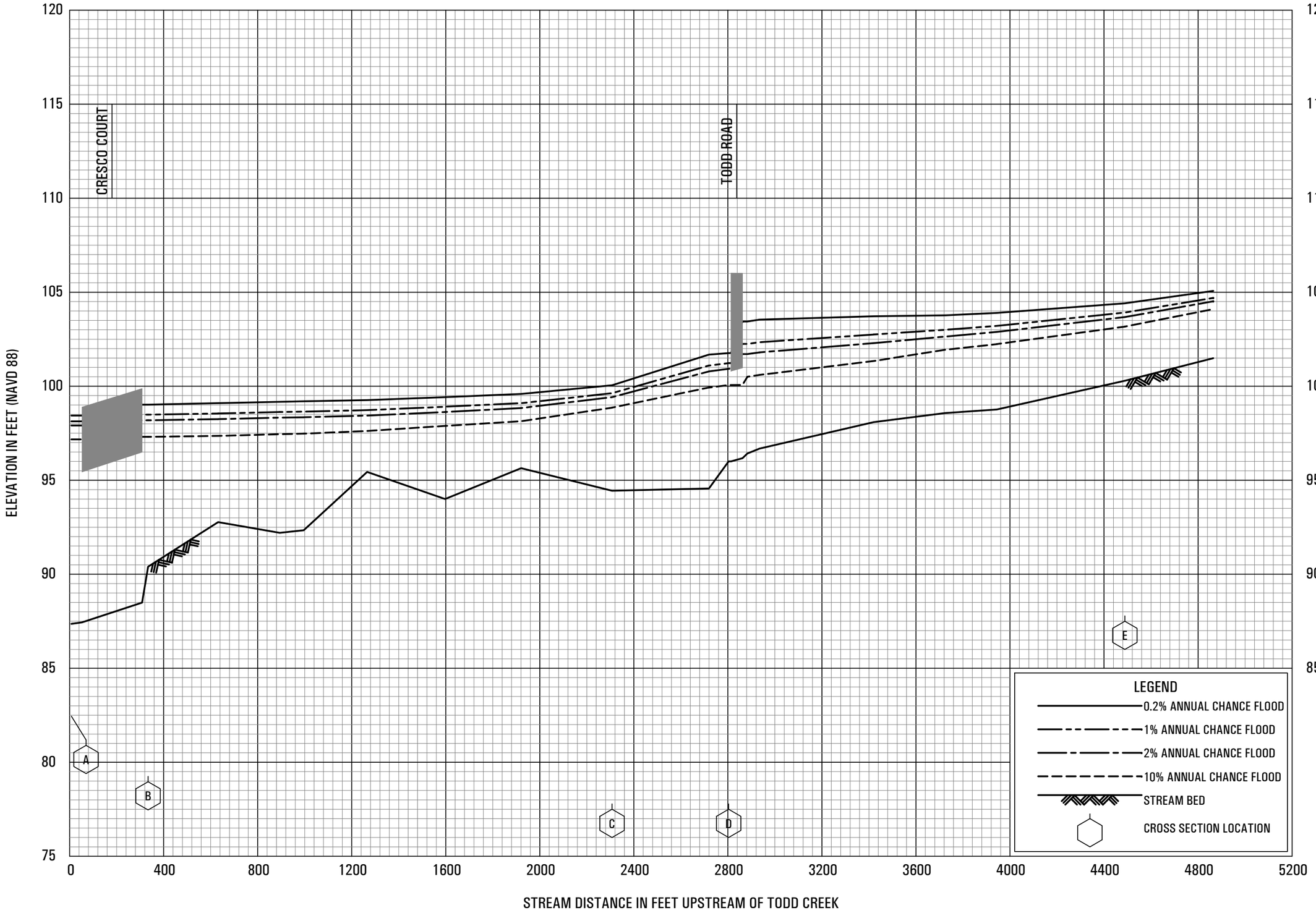
HUNTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

200P



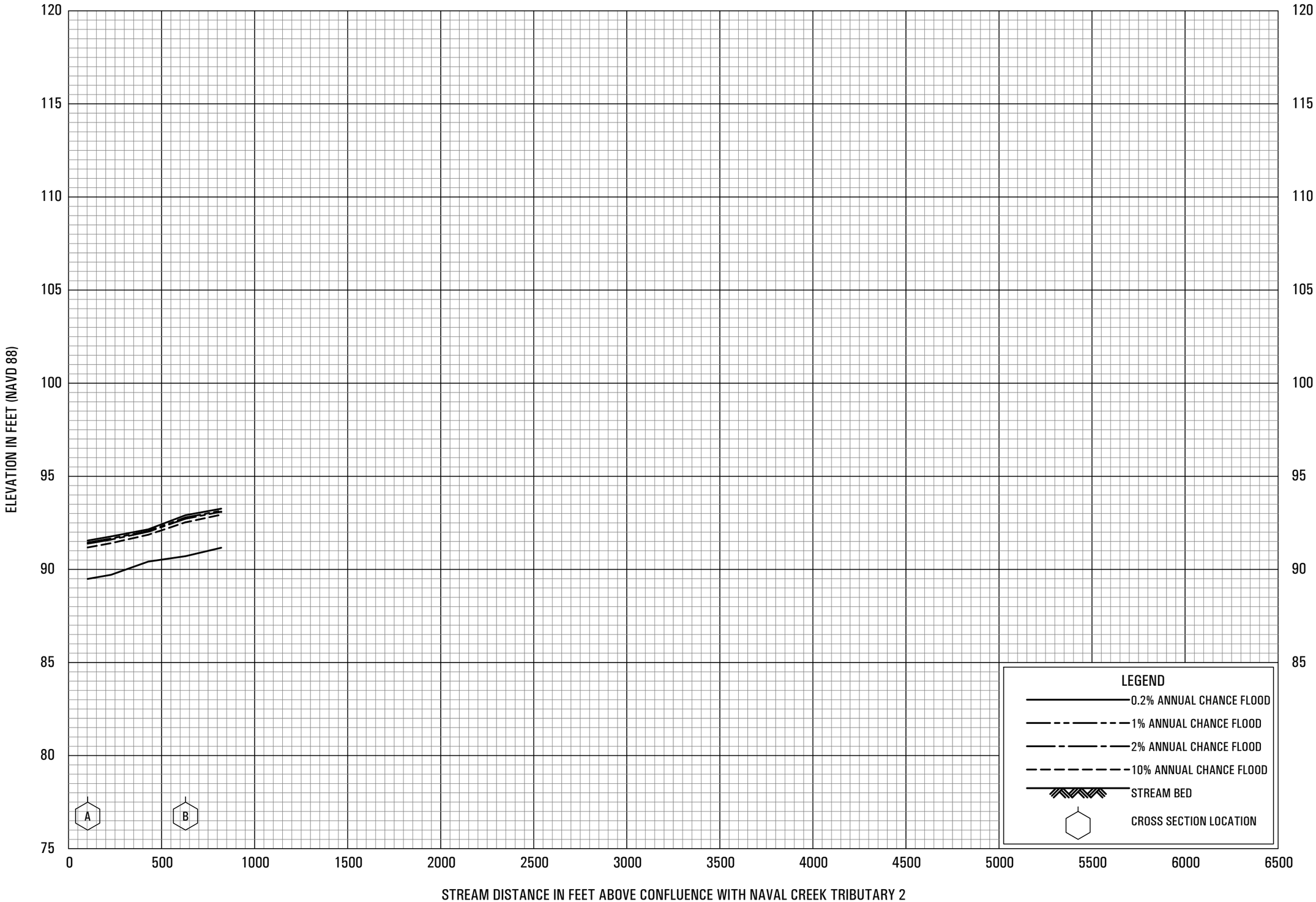
FLOOD PROFILES

MOORLAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

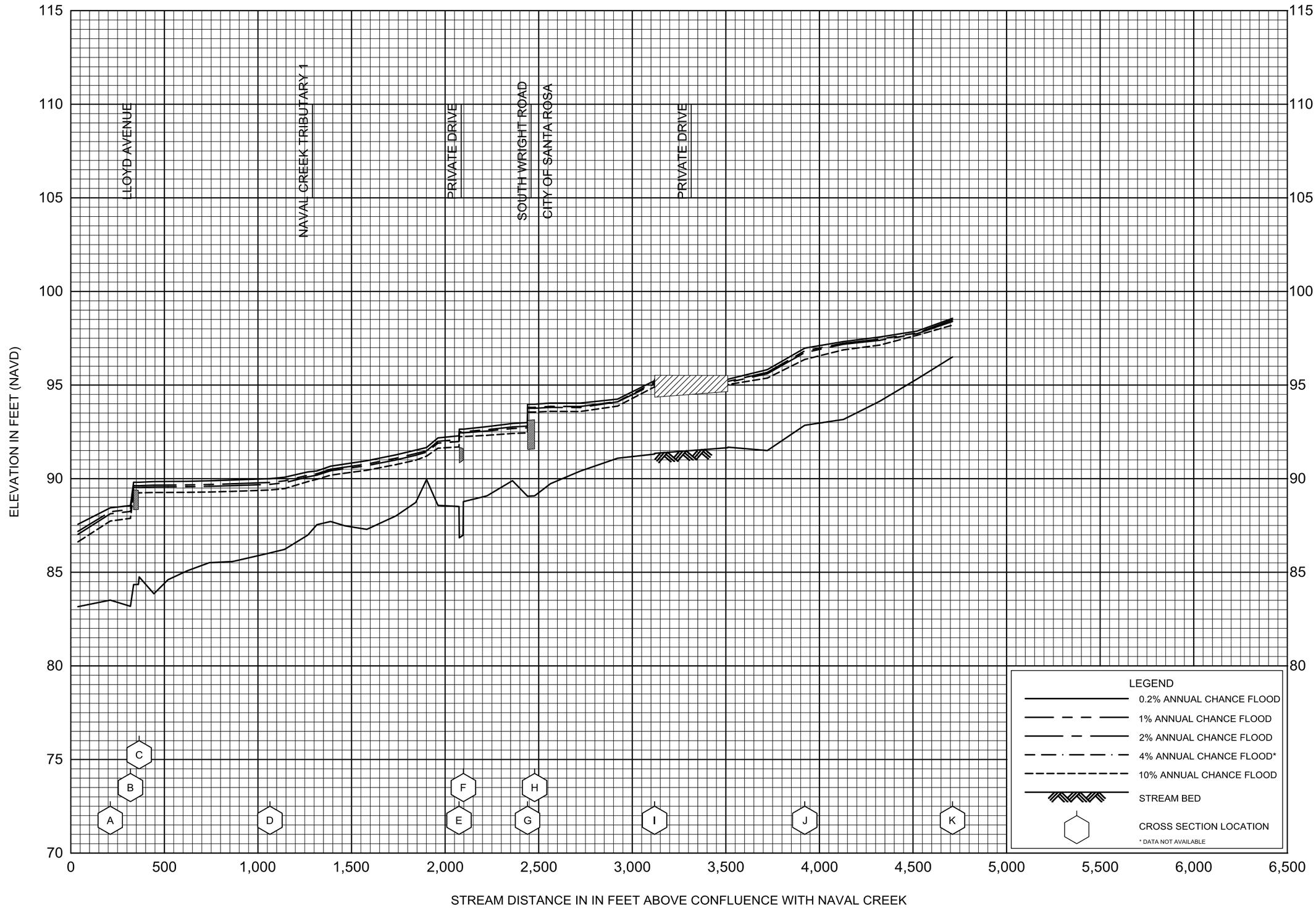
NAVAL CREEK TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

202P



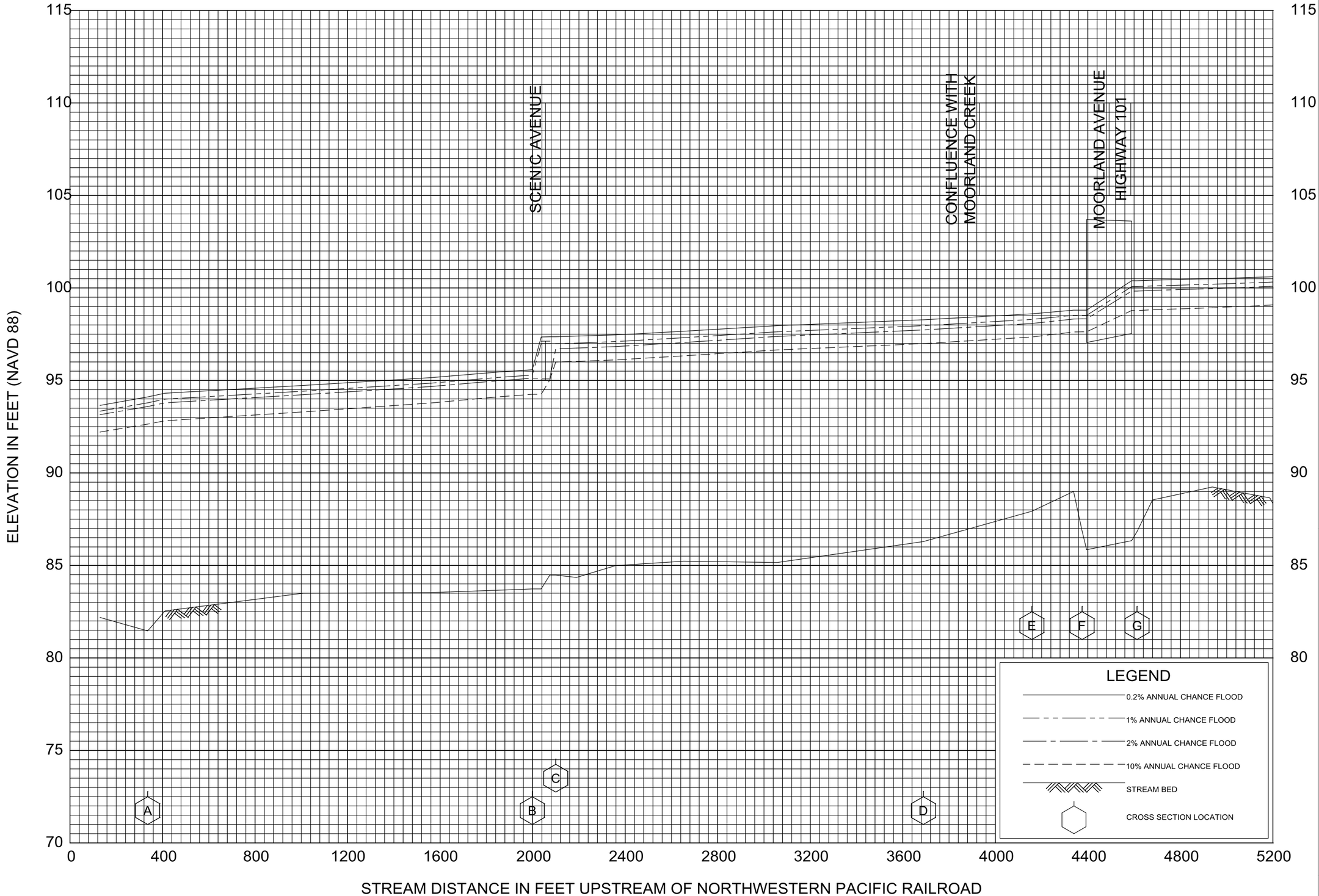
FLOOD PROFILES

NAVAL CREEK TRIBUTARY 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS



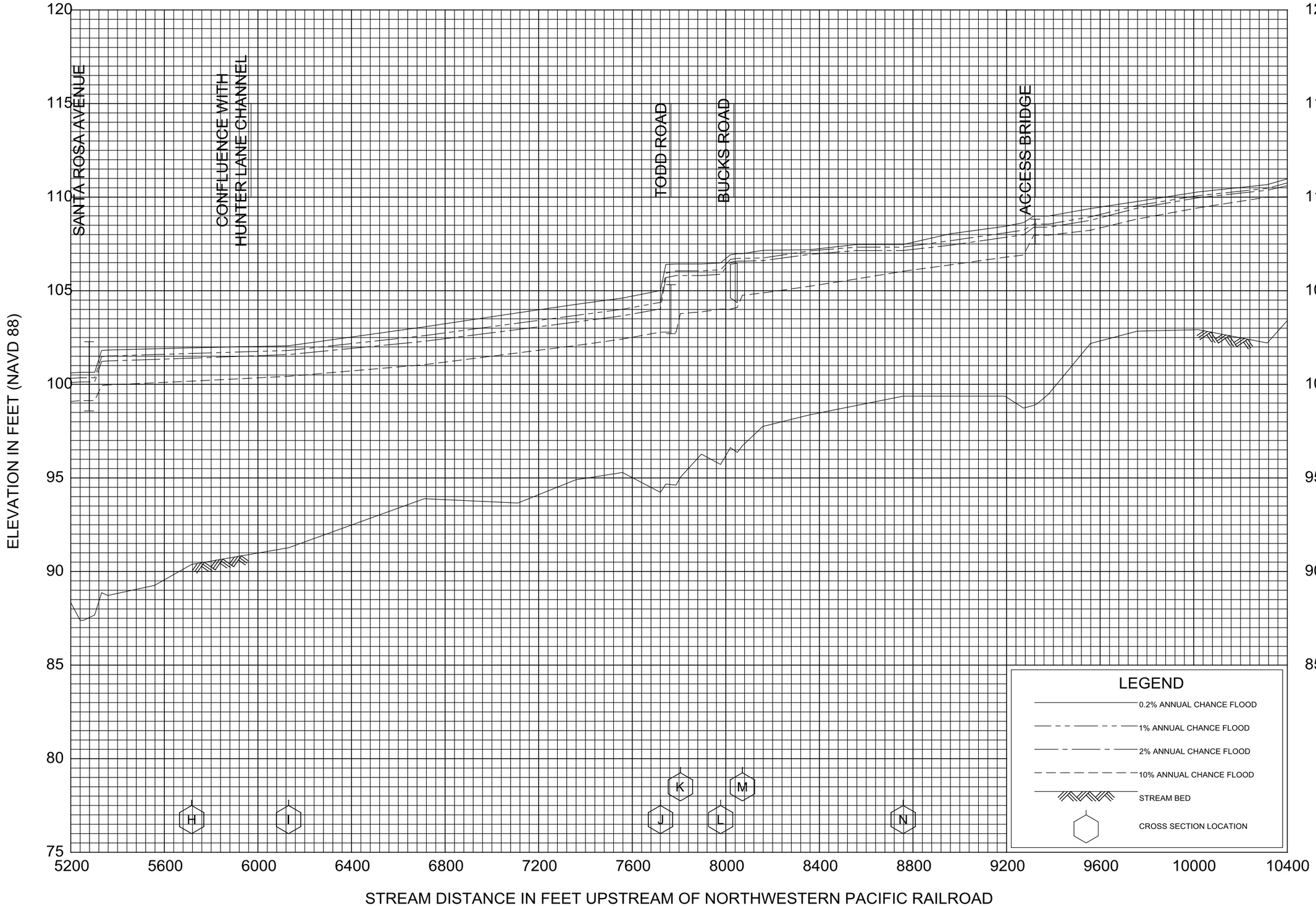
FLOOD PROFILES

TODD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS



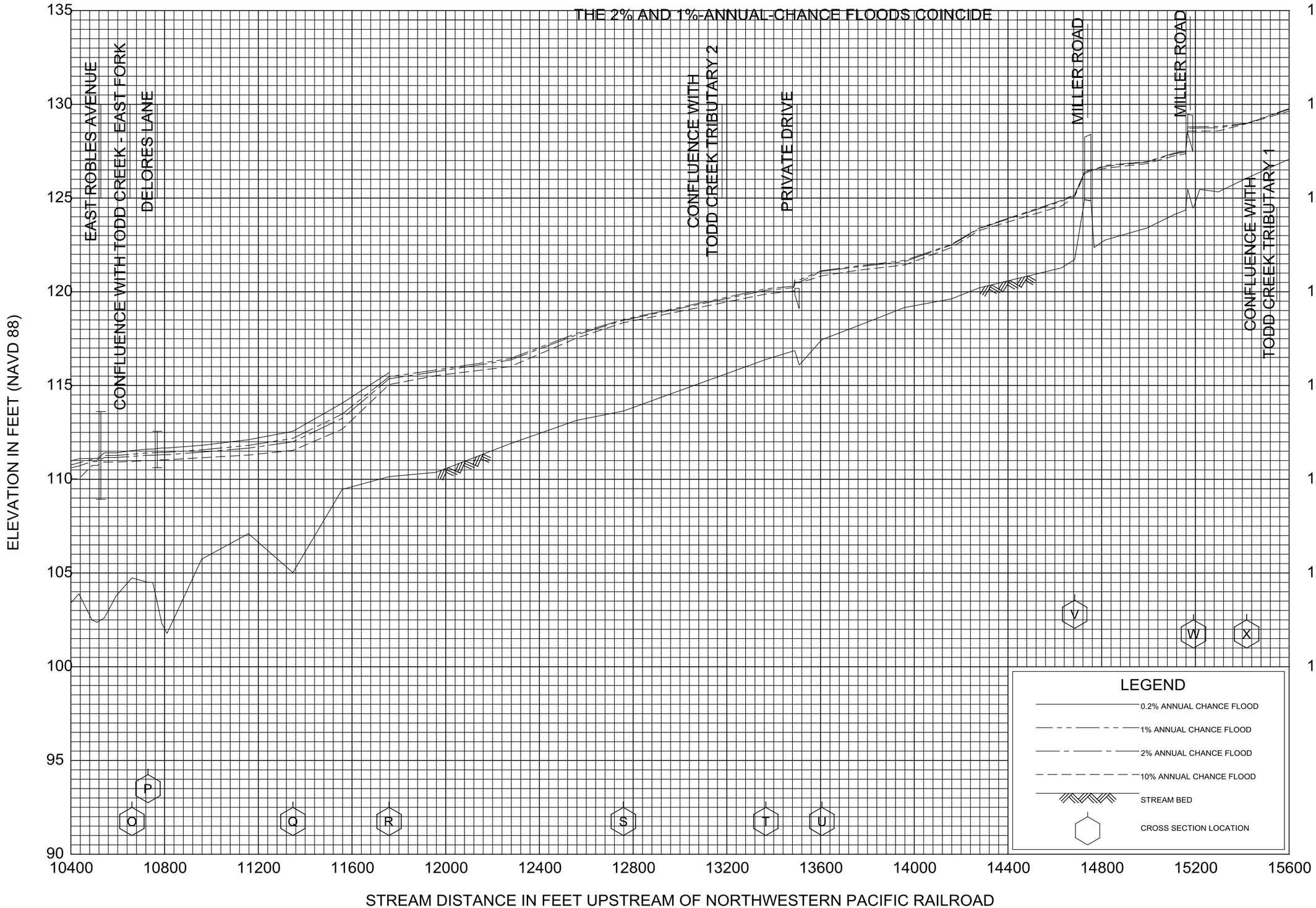
FLOOD PROFILES

TODD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS



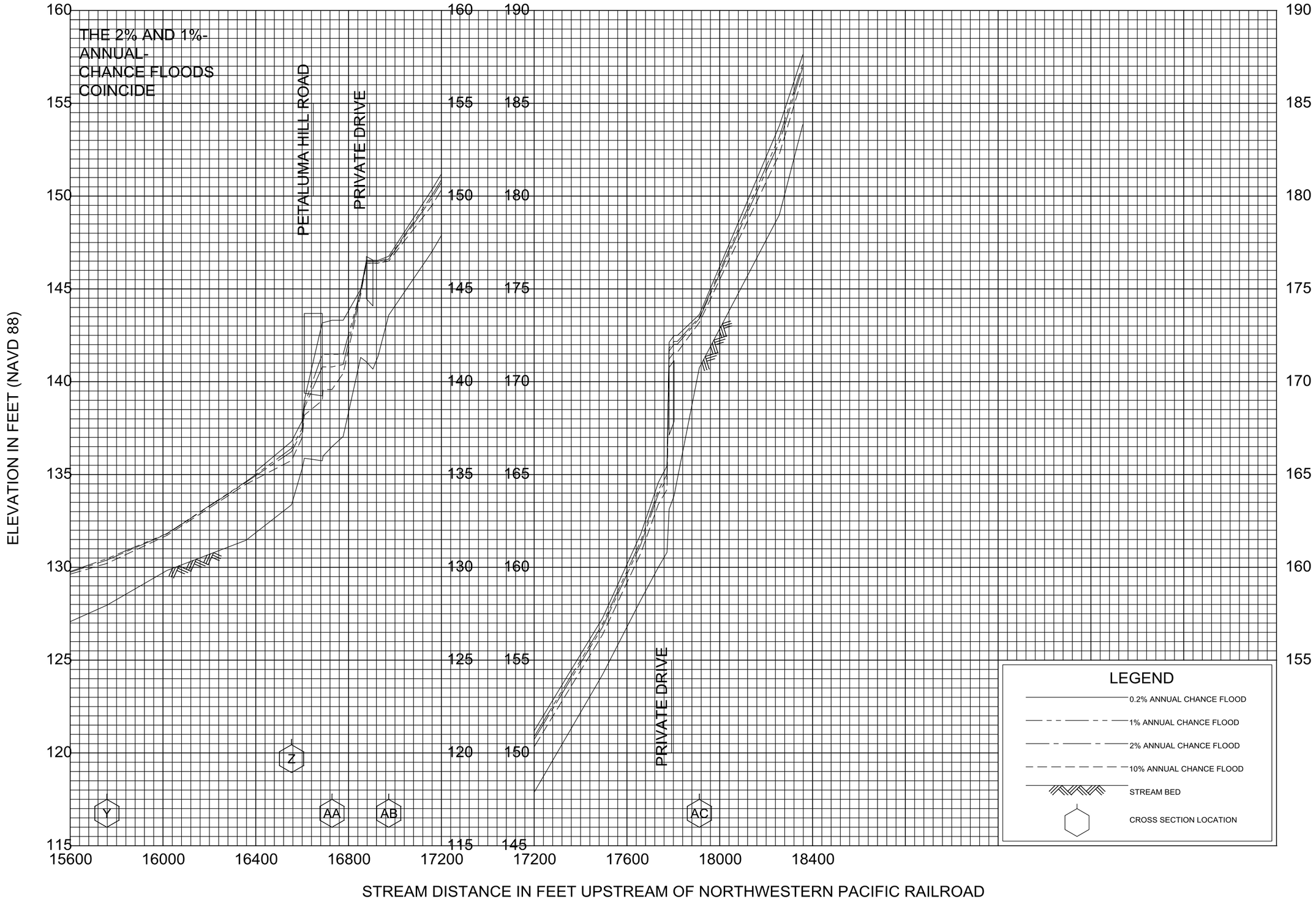
FLOOD PROFILES

TODD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS



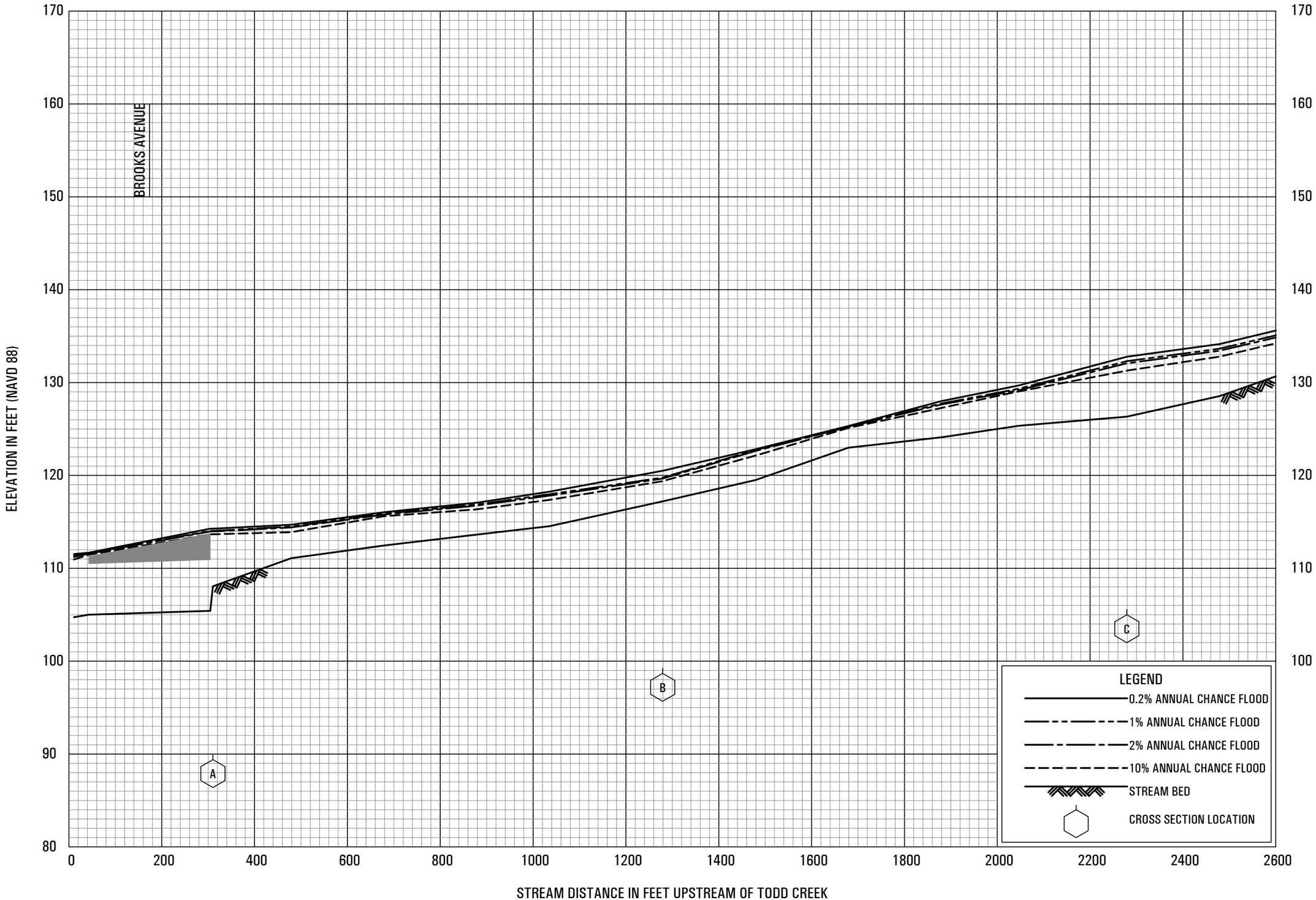
FLOOD PROFILES

TODD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

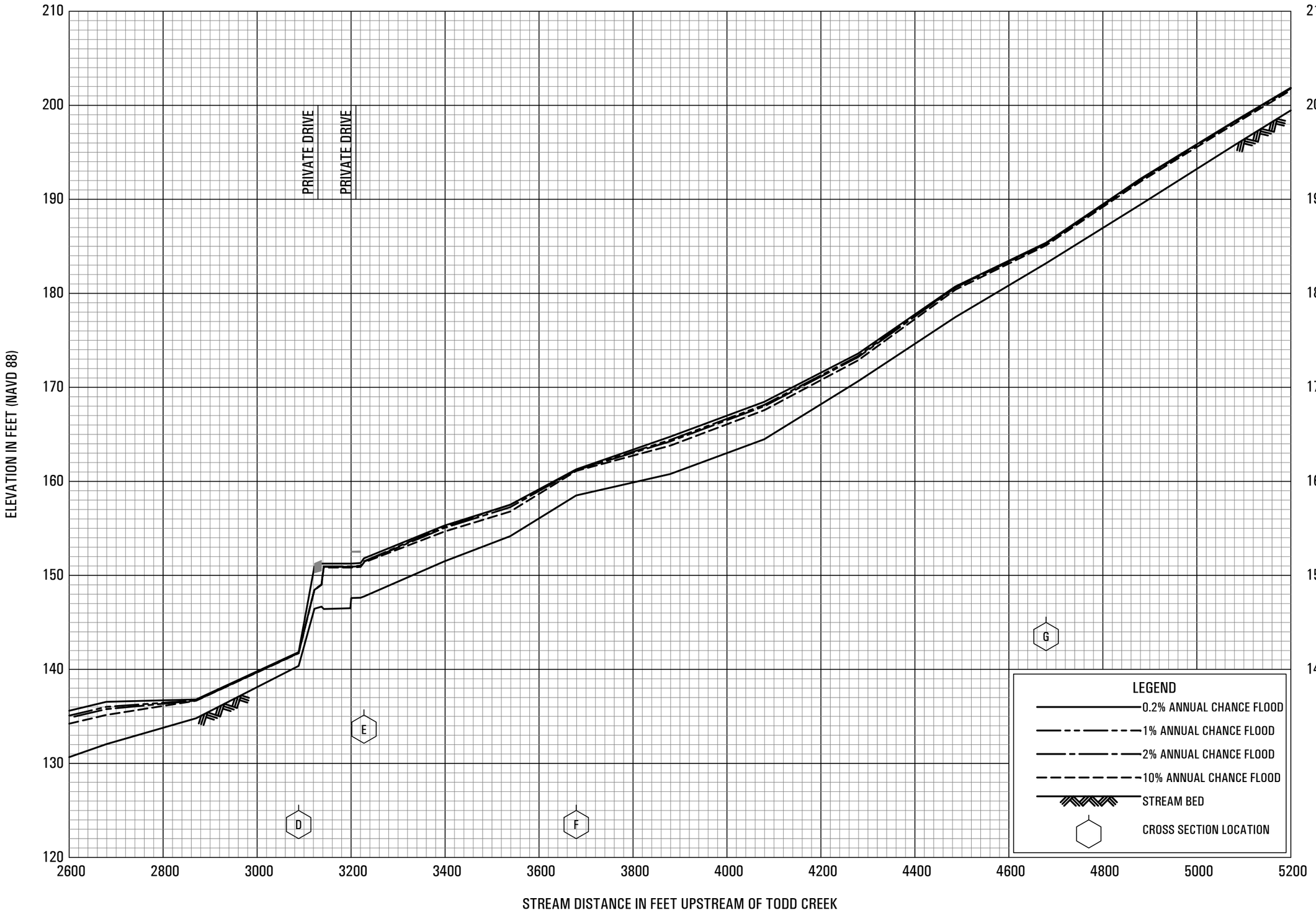
TODD CREEK EAST FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

208P



FLOOD PROFILES

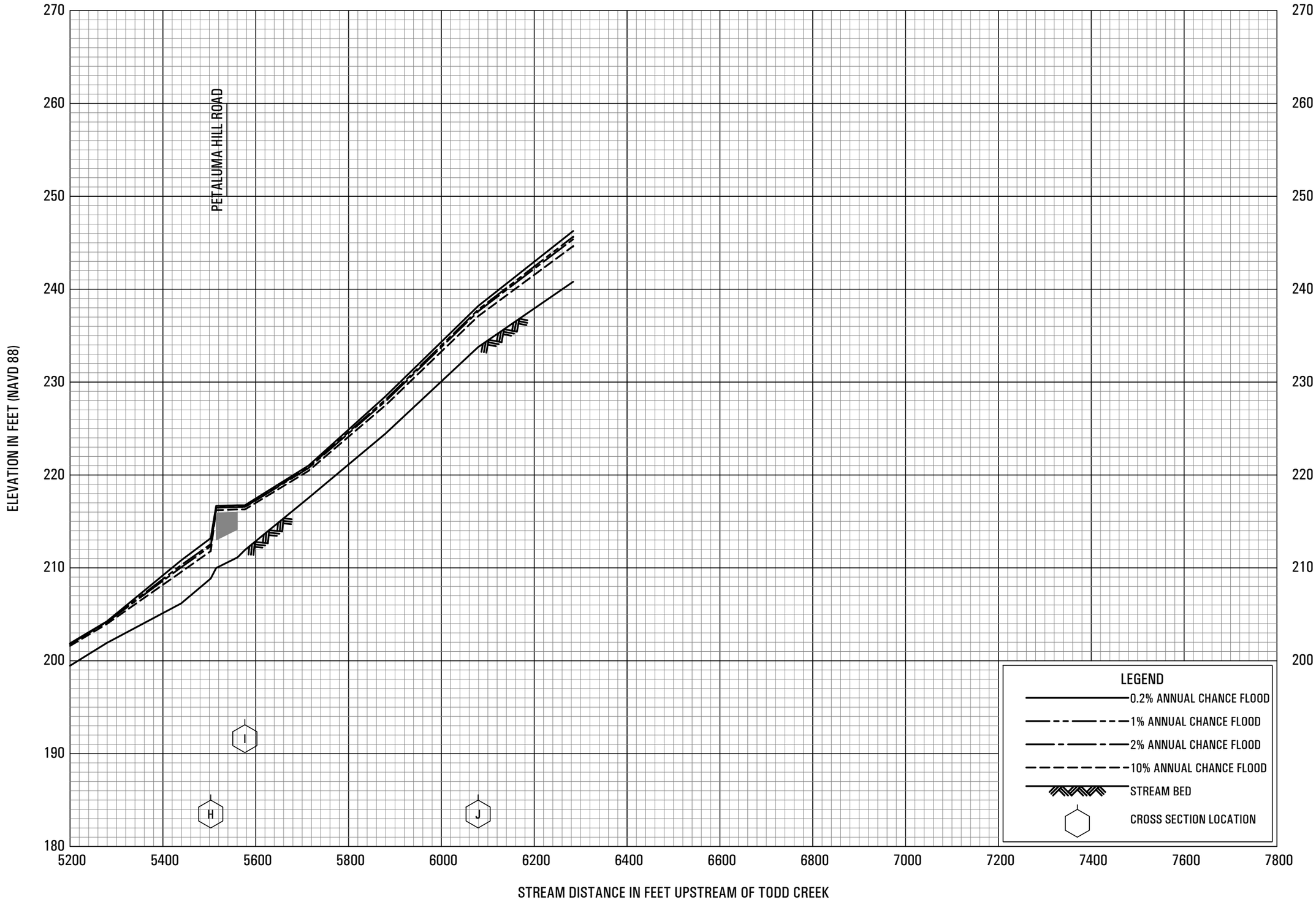
TODD CREEK EAST FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

209P



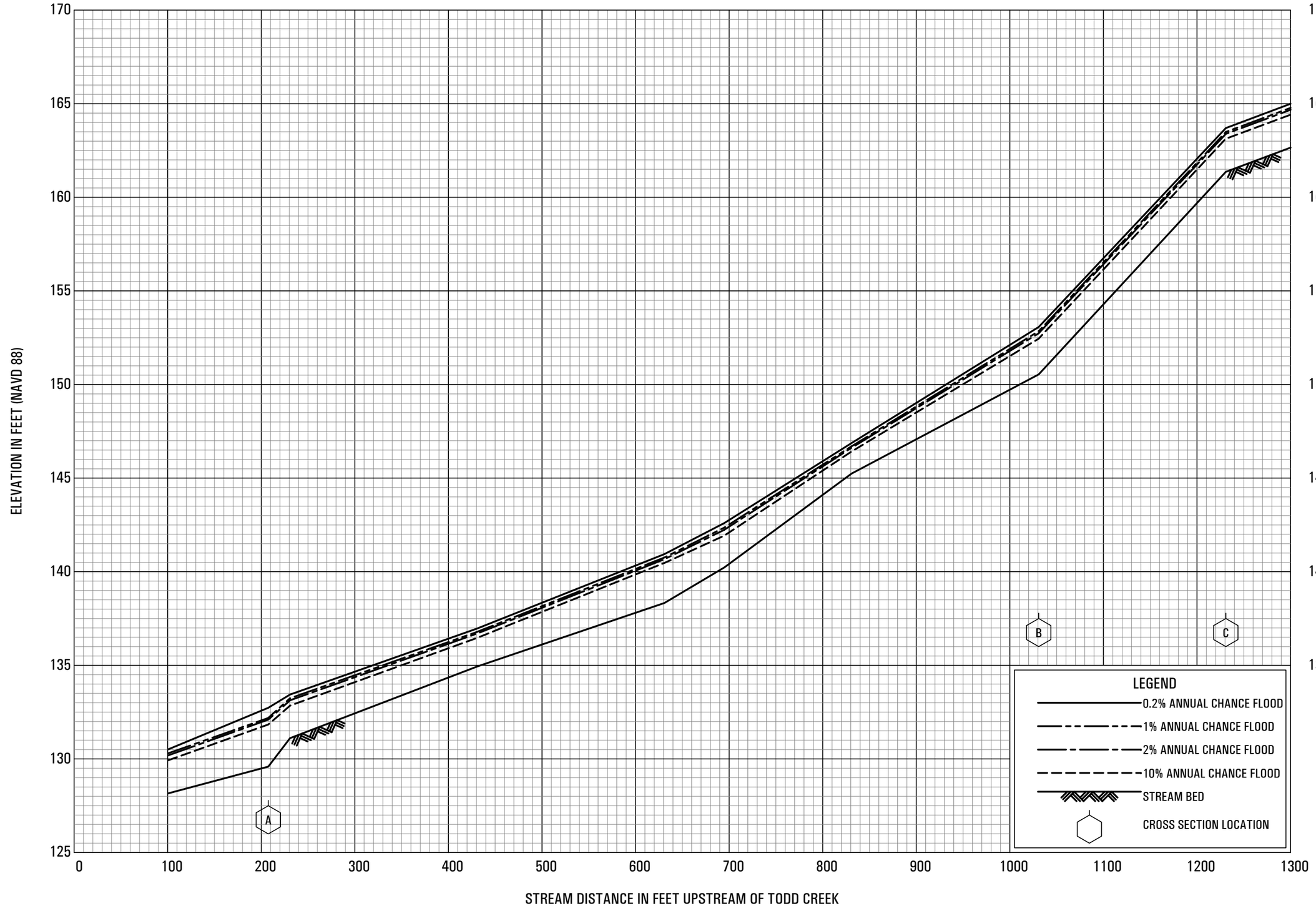
FLOOD PROFILES

TODD CREEK EAST FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

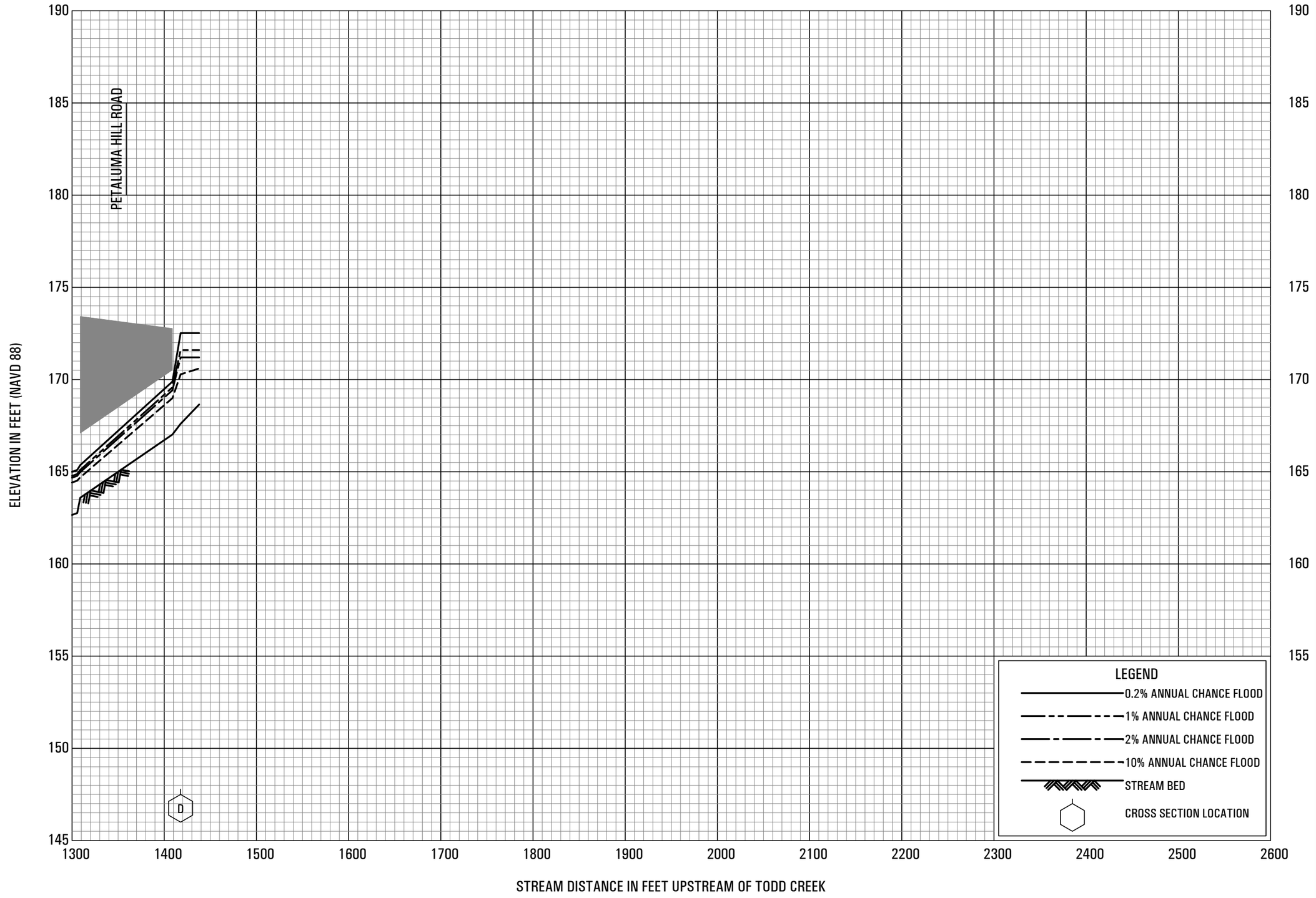
TODD CREEK TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

211P



FLOOD PROFILES

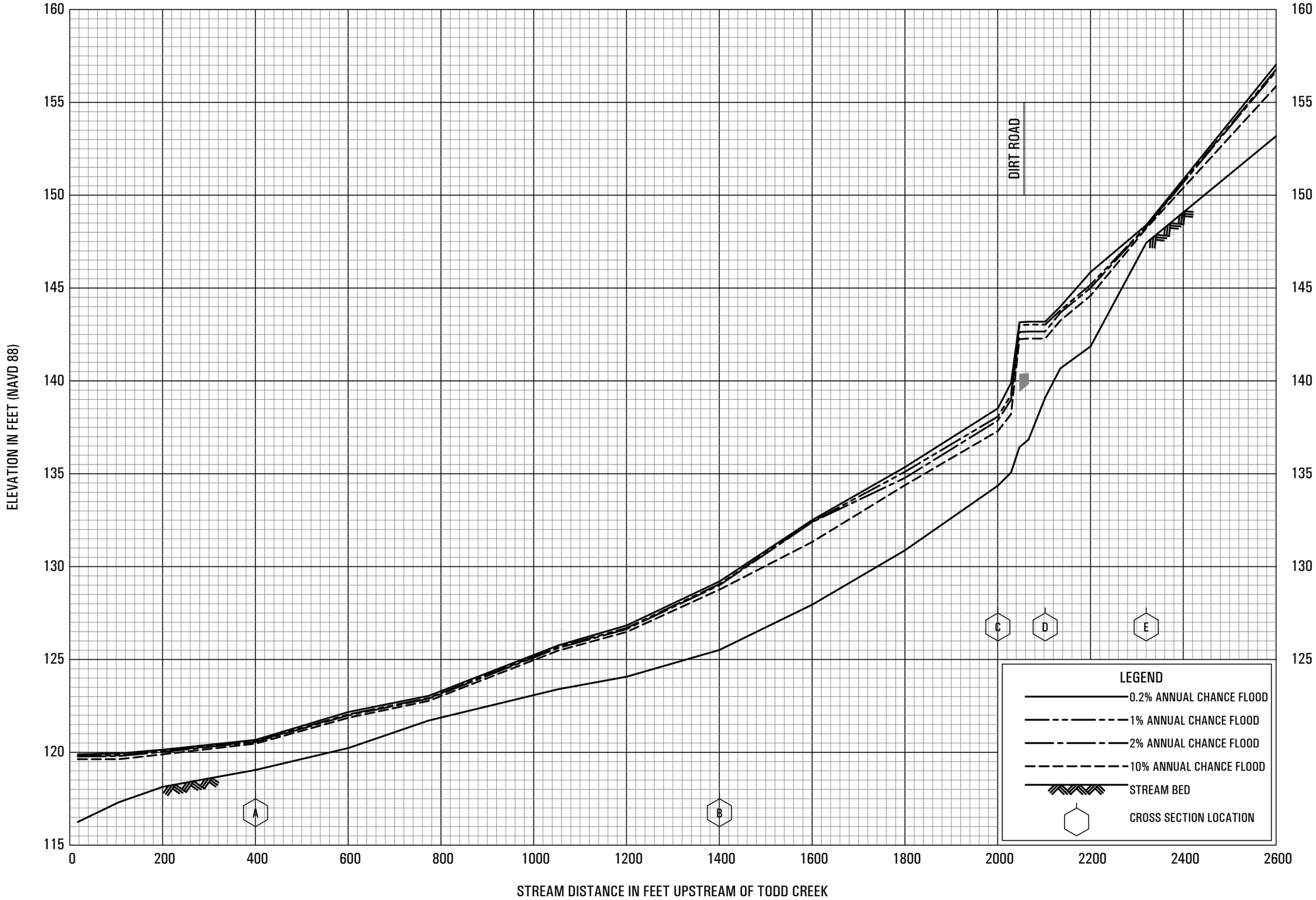
TODD CREEK TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS

212P



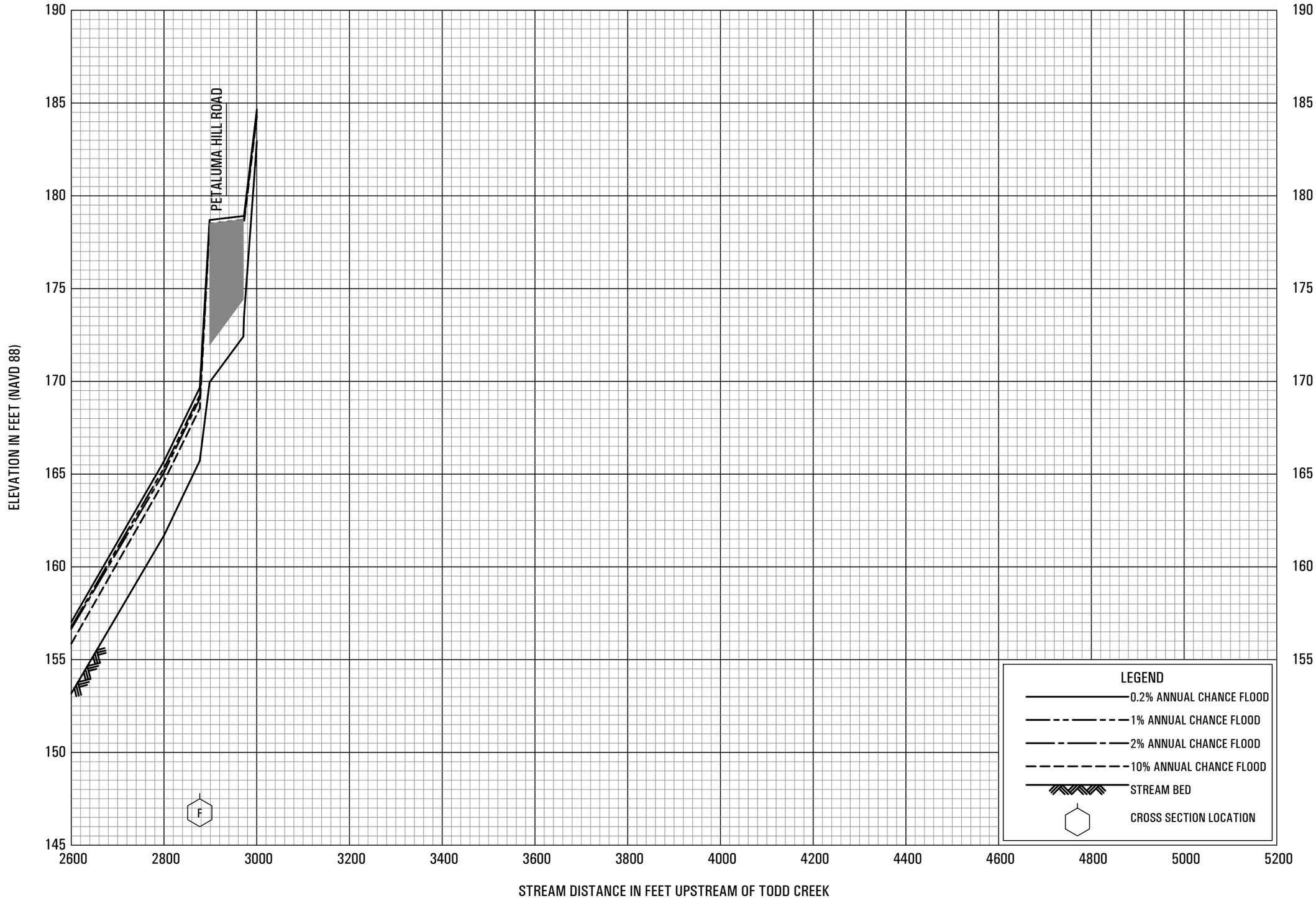
FLOOD PROFILES

TODD CREEK TRIBUTARY 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

TODD CREEK TRIBUTARY 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

SONOMA COUNTY, CA

AND INCORPORATED AREAS