FLOOD INSURANCE STUDY

VOLUME 2 OF 5

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

Community Name	Community Number
ANTIOCH, CITY OF	060026
BRENTWOOD, CITY OF	060439
CLAYTON, CITY OF	060027
CONCORD, CITY OF	065022
DANVILLE, TOWN OF	060707
EL CERRITO, CITY OF	065027
HERCULES, CITY OF	060434
LAFAYETTE, CITY OF	065037
MARTINEZ, CITY OF	065044
MORAGA, TOWN OF	060637
OAKLEY, CITY OF	060766
ORINDA, CITY OF	060722
PINOLE, CITY OF	060032
PITTSBURG, CITY OF	060033
PLEASANT HILL, CITY OF	060034
RICHMOND, CITY OF	060035
SAN PABLO, CITY OF	060036
SAN RAMON, CITY OF	060710
WALNUT CREEK, CITY OF	065070
CONTRA COSTA COUNTY (UNINCORPORATED AREAS)	060025

REVISED
March 21, 2017

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06013CV002C

**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: June 16, 2009

Revised Countywide FIS Dates: September 30, 2015
March 21, 2017

TABLE OF CONTENTS

VOLUME 1 – March 21, 2017

TABLES

TABLE OF CONTENTS, continued

VOLUME 2 – March 21, 2017

FIGURES

TABLES, continued

TABLE OF CONTENTS, continued

VOLUME 3 – March 21, 2017

FIGURES, continued

TABLES, continued

EXHIBITS

TABLE OF CONTENTS, continued

VOLUME 3, continued – March 21, 2017

Exhibit 1 – Flood Profiles (continued)

VOLUME 4

Exhibit 1 – Flood Profiles (continued)

TABLE OF CONTENTS, continued

VOLUME 5 – March 21, 2017

Exhibit 1 – Flood Profiles (continued)

3.2 Hydraulic Analyses

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

Flood elevations were computed using the USACE HEC-2 step-backwater computer program (Reference 44), supplemented by hand calculations and special computer programs where required (Reference 69).

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

<u>City of Antioch</u>

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

Most culverts were analyzed using a separate computer program developed by Tudor that gave a headwater elevation to be used in continuing the backwater analysis upstream.

Cross sections for the backwater analyses were obtained from topographic maps at a scale of 1”:3,600’, with a contour interval of 2 feet (Reference 46) and from grading plans at a scale of 1”:480’, with a contour interval of 2 feet (Reference 47).

East Antioch Creek was analyzed using the available mapping from the Contra Costa County Flood Control District. The scale of the mapping is 1":100' with a 2 foot contour interval and 1":600' with a 5 foot contour interval. The mapping data was supplemented with surveyed cross sections.

Cavallo Drain consists of all closed conduits. Flow through the conduit system was analyzed using Mannings equation with a roughness coefficient of 0.015.

Starting water-surface elevations for East Antioch and West Antioch Creeks were calculated using mean higher high water for the tides at the San Joaquin River. The effects of tsunami induced flooding were considered and found to be insignificant compared to tidal flooding. Starting water-surface elevations for Markley Creek, Hillcrest Branch East Antioch Creek, Los Medanos Wasteway, Middle Branch West Antioch Creek, and West Branch East Antioch Creek were calculated using the slope-area method.

Shallow flooding, with average depths of 3 feet, occurs on West Antioch Creek in the area of Contra Loma Boulevard and Whately Court. Depths were determined by performing weir calculations from the upstream culvert area to the downstream culvert area.

City of Brentwood

There is no hydraulic data available at this time.

City of Clayton

For the original study, water-surface profiles were developed along Mount Diablo, Mitchell and Donner Creeks for the 10-, 2-, 1- and 0.2-percent annual chance floods using the USACE HEC-2 step-backwater computer program (Reference 44). Culverts were analyzed using a culvert computer program based on the Federal Highway Administration methods (Reference 48). Cross section data and work maps were obtained by photogrammetry and supplemented by field survey of bridges and culverts (Reference 49).

Starting water-surface elevations for Mount Diablo Creek were taken from normal depth calculations downstream of the Kirker Pass Bridge. Starting water-surface elevations for Mitchell and Donner Creeks were determined from their respective confluence elevations with Mount Diablo Creek.

Roughness factors (Manning's "n" values) for the hydraulic computations were assigned on the basis of field inspection of the floodplain and channel. Cross sections were photographed and compared with information published by the U.S. Geological Survey (USGS) concerning roughness factors (Reference 50). Roughness values assigned as part of this of this restudy are shown in Table 8 "Manning's "n" Values".

Cross sections for Mount Diablo Creek, Mitchell Creek, and Donner Creek were field surveyed by Allied Engineering Company. Photogrammetry was used in the overbank areas with a clear line of sight. As-built drawings were used throughout the study reaches of Mount Diablo Creek, Mitchell Creek, and Donner Creek. Plans and drawings were obtained from the City of Clayton and Contra Costa County and used as general reference for the hydraulic analysis of Mount Diablo Creek, Mitchell Creek, and Donner Creek (References 51 to 68).

Starting water-surface elevations for Mount Diablo Creek were determined based on normal depth calculations using the slope area method. Starting water-surface elevations for Mitchell Creek and Donner Creek were taken from the Mount Diablo Creek HEC-2 runs.

City of Concord

Water-surface elevations for the 1-percent annual chance flood on Mt. Diablo Creek downstream of Ayers Road account for 1-percent annual chance overflow losses at Ayers Road. Flood elevations were not determined for the 2-percent annual chance flood. The 1-percent annual chance flood elevations were computed using the USACE HEC-2 computer program.

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 69).

Flooding along Walnut Creek was determined to be contained within the levees and channel. Flows along Pine Creek downstream of the BART tracks were determined to be contained within the channel. Flooding on Clayton Valley Drain downstream of Solano Way was determined to be contained within the levees.

Cross sections for the hydraulic analyses were digitized from aerial photographs flown in March 1978 at a scale of 1":12,000' (Reference 70). These data were supplemented by field measurements.

The cross sections were located short distances upstream and downstream of bridges and other hydraulically significant features in order to establish the backwater effect of such features.

Flood profiles were not presented for those stream segments where flooding is contained within channels or levees.

Starting water-surface elevations for Ditch No. 2, Clayton Valley Drain, Mt. Diablo Creek, Pine Creek, and Galindo Creek were calculated using the slope-area method. The starting water-surface elevation for the Farm Bureau Road Drain was determined using culvert and weir analyses at the outlet to the Contra Costa Canal.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed and operate properly.

Where overbank flooding is shallow and hydraulically independent of the adjacent stream channel, channel flood profiles are not applicable. The extent of such overbank flooding was determined by normal depth calculations.

From Ditch No. 2, 0.2-percent annual chance flooding flows northward along Sierra Road and enters Pine Creek upstream of Monument Boulevard.

North of Willow Pass Road, 1-percent annual chance flood boundaries were determined for the levee-protected area west of Walnut Creek where there is less than 3 feet of freeboard between the top of the levee and the 1-percent annual chance flood along Walnut Creek. This flooding was determined using a normal-depth analysis.

Approximate 1-percent annual chance flood boundaries presented along Galindo Creek downstream of Dam No. 1 were determined using the USACE HEC-2 computer analysis (Reference 44).

Approximate 1-percent annual chance flood boundaries were determined in the levee-protected overbank area along Clayton Valley Drain.

Water-surface elevations for the restudied areas were computed using the USACE HEC-2 step-backwater computer program (Reference 128). The depth of sheet flow areas were calculated using Manning's equation.

Roughness factors (Manning's "n" values) for the hydraulic computations were assigned on the basis of field inspection of the floodplain and channel. Cross sections were photographed and compared with information published by the U.S. Geological Survey (USGS) concerning roughness factors (Reference 50).

Cross sections along Galindo and Mount Diablo Creeks were field surveyed by Allied Engineering Company. Photogrammetry was used in the overbank areas where a clear line of sight existed. Plans and drawings obtained from the Cities of Clayton and Concord and from Contra Costa County were used as general reference for the hydraulic analysis of Galindo and Mount Diablo Creeks (References 51-68, 129-159). Starting water-surface elevations for Galindo and Mount Diablo Creeks were determined based on normal depth calculations using the slope-area method.

The 1- and 0.2-percent annual chance flood boundaries shown on the Flood Insurance Rate Map have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using aerial topographic mapping at a scale of 1"=400' with a contour of 4 feet, which was prepared for this restudy (Reference 160).

Town of Danville

Water-surface elevations and capacity of natural channels were computed using the USACE HEC-2 step-backwater computer program (Reference 22), supplemented by hand calculations and special computer programs developed by the study contractor, where required (Reference 36). Cross sections for backwater analyses were located short distances upstream and downstream of hydraulically significant features in order to establish the backwater effect of such features. For manmade prismatic channels, elevations and capacities were computed by using the direct step-backwater computer program (Reference 71).

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 36). Manning's equation was used to determine the capacity of long, uniform, concrete channels.

Cross sections and topographic mapping were obtained through aerial photogrammetric techniques. Digitized cross sections were provided by the mapper at preselected locations; contour mapping was provided at a scale of 1”:3,600’, with a contour interval of 2 feet (Reference 72). Field measurements were used to supplement the available data.

For San Ramon Creek and segments of Sycamore and Green Valley Creeks, it was determined that the 1-percent annual chance floodflow is either contained within the channels or results in shallow flooding. Therefore, profiles will not be presented for these segments.

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

Starting water-surface elevations for all streams were determined by normal-depth analysis.

Water-surface elevations for the restudied areas were computed using the USACE HEC-2 step-backwater computer program (Reference 128).

Roughness factors (Manning's "n") for the hydraulic computations were assigned on the basis of field inspection of the floodplain and channel. Cross sections were photographed and compared with information published by the U.S. Geological Survey (USGS) concerning roughness factors (Reference 50).

Most of the structures and cross sections in the upper portion of the reach were field surveyed by Allied Engineering Company. Photogrammetry was used in the overbank areas where a clear line of sight existed. Other cross sections and the Interstate 680 culvert routine were taken from information generated by the USACE (Reference 161). In areas where the USACE mapping did not fully cover the floodplain, Questa obtained aerial photo diapositives from USACE and extended the topographic mapping to cover the floodplain area. The scale and contour interval utilized by USACE in their mapping was maintained in these extended areas. Plans and drawings obtained from the Town of Danville and Contra Costa County were used as reference (References 162-164).

Starting water-surface elevations at the headwater of Interstate 680 were obtained by utilizing the original USACE model with CCCFCWCD flows. The initial boundary conditions in the model have limited effect on the floodplain delineation because the channel invert and slope change very quickly. Any effect from starting water surface elevation assumptions is quickly lost.

The 1- and 0.2-percent annual chance flood boundaries shown on the Flood Insurance Rate Map have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using aerial topographic mapping at a scale of 1"=400', with a contour interval of 4 feet, which was prepared for this restudy (Reference 165).

City of El Cerrito

Analyses of the hydraulic characteristics of Cerrito Creek in the city are carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the stream studied in detail. Water-surface elevations of floods of the selected recurrence intervals were determined. These were based on routing runoff hydrographs of the various flood events. The computations were manually done. Cross sections for the hydraulic analyses of the stream were field surveyed at key points, and culvert sizes and elevations were also determined.

Channel roughness factors (Manning's "n") for these computations were assigned on the basis of field inspection of flood plain areas.

City of Hercules

Cross sections for backwater analyses were located short distances upstream and downstream of bridges and other hydraulically significant features in order to establish the backwater effect of such features. Most culverts were analyzed using a separate culvert analysis computer program (Reference 69), which gave a headwater elevation to be used in continuing the backwater analysis upstream. Topographic maps from the City of Hercules (References 73 and 74), as well as maps and drawings (References 75 and 76), were used to generate the cross sections. Field measurements were used to supplement the available data.

On Refugio Creek, between Interstate 80 and Sycamore Avenue, elevations were based on recent channel improvements and grading plans.

Starting water-surface elevations for Refugio and Pinole Creeks were obtained from a mean higher high water for San Pablo Bay. Starting water-surface elevations for West and East Branches Refugio Creek were determined using the normal depth at their confluences with Refugio Creek.

Tidal elevations for tidal floods of the selected recurrence intervals were obtained by extrapolating the existing U.S. Coast and Geodetic Survey data and correlating the data from various gages (References 36 and 37). Starting water-surface elevations in San Pablo Bay concurrent with floods of the selected recurrence intervals were set at mean higher high water. The effects of tsunami-induced flooding were considered and found to be insignificant compared to tidal flooding.

In approximate study areas subject to tidal flooding, numbered insurance zones have been assigned on the basis of detailed tidal water-surface data; no wave studies have been performed. The aerial extent of potential wave action (Zone V) was determined by approximate methods only.

City of Lafayette

Water-surface elevations for all streams studied in detail, except North Branch Reliez Creek, were computed using the U.S. Army Corps of Engineering HEC-2 step-backwater program (Reference 44), supplemented by hand calculations and a special computer program developed by the study contractor (Reference 69). Most culverts were analyzed using this special computer program, which calculated a headwater elevation to be used in continuing the backwater analysis. North Branch Reliez Creek water-surface elevations were obtained from normal-depth calculations. It was determined that all flows for North Branch Reliez Creek will be contained in the channel.

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

Cross section locations and overbank ground elevations were obtained from topographic maps at a scale of 1”:3600’ with a contour interval of 2 feet (Reference 46). Underwater data were obtained from field measurements made by the U.S. Geological Survey in 1972.

Roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of field inspection of flood plain areas. The values used for the channel and overbank areas are shown on Table 8, "Manning's "n" Values".

Starting water-surface elevations were determined for the streams in Lafayette using four methods. Normal-depth calculations were used for North Branch Reliez Creek. For Reliez Creek, Happy Valley Creek, Lafayette Creek, Jonas Hill Creek, and Grizzly Creek, the slope-area method was used. The headwater elevation calculated in the culvert analysis was used for Hidden, Valley Creek. The starting water-surface elevation for Las Trampas Creek was taken from the backwater analysis of that stream for the Contra Costa County Flood Insurance Study (Reference 8).

Some of the culverts on Happy Valley Creek, Hidden Valley Creek, Lafayette Creek, and Grizzly Creek will not contain the 1-percent annual chance floodflow. The result will be shallow flooding above these culverts and/or along the roads. Shallow flooding depths were determined from critical-depth calculations, using the overflow discharge given by the backwater analysis (Reference 44). Shallow flooding elevations were taken from the backwater analysis.

The hydraulic analyses for the revised streams were performed using the HEC-2 step-backwater hydraulic computer model. Channel cross sections for the detailed analyses were obtained from previous completed HEC-2 models, as-built plans, and infield surveys conducted by Allied Engineering. Roughness coefficients (Manning's "n") used for the hydraulic computations were based on field inspection of the flood plain and channel. The data to define the dimensions for the hydraulic structures were obtained by field surveys or as-built plans supplied by local agencies. These agencies are the USACE, CCCFCWCD, City of Walnut Creek, California Department of Transportation, and U.S. Department of Agriculture, NRCS.

The starting water-surface elevation for Las Trampas Creek was based on the computed 1- percent annual chance water-surface elevation for Walnut Creek at the confluence of San Ramon Creek and Las Trampas Creek. Backwater from Las Trampas Creek affected Reliez Creek between its confluence with Las Trampas to approximately 50 feet upstream of the confluence.

The 1- and 0.2-percent annual chance flood plain boundaries and the 1-percent annual chance floodway boundary for Las Trampas Creek were delineated on Questa Engineering Corporation, Cal Aerial Surveys contour maps at a scale of 1"=400', with 4-foot contour intervals.

Reliez Creek was studied using detailed methods from approximately 150 feet downstream of Tunnel Road to approximately 3,340 feet upstream of Stanley Boulevard, a total distance of approximately 7,460 feet, within the City of Lafayette. In general, flow capacities at crossings cannot convey 1-percent annual chance peak flows and force significant overbank flooding to occur along portions of Reliez Creek

Reliez Creek overflow was studied using approximate methods for 4,860 feet from Pleasant Hill Road, where it splits from Reliez Creek, to where it rejoins the main channel at approximately 380 feet upstream of Highway 24. The downstream area (approximately 750 feet) of the overflow is shown as backwater from Reliez Creek.

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in Table 13, "Floodway Data," in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or flood plain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross sections for the restudied stream were compiled photogrammetrically and by field survey in areas of dense vegetation and at stream crossings. Hydraulic structure dimensions were determined using as-built construction plans and field measurements.

Channel roughness factors (Manning's "n" values) were assigned to the channels and overbanks using photographs obtained from field visits and the methodology described in U.S. Geological Survey (USGS) Water Supply Paper 2339 (Reference 118).

The USACE HEC-2 program (Reference 183) was used to determine water surface elevations for the 1-percent annual chance flood event. Starting water surface elevations were established using the effective study elevations for Reliez Creek downstream of the study reach (Reference 184).

In order to determine the location at which the overflow from Pleasant Hill Road returns to the main channel, a separate HEC-2 model of the overbank area was developed using topography at a scale of 1"=100', with a contour interval of four feet. From this topography, it was evident that the overflow would extend no farther to the west than the north-south running portion of Pleasant Hill Road. Because of the vertical height of Highway 24, it was clear that all overflow not already returned to the main channel would return to the channel at the upstream face of the Highway 24 culvert.

Topographic mapping based upon aerial photogrammetry was used to delineate revised flood plain boundaries in this restudy. Maps were developed at a scale of 1"=200' with a contour interval of 2 feet (Reference 180).

Downstream of Highway 24, the 1-percent annual chance floodflow is completely contained within the channel banks. Therefore, no floodway analysis was performed on this reach, as additional encroachments (structures) on the flood plain would result in no surcharge of the 1-percent annual chance water surface elevation. Upstream of the split flow reach, there is a 114-foot reach between the upstream study limit and Pleasant Hill Road. Due to the short length of this reach, no floodway analysis was performed.

<u>City of Martinez</u>

The depth of flow through the depression area (between Muir Station Road and Tahoe Drive) of Arroyo del Hambra Creek was calculated using Manning's equation. Roughness factors (Manning's "n" values) for the hydraulic computations were assigned on the basis of field inspection of the floodplain and channel. Cross sections were photographed and compared with information published by the U.S. Geological Survey (USGS) concerning roughness factors (Reference 50).

The capacities of the two culverts along Line A, DA-40 at Pacheco Boulevard and Howe Road were computed by the storm drain hydraulic analysis program TLW_HYDR (Reference 77).

Cross sections and structures for Arroyo del Hambra Creek and Line A, DA-40 were field surveyed by Allied Engineering Company. Photogrammetry was used in the overbank areas that exhibited a clear line of sight. As-built drawings were used minimally for the Line A, DA-40 hydraulic analysis. No as-built drawings were used for the Arroyo del Hambra Creek hydraulic model. Plans and drawings (Reference 78 through 84) were obtained from the City of Martinez and Contra Costa County and used as general reference for the Line A, DA-40 hydraulic analyses.

Starting water-surface elevations for Arroyo del Hambra Creek were determined based on normal depth calculations using the slope-area method. Along Line A, DA-40 starting water-surface elevations were determined through calculations of the headwater depth at the mouth of the Pacheco Boulevard culvert according to parameters and assumptions established by Bechtel Corporation (Reference 85).

For the original study, water-surface elevation of floods of the selected recurrence interval were computed using hand-backwater calculations incorporating observed field data and high-water marks from former floods.

As part of the original study, the flood elevations on Franklin Creek were estimated by normal depth calculations at selected cross sections. Channel slopes and cross sectional areas were taken from the USGS Quadrangle Maps (Reference 86).

Town of Moraga

Cross sections for backwater analyses were located short distances upstream and downstream of bridges and other hydraulically significant features in order to establish the backwater effect of such features. Most culverts were analyzed using a separate computer program, which gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 69).

Cross sections for the backwater analyses were obtained from topographic maps at a scale of 1”:3600’, with a contour interval of 2 feet (Reference 46). The topographic mapping was based on aerial photography flown in April 1977 (Reference 87). Field measurements were used to supplement the available data.

Starting water-surface elevations for Moraga Creek and Las Trampas Creek were calculated using the slope-area method. The 10-percent annual chance flood elevation from Moraga Creek was used as the starting water-surface elevation for Ivy Drive Tributary, Larch Creek, South Branch Moraga Creek, and Laguna Creek. The 10-percent annual chance flood elevation from Laguna Creek was used as the starting water-surface elevation for Corliss Drive Tributary and St. Marys Road Tributary.

During the analysis, 1-percent annual chance shallow flooding (less than 1.0 foot) was determined along streets having inadequate drainage facilities. The 1-percent annual chance shallow flooding (less than 1.0 foot) overtops the 0.5-mile-long culvert along

Laguna Creek near Rheem Boulevard, follows the topography, and reenters the channel farther downstream.

City of Oakley

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation for use in the backwater analysis upstream (Reference 69).

Manning's Equation was used to determine the capacity of long, uniform concrete channels and closed conduit storm drains and for normal-depth calculations of independent shallow flooding areas.

Cross sections and topographic mapping for most of the study areas were obtained through aerial photogrammetric techniques. Digitized cross sections were prepared at preselected locations; mapping was provided at a scale of 1”:3,600’, with a contour interval of 2 feet (Reference 46). Field measurements were used to supplement the available data. For the area of Marsh Creek, topographic mapping obtained from Contra Costa County was prepared at a scale of 1”:6,000’, with a contour interval of 2 feet (Reference 88).

Starting water-surface elevations for reaches extending into tidal areas were set at the Mean Higher High Water tidal level. In non-tidal reaches, starting water-surface elevations were determined by normal-depth analysis.

City of Orinda

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 69).

Manning's equation was used to determine the capacity of long, uniform concrete channels and closed conduit storm drains and for normal depth calculations of independent shallow flooding areas.

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

Where overbank flooding is shallow and hydraulically independent of the adjacent stream channel, channel flood profiles are inapplicable.

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

Starting water-surface elevations were determined by normal depth analysis.

The stream reaches studied by detailed methods in the restudy were: San Pablo Creek, Reach 1, from downstream of the Orinda Way bridge to 1,000 feet upstream of the inlet to the culvert crossing under State Highway 24 (approximate length 1.2 miles); San Pablo Creek, Reach 2, from the upstream limit of the effective detailed study (200 feet downstream of Brookside Road) to the upstream limit of unnumbered Zone A on the effective Flood Insurance Rate Map, immediately upstream of Greenwood Court (approximate length 1.9 miles); and Brookside Road Tributary, from the confluence with San Pablo Creek to the upstream limit of unnumbered Zone A on the effective Flood Insurance Rate Map (approximate length 0.45 mile).

The San Pablo Creek channel through the Orinda Village area, between Highway 24 and Orinda Way, has been channelized.

Significant portions of the channel through the Orinda Village area, under Highway 24 and the Bay Area Rapid Transit District's Orinda station and tracks, has been replaced with a reinforced concrete box closed conduit.

Upstream of Highway 24, there are no substantial flood-protection facilities. The only structures of significance are culverts for road crossings and through some private properties.

The San Pablo Creek discharges through the Orinda Village area, between Orinda Way and the upstream end of the restudy reach upstream of the Camino Encinatas North Crossing, were adopted from the effective Flood Insurance Study.

Water-surface elevations were computed through the use of the USACE HEC-2 computer program (Reference 128). The following parameters were used:

For San Pablo Creek, Reach 1, channel and overbank cross sections were determined from City of Orinda Topographic Mapping (Reference 170); the San Pablo Creek Drainage Study (Reference 171), Hydrology Map, and Storm Drain System Maps and Hydraulic Model; the Crossroad Drainage Study (Reference 172) and Storm Drain System Maps and Hydraulic Model; the Effective Flood Insurance Study Work Map and Hydraulic Model; and Supplemental Field Surveys.

For San Pablo Creek, Reach 2, and Brookside Road Tributary, channel and overbank cross sections were determined from City of Orinda Topographic Mapping (Reference 171) and Field Channel Cross Sections and Structure Surveys.

The Manning’s “n” roughness values for the restudy were estimated based on field observations and USACE and USGS guidelines (References 173 and 175). The channel roughnesses used were 0.02 for lined sections and between 0.035 and 0.10 for unlined and natural sections. Overbank roughness values used ranged from 0.02, for street flow, to a maximum of 0.1.

Contraction and expansion coefficients of 0.1 and 0.3 from open channel sections were used in accordance with USACE guidelines.

HEC-2 normal and special bridge and culvert routines were used to model the existing road crossings. Roughness coefficients of 0.013 for concrete and 0.025 for corrugated metal pipe and arches were used. Contraction and expansion coefficients and inlet control parameters were determined based on structure configuration in accordance with USACE HEC-2 guidelines.

All bridges and culverts were assumed to be unobstructed. Supplemental manual calculations were performed for the structures located in the Orinda Village area to verify the reasonableness of the modeling results.

Generally, a weir coefficient of 2.6 was used for split-flow and road-overtopping analyses. For the overflow upstream of the City of Orinda, the weir coefficient was adjusted to consider tailwater submergence of the weir crest (Reference 174).

Flow blockage by buildings and other structures, such as in the Orinda Village overflow area, was considered in the HEC-2 modeling. Where buildings constricted the overbank flow areas, the effective flow boundaries were determined by the HEC-1 expansion and contraction guidelines.

For San Pablo Creek, the downstream starting water-surface elevation for the HEC-2 models is based on the effective City of Orinda Flood Insurance Study. Downstream of Orinda Way, the water surface elevation is at critical depth. The water-surface elevation downstream of Brookside Road, as shown on the effective Flood Insurance Study, was adjusted upwards to reflect the higher peak discharges used in this study. It should be noted that these water-surface elevations do not appear to control the upstream water-surface profile and resulting floodplain and base flood elevations (BFEs). The upstream BFEs within the study area are controlled by the culvert inlet capacities.

For the Brookside Road Tributary, the starting water-surface elevation downstream of Moraga Way was assumed to coincide with the water-surface elevation in San Pablo Creek for a 10-percent annual chance flood discharge, as shown in the effective Flood Insurance Study. It should be noted that the water-surface elevation upstream of Moraga Way is governed by inlet control at the culvert, and is not affected by the water-surface elevations downstream of the culvert.

Supercritical flow conditions can occur in some natural channel reaches. In accordance with FEMA guidelines, subcritical analyses were conducted to determine BFEs for all stream reaches. Therefore, the minimum computed water-surface elevations are at critical depths.

The Orinda Village overflow discharge was determined by a HEC-2 split- and weir-flow analysis immediately upstream of the reinforced-concrete-box conduits located at Highway 24, approximately 500 feet upstream of Camino Sobrante and upstream of Orinda Way.

The following overflows were calculated:

at Highway 24 - 940 cfs

at Camino Sobrante - 1,630 cfs

at Orinda Way - 1,860 cfs

Separate HEC-2 models were used to determine the Orinda Village area overflow water-surface elevations.

The floodplain and floodway boundaries, as determined by the hydrologic and hydraulic analyses, have been delineated using City of Orinda horizontal-scale orthophoto topographic mapping at a scale of 1"=300', with 10-foot contour intervals (Reference 170). All elevations, as shown on the Flood Insurance Rate Map and Flood Profiles and in the Floodway Data Tables, are referenced to the NAVD. Elevation reference marks and their descriptions used for the field surveys for this study are shown on the Flood Insurance Rate Map.

City of Pinole

In approximate study areas subject to tidal flooding, numbered insurance zones have been assigned on the basis of detailed tidal water surface data; no wave studies were performed. The area extent of potential wave action (V-Zone) was determined by approximate methods only.

Cross sections for backwater analysis were located short distances upstream and downstream from bridges and culverts and other hydraulically significant features in order to establish the backwater effect of such structures. It was assumed that the effects of potential debris plugging of these structures during future floods will be minimal. Substantial plugging would materially raise flood elevations in the area immediately upstream of these structures.

Topographic maps from the City of Pinole at a scale of 1”:3600’, with a contour interval of 5 feet (Reference 89), and as-built drawings from the USACE for the improved channel (Reference 14) were used to generate the cross sections. Field measurements were used to supplement the available data.

Water-surface elevations were computed through the use of the USACE HEC-2 step backwater computer program (Reference 44), supplemented by hand calculations where required.

Starting water-surface elevation for Pinole Creek was obtained from a mean higher high water for San Pablo Bay, as obtained from U.S. Coast and Geodetic Survey data (Reference 35).

The effects of tsunami-induced flooding were considered and found to be insignificant in that part of the bay compared to tidal flooding.

City of Pittsburg

Flooding in the New York Slough, located near the lower reaches of the Delta formed by the Sacramento and San Joaquin Rivers is under the influence of tides. Elevations for tidal floods of the selected recurrence intervals were obtained by extrapolating the existing U.S. Coast and Geodetic Survey data and correlating the data from various gages (References 35 and 71). Starting water-surface elevations in Suisun Bay (New York Slough) concurrent with floods of the selected recurrence intervals were set at mean higher high water. The effects of tsunami-induced flooding were considered and found to be insignificant compared to tidal flooding in that part of the bay.

Cross sections for backwater analyses were located at short distances upstream and downstream of bridges and other hydraulically significant features in order to establish the backwater effect of such features. Cross section data and work maps were obtained by photogrammetry and supplemented by field survey of bridges and culverts.

For both Kirker and Lawlor Creeks, roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of field inspection of floodplain areas. Starting water-surface elevations for Kirker Creek were taken from Los Medanos Wasteway at the outlet from Kirker Creek. Lawlor Creek water-surface elevations were started at normal depth downstream of the Union Pacific Railroad. Los Medanos Wasteway starting water-surface elevations were developed using normal depth calculations.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of ±0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Kirker Creek flows through a section of Pittsburg that was formerly the U.S. Army Camp Stoneman. Many undersized culverts under abandoned roads in this reach would force floodwaters to pond and overflow the banks of the channel to the east.

This water flows overland through the former campsite into another concrete channel carrying the overflow back to the main channel at State Highway 4. The backwater effects from each culvert aggravate the flooding at the next upstream crossing. This area is planned for residential and light industrial development. Some small industries and housing development have been built in flood prone areas and additional areas are under construction.

An undersized culvert under State Highway 4 subjects the other area in Pittsburg to serious flooding. The flooding here is aggravated by the traffic deflection barrier on the highway. This barrier acts as a dam and prevents any water from flowing over the highway back into Kirker Creek. The water is backed up behind the highway and overflows behind the Union Pacific Railroad track, along the highway and down the highway, until it fills the underpass at Loveridge Road. The water then overflows the east side of the underpass and joins a small creek flowing north to join Kirker Creek.

For the Willow Creek feeder tributary, approximate 1-percent annual chance flood elevations were determined using normal depth calculations.

A stage-versus-storage and a stage-versus-discharge curve were compiled to determine the backwater effect of Buchanan Road culvert. The discharge rating curve was determined using Federal Bureau of Public Roads nomographs for box culverts with inlet control.

Water-surface elevations were computed through the use of the USACE HEC-2 computer program (Reference 128), For overflow areas (Kelley Court and Loveridge Road underpass areas) the water-surface elevations were determined using a HEC-1 reservoir routing and diversion model.

Roughness factors (Manning's ‘n’ values) for the hydraulic computations were assigned on the basis of field inspection of the floodplain and channel. Cross sections were photographed and compared with information published by the USGS concerning roughness factors (Reference 50). Roughness coefficients (Manning's 'n' values) used for the channel ranged from 0.030 to 0.080 and the values used for overbanks ranged from 0.035 to 0.100.

Cross sections and structures for Kirker Creek were field surveyed by Allied Engineering Company. Photogrammetry was used in the overbank areas with clear line of sight. As-built drawings were used minimally for the hydraulic analysis. Plans and drawings were obtained from the City of Pittsburg and used as general references (References 196-199).

Starting water-surface elevations for Kirker Creek were determined based on normal depth calculations using the slope-area method.

The 1- and 0.2-year flood boundaries shown on the Flood Insurance Rate Map have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using aerial topographic mapping at a scale of 1":400', with a contour of four feet (Reference 200).

City of Pleasant Hill

West Fork Grayson Creek, Monument Drain, McCollum Creek, Flame Drive Creek, and Mangini Creek

For these stream channels studied in detail, water-surface elevations (WSELs) and capacities were computed by using a direct step-backwater computer program (Reference 45).

The results of the foregoing backwater analyses revealed that with one exception, all riverine 0.2-percent annual chance flood discharges were either contained in the channel or resulted in shallow, independent overbank flooding because of inadequate culvert capacity. The extent of such shallow flooding was determined by using normal-depth calculations and topographic maps (Reference 87).

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

Cross sections for backwater analyses were located short distances upstream and downstream of bridges and other hydraulically significant features to establish the backwater effect of such features. Most culverts were analyzed using a separate computer program, developed by the SC that calculated a headwater elevation to be used in continuing the backwater analysis upstream (Reference 69).

Cross sections for the riverine backwater analyses were obtained from topographic maps that were developed using aerial photogrammetry at a scale of 1":3,600', with a contour interval of 2 feet (Reference 87). Digitized cross sections were obtained at pre-selected locations. Field measurements were used to supplement the available data. All bridges, culverts, and other hydraulically significant features were field checked to verify elevation data and define structural geometry.

Along West Fork Grayson Creek, flooding is confined to the channel except at Pleasant Hill Road, where sheetflow will travel into the area near Mercury Way and Apollo Way and then into Mangini Creek. This sheetflow is a result of the inadequate capacity of the Pleasant Hill Road culvert. Inadequate culvert capacity causes shallow flooding (less than 1 foot deep) to flow from West Fork Grayson Creek northward along the western edge of Taylor Boulevard into an unnamed tributary. Inadequate culvert capacity, coupled with additional inflow from the shallow flooding, also causes backwater on the unnamed tributary upstream of Taylor Boulevard. Floodflows are carried under Taylor Boulevard and are confined in the channel downstream to the confluence with West Fork Grayson Creek.

Some shallow flooding also will occur near McCollum and Flame Drive Creeks. In both cases, the creeks have been partially replaced by underground culverts that are too small to convey the 1-percent annual chance flood discharge. Shallow flooding along these streams will primarily occur in the streets, although a few homes may be affected. This shallow flooding enters Grayson Creek at the northern corporate limits of the city, upstream of Second Avenue South.

The 1-percent annual chance floodflow is contained in the McCollum Creek channel upstream of the culvert; however, downstream of the culvert, backwater occurs in an incised gully that once carried the natural channel. Downstream of this backflow, flooding is contained in the natural channel of McCollum Creek until it joins Grayson Creek.

Two storm drain networks were also studied in the original study: Monument Drain, flowing under Monument Plaza and I-680, and a drain system that flows under Astrid Drive and I-680. Both systems allow drainage to flow up and out of manholes during the 1-percent annual chance flood. A small drainage channel near Hookston Road will carry enough water to exceed the capacity of the inlet to the Monument Plaza system. Most of this drainage will flow into the parking lot of the Contra Costa Shopping Centre and gradually drain into Walnut Creek north of Sherman Drive.

The hydraulic analyses for the original study were based on unobstructed flow as found in the field. The BFEs shown are thus considered valid only if hydraulic structures remain unobstructed and operate properly. A 10-percent annual chance flood or smaller flood could produce flooding that equals the depth and extent of the 1-percent annual chance flood in the vicinity of the structure if debris or material stored adjacent to the channel is swept into and plugs the structure.

<u>Grayson Creek and East Fork Grayson Creek Downstream of Gregory Lane</u>

Channel roughness factors (Manning's "n" values) for the hydraulic computations were assigned to the channels and overbanks based on the inspection of the floodplain and channel. Cross sections were photographed and compared with information published by the USGS concerning roughness factors (Reference 50).

Almost all the cross sections and structures along Grayson Creek and East Fork Grayson Creek through the study reach were field surveyed. Photogrammetry was used in the overbank areas with clear line of sight. As-built drawings were used for the hydraulic analyses of several bridges, including those at Pacheco Boulevard, Second Avenue South, Concord Avenue, Cottonwood Drive, Viking Drive, and Golf Club Drive. As-built plans for the concrete channel in the upper portion of the reach were used for channel inverts and box culvert sizes. Plans and drawings from the Pleasant Hill Assessment District and the Contra Costa County Public Works Department were used as general references (References 97- 117).

A HEC-2 hydraulic analysis was performed to determine the flow capacity in the concrete-lined channel of East Fork Grayson Creek and Grayson Creek from Gregory Lane downstream to Viking Drive. The results demonstrated that the channel contained the base (1-percent-annual-chance) flood discharge except along the reach between Vivian Drive and Gregory Lane and along the reach between Taylor Boulevard and Beverly Drive.

To evaluate the capacity of the channel, flows were limited only to the channel, and rating curves were created based on multiple HEC-2 analyses to determine the locations along the channel where the base flood could escape. The east bank of the channel is generally lower in elevation than the west; therefore, the base flood would escape over the lower east bank elevations. In these areas, a shallow flooding analysis was performed based on the amount of the base flood that could escape the channel at the above-mentioned locations. For the shallow flooding analyses, only the overbank portions of the cross sections were used to determine the flooding depths.

As a result, the areas located in the right (east) overbank area downstream of Beverly Drive are subject to shallow flooding with depths of 1 foot to 3 feet, with BFEs determined. For the reach upstream of Beverly Drive, which is subject to shallow flooding, average depths were determined to be less than 1 foot.

East Fork Grayson Creek Upstream of Gregory Lane and Murderers Creek

Manning's "n" values were assigned to the channels and overbanks using photographs obtained from field visits and the methodology described in USGS Water Supply Paper 2339 (Reference 118).

Cross sections through this reach of the study were compiled photogrammetrically and through use of field surveys in areas of dense vegetation and at stream crossings. The dimensions of hydraulic structures were determined using as-built construction plans and field measurements.

The hydraulic analyses for this study were based on unobstructed flow. The BFEs shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

City of Richmond

Water-surface elevations of floods of the selected recurrence intervals for study area streams and overland flows were obtained from field investigations, review of historical records, and application of step-backwater computations. Cross sections for the backwater analyses were determined from information supplied by the City of Richmond and the CCCFCWCD, and from topographic maps including USGS quadrangles (Reference 90).

Channel roughness factors (Manning's "n") for these computations were assigned on the basis of field inspection and engineering judgment of flood plain areas and on previous studies by the USACE.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Tidal flood elevations were used as starting elevations for backwater analyses on Rheem Creek and Wildcat Creek.

Cerrito Creek and its North Branch were originally studied in detail in this report. Subsequent construction of a cement median strip along a highway perpendicular to Cerrito Creek rendered this detailed analysis invalid; hence, the 1-percent annual chance flood elevation for Cerrito Creek and its North Branch were developed by approximate methods from the previous investigation.

Water-surface elevations for the restudy of Rheem Creek were obtained from field investigations, review of historical records, and application of the USACE HEC-2 computer program (Reference 178). Shallow depth flooding was computed using normal depth calculations in areas designated as shaded Zone X. Culverts were analyzed through use of the COB computer program, SPOKES (Reference 92), in order to determine the amount of water that backs up behind the culvert embankment. Cross sections for the water-surface profile analyses were determined from information supplied by the COB, San Francisco District's records, the City of Richmond, the Contra Costa Flood Control and Water Conservation District, and from the United States Geological Survey quadrangles (Reference 179) and topographic maps obtained from aerial photographs (Reference 94). Cross sections were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures. Mean Higher High Water was used as the starting water-surface elevations for backwater analyses on Rheem Creek.

It was determined from the revised hydraulic analysis of Rheem Creek that the levee freeboard was inadequate, i.e., that the levee crown was not a minimum of 3 feet above the 1-percent annual chance water-surface elevation. Subsequently, flooding was modeled with flow on both sides of the levee.

City of San Pablo

For Rheem Creek, water-surface elevations (WSELs) were obtained from field investigations, review of historical records, and application of the USACE HEC-2 computer program (Reference 91). Shallow depth flooding was computed using normal-depth calculations in areas designated Zone X. Culverts were analyzed using the USACE computer program SPOKES (Reference 92) to determine the amount of water that backs up behind the culvert embankment. WSELs for San Pablo and Wildcat Creeks were computed using the USACE HEC-RAS computer program (Reference 93). Starting WSELs were taken from a study prepared by Questa for the City of Richmond and Contra Costa County.

For San Pablo and Wildcat Creeks, the hydraulic analyses are described in detail in the report entitled "Hydraulic Analysis Report, San Pablo and Wildcat Creeks, San Pablo, California," prepared by WRECO and dated August 2001 (Reference 7). Separate HEC-RAS models were used to calculate overland flows from San Pablo and Wildcat Creeks. Flow rates were determined by comparing the channel WSEL with the channel-bank elevation to obtain an approximate flow depth away from the channel. Normal depths were established for various flow rates and a rating curve was developed for the flow associated with each depth. The flows were then routed along the ground surface outside the channel area. The results of the HEC-RAS model provided the WSEL along the flow route, which allowed for delineation of a Zone AE boundary and placement of Base Flood Elevations (BFEs). For the 10-, 2-, and 0.2-percent-annual-chance floods, FEMA used the discharges for each flood and incorporated those data into the hydraulic models. No flood profile exists for these study areas.

Cross sections for water-surface profile analyses for Rheem Creek were determined from information supplied by the USACE, San Francisco District; records; the City of Richmond; the CCCFCWCD; U.S. Geological Survey quadrangles (Reference 90); and from topographic maps that were obtained from aerial photographs (Reference 94). Cross sections were located at close intervals above and below bridges and culverts for ease in computing the significant backwater effect of these structures.

Cross-section data for San Pablo and Wildcat Creeks were derived from an aerial survey for the city performed by Towill, Inc., in December 2000. The survey information provided a 2-foot contour interval. Spot elevations with 0.1-foot accuracy also were provided for the overbank areas, allowing for better definition of top-of-bank elevations (Reference 7).

Cross sections typically were developed perpendicular to the flow direction. Near bridges, cross sections were located at close intervals upstream and downstream from the bridge in order to establish the backwater effect of such structures in areas presently urbanized or subject to development. Locations of selected cross sections used in the hydraulic analyses are shown on the flood profiles and the FIRM.

City of San Ramon

Cross sections and topographic mapping were obtained through aerial photogrammetric and Land surveying techniques. Digitized cross sections were provided by the mapper at preselected locations; contour mapping was provided at a scale of 1”:3,600’, with a contour interval of 2 feet (Reference 46). Field measurements were used to supplement the available data.

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

Starting water-surface elevations were determined by normal-depth analysis for San Ramon Creek. For South San Ramon Creek, the starting water-surface elevations were determined by backwater analyses for the channel reach further downstream. No flood profile exists for San Ramon Creek and Wildcat Creek study areas.

The 0.2-percent annual chance flood event overtops the levee on South San Ramon Creek approximately 1,000 feet upstream of the Pacific Gas & Electric bridge crossing. The 1-percent annual chance flood event was determined to be contained within the levees, but, since the criteria for three feet of freeboard was not met, the adjacent land is shown to be subject to flooding during this event. Following FEMA's requirements, the base (1-percent annual chance) flood elevations within the channel are shown for the condition of non-levee failure.

City of Walnut Creek

Manning's equation was used to determine the capacity of rectangular concrete channels and closed conduit storm drains and for normal-depth calculations of independent shallow flooding areas.

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

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 69).

Cross sections for the riverine backwater analyses were obtained from direct aerial photogrammetric analyses (References 95 and 46). The digitized cross sections were obtained at preselected locations with field measurements used to supplement the available data.

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

Starting water-surface elevations for Walnut, Las Trampas, and Pine Creeks were calculated using the slope-area method; for San Ramon Creek, a known elevation calculated from the headwater upstream from the culvert at Capwell's store was used; for Tice, Homestead, and East Branch Homestead Creeks, critical depth was used for a starting water-surface elevation.

For Homestead Creek, hand computations that take into account the 96-inch underground bypass pipe with an inlet structure at Brasero Lane indicate that the 1-percent annual chance flood will be contained in the channel downstream of Brasero Lane, while the 0.2-percent annual chance flood will produce shallow overbank flooding between Brasero Lane and Ygnacio Valley Road. Downstream of Ygnacio Valley Road, it was determined through hand computations that the effect of the 96-inch pipe at Brasero Lane and another 72-inch underground bypass pipe downstream of Ygnacio Valley Road is to reduce the flows such that the 1-and 0.2-percent annual chance floods are contained in the channel.

No profile is shown for Homestead Creek downstream of the inlet structure to the 96-inch pipe at Brasero Lane because the 1-percent annual chance flood is contained in the channel.

Backwater computations indicate that Las Trampas Creek elevations are controlled by San Ramon Creek elevations; therefore, no profiles are presented.

At the entrance of the culvert under Interstate Highway 680 and thence downstream, Tice Creek elevations are controlled by San Ramon Creek; therefore, no profiles are presented for this stream segment.

Backwater computations indicate that flooding in Eccleston Avenue Tributary and East Fork Grayson Creek is contained within their respective channels; therefore, no profiles are presented for these streams.

Many areas in Walnut Creek are subject to overland flooding that is broad, shallow, and generally less than 3 feet deep. The water-surface elevations of flooding in these areas are essentially independent of those along the adjacent channels and are affected principally by overflow from channels or runoff in excess of storm-drain capacity.

The hydraulic analyses for the revised streams were performed using the HEC-2 step-backwater hydraulic computer model. Channel cross sections for the detailed analyses were obtained from previous completed HEC-2 models, as-built plans, and in-field surveys conducted by Allied Engineering. Roughness coefficients (Manning's "n") used for the hydraulic computations were based on field inspection of the flood plain and channel. The data to define the dimensions for the hydraulic structures were obtained by field surveys or as-built plans supplied by local agencies. These agencies are the USACE, CCCFCWCD, City of Walnut Creek, California Department of Transportation, and U.S. Department of Agriculture, NRCS.

The 1- and 0.2-percent annual chance flood plain boundaries and the 1-percent annual chance floodway boundary for Las Trampas Creek, Walnut Creek, San Ramon Creek, and a portion of San Ramon Creek between Livorna Road and Stone Valley Road, were delineated on Questa Engineering Corporation Cal Aerial Survey contour maps at a scale of 1":400', with 4 foot contour intervals. The 1- and 0.2-percent annual chance flood plain boundaries and 1-percent annual chance floodway boundaries for Tice Creek and a portion of San Ramon Creek between Hillgrade Avenue and Livorna Road were delineated on USACE maps compiled for the Walnut Creek Basin Study. The maps are at a scale of 1":400', with 2 foot contour intervals. The 1- and 0.2-percent annual chance flood plain boundaries and the 1-percent annual chance floodway boundary for San Ramon Creek between Rudgear Road and Hillgrade Avenue were delineated on USACE maps with Questa Engineering Corporation’s additional contours. The maps are at a scale of 1":400', with 2 foot contour intervals. The maps used to delineate the overbank areas were: Walnut Creek Restoration Maps compiled by Hammon, Jenson and Wallen Associates, dated November 9, 1990, at a scale of 1":40', with 2 foot contours; Contra Costa County Flood Plain/Parcel Maps compiled by the Contra Costa Public Works/Flood Control Department, dated 1987, at a scale of 1":600', with no contours; and Contra Costa County Topographic Maps, compiled by the CCCFCWCD, dated 1970, at a scale of 1":200', with 5 foot contours.

The starting water-surface elevations (SWSELs) for Walnut Creek and San Ramon Bypass were determined by critical depth. The SWSEL for Las Trampas Creek was based on the computed 1-percent annual chance water-surface elevation (WSEL) for Walnut Creek at the confluence of San Ramon and Las Trampas Creeks. The SWSEL for Tice Creek was based on the computed 1-percent annual chance WSEL in Las Trampas Creek at its confluence with Tice Creek. The SWSEL for Sans Crainte Creek was based on the computed 1-percent annual chance WSEL for San Ramon Creek at its confluence with Sans Crainte Creek. The SWSEL for San Ramon Creek above Rudgear Road used the slope-area method, starting above the box culvert entrance.

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

Cross sections for the studied stream reaches were compiled photogrammetrically and by field surveys in areas of dense vegetation and at stream crossings. Hydraulic structure dimensions were determined using as-built construction plans and field measurements.

Channel roughness factors (Manning's "n" values) were assigned to the channels and overbanks using photographs obtained from field visits and the methodology described in USGS Water Supply Paper 2339 (Reference 118). Roughness coefficients are shown in Table 8, "Manning's `n' Values".

The hydraulic analyses for East Fork Grayson Creek and Eccleston Avenue Tributary were performed using the USACE HEC-2 step-backwater hydraulic computer model (Reference 186). The SWSEL for East Fork Grayson Creek was based on the computed 1-percent annual chance WSEL at the limit of study for Grayson Creek, downstream of the restudied reach. The previously effective study showed the 1-percent annual chance WSELs along East Fork Grayson Creek to be contained within the channel. This restudy provides more detailed information to show that the 1-percent annual chance WSELs will no longer be contained within the channel banks of East Fork Grayson Creek in the restudied area. Based on the revised hydraulic analysis for the 1-percent annual chance flood, the areas along Eccleston Avenue Tributary from just upstream of the confluence with East Fork Grayson Creek to just downstream of Putnam Boulevard are subject to shallow flooding with average depths of less than 1.0 foot.

Topographic mapping based upon aerial photogrammetry and survey data developed by Andregg, Inc. was used in this restudy (Reference 187). Maps were developed at 1":200' with a 2 foot contour interval. Minor revisions were made to street names and nonessential cross sections were removed as part of this restudy.

Contra Costa County (Unincorporated Areas)

Most culverts were analyzed using a separate computer program developed by the study contractor that gave a headwater elevation to be used in continuing the backwater analysis upstream (Reference 69).

Manning's equation was used to determine the capacity of long, uniform concrete channels and closed conduit storm drains and for normal-depth calculations of independent shallow flooding areas.

Cross sections and topographic mapping for most of the study areas were obtained through aerial photogrammetric techniques. Digitized cross sections were prepared at preselected locations; mapping was provided at a scale of 1”:3,600’, with a contour interval of 2 feet (Reference 46). Field measurements were used to supplement the available data. On Pacheco Creek and the lower reaches of Grayson and San Ramon Creeks, channel cross sections obtained by field survey were available from the CCCFCWCD. For the area of marsh, Deer, and Sand Creeks, topographic mapping, obtained from Contra Costa County, was prepared at a scale of 1”:6,000’, with a contour interval of 2 feet (Reference 96).

Where overbank flooding is shallow and hydraulically independent of the adjacent stream channel, channel flood profiles are inapplicable.

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

Starting water-surface elevations for reaches extending into tidal areas were set at the Mean Higher High Water tidal level. In nontidal reaches, starting water-surface elevations were determined by normal-depth analysis.

West Fork Grayson Creek, Monument Drain, McCollum Creek, Flame Drive Creek, and Mangini Creek

The results of the foregoing backwater analyses revealed that with one exception, all riverine 0.2-percent annual chance flood discharges were either contained in the channel or resulted in shallow, independent overbank flooding because of inadequate culvert capacity. The extent of such shallow flooding was determined by using normal-depth calculations and topographic maps (Reference 46).

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

Cross sections for backwater analyses were located short distances upstream and downstream of bridges and other hydraulically significant features to establish the backwater effect of such features. Most culverts were analyzed using a separate computer program, developed by the SC, which calculated a headwater elevation to be used in continuing the backwater analysis upstream (Reference 69).

Cross sections for the riverine backwater analyses were obtained from topographic maps that were developed using aerial photogrammetry at a scale of 1”:3,600’, with a contour interval of 2 feet (Reference 46). Digitized cross sections were obtained at preselected locations. Field measurements were used to supplement the available data. All bridges, culverts, and other hydraulically significant features were field checked to verify elevation data and define structural geometry.

In the original study, Flood Profiles were drawn showing computer WSELs to an accuracy level of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). A Flood Profile for Mangini Creek was only shown between Apollo Way and Manigini Road because the remainder of the 1-percent annual chance flooding is contained in the channel.

Along West Fork Grayson Creek, flooding is confined to the channel except at Pleasant Hill Road, where sheetflow will travel into the area near Mercury Way and Apollo Way and then into Mangini Creek. This sheetflow is a result of the inadequate capacity of the Pleasant Hill Road culvert. Inadequate culvert capacity causes shallow flooding (less than 1 foot deep) to flow from West Fork Grayson Creek northward along the western edge of Taylor Boulevard into an unnamed tributary. Inadequate culvert capacity, coupled with additional inflow from the shallow flooding, also causes backwater on the unnamed tributary upstream of Taylor Boulevard. Floodflows are carried under Taylor Boulevard and are confined in the channel downstream to the confluence with West Fork Grayson Creek.

Some shallow flooding also will occur near McCollum and Flame Drive Creeks. In both cases, the creeks have been partially replaced by underground culverts that are too small to convey the 1-percent annual chance flood discharge. Shallow flooding along these streams will primarily occur in the streets, although a few homes may be affected. This shallow flooding enters Grayson Creek at the northern corporate limits of the city, upstream of Second Avenue South.

The 1-percent annual chance floodflow is contained in the McCollum Creek channel upstream of the culvert; however, downstream of the culvert, backwater occurs in an incised gully that once carried the natural channel. Downstream of this backflow, flooding is contained in the natural channel of McCollum Creek until it joins Grayson Creek.

Two storm drain networks were also studied in the original study: Monument Drain, flowing under Monument Plaza and I-680, and a drain system that flows under Astrid Drive and I-680. Both systems allow drainage to flow up and out of manholes during the 1-percent annual chance flood. A small drainage channel near Hookston Road will carry enough water to exceed the capacity of the inlet to the Monument Plaza system. Most of this drainage will flow into the parking lot of the Contra Costa Shopping Centre and gradually drain into Walnut Creek north of Sherman Drive.

The hydraulic analyses for the original study were based on unobstructed flow as found in the field. The BFEs shown are thus considered valid only if hydraulic structures remain unobstructed and operate properly. A 10- percent annual chance flood or smaller flood could produce flooding that equals the depth and extent of the 1-percent annual chance flood in the vicinity of the structure if debris or material stored adjacent to the channel is swept into and plugs the structure.

Grayson Creek and East Fork Grayson Creek Downstream of Gregory Lane

Starting WSELs for Grayson Creek were determined based on normal-depth calculations using the slope-area method.

Channel roughness factors (Manning's "n" values) for the hydraulic computations were assigned to the channels and overbanks based on the inspection of the floodplain and channel. Cross sections were photographed and compared with information published by the USGS concerning roughness factors (Reference 50).

Almost all the cross sections and structures along Grayson Creek and East Fork Grayson Creek through the study reach were field surveyed. Photogrammetry was used in the overbank areas with clear line of sight. As-built drawings were used for the hydraulic analyses of several bridges, including those at Pacheco Boulevard, Second Avenue South, Concord Avenue, Cottonwood Drive, Viking Drive, and Golf Club Drive. As-built plans for the concrete channel in the upper portion of the reach were used for channel inverts and box culvert sizes. Plans and drawings from the Pleasant Hill Assessment District and the Contra Costa County Public Works Department were used as general references (References 97 through 117).

A HEC-2 hydraulic analysis was performed to determine the flow capacity in the concrete-lined channel of East Fork Grayson Creek and Grayson Creek from Gregory Lane downstream to Viking Drive. The results demonstrated that the channel contained the base (1-percent-annual-chance) flood discharge except along the reach between Vivian Drive and Gregory Lane and along the reach between Taylor Boulevard and Beverly Drive.

To evaluate the capacity of the channel, flows were limited only to the channel, and rating curves were created based on multiple HEC-2 analyses to determine the locations along the channel where the base flood could escape. The east bank of the channel is generally lower in elevation than the west; therefore, the base flood would escape over the lower east bank elevations. In these areas, a shallow flooding analysis was performed based on the amount of the base flood that could escape the channel at the above-mentioned locations. For the shallow flooding analyses, only the overbank portions of the cross sections were used to determine the flooding depths.

As a result, the areas located in the right (east) overbank area downstream of Beverly Drive are subject to shallow flooding with depths of 1 foot to 3 feet, with BFEs determined. For the reach upstream of Beverly Drive, which is subject to shallow flooding, average depths were determined to be less than 1 foot.

East Fork Grayson Creek Upstream of Gregory Lane and Murderers Creek

Manning’s “n” values were assigned to the channels and overbanks using photographs obtained from field visits and the methodology described in USGS Water Supply Paper 2339 (Reference 118).

Cross sections through this reach of the study were compiled photogrammetrically and through use of field surveys in areas of dense vegetation and at stream crossings. The dimensions of hydraulic structures were determined using as-built construction plans and field measurements.

The hydraulic analyses for the revised streams were performed using the HEC-2 step-backwater hydraulic computer model. Channel cross sections for the detailed analyses were obtained from previous completed HEC-2 models, as-built plans, and in-field surveys conducted by Allied Engineering. Roughness coefficients (Manning's "n") used for the hydraulic computations were based on field inspection of the flood plain and channel. The data to define the dimensions for the hydraulic structures were obtained by field surveys or as-built plans supplied by local agencies. These agencies are the USACE, CCCFCWCD, City of Walnut Creek, California Department of Transportation, and U.S. Department of Agriculture, NRCS.

The 1- and 0.2-percent annual chance flood plain boundaries and the 1-percent annual chance floodway boundary for Las Trampas Creek and a portion of San Ramon Creek between Livorna Road to Stone Valley Road, were delineated on Questa Engineering Corporation, Cal Aerial Surveys contour maps at a scale of 1":400', with 4 foot contour intervals. The 1- and 0.2-percent annual chance flood plain boundaries and the 1-percent annual chance floodway boundary for Tice Creek and a portion of San Ramon Creek between Hillgrade Avenue and Livorna Road, were delineated on USACE maps compiled for the Walnut Creek Basin Study. The maps are at a scale of 1":400', with 2 foot contour intervals. The 1- and 0.2- percent annual chance flood plain boundaries and the 1-percent annual chance floodway boundary for San Ramon Creek between Rudgear Road and Hillgrade Avenue were delineated on USACE maps with Questa Engineering Corporation's additional contours. The maps are at a scale of 1":400', with 2 foot contour intervals. The maps used to delineate the overbank areas were: Walnut Creek Restoration Maps compiled by Hammon, Jenson and Wallen Associates, dated November 9, 1990, at a scale of 1":40', with 2 foot contours; Contra Costa County Flood Plain/Parcel Maps compiled by the CCCFCWCD, dated 1987, at a scale of 1":600', with no contours; and Contra Costa County Topographic Maps, also compiled by the CCCFCWCD, dated 1970, at a scale of 1":200', with 5 foot contours.

The starting water-surface elevation (SWSEL) for Las Trampas Creek was based on the computed 1-percent annual chance water-surface elevation (WSEL) for Walnut Creek at the confluence of San Ramon Creek and Las Trampas Creek. The SWSEL for Tice Creek was based on the computed 1-percent annual chance WSEL for Las Trampas Creek at its confluence with Tice Creek. The SWSEL for Sans Crainte Creek was based on the computed 1-percent annual chance WSEL in San Ramon Creek at its confluence with Sans Crainte Creek. The SWSEL for San Ramon Creek above Rudgear Road used the slope-area method, starting above the box culvert entrance.

Water-surface elevations for floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 91) for each stream studied using detailed methodology.

Cross sections for Mount Diablo, Mitchell, Appian and Arroyo del Hambra Creek and Line A, DA-40 were field surveyed by Allied Engineering Company. Photogrammetry was used in the overbank areas with a clear line of sight. As-built drawings were used throughout the study reaches of Mount Diablo Creek, Mitchell Creek, and Donner Creek. Plans and drawings were obtained from the City of Clayton and Contra Costa County and used as general reference for the hydraulic analysis of Mount Diablo Creek and Mitchell Creek (References 51-57, 59-68, and 159). Plans and drawings (Reference 79-84) were obtained from the City of Martinez and Contra Costa County and used as general reference for the Line A, DA-40 hydraulic analyses. Along Rodeo Creek and Garrity, Arroyo del Hambra, West Alamo Creek's structures were field surveyed.

Almost all of the cross sections and structures for Grayson Creek and East Fork Grayson Creek were field surveyed by Allied Engineering Company. Photogrammetry was used in the overbank areas with clear line of sight. As-built drawings were used for the hydraulic analysis for several bridges including: Pacheco Boulevard, 2nr1 Avenue South, Concord Avenue, Cottonwood Drive, Viking Drive and Golf Club Drive. As -built plans for the concrete channel in the upper portion of the reach were used for channel inverts and box culvert sizes. Plans and drawings were obtained from the Pleasant Hill Assessment District and the Contra Costa County Public Works Department and used as general references (References 97-117).

Along Green Valley Creek most of the structures and cross sections in the upper portion of the reach were field surveyed by Allied Engineering Company. Photogrammetry was used in the overbank areas where a clear line of sight existed. Other cross sections and the Interstate 680 culvert routine were taken from information generated by the USACE (Reference 161). In areas where the USACE mapping did not fully cover the floodplain, Questa obtained aerial photo diapositives from USACE and extended the topographic mapping to cover the floodplain area. The scale and contour interval utilized by USACE in their mapping was maintained in these extended areas. Plans and drawings obtained from the Town of Danville and Contra Costa County were used as reference (References 162-164).

Cross sections along Wildcat and San Pablo Creeks were taken from the WET study (Reference 6) and from as-built drawings of the USACE improvements. In the upper reaches of these two creeks, the cross sections obtained did not utilize complete cross sections. Instead, X3 cards were added to the HEC-2 model to limit conveyance calculations of the channel area. In this region the overbank areas have little conveyance ability and are largely urbanized. To account for this situation, extensive split-flow routines were incorporated into the HEC-2 models to account for overbank storage and losses during high flow events.

In performing the approximate study of Sinks DA 290-300, the sinks that were delineated by the previous approximate study (Reference 188) and potential new sinks observed on a recent aerial topographic map of the area were investigated. An approximate infiltration study was performed in which sink delineations were determined based upon the following criteria:

- Recent topographic mapping shows that the sink has not been eliminated or reduced in size;
- A minimum sink depth of four feet (measured from the rim of the sink to sink bottom);
- The watershed contributing to the sink must be larger than the sink itself, i.e., direct precipitation alone would not create a sink;
- If a sink covers a roadway, the sink must extend at least 50 feet from the roadway (to include development);
- If any drainage improvements were made in the region of a sink, such improvements are not capable of preventing or significantly reducing flooding during the 1-percent annual chance flood.

Starting water-surface elevations for Mitchell Creek were taken from the Mount Diablo Creek HEC-2 runs. Starting water-surface elevations for Mount Diablo, Grayson, Appian and Arroyo del Hambra Creeks were determined based on normal depth calculations using the slope-area method. Along Green Valley Creek starting water-surface elevations at the headwater of Interstate 680 were obtained by utilizing the original USACE model with CCCFCWCD flows. The initial boundary conditions in the model have limited effect on the floodplain delineation because the channel invert and slope change very quickly. Any effect from starting water-surface elevation assumptions is quickly lost. Along Rodeo, Garrity, Wildcat and San Pablo Creeks Mean Higher High Water, elevations as determined in the USACE report "San Francisco Bay Tidal Stage vs. Frequency Stage" (Reference 177) were used for the starting water-surface elevations. Along West Alamo Creek starting water-surface elevations were taken as the 1-percent annual chance water-surface elevation of the downstream detention pond. Along Line A, DA-40 starting water-surface elevations were determined through calculations of the headwater depth at the mouth of the Pacheco Boulevard culvert according to parameters and assumptions established by Bechtel Corporation (Reference 189)

The boundaries of the 1- and 0.2-percent annual chance floods have been delineated using the flood elevations determined along Mitchell, Mount Diablo, Appian, Green Valley, Rodeo, Garrity, Grayson, Arroyo del Hambra and West Alamo Creeks and Line A, DA-40 and topographic mapping at a scale of 1":400' with a contour interval of 4 feet (References 190-191).

The boundaries of the 1- and 0.2-percent annual chance floods have been delineated using the flood elevations determined for Wildcat and San Pablo Creeks using topographic mapping at a scale of 1":500' with a contour interval of 5 feet (Reference 127). Where the 1- and 0.2-percent annual chance flood boundaries are close together only the 1-percent annual chance flood boundary is shown.

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (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 Flood Insurance Study (FIS) report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross sections for the studied stream reaches were compiled photogrammetrically and by field surveys in areas of dense vegetation and at stream crossings. Hydraulic structure dimensions were determined using as-built construction plans and field measurements.

Channel roughness factors (Manning's "n" values) were assigned to the channels and overbanks using photographs obtained from field visits and the methodology described in USGS Water Supply Paper 2339 (Reference 118).

The USACE HEC-2 computer program was used to determine water-surface elevations (WSELs) for the 1-percent annual chance flood event (Reference 186). The WSELs at the limit of study for Grayson Creek, downstream of the restudy reaches, were used as the starting WSELs for the restudy area.

Topographic mapping based upon aerial photogrammetry and survey data developed by Andregg, Inc., was used in this restudy (Reference 187). Maps were developed at a scale of 1":200' with a 2 foot contour interval. Minor revisions to street names and removal of nonessential cross sections were performed as part of this restudy.

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 8, “Manning’s “n” Values”.

Table 8: Manning's "n" Values

Stream Name	Roughness Values	
	Channel	Overbanks
Appian Creek	0.020 – 0.050	0.030 – 0.090
Arroyo del Hambra Creek	0.025 – 0.055	0.060 – 0.075
Brushy Creek	0.030	0.035
Donner Creek	0.018 – 0.045	0.035 – 0.065
East Fork Grayson Creek	0.013 – 0.080	0.013 – 1.000
Eccleston Avenue Tributary	0.040	0.013 – 0.070
Frisk Creek	0.030	0.045
Galindo Creek	0.015 – 0.035	0.030 – 0.100
Garrity Creek	0.025 – 0.080	0.030 – 0.095
Grayson Creek	0.030 – 0.080	0.035 – 0.100
Green Valley Creek	0.015 – 0.060	0.035 – 0.100
Grizzly Creek	0.030 – 0.060	0.060
Happy Valley Creek	0.040 – 0.065	0.060 – 0.070
Hidden Valley Creek	0.040 – 0.050	0.060
Jonas Hill Creek	0.025 – 0.055	0.060
Kellogg Creek	0.030	0.035
Kirker Creek	0.014 – 0.045	0.030 – 0.050
Lafayette Creek	0.022 – 0.060	0.065 – 0.070
Las Trampas Creek	0.030 – 0.070	0.050 – 0.100
Lawlor Creek	0.014 – 0.045	0.030 – 0.050
Line A, DA-40	0.030 – 0.060	0.050 – 0.060
Marsh Creek	0.035-0.08	0.04-0.2
Mitchell Creek	0.025 – 0.060	0.045 – 0.075
Mount Diablo Creek	0.025 – 0.075	0.035 – 0.100
Murderer's Creek	0.045 – 0.070	0.066 – 0.100
Reliez Creek	0.037 – 0.065	0.032 – 0.140
Rheem Creek	0.015 – 0.030	0.015 – 0.070
Rodeo Creek	0.010 – 0.045	0.055 – 0.075
San Pablo Creek	0.013 – 0.070	0.030 – 0.050
San Ramon Creek	0.094	0.040
South San Ramon Creek	0.014 – 0.060	0.020 – 0.080
West Alamo Creek	0.025 – 0.045	0.045 – 0.055
Wildcat Creek	0.013 – 0.060	0.060 – 0.080
ALL OTHERS	0.012 – 0.100	0.020 – 0.200

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

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

All elevations are referenced to the North American Vertical Datum of 1988 (NAVD88). Elevation reference marks (ERMs) used in this study, and their descriptions, are shown on the FIRM. ERMs shown on the FIRM represent those used during the preparation of this and previous FISs. The elevations associated with each ERM were obtained and/or developed during FIS production to establish vertical control for determination of flood elevations and floodplain boundaries shown on the FIRM. Users should be aware that these ERM elevations might have changed since the publication of this FIS. To obtain up-to-date elevation information on National Geodetic Survey (NGS) ERMs shown on this map, please contact the NGS at:

NGS Information Services
NOAA, N/NGS12
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
www.ngs.noaa.gov

Map users should seek verification of non-NGS ERM monument elevations when using these elevations for construction or floodplain management purposes.

Qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Benchmarks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)

- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)

- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)

- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS benchmarks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for benchmarks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

Levee Hazard Analysis

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

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

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

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

FEMA understood that it may take time to acquire and/or assemble the documentation necessary to fully comply with 44 CFR 65.10. Therefore, FEMA put forth a process to provide the communities with additional time to submit all the necessary documentation. For a community to avail itself of the additional time, it had to sign an agreement with FEMA. Levees for which such agreements were signed are shown on the final effective FIRM as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year and labeled as a Provisionally Accredited Levee (PAL). Communities have two years from the date of FEMA's initial coordination to submit to FEMA final accreditation data for all PALs. Following receipt of final accreditation data, FEMA will revise the FIS and FIRM as warranted.

FEMA coordinated with the U.S. Army Corps of Engineers, the local communities, and other organizations to compile a list of levees that exist within Contra Costa County. Table 9, "List of Structures Requiring Flood Hazard Revisions" lists all levees shown on the FIRM, to include PALs, for which corresponding flood hazard revisions were made.

Approximate analyses of "behind levee" flooding were conducted for all the levees in Table 9 to indicate the extent of the "behind levee" floodplains. The methodology used in these analyses is discussed below.

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

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

Table 9: List of Structures Requiring Flood Hazard Revisions

Community	Flood Source	Levee Inventory ID (Lat./Long. Coordinates)	USACE Levee
City of Concord	Walnut Creek	P100 (-122.053, 37.998; -122.049, 37.997)	Yes
City of Concord	Walnut Creek	P161 (-122.056, 37.99; -122.054, 37.998)	Yes
City of Concord	Walnut Creek	P191 (-122.050, 37.997; -122.047, 37.997)	Yes
City of Concord	Walnut Creek	P68 (-122.055, 37.997; -122.053, 37.997)	Yes
City of Concord	Walnut Creek	P70 (-122.055, 37.998; -122.051, 37.981)	Yes
City of Oakley	Undetermined	P438 (-121.681, 38.000; -121.680, 38.000)	Yes
City of Pittsburg[1]	Undetermined	P177 (-121.914, 38.028; -121.914, 38.027)	Yes
City of Pittsburg	Undetermined	P179 (-121.850, 38.029; -121.849, 38.028)	No
City of Pittsburg[2]	Undetermined	P455 (-121.862, 38.016; -121.860, 38.015)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P204 (-122.106, 38.021; -122.105, 38.021)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P444 (-121.593, 37.828; -121.555, 37.831)	No
Contra Costa County (Unincorporated Areas)	San Francisco Bay	P456 (-122.105, 38.021; -122.105, 38.019)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P482 (-121.557, 37.830; -121.559, 37.817)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P117 (-121.714, 37.918; -121.706, 37.918)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P118 (-121.593, 37.837; -121.554, 37.831)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P375 (-121.610, 37.940; -121.572, 37.940)	No
Contra Costa County (Unincorporated Areas)	Marsh Creek	P4 (-121.732, 37.887; -121.724, 37.875)	No

[1]*Channel*

[2]*Road*

Table 9: List of Structures Requiring Flood Hazard Revisions, continued

Community	Flood Source	Levee Inventory ID (Lat./Long. Coordinates)	USACE Levee
Contra Costa County (Unincorporated Areas)	Undetermined	P413 *	No
Contra Costa County (Unincorporated Areas)	Undetermined	P434 (-121.562, 37.849; -121.554, 37.831)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P435 (-121.593, 37.837; -121.562, 37.849)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P437 (-121.573, 37.940; -121.572, 37.940)	No
Contra Costa County (Unincorporated Areas)[1]	Undetermined	P458 (-121.897, 38.032; -121.894, 38.035)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P413 (-121.614, 37.899; -121.614, 37.875)	No
Contra Costa County (Unincorporated Areas)[2]	Undetermined	P489 (-122.043, 38.021; -122.036, 38.014)	No
Contra Costa County (Unincorporated Areas)[2]	Undetermined	P494 (-121.950, 38.036; -121.947, 38.036)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P496 (-121.952, 38.039; -121.951, 38.037)	No
Contra Costa County (Unincorporated Areas)	Old River	P503 (-121.572, 37.940; -121.951, 38.037)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P63 (-121.579, 37.813; -121.559, 37.817)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P64 (-121.578, 37.812; -121.562, 37.816)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P67 (-121.603, 37.832; -121.600, 37.829)	No
Contra Costa County (Unincorporated Areas)	Walnut Creek	P71 (-122.051, 37.991; -122.052, 37.981)	Yes
Contra Costa County (Unincorporated Areas)	Walnut Creek	P72 (-122.052, 37.992; -122.051, 37.991)	Yes
Contra Costa County (Unincorporated Areas)	Walnut Creek	P73 (-122.057, 37.999; -122.052, 37.992)	Yes

** Data Not Available*

[1]Berm

[2]Dam

Several levees within Contra Costa County and its incorporated communities meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled “Mapping of Areas Protected by Levee Systems.” Table 10, “List of Certified and Accredited Levees” lists all levees shown on the FIRM that meet the requirements of 44 CFR 65.10 and have been determined to provide protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year.

Table 10: List of Certified and Accredited Levees

Community	Flood Source	Levee Inventory ID (Lat./Long. Coordinates)	USACE Levee
City of Oakley	Contra Costa Canal	P12 (-121.693, 37.998; -121.688, 37.998)	No
City of Oakley	Contra Costa Canal	P477 (-121.696, 37.991; -121.693, 37.998)	No
City of Oakley	Contra Costa Canal	P15 (-121.688, 37.998; -121.678, 37.997)	No
City of Richmond	Wildcat Creek[1]	P608 (-122.381, 37.958; -122.374, 37.958)	Yes
City of Richmond	Wildcat Creek[1]	P609 (-122.377, 37.957; -122.376, 37.957)	Yes
Contra Costa County (Unincorporated Areas)	Undetermined	P153 (-121.618, 37.918; -121.618, 37.911)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P451 (-121.614, 37.933; -121.618, 37.918)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P452 (-121.616, 37.933; -121.614, 37.932)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P107 (-121.606, 37.915; -121.600, 37.916)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P108 (-121.604, 37.912; -121.600, 37.916)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P109 (-121.603, 37.912; -121.599, 37.916)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P110 (-121.599, 37.916; -121.595, 37.917)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P413 *	No
Contra Costa County (Unincorporated Areas)	Undetermined	P476 (-121.644, 37.994; -121.627, 37.894; -121.627, 37.983; -121.640, 37.984)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P480 (-121.586, 37.918; -121.564, 37.911)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P481 (-121.595, 37.917; -121.586, 37.918)	No
Contra Costa County (Unincorporated Areas)	Old River	P504 (-121.564, 37.911; -121.606, 37.842)	No
Contra Costa County (Unincorporated Areas)	Undetermined	P507 (-121.611, 37.844; -121.606, 37.843)	No

Table 10: List of Certified and Accredited Levees, continued

Community	Flood Source	Levee Inventory ID (Lat./Long. Coordinates)	USACE Levee
Contra Costa County (Unincorporated Areas)	San Pablo Creek[1]	P600 (-122.378, 37.968; -122.374, 37.967)	Yes
Contra Costa County (Unincorporated Areas)	San Pablo Creek[1]	P601 (-122.378, 37.968; -122.376, 37.967)	Yes
Contra Costa County (Unincorporated Areas)	San Pablo Creek[1]	P602 (-122.367, 37.967; -122.367, 37.968)	Yes
Contra Costa County (Unincorporated Areas)	San Pablo Creek[1]	P603 (-122.367, 37.967; -122.367, 37.968)	Yes
Contra Costa County (Unincorporated Areas)	San Pablo Creek[1]	P604 (-122.373, 37.967; -122.367, 37.967)	Yes
Contra Costa County (Unincorporated Areas)	San Pablo Creek[1]	P605 (-122.373, 37.966; -122.367, 37.967)	Yes
Contra Costa County (Unincorporated Areas)	San Pablo Creek[1]	P606 (-122.376, 37.967; -122.376, 37.967)	Yes
Contra Costa County (Unincorporated Areas)	San Pablo Creek	P607 (-122.378, 37.970; -122.378, 37.968)	Yes
Contra Costa County (Unincorporated Areas)	Wildcat Creek[1]	P608 (-122.381, 37.958; -122.374, 37.957)	Yes
Contra Costa County (Unincorporated Areas)	Wildcat Creek[1]	P609 (-122.377, 37.957; -122.376, 37.957)	Yes
Contra Costa County (Unincorporated Areas)	Wildcat Creek[1]	P610 (-122.376, 37.957; -122.374, 37.958)	Yes
Contra Costa County (Unincorporated Areas)	Wildcat Creek[1]	P611 (-122.373, 37.958; -122.369, 37.960)	Yes
Contra Costa County (Unincorporated Areas)	Wildcat Creek[1]	P612 (-122.373, 37.959; -122.370, 37.960)	Yes
Contra Costa County (Unincorporated Areas)	Undetermined	P69 (-121.614, 37.875; -121.614, 37.856)	No

* Data Not Available

[1] These levee segments currently do not comply with Section 65.10 of the NFIP Regulations. As such, these flooding sources will be revised at a later date to update the flood hazard information associated with the applicable structures. The flood hazard data shown inside the "seclusion zone" displayed on FIRM panels 0209, 0226, and 0228 has been re-published from the June 16, 2009 FIRM for Contra Costa County and should continue to be used until those FIRM panels are revised to update the flood hazard information in those areas.

3.3 Vertical Datum

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

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

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

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

For more information on NAVD88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA20/June 1992, or contact the Spatial Reference System Division, National Geodetic Survey, NOAA, Silver Spring Metro Center, 1315 East-West Highway, Silver Spring, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

Table 11: Vertical Datum Conversions

Stream Name	Conversion Factor
Along Giant Road from Standard Oil to Rheem Creek	2.64
Appian Creek	2.72
Arroyo del Hambra Creek	2.70
Brookside Road Tributary	2.81
Cascade Creek	2.79
Cerrito Creek	2.73
Clayton Valley Drain	2.60
Corliss Drive Tributary	2.80
Deer Creek	2.47
Ditch No. 2	2.63
Donner Creek	2.68
East Antioch Creek	2.44

Table 11: Vertical Datum Conversions, continued

Stream Name	Conversion Factor
East Branch Green Valley Creek	2.71
East Branch Homestead Creek	2.66
East Branch Refugio Creek	2.70
East Fork Grayson Creek	2.66
Eccleston Avenue Tributary	2.67
Farm Bureau Road Drain	2.61
Galindo Creek	2.63
Garrity Creek	2.65
Grayson Creek	2.63
Green Valley Creek	2.71
Grizzly Creek	2.78
Happy Valley Creek	2.76
Hidden Valley Creek	2.78
Hillcrest Branch East Antioch Creek	2.43
Homestead Creek	2.66
Ivy Drive Tributary	2.79
Jonas Hill Creek	2.76
Kirker Creek	2.51
Lafayette Creek	2.76
Laguna Creek	2.79
Larch Creek	2.80
Las Trampas Creek	2.75
Lauterwasser Creek	2.78
Lawlor Creek	2.56
Line A, DA-40	2.65
Los Medanos Wasteway	2.47
Mangini Creek	2.68
Markley Creek	2.47
Marsh Creek	2.41
Middle Branch West Antioch Creek	2.47
Miranda Creek	2.71
Mitchell Creek	2.67
Moraga Creek	2.80
Mt. Diablo Creek	2.64
Mt. Diablo Creek Split Flow	2.64
Murderers Creek	2.67
North Branch Reliez Creek	2.74
North Branch Stone Valley Creek	2.72
Orinda Village Overflow	2.80

Table 11: Vertical Datum Conversions, continued

Stream Name	Conversion Factor
Overhill Creek	2.80
Overland Cross Section	2.65
Pacheco Creek	2.60
Refugio Creek	2.70
Reliez Creek	2.73
Payton Slough	2.63
Pine Creek	2.65
Pinole Creek	2.70
Rheem Creek	2.64
Rodeo Creek	2.68
Sand Creek	2.44
San Pablo Creek	2.67/2.79
San Ramon Creek	2.74
San Ramon Creek Overflow	2.74
Sans Crainte Creek	2.69
Sans Crainte Creek Tributary A	2.69
Shore Acres Creek	2.57
South Branch Moraga Creek	2.81
South San Ramon Creek (overbank flooding)	2.71
South San Ramon Creek	2.71
St. Marys Road Tributary	2.80
Stone Valley Creek	2.72
Sycamore Creek	2.72
Tice Creek	2.71
Tice Creek Overflow	2.71
Walnut Creek	2.67
West Antioch Creek	2.43
West Branch Alamo Creek	2.72
West Branch East Antioch Creek	2.44
West Branch Refugio Creek	2.70
Wildcat Creek	2.67

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-percent annual chance and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the FIRM (Published Separately). On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A 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 (Published Separately).

Approximate 1-percent annual chance floodplain boundaries were taken originally from the Flood Hazard Boundary Map for the unincorporated areas of Contra Costa County (Reference 119).

Table 12: Topographic Map Information

Community	Scale	Contour Interval	Reference
City of Antioch	1" = 3,600'	2 foot	46
	1" = 480'	2 foot	47
	1" = 100'	2 foot	*
	1" = 600'	5 foot	*
City of Clayton	1" = 3,600' (original)	2 foot	49
	1" = 400' (restudy)	4 foot	122
City of Concord	1" = 3,600' (original)	2 foot	46
	1" = 12,000' (original)	*	70
	1" = 400' (restudy)	4 foot	160
Town of Danville	1" = 3,600' (original)	2 foot	72
	1" = 400' (restudy)	4 foot	165
City of El Cerrito	1" = 2,400'	1 foot	123
City of Hercules	1" = 1,200'	5 foot	73
City of Lafayette	1" = 3,600' (original)	2 foot	46
	1" = 400' (restudy)	4 foot	*
	1" = 200'(restudy)	2 foot	180
	1" = 100' (restudy)	1 foot	*
City of Martinez	1" = 24,000' (original)	20 foot	86
	1" = 400' (restudy)	4 foot	124
Town of Moraga	1" = 3,600'	2 foot	46
City of Oakley	1" = 3,600'	2 foot	46
	1" = 600'	2 foot	88
City of Orinda	1" = 3,600' (original)	2 foot	46
	1" = 24,000' (original)	10 foot	86
	1" = 300' (restudy)	10 foot	170
City of Pinole	1" = 3,600'	5 foot	89
City of Pittsburg	1" = 2,400'	2 foot	125
	1" = 400'	4 foot	200
City of Pleasant Hill	1" = 3,600' (original)	2 foot	46 / 87
	1" = 400' (restudy)	4 foot	126
	1" = 200' (restudy)	2 foot	5

**Data not available*

Table 12: Topographic Map Information, continued

Community	Scale	Contour Interval	Reference
City of Richmond	1" = 24,000'	20 foot	90
City of San Pablo	1" = 6,000'	5 foot	7
City of San Ramon	1" = 3,600'	2 foot	46
City of Walnut Creek	1" = 3,600' (original)	2 foot	46
	1" = 2,400' (original)	5 foot	95
	1" = 400' (restudy)	4 foot	*
	1" = 400' (restudy)	2 foot	*
	1" = 40' (restudy)	2 foot	*
	1" = 600' (restudy)	0 foot	*
	1" = 200' (restudy)	5 foot	*
	1" = 200' (restudy)	2 foot	187
Contra Costa County	1" = 3,600' (original)	2 foot	46
(Unincorporated areas)	1" = 6,000' (original)	2 foot	96
	1" = 400' (restudy)	4 foot	190 / 191
	1" = 400' (restudy)	2 foot	*
	1" = 40' (restudy)	2 foot	*
	1" = 600' (restudy)	0 foot	*
	1" = 200' (restudy)	5 foot	*
	1" = 500' (restudy)	5 foot	127
	1" = 200' (restudy)	2 foot	187

**Data not available*

City of Antioch

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of Brentwood

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of Clayton

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of Concord

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

Town of Danville

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of El Cerrito

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1-

and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of Hercules

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of Lafayette

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of Martinez

Approximate 1-percent annual chance floodplain boundaries in some portions of the study area were also taken directly from the Flood Insurance Rate Map for the City of Martinez, California (Reference 120).

Town of Moraga

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of Oakley

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, “Topographic Map Information.”

City of Orinda

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, “Topographic Map Information.”

In accordance with FEMA guidelines, restudied floodplain boundaries and BFEs have been defined based on the BFEs as determined by subcritical flow analyses. In channel reaches where supercritical flow conditions could occur, the BFEs are based on critical depth.

Due to the topographic mapping's large 10-foot contour interval, the restudied floodplain limits have been plotted using the more detailed field surveys and mapping (References 171 and 172) to the greatest extent possible. The topographic mapping was used only where there were no other data available.

The Zone AE flooding in the Orinda Village area is due to the overflow upstream of Highway 24, Camino Sobrante, and Orinda Way. The ponded Zone AH on Camino Pablo, below State Highway 24 and the Bay Area Rapid Transit District's tracks, is caused by overtopping of the inlet to the conduit immediately downstream of Brookwood Road.

City of Pinole

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, “Topographic Map Information.”

City of Pittsburg

For the Willow Creek feeder tributary, approximate 1-percent annual chance flood boundaries were delineated using the Honker Bay Quadrangle at a scale of 1:24,000 and a contour interval of 10 feet (Reference 121).

City of Pleasant Hill

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of Richmond

The following areas designated as shaded Zone X are affected principally by shallow sheet flows:

- Wildcat Creek: Area between Santa Fe and Union Pacific tracks, defined by Chelsey and Market Avenues;

- Wildcat and Rheem Creeks: Area west of Santa Fe tracks, between Parr Boulevard and Rheem Creek and extending northwest to San Pablo Bay;

- Wildcat Creek: Two sections of the mixed light and heavy industrial and undeveloped area including marshlands; largely in corporate limits of North Richmond, but taking in, in Richmond, the area along Gertrude Street from Kelsey Street west to the corporate limits, and an area just west of the North Richmond corporate limits, running between Wildcat and San Pablo Creeks;

- Direct runoff west of Interstate 80: An area bounded by San Joaquin and Napa Streets, Burlingame Avenue, and Hoffman and Columbia Boulevards;

- Intermittent stream west of Interstate 80: Two areas, one extending from Wall Street on the north to Carson Boulevard on the south with widths between 500 and 600 feet. The other areas extending along and between Carlson and Hoffman Boulevards from 47th Street to Carl Avenue.

The following areas designated as shaded Zone X are affected principally by shallow ponding due to inadequate drainage. (Source for following - stream overflows and direct runoff conveyed along streets or overland to low areas.):

- Along Santa Fe Railroad, between 33rd and 29th Streets;

- One block area bounded by 34th and 35th Streets and Solano and Clinton Avenues;

- Area between 35th and 37th Streets and from Roosevelt Avenue extending one-half block north;

- Block included by Nevin and Bissell Avenues between 24th and 25th Streets;

- Irregular area bounded by Santa Fe tracks/Meeker Avenue and Wright Avenue as far east as South 20th Street;

- Irregular area bounded by Wright Avenue, South 13th Street, Hoffman Boulevard, South 9th Street, Cutting Boulevard and (south of Hoffman Boulevard) South 8th Street;

- Four-block area bounded by South 22nd and South 24th Streets and Virginia and Portrero Avenues;

- Irregular area along Standard Avenue and extending northeast along Castro Street (1,100 feet), along Railroad Avenue (2,100 feet), and along Garrard Boulevard (1,100 feet);

- Irregular area between Garrard Boulevard, Ohio Avenue and the Santa Fe Railroad spur.

City of San Pablo

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of San Ramon

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

City of Walnut Creek

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

Contra Costa County (Unincorporated Areas)

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 1- and 0.2- percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale and a contour interval as shown on Table 12, "Topographic Map Information."

4.2 Floodways

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

City of Antioch

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

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 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 1, "Floodway Schematic."

Because Lake Alhambra has a pronounced impoundment effect on the 1-percent annual chance floodflow, no floodway has been delineated for the lake. No floodway has been delineated for the San Joaquin River due to permanent tidal inundation.

City of Brentwood

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

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 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 1, “Floodway Schematic.”

City of Clayton

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

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 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 1, “Floodway Schematic.”

City of Concord

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

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 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 1, “Floodway Schematic.”

Floodways were not determined for Pine Creek downstream of Treat Boulevard, Ditch No. 2, and Clayton Valley Drain due to shallow overflows leaving the streams.

The restudied floodways presented for Galindo Creek and Mount Diablo Creek were computed on the basis of equal conveyance reduction from each side of the floodplain.

Town of Danville

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

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 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 1, "Floodway Schematic."

Floodways were not applicable for those stream reaches on San Ramon, Sycamore, and Green Valley Creeks where the 1-percent annual chance floodflow is either contained within the channels, or results in shallow flooding.

The restudied floodway presented for Green Valley Creek was computed on the basis of equal conveyance reduction from each side of the floodplain.

City of El Cerrito

No floodways were computed for streams within the City of El Cerrito.

City of Hercules

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

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 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 1, "Floodway Schematic."

<u>City of Lafayette</u>

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

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 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 1, "Floodway Schematic."

For the entire lengths of Reliez and Grizzly Creeks and portions of Las Trampas Creek, the floodway is contained in the channel and no FIRM (Published Separately) has been prepared; therefore, cross sections are not presented for these areas on Table 13, "Floodway Data Table."

All restudied floodways were determined using method 4 or the equal conveyance reduction method. No floodway was designated for the City of Lafayette.

<u>City of Martinez</u>

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

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 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 1, "Floodway Schematic."

<u>Town of Moraga</u>

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections. The computed floodways are shown on the revised FIRM (Published

Separately). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

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 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 1, "Floodway Schematic."

City of Oakley

No floodways were computed for streams within the City of Oakley.

City of Orinda

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

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 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 1, "Floodway Schematic."

Floodways have been determined, based on FEMA guidelines, by limiting the maximum rise in water-surface elevation or energy gradeline to 1 foot, based on the HEC-2 floodplain encroachment analyses. Equal-conveyance reduction on each side of the stream channel was used where possible.

The restudied floodways were determined only where there is an existing channel, and not for overflow areas. A floodway could not be determined for the reach of the Brookside Road Tributary immediately upstream of Moraga Way. At this location, the flow overtops the right bank of the channel. When this overflow is confined to the channel such that it would pass through the Moraga Way culvert, the channel water-surface elevation would increase by more than 1 foot.

City of Pinole

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections. The computed floodways are shown on the revised FIRM (Published

Separately). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

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 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 1, "Floodway Schematic."

City of Pittsburg

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

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 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 1, "Floodway Schematic."

Because of the overflow nature of the flooding from Kirker Creek, both improvements to and encroachments on the creek would tend to increase the flood peak downstream and increase the overflow flooding elsewhere. The entire creek will have to be improved as one project in order to reduce flooding problems; therefore, no floodway was computed. The 1-percent annual chance flooding along Lawlor Creek is contained within the channel; therefore, no floodway was computed. A floodway was computed for Los Medanos Wasteway.

City of Pleasant Hill

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

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 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 1, "Floodway Schematic."

City of Richmond

Around Rheem Creek, west of the Union Pacific Railroad, and along Cerrito Creek, low-lying land areas slope away from the higher stream banks. Floodflows are shallow and are contributed to by tidal flooding, tsunamis, and other bay flooding conditions. In the area of Rheem Creek between the two railroads and the Cerrito Creek area, the 1-percent annual chance flood is confined by physical features such as railroad and highway fills and limited culvert capacities. Although some development exists in all of these areas, the effect of further development would simply mean displacing floodwaters to other adjacent areas. The encroachment concept of floodway determinations then becomes inapplicable.

City of San Pablo

No floodways were computed for the City of San Pablo because most areas of the city are subject to conditions of shallow overland flow outside the main stream channels.

City of San Ramon

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

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 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 1, "Floodway Schematic."

City of Walnut Creek

The floodways for Homestead and Pine Creeks were computed on the basis of equal-conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed.

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections. The computed floodways are shown on the revised FIRM (Published

Separately). In cases where the floodway and 1- percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Floodways were determined for Homestead and Pine Creeks only, as a potential for flood plain management still exists on these streams. The flood plain on all other study reaches within the City of Walnut Creek has been fully developed with encroachments that often extend to the channel bank. Flooding is widespread, with little relation to adjacent channels, rendering flooding delineation within the flood plain of little practical value. However, a de facto floodway exists on all streams within their active channel, and further encroachment beyond the top of existing banks is to be avoided.

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 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 1, "Floodway Schematic."

All restudied floodways were determined using Method 4 or the equal conveyance reduction method. No floodway was allowed to encroach inside the channel.

Contra Costa County (Unincorporated Areas)

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

No floodways were computed for those stream reaches where 1-percent annual chance floodflow was contained in the channel nor independent overbank flows bypass the channel such that the total flow would not be carried in the floodway.

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 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 1, "Floodway Schematic."

The restudied floodways presented in this restudy were computed on the basis of equal conveyance reduction from each side of the floodplain. No floodways have been computed for Wildcat or San Pablo Creeks due to the extensive amount of existing encroachments within the creeks' floodplains and channels.

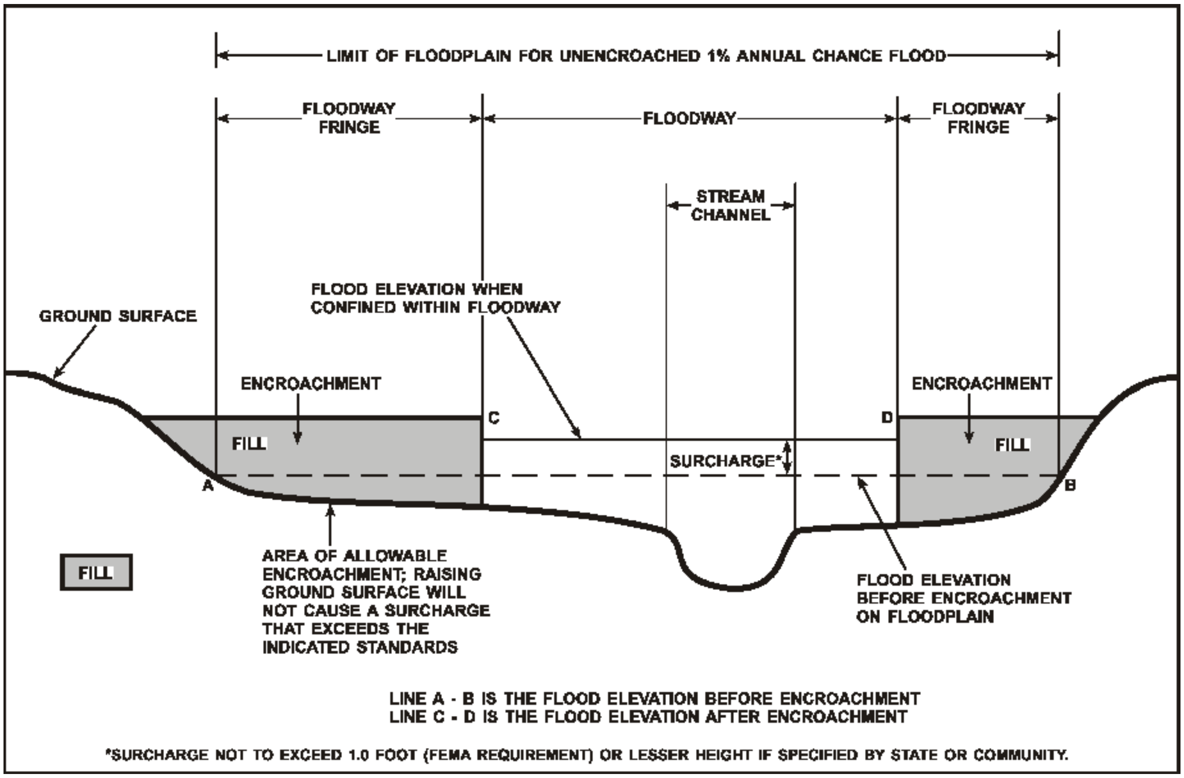

Figure 1. Floodway Schematic

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
Appian Creek								
A	3,550 [1]	*	*	*	115.4	115.4	*	*
B	4,750 [1]	35	180	3.6	128.8	128.8	128.8	0.0
C	5,300 [1]	29	108	4.5	136.2	136.3	137.3	1.0
Arroyo del Hambra Creek								
A-C [2]								
D	16,651 [3]	90	627	5.8	141.6	141.6	142.3	0.7
E	17,176 [3]	41	472	7.7	142.8	142.8	143.4	0.6
F	18,176 [3]	66	481	7.6	156.9	156.9	157.1	0.2
G	18,676 [3]	73	519	7.0	159.0	159.0	159.4	0.4
H	20,207 [3]	55	489	7.5	173.7	173.7	173.7	0.0
I	21,257 [3]	166	803	4.6	180.5	180.5	180.5	0.0
J	22,107 [3]	48	362	10.1	188.4	188.4	188.4	0.0
Brookside Road Tributary								
A	*	*	*	*	*	*	*	*
B	*	*	*	*	*	*	*	*
C	*	*	*	*	*	*	*	*
D	*	*	*	*	*	*	*	*
E	*	*	*	*	*	*	*	*

[1] Feet above confluence with San Pablo Creek
[2] No floodway determined
[3] Feet above mouth
* Data not available

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

APPIAN CREEK - ARROYO DEL HAMBRA CREEK - BROOKSIDE ROAD TRIBUTARY

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
Brushy Creek								
A	790	123	244	5.9	26.4	26.4	27.4	1.0
B	1,885	432	464	3.1	31.5	31.5	32.4	0.9
C	2,162	436	436	3.3	32.9	32.9	33.5	0.6
D	2,811	405	364	4.0	35.1	35.1	35.7	0.6
E	3,407	828	592	2.5	36.9	36.9	37.7	0.8
F	3,933	109	181	8.0	39.7	39.7	39.9	0.2
G	4,511	154	280	5.2	44.1	44.1	44.5	0.4
H	4,657	191	702	2.1	47.1	47.1	47.7	0.6
I	5,406	89	133	6.9	48.9	48.9	49.5	0.6
J	5,673	93	164	5.6	52.4	52.4	52.4	0.0
K	6,827	145	236	3.9	57.3	57.3	58.0	0.7
L	7,730	131	276	3.3	60.3	60.3	60.7	0.4
M	8,038	203	231	4.0	62.7	62.7	63.1	0.4
N	8,217	290	310	3.0	63.7	63.7	64.0	0.3
O	8,980	985	387	2.4	67.4	67.4	67.4	0.0
P	9,626	1,373	964	1.7	68.4	68.4	68.6	0.2
Q	10,684	479	469	3.4	70.1	70.1	70.8	0.7
R	12,080	204	291	5.6	78.5	78.5	79.3	0.8
S	13,589	197	303	5.3	87.4	87.4	88.2	0.8
T	14,017	151	259	5.4	89.5	89.5	90.3	0.8
U	14,403	64	152	9.3	92.5	92.5	92.9	0.4
V	15,464	179	279	5.1	98.9	98.9	99.4	0.5
W	16,181	99	339	10.5	102.6	102.6	103.4	0.8
X	16,753	277	671	5.3	106.9	106.9	106.9	0.0
Y	18,000	81	341	10.4	121.3	121.3	121.8	0.5
Z	19,281	56	292	12.2	139.7	139.7	140.0	0.3

[1]Feet above intersection Byron Highway and Clifton Ct Intersection

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

BRUSHY 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
Brushy Creek								
AA	20,043	140	455	7.9	149.6	149.6	149.6	0.0
AB	20,934	146	397	9.0	158.8	158.8	159.6	0.8
AC	21,723	246	483	7.4	168.0	168.0	168.4	0.4
AD	21,758	223	700	5.1	169.7	169.7	170.7	1.0
AE	21,881	113	377	9.5	171.1	171.1	172.0	0.9

[1]Feet above intersection Byron Highway and Clifton Ct Intersection

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

BRUSHY 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
Cascade Creek								
A	144[1]	59	254	1.4	400.4	400.4	400.4	0.0
B	883[1]	15	39	9.2	419.2	419.2	419.2	0.0
C	1,572[1]	25	46	7.8	455.1	455.1	455.1	0.0
Corliss Drive Tributary								
A	247[2]	65	65	4.8	508.5	508.5	508.5	0.0
B	863[2]	54	58	5.4	525.6	525.6	525.6	0.0
C	1,204[2]	65	205	1.5	532.1	532.1	532.1	0.0
D	1,900[2]	41	45	6.9	551.5	551.5	551.5	0.0
E	2,409[2]	27	43	7.2	569.3	569.3	569.3	0.0
Deer Creek								
A	10,670[3]	29	217	3.2	117.2	117.2	118.1	0.9
B	11,320[3]	28	201	3.5	119.0	119.0	119.8	0.8
C	13,569[3]	32	233	1.6	139.5	139.5	140.5	1.0

[1]Feet above confluence with San Pablo Creek
[2]Feet above confluence with Laguna Creek
[3]Feet above confluence with Marsh Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

CASCADE CREEK - CORLISS DRIVE TRIBUTARY - DEER 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
Donner Creek								
A	500 [1]	65	169	8.2	432.9	432.9	432.9	0.0
B	999 [1]	110	211	6.6	440.2	440.2	440.3	0.1
C	1,483 [1]	95	181	7.7	448.4	448.4	448.4	0.0
D	1,983 [1]	125	198	7.0	459.0	459.0	459.0	0.0
E	2,962 [1]	113	551	2.5	476.0	476.0	477.0	1.0
F	3,454 [1]	60	153	9.1	482.5	482.5	482.6	0.1
G	3,954 [1]	59	152	9.2	494.4	494.4	494.4	0.0
H	4,690 [1]	75	90	9.8	508.6	508.6	508.6	0.0
I	5,270 [1]	39	100	8.8	519.1	519.1	519.3	0.2
East Antioch Creek								
A	1,310 [2]	316	2,054	0.6	11.2	9.2 [3]	9.3	0.1
B	2,680 [2]	135	1,015	1.2	11.2	10.6 [3]	10.7	0.1
C	3,500 [2]	71	504	2.3	11.3	11.3	11.5	0.2
D	7,700 [2]	145	853	1.0	11.8	11.8	15.5	3.7
E	8,840 [2]	72	335	2.6	17.3	17.3	18.1	0.8
F	10,420 [2]	50	101	8.1	22.5	22.5	22.9	0.4
G	12,210 [2]	39	136	6.0	29.6	29.6	29.6	0.0
H	15,632 [2]	104	128	5.9	46.1	46.1	46.2	0.1
I	16,546 [2]	111	286	2.7	49.0	49.0	49.4	0.4
J	17,523 [2]	20	71	10.7	54.3	54.3	54.5	0.2
K	18,430 [2]	94	283	2.7	57.5	57.5	58.5	1.0
L	18,893 [2]	120	367	1.9	64.0	64.0	64.0	0.0
M	19,125 [2]	124	379	2.0	64.0	64.0	64.0	0.0

[1]Feet above confluence with Mt. Diablo Creek

[2]Feet above confluence with San Joaquin River

[3]Elevation computed without consideration of backwater effects from Suisun Bay

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

DONNER CREEK - EAST ANTIOCH 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 Branch Green Valley Creek								
A	116 [1]	43	235	6.6	427.1	427.1	427.1	0.0
B	570 [1]	44	165	9.4	434.6	434.6	434.6	0.0
C	1,251 [1]	47	181	8.6	445.2	445.2	446.0	0.8
D	2,210 [1]	38	170	9.1	460.4	460.4	460.4	0.0
East Branch Refugio Creek								
A	1,300 [2]	40	98	2.6	37.9	37.9	37.9	0.0
B	2,030 [2]	38	140	1.9	40.8	40.8	40.8	0.0
C	2,300 [2]	48	129	2.0	40.9	40.9	40.9	0.0
D	2,908 [2]	28	39	6.7	44.4	44.4	44.7	0.3
E	3,466 [2]	27	38	6.8	54.1	54.1	54.1	0.0
Farm Bureau Road Drain								
D	2,267 [3]	27	72	8.5	129.1	129.1	129.2	0.1
E	2,637 [3]	40	199	3.1	132.6	132.6	133.4	0.8

[1]Feet above confluence with Green Valley Creek
[2]Feet above confluence with Refugio Creek
[3]Feet above culvert entrance to Contra Costa Canal

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

EAST BRANCH GREEN VALLEY CREEK - EAST BRANCH REFUGIO CREEK - FARM BUREAU ROAD DRAIN

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
Frisk Creek Reach 1								
A	105 [1]	46	160	6.2	9.9	8.8 [2]	8.8	0.0
B	433 [1]	40	187	5.3	9.9	9.7 [2]	9.7	0.0
C	656 [1]	1,281	1,837	0.5	10.7	10.7	10.7	0.0 [3]
D	1879 [1]	1,037	2,452	0.4	10.8	10.8	10.8	0.0 [3]
E	2063 [1]	1,076	2,262	0.4	10.9	10.9	10.9	0.0 [3]
F	3189 [1]	784	1,862	0.5	11.0	11.0	11.0	0.0 [3]
G	3309 [1]	934	2,273	0.4	11.0	11.0	11.0	0.0 [3]
H	5634 [1]	1,838	2,525	0.4	11.2	11.2	11.2	0.0 [3]
I	8476 [1]	1,501	2,587	0.4	11.4	11.4	11.4	0.0 [3]
J	8615 [1]	1,408	3,782	0.3	11.4	11.4	11.4	0.0 [3]
Frisk Creek Reach 2								
K	2,814[4]	1,132	826	1.8	14.6	14.6	14.7	0.1
L	4,049[4]	689	813	1.8	18.7	18.7	19.0	0.3
M	4,212[4]	672	442	3.4	19.1	19.1	19.5	0.4
N	5,410[4]	617	696	2.2	23.6	23.6	24.2	0.6
O	5,555[4]	815	1,167	1.3	25.2	25.2	26.1	0.9
P	5,733[4]	917	312	4.8	26.7	26.7	26.9	0.2
Q	6,155[4]	1,001	631	2.4	29.6	29.6	30.1	0.5

[1] Feet above confluence with Discovery Bay
[2] Elevation computed without consideration of backwater effects from Discovery Bay
[3] The floodway is coincident with the 1% annual chance floodplain to maintain the storage area upstream of Highway 4
[4] Feet above confluence with Frisk Creek Reach 1

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

FRISK CREEK REACHES 1 AND 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
Galindo Creek								
A - S [2]								
T	16,620	105	382	5.9	151.8	151.8	152.8	1.0
U	17,220	95	338	6.7	155.2	155.2	155.6	0.4
V	17,770	54	246	9.2	158.9	158.9	159.0	0.1
W	18,270	52	234	9.4	163.8	163.8	164.0	0.2
X	18,590	45	170	12.9	166.1	166.1	166.2	0.1
Y	19,010	56	232	9.5	171.3	171.3	171.4	0.1
Z	19,330	46	272	8.1	172.9	172.9	173.9	1.0
AA	19,630	50	180	12.2	176.1	176.1	176.1	0.0
AB	19,880	61	348	6.2	178.1	178.1	178.1	0.0
AC	20,280	84	594	3.6	181.4	181.4	181.4	0.0
AD	20,680	50	347	6.2	181.5	181.5	181.5	0.0
AE	20,910	119	299	7.2	186.3	186.3	186.3	0.0
AF	21,440	55	227	9.4	191.0	191.0	191.1	0.1
AG	21,890	45	203	10.5	195.8	195.8	195.8	0.0
AH	22,540	55	257	8.3	201.8	201.8	202.1	0.3
AI	23,040	46	226	8.8	205.8	205.8	206.6	0.8
AJ	23,540	59	288	6.9	210.0	210.0	210.7	0.7
AK	24,040	42	209	9.5	213.8	213.8	214.3	0.5
AL	24,570	45	234	8.5	219.6	219.6	220.2	0.6
AM	25,318	207	219	5.9	226.4	226.4	226.4	0.0
AN	25,841	109	325	4.0	227.9	227.9	228.3	0.4
AO	26,296	41	134	9.7	233.5	233.5	233.9	0.4
AP	26,393	444	247	5.3	239.9	239.9	240.1	0.2
AQ	27,536	138	918	1.4	251.4	251.4	251.4	0.0
AR	29,000	32	141	9.2	260.4	260.4	261.4	1.0
AS	30,177	128	205	6.4	273.7	273.7	273.9	0.2

[1]Feet above mouth

[2]No floodway determined

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

GALINDO 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
Galindo Creek (Continued)								
AT	32,008[1]	70	942	1.4	296.8	296.8	296.8	0.0
AU	32,591[1]	39	150	4.7	303.1	303.1	303.1	0.0
AV	33,179[1]	22	70	10.2	317.3	317.3	317.3	0.0
AW	33,925[1]	80	112	7.8	336.8	336.8	336.9	0.1
Garrity Creek								
A	205[2]	80	270	5.8	9.9	7.2[3]	8.2	1.0
B	748[2]	66	366	4.3	10.5	10.5	10.7	0.2
C	1,444[2]	73	315	5.0	13.7	13.7	14.2	0.5
D	1,783[2]	55	325	4.8	14.8	14.8	15.8	1.0
E	2,147[2]	90	390	4.0	16.7	16.7	17.7	1.0
F	2,544[2]	63	326	4.8	19.3	19.3	20.0	0.7
G	2,901[2]	39	234	4.3	22.8	22.8	23.0	0.2
H	3,567[2]	27	179	5.6	24.8	24.8	25.2	0.4
I	3,909[2]	70	247	4.1	25.7	25.7	26.3	0.6
J	4,159[2]	41	187	5.3	26.0	26.0	26.4	0.4

[1]Feet above mouth

[2]Feet above confluence with San Pablo Bay

[3]Elevation computed without consideration of backwater effects from San Pablo Bay

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

GALINDO CREEK - GARRITY 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
Grayson Creek								
A	6,500	326	2,036	2.6	18.1/17.9 [2]	17.9	18.9	1.0
B	7,000	242	1,699	3.1	18.2/18.1 [2]	18.1	19.1	1.0
C	9,070	151	1,073	5.0	19.2/18.9 [2]	18.9	19.8	0.9
D	10,170	184	1,117	4.8	20.2	20.2	20.7	0.5
E	10,920	129	1,206	4.4	21.8	21.8	22.2	0.4
F	12,020	151	875	6.1	23.0	23.0	23.4	0.4
G	12,520	141	870	6.1	24.2	24.2	24.4	0.2
H	13,520	86	807	6.6	25.5	25.5	25.7	0.2
I	14,770	94	832	6.4	27.4	27.4	27.7	0.3
J	15,620	230	1,345	4.0	28.8	28.8	29.0	0.2
K	16,940	220	1,507	3.5	30.0	30.0	30.8	0.8

[1]Feet above confluence with Pacheco Creek

[2]With Levee/Without Levee

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

GRAYSON 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
Green Valley Creek								
A	1,855	57	413	9.8	359.6	359.6	359.9	0.3
B	2,569	78	342	11.8	371.8	371.8	371.8	0.0
C	3,257	155	692	5.8	377.3	377.3	378.3	1.0
D	3,785	91	373	9.5	379.8	379.8	380.0	0.2
E	5,412	204	758	4.7	392.4	392.4	392.4	0.0
F	6,750	119	657	5.4	404.9	404.9	405.1	0.2
G	7,558	46	260	13.6	412.4	412.4	412.4	0.0
H	7,903	61	448	7.9	416.4	416.4	416.4	0.0
I	9,023	67	244	5.7	431.7	431.7	431.9	0.2
J	9,407	80	281	5.0	435.2	435.2	435.2	0.0
K	9,877	35	137	10.2	437.2	437.2	437.5	0.3
L	10,357	55	201	7.0	444.4	444.4	444.4	0.0
M	10,857	80	203	6.9	449.5	449.5	449.6	0.1
N	12,053	35	129	10.9	463.1	463.1	463.1	0.0
O	13,397	31	176	8.0	485.7	485.7	485.7	0.0
P	14,440	32	132	10.6	506.8	506.8	506.8	0.0
Q	15,476	23	112	12.5	532.2	532.2	532.2	0.0
R	16,871	28	118	11.8	575.9	575.9	576.1	0.2

[1]Feet above confluence with San Ramon Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

GREEN VALLEY 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
Happy Valley Creek								
A	740[1]	37	134	9.2	297.3	297.3	297.3	0.0
B	1,775[1]	44	486	2.5	320.6	320.6	320.6	0.0
C	2,095[1]	100	599	2.1	328.2	328.2	328.2	0.0
D	3,225[1]	72	534	2.3	345.2	345.2	345.2	0.0
E	4,785[1]	35	197	6.2	364.3	364.3	364.3	0.0
F	5,555[1]	51	129	9.6	382.3	382.3	382.3	0.0
G	6,115[1]	48	128	9.6	396.8	396.8	396.8	0.0
H	7,295[1]	41	104	9.2	425.2	425.2	425.2	0.0
I	8,830[1]	59	241	3.9	461.6	461.6	461.6	0.0
J	9,685[1]	17	85	11.2	472.4	472.4	472.4	0.0
K	10,975[1]	38	128	7.4	499.0	499.0	499.0	0.0
L	12,085[1]	24	56	8.9	531.3	531.3	531.3	0.0
M	14,290[1]	17	36	8.3	585.0	585.0	595.0	10.0
Hidden Valley Creek								
A	3,725[1]	75	1,169	1.0	465.9	465.9	465.9	0.0
B	4,240[1]	43	353	3.2	465.9	465.9	465.9	0.0
C	5,355[1]	15	59	11.4	500.7	500.7	500.7	0.0
D	6,190[1]	49	88	7.6	526.6	526.6	526.6	0.0
Hillcrest Branch East Antioch Creek								
A	948[2]	51	41	5.1	19.4	14.8[3]	14.8[3]	0.0
B	1,285[2]	85	84	2.5	19.4	17.1[3]	17.1[3]	0.0
C	1,804[2]	56	42	5.0	21.8	21.8	21.8	0.0
D	2,621[2]	62	65	3.2	28.6	28.6	28.6	0.0

[1]Feet above confluence With Lafayette Creek
[2]Feet above confluence with West Branch East Antioch Creek
[3]Elevations computed without consideration of West Branch East Antioch Creek influence

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

HAPPY VALLEY CREEK - HIDDEN VALLEY CREEK - HILLCREST BRANCH EAST ANTIOCH 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
Homestead Creek								
A	6,985	186	709	1.0	126.3	126.3	127.3	1.0
B	7,585	220	626	1.1	126.8	126.8	127.7	0.9
C	8,275	188	272	1.4	131.1	131.1	132.0	0.9
Ivy Drive Tributary								
A	145 [1]	31	60	5.2	521.4	521.4	521.4	0.0
B	569 [1]	29	58	5.4	527.1	527.1	527.1	0.0
C	874 [1]	31	57	5.5	531.5	531.5	531.5	0.0
Jonas Hill Creek								
A	610 [2]	12	76	7.7	284.0	284.0	284.1	0.1
B	1,260 [2]	18	67	8.8	291.2	291.2	291.9	0.7
C	1,385 [2]	23	92	6.4	294.6	294.6	294.6	0.0
D	1,855 [2]	18	87	6.8	298.2	298.2	298.5	0.3
E	2,425 [2]	15	63	9.4	307.3	307.3	307.7	0.4
F	2,775 [2]	23	89	6.6	312.0	312.0	312.0	0.0
G	3,200 [2]	21	61	9.7	317.0	317.0	317.0	0.0
H	3,935 [2]	16	55	10.7	334.4	334.4	334.4	0.0
I	4,750 [2]	15	42	9.7	356.8	356.8	356.8	0.0
J	4,990 [2]	72	203	2.0	363.7	363.7	363.7	0.0
K	5,995 [2]	9	36	11.4	392.3	392.3	392.4	0.1
L	6,495 [2]	37	48	8.8	403.9	403.9	403.9	0.0

* Data not available
[1]Feet above confluence with Moraga Creek
[2]Feet above confluence with Las Trampas Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

HOMESTEAD CREEK - IVY DRIVE TRIBUTARY - JONAS HILL 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
Kellogg Creek								
A	59	60	395	3.2	9.9	9.9	10.3	0.4
B	633	110	765	1.7	10.3	10.3	10.7	0.4
C	2,170	70	385	3.3	10.7	10.7	11.1	0.4
D	3,456	991	933	1.4	12.1	12.1	12.1	0.0 [2]
E	3,585	609	1,681	1.7	15.8	15.8	16.0	0.2
F	6,539	604	604	4.7	16.7	16.7	17.1	0.4
G	7,075	571	974	2.9	19.3	19.3	20.2	0.9
H	7,959	478	1,009	2.8	22.6	22.6	23.2	0.6
I	8,049	481	1,447	1.9	22.8	22.8	23.4	0.6
J	9,387	812	1,473	1.9	26.2	26.2	27.1	0.9
K	10,682	636	1,180	2.4	30.5	30.5	31.4	0.9
L	10,858	664	1,719	1.6	33.1	33.1	33.3	0.2
M	11,571	384	492	5.7	33.7	33.7	34.3	0.6
N	12,690	371	515	5.5	37.6	37.6	38.2	0.6

[1] Feet above confluence with Discovery Bay
[2] The floodway is coincident with the 1% annual chance floodplain to maintain the storage area upstream of Highway 4

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

KELLOGG 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
Kirker Creek								
A	10,690	38	352	1.4	65.5	65.5	65.5	0.0
B	11,040	65	381	1.3	66.8	66.8	66.8	0.0
C	11,540	87	295	7.3	68.2	68.2	68.2	0.0
D	11,970	98	235	9.2	72.7	72.7	72.7	0.0
E	12,330	50	310	7.0	78.1	78.1	78.1	0.0
F	13,210	50	239	9.1	82.2	82.2	82.2	0.0
G	14,020	49	192	11.3	88.9	88.9	88.9	0.0
H	14,540	49	270	8.0	96.1	96.1	96.1	0.0
I	15,190	88	901	2.4	109.5	109.5	109.5	0.0
J	15,440	95	913	2.4	109.6	109.6	109.6	0.0
K	16,040	102	1,282	1.7	121.2	121.2	121.2	0.0
L	16,520	83	992	2.0	121.3	121.3	121.3	0.0
M	16,920	69	448	3.9	121.3	121.3	121.3	0.0
N	17,810	88	407	4.3	127.5	127.5	127.6	0.1
O	18,410	98	298	5.9	130.1	130.1	130.5	0.4
P	18,810	62	181	9.7	137.7	137.7	137.8	0.1
Q	19,710	239	1,728	1.0	157.9	157.9	157.9	0.0
R	20,240	49	208	11.8	157.9	157.9	157.9	0.0
S	21,090	129	1,640	1.5	199.0	199.0	199.0	0.0
T	21,630	119	1,274	1.9	199.0	199.0	199.0	0.0
U	22,300	105	1,297	1.9	210.4	210.4	210.5	0.1

[1] Distance in feet above confluence with Los Medanos Wasteway

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

KIRKER 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
Lafayette Creek								
A	230	51	392	7.9	269.5	265.8 [2]	265.8 [2]	0.0
B	710	39	259	12.0	269.5	269.5	269.5	0.0
C	850	33	370	8.4	276.3	276.3	276.3	0.0
D	1,635	45	238	13.0	278.2	278.2	278.3	0.1
E	2,120	108	447	6.9	285.6	285.6	285.8	0.2
F	2,705	31	223	7.8	289.8	289.8	290.0	0.2
G	3,650	31	148	11.8	295.3	295.3	295.4	0.1
H	3,840	10	142	12.3	303.5	303.5	303.5	0.0
I	5,300	54	211	8.2	311.5	311.5	312.3	0.8
J	5,630	52	286	6.1	315.0	315.0	315.0	0.0
K	6,740	69	360	4.8	322.6	322.6	322.6	0.0
L	7,110	49	204	8.5	323.9	323.9	323.9	0.0
M	7,840	38	249	7.0	329.7	329.7	329.7	0.0
N	8,070	39	154	11.3	333.2	333.2	333.2	0.0
O	8,840	51	168	10.4	343.6	343.6	343.6	0.0
P	9,605	37	193	9.0	352.8	352.8	352.8	0.0
Q	10,085	53	387	4.5	361.8	361.8	361.8	0.0
R	10,265	40	416	4.2	362.1	362.1	362.1	0.0
S	10,725	43	159	11.0	367.2	367.2	367.2	0.0
T	11,170	58	415	2.7	370.5	370.5	370.5	0.0

[1]Feet above confluence with Las Trampas Creek

[2]Elevation computed without consideration of backwater effect from Las Trampas Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

LAFAYETTE 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 Creek								
A	259	54	259	8.1	478.8	478.8	478.8	0.0
B	810	60	331	6.4	483.0	483.0	483.0	0.0
C	1,040	113	691	3.0	486.0	486.0	486.0	0.0
D	1,292	148	636	3.3	486.3	486.3	486.3	0.0
E	1,527	73	323	6.5	487.4	487.4	487.4	0.0
F	2,798	89	385	5.0	494.4	494.4	494.4	0.0
G	3,930	64	195	6.7	500.9	500.9	500.9	0.0
H	5,106	56	230	5.7	510.5	510.5	510.5	0.0
I	6,064	40	163	8.0	518.0	518.0	518.0	0.0
J	6,480	70	540	2.4	533.4	533.4	533.4	0.0
K	7,168	55	240	5.4	534.3	534.3	534.3	0.0
L	7,467	49	190	6.9	536.9	536.9	536.9	0.0
M	8,208	59	315	4.1	551.2	551.2	551.2	0.0
N	8,587	137	1,073	1.0	559.5	559.5	559.5	0.0
O	13,850	138	260	1.8	607.7	607.7	607.7	0.0
P	13,930	48	68	6.8	608.6	608.6	608.6	0.0
Q	14,380	186	265	1.7	613.6	613.6	613.6	0.0
R	14,559	82	75	6.1	617.3	617.3	617.3	0.0
S	14,766	114	344	1.3	622.1	622.1	622.1	0.0
T	14,821	77	267	1.7	622.1	622.1	622.1	0.0
U	15,437	23	53	8.7	637.3	637.3	637.3	0.0
V	16,271	52	100	4.6	661.6	661.6	661.6	0.0
W	17,220	47	67	6.9	688.9	688.9	688.9	0.0

[1] Feet above confluence with Moraga Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

LAGUNA 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
Larch Creek								
A	242	21	30	5.1	469.9	262.7 [2]	262.7 [2]	0.0
B	527	33	29	5.4	471.6	471.6	471.6	0.0
C	756	96	313	0.5	476.0	476.0	476.0	0.0
D	1,469	50	33	4.6	483.7	483.7	483.7	0.0
E	1,678	34	29	5.4	487.4	487.4	487.4	0.0
F	2,265	57	71	2.2	496.9	496.9	496.9	0.0
G	2,590	29	28	5.6	503.3	503.3	503.3	0.0

[1]Feet above confluence with Moraga Creek

[2]Elevation computed without consideration of backwater effect from Moraga Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

LARCH 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
Las Trampas Creek								
A	1,570	53	1,464	6.1	146.4	146.4	146.4	0.0
B	2,420	108	1,018	7.5	148.7	148.7	148.7	0.0
C	3,000	111	1,065	7.1	150.0	150.0	150.0	0.0
D	3,640	104	1,085	7.0	151.8	151.8	151.8	0.0
E	4,740	104	1,154	6.6	161.4	161.4	161.4	0.0
F	5,910	74	636	11.9	164.3	164.3	164.3	0.0
G	7,110	76	673	11.3	169.0	169.0	169.0	0.0
H	9,010	63	805	9.4	184.6	184.6	184.6	0.0
I	10,250	78	1,161	6.5	192.0	192.0	192.0	0.0
J	11,370	63	759	10.0	196.2	196.2	196.2	0.0
K	12,330	76	918	8.3	202.0	202.0	202.1	0.1
L	17,144	71	627	12.0	224.9	224.9	224.9	0.0
M	17,654	77	727	10.3	228.6	228.6	228.6	0.0
N	19,024	64	752	10.0	234.7	234.7	234.7	0.0
O	19,799	73	773	9.7	236.7	236.7	236.7	0.0
P	20,304	84	779	9.6	239.2	239.2	239.2	0.0
Q	20,989	92	1,165	6.4	254.6	254.6	254.7	0.1
R	22,509	81	818	9.2	257.2	257.2	257.3	0.1
S	23,309	77	905	8.3	260.0	260.0	260.0	0.0
T	23,719	77	813	5.3	269.6	269.6	269.9	0.3
U	24,769	51	495	8.7	272.1	272.1	272.2	0.1
V	25,824	67	594	6.1	279.8	279.8	279.8	0.0
W	*	*	*	*	*	*	*	*
X	28,084	65	449	6.4	296.2	296.2	296.2	0.0
Y	28,584	53	408	8.8	304.8	304.8	304.8	0.0
Z	28,884	59	500	7.2	307.0	307.0	307.0	0.0

[1]Feet above confluence with San Ramon Creek

* Data not available

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

LAS TRAMPAS 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
Las Trampas Creek (Continued)								
AA	29,714	73	519	6.9	310.4	310.4	310.4	0.0
AB	31,509	54	510	7.1	321.7	321.7	321.7	0.0
AC	32,274	85	676	5.3	324.2	324.2	324.2	0.0
AD	32,939	40	356	10.1	329.7	329.7	329.7	0.0
AE	33,644	77	382	9.4	334.8	334.8	334.8	0.0
AF	34,494	56	424	8.5	339.8	339.8	339.8	0.0
AG	35,314	62	517	7.0	349.0	349.0	349.0	0.0
AH	36,379	40	354	10.2	358.0	358.0	358.0	0.0
AI	37,309	53	578	6.2	361.9	361.9	361.9	0.0
AJ	37,889	69	479	7.5	364.1	364.1	364.1	0.0
AK - AL [2]								
AM	39,789	53	353	6.8	384.9	384.9	384.9	0.0
AN	40,589	61	412	5.8	388.9	388.9	388.9	0.0
AO - AR [2]								
AS	46,939	56	287	8.4	460.0	460.0	460.0	0.0
AT	49,149	85	269	8.9	484.8	484.8	484.8	0.0
AU	50,764	69	238	10.1	526.9	526.9	526.9	0.0
AV	51,334	113	2,139	1.1	554.0	554.0	554.0	0.0
AW	51,789	205	2,292	0.7	554.0	554.0	554.0	0.0
AX	51,969	589	3,542	0.4	579.2	579.2	579.2	0.0
AY	53,124	112	1,127	1.3	579.3	579.3	579.3	0.0
AZ	54,284	67	139	10.8	584.6	584.6	584.6	0.0
BA	55,134	191	659	2.3	593.2	593.2	593.2	0.0
BB	55,994	62	155	9.7	605.4	605.4	605.4	0.0

[1] Feet above confluence with San Ramon Creek
[2] Data not available

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

LAS TRAMPAS 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
Lauterwasser Creek								
A	275 [1]	78	502	2.6	394.2	394.2	394.2	0.0
B	792 [1]	55	532	2.5	405.4	405.4	405.4	0.0
C	1,482 [1]	81	657	2.0	410.2	410.2	410.2	0.0
D	2,711 [1]	63	583	2.2	425.5	425.5	425.5	0.0
E	3,453 [1]	81	832	1.6	432.6	432.6	432.6	0.0
F	4,112 [1]	52	444	2.9	439.4	439.4	439.4	0.0
G	5,454 [1]	88	603	2.2	453.5	453.5	453.5	0.0
H	7,001 [1]	60	262	5.0	478.1	478.1	478.1	0.0
I	7,400 [1]	77	553	2.4	490.9	490.9	490.9	0.0
J	8,148 [1]	23	70	9.9	495.1	495.1	495.1	0.0
K	8,851 [1]	30	147	4.7	519.0	519.0	519.0	0.0
L	9,666 [1]	36	98	7.0	540.2	540.2	540.2	0.0
Lawlor Creek								
A	4,480 [2]	26	71	5.6	20.8	20.8	20.8	0.0
B	6,633 [2]	84	376	1.1	52.7	52.7	52.7	0.0
C	7,220 [2]	22	47	8.4	53.9	53.9	53.9	0.0
D	7,530 [2]	35	93	4.3	58.6	58.6	58.6	0.0
E	8,379 [2]	21	43	8.2	70.0	70.0	70.0	0.0
F	8,971 [2]	77	81	4.3	78.3	78.3	78.5	0.2
G	9,383 [2]	54	100	3.5	82.4	82.4	82.4	0.0

[1]Feet above confluence with San Pablo Creek
[2]Feet above confluence with Honker Bay

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

LAUTERWASSER CREEK - LAWLOR 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
Line A, DA-40								
A	530 [1]	39	219	4.3	24.9	24.9	25.9	1.0
Los Medanos Wasteway								
A	959 [2]	69	280	4.4	11.2	9.4 [3]	9.4	0.0
B	1,631 [2]	74	287	4.3	11.2	10.4 [3]	10.4	0.0
C	1,912 [2]	62	330	3.8	11.2	10.7 [3]	11.7	1.0
D	1,945 [2]	37	120	10.4	12.5	12.5	12.5	0.0
E	2,034 [2]	45	177	7.0	13.9	13.9	13.9	0.0
F	2,793 [2]	43	164	7.5	16.3	16.3	16.3	0.0
G	3,478 [2]	45	225	5.5	18.2	18.2	18.2	0.0
H	4,265 [2]	81	334	3.7	19.2	19.2	19.3	0.1
I	4,466 [2]	62	1,289	1.0	19.3	19.3	19.6	0.3
J	4,715 [2]	22	54	5.4	21.1	21.1	21.1	0.0
K	5,073 [2]	29	102	2.8	22.0	22.0	22.0	0.0
L	5,237 [2]	31	120	2.4	22.1	22.1	22.1	0.0
M	5,412 [2]	33	126	2.3	22.2	22.2	22.2	0.0
N	5,520 [2]	8	30	9.7	26.0	26.0	26.0	0.0
O	5,881 [2]	8	31	9.6	27.9	27.9	27.9	0.0
P	6,301 [2]	23	67	4.3	53.0	53.0	53.0	0.0
Q	6,995 [2]	37	73	4.0	54.3	54.3	54.3	0.0
R	7,788 [2]	51	750	0.2	58.0	58.0	58.0	0.0
S	8,207 [2]	47	750	0.2	58.0	58.0	58.0	0.0
T	8,856 [2]	32	73	2.1	72.8	72.8	72.8	0.0
U	9,470 [2]	30	31	4.8	74.4	74.4	74.4	0.0
V	10,462 [2]	28	26	5.9	122.0	122.0	122.0	0.0

[1]Feet above Pacheco Boulevard
[2]Feet above mouth
[3]Elevation computed without consideration of backwater effects from Suisun Bay

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

LINE A, DA-40 - LOS MEDANOS WASTEWAY

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
Mangini Creek								
A	845 [1]	28	178	5.4	76.1	76.1	76.1	0.0
B	1,235 [1]	31	97	10.0	77.8	77.8	77.9	0.1
Markley Creek								
A	125 [2]	55	112	6.1	23.1	23.1	23.1	0.0
B	842 [2]	28	90	7.6	30.9	30.9	30.9	0.0
C	1,262 [2]	30	111	6.2	33.4	33.4	33.4	0.0
D	1,790 [2]	42	148	4.6	35.3	35.3	35.3	0.0
E	2,140 [2]	77	509	1.3	44.2	44.2	44.2	0.0
F	2,445 [2]	75	480	1.4	44.2	44.2	44.2	0.0
G	2,889 [2]	73	442	1.5	44.4	44.4	44.4	0.0
H	3,657 [2]	71	420	1.6	45.0	45.0	45.0	0.0
I	4,502 [2]	78	103	6.6	56.4	56.4	56.4	0.0
J	5,110 [2]	55	92	7.4	63.6	63.6	63.6	0.0
K	5,440 [2]	60	340	2.0	73.4	73.4	73.4	0.0
L	6,256 [2]	29	74	9.2	79.4	79.4	79.4	0.0
M	6,571 [2]	46	163	3.5	84.6	84.6	85.1	0.5
N	7,104 [2]	32	69	8.4	87.9	87.9	87.9	0.0
O	7,579 [2]	45	88	6.5	94.4	94.4	94.4	0.0
P	8,212 [2]	61	122	4.7	99.3	99.3	99.3	0.0
Q	9,035 [2]	42	75	7.7	106.6	106.6	106.6	0.0
R	10,005 [2]	38	75	7.7	121.4	121.4	121.4	0.0
S	11,039 [2]	18	56	10.2	145.9	145.9	145.9	0.0
T	11,459 [2]	18	56	10.2	154.7	154.7	154.7	0.0

[1]Feet above confluence with West Fork Grayson Creek

[2]Feet above confluence with West Antioch Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

MANGINI CREEK - MARKLEY 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
Marsh Creek								
A	9,975	113	805	3.6	20.0	20.0	21.0	1.0
B	10,864	94	689	4.1	21.3	21.3	21.9	0.6
C	11,561	82	582	4.9	22.4	22.4	22.9	0.5
D	12,058	455	2,924	3.3	23.4	23.4	23.8	0.4
E	12,854	93	561	4.7	25.0	25.0	25.2	0.2
F	13,451	92	575	4.5	26.0	26.0	26.1	0.1
G	14,042	108	600	4.3	26.9	26.9	27.0	0.1
H	14,838	97	489	5.3	28.6	28.6	28.8	0.2
I	15,535	76	487	5.4	30.3	30.3	30.4	0.1
J	16,132	104	499	5.3	31.5	31.5	31.6	0.1
K	16,629	126	585	4.5	32.8	32.8	32.9	0.1
L	17,326	112	513	5.2	34.3	34.3	34.3	0.0
M	17,823	94	559	0.8	35.6	35.6	35.6	0.0
N	18,818	179	651	4.2	37.6	37.6	37.8	0.2
O	19,987	90	640	4.5	40.2	40.2	40.2	0.0
P	20,783	105	606	4.8	41.6	41.6	42.4	0.8
Q	21,778	221	683	4.1	43.6	43.6	44.0	0.4
R	22,749	82	542	5.2	45.4	45.4	45.5	0.1
S	23,256	76	492	6.2	50.9	50.9	51.0	0.1
T	23,654	94	472	6.4	52.3	52.3	52.4	0.1
U	24,351	437	1,142	2.7	54.0	54.0	54.5	0.5
V	24,848	199	642	4.7	54.7	54.7	55.1	0.4
W	25,346	116	585	5.2	55.8	55.8	56.0	0.2
X	25,843	107	577	5.2	57.0	57.0	57.1	0.1
Y	26,341	76	539	5.6	57.8	57.8	58.0	0.2
Z	26,938	72	479	6.2	58.7	58.7	59.1	0.4

[1]Feet above confluence with Dutch Slough

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

MARSH 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
Marsh Creek								
AA	27,833	93	583	5.2	61.5	61.5	61.6	0.1
AB	28,330	71	460	5.9	62.4	62.4	62.5	0.1
AC	28,728	85	484	5.6	63.4	63.4	63.4	0.0
AD	29,723	124	606	4.5	65.3	65.3	65.5	0.2
AE	30,320	142	591	6.0	66.4	66.4	66.6	0.2
AF	30,718	111	465	5.8	67.3	67.3	67.5	0.2
AG	31,415	135	575	4.6	69.3	69.3	69.4	0.1
AH	32,420	583	1,207	2.2	71.4	71.4	71.4	0.0
AI	33,116	147	685	3.5	72.7	72.7	72.8	0.1
AJ	33,713	85	483	5.0	73.6	73.6	73.8	0.2
AK	34,460	91	464	5.3	74.7	74.7	75.0	0.3
AL	36,059	47	417	2.8	76.2	76.2	76.8	0.6
AM	36,619	103	406	2.9	77.8	77.8	77.8	0.0
AN	37,096	86	365	3.2	78.1	78.1	78.2	0.1
AO	37,591	93	287	3.9	79.2	79.2	79.3	0.1
AP	38,116	87	295	3.8	81.5	81.5	81.6	0.1
AQ	38,616	71	301	3.7	83.1	83.1	83.1	0.0
AR	39,116	78	391	2.8	84.5	84.5	84.5	0.0
AS	39,716	86	350	3.2	85.7	85.7	85.7	0.0
AT	40,124	70	242	4.6	86.3	86.3	86.3	0.0
AU	40,759	139	288	3.2	87.2	87.2	87.2	0.0
AV	41,350	153	307	3.0	88.4	88.4	88.4	0.0

[1]Feet above confluence with Dutch Slough

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

MARSH 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
Middle Branch West Antioch Creek								
A	175 [1]	80	68	3.0	59.2	59.2	59.5	0.3
B	339 [1]	66	43	4.6	60.0	60.0	60.0	0.0
C	950 [1]	58	284	0.7	70.9	70.9	70.9	0.0
D	1,170 [1]	41	229	0.9	71.2	71.2	71.2	0.0
E	1,579 [1]	50	186	1.1	71.2	71.2	71.2	0.0
F	1,856 [1]	50	75	2.7	73.6	73.6	73.6	0.0
G	2,466 [1]	50	27	7.5	76.8	76.8	76.8	0.0
H	2,973 [1]	43	31	6.5	86.7	86.7	86.7	0.0
I	3,989 [1]	50	28	7.0	98.8	98.8	98.8	0.0
J	4,350 [1]	51	54	3.7	102.4	102.4	102.4	0.0
K	5,033 [1]	91	48	4.2	113.3	113.3	113.3	0.0
L	5,277 [1]	34	35	5.7	116.2	116.2	116.2	0.0
M	5,990 [1]	59	42	4.8	134.9	134.9	134.9	0.0
Miranda Creek								
A	436 [2]	52	331	2.3	284.3	284.3	284.3	0.0
B	1,016 [2]	39	88	8.5	288.0	288.0	288.0	0.0
C	1,707 [2]	19	69	10.9	307.8	307.8	307.8	0.0
D	3,189 [2]	22	72	10.4	324.9	324.9	325.1	0.2
E	5,248 [2]	27	77	9.7	338.4	338.4	338.4	0.0
F	6,477 [2]	32	158	4.7	351.2	351.2	351.2	0.0
G	7,186 [2]	25	75	10.0	354.3	354.3	354.3	0.0
H	7,659 [2]	36	85	8.8	361.3	361.3	361.3	0.0

[1]Feet above confluence with West Antioch Creek
[2]Feet above confluence with San Ramon Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

MIDDLE BRANCH WEST ANTIOCH CREEK - MIRANDA 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
Mitchell Creek								
A	750	90	208	8.7	395.0	395.0	395.0	0.0
B	1,100	107	320	5.7	402.1	402.1	403.0	0.9
C	1,645	45	164	11.0	410.7	410.7	410.8	0.1
D	1,925	80	218	8.3	418.0	418.0	418.5	0.5
E	2,655	80	293	6.2	428.2	428.2	429.1	0.9
F	3,155	44	164	11.1	438.4	438.4	438.4	0.0
G	4,345	55	242	7.5	466.0	466.0	466.5	0.5
H	5,016	88	246	7.4	478.7	478.7	478.7	0.0
I	5,690	58	245	7.4	493.5	493.5	493.5	0.0
J	6,491	130	271	6.7	514.7	514.7	514.7	0.0

[1]Feet above confluence with Mt. Diablo Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

MITCHELL 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
Moraga Creek								
A	1,000	87	707	7.1	469.8	456.7	456.7	0.0
B	1,308	104	839	6.0	469.8	457.7	457.7	0.0
C	3,532	96	700	6.0	469.9	466.7 [2]	466.7 [2]	0.0
D	4,352	57	312	13.4	470.7	470.7	470.7	0.0
E	5,246	82	645	5.9	477.7	477.7	477.7	0.0
F	5,697	54	315	5.4	478.9	478.9	478.9	0.0
G	6,446	51	216	7.9	482.2	482.2	482.2	0.0
H	6,816	59	352	4.8	484.3	484.3	484.3	0.0
I	6,953	50	200	8.5	489.6	489.6	489.6	0.0
J	7,555	51	237	7.2	495.0	495.0	495.0	0.0
K	7,609	104	318	5.3	499.6	499.6	499.6	0.0
L	8,088	137	434	3.9	501.8	501.8	501.8	0.0
M	8,535	66	271	6.3	503.4	503.4	503.4	0.0
N	9,110	49	164	10.4	510.0	510.0	510.0	0.0
O	9,778	61	316	5.4	515.8	515.8	515.8	0.0
P	9,979	53	239	4.6	518.9	518.9	518.9	0.0
Q	10,123	49	242	4.5	519.1	519.1	519.1	0.0
R	11,007	96	482	2.3	524.7	524.7	524.7	0.0
S	11,622	42	163	6.8	524.8	524.8	524.8	0.0
T	12,368	50	150	7.3	535.0	535.0	535.0	0.0
U	13,164	76	433	2.5	550.0	551.0	551.0	0.0
V	13,940	47	120	9.2	551.5	551.5	551.5	0.0
W	14,837	139	774	1.4	577.6	577.6	577.6	0.0
X	16,085	34	74	8.3	584.0	584.0	584.0	0.0
Y	16,788	35	51	6.9	608.5	608.5	608.5	0.0

[1]Feet above confluence with San Leandro Reservoir

[2]Elevation computed without consideration of backwater from Upper San Leandro Reservoir

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

MORAGA 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
Mt. Diablo Creek								
A	2,868	2,539	9,589	0.8	10.6	10.6	11.1	0.5
B	7,732	715	2,372	2.6	17.3	17.3	18.1	0.8
C	17,186	404	1,937	2.1	64.8	64.8	64.8	0.0
D	22,294	74	454	8.9	97.2	97.2	98.1	0.9
E	23,945	63	536	7.5	112.2	112.2	112.4	0.2
F	35,886	46	472	5.9	195.4	195.4	195.8	0.4
G	40,125	300	1,578	3.9	221.9	221.9	222.3	0.4
H	41,576	60	600	11.3	229.0	229.0	229.0	0.0
I	44,086	77	916	6.2	250.3	250.3	250.5	0.2
J	45,148	243	1,334	4.3	256.2	256.2	257.0	0.8
K	49,162	86	769	7.6	290.7	290.7	291.7	1.0
L	50,216	200	867	11.1	308.5	308.5	308.9	0.4
M	50,861	202	846	8.8	310.8	310.8	311.5	0.7
N	51,912	163	659	11.7	321.1	321.1	321.9	0.8
O	53,432	85	457	12.8	338.0	338.0	338.0	0.0
P	54,312	265	781	7.5	344.4	344.4	344.5	0.1
Q	55,662	99	373	11.0	355.7	355.7	355.7	0.0
R	56,262	147	561	7.3	361.6	361.6	361.6	0.0
S	57,012	148	640	6.4	369.7	369.7	369.7	0.0
T	57,612	89	518	11.3	375.3	375.3	376.2	0.9
U	57,892	190	631	9.3	378.8	378.8	378.8	0.0
V	58,639	75	302	14.6	387.0	387.0	387.0	0.0
W	60,990	70	317	9.9	415.6	415.6	415.6	0.0
X	61,788	123	329	9.5	423.2	423.2	423.3	0.1
Y	62,508	84	225	7.8	430.9	430.9	431.0	0.1
Z	64,038	67	237	7.4	452.3	452.3	452.8	0.5

[1]Feet above confluence with Suisun Bay

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

MT. DIABLO 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
Mt. Diablo Creek (Continued)								
AA	65,083 [1]	63	277	6.3	466.5	466.5	466.5	0.0
AB	66,038 [1]	89	313	5.6	480.2	480.2	480.2	0.0
AC	67,058 [1]	51	181	9.6	497.2	497.2	497.2	0.0
AD	69,008 [1]	40	145	10.9	535.8	535.8	535.8	0.0
AE	72,072 [1]	70	249	5.7	584.1	584.1	584.8	0.7
Mt. Diablo Creek-Split Flow								
A	620 [2]	230	453	8.0	353.1	353.1	353.1	0.0
B	1,170 [2]	399	616	5.9	358.3	358.3	358.5	0.2
North Branch Stone Valley Creek								
A	364 [3]	22	40	7.6	295.4	295.4	295.4	0.0
B	612 [3]	21	39	7.7	302.7	302.7	302.7	0.0
C	1,288 [3]	19	38	8.0	311.8	311.8	311.8	0.0
D	1,823 [3]	17	43	7.0	317.6	317.6	318.1	0.5

[1]Feet above confluence with Suisun Bay
[2]Feet above convergence with Mt. Diablo Creek
[3]Feet above confluence with Stone Valley Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

MT. DIABLO CREEK - MT. DIABLO CREEK SPLIT FLOW - NORTH BRANCH STONE VALLEY 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
Overhill Creek								
A	323 [1]	26	114	2.2	477.5	477.5	477.5	0.0
B	1,241 [1]	15	31	8.2	513.7	513.7	513.7	0.0
C	1,994 [1]	16	73	3.4	535.2	535.2	535.2	0.0
Payton Slough								
A	5,885 [2]	200	1,606	0.5	11.2	11.2	11.2	0.0
B	6,650 [2]	100	812	0.9	11.2	11.2	11.2	0.0
C	8,368 [2]	100	781	1.0	11.2	11.2	11.4	0.2
D	8,910 [2]	100	885	0.8	11.2	11.2	11.4	0.2
E	9,578 [2]	100	736	1.0	11.2	11.2	11.4	0.2
F	9,833 [2]	100	849	0.9	15.7	15.7	15.7	0.0
G	10,437 [2]	100	701	0.6	15.7	15.7	15.7	0.0

[1]Feet above confluence with San Pablo Creek
[2]Feet above confluence with Suisun Bay

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY
CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

OVERHILL CREEK - PAYTON SLOUGH

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
Pinole Creek								
A	1,648	54	321	7.2	*	8.9 [2]	8.9	0.0
B	1,778	95	465	5.0	*	8.9 [2]	9.4	0.5
C	2,260	83	397	5.8	*	9.6 [2]	10.1	0.5
D	2,850	88	434	5.3	11.5	11.5	11.8	0.3
E	3,480	57	287	8.1	12.4	12.4	12.5	0.1
F	3,980	58	292	7.9	14.2	14.2	14.2	0.0
G	4,335	59	303	7.7	15.5	15.5	15.5	0.0
H	4,435	22	154	15.1	15.5	15.5	15.5	0.0
I	4,693	22	193	12.0	17.7	17.7	17.7	0.0
J	4,885	77	553	4.2	21.2	21.2	21.2	0.0
K	5,500	69	433	5.4	21.5	21.5	21.5	0.0
L	5,550	74	466	5.0	21.5	21.5	22.5	1.0
M	5,900	67	431	5.4	21.9	21.9	22.7	0.8
N	6,180	25	285	8.1	24.2	24.2	25.0	0.8
O	6,620	76	527	4.4	25.5	25.5	26.1	0.6
P	6,710	56	261	8.9	27.4	27.4	27.4	0.0
Q	7,300	57	278	8.3	29.7	29.7	29.7	0.0
R	7,900	47	242	9.6	31.4	31.4	31.4	0.0
S	8,371	59	315	7.4	33.5	33.5	33.5	0.0
T	8,461	66	394	5.9	38.6	38.6	38.6	0.0
U	8,771	58	297	7.8	38.9	38.9	38.9	0.0
V	9,225	49	370	6.1	44.6	44.6	44.6	0.0
W	9,680	29	164	13.6	45.9	45.9	45.9	0.0
X	9,985	44	331	6.8	49.9	49.9	50.0	0.1
Y	10,282	60	392	6.7	50.8	50.8	51.0	0.2
Z	10,592	46	274	8.2	51.4	51.4	52.4	1.0

[1]Feet above mouth
[2]Elevation computed without consideration of backwater effects from San Pablo Bay
* Controlled by coastal flooding - see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 13	FEDERAL EMERGENCY MANAGEMENT AGENCY **CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS**	**FLOODWAY DATA** **PINOLE 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
Pinole Creek (Continued)								
AA	11,190	51	301	7.4	55.2	55.1	55.2	0.1
AB	11,564	51	359	6.2	58.1	58.1	58.1	0.0
AC	12,164	42	273	8.2	60.0	60.0	60.0	0.0
AD	12,732	51	413	5.4	63.0	62.6	63.0	0.4
AE	13,353	71	393	5.7	65.0	65.0	65.9	0.9
AF	13,945	59	428	5.2	69.4	69.4	70.1	0.7
AG	14,307	58	458	4.9	74.1	73.1	74.1	1.0
AH	14,833	59	517	4.3	77.0	76.6	77.0	0.4
AI	15,375	73	722	3.1	78.3	78.1	78.3	0.2
AJ	15,520	38	310	7.2	84.8	84.8	84.8	0.0
AK	16,392	43	265	8.5	93.7	93.6	93.7	0.1
AL	17,141	71	572	3.9	99.7	99.7	99.7	0.0
AM	17,582	76	586	3.8	101.1	101.1	101.1	0.0
AN	17,842	50	441	5.1	102.3	102.3	102.3	0.0
AO	20,280	68	388	5.9	125.7	125.7	125.7	0.0
AP	21,175	74	477	4.7	131.3	131.3	131.3	0.0
AQ	22,053	39	286	7.8	139.1	139.1	139.1	0.0

[1]Feet above mouth

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

PINOLE 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
Refugio Creek								
A	675	60	332	7.4	14.0	14.0	14.0	0.0
B	1,998	308	1,992	2.7	16.4	16.4	17.3	0.9
C	2,136	380	2,359	2.0	16.5	16.5	17.4	0.9
D	2,281	360	1,884	2.6	16.5	16.5	17.4	0.9
E	2,619	425	2,094	2.4	16.7	16.7	17.6	0.9
F	3,094	97	606	5.9	17.8	17.8	18.8	1.0
G	3,895	90	594	6.9	20.7	20.7	21.4	0.7
H	4,652	160	524	10.3	25.4	25.4	25.5	0.1
I	4,996	150	277	3.5	27.3	27.3	27.9	0.6
J	6,728	26	142	4.2	42.2	42.2	42.3	0.1
K	8,107	50	172	2.9	52.7	52.7	52.7	0.0
L	8,647	47	137	3.6	52.7	52.7	52.7	0.0
M	10,062	44	220	2.3	63.7	63.7	63.7	0.0
N	11,325	39	126	4.1	76.4	76.4	76.4	0.0
O	11,887	63	234	2.2	81.8	81.8	81.8	0.0
P	12,462	46	178	2.8	83.6	83.6	83.6	0.0
Q	14,820	62	97	4.2	106.0	106.0	106.0	0.0
R	15,736	66	134	3.0	118.1	118.1	118.1	0.0
S	16,570	63	112	3.6	135.7	135.7	135.7	0.0
T	17,579	57	76	5.4	160.0	160.0	160.0	0.0
U	18,879	41	80	4.1	179.5	179.5	179.5	0.0
Rodeo Creek								
A	1,573	*	*	*	14.3	14.3	*	*
B	2,856	*	*	*	16.9	16.9	*	*
C	3,823	*	*	*	19.9	19.9	*	*
D	5,065	*	*	*	23.4	23.4	*	*
E	5,925	*	*	*	30.4	30.4	*	*

[1]Feet above mouth

* Data not available

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

REFUGIO CREEK - RODEO 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
San Pablo Creek								
A-O [2]								
P	72,159	162	2,443	2.7	342.8	342.8	342.8	0.0
Q	73,059	190	1,170	5.3	344.7	344.7	344.7	0.0
R	73,989	248	1,514	4.4	354.1	354.1	354.4	0.3
S	75,559	178	1,214	5.5	365.9	365.9	365.9	0.0
T	76,351	117	900	7.4	370.9	370.9	370.9	0.0
U	77,315	80	742	9.0	379.7	379.7	379.7	0.0
V	78,042	69	539	10.8	389.2	389.2	389.2	0.0
W	78,795	157	884	5.4	397.4	397.4	397.4	0.0
X	79,444	91	568	7.8	399.9	399.9	399.9	0.0
Y	79,996	51	352	1.5	404.9	404.9	404.9	0.0
Z	81,512	90	74	6.5	433.9	433.9	433.9	0.0
AA	82,220	60	541	9.3	440.3	440.3	440.4	0.1
AB	82,755	57	353	14.3	442.0	442.0	442.1	0.1
AC	85,164	19	413	6.2	481.1	481.1	481.1	0.0
AD	86,167	46	374	6.0	481.5	481.5	482.1	0.6
AE	87,179	40	352	5.2	498.4	498.4	498.4	0.0
AF	87,734	82	1,050	1.8	510.3	510.3	510.3	0.0
AG	88,603	45	246	7.5	510.4	510.4	510.6	0.2
AH	89,392	39	245	7.5	521.8	521.8	521.8	0.0
AI	90,102	43	258	5.7	529.8	529.8	529.9	0.1
AJ	90,173	36	169	8.7	530.4	530.4	530.5	0.1
AK	90,315	43	453	3.2	540.6	540.6	540.7	0.1
AL	90,488	29	319	4.6	540.7	540.7	540.9	0.2
AM	90,678	39	140	10.5	541.9	541.9	541.9	0.0
AN	90,793	40	161	9.1	544.8	544.8	544.8	0.0
AO	91,038	43	308	4.8	547.1	547.1	547.9	0.8

[1]Feet above confluence with San Pablo Bay
[2]No floodway determined

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

SAN PABLO 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
San Pablo Creek (Continued)								
AP	91,328	47	271	5.4	548.4	548.4	549.3	0.9
AQ	91,743	42	241	6.1	551.6	551.6	551.6	0.0
AR	92,118	38	183	8.0	555.3	555.3	555.3	0.0
AS	92,303	55	631	1.8	567.6	567.6	567.6	0.0
AT	92,768	53	214	5.2	567.6	567.6	567.7	0.1
AU	93,068	32	146	7.7	570.5	570.5	570.5	0.0
AV	93,398	30	156	7.2	574.9	574.9	574.9	0.0
AW	93,818	38	195	5.7	579.2	579.2	579.2	0.0
AX	94,088	39	140	8.0	582.1	582.1	582.1	0.0
AY	94,388	37	189	5.9	586.3	586.3	586.3	0.0
AZ	94,818	23	96	11.7	598.8	598.8	598.8	0.0
BA	95,018	47	186	6.0	605.0	605.0	605.0	0.0
BB	95,167	70	628	0.7	618.3	618.3	618.3	0.0
BC	95,344	31	182	2.4	618.3	618.3	618.3	0.0
BD	95,451	28	113	3.9	618.5	618.5	618.5	0.0
BE	95,622	34	265	1.7	627.4	627.4	627.4	0.0
BF	96,058	27	124	3.6	627.7	627.7	627.7	0.0
BG	96,268	11	41	11.0	631.4	631.4	631.4	0.0
BH	96,418	37	152	2.9	638.7	638.7	638.7	0.0
BI	96,948	21	50	8.8	641.8	641.8	641.8	0.0
BJ	97,328	18	69	6.5	653.1	653.1	653.1	0.0
BK	97,456	24	128	3.5	661.3	661.3	661.8	0.5
BL	97,678	31	127	3.5	666.8	666.8	666.9	0.1
BM	97,786	37	142	3.1	669.5	669.5	669.6	0.1
BN	98,126	33	134	3.3	680.8	680.8	681.0	0.2
BO	98,668	27	54	8.2	686.7	686.7	686.7	0.0

[1]Feet above confluence with San Pablo Bay

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

SAN PABLO 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
San Pablo Creek (Continued)								
BP	99,208 [1]	35	115	3.9	694.6	694.6	694.6	0.0
BQ	99,956 [1]	55	278	0.6	724.0	724.0	724.0	0.0
BR	100,182 [1]	55	401	0.4	733.4	733.4	733.4	0.0
San Ramon Creek								
A	8,950 [2]	32	517	22.9	187.8	187.8	187.8	0.0
B	9,110 [2]	206	1,655	7.3	195.9	195.9	195.9	0.0
C	9,840 [2]	88	1,136	8.7	196.3	196.3	196.3	0.0
D	10,140 [2]	86	1,065	9.3	196.9	196.9	196.9	0.0
E	12,518 [2]	95	743	15.9	207.0	210.9	210.9	0.0
F	12,691 [2]	125	1,487	7.9	218.6	218.6	218.6	0.0
G	15,707 [2]	55	618	19.1	229.1	229.1	229.1	0.0
H	15,948 [2]	106	1,352	8.7	235.3	235.3	235.3	0.0
I	17,194 [2]	60	1,081	10.9	237.7	237.7	237.7	0.0
J	17,326 [2]	163	1815	6.6	245.8	245.8	245.8	0.0
K	19,500 [2]	108	1,354	8.2	252.1	252.1	252.1	0.0
L	20,560 [2]	134	1,982	5.6	263.4	263.4	263.4	0.0
M	21,485 [2]	110	1,797	7.4	263.3	263.3	264.0	0.7
N	22,185 [2]	182	2,439	5.5	276.2	276.2	276.6	0.4
O	58,648 [2]	64	486	6.6	471 [3]	471 [3]	471 [3]	0.0

[1]Feet above confluence with San Pablo Bay
[2]Feet above confluence with Walnut Creek
[3]Elevations rounded to nearest whole foot

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

SAN PABLO CREEK - SAN RAMON 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
Sans Crainte Creek								
A	150	38	342	3.8	175.8	175.8	175.8	0.0
B	725	37	124	10.4	180.2	180.2	180.2	0.0
C	1,769	200	297	4.3	189.4	189.4	190.2	0.8
D	2,784	39	131	9.8	196.7	196.7	196.7	0.0
E	4,187	44	150	3.6	215.9	215.9	215.9	0.0
F	5,677	70	196	3.4	236.0	236.0	236.7	0.7
G	5,800	12	59	8.5	237.7	237.7	237.7	0.0
H	6,770	24	71	7.4	247.0	247.0	247.7	0.7
I	7,700	14	75	6.9	256.0	256.0	256.3	0.3
J	8,500	38	103	5.0	268.2	268.2	268.5	0.3

[1]Feet above confluence with San Ramon Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

SANS CRAINTE 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
Shore Acres Creek								
A[2]								
B	5,583	67	115	5.0	14.0	14.0	14.0	0.0
C	6,038	27	75	7.7	17.1	17.1	17.1	0.0
D	6,541	31	68	8.5	21.5	21.5	21.5	0.0
E	7,619	41	109	5.3	30.3	30.3	30.3	0.0
F	8,205	30	162	3.6	39.1	39.1	39.1	0.0
G	8,649	24	63	9.2	40.9	40.9	40.9	0.0
H	9,151	81	272	2.1	50.2	50.2	50.2	0.0
I	10,201	91	97	6.0	54.5	54.5	54.5	0.0
J	10,796	75	118	4.9	60.1	60.1	60.1	0.0
K	11,136	104	285	2.0	66.3	66.3	66.3	0.0
L	11,438	104	263	2.2	68.6	68.6	68.6	0.0
M	11,647	104	257	2.3	68.8	68.8	68.8	0.0

[1]Feet above confluence with Suisun Bay
[2]No floodway determined

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

SHORE ACRES 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
South Branch Moraga Creek								
A	100 [1]	47	117	9.0	469.9	454.5 [2]	454.5 [2]	0.0
B	807 [1]	70	157	6.7	469.9	468.2 [2]	468.2 [2]	0.0
C	1,674 [1]	44	114	9.2	488.0	488.0	488.0	0.0
D	2,493 [1]	50	192	5.5	498.0	498.0	498.0	0.0
E	3,329 [1]	37	107	9.8	507.3	507.3	507.3	0.0
F	3,505 [1]	94	786	1.3	520.5	520.5	520.5	0.0
G	3,994 [1]	96	545	1.9	520.6	520.6	520.6	0.0
H	4,512 [1]	30	100	10.5	523.0	523.0	523.0	0.0
I	5,043 [1]	37	175	6.0	533.4	533.4	533.4	0.0
J	5,463 [1]	34	132	7.9	538.3	538.3	538.3	0.0
K	5,766 [1]	42	158	6.6	543.3	543.3	543.3	0.0
L	5,951 [1]	124	957	1.1	557.2	557.2	557.2	0.0
M	6,664 [1]	38	108	9.7	560.6	560.6	560.6	0.0
N	7,957 [1]	81	227	4.6	578.1	578.1	578.1	0.0
O	8,711 [1]	34	104	10.1	589.8	589.8	589.8	0.0
South San Ramon Creek								
A	82 [3]	130 [4]	828	5.3	360.9	360.9	361.1	0.2
B	465 [3]	84 [4]	477	9.1	360.7	360.7	361.7	1.0
C	877 [3]	89 [4]	515	8.5	364.8	364.8	365.5	0.7
D	1,302 [3]	99 [4]	709	5.3	368.2	368.2	369.2	1.0
E	1,702 [3]	99 [4]	648	5.8	369.5	369.5	370.3	0.8
F	2,140 [3]	108 [4]	673	5.6	370.8	370.8	371.2	0.4
G	2,460 [3]	76 [5]	545	6.9	371.3	371.3	371.6	0.3

[1]Feet above confluence with Moraga Creek
[2]Elevation computed without consideration of backwater from Moraga Creek
[3]Feet above Alcosta Boulevard
[4]Floodway contained in channel
[5]Beginning of flood control channel. Floodway contained in channel for remaining study reach

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

SOUTH BRANCH MORAGA CREEK - SOUTH SAN RAMON 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
St. Marys Road Tributary								
A	231[1]	64	123	3.9	496.2	495.4[2]	495.4[2]	0.0
B	562[1]	160	1,550	0.3	511.4	511.4	511.4	0.0
C	1,619[1]	46	69	7.0	512.6	512.6	512.6	0.0
D	2,696[1]	34	101	4.8	526.4	526.4	526.4	0.0
E	3,471[1]	22	54	8.9	556.4	556.4	556.4	0.0
Stone Valley Creek								
A	1,119[3]	41	87	8.3	261.5	261.5	261.5	0.0
B	1,717[3]	26	75	9.6	281.0	281.0	281.0	0.0
C	2,277[3]	32	80	9.1	298.4	298.4	298.4	0.0
D	3,108[3]	53	99	6.3	314.7	314.7	315.5	0.8
E	3,427[3]	60	90	7.0	320.4	320.4	321.0	0.6
F	4,017[3]	17	60	10.6	326.6	326.6	326.7	0.1
G	4,449[3]	39	174	3.6	333.5	333.5	333.5	0.0
H	4,757[3]	34	75	8.5	334.1	334.1	334.1	0.0
I	5,075[3]	36	104	6.1	337.2	337.2	337.3	0.1
J	6,028[3]	32	86	7.3	342.4	342.4	342.9	0.5
K	6,513[3]	39	136	3.1	350.3	350.3	350.3	0.0

[1]Feet above confluence with Laguna Creek
[2]Elevation computed without consideration of backwater from Laguna Creek
[3]Feet above confluence with San Ramon Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

ST. MARYS ROAD TRIBUTARY - STONE VALLEY 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
Sycamore Creek								
A	4,535 [1]	49	264	7.2	425.4	425.4	425.4	0.0
B	5,381 [1]	70	368	5.2	429.1	429.1	429.1	0.0
C	6,023 [1]	40	163	11.6	431.9	431.9	431.9	0.0
D	6,872 [1]	53	239	7.9	444.6	444.6	444.6	0.0
E	7,704 [1]	68	298	6.4	451.7	451.7	452.5	0.8
F	8,404 [1]	72	305	6.2	460.6	460.6	460.6	0.0
Tice Creek								
A	2,500 [2]	72	303	5.8	160.7	160.7	161.0	0.3
B	3,500 [2]	128	345	5.1	165.0	165.0	165.6	0.6
C	4,266 [2]	27	201	5.5	168.6	168.6	169.2	0.6
D	5,387 [2]	29	158	7.0	177.0	177.0	177.0	0.0
E	6,780 [2]	25	152	10.0	184.6	184.6	184.8	0.2
F	8,557 [2]	57	387	4.2	196.4	196.4	196.6	0.2
G	11,064 [2]	30	221	6.7	215.2	215.2	215.5	0.3
H	12,149 [2]	51	227	4.9	222.5	222.5	222.8	0.3
I	12,678 [2]	32	138	9.8	228.8	228.8	228.8	0.0
Walnut Creek								
A	66,595 [3]	89	2,054	4.6	136.5	136.5	136.5	0.0
B	67,610 [3]	87	1,822	5.2	136.6	136.6	136.6	0.0
C	68,665 [3]	111	2,283	4.2	137.2	137.2	137.5	0.3

[1] Feet above confluence with San Ramon Creek
[2] Feet above confluence with Las Trampas Creek
[3] Feet above confluence with Pacheco Creek

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY
CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

SYCAMORE CREEK - TICE CREEK - WALNUT 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
West Antioch Creek								
A[2]								
B	2,564	173	642	3.1	11.3	11.3	11.3	0.0
C	3,319	178	286	7.0	12.6	12.6	13.0	0.4
D	4,069	255	661	3.0	16.4	16.4	17.1	0.7
E	4,529	255	685	2.9	16.7	16.7	17.5	0.8
F	5,184	255	846	2.4	16.7	16.7	17.7	1.0
G	5,616	217	438	4.6	17.2	17.2	18.0	0.8
H	5,778	254	989	2.0	18.1	18.1	18.8	0.7
I	6,790	255	529	3.6	18.4	18.4	19.1	0.7
J	7,534	192	329	5.9	22.0	22.0	22.3	0.3
K	8,169	100	791	1.1	30.4	30.4	30.4	0.0
L	9,013	95	408	2.2	30.4	30.4	30.4	0.0
M	9,646	63	158	5.6	30.5	30.5	30.5	0.0
N	10,792	150	610	1.7	38.0	38.0	38.1	0.1
O	11,116	150	327	2.1	38.0	38.0	38.1	0.1
P	11,509	42	98	6.9	39.2	39.2	39.2	0.0
Q	11,807	25	71	9.6	42.0	42.0	42.0	0.0
R	12,017	38	176	3.9	43.2	43.2	43.8	0.6
S	12,300	42	168	4.0	44.0	44.0	44.4	0.4
T	12,519	59	366	1.9	44.3	44.3	44.6	0.3
U	12,922	73	472	1.4	44.4	44.4	44.7	0.3
V	13,662	81	244	2.1	49.1	49.1	49.1	0.0
W	14,118	39	95	5.4	49.1	49.1	49.1	0.0
X	14,238	157	108	4.7	57.1	57.1	57.1	0.0
Y	14,534	100	94	5.4	60.4	60.4	60.7	0.3
Z	15,012	100	107	4.8	65.1	65.1	65.2	0.1

[1]Feet above confluence with San Joaquin River

[2]No floodway determined

TABLE 13	FEDERAL EMERGENCY MANAGEMENT AGENCY **CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS**	**FLOODWAY DATA** **WEST ANTIOCH 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
West Branch East Antioch Creek								
A	1,085 [1]	46	175	2.6	12.8	10.8	10.9	0.9
B	4,940 [1]	98	1,658	0.2	39.9	39.9	39.9	0.0
West Branch Refugio Creek								
A	52 [3]	180	447	2.1	25.4	25.4	26.4	1.0
B	447 [3]	133	260	3.6	26.9	26.9	27.7	0.8
C	920 [3]	23	102	2.4	33.3	33.3	33.3	0.0
D	1,152 [3]	21	60	3.6	34.1	34.1	34.4	0.3
E	1,805 [3]	45	92	2.2	39.6	39.6	39.6	0.0
F	2,680 [3]	29	92	2.3	50.0	50.0	50.0	0.0
G	3,090 [3]	45	37	5.7	55.0	55.0	55.0	0.0
H	3,800 [3]	6	42	4.6	71.8	71.8	71.8	0.0
I	4,160 [3]	68	42	4.8	77.2	77.2	77.2	0.0
J-K*	*	*	*	*	*	*	*	*
L	7,180 [3]	17	21	6.4	147.2	147.2	147.2	0.0
M	8,180 [3]	10	12	6.3	182.6	182.6	182.6	0.0
N	8,780 [3]	8	11	6.7	205.5	205.5	205.5	0.0
O	9,300 [3]	10	12	6.2	252.1	252.1	252.1	0.0

[1]Feet above confluence with East Antioch Creek

[2]Feet above confluence with Refugio Creek

* Data not available

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

CONTRA COSTA COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

WEST BRANCH EAST ANTIOCH CREEK - WEST BRANCH REFUGIO CREEK