Santa Clara River 2006 Hydrology Update

Phase I

From Ocean to County Line

Ventura County Watershed Protection District

VENTURA COUNTY

WATERSHED PROTECTION DISTRICT

ADVANCED PLANNING SECTION

December 2006

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EXCUTIVE SUMMARY

In 1994, the Ventura County Watershed Protection District (formerly known as the Ventura County Flood Control District), in cooperation with the Los Angeles County Department of Public Works (LADPW) and the U. S. Army Corps of Engineers, Los Angeles District (Corps) completed a hydrology study for the main stem of the Santa Clara River. Since that time, rapid development (in terms of agricultural expansion and urbanization) has occurred in a relatively small portion of the watershed.

In response to these changes, the Santa Clara River Watershed Management Plan is preparing for new studies; i.e., HSPF modeling, sediment transport study, and Flood Insurance Study (FIS). All these study models require an up-to-date statistical hydrology as an input of the model or a tool for model calibration. With more than 10 years of additional stream gage data available, Santa Clara River hydrology is being updated to reflect these changes and to aid in the study efforts.

The Santa Clara River Hydrology Update follows the methodology of the 1994 report. The results show an increase of peak discharges from 11% at County Line to 13% at Montalvo. These increases reflect the two major flooding events, which occurred in 1998 and 2005.

A draft report of this study has passed through the peer review process. Comments received from HDR Engineering, Inc.; LA County and the U.S Army Corps of Engineers (LA District) have been duly noted and addressed. Please refer to Appendix 1 for the comments and responses.

In addition to the statistical analysis for the main stem of Santa Clara River, flood frequency analysis for gauged tributaries—namely, Santa Paula Creek, Sespe Creek, Pole Creek, and Hopper Canyon—are attached in Appendix 3. Determination of peak discharges for un-gauged tributaries—namely Orcutt Canyon, Grimes Canyon, El Rio Drain, Patterson Drain, and Basolo Ditch are also attached in Appendix 4.

I. INTRODUCTION

The Santa Clara River is one of the largest river systems in Southern California. It flows about 100 miles from its headwater at Pacifico Mountain in the San Gabriel Mountains toward the Oxnard Plain before discharging into the Pacific Ocean near the Ventura Marina. Of the 1,634 square miles of the watershed area, about 40 percent of the watershed is located in Los Angeles County and 60 percent is in Ventura County.

In 1994, the Ventura County Watershed Protection District (formerly known as the Ventura County Flood Control District)—in cooperation with the Los Angeles County Department of Public Works and the U. S. Army Corps of Engineers, Los Angeles District—completed a hydrology study for the main stem of the Santa Clara River. Since that time, rapid development (agricultural expansion and urbanization) has occurred in a relatively small portion of the watershed. Increasing human activities are expected to impact the watershed hydrology.

With Santa Clara River Watershed Management Plan gearing up for new studies, such as HSPF modeling, sediment transport study, and Flood Insurance Study (FIS), and with more than ten years of additional stream gage data available, it is time to update the Santa Clara River Hydrology.

This update of hydrology follows the methodology, assumptions, and procedures adopted in the 1994 Report and are summarized as follows:

- Multiple linear correlations in filling missing data.

- The adopted skew was obtained through a weighted average of station skew and regional skew as indicated in the Water Resources Council Bulletin 17B.

- The Corps of Engineers plotted all frequency results and hand adjusted to a family of curves that represented the characteristics of the watershed.

- For gauging stations that differed significantly from the family of curves, for example, Lang, the frequency curve was adjusted based on a ratio established by the Corps of Engineers. The ratio is the result of the Corps of Engineers (Los Angeles District) study of the Santa Clara River Watershed. Various frequencies of flooding peaks were developed. The SPF was used to prorate the peak flow predicted between gauge stations.

II. DATA AVAILABILITY AND ANALYSIS

2.1 DATA AVAILABILITY

Annual peak flow data are available for main stem of Santa Clara River at Montalvo (USGS gage number 11114000), at County Line (gage number 1110850) in Ventura County (Figure 1). The earliest recorded data dates back to the early 1930s. Adjusted data for Montalvo and County Line in Table 7 and Table 8 of Reference 1 were used through 1993. A complete list of data available is shown in Table 1.

2.2 DATA ANALYSIS

- **Tests of Outliers**

Outliers are data points which depart significantly from the trend of the remaining data. All procedures for treating outliers ultimately require judgment involving both mathematical and hydrological considerations. Guidelines for Determining Flood Flow Frequency (Bulletin #17B, Ref. 2) described the detection and treatment of high and low outliers.

Test of high outliers:

$$X_H = \overline{X} + K_N S$$

Where X_H = high outlier threshold in log units

$\overline{X}$ = mean logarithm of systematic peaks excluding zero flood events, peaks below gage base, and outliers previously detected.

S = standard deviation of X's

K_N = K value from Appendix 4 of Ref. 2 for sample size N

Test of lower outliers:

$$X_L = \overline{X} - K_N S$$

Where X_L = low outlier threshold in log units

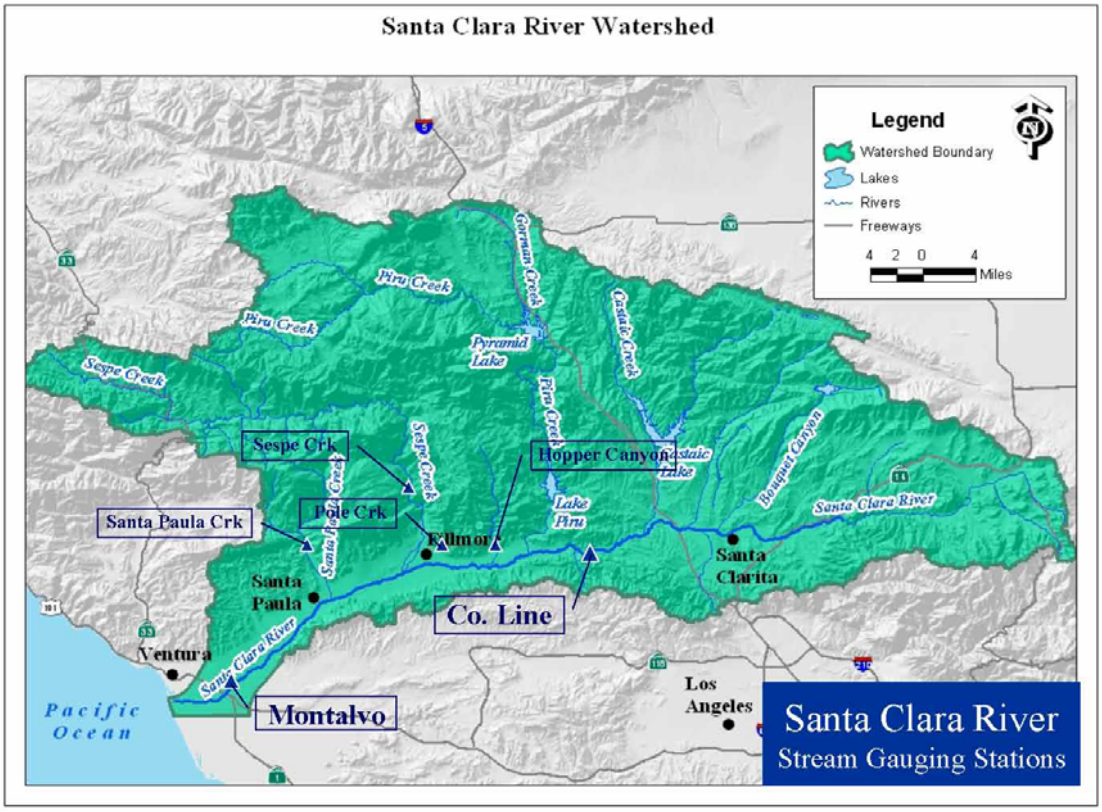


Figure 1. Santa Clara River Stream Gauging Stations in Ventura County

Table 1: List of Data Available – Annual Peak Discharges

Discharge Unit: CFS

Year	Montalvo*	Co. Line**
1931	--	--
1932	22,000	--
1933	--	--
1934	46,000	--
1935	17,000	--
1936	16,000	--
1937	19,000	--
1938	95,000	--
1939	6,400	--
1940	3,300	--
1941	30,000	--
1942	3,600	--
1943	72,000	--
1944	28,000	--
1945	16,000	--
1946	14,000	--
1947	9,000	--
1948	--	--
1949	--	--
1950	2,280	--
1951	--	--
1952	45,000	--
1953	2,700	375
1954	5,300	578
1955	500	419
1956	5,500	672
1957	3,780	1,209
1958	50,000	5,411
1959	11,000	1,561
1960	408	83
1961	216	145
1962	44,000	6,965
1963	5,060	1,026
1964	2,350	411
1965	3,360	1,064
1966	44,000	22,213
1967	35,000	4,998
1968	4,000	2,174
1969	147,000	49,870
1970	9,960	759
1971	28,800	6,949
1972	8,350	3,410
1973	58,200	12,800
1974	14,700	5,150

1975	10,800	2,210
1976	5,420	1,700
1977	3,850	1,880
1978	102,200	22,800
1979	18,600	6,020
1980	81,400	13,900
1981	3,620	2,470
1982	8,600	1,730
1983	100,000	30,600
1984	4,930	308
1985	4,040	2,270
1986	43,700	12,300
1987	851	1,460
1988	13,500	1,340
1989	--	3,900
1990	1,200	1,870
1991	25,000	6,960
1992	104,000	12,300
1993	44,300	10,700
1994	4,000	597
1995	--	17,100
1996	17,000	4,450
1997	20,500	303
1998	84,000	--
1999	763	277
2000	6,370	2,440
2001	32,900	1,230
2002	331	729
2003	13,600	2,330
2004	19,600	2,640
2005	136,000	32,000
N	68	52

Notes:
* Data adjusted through 1993 from 1994 Report
** Data adjusted through 1971 per 1994 Report

III. FREQUENCY ANALYSIS

3.1 Log-Pearson Type III Distribution

Computer program HEC-FFA was used to conduct frequency analysis.

The HEC Flood-Flow Frequency Analysis program performs frequency computations of annual maximum flood peaks in accordance with the Water Resources Council "Guidelines for Determining Flood Flow Frequency," Bulletin 17B. The Guideline recommended a Log-Pearson Type III probability distribution:

$$\text{Log Q} = \overline{X} + \text{KS}$$

Where K is a factor and is a function of the skew coefficient and selected exceedance probability that can be obtained from Appendix 3 of Ref. 2.

$\overline{X}$, S, and G are mean, standard deviation, and skew coefficient of station data and can be computed using the following equations:

$$\overline{X} = \frac{\sum X}{N}$$

$$\text{S} = \sqrt{\frac{\sum (X - \overline{X})^2}{(N-1)}}$$

$$\text{G} = \frac{N\sum (X - \overline{X})^3}{(N-1)(N-2)S^3}$$

Where X = logarithm of annual peak flow
N = number of items in data set

The skew coefficient of the station record (station skew) is sensitive to extreme events, thus it is difficult to obtain accurate skew estimates form small samples. The accuracy of the estimated skew coefficient can be improved by weighting the station skew with generalized skew.

Generalized skew coefficient for Santa Clara River below I-5 is found to be –0.3 from Plate I of Ref. 2. Weighted skew coefficient is computed as follows:

$$\text{G}_\text{w} = \frac{MSE_{\overline{G}}(G) + MSE_G(\overline{G})}{MSE_{\overline{G}} + MSE_G}$$

Where G_w = weighted skew coefficient
G = station skew
$\overline{G}$ = Generalized skew
$MSE_{\overline{G}}$ = Mean square error of generalized skew, $MSE_{\overline{G}}$ = 0.302 when generalized skews are read from Plate I
MSE_G = Mean square error of station skew, can be approximated by:

$$MSE_G = 10^{\{A-B[\log(N/10)]\}}$$

Where A = -0.33 + 0.08 |G| if $|G| \leq 0.90$
-0.52 + 0.30 |G| if $|G| > 0.90$

B = 0.94 – 0.26 |G| if $|G| \leq 1.50$
0.55 if $|G| > 1.50$

3.2 Result Analysis

- **Frequency Analysis for Santa Clara River at Montalvo**

68 years of records (from year 1932 to 2005) were used to conduct the analysis. Data are considered homogeneous after data from 1932 to 1993 were adjusted for effects of reservoirs etc. in Ref. 1. No outliers were detected. Generalized skew coefficient of -0.3 was used according to Plate I of Ref. 2. With a station skew coefficient of –0.515, a weighted skew of –0.5 was adopted.

- **Frequency Analysis for Santa Clara River at County Line**

52 years of records (from year 1953 to 2005) were used to conduct the analysis. No outliers were detected. Generalized skew coefficient of -0.3 was used according to Plate I of Ref. 2. With a station skew coefficient of –0.012, a weighted skew of –0.1 was adopted.

- **Peak Discharges for Santa Clara River at Sespe Creek, and Fillmore.**

Determination of peak discharges of Santa Clara River at Sespe and Fillmore follows the procedure used in 1994 report, i.e.

- Discharges for d/s of Sespe Creek were determined by multiplying n-year peaks at Montalvo by the ratio of SPFs
- Discharges for Fillmore were determined by multiplying n-year peaks at County Line by the ratio of SPFs

Standard Project Floods (SPFs) were determined by the COE (LA District) in 1994 hydrology study using HEC-1 model of Santa Clara River Watershed. No efforts were made in this study to update the SPFs.

- **Comparison of Updated Hydrology with 1994 Hydrology Study**

Table 2 shows the comparison of the updated hydrology with 1994 study results. In general, 100-year peak discharges increase from 11% (at County Line) to 13% (at Montalvo). From statistics point of view, these increases are justified because two significant storm events occurred after 1994 (1998 and 2005 storms).

Summary of the updated hydrology is listed in Table 3.

Discharge-frequency curves are plotted on Figure 2.

Please refer to Appendix 2 for details of flood frequency analysis.

Table 2: Comparison of Updated Hydrology with 1994 Study

Unit: CFS

	Return Period (year)							
Santa Clara River	**2-yr**	**5-yr**	**10-yr**	**20-yr**	**50-yr**	**100-yr**	**200-yr**	**500-yr**
At Co. Line (FFA)								
94 study results	2,600	8,480	15,400	24,900	42,400	60,000	82,000	119,000
Updated (all data)	2,490	8,420	15,700	26,100	45,900	66,600	93,300	140,000
Differences	-110	-60	300	1,200	3,500	6,600	11,300	21,000
At Fillmore (SPF Ratio)								
94 study results	4,000	14,000	25,000	41,000	69,000	98,000	134,000	194,000
Updated (all data)	4,100	13,700	25,600	42,500	74,700	108,400	151,900	227,900
Differences	100	-300	600	1,500	5,700	10,400	17,900	33,900
At Sespe Crk (SPF Ratio)								
94 study results	12,200	38,300	65,400	98,000	151,000	196,000	245,000	318,000
Updated (all data)	12,500	41,000	71,200	108,600	168,200	221,000	279,700	364,800
Differences	300	2,700	5,800	10,600	17,200	25,000	34,700	46,800
At Montalvo (FFA)								
94 study results	12,500	39,200	66,900	100,000	154,000	200,000	251,000	325,000
Updated (all data)	12,800	41,900	72,800	111,000	172,000	226,000	286,000	373,000
Differences	300	2,700	5,900	11,000	18,000	26,000	35,000	48,000

Table 3: Summary of Updated Hydrology

Unit: CFS

Santa Clara River	Return Period (year) 2-yr	5-yr	10-yr	20-yr	50-yr	100-yr	200-yr	500-yr
At Co. Line	2,490	8,420	15,700	26,100	45,900	66,600	93,300	140,000
At Fillmore	4,100	13,700	25,600	42,500	74,700	108,400	151,900	227,900
At Sespe Crk	12,500	41,000	71,200	108,600	168,200	221,000	279,700	364,800
At Montalvo	12,800	41,900	72,800	111,000	172,000	226,000	286,000	373,000

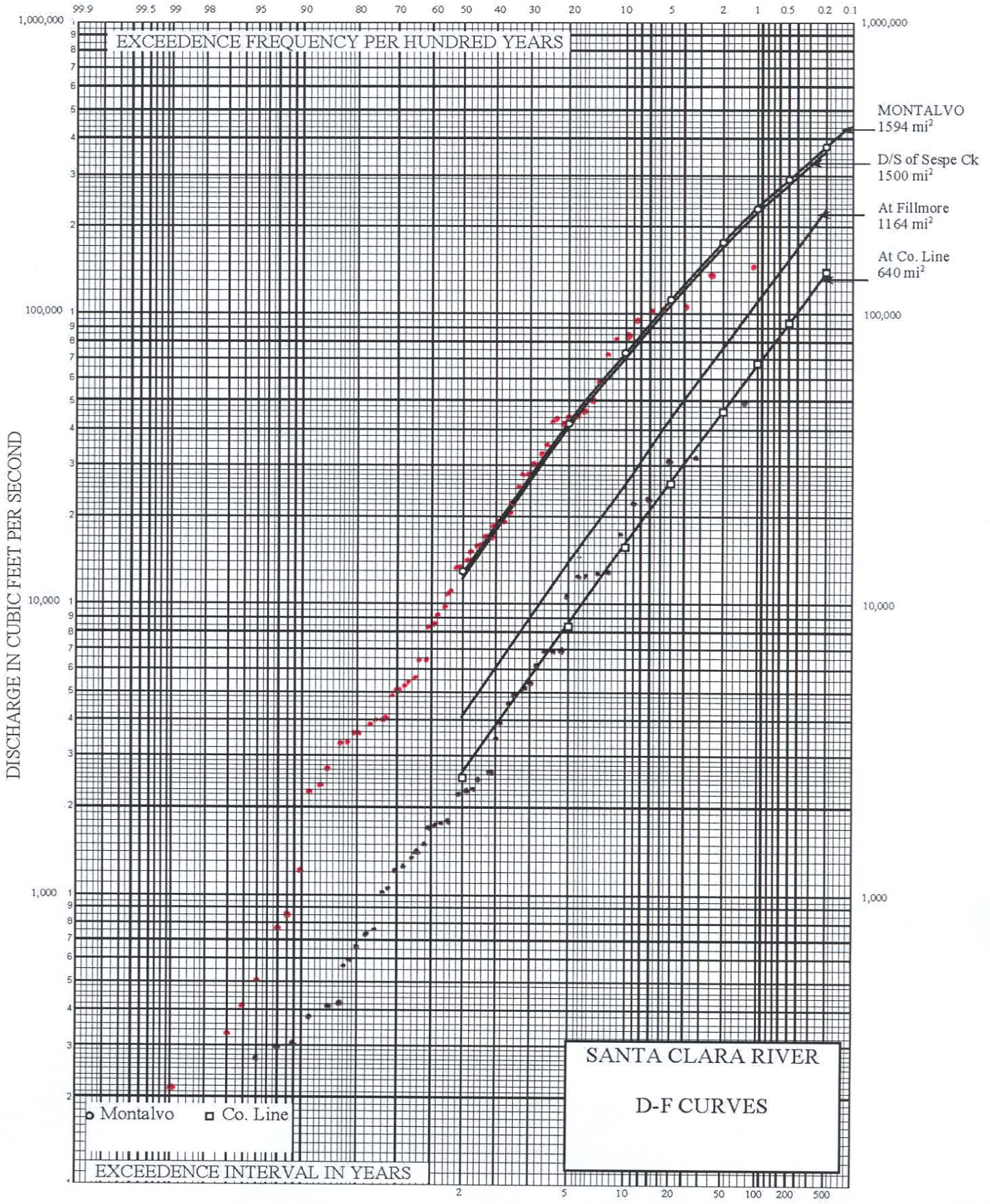


Figure 2: Santa Clara River Discharge-Frequency Curves with Median Plotting Positions

IV. FREQUENCY ANALYSIS FOR GAUGED TRIBUTARIES

Gauged tributaries of Santa Clara River in Ventura County include: Santa Paula Creek (Gauge ID 709b), Sespe Creek (710a), Pole Creek (713), and Hopper Creek (701). Locations of these gauging stations are shown in Figure 1. Most of the gauging stations have records dating from the early 1930's with the Pole Creek record starting in 1974. Table 4 shows annual peak flows of the four gauged tributaries.

In terms of record homogeneity, most of the watersheds upstream of the gauging stations have not experienced dramatic changes in watershed characteristics. The watersheds have mostly maintained their natural conditions during the period of record. No major water regulation facilities were built. Therefore, the records are considered to be homogeneous.

Frequency analyses for gauged tributaries are conducted following the method recommended in Bulletin 17B, i.e. Log-Pearson Type III distribution is used and station skew is weighted with generalized skew to come up with a weighted skew. Generalized skew coefficient of -0.3 is used according to the geographical locations of the watersheds.

According to Section V.C of Bulletin 17B, the length of record has to be 50 or longer in order to determine 100-year floods using statistical analysis only using station skew. Otherwise, a comparison with similar watersheds nearby is necessary. As to Pole Creek with a record length of 31 years, a statistical analysis is conducted and the results are compared with those of Hopper Creek. Pole Creek and Hopper Creek are only approximately 5 miles apart with watersheds areas of 9.1 and 23.6 square miles, respectively. Hopper Creek has a record of 70 years and statistical analysis shows a 100-year runoff yield of 1.271 cfs per acre compared with a yield of 1.269 cfs per acre for Pole Creek. With the station skew weighted with regional skew, the statistical analysis results for Pole Creek are deemed valid.

Table 5 summarizes the updated hydrology for gauged tributaries.

Please refer to Appendix 2 for detailed frequency analysis results for the gauged tributaries.

Table 4: Annual Peak Flows for Gauged Tributaries

Discharge Unit: CFS

Water Year	Sespe Nr Fillmore	Pole Ck	Santa Paula Ck	Hopper Ck
1933	12,000		2,650	
1934	34,000		8,500	5,300
1935	12,500		1,530	750
1936	7,200		2,900	810
1937	12,800		1,350	NA
1938	56,000		13,500	8,000
1939	5,000		371	1,250
1940	5,500		364	221
1941	17,300		3,150	1,340
1942	3,150		554	NA
1943	44,000		10,000	4,200
1944	13,000		1,900	1,350
1945	11,500		2,500	1,020
1946	11,300		1,350	710
1947	4,850		850	578
1948	748		85	100
1949	725		147	90
1950	3,000		660	1,000
1951	47		8	18
1952	23,200		7,300	2,200
1953	3,370		219	126
1954	4,400		977	146
1955	785		78	255
1956	3,900		835	992
1957	7,650		825	1,160
1958	28,400		9,130	3,690
1959	8,280		954	496
1960	1,330		156	249
1961	836		178	61
1962	25,600		3,150	1,840
1963	4,400		684	470
1964	2,590		572	307
1965	2,440		548	504
1966	21,600		6,480	3,000
1967	21,600		4,500	4,450
1968	1,940		345	450
1969	60,000		21,000	8,400
1970	8,800		940	800
1971	22,800		2,530	1,620
1972	4,810		937	691
1973	38,300		13,400	1,670
1974	6,860	78	614	547
1975	7,210	NA	1,440	799

1976	3,650	11	458	266
1977	1,020	93	134	390
1978	73,000	1,089	16,000	5,460
1979	6,300	530	3,680	1,030
1980	40,700	2,905	11,800	8,120
1981	2,160	91	527	311
1982	9,660	14	1,910	527
1983	56,000	1,480	4,750	4,410
1984	6,330	132	1,230	981
1985	1,450	60	90	339
1986	NA	1,030	3,550	3,290
1987	NA	29	170	210
1988	NA	162	1,950	1,460
1989	NA	26	109	307
1990	NA	46	499	412
1991	16,300	817	1,010	1,680
1992	44,000	1,437	10,000	4,799
1993	NA	802	7,130	2,140
1994	2,590	124	698	406
1995	65,000	1,231	8,140	7,040
1996	4,870	388	1,230	400
1997	19,800	249	2,130	1,000
1998	62,500	1,371	NA	17,344
1999	445	101	97	199
2000	4,900	112	1,410	1,420
2001	25,900	538	3,480	1,619
2002	93	10	35	196
2003	7,630	111	782	812
2004	17,700	1,053	NA	2,680
2005	85,300	3,042	27,500	17,600
N	67	31	71	70

Table 5: Summary of Updated Hydrology for Gauged Tributaries

Discharge Unit: CFS

	Return Period (year)							
Gauging Stations	**2-yr**	**5-yr**	**10-yr**	**20-yr**	**50-yr**	**100-yr**	**200-yr**	**500-yr**
Santa Paula Creek	1,260	4,500	8,620	14,600	26,400	38,800	55,200	84,100
Sespe Creek	8,430	25,700	43,700	66,000	102,000	135,000	172,000	227,000
Pole Creek	240	917	1,760	2,960	5,170	7,390	10,100	14,700
Hopper Creek	925	2,850	5,060	8,080	13,600	19,200	26,100	37,900

V. DESIGN FLOWS FOR UNGAUGED TRIBUTARIES

For ungauged tributaries to be included in the FEMA Floodplain Study, namely: Orcutt Canyon, Grimes Canyon Wash, Basolo Ditch, El Rio Drain, and Patterson Drain, no gauging station data are available. This report documents the 100-year peak discharges for these ungauged tributaries from various sources including the Oxnard City Master Plan, modified rational method (VCRAT) studies, etc. Table 6 summarizes the 100-year flows for these tributaries. Please refer to Appendix 3 for details of the determination of the flows.

Table 6: Summary of 100-Year Flows for Ungauged Tributaries

Tributary Name	**100 year flow (cfs)**	**Description**
Orcutt Canyon	14,600	Ellsworth Barranca at Foothill road flood flow frequency analysis was used because of relatively similar size, soil type, and land use. The pro-rated computed Q100 flow was obtained by calculating the unit discharge in cfs per square mile and then multiplying it by the area of Orcutt Canyon to determine the flow.
Grimes Canyon Wash	7,450	Due to comparatively similar size, soil type, and land use with Pole Creek, the pro-rated 100 year flow was calculated as described above using the Pole Creek frequency results.
El Rio Drain	1,050	Using the VCRAT study with proposed facilities and Stroube diversion, a Q50 with future condition was obtained. The VCWPD multiplier for developed watersheds was applied to the given Q50 to determine 100 year flow at El Rio Drain.
Patterson Drain	1,450	From the City of Oxnard Master Plan of Drainage and Drainage Hydrology Map published in 2001, the Q100s were obtained for 15 different sub areas that drain into Patterson Drain. These flows were added to determine the total 100 year flow for Patterson Drain.
Basolo Ditch	1,625	Due to proximity and similar soil type, and land use with Pole Creek, the pro-rated 100 year flow was calculated as described above using Pole Creek frequency results.

VI. REFERENCES

1. Santa Clara River 1994 Hydrology Study. Ventura County Flood Control District, October 27, 1994.

2. Guidelines for Determining Flood Flow Frequency, Bulletin #17B of the Hydrology Subcommittee, USGS, 1982.

Appendix 1

Comments and Responses

From: Denny Tuan
To: Brian.Doeing@hdrinc.com; Lee.Frederiksen@hdrinc.com
Date: 11/7/2006 3:14:38 PM
Subject: Fwd: Review Comments: Draft Santa Clara River 2006 Hydrology Update

Dear Brian and Lee:

Please accept my apologies for the delay in responding to your review comments of the Santa Clara River 2006 Hydrology Update. I was out of the Country on leave visiting China and unable to attend the meeting held on October 5, 2006. I have reviewed your comments on the subject study and my response is provided below.

Your comment regarding the use of HEC-FFA to conduct the frequency analysis, versus using the older HEC-WRC program, is well taken. For all of our future studies and submittals to FEMA we will use HEC-FFA. Mark Bandurraga and the Hydrology Section will use HEC-FFA for the work being done on the Santa Clara River tributaries.

The principle difference between HEC-WRC and HEC-FFA is in the treatment of historical outliers and the way each handles the outliers and the special situation of low-flow and no-flow periods. Otherwise, in normal cases there does not appear to be any difference such that it shows in the results between the two programs.

In our draft report of the frequency analysis of the gauged records we should have included a description of the methodology we followed. The hydrology update study followed the 1994 Santa Clara River Hydrology study that was a joint effort of the Los Angeles County, the US Army Corps of Engineers, and Ventura County. The 1994 report included a discussion of the methodology, assumptions, and procedures used in the analysis. The methodology included:

- Multiple linear correlations to fill in missing data.

- The adopted skew was obtained through a weighted average of station skew and regional skew as indicated in the Water Resources Council Bulletin 17B.

- The Corps of Engineers plotted all frequency results and hand adjusted to a family of curves that represented the characteristics of the Watershed.

- For gauging stations that differed significantly from the family of curves, for example, Aliso, the frequency curve was adjusted based on a ratio established by the Corps. The ratio is the result of the Corps of Engineers HEC-1 study of the Santa Clara River Watershed. Various frequencies of flooding peaks were developed. The SPF was used to prorate the peak flow predicted between gauge stations.

The final flood frequency adjustments were made by Dennis Marfice, Chief of the Los Angeles District Hydrologic Section. It is based on his knowledge, expertise, and judgment of the Santa Clara River Watershed, referenced with the COE developed HEC-1 model, it also considered reservoir impact, modified, or eliminated, non-USGS data considered to be unreliable. Dennis has many years of hydrologic experience, and a clear knowledge of the Santa Clara River

Watershed. With the HEC-1 model COE developed we trust the results of the 1994 study. This process represents a best judgment that combines theoretical analysis with practical experience.

The 1994 report was the result of the collaboration of the efforts of Iraj Nasseri, Los Angeles County, Dennis Marfice of the Los Angeles District of the USACE, and Denny Tuan representing Ventura County. Differences or variations in the desires of these individuals as to these items were mediated by Joe Evelyn, Hydrology Branch Chief, Los Angeles District, and agreement reached in order to arrive at the final report.

For the 2006 hydrology update, Ventura County followed the methodology of the 1994 study with the following exceptions. Instead of hand adjusting the frequency, we tried the sensitivity of, and adjusted, the low-flow outliers to bring the station frequency into the family of frequency curves for the Santa Clara River watershed. Figure 1 attached provides the 2006 FFA studied frequency analysis results. Figure 2 provides the final adjusted family of frequency curves.

Following HDR's recommendation, we also re-ran all guage station data using both HEC-WRC and HEC-FFA and found them to be exactly the same. No historical hi-outlier data was used in the adjustment and the low flow data are not specifically outstanding enough to make a difference.

Regarding Comment #3 about skew adjustment, we also tested the weighing of the regional skew with the skew computed for the station of short record and found the difference to be insignificant.

After consultation with Iraj (Los Angeles County) we concur with the majority of the results previously presented to Ray Lenaburg (FEMA) with the exception of the Aliso data. For Aliso station, Iraj recommends adopting the original frequency analysis (1994) as presented.

The final Ventura County frequency analysis will be presented to you at the next meeting in Los Angeles. The final results will essentially be the same as previously presented to Ray Lenaburg.

Brian's comment to include the units in the text and the tables has been adopted and will be included in the final version of the report.

The frequency analysis study has been completed and the report finalized. It is now time to move onto the next task. We need to meet and determine the general parameters and set criteria for the HEC-1 modeling of the watershed.

>>> "Frederiksen, Lee E." <Lee.Frederiksen@hdrinc.com> 10/17/2006 11:34 AM >>>
Vincent and Sergio:

Brian Doeing of HDR and I have reviewed the above referenced document and offer the following comments for your consideration:

1. General - Computer program HEC-WRC was used to conduct the frequency analysis; however, HEC-WRC has been replaced by computer program HEC-FFA. According to the HEC-FFA User's Manual, the input and output

formats were restructured, a number of improvements and options were added, and a few computational errors were corrected. FEMA no longer lists HEC-WRC as an accepted model for statistical analysis, but lists HEC-FFA and indicates that it supersedes HEC-WRC. For these reasons, it would be appropriate to use HEC-FFA for this hydrology update. See FEMA website link below:

http://www.fema.gov/plan/prevent/fhm/en_stat.shtm

2. Section 2.2 Data Analysis, Test of Outliers - Suggest leaving the data set unadjusted for zero flows and low outliers and let the HEC-FFA program evaluate the full data set. The program is capable of performing the tests and adjusting the frequency in accordance with Bulletin 17B procedures. The effect of removing the low outliers and zero flows before running the program causes the program to calculate different thresholds for low outliers based on the adjusted data set. Whether or not this will affect the computed frequency in this case is not certain, but it would be more consistent with the program operation and give more confidence to the results.

3. Section 2.2 Data Analysis, Missing Data Filling for Aliso - Is data filling for Aliso consistent with the Bulletin 17B procedures? Appendix 7 of the Bulletin provides a method to adjust the logarithmic mean and standard deviation of a short record, pending meeting certain criteria. It states on page 7-6 that is not necessary to estimate the actual annual peaks from the regression equation, but only to adjust the logarithmic mean and standard deviation of the short record. It is suggested that Appendix 7 in the Bulletin be followed to determine the adjustments for Aliso.

4. Section 3.2 Result Analysis, Frequency Analysis for Santa Clara River at Aliso - Again, according to Appendix 7, page 7-6 of Bulletin 17B, the adjusted skew should be obtained by weighting the regional skew with the skew computed from the short record site. Suggest that this procedure be followed rather than trying to match the 1994 frequency curve. Should the results deviate from the 1994 report, they might be considered improved results, based on an updated and refined approach.

5. Section 3.2 Result Analysis, Peak Discharges for Santa Clara River at Sespe Creek, Fillmore and Lang - Is the ratio of SPFs still a valid procedure to determine peak flows at these locations? Have the SPFs been recalculated since the 1994 report or is there a need to update the SPFs given the changes in the watershed that precipitated the need for a hydrology update. Would a basin area ratio applied to the newly computed frequency flows be more appropriate to calculate peak discharges for these locations? Also, since Lang has 30 years of record (albeit a broken record) has it been determined that the short record method in Appendix 7 of Bulletin 17B would not be appropriate to determine the frequency flows at Lang?

6. It would be helpful to include the units (cfs) in the text and tables where flow data are listed in the report.

7. HEC has replaced HEC-FFA with HEC-SSP. HEC-SSP is a beta version and

is not listed by FEMA as an acceptable program. We should confirm that HEC-SSP is not appropriate for this effort.

We appreciate the opportunity to review the draft report. If you have any questions or if you would like to discuss our comments please call me.

Sincerely,

Lee E. Frederiksen, PE
Vice President

HDR ONE COMPANY | Many Solutions
2365 Iron Point Road, Suite 300 | Folsom, CA | 95630
Phone: 916.817.4883 | Cell: 916.213.0569 | Fax: 916.817.4747 Email: Lee.Frederiksen@hdrinc.com

CC: inasseri@ladpw.org; james.d.hutchison@usace.army.mil; kerry.t.casey@usace.army.mil; raymond.lenaburg@dhs.gov; Su, Yunsheng; Vargas, Sergio

FFA RUN

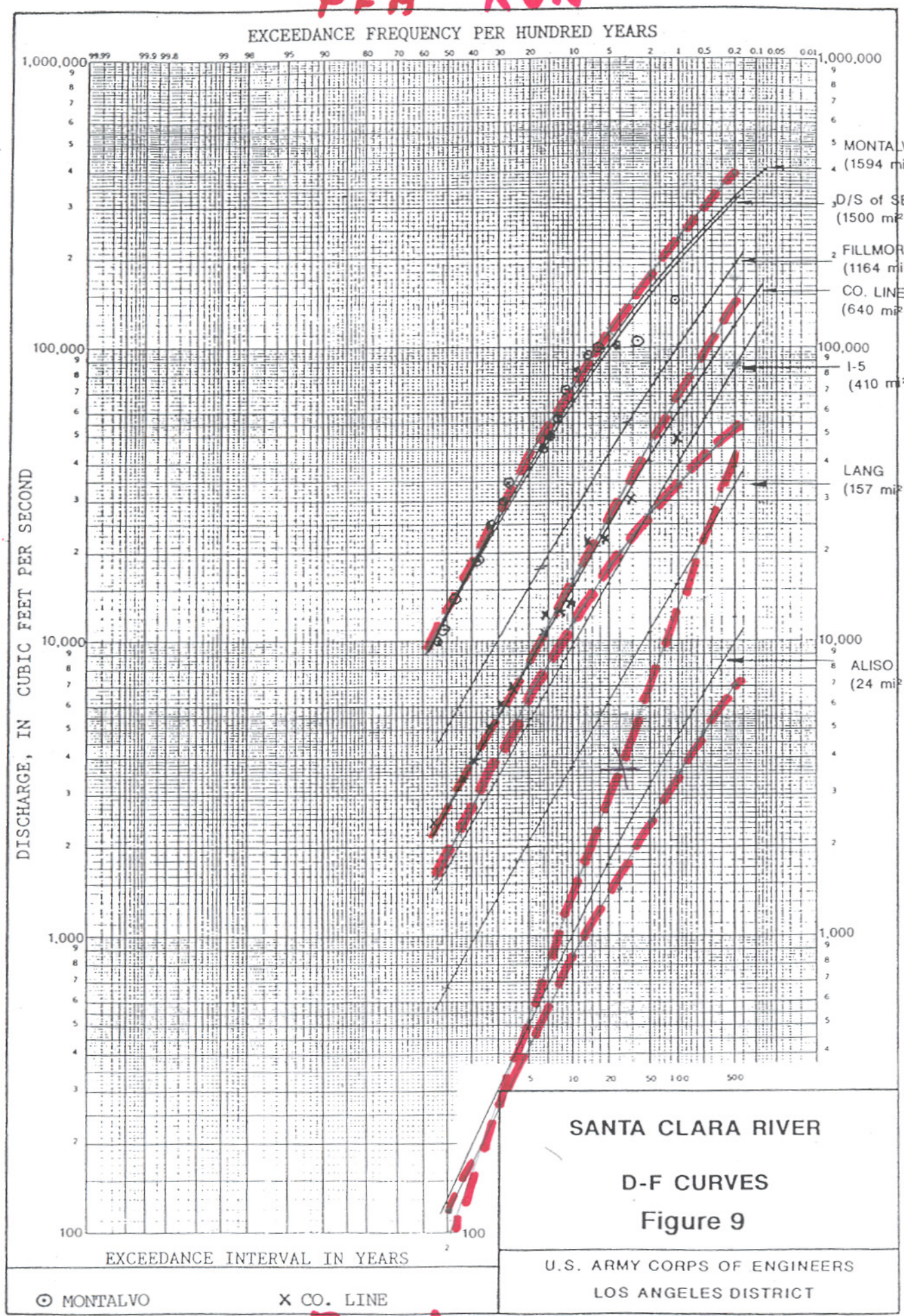
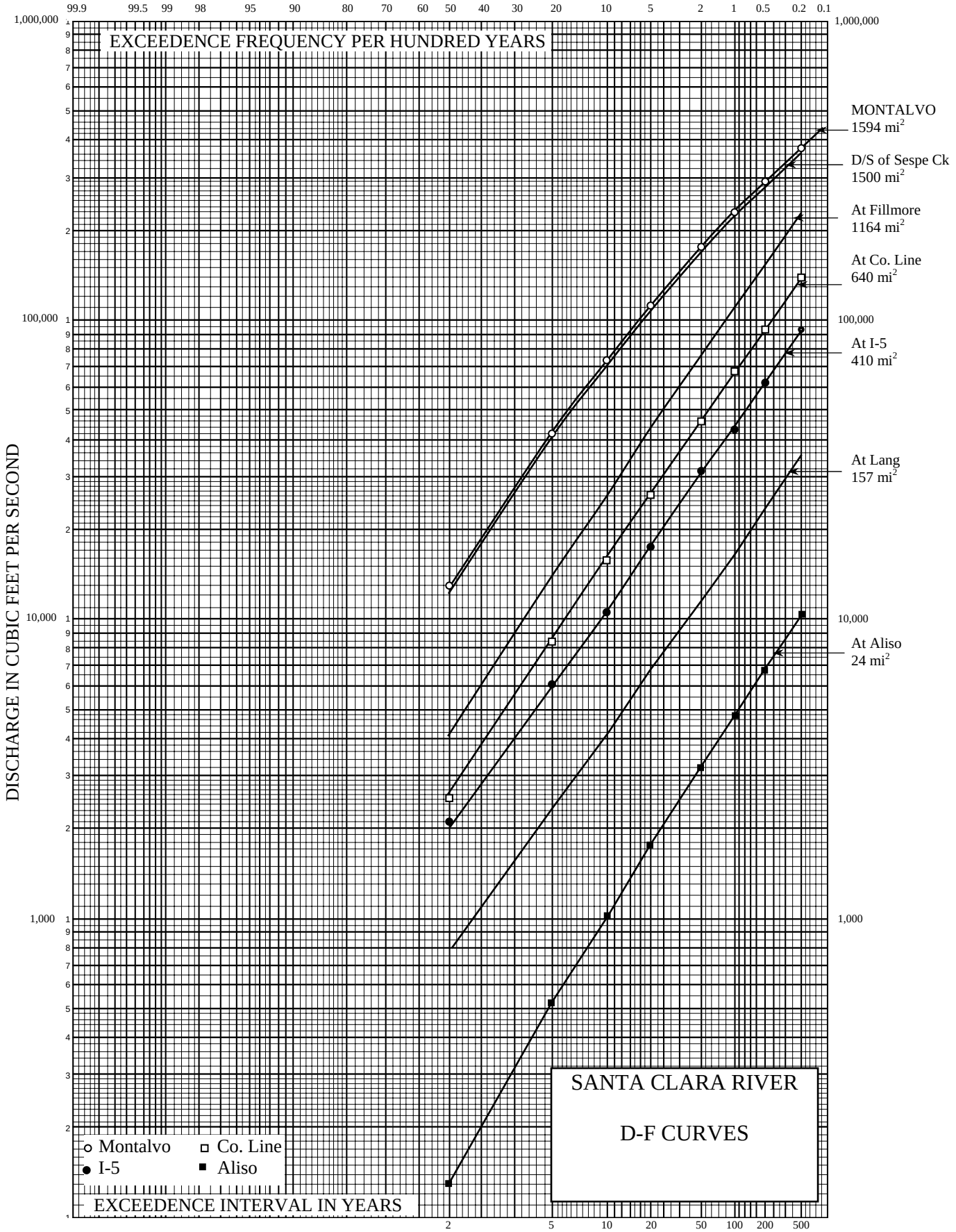

EXCEEDANCE FREQUENCY PER HUNDRED YEARS
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
1,000,000
100,000
10,000
1,000
100
DISCHARGE, IN CUBIC FEET PER SECOND
MONTALVO (1594 mi²)
D/S of SESPE C (1500 mi²)
FILLMORE (1164 mi²)
CO. LINE (640 mi²)
I-5 (410 mi²)
LANG (157 mi²)
ALISO (24 mi²)
5 10 20 50 100 500
EXCEEDANCE INTERVAL IN YEARS
⊙ MONTALVO
× CO. LINE
SANTA CLARA RIVER
D-F CURVES
Figure 9
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Fig. 1


EXCEEDENCE FREQUENCY PER HUNDRED YEARS
99.9
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
1,000,000
100,000
10,000
1,000
DISCHARGE IN CUBIC FEET PER SECOND
MONTALVO
1594 mi2
D/S of Sespe Ck
1500 mi2
At Fillmore
1164 mi2
At Co. Line
640 mi2
At I-5
410 mi2
At Lang
157 mi2
At Aliso
24 mi2
Montalvo
Co. Line
I-5
Aliso
EXCEEDENCE INTERVAL IN YEARS
2
5
10
20
50
100
200
500
SANTA CLARA RIVER
D-F CURVES

From: Yunsheng Su
To: Casey, Kerry T SPL; Vargas, Sergio
Date: 12/27/2006 3:15:20 PM
Subject: Re: Hydrology for Santa Clara River (UNCLASSIFIED)

Kerry:

Thank you very much for your review, comments, and endorsement of the Santa Clara River phase I hydrology update. Phase I hydrology update covers Santa Clara River from ocean to LA County line. Phase II will cover the whole watershed. Please find my response to your comments below:

>>> "Casey, Kerry T SPL" <Kerry.T.Casey@spl01.usace.army.mil> 12/22/2006 11:19 AM >>>
Classification: UNCLASSIFIED
Caveats: NONE

Sergio-

I have done a cursory review of the latest hydrologic documentation for Santa Clara River Phase I. I do have some comments, but they do not impact the discharges proposed for the Ventura County portion of the Santa Clara River watershed. It is appropriate to use Table 3: Summary of Updated Hydrology, Table 5: Summary of Updated Hydrology for Gauged Tributaries, and Table 6: Summary of 100-Year Flows for Ungauged Tributaries, for use in revising the flood plains in the Santa Clara River watershed in Ventura County.
++

Some questions/comments:

Suggest date this as Dec. 2006 Update.

A: Agree. The document will be dated as December 2006

All of the previous work used median plotting positions. Why was Weibull p.p. used? For our Santa Clara River watershed study I would like see the FFA files reflect median p.p. (doesn't impact the statistical results - but would like to see consistency).

A: Agree. FFA program has been adjusted to produce Median Plotting Positions and it is plotted on Figure 2

Should Ellsworth Barranca be listed in gaged tributaries and shown on Fig. 1? or is there no plan to map flood plains?

A: There is no plan to map floodplain in Ellsworth Barranca. It is shown in ungaged tributaries to help determine flow rate in Orcutt Canyon

Why is Santa Clara R. at I-5 FFA output file still included in Appendix 3 of this Phase I document? It is probably best to remove until we some

concurrence with LACDPW.

A: Yes. It has been removed from the appendix.

Why is Pole Creek listed under gaged as well as ungaged?

A: Pole Creek was listed in ungaged tributaries to help determine flow rates at Grimes Canyon and Basolo Ditch. It has been removed from ungaged tributaries to be less confusing.

I'd disagree with the interpretation (on pg. 12) of Section V.C. of Bulletin 17B, but it doesn't change the results.

A: Mark and I agree to check the yield of Pole Creek with that of Hoper Creek so that we have higher confidence about the FFA resulting from much shorter period of record.

Have you made any effort to estimate a "new" generalized skew coefficient based on all of the stream gages in the Santa Clara R. watershed? That might be informative.

A: Due to time limit, we did not make effort to update the generalized skew coefficient.

I reserve the option to have comments on the discharge-frequency relationships for the LA County portion of the watershed once we have discussed with LACDPW.

Classification: UNCLASSIFIED
Caveats: NONE

As we discussed on the phone today, I wil finalize this report and put it on COE's ftp site.

Thank you again

Vincent

CC: Bandurraga, Mark; Buxton, Darrell W SPL; BWILLARD@ladpw.org; Hutchison, James D SPL; Vermeeren, Rene A SPL

Appendix 2

Flood Frequency Analysis (FFA)

Input and Output Files

For

Main Stem of Santa Clara River

Input and Output Files at Montalvo

```
TT FLOOD FLOW FREQUENCY PROGRAM - SANTA CLARA RIVER AT MONTALVO(HWY.101 BRIDGE)
TT PEAK VALUES FOR 1932-1955 GENERATED DURING HYDROLOGIC ANALYSIS W/ COE
TT REGIONAL SKEW -.3 TO DUPLICATE C.O.E. RESULTS IN VENTURA CO
ID   708 SANTA CLARA RIVER AT MONTALVO  DA= 1624SQMI REC BEGAN:1932 TYPE RG/FW
J1     2
GS   708             -.3    SANTA CLARA RIVER AT MONTALVO
QR   708    1932   22000    SANTA CLARA RIVER AT MONTALVO
QR   708    1934   46000    SANTA CLARA RIVER AT MONTALVO
QR   708    1935   17000    SANTA CLARA RIVER AT MONTALVO
QR   708    1936   16000    SANTA CLARA RIVER AT MONTALVO
QR   708    1937   19000    SANTA CLARA RIVER AT MONTALVO
QR   708    1938   95000    SANTA CLARA RIVER AT MONTALVO
QR   708    1939    6400    SANTA CLARA RIVER AT MONTALVO
QR   708    1940    3300    SANTA CLARA RIVER AT MONTALVO
QR   708    1941   30000    SANTA CLARA RIVER AT MONTALVO
QR   708    1942    3600    SANTA CLARA RIVER AT MONTALVO
QR   708    1943   72000    SANTA CLARA RIVER AT MONTALVO
QR   708    1944   28000    SANTA CLARA RIVER AT MONTALVO
QR   708    1945   16000    SANTA CLARA RIVER AT MONTALVO
QR   708    1946   14000    SANTA CLARA RIVER AT MONTALVO
QR   708    1947    9000    SANTA CLARA RIVER AT MONTALVO
QR   708    1950    2280    SANTA CLARA RIVER AT MONTALVO
QR   708    1952   45000    SANTA CLARA RIVER AT MONTALVO
QR   708    1953    2700    SANTA CLARA RIVER AT MONTALVO
QR   708    1954    5300    SANTA CLARA RIVER AT MONTALVO
QR   708    1955     500    SANTA CLARA RIVER AT MONTALVO
QR   708    1956    5550    SANTA CLARA RIVER AT MONTALVO
QR   708    1957    3780    SANTA CLARA RIVER AT MONTALVO
QR   708    1958   50000    SANTA CLARA RIVER AT MONTALVO
QR   708    1959   11000    SANTA CLARA RIVER AT MONTALVO
QR   708    1960     408    SANTA CLARA RIVER AT MONTALVO
QR   708    1961     216    SANTA CLARA RIVER AT MONTALVO
QR   708    1962   44000    SANTA CLARA RIVER AT MONTALVO
QR   708    1963    5060    SANTA CLARA RIVER AT MONTALVO
QR   708    1964    2350    SANTA CLARA RIVER AT MONTALVO
QR   708    1965    3360    SANTA CLARA RIVER AT MONTALVO
QR   708    1966   44000    SANTA CLARA RIVER AT MONTALVO
QR   708    1967   35000    SANTA CLARA RIVER AT MONTALVO
QR   708    1968    4000    SANTA CLARA RIVER AT MONTALVO
QR   708    1969  147000    SANTA CLARA RIVER AT MONTALVO
QR   708    1970    9960    SANTA CLARA RIVER AT MONTALVO
QR   708    1971   28800    SANTA CLARA RIVER AT MONTALVO
QR   708    1972    8350    SANTA CLARA RIVER AT MONTALVO
QR   708    1973   58200    SANTA CLARA RIVER AT MONTALVO
QR   708    1974   14700    SANTA CLARA RIVER AT MONTALVO
QR   708    1975   10800    SANTA CLARA RIVER AT MONTALVO
QR   708    1976    5420    SANTA CLARA RIVER AT MONTALVO
QR   708    1977    3850    SANTA CLARA RIVER AT MONTALVO
QR   708    1978  102200    SANTA CLARA RIVER AT MONTALVO
QR   708    1979   18600    SANTA CLARA RIVER AT MONTALVO
QR   708    1980   81400    SANTA CLARA RIVER AT MONTALVO
QR   708    1981    3620    SANTA CLARA RIVER AT MONTALVO
QR   708    1982    8600    SANTA CLARA RIVER AT MONTALVO
QR   708    1983  100000    SANTA CLARA RIVER AT MONTALVO
QR   708    1984    4930    SANTA CLARA RIVER AT MONTALVO
QR   708    1985    4040    SANTA CLARA RIVER AT MONTALVO
QR   708    1986   43700    SANTA CLARA RIVER AT MONTALVO
QR   708    1987     851    SANTA CLARA RIVER AT MONTALVO
```

```
QR   708    1988   13500    SANTA CLARA RIVER AT MONTALVO
QR   708    1990    1200    SANTA CLARA RIVER AT MONTALVO
QR   708    1991   25000    SANTA CLARA RIVER AT MONTALVO
QR   708    1992  104000    SANTA CLARA RIVER AT MONTALVO
QR   708    1993   44300    SANTA CLARA RIVER AT MONTALVO
QR   708    1994    4000    SANTA CLARA RIVER AT MONTALVO  WPD
QR   708    1996   17000    SANTA CLARA RIVER AT MONTALVO
QR   708    1997   20500    SANTA CLARA RIVER AT MONTALVO
QR   708    1998   84000    SANTA CLARA RIVER AT MONTALVO
QR   708    1999     763     SANTA CLARA RIVER AT MONTALVO
QR   708    2000    6370    SANTA CLARA RIVER AT MONTALVO
QR   708    2001   32900    SANTA CLARA RIVER AT MONTALVO
QR   708    2002     331    SANTA CLARA RIVER AT MONTALVO USGS
QR   708    2003   13600    SANTA CLARA RIVER AT MONTALVO USGS
QR   708    2004   19600    SANTA CLARA RIVER AT MONTALVO USGS
QR   708    2005  136000    SANTA CLARA RIVER AT MONTALVO VCWPD
ED
```

```
************************************      ************************************
 *              FFA                 *      *                                  *
 *     FLOOD FREQUENCY ANALYSIS     *      *   U.S. ARMY CORPS OF ENGINEERS   *
 *     PROGRAM DATE:  FEB 1995      *      * THE HYDROLOGIC ENGINEERING CENTER *
 *          VERSION:  3.1           *      *         609 SECOND STREET        *
 *     RUN  DATE   AND   TIME:      *      *      DAVIS, CALIFORNIA 95616     *
 *        27 DEC 06    09:40:50     *      *          (916) 756-1104          *
 *                                  *      *                                  *
 ************************************      ************************************


  INPUT FILE NAME: 70805m.txt
 OUTPUT FILE NAME: 70805m.out


 **TITLE RECORD(S)**
 TT   FLOOD FLOW FREQUENCY PROGRAM - SANTA CLARA RIVER AT MONTALVO(HWY.101 BRIDGE)
 TT   PEAK VALUES FOR 1932-1955 GENERATED DURING HYDROLOGIC ANALYSIS W/ COE
 TT   REGIONAL SKEW -.3 TO DUPLICATE C.O.E. RESULTS IN VENTURA CO

 **STATION IDENTIFICATION**
 ID     708 SANTA CLARA RIVER AT MONTALVO  DA= 1624SQMI REC BEGAN:1932 TYPE RG/FW

 **JOB RECORD(S)**
      IPPC   ISKFX  IPROUT    IFMT    IWYR   IUNIT   ISMRY   IPNCH    IREG
 J1     2       0       0       0       0       0       0       0       0

 **GENERALIZED SKEW**
      ISTN   GGMSE    SKEW
 GS    708    .000    -.30

 **SYSTEMATIC EVENTS**
      68 EVENTS TO BE ANALYZED

 **END OF INPUT DATA**
 ED ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ FINAL RESULTS ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

-PLOTTING POSITIONS- 708 SANTA CLARA RIVER AT MONTALVO DA= 162

EVENTS ANALYZED					ORDERED EVENTS			
			FLOW		WATER		FLOW	MEDIAN
MON	DAY	YEAR	CFS	RANK	YEAR		CFS	PLOT POS
0	0	1932	22000.	1	1969		147000.	1.02
0	0	1934	46000.	2	2005		136000.	2.49
0	0	1935	17000.	3	1992		104000.	3.95
0	0	1936	16000.	4	1978		102200.	5.41
0	0	1937	19000.	5	1983		100000.	6.87
0	0	1938	95000.	6	1938		95000.	8.33
0	0	1939	6400.	7	1998		84000.	9.80
0	0	1940	3300.	8	1980		81400.	11.26
0	0	1941	30000.	9	1943		72000.	12.72
0	0	1942	3600.	10	1973		58200.	14.18
0	0	1943	72000.	11	1958		50000.	15.64
0	0	1944	28000.	12	1934		46000.	17.11
0	0	1945	16000.	13	1952		45000.	18.57
0	0	1946	14000.	14	1993		44300.	20.03
0	0	1947	9000.	15	1962		44000.	21.49
0	0	1950	2280.	16	1966		44000.	22.95
0	0	1952	45000.	17	1986		43700.	24.42
0	0	1953	2700.	18	1967		35000.	25.88
0	0	1954	5300.	19	2001		32900.	27.34
0	0	1955	500.	20	1941		30000.	28.80
0	0	1956	5550.	21	1971		28800.	30.26
0	0	1957	3780.	22	1944		28000.	31.73
0	0	1958	50000.	23	1991		25000.	33.19
0	0	1959	11000.	24	1932		22000.	34.65
0	0	1960	408.	25	1997		20500.	36.11
0	0	1961	216.	26	2004		19600.	37.57
0	0	1962	44000.	27	1937		19000.	39.04
0	0	1963	5060.	28	1979		18600.	40.50
0	0	1964	2350.	29	1935		17000.	41.96
0	0	1965	3360.	30	1996		17000.	43.42
0	0	1966	44000.	31	1936		16000.	44.88
0	0	1967	35000.	32	1945		16000.	46.35
0	0	1968	4000.	33	1974		14700.	47.81
0	0	1969	147000.	34	1946		14000.	49.27
0	0	1970	9960.	35	2003		13600.	50.73
0	0	1971	28800.	36	1988		13500.	52.19
0	0	1972	8350.	37	1959		11000.	53.65
0	0	1973	58200.	38	1975		10800.	55.12
0	0	1974	14700.	39	1970		9960.	56.58
0	0	1975	10800.	40	1947		9000.	58.04
0	0	1976	5420.	41	1982		8600.	59.50
0	0	1977	3850.	42	1972		8350.	60.96
0	0	1978	102200.	43	1939		6400.	62.43
0	0	1979	18600.	44	2000		6370.	63.89
0	0	1980	81400.	45	1956		5550.	65.35
0	0	1981	3620.	46	1976		5420.	66.81
0	0	1982	8600.	47	1954		5300.	68.27
0	0	1983	100000.	48	1963		5060.	69.74
0	0	1984	4930.	49	1984		4930.	71.20
0	0	1985	4040.	50	1985		4040.	72.66
0	0	1986	43700.	51	1994		4000.	74.12
0	0	1987	851.	52	1968		4000.	75.58
0	0	1988	13500.	53	1977		3850.	77.05
0	0	1990	1200.	54	1957		3780.	78.51

```
º   0   0  1991    25000.  ³    55   1981      3620.    79.97  º
º   0   0  1992   104000.  ³    56   1942      3600.    81.43  º
º   0   0  1993    44300.  ³    57   1965      3360.    82.89  º
º   0   0  1994     4000.  ³    58   1940      3300.    84.36  º
º   0   0  1996    17000.  ³    59   1953      2700.    85.82  º
º   0   0  1997    20500.  ³    60   1964      2350.    87.28  º
º   0   0  1998    84000.  ³    61   1950      2280.    88.74  º
º   0   0  1999      763.  ³    62   1990      1200.    90.20  º
º   0   0  2000     6370.  ³    63   1987       851.    91.67  º
º   0   0  2001    32900.  ³    64   1999       763.    93.13  º
º   0   0  2002      331.  ³    65   1955       500.    94.59  º
º   0   0  2003    13600.  ³    66   1960       408.    96.05  º
º   0   0  2004    19600.  ³    67   2002       331.    97.51  º
º   0   0  2005   136000.  ³    68   1961       216.    98.98  º
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼


-OUTLIER TESTS  -
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
LOW OUTLIER TEST
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ


BASED ON  68 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.883

       0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF    136.0

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
HIGH OUTLIER TEST
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ


BASED ON  68 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.883

      0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF  936603.
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ


-SKEW WEIGHTING -
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
BASED ON  68 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW =   .110
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW =   .302
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ


FINAL RESULTS

-FREQUENCY CURVE-   708 SANTA CLARA RIVER AT MONTALVO  DA= 162
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÑÍÍÍÍÍÍÍÍÍÍÍÍÍÍÑÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º  COMPUTED   EXPECTED   ³   PERCENT   ³    CONFIDENCE LIMITS  º
º   CURVE   PROBABILITY  ³    CHANCE   ³      .05        .95   º
º      FLOW IN CFS       ³  EXCEEDANCE ³      FLOW IN CFS      º
ÇÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ¶
º   373000.    415000.   ³        .2   ³  727000.    222000.  º
º   286000.    311000.   ³        .5   ³  535000.    174000.  º
º   226000.    242000.   ³       1.0   ³  409000.    141000.  º
º   172000.    182000.   ³       2.0   ³  300000.    110000.  º
º   111000.    115000.   ³       5.0   ³  183000.     73900.  º
º    72800.     74700.   ³      10.0   ³  114000.     50200.  º
º    41900.     42600.   ³      20.0   ³   61900.     30000.  º
º    12800.     12800.   ³      50.0   ³   17500.      9430.  º
º     3270.      3200.   ³      80.0   ³    4560.      2230.  º
```

```
º     1490.      1420.   ³      90.0    ³      2180.       930.  º
º      744.       694.   ³      95.0    ³      1160.       426.  º
º      184.       156.   ³      99.0    ³       331.        86.  º
ÌÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¹
º                      SYSTEMATIC STATISTICS                     º
ÇÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÂÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ¶
º LOG TRANSFORM: FLOW, CFS       ³       NUMBER OF EVENTS      º
ÇÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ¶
º  MEAN                  4.0526  ³  HISTORIC EVENTS         0  º
º  STANDARD DEV           .6656  ³  HIGH OUTLIERS       0      º
º  COMPUTED SKEW         -.5154  ³  LOW OUTLIERS        0      º
º  REGIONAL SKEW         -.3000  ³  ZERO OR MISSING     0      º
º  ADOPTED SKEW          -.5000  ³  SYSTEMATIC EVENTS      68  º
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼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+ END OF RUN            +
+ NORMAL STOP IN FFA    +
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Input and Output Files at County Line

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TT FLOOD FLOW FREQUENCY PROGRAM - SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
TT PEAK VALUES FOR 1953-2005
TT REGIONAL SKEW -.3 TO DUPLICATE C.O.E. RESULTS IN VENTURA CO
J1     2
ID   707 SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE REC BEGAN:1952 TYPE RG/FW
GS   707            -0.3    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70711151953     375    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702131954     578    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701181955     419    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701261956     672    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70703011957    1209    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70704031958    5411    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701061959    1561    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701061960      83    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70711061961     145    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702111962    6965    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70703161963    1026    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701221964     411    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70704091965    1064    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70712291966   22213    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701241967    4998    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70711191967    2174    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701251969   49870    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70703021970     759    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70711291971    6949    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70712271972    3410    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702111973   12800    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701071974    5150    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70712041975    2210    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702091976    1700    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70705081977    1880    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702091978   22800    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70703271979    6020    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702161980   13900    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701281981    2470    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70703171982    1730    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70703011983   30600    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70712251984     308    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70712191985    2270    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702151986   12300    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70711181987    1460    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70712141988    1340    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702281989    3900    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702171990    1870    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70703011991    6960    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702121992   12300    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702181993   10700    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70712111994     597    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70701101995   17100    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
QR   70702201996    4450    SANTA CLARA RIVER AT VENTURA/LA COUNTY LINENEW
NUMB11109000
QR 1110903241997     303    SANTA CLARA RIVER NEAR PIRU - NEW NAME
QR 1110904121999     277    SANTA CLARA RIVER NEAR PIRU
QR 1110902232000    2440    SANTA CLARA RIVER NEAR PIRU
QR 1110903062001    1230    SANTA CLARA RIVER NEAR PIRU
QR 1110911242001     729    SANTA CLARA RIVER NEAR PIRU
QR 1110902122003    2330    SANTA CLARA RIVER NEAR PIRU
QR 1110902262004    2640    SANTA CLARA RIVER NEAR PIRU
QR 1110901102005   32000    SANTA CLARA RIVER NEAR PIRU
ED
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************************************      ************************************
 *              FFA                  *      *                                  *
 *     FLOOD FREQUENCY ANALYSIS      *      *   U.S. ARMY CORPS OF ENGINEERS    *
 *     PROGRAM DATE:  FEB 1995       *      * THE HYDROLOGIC ENGINEERING CENTER *
 *          VERSION:  3.1            *      *         609 SECOND STREET         *
 *     RUN  DATE   AND   TIME:       *      *      DAVIS, CALIFORNIA 95616      *
 *       27 DEC 06    09:48:18       *      *          (916) 756-1104           *
 *                                   *      *                                  *
 ************************************      ************************************



  INPUT FILE NAME: 70705m.txt
 OUTPUT FILE NAME: 70705m.out



 **TITLE RECORD(S)**
 TT   FLOOD FLOW FREQUENCY PROGRAM - SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE
 TT   PEAK VALUES FOR 1953-2005
 TT   REGIONAL SKEW -.3 TO DUPLICATE C.O.E. RESULTS IN VENTURA CO

 **JOB RECORD(S)**
      IPPC   ISKFX  IPROUT    IFMT    IWYR   IUNIT   ISMRY   IPNCH    IREG
 J1     2       0       0       0       0       0       0       0       0

 **STATION IDENTIFICATION**
 ID     707 SANTA CLARA RIVER AT VENTURA/LA COUNTY LINE REC BEGAN:1952 TYPE RG/FW

 **GENERALIZED SKEW**
      ISTN   GGMSE    SKEW
 GS    707    .000    -.30

 **SYSTEMATIC EVENTS**
      52 EVENTS TO BE ANALYZED

 **END OF INPUT DATA**
 ED ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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 ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ   FINAL RESULTS    ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

 -PLOTTING POSITIONS-   707 SANTA CLARA RIVER AT VENTURA/LA COUNTY
 ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÑÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
 º      EVENTS ANALYZED     ³           ORDERED EVENTS         º
 º                    FLOW  ³        WATER      FLOW    MEDIAN  º
 º MON DAY  YEAR     CFS    ³   RANK  YEAR      CFS    PLOT POS º
 ÇÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ¶
 º  11  15  1953      375.  ³     1   1969     49870.     1.34  º
 º   2  13  1954      578.  ³     2   2005     32000.     3.24  º
 º   1  18  1955      419.  ³     3   1983     30600.     5.15  º
 º   1  26  1956      672.  ³     4   1978     22800.     7.06  º
 º   3   1  1957     1209.  ³     5   1967     22213.     8.97  º
 º   4   3  1958     5411.  ³     6   1995     17100.    10.88  º
 º   1   6  1959     1561.  ³     7   1980     13900.    12.79  º
 º   1   6  1960       83.  ³     8   1973     12800.    14.69  º
```

11	6	1961	145.	9	1986	12300.	16.60
2	11	1962	6965.	10	1992	12300.	18.51
3	16	1963	1026.	11	1993	10700.	20.42
1	22	1964	411.	12	1962	6965.	22.33
4	9	1965	1064.	13	1991	6960.	24.24
12	29	1966	22213.	14	1972	6949.	26.15
1	24	1967	4998.	15	1979	6020.	28.05
11	19	1967	2174.	16	1958	5411.	29.96
1	25	1969	49870.	17	1974	5150.	31.87
3	2	1970	759.	18	1967	4998.	33.78
11	29	1971	6949.	19	1996	4450.	35.69
12	27	1972	3410.	20	1989	3900.	37.60
2	11	1973	12800.	21	1973	3410.	39.50
1	7	1974	5150.	22	2004	2640.	41.41
12	4	1975	2210.	23	1981	2470.	43.32
2	9	1976	1700.	24	2000	2440.	45.23
5	8	1977	1880.	25	2003	2330.	47.14
2	9	1978	22800.	26	1986	2270.	49.05
3	27	1979	6020.	27	1976	2210.	50.95
2	16	1980	13900.	28	1968	2174.	52.86
1	28	1981	2470.	29	1977	1880.	54.77
3	17	1982	1730.	30	1990	1870.	56.68
3	1	1983	30600.	31	1982	1730.	58.59
12	25	1984	308.	32	1976	1700.	60.50
12	19	1985	2270.	33	1959	1561.	62.40
2	15	1986	12300.	34	1988	1460.	64.31
11	18	1987	1460.	35	1989	1340.	66.22
12	14	1988	1340.	36	2001	1230.	68.13
2	28	1989	3900.	37	1957	1209.	70.04
2	17	1990	1870.	38	1965	1064.	71.95
3	1	1991	6960.	39	1963	1026.	73.85
2	12	1992	12300.	40	1970	759.	75.76
2	18	1993	10700.	41	2002	729.	77.67
12	11	1994	597.	42	1956	672.	79.58
1	10	1995	17100.	43	1995	597.	81.49
2	20	1996	4450.	44	1954	578.	83.40
3	24	1997	303.	45	1955	419.	85.31
4	12	1999	277.	46	1964	411.	87.21
2	23	2000	2440.	47	1954	375.	89.12
3	6	2001	1230.	48	1985	308.	91.03
11	24	2001	729.	49	1997	303.	92.94
2	12	2003	2330.	50	1999	277.	94.85
2	26	2004	2640.	51	1962	145.	96.76
1	10	2005	32000.	52	1960	83.	98.66

-OUTLIER TESTS -

LOW OUTLIER TEST

BASED ON 52 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.783

0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF 40.6

HIGH OUTLIER TEST

BASED ON 52 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.783

0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF 145291.

-SKEW WEIGHTING -

BASED ON 52 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW = .100
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW = .302

FINAL RESULTS

-FREQUENCY CURVE- 707 SANTA CLARA RIVER AT VENTURA/LA COUNTY

COMPUTED CURVE FLOW IN CFS	EXPECTED PROBABILITY FLOW IN CFS	PERCENT CHANCE EXCEEDANCE	CONFIDENCE LIMITS .05 FLOW IN CFS	CONFIDENCE LIMITS .95 FLOW IN CFS
140000.	174000.	.2	333000.	73100.
93300.	110000.	.5	207000.	51300.
66600.	76100.	1.0	140000.	38100.
45900.	50800.	2.0	90500.	27400.
26100.	27900.	5.0	47000.	16500.
15700.	16400.	10.0	26200.	10400.
8420.	8610.	20.0	13000.	5850.
2490.	2490.	50.0	3500.	1770.
710.	694.	80.0	1020.	462.
364.	347.	90.0	550.	217.
208.	193.	95.0	331.	114.
71.	61.	99.0	128.	33.

SYSTEMATIC STATISTICS

LOG TRANSFORM: FLOW, CFS		NUMBER OF EVENTS	
MEAN	3.3853	HISTORIC EVENTS	0
STANDARD DEV	.6385	HIGH OUTLIERS	0
COMPUTED SKEW	-.0120	LOW OUTLIERS	0
REGIONAL SKEW	-.3000	ZERO OR MISSING	0
ADOPTED SKEW	-.1000	SYSTEMATIC EVENTS	52

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+++++++++++++++++++++++++
+ END OF RUN            +
+ NORMAL STOP IN FFA    +
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Appendix 3

Flood Frequency Analysis (FFA)

For

Gauged Tributaries of Santa Clara River

Ventura County
Watershed Protection District
Planning & Regulatory
Hydrology Section
MEMORANDUM

DATE: December 20, 2006
TO: Files
FROM: Mark Bandurraga

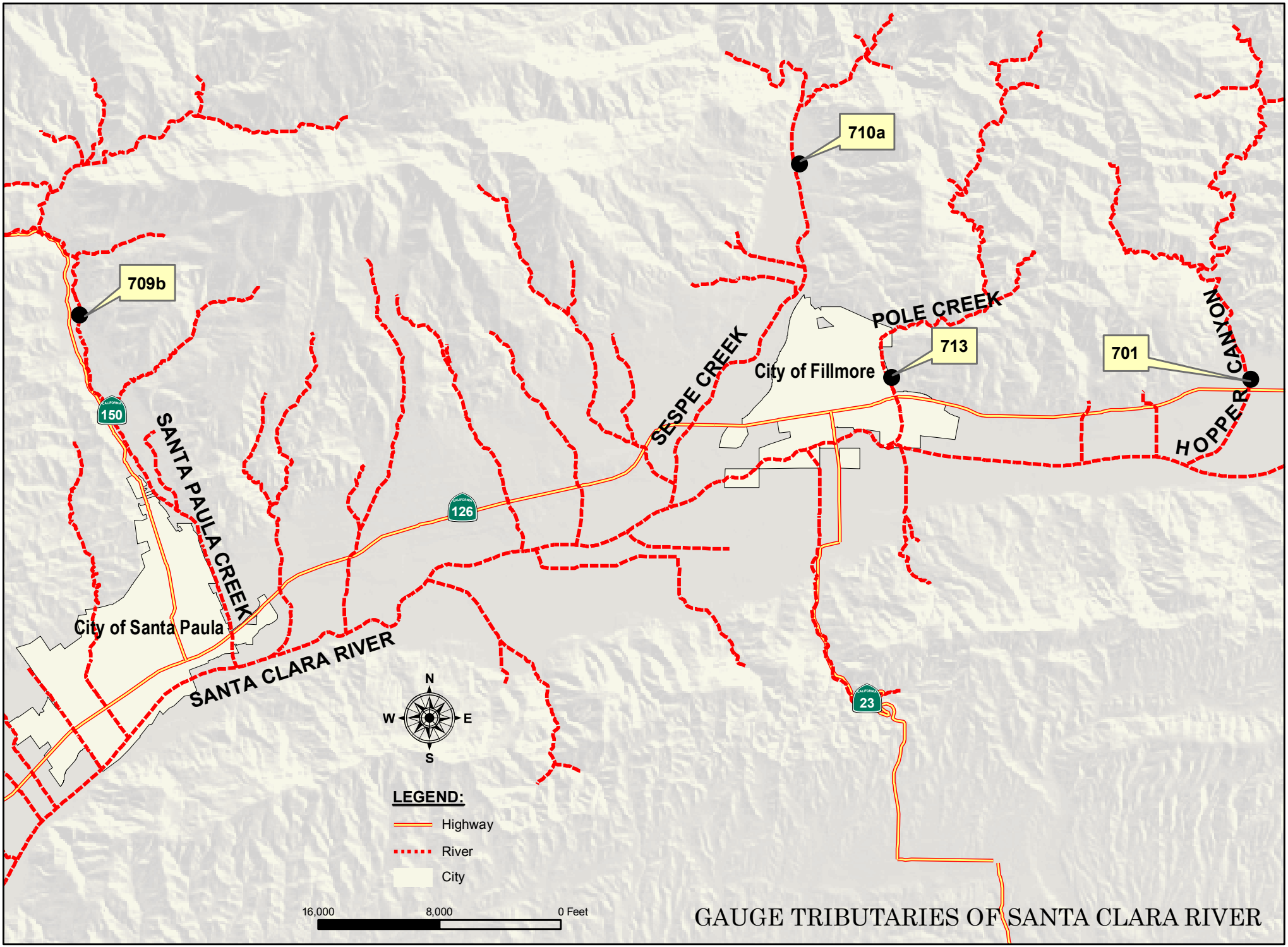
SUBJECT: Addendum to Santa Clara Hydrology Report- Gaged Tributary Flow Frequency Results

This memo documents and summarizes the work that was done to generate flow frequency results for the gaged tributaries in the Ventura County portion of the Santa Clara River Watershed. The project used the HEC-FFA program in accordance with FEMA guidelines. The frequency analyses used official annual peak flow data published on the USGS website for Santa Paula and Sespe Creeks. Pole Creek is a VCWPD gage and so WPD data were used in the analysis. Hopper Creek has been operated by VCWPD since 1984, and therefore USGS data from the USGS website were included with the VCWPD data obtained since 1984. Piru Creek used the existing FEMA (1997) results.

The frequency analyses were done following the guidelines published in Bulletin 17B (USGS) and using a weighted skew value obtained from combining the station skew with the regional skew according to their mean square error (MSE) values. Because the MSE is unknown for regional values, the default recommended value of 0.302 from Bulletin 17B was used. Regional skew coefficients are obtained from the maps published in Bulletin 17B by comparing the watershed centroids to the regional contour lines provided on the map. The results of the analyses are summarized below.

Gage ID	709b	710a	713	701	705
Creek	Santa Paula	Sespe	Pole	Hopper	Piru*
Design Flow Level	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)
100-Yr	38,800	135,000	7,390	19,200	41,000
50-Yr	26,400	102,000	5,170	13,600	33,000
10-Yr	8,620	43,700	1,760	5,060	2,500

*Design flows from FEMA (1997)



GAUGE TRIBUTARIES OF SANTA CLARA RIVER

K\PR\PLANNING\RYP\SANTA CLARA clmor\santa clara-su.mxd

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************************************      ************************************
*               FFA                *      *                                  *
*     FLOOD FREQUENCY ANALYSIS     *      *   U.S. ARMY CORPS OF ENGINEERS   *
*     PROGRAM DATE:  FEB 1995      *      * THE HYDROLOGIC ENGINEERING CENTER *
*          VERSION:  3.1           *      *        609 SECOND STREET         *
*     RUN  DATE   AND   TIME:      *      *     DAVIS, CALIFORNIA 95616      *
*        23 OCT 06    08:01:16     *      *         (916) 756-1104           *
*                                  *      *                                  *
************************************      ************************************



 INPUT FILE NAME: 701_USWP.DAT
OUTPUT FILE NAME: 701_USWP.FFO



**TITLE RECORD(S)**
TT   FLOOD FLOW FREQUENCY PROGRAM TEST 4-HOPPER CREEK NEAR PIRU MIX OF GS&WPD
TT   REGIONAL SKEW -.3 TO DUPLICATE C.O.E. RESULTS AND BULL 17B MAP

**STATION IDENTIFICATION**
ID    1105 HOPPER CREEK NEAR PIRU (V.C. #701)   DA=23.6SQMI REC BEGAN:1933 TYPE:G

**GENERALIZED SKEW**
     ISTN   GGMSE    SKEW
GS   1105    .000    -.30

**SYSTEMATIC EVENTS**
     70 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
ED ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ   FINAL RESULTS    ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

-PLOTTING POSITIONS-  1105 HOPPER CREEK NEAR PIRU (V.C. #701)   D
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÑÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º      EVENTS ANALYZED     ³         ORDERED EVENTS          º
º                  FLOW    ³        WATER      FLOW   WEIBULL  º
º MON DAY  YEAR    CFS     ³   RANK  YEAR      CFS    PLOT POS º
ÇÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ¶
º   0   0  1934     5300.  ³      1   2005     17600.     1.41  º
º   0   0  1935      750.  ³      2   1998     17344.     2.82  º
º   2   2  1936      810.  ³      3   1969      8400.     4.23  º
º   3   2  1938     8000.  ³      4   1980      8120.     5.63  º
º   1   5  1939     1250.  ³      5   1938      8000.     7.04  º
º   2  25  1940      221.  ³      6   1995      7040.     8.45  º
º   2  21  1941     1340.  ³      7   1978      5460.     9.86  º
º   1  22  1943     4200.  ³      8   1934      5300.    11.27  º
º   2  22  1944     1350.  ³      9   1992      4799.    12.68  º
º   2   2  1945     1020.  ³     10   1967      4450.    14.08  º
º  12  21  1945      710.  ³     11   1983      4410.    15.49  º
º  11  13  1946      578.  ³     12   1943      4200.    16.90  º
º   3  24  1948      100.  ³     13   1958      3690.    18.31  º
º   3  11  1949       90.  ³     14   1986      3290.    19.72  º
º   2   6  1950     1000.  ³     15   1966      3000.    21.13  º
º   1  19  1951       18.  ³     16   2004      2680.    22.54  º
º   1  15  1952     2200.  ³     17   1952      2200.    23.94  º
º  12   1  1952      126.  ³     18   1993      2140.    25.35  º
º   2  13  1954      146.  ³     19   1962      1840.    26.76  º
º   2  27  1955      255.  ³     20   1991      1680.    28.17  º
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º	1	26	1956	992.	³	21	1973	1670.	29.58	º
º	1	13	1957	1160.	³	22	1971	1620.	30.99	º
º	4	3	1958	3690.	³	23	2001	1619.	32.39	º
º	2	16	1959	496.	³	24	1988	1460.	33.80	º
º	4	27	1960	249.	³	25	2000	1420.	35.21	º
º	11	6	1960	61.	³	26	1944	1350.	36.62	º
º	2	10	1962	1840.	³	27	1941	1340.	38.03	º
º	2	9	1963	470.	³	28	1939	1250.	39.44	º
º	11	20	1963	307.	³	29	1957	1160.	40.85	º
º	4	9	1965	504.	³	30	1979	1030.	42.25	º
º	12	29	1965	3000.	³	31	1945	1020.	43.66	º
º	12	6	1966	4450.	³	32	1950	1000.	45.07	º
º	11	20	1967	450.	³	33	1997	1000.	46.48	º
º	1	25	1969	8400.	³	34	1956	992.	47.89	º
º	2	28	1970	800.	³	35	1984	981.	49.30	º
º	11	29	1970	1620.	³	36	2003	812.	50.70	º
º	12	24	1971	691.	³	37	1936	810.	52.11	º
º	2	11	1973	1670.	³	38	1970	800.	53.52	º
º	1	7	1974	547.	³	39	1975	799.	54.93	º
º	12	4	1974	799.	³	40	1935	750.	56.34	º
º	2	9	1976	266.	³	41	1946	710.	57.75	º
º	1	3	1977	390.	³	42	1972	691.	59.15	º
º	2	9	1978	5460.	³	43	1947	578.	60.56	º
º	3	27	1979	1030.	³	44	1974	547.	61.97	º
º	2	16	1980	8120.	³	45	1982	527.	63.38	º
º	1	29	1981	311.	³	46	1965	504.	64.79	º
º	4	1	1982	527.	³	47	1959	496.	66.20	º
º	3	1	1983	4410.	³	48	1963	470.	67.61	º
º	12	25	1983	981.	³	49	1968	450.	69.01	º
º	12	16	1984	339.	³	50	1990	412.	70.42	º
º	2	14	1986	3290.	³	51	1994	406.	71.83	º
º	3	6	1987	210.	³	52	1996	400.	73.24	º
º	2	29	1988	1460.	³	53	1977	390.	74.65	º
º	12	21	1988	307.	³	54	1985	339.	76.06	º
º	2	17	1990	412.	³	55	1981	311.	77.46	º
º	3	19	1991	1680.	³	56	1989	307.	78.87	º
º	2	12	1992	4799.	³	57	1964	307.	80.28	º
º	2	23	1993	2140.	³	58	1976	266.	81.69	º
º	2	20	1994	406.	³	59	1955	255.	83.10	º
º	1	10	1995	7040.	³	60	1960	249.	84.51	º
º	2	20	1996	400.	³	61	1940	221.	85.92	º
º	12	22	1996	1000.	³	62	1987	210.	87.32	º
º	2	7	1998	17344.	³	63	1999	199.	88.73	º
º	2	9	1999	199.	³	64	2002	196.	90.14	º
º	2	20	2000	1420.	³	65	1954	146.	91.55	º
º	1	11	2001	1619.	³	66	1953	126.	92.96	º
º	11	24	2001	196.	³	67	1948	100.	94.37	º
º	3	15	2003	812.	³	68	1949	90.	95.77	º
º	2	26	2004	2680.	³	69	1961	61.	97.18	º
º	1	10	2005	17600.	³	70	1951	18.	98.59	º

-OUTLIER TESTS -

LOW OUTLIER TEST

BASED ON 70 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.893

0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF 17.9

HIGH OUTLIER TEST

BASED ON 70 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.893

      0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF   45626.

-SKEW WEIGHTING -

BASED ON 70 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW =   .079
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW =   .302

FINAL RESULTS

-FREQUENCY CURVE- 1105 HOPPER CREEK NEAR PIRU (V.C. #701)   D

COMPUTED CURVE FLOW IN CFS	EXPECTED PROBABILITY FLOW IN CFS	PERCENT CHANCE EXCEEDANCE	CONFIDENCE LIMITS .05 FLOW IN CFS	CONFIDENCE LIMITS .95
37900.	44000.	.2	74300.	22500.
26100.	29300.	.5	48500.	16100.
19200.	21000.	1.0	34000.	12200.
13600.	14600.	2.0	23000.	8960.
8080.	8450.	5.0	12800.	5590.
5060.	5200.	10.0	7540.	3640.
2850.	2890.	20.0	3990.	2130.
925.	925.	50.0	1210.	707.
291.	287.	80.0	390.	208.
157.	152.	90.0	219.	105.
94.	89.	95.0	137.	59.
35.	32.	99.0	56.	19.

SYSTEMATIC STATISTICS

LOG TRANSFORM: FLOW, CFS		NUMBER OF EVENTS	
MEAN	2.9566	HISTORIC EVENTS	0
STANDARD DEV	.5885	HIGH OUTLIERS	0
COMPUTED SKEW	-.0763	LOW OUTLIERS	0
REGIONAL SKEW	-.3000	ZERO OR MISSING	0
ADOPTED SKEW	-.1000	SYSTEMATIC EVENTS	70

+++++++++++++++++++++++++
+ END OF RUN   +
+ NORMAL STOP IN FFA   +
+++++++++++++++++++++++++

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**********************************      **********************************
*              FFA                 *      *                                *
*     FLOOD FREQUENCY ANALYSIS     *      *   U.S. ARMY CORPS OF ENGINEERS *
*     PROGRAM DATE:  FEB 1995      *      * THE HYDROLOGIC ENGINEERING CENTER *
*          VERSION:  3.1           *      *         609 SECOND STREET      *
*     RUN  DATE   AND   TIME:      *      *      DAVIS, CALIFORNIA 95616   *
*        16 NOV 06    09:16:22     *      *          (916) 756-1104        *
*                                 *      *                                *
**********************************      **********************************



 INPUT FILE NAME: 713_wpdr.dat
OUTPUT FILE NAME: 713_wpdr.ffo



**TITLE RECORD(S)**
TT    FLOOD FLOW FREQ POLE CREEK @ SESPE AVE 713 ANNUAL PEAK High Flows n=0.02
TT   REGIONAL SKEW -.3 TO DUPLICATE C.O.E. RESULTS AND BULL 17B MAP

**STATION IDENTIFICATION**
ID     713 POLE CREEK AT SESPE AVENUE              DA= 9.1SQMI REC BEGAN1975TYPELS

**GENERALIZED SKEW**
     ISTN   GGMSE    SKEW
GS    713    .000    -.30

**SYSTEMATIC EVENTS**
     31 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
ED ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ   FINAL RESULTS    ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

-PLOTTING POSITIONS-   713 POLE CREEK AT SESPE AVENUE
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÑÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º      EVENTS ANALYZED     ³           ORDERED EVENTS          º
º                   FLOW   ³        WATER      FLOW   WEIBULL  º
º MON DAY  YEAR     CFS    ³   RANK  YEAR      CFS    PLOT POS º
ÇÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ¶
º  12   4  1974       78.  ³     1   2005      3042.     3.13  º
º   9  10  1976       11.  ³     2   1980      2905.     6.25  º
º   1   2  1977       93.  ³     3   1983      1480.     9.38  º
º   3   4  1978     1089.  ³     4   1992      1437.    12.50  º
º   3  27  1979      530.  ³     5   1998      1371.    15.63  º
º   2  16  1980     2905.  ³     6   1995      1231.    18.75  º
º   1  29  1981       91.  ³     7   1978      1089.    21.88  º
º   4   1  1982       14.  ³     8   2004      1053.    25.00  º
º   3   1  1983     1480.  ³     9   1986      1030.    28.13  º
º  12  25  1983      132.  ³    10   1991       817.    31.25  º
º  12  10  1984       60.  ³    11   1993       802.    34.38  º
º   2  14  1986     1030.  ³    12   2001       538.    37.50  º
º  11  18  1986       29.  ³    13   1979       530.    40.63  º
º   2  29  1988      162.  ³    14   1996       388.    43.75  º
º  12  21  1988       26.  ³    15   1997       249.    46.88  º
º   2  17  1990       46.  ³    16   1988       162.    50.00  º
º   3   1  1991      817.  ³    17   1984       132.    53.13  º
º   2  12  1992     1437.  ³    18   1994       124.    56.25  º
º   1  13  1993      802.  ³    19   2000       112.    59.38  º
º   2  20  1994      124.  ³    20   2003       111.    62.50  º
```

º	1	10	1995	1231.	³	21	1999	101.	65.63	º
º	2	20	1996	388.	³	22	1977	93.	68.75	º
º	1	26	1997	249.	³	23	1981	91.	71.88	º
º	2	7	1998	1371.	³	24	1975	78.	75.00	º
º	1	31	1999	101.	³	25	1985	60.	78.13	º
º	2	23	2000	112.	³	26	1990	46.	81.25	º
º	2	13	2001	538.	³	27	1987	29.	84.38	º
º	11	24	2001	10.	³	28	1989	26.	87.50	º
º	3	15	2003	111.	³	29	1982	14.	90.63	º
º	2	25	2004	1053.	³	30	1976	11.	93.75	º
º	1	9	2005	3042.	³	31	2002	10.	96.88	º

-OUTLIER TESTS -

LOW OUTLIER TEST

BASED ON 31 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.577

0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF 3.0

HIGH OUTLIER TEST

BASED ON 31 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.577

0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF 16258.

-SKEW WEIGHTING -

BASED ON 31 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW = .179
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW = .302

FINAL RESULTS

-FREQUENCY CURVE- 713 POLE CREEK AT SESPE AVENUE

COMPUTED CURVE FLOW IN CFS	EXPECTED PROBABILITY	PERCENT CHANCE EXCEEDANCE	CONFIDENCE LIMITS .05 FLOW IN CFS	.95 FLOW IN CFS
14700.	20700.	.2	51900.	6210.
10100.	13300.	.5	32700.	4520.
7390.	9170.	1.0	22100.	3440.
5170.	6110.	2.0	14200.	2530.
2960.	3300.	5.0	7190.	1550.
1760.	1890.	10.0	3850.	982.
917.	953.	20.0	1780.	541.
240.	240.	50.0	399.	146.
56.	53.	80.0	95.	29.
25.	23.	90.0	45.	11.
12.	11.	95.0	25.	5.
3.	2.	99.0	8.	1.

SYSTEMATIC STATISTICS

LOG TRANSFORM: FLOW, CFS		NUMBER OF EVENTS	
MEAN	2.3444	HISTORIC EVENTS	0
STANDARD DEV	.7243	HIGH OUTLIERS	0
COMPUTED SKEW	-.2210	LOW OUTLIERS	0
REGIONAL SKEW	-.3000	ZERO OR MISSING	0
ADOPTED SKEW	-.3000	SYSTEMATIC EVENTS	31

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+ END OF RUN            +
+ NORMAL STOP IN FFA    +
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************************************      ************************************
*               FFA                *      *                                  *
*     FLOOD FREQUENCY ANALYSIS     *      *   U.S. ARMY CORPS OF ENGINEERS   *
*     PROGRAM DATE:  FEB 1995      *      * THE HYDROLOGIC ENGINEERING CENTER *
*          VERSION:  3.1           *      *         609 SECOND STREET        *
*     RUN  DATE   AND   TIME:      *      *      DAVIS, CALIFORNIA 95616     *
*        29 NOV 06    07:53:47     *      *          (916) 756-1104          *
*                                  *      *                                  *
************************************      ************************************
```

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 INPUT FILE NAME: 710USGSR.DAT
OUTPUT FILE NAME: 710USGSR.FFO
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**TITLE RECORD(S)**
TT   FLOOD FLOW FREQUENCY PROGRAM-SESPE CREEK NEAR FILLMORE
TT   REGIONAL SKEW -.3 TO MATCH MAINSTEM VALUES FOR 2006 FEMA

**STATION IDENTIFICATION**
ID    1130 SESPE CREEK NEAR FILLMORE (VC #710) DA=251.0SQMI REC BEGAN:1932 TYPE:GD

**GENERALIZED SKEW**
     ISTN   GGMSE    SKEW
GS   1130    .000    -.30

**SYSTEMATIC EVENTS**
     67 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
ED ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄPRELIMINARY RESULTS ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

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-SKEW WEIGHTING -
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BASED ON  67 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW =   .136
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW =   .302
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PRELIMINARY RESULTS

-FREQUENCY CURVE- 1130 SESPE CREEK NEAR FILLMORE (VC #710) DA

COMPUTED CURVE FLOW IN CFS	EXPECTED PROBABILITY FLOW IN CFS	PERCENT CHANCE EXCEEDANCE	CONFIDENCE LIMITS .05 FLOW IN CFS	CONFIDENCE LIMITS .95 FLOW IN CFS
171000.	185000.	.2	320000.	105000.
140000.	149000.	.5	254000.	87500.
117000.	123000.	1.0	206000.	74100.
93600.	98000.	2.0	161000.	60700.
64800.	67000.	5.0	106000.	43400.
44800.	45800.	10.0	70100.	30900.
27100.	27500.	20.0	40200.	19300.
8690.	8690.	50.0	11900.	6380.
2160.	2110.	80.0	3010.	1470.
938.	895.	90.0	1380.	583.

	445.	412.		95.0		701.	251.		
	95.	79.		99.0		176.	43.		

SYSTEMATIC STATISTICS

LOG TRANSFORM: FLOW, CFS		NUMBER OF EVENTS	
MEAN	3.8616	HISTORIC EVENTS	0
STANDARD DEV	.6672	HIGH OUTLIERS	0
COMPUTED SKEW	-.8182	LOW OUTLIERS	0
REGIONAL SKEW	-.3000	ZERO OR MISSING	0
ADOPTED SKEW	-.7000	SYSTEMATIC EVENTS	67

FINAL RESULTS

-PLOTTING POSITIONS- 1130 SESPE CREEK NEAR FILLMORE (VC #710) DA

EVENTS ANALYZED					ORDERED EVENTS			
			FLOW		WATER	FLOW	WEIBULL	
MON	DAY	YEAR	CFS	RANK	YEAR	CFS	PLOT POS	
1	19	1933	12000.	1	2005	85300.	1.47	
12	31	1933	34000.	2	1978	73000.	2.94	
1	5	1935	12500.	3	1995	65000.	4.41	
2	12	1936	7200.	4	1998	62500.	5.88	
2	14	1937	12800.	5	1969	60000.	7.35	
3	2	1938	56000.	6	1938	56000.	8.82	
3	9	1939	5000.	7	1983	56000.	10.29	
2	25	1940	5500.	8	1943	44000.	11.76	
3	4	1941	17300.	9	1992	44000.	13.24	
12	28	1941	3150.	10	1980	40700.	14.71	
1	23	1943	44000.	11	1973	38300.	16.18	
2	22	1944	13000.	12	1934	34000.	17.65	
2	2	1945	11500.	13	1958	28400.	19.12	
3	30	1946	11300.	14	2001	25900.	20.59	
12	25	1946	4850.	15	1962	25600.	22.06	
3	24	1948	748.	16	1952	23200.	23.53	
3	11	1949	725.	17	1971	22800.	25.00	
2	6	1950	3000.	18	1966	21600.	26.47	
1	11	1951	47.	19	1967	21600.	27.94	
1	15	1952	23200.	20	1997	19800.	29.41	
12	4	1952	3370.	21	2004	17700.	30.88	
2	13	1954	4400.	22	1941	17300.	32.35	
4	30	1955	785.	23	1991	16300.	33.82	
1	26	1956	3900.	24	1944	13000.	35.29	
1	13	1957	7650.	25	1937	12800.	36.76	
4	3	1958	28400.	26	1935	12500.	38.24	
2	16	1959	8280.	27	1933	12000.	39.71	
1	10	1960	1330.	28	1945	11500.	41.18	
11	6	1960	836.	29	1946	11300.	42.65	
2	10	1962	25600.	30	1982	9660.	44.12	
2	10	1963	4400.	31	1970	8800.	45.59	
4	1	1964	2590.	32	1959	8280.	47.06	
4	9	1965	2440.	33	1957	7650.	48.53	
12	29	1965	21600.	34	2003	7630.	50.00	
12	6	1966	21600.	35	1975	7210.	51.47	
11	21	1967	1940.	36	1936	7200.	52.94	
1	25	1969	60000.	37	1974	6860.	54.41	
2	28	1970	8800.	38	1984	6330.	55.88	
11	29	1970	22800.	39	1979	6300.	57.35	
12	25	1971	4810.	40	1940	5500.	58.82	
2	11	1973	38300.	41	1939	5000.	60.29	
1	7	1974	6860.	42	2000	4900.	61.76	
3	8	1975	7210.	43	1996	4870.	63.24	

º	2	9	1976	3650.	³	44	1947	4850.	64.71	º
º	5	9	1977	1020.	³	45	1972	4810.	66.18	º
º	2	10	1978	73000.	³	46	1963	4400.	67.65	º
º	3	28	1979	6300.	³	47	1954	4400.	69.12	º
º	2	16	1980	40700.	³	48	1956	3900.	70.59	º
º	3	1	1981	2160.	³	49	1976	3650.	72.06	º
º	4	1	1982	9660.	³	50	1953	3370.	73.53	º
º	3	1	1983	56000.	³	51	1942	3150.	75.00	º
º	12	25	1983	6330.	³	52	1950	3000.	76.47	º
º	12	19	1984	1450.	³	53	1994	2590.	77.94	º
º	3	19	1991	16300.	³	54	1964	2590.	79.41	º
º	2	12	1992	44000.	³	55	1965	2440.	80.88	º
º	2	7	1994	2590.	³	56	1981	2160.	82.35	º
º	1	10	1995	65000.	³	57	1968	1940.	83.82	º
º	2	21	1996	4870.	³	58	1985	1450.	85.29	º
º	12	22	1996	19800.	³	59	1960	1330.	86.76	º
º	2	3	1998	62500.	³	60	1977	1020.	88.24	º
º	2	9	1999	445.	³	61	1961	836.	89.71	º
º	2	23	2000	4900.	³	62	1955	785.	91.18	º
º	3	6	2001	25900.	³	63	1948	748.	92.65	º
º	11	24	2001	93.	³	64	1949	725.	94.12	º
º	2	12	2003	7630.	³	65	1999	445.	95.59	º
º	2	25	2004	17700.	³	66	2002	93.	97.06	º
º	1	10	2005	85300.	³	67	1951	47.	98.53	º

-OUTLIER TESTS -

LOW OUTLIER TEST

BASED ON 67 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.877

1 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF 87.5

STATISTICS AND FREQUENCY CURVE ADJUSTED FOR 1 LOW OUTLIER(S)

HIGH OUTLIER TEST

BASED ON 66 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.871

0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF 455008.

-SKEW WEIGHTING -

BASED ON 67 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW = .109

DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW = .302

FINAL RESULTS

-FREQUENCY CURVE- 1130 SESPE CREEK NEAR FILLMORE (VC #710) DA

º COMPUTED CURVE FLOW IN CFS	EXPECTED PROBABILITY	³ PERCENT CHANCE EXCEEDANCE	³ CONFIDENCE LIMITS .05 FLOW IN CFS	.95 º

227000.	254000.	.2	432000.	138000.	
172000.	188000.	.5	313000.	107000.	
135000.	145000.	1.0	238000.	86100.	
102000.	108000.	2.0	173000.	67100.	
66000.	68600.	5.0	106000.	45100.	
43700.	44800.	10.0	66400.	30900.	
25700.	26000.	20.0	36900.	18800.	
8430.	8430.	50.0	11300.	6340.	
2430.	2380.	80.0	3300.	1700.	
1200.	1150.	90.0	1710.	776.	
649.	610.	95.0	977.	389.	
191.	166.	99.0	326.	96.	

SYNTHETIC STATISTICS

LOG TRANSFORM: FLOW, CFS		NUMBER OF EVENTS	
MEAN	3.8853	HISTORIC EVENTS	0
STANDARD DEV	.6130	HIGH OUTLIERS	0
COMPUTED SKEW	-.4936	LOW OUTLIERS	1
REGIONAL SKEW	-.3000	ZERO OR MISSING	0
ADOPTED SKEW	-.4000	SYSTEMATIC EVENTS	67

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+ END OF RUN             +
+ NORMAL STOP IN FFA     +
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************************************      ************************************
*              FFA                 *      *                                  *
*     FLOOD FREQUENCY ANALYSIS     *      *   U.S. ARMY CORPS OF ENGINEERS   *
*     PROGRAM DATE:  FEB 1995      *      * THE HYDROLOGIC ENGINEERING CENTER *
*          VERSION:  3.1           *      *         609 SECOND STREET        *
*     RUN  DATE   AND   TIME:      *      *      DAVIS, CALIFORNIA 95616     *
*        23 OCT 06    08:01:39     *      *          (916) 756-1104          *
*                                  *      *                                  *
************************************      ************************************
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 INPUT FILE NAME: 709_USGS.DAT
OUTPUT FILE NAME: 709_USGS.FFO
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**TITLE RECORD(S)**
TT    FLOOD FLOW FREQUENCY SANTA PAULA CRK NEAR SANTA PAULA CR 709 SEASONAL PEAK
TT    REGIONAL SKEW -.3 TO DUPLICATE C.O.E. AND BULL 17B MAP

**STATION IDENTIFICATION**
ID     709  SANTA PAULA CRK NEAR SANTA PAULA  DA=40 SQ MI RECORD BEGAN IN 1927

**GENERALIZED SKEW**
     ISTN   GGMSE    SKEW
GS    709    .000    -.30

**SYSTEMATIC EVENTS**
     71 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
ED ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄPRELIMINARY RESULTS ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ


-SKEW WEIGHTING -
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
BASED ON  71 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW =   .097
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW =   .302
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PRELIMINARY RESULTS

-FREQUENCY CURVE-   709 SANTA PAULA CRK NEAR SANTA PAULA DA=

COMPUTED CURVE FLOW IN CFS	EXPECTED PROBABILITY FLOW IN CFS	PERCENT CHANCE EXCEEDANCE	CONFIDENCE LIMITS .05 FLOW IN CFS	CONFIDENCE LIMITS .95 FLOW IN CFS
60600.	68500.	.2	125000.	34300.
43700.	48200.	.5	86100.	25600.
33000.	35700.	1.0	62500.	19800.
23900.	25400.	2.0	43300.	14800.
14300.	15000.	5.0	24400.	9310.
8860.	9120.	10.0	14200.	5980.
4770.	4850.	20.0	7180.	3350.
1300.	1300.	50.0	1810.	945.
305.	299.	80.0	433.	204.
134.	128.	90.0	201.	82.

	66.	61.		95.0		104.	37.		
	16.	14.		99.0		29.	7.		

SYSTEMATIC STATISTICS

LOG TRANSFORM: FLOW, CFS		NUMBER OF EVENTS	
MEAN	3.0678	HISTORIC EVENTS	0
STANDARD DEV	.7145	HIGH OUTLIERS	0
COMPUTED SKEW	-.3813	LOW OUTLIERS	0
REGIONAL SKEW	-.3000	ZERO OR MISSING	0
ADOPTED SKEW	-.4000	SYSTEMATIC EVENTS	71

FINAL RESULTS

-PLOTTING POSITIONS- 709 SANTA PAULA CRK NEAR SANTA PAULA DA=

EVENTS ANALYZED					ORDERED EVENTS			
			FLOW		WATER	FLOW	WEIBULL	
MON	DAY	YEAR	CFS	RANK	YEAR	CFS	PLOT POS	
1	19	1933	2650.	1	2005	27500.	1.39	
12	31	1933	8500.	2	1969	21000.	2.78	
1	5	1935	1530.	3	1978	16000.	4.17	
2	12	1936	2900.	4	1938	13500.	5.56	
2	14	1937	1350.	5	1973	13400.	6.94	
3	2	1938	13500.	6	1980	11800.	8.33	
3	9	1939	371.	7	1943	10000.	9.72	
2	25	1940	364.	8	1992	10000.	11.11	
3	4	1941	3150.	9	1958	9130.	12.50	
12	29	1941	554.	10	1934	8500.	13.89	
1	22	1943	10000.	11	1995	8140.	15.28	
2	22	1944	1900.	12	1952	7300.	16.67	
2	2	1945	2500.	13	1993	7130.	18.06	
3	30	1946	1350.	14	1966	6480.	19.44	
11	20	1946	850.	15	1983	4750.	20.83	
3	24	1948	85.	16	1967	4500.	22.22	
3	11	1949	147.	17	1979	3680.	23.61	
2	9	1950	660.	18	1986	3550.	25.00	
4	28	1951	8.	19	2001	3480.	26.39	
1	15	1952	7300.	20	1941	3150.	27.78	
12	20	1952	219.	21	1962	3150.	29.17	
1	24	1954	977.	22	1936	2900.	30.56	
4	30	1955	78.	23	1933	2650.	31.94	
1	26	1956	835.	24	1971	2530.	33.33	
1	13	1957	825.	25	1945	2500.	34.72	
4	3	1958	9130.	26	1997	2130.	36.11	
2	16	1959	954.	27	1988	1950.	37.50	
2	2	1960	156.	28	1982	1910.	38.89	
11	12	1960	178.	29	1944	1900.	40.28	
2	10	1962	3150.	30	1935	1530.	41.67	
2	9	1963	684.	31	1975	1440.	43.06	
4	1	1964	572.	32	2000	1410.	44.44	
4	9	1965	548.	33	1946	1350.	45.83	
11	24	1965	6480.	34	1937	1350.	47.22	
12	6	1966	4500.	35	1984	1230.	48.61	
11	21	1967	345.	36	1996	1230.	50.00	
2	25	1969	21000.	37	1991	1010.	51.39	
2	28	1970	940.	38	1954	977.	52.78	
11	29	1970	2530.	39	1959	954.	54.17	
12	25	1971	937.	40	1970	940.	55.56	
2	11	1973	13400.	41	1972	937.	56.94	
1	6	1974	614.	42	1947	850.	58.33	
12	4	1974	1440.	43	1956	835.	59.72	

º	2	9	1976	458.	³	44	1957	825.	61.11	º
º	1	2	1977	134.	³	45	2003	782.	62.50	º
º	2	10	1978	16000.	³	46	1994	698.	63.89	º
º	1	15	1979	3680.	³	47	1963	684.	65.28	º
º	2	16	1980	11800.	³	48	1950	660.	66.67	º
º	3	1	1981	527.	³	49	1974	614.	68.06	º
º	4	1	1982	1910.	³	50	1964	572.	69.44	º
º	11	30	1982	4750.	³	51	1942	554.	70.83	º
º	12	25	1983	1230.	³	52	1965	548.	72.22	º
º	12	19	1984	90.	³	53	1981	527.	73.61	º
º	2	14	1986	3550.	³	54	1990	499.	75.00	º
º	3	6	1987	170.	³	55	1976	458.	76.39	º
º	2	28	1988	1950.	³	56	1939	371.	77.78	º
º	2	9	1989	109.	³	57	1940	364.	79.17	º
º	2	17	1990	499.	³	58	1968	345.	80.56	º
º	3	18	1991	1010.	³	59	1953	219.	81.94	º
º	2	12	1992	10000.	³	60	1961	178.	83.33	º
º	1	14	1993	7130.	³	61	1987	170.	84.72	º
º	2	20	1994	698.	³	62	1960	156.	86.11	º
º	1	10	1995	8140.	³	63	1949	147.	87.50	º
º	2	20	1996	1230.	³	64	1977	134.	88.89	º
º	12	22	1996	2130.	³	65	1989	109.	90.28	º
º	4	11	1999	97.	³	66	1999	97.	91.67	º
º	2	23	2000	1410.	³	67	1985	90.	93.06	º
º	3	5	2001	3480.	³	68	1948	85.	94.44	º
º	11	24	2001	35.	³	69	1955	78.	95.83	º
º	3	15	2003	782.	³	70	2002	35.	97.22	º
º	1	10	2005	27500.	³	71	1951	8.	98.61	º

-OUTLIER TESTS -

LOW OUTLIER TEST

BASED ON 71 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.897

1 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF 9.9

STATISTICS AND FREQUENCY CURVE ADJUSTED FOR 1 LOW OUTLIER(S)

HIGH OUTLIER TEST

BASED ON 71 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.897

0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF 137363.

-SKEW WEIGHTING -

BASED ON 71 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW = .078

DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW = .302

FINAL RESULTS

-FREQUENCY CURVE- 709 SANTA PAULA CRK NEAR SANTA PAULA DA=

COMPUTED CURVE FLOW IN CFS	EXPECTED PROBABILITY FLOW IN CFS	PERCENT CHANCE EXCEEDANCE	CONFIDENCE LIMITS .05 FLOW IN CFS	.95
84100.	99200.	.2	179000.	46800.
55200.	62600.	.5	110000.	32100.
38800.	42900.	1.0	73900.	23400.
26400.	28500.	2.0	47500.	16500.
14600.	15400.	5.0	24400.	9680.
8620.	8900.	10.0	13500.	5950.
4500.	4580.	20.0	6580.	3240.
1260.	1260.	50.0	1710.	934.
342.	336.	80.0	474.	234.
170.	164.	90.0	247.	108.
95.	90.	95.0	145.	56.
31.	28.	99.0	53.	16.

SYNTHETIC STATISTICS

LOG TRANSFORM: FLOW, CFS		NUMBER OF EVENTS	
MEAN	3.0903	HISTORIC EVENTS	0
STANDARD DEV	.6654	HIGH OUTLIERS	0
COMPUTED SKEW	-.0770	LOW OUTLIERS	1
REGIONAL SKEW	-.3000	ZERO OR MISSING	0
ADOPTED SKEW	-.1000	SYSTEMATIC EVENTS	71

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++++++++++++++++++++++++++
+ END OF RUN             +
+ NORMAL STOP IN FFA     +
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Appendix 4

Design Flows

For

Un-gauged Tributaries of Santa Clara River

Ventura County
Watershed Protection District
Planning & Regulatory
Hydrology Section
MEMORANDUM

DATE: December 26, 2006

TO: Mark Bandurraga

FROM: Shenna Tolentino

SUBJECT: SANTA CLARA TRIBUTARY DESIGN FLOWS FOR FEMA STUDY

The purpose of this memo is to provide 100-year design flows for Santa Clara river tributaries. The lists of tributaries to be studied were agreed upon by FEMA and VCWPD. The 100-yr design flows for Sespe, Pole, Hopper, and Santa Paula Creeks are available from flow frequency studies. The additional requested tributaries are Orcutt Canyon, Grimes Canyon Wash, Basolo Ditch, El Rio Drain, and Patterson Drain. The following summary table provides the results. The supporting data used to generate the results are also attached.

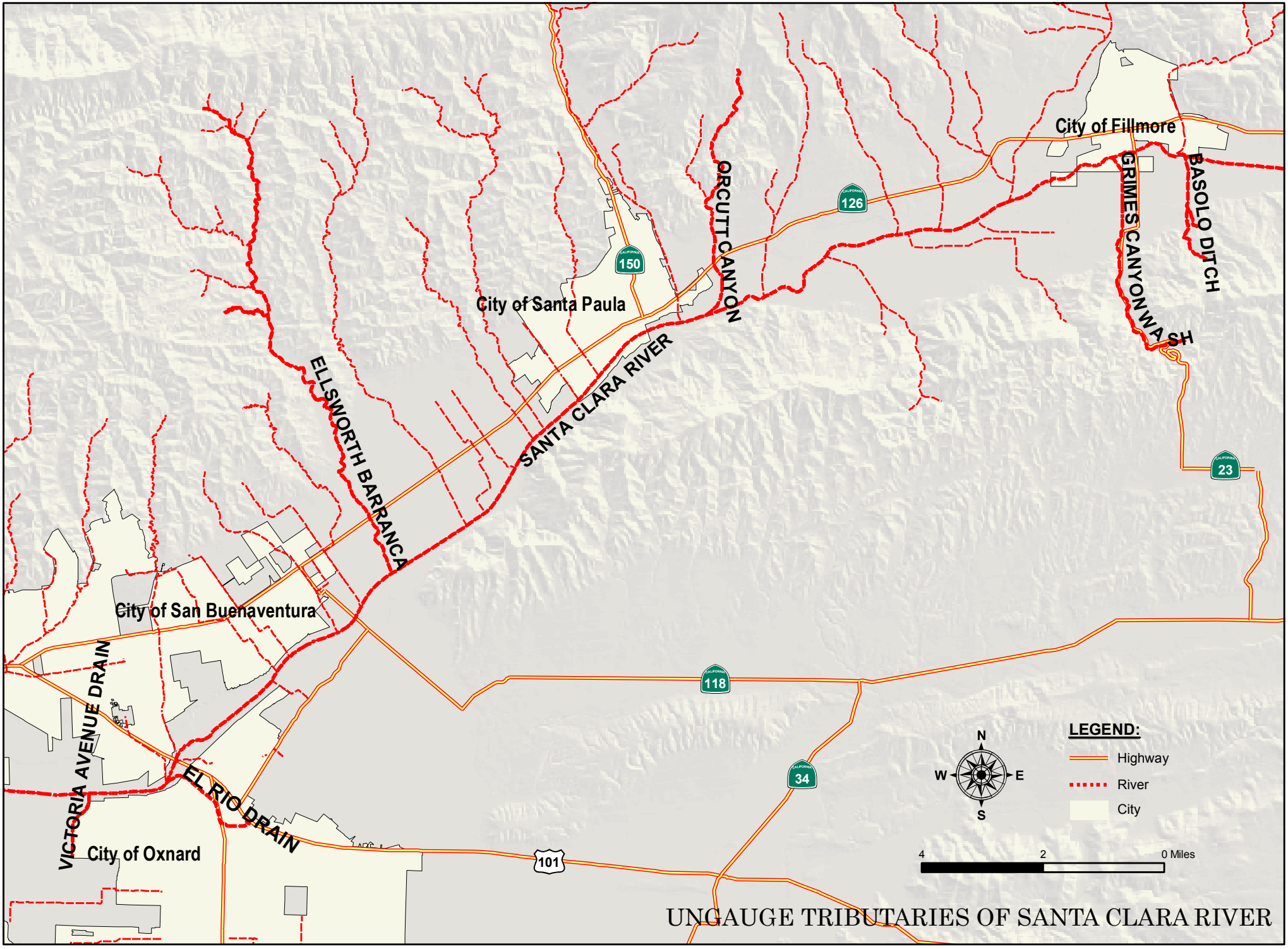
Summary Table 1. Design Flow Results

Tributary Name	100 year flow (cfs)	Description
Orcutt Canyon	14,600	Ellsworth Barranca at Foothill road flood flow frequency analysis was used because of relatively similar size, soil type, and land use. The pro-rated computed Q100 flow was obtained by calculating the unit discharge in cfs per square mile and then multiplying it by the area of Orcutt Canyon to determine the flow.
Grimes Canyon Wash	7,450	Due to comparatively similar size, soil type, and land use with Pole Creek, the pro-rated 100 year flow was calculated as described above using the Pole Ck frequency results.
El Rio Drain	1,050	Using the VCRAT study with proposed facilities and Stroube diversion, a Q50 with future condition was obtained. The VCWPD multiplier for developed watersheds was applied to the given Q50 to determine 100 year flow at El Rio Drain.

Tributary Name	100 year flow (cfs)	Description
Patterson Drain	1,450	From the City of Oxnard Master Plan of Drainage and Drainage Hydrology Map published in 2001, the Q100s were obtained for 15 different sub areas that drain into Patterson Drain. These flows were added to determine the total 100 year flow for Patterson Drain.
Basolo Ditch	1,625	Due to proximity and similar soil type, and land use with Pole Creek, the pro-rated 100 year flow was calculated as described above using the Pole Ck frequency results.

File Locations:

K:\PR\hydrology\Watersheds\Santa Clara\FEMA06



UNGAUGE TRIBUTARIES OF SANTA CLARA RIVER

K\PR\PLANNING\RYP\SANTA CLARA cmor\santa clara-su2.mxd

Grimes Canyon Santa Clara Tributary

Source: assumptions from Pole Creek Flood Flow Frequency Analysis
GIS data

Area =	9.17368	sq. mi
Q/A of Pole Creek=	812.09	cfs/sq.mi
Q 100 =	7449.83	cfs

Pole Creek

Computed Q100=	7390	cfs
Area =	9.1	sq mi
Q/A=	812.09	

Orcutt Canyon

Source: assumptions from Ellsworth Barranca Flood Flow Frequency Analysis
GIS data

Ellsworth Barranca at Foothill Road

Area =	13.8	sq. mi
Computed Q 100 =	15300	cfs
Q/A =	1108.70	cfs/sq.mi.

Orcutt Canyon

Area =	13.1633	sq. mi.
Q/A of Ellsworth =	1108.70	cfs/sq.mi.
Q 100 =	14594.09	cfs

Basolo Ditch

Source: assumptions from Pole Creek Flood Flow Frequency Analysis
GIS Data
Pole Creek
Computed Q100= 7390 cfs
Area = 9.1 sq mi
Q/A= 812.09

From Pole Creek
Q/A = 812.09 cfs/sq.mi
Area = 1281.293 ac. = 2.00202 sq. mi.
Q/L = 1625.82 cfs

El Rio Drain

Source: VCRAT study
With proposed facility and stroube diversion
Q50 Future Condition

Node	Area (Ac)	Q (cfs)
42A	889	873

VCWPD Multiplier for developed watersheds
Q50 to Q100 = 1.2

Q 100 = 1047.6 cfs

VENTURA COUNTY FLOOD CONTROL DISTRICT

MODIFIED RATIONAL METHOD HYDROLOGY / PC1292000-1.0

EL RIO DRN W/PROP.FACIL,& STROUBE DIVERS,NO FN TRT. Q50F DT 11/8 STORM DAY 4

LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
4283	1A	54.	73.	54.	73.	5	1500.	0.00050	6.00	0.00	0.	40	28	K50	0.23
4283	2A	0.	0.	54.	67.	0	0.	0.00000	0.00	0.00	0.	40	99	K50	0.00
4283	3A	44.	62.	98.	117.	5	500.	0.00050	6.00	0.00	0.	50	24	K50	0.23
4283	4A	0.	0.	98.	117.	5	1400.	0.00050	8.00	0.00	0.	50	99	K50	0.00
4283	5A	48.	68.	146.	150.	0	0.	0.00000	0.00	0.00	0.	50	24	K50	0.23
4283	6E	37.	70.	37.	70.	4	150.	0.00200	4.25	0.00	0.	50	18	K50	0.50

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* CONFLUENCE Q'S *

* 4283 7A TA 1173 QA 150. QAE 164. QE 14. 4283 7E TE 1155 QE 70. QEA 166. QA 96. *

* 4283 7AE TAE 1168 QAE 192. QA 142. QE 50. *

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LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
4283	7AE	37.	70.	183.	192.	4	1200.	0.00200	6.00	0.00	0.	50	0	K50	0.00
4283	8B	21.	37.	21.	37.	4	1900.	0.00200	3.25	0.00	0.	50	21	K50	0.50
4283	9B	30.	42.	51.	70.	0	0.	0.00000	0.00	0.00	0.	50	24	K50	0.23

****

* CONFLUENCE Q'S *

* 4283 10A TA 1171 QA 190. QAB 254. QB 64. 4283 10B TB 1164 QB 70. QBA 246. QA 175. *

* 4283 10AB TAB 1170 QAB 255. QA 189. QB 66. *

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LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
4283	10AB	51.	70.	234.	255.	5	800.	0.00200	6.00	0.00	0.	50	0	K50	0.00
4283	11A	0.	0.	234.	254.	0	0.	0.00000	0.00	0.00	0.	50	99	K50	0.00
4283	12A	0.	0.	234.	254.	0	0.	0.00000	0.00	0.00	0.	50	99	K50	0.00
4283	13C	16.	27.	16.	27.	4	2800.	0.00050	3.75	0.00	0.	40	20	K50	0.23
4283	14C	0.	0.	16.	19.	0	0.	0.00000	0.00	0.00	0.	50	99	K50	0.00
4283	15C	48.	61.	64.	66.	0	0.	0.00000	0.00	0.00	0.	50	28	K50	0.23

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* CONFLUENCE Q'S *

* 4283 16A TA 1172 QA 254. QAC 317. QC 63. 4283 16C TC 1163 QC 66. QCA 296. QA 230. *

* 4283 16AC TAC 1171 QAC 317. QA 254. QC 64. *

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LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
4283	16AC	64.	66.	298.	317.	5	600.	0.00200	6.00	0.00	0.	50	0	K50	0.00
4283	17A	0.	0.	298.	317.	5	600.	0.00200	6.00	0.00	0.	50	99	K50	0.00
4283	18D	37.	53.	37.	53.	4	225.	0.00200	3.75	0.00	0.	50	25	K50	0.30

****

* CONFLUENCE Q'S *

* 4283 19A TA 1175 QA 316. QAD 352. QD 36. 4283 19D TD 1160 QD 53. QDA 267. QA 215. *

* 4283 19AD TAD 1173 QAD 355. QA 315. QD 39. *

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LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
4283	19AD	37.	53.	335.	355.	0	0.	0.00000	0.00	0.00	0.	50	0	K50	0.00
4283	20A	0.	0.	335.	355.	0	0.	0.00000	0.00	0.00	0.	50	99	K50	0.00
4283	21B	34.	57.	34.	57.	4	600.	0.00050	5.00	0.00	0.	40	22	K50	0.37
4283	22B	37.	57.	71.	110.	4	650.	0.00050	6.25	0.00	0.	40	24	K50	0.30

VENTURA COUNTY FLOOD CONTROL DISTRICT

MODIFIED RATIONAL METHOD HYDROLOGY / PC1292000-1.0

EL RIO DRN W/PROP.FACIL,& STROUBE DIVERS,NO FN TRT. Q50F DT 11/8 STORM DAY 4

LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
4283	23B	0.	0.	71.	108.	0	0.	0.00000	0.00	0.00	0.	40	99	K50	0.00
4283	24B	41.	67.	112.	165.	4	375.	0.00050	7.25	0.00	0.	40	21	K50	0.23
4283	25C	58.	78.	58.	78.	0	0.	0.00000	0.00	0.00	0.	50	26	K50	0.23
4283	26C	0.	0.	58.	78.	0	0.	0.00000	0.00	0.00	0.	50	99	K50	0.00

****

* CONFLUENCE Q'S *

* 4283 27B TB 1167 QB 164. QBC 233. QC 69. 4283 27C TC 1160 QC 78. QCB 224. QB 147. *

* 4283 27BC TBC 1165 QBC 235. QB 163. QC 72. *

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LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
4283	27BC	58.	78.	170.	235.	5	1800.	0.00200	8.00	2.00	0.	50	0	K50	0.00
4283	28B	0.	0.	170.	230.	5	550.	0.00150	8.00	0.00	0.	50	99	K50	0.00
4283	29B	42.	80.	212.	273.	0	0.	0.00000	0.00	0.00	0.	50	18	K50	0.50
4283	30D	37.	64.	37.	64.	4	2000.	0.00200	4.00	0.00	0.	50	21	K50	0.50
4283	31D	89.	125.	126.	179.	4	300.	0.00200	5.75	0.00	0.	50	30	K50	0.50

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* CONFLUENCE Q'S *

* 4283 32B TB 1168 QB 273. QBD 450. QD 178. 4283 32D TD 1166 QD 179. QDB 447. QB 268. *

* 4283 32BD TBD 1167 QBD 451. QB 272. QD 179. *

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LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
4283	32BD	126.	179.	338.	451.	0	0.	0.00000	0.00	0.00	0.	50	0	K50	0.00

****

* CONFLUENCE Q'S *

* 4283 33A TA 1173 QA 355. QAB 764. QB 409. 4283 33B TB 1167 QB 451. QBA 793. QA 343. *

* 4283 33AB TAB 1168 QAB 797. QA 347. QB 450. *

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LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
4283	33AB	338.	451.	673.	797.	5	570.	0.00070	16.00	0.00	0.	50	0	K50	0.00
4283	34A	58.	96.	731.	867.	5	1875.	0.00070	16.00	0.00	0.	50	23	K50	0.50
4283	35A	45.	85.	776.	855.	5	440.	0.00050	16.00	0.00	0.	50	18	K50	0.50
4283	36A	24.	41.	800.	861.	5	900.	0.00050	12.00	2.00	0.	50	22	K50	0.50
4283	37A	14.	25.	814.	860.	5	700.	0.00050	12.00	2.00	0.	50	20	K50	0.50
4283	38A	0.	0.	814.	856.	0	0.	0.00000	0.00	0.00	0.	50	99	K50	0.00
4283	39A	0.	0.	814.	856.	0	0.	0.00000	0.00	0.00	0.	50	99	K50	0.00
4283	40A	41.	61.	855.	869.	5	1000.	0.00050	12.00	2.00	0.	50	27	K50	0.50
4283	41A	10.	20.	865.	868.	5	100.	0.00050	12.00	2.00	0.	50	16	K50	0.50
4283	42A	24.	41.	889.	873.	0	0.	0.00000	0.00	0.00	0.	50	20	K50	0.37

Patterson Drain -- Victoria

Source: City of Oxnard Master Plan of Drainage January 2001
Page D-18
Master Plan of Drainage Hydrology Map H-1

CONC_ID	Area (ac)	C	Length	Width	L/W	Q10	Q25	Q50	Q100	cfs/ac
WV07-01s	64.02	59.3	2948	946	3.12	61	83	104	122	0.95
WV08-1t	10.99	59.9	809	592	1.37	14	20	25	29	1.32
WV08-2s	75.01	59.4	3750	871	4.3	65	88	111	131	0.87
WV09-3s	91.68	59.5	5169	773	6.69	73	99	125	147	0.8
WV10-1s	25.57	60	2036	547	3.72	28	37	47	55	1.08
WV11-2s	34.39	59.9	2406	623	3.86	35	48	60	71	1.03
WV12-3s	57.44	59.9	3385	739	4.58	54	72	90	107	0.93
WV13-4s	71.8	59.7	4351	719	6.05	61	83	104	122	0.85
WV15-1s	24.34	58.2	3274	324	10.11	24	32	40	47	0.97
WV16-1s	23.74	60	1524	679	2.25	28	38	48	56	1.19
WV22-1	67.4	60	0	0	0	54	72	91	107	0.8
WV23-1	80.21	60	0	0	0	64	86	109	128	0.8
WV24-1	79.59	59.9	0	0	0	63	85	107	126	0.79
WV25-1	118.9	50.7	0	0	0	66	90	113	133	0.56
WV26-1	40.67	60	0	0	0	32	44	55	65	0.8
total area	**865.75**				**total Q**	**722**	**977**	**1229**	**1446**	

```
************************************      ************************************
*              FFA                 *      *                                  *
*     FLOOD FREQUENCY ANALYSIS     *      *   U.S. ARMY CORPS OF ENGINEERS   *
*     PROGRAM DATE:  FEB 1995      *      * THE HYDROLOGIC ENGINEERING CENTER *
*          VERSION:  3.1           *      *         609 SECOND STREET        *
*     RUN  DATE   AND   TIME:      *      *      DAVIS, CALIFORNIA 95616     *
*        30 NOV 06    07:28:32     *      *          (916) 756-1104          *
*                                  *      *                                  *
************************************      ************************************

 INPUT FILE NAME: 731.DAT
OUTPUT FILE NAME: 731.FFO

**TITLE RECORD(S)**
TT    FLOOD FLOW FREQUENCY PROGRAM ELLSWORTH BARR AT FOOTHILL RD 731 SEASONAL PEAK
TT   REGIONAL SKEW -.3 TO MATCH FEMA06 WORK

**STATION IDENTIFICATION**
ID     731 ELLSWORTH BARRANCA AT FOOTHILL ROAD     DA=13.8SQMI REC BEGAN1970TYPEBR

**GENERALIZED SKEW**
     ISTN   GGMSE    SKEW
GS    731    .000    -.30

**SYSTEMATIC EVENTS**
     30 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
ED ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ FINAL RESULTS ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

-PLOTTING POSITIONS- 731 ELLSWORTH BARRANCA AT FOOTHILL ROAD

EVENTS ANALYZED			ORDERED EVENTS			
		FLOW		WATER	FLOW	WEIBULL
MON	DAY	YEAR	CFS	RANK	YEAR	CFS	PLOT POS
12	21	1970	1945.	1	1980	10260.	3.23
12	27	1971	980.	2	2005	9750.	6.45
2	10	1973	1945.	3	1998	9718.	9.68
1	7	1974	602.	4	1978	4200.	12.90
12	4	1974	950.	5	1995	4130.	16.13
9	29	1976	96.	6	2001	2299.	19.35
1	2	1977	775.	7	1992	2140.	22.58
3	4	1978	4200.	8	1979	2000.	25.81
3	27	1979	2000.	9	1971	1945.	29.03
2	16	1980	10260.	10	1973	1945.	32.26
3	5	1981	424.	11	1997	1941.	35.48
1	20	1982	166.	12	1986	1510.	38.71
3	1	1983	1310.	13	1993	1410.	41.94
12	25	1983	380.	14	1983	1310.	45.16
2	14	1986	1510.	15	2004	1137.	48.39
2	17	1990	193.	16	1972	980.	51.61
3	26	1991	822.	17	1975	950.	54.84
2	12	1992	2140.	18	2000	866.	58.06
2	7	1993	1410.	19	1991	822.	61.29
2	20	1994	233.	20	1977	775.	64.52

3	10	1995	4130.	21	2003	745.	67.74	
12	22	1996	1941.	22	1974	602.	70.97	
2	7	1998	9718.	23	1981	424.	74.19	
4	11	1999	32.	24	1984	380.	77.42	
2	23	2000	866.	25	2002	261.	80.65	
3	6	2001	2299.	26	1994	233.	83.87	
11	24	2001	261.	27	1990	193.	87.10	
3	15	2003	745.	28	1982	166.	90.32	
2	25	2004	1137.	29	1976	96.	93.55	
1	10	2005	9750.	30	1999	32.	96.77	

-OUTLIER TESTS -

LOW OUTLIER TEST

BASED ON 30 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.563

0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF 31.5

HIGH OUTLIER TEST

BASED ON 30 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.563

0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF 31440.

-SKEW WEIGHTING -

BASED ON 30 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW = .200
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW = .302

FINAL RESULTS

-FREQUENCY CURVE- 731 ELLSWORTH BARRANCA AT FOOTHILL ROAD

COMPUTED CURVE FLOW IN CFS	EXPECTED PROBABILITY	PERCENT CHANCE EXCEEDANCE	CONFIDENCE LIMITS .05 FLOW IN CFS	.95
25200.	32400.	.2	68500.	12700.
19300.	23600.	.5	49100.	10100.
15300.	18000.	1.0	36900.	8310.
11800.	13400.	2.0	26600.	6620.
7750.	8450.	5.0	16000.	4600.
5230.	5530.	10.0	9920.	3240.
3150.	3250.	20.0	5440.	2040.
1090.	1090.	50.0	1650.	722.
331.	318.	80.0	509.	194.
169.	155.	90.0	276.	87.
94.	82.	95.0	165.	43.
29.	21.	99.0	61.	10.

SYSTEMATIC STATISTICS

LOG TRANSFORM: FLOW, CFS NUMBER OF EVENTS

MEAN	2.9978	³	HISTORIC EVENTS	0
STANDARD DEV	.5851	³	HIGH OUTLIERS	0
COMPUTED SKEW	-.3922	³	LOW OUTLIERS	0
REGIONAL SKEW	-.3000	³	ZERO OR MISSING	0
ADOPTED SKEW	-.4000	³	SYSTEMATIC EVENTS	30

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++++++++++++++++++++++++
+ END OF RUN            +
+ NORMAL STOP IN FFA    +
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