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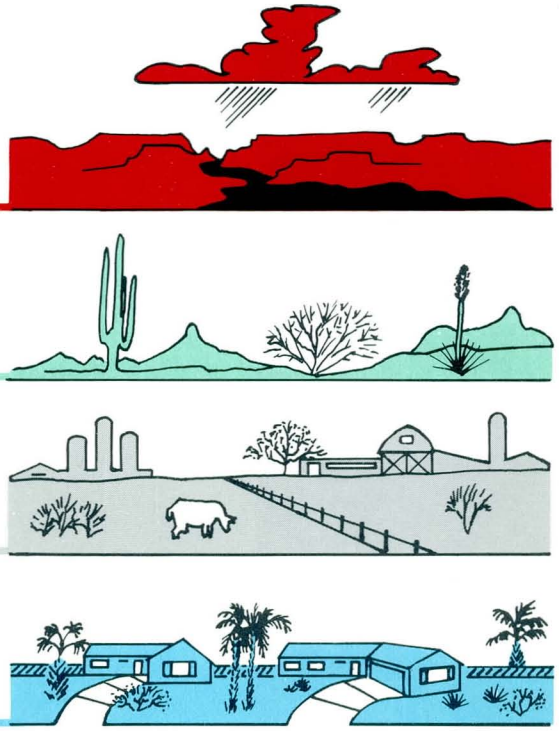

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HEC-1 MODEL ASSESSMENT FOR SELECTED WATERSHEDS IN MARICOPA COUNTY, AZ

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
HYDROLOGY DIVISION

HEC-1 MODEL ASSESSMENT FOR SELECTED WATERSHEDS IN MARICOPA COUNTY, ARIZONA

Maximo R. De Vera
Hydrologist

WATERSHED MANAGEMENT BRANCH
July 1993

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HEC-1 MODEL ASSESSMENT FOR SELECTED WATERSHEDS IN MARICOPA COUNTY, ARIZONA

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Abstract:

The US Army Corps of Engineers HEC-1 model has been applied to many watersheds in Maricopa County to estimate the peak flood of various return periods using a design storm. Basic input data files for 26 selected watersheds as formulated by various Consultants and Flood Control District staff have been re-run without modification using Version 4.0 of the model dated September 1990. Only the 100yr-24hr storm which is generally used for floodplain management studies has been used in the analysis. Multiple regression analysis using 23 wateraheds shows a mean R-square of 0.83 for the linear model relating generated peak discharge to watershed characteristics. Correlation coefficent between unit peak discharge and various HEC-1 parameters have been determined. Results also show that the unit peak discharge which ranges from 30 to 1729 cfs/sq. mile are not significantly different from results of frequency analysis by USGS for gaged watersheds in the county, even at 1% significance level. In addition, some statistical characteristics of model parameters have been summarized for water resources planners and decision makers.

INTRODUCTION

The planning and design of many water resources projects depend upon the results of hydrological studies. One of the most important task is the estimation of a design peak flow for a given return period as decided through guidelines and criteria set by a water resources planning and development agency or by the various cities and jurisdictions . In Maricopa County, usage of the HEC-1 model has a long history as in many parts of the US and in the world. It is probably the most widely used hydrologic model in the United States.

In Maricopa County, a multi-agency task force representing various agencies and juristidctions was formed in 1985 under the auspices of the Flood Control District to develop uniform policies and standards for drainage projects. Eventually, a Drainage Design Manual for Maricopa County was prepared consisting of 2 volumes, the first volume of which covers hydrology which deal mostly with procedures dealing on HEC-1 model. During the last 10 years most of the hydrological studies done by the Flood Control District use the HEC-1 model to estimate peak floods. Few studies made use of SWMM of Environmental Protection Agency and TR20 or TR55 of USDA Soil Conservation Service.

This report summarizes the input data and results of HEC-1 model for 26 selected watersheds in Maricopa County using the 100yr-24hr storm as input. Multiple regression analysis was done to determine how much of the variability in estimated peak discharges have been accounted for by various parameters used in the HEC-1 model. No rigid criteria was used in selecting the watersheds except that relative location was considered such that all conditions in the county are represented and that the original model input data is available. As a check on the applicability of results a comparison with results of flood frequency analysis done by USGS for gaged rivers in the county was performed.

REVIEW OF RELATED REPORTS

An attempt to develop methods for estimating the magnitude and frequency of floods in Arizona was done by Roeske (1978). Regression equations that relate flood maagnitude to some watershed characteristics were developed using 221 gauging stations having 10 or more years of record. Some 29 statons are located in Maricopa County. Only drainage area, mean elevation and mean annual precipitation were found significant in the regression analyses.

Garrett and Gellenbeck (1989) summarized the basin characteristics and streamflow statistics in Arizona as of 1989 with results of flood frequency anaysis using log Pearson Type III method. The 100yr flood peak estimated from instantaneous peak flow records have been presented in this report for 29 stations located within Maricopa County.

In southeastern Arizona, the flood frequency characteristics of 18 watersheds have been determined by Boughton and Renard (1984) with the development of generalized envelope curve for 100yr Peak Q estimate for watersheds ranging from 0.01 to 4000 sq. miles in size. They found that the Roeske regression equation gives significantly lower 100yr peak Q than their derived regression equation.

BRIEF DESCRIPTION OF HEC-1 MODEL

HEC-1 was originally developed in 1967 by the Hydrologic Engineering Center of the US Army Corps of Engineers. Several subsequent revisions have been made to meet changing demands and technology. DeVantier and Fieldman(1993) noted that HEC-1 is a lumped rainfall-runoff parameter model in which each sub-basin is taken as a hydrologic response unit and that it can also operate as a distributed model through use of small sub-basins and/or kinematic wave routing options. Basically, the model simulates the surface runoff response of a watershed to rainfall input through a system of interconnected hydrologic and hydraulic components (USACOE-HEC,1990). It allows a wide variety of options in

specifying rainfall and its distribution, rainfall losses, baseflow, rainfall-runoff transformation and routing. Available subprograms include calibration of unit hydrograph and loss rate parameters, calibration of routing parameters, generation of hypothetical storm, dam safety application, multiflood and flood damage analyses and optimization of flood control system components.

Use of the HEC-1 model at the Flood Control District has been made easier with the preparation of a Hydrology Manual, Volume 1 of Drainage Design Manual for Maricopa County which includes two HEC-1 input loader programs, MCUHP1 for Clark Unit Hydrograph and MCUHP2 for S-Graph options. Most of the modeling done prior to publication of the manual in 1990 made use of SCS Type II rainfall distribution and later, rainfall distribution patterns deemed more appropriate to Maricopa County conditions were developed and included in the input loader programs. The loader program generates a rainfall pattern depending on the magnitude of the drainage area As the pattern number increases from 1 to 5, the rainfall intensity decreses. Depth-area adjustments were made based on recomendations from NOAA Technical memorandum NWS Hydro-40 (Zehr, R.M. and V. A Myers, 1984).

The tranformation of rainfall excess into sub-basin outflow in so far as modeling in Maricopa County is concerned used either the Clark Unit Hydrograph or the S-graph options. Kinematic wave routing through sub-basins overland flow regimes is done for some watersheds. Flood wave movement through the river reaches and reservoirs or detention basins have been simulated using such methods as Muskingum, Muskingum-Conge and Modified Puls methods.

SELECTED WATERSHED

Table 1 shows the selected watersheds and some of the characteristics. The location of the watersheds are shown in Figure 1. The drainage area which ranges from 5.13 to 476.16 square miles and the number of sub-basins were taken from the HEC-1 output printout. The length, highest elevationa and lowest elevation were taken from the watershed or hydrologic network map. A useful quantative expression for drainage basin configration as developed by Horton and cited by Chow(1964) is basin form factor, Bf which is a dimensionless ratio of the drainage area A to square of basin length, L or simply Bf = A/L2. The reciprocal of this factor which is L2/A was used earlier by US Army Corp of Engineers in their study of unit hydrograph applications.

The drainage area for the selected watersheds covers a wide range from 5.13 to 476.16 square miles approximating the drainage area of most gaged watersheds in the county. It can be noted that in sub-dividing the watersheds into sub-basins no specific criteria was imposed on Consultants. Identification of sub-basin concentrations points is mostly based on available USGS topographic map of 1:24,000 scale (7.5 minutes series). For the selected

watersheds the number of sub-basins ranges from 3 to 211.

Table 1 - Selected Watersheds and Some Characteristics

WATERSHED	DA(sq.mi)	NO.SUB-B	LENGTH	H.ELEV	L.ELEV	Recip.Bf	REFERENCE REPORT
1. Apache Wash	32.46	30	12.9	3100	1320	5.13	J.R. Jones, Jul 1990
2. Bender Wash	77.9	23	22.8	3800	1126	6.67	FCD-WSMB, Apr 1991
3. Buchanan Wash	11.28	13	6.2	2269	1435	3.41	Huitt-Zollars, Inc, Mar 1990
4. Cave Creek(Lower)	34.71	36	24.1	2045	1236	16.73	Burgess & Nipple Jan 1990
5. Cline Creek	16.01	13	7.3	4690	2000	3.33	Baker Engineers, Dec 1989
6. Deadman Wash	32.57	51	10.7	3176	1430	3.52	SEA, Inc.,Sept 1990
7. Eageltail	134.15	55	17.1	2400	1300	2.18	FCD-JRG/TWL, Mar 1993
8. Hidden Valley	28.48	90	12.1	2698	976	5.14	Cella Barr Assoc, Sep 1991
9. Jackrabbit Wash	476.16	114	35.6	3382	1050	2.66	Burgess & Nipple May 1991
10. Moon Valley Wash	7.25	15	4.1	2039	1300	2.32	Kaminski Hubbard Dec 1991
11. Morgan City Wash	23	13	11.6	3550	1300	5.85	Baker Engineers, Dec 1989
12. Quuen Creek	244.34	117	16.9	3104	1320	1.17	Wood & Associates, Jan 1991
13. Rodger Creek	5.13	3	6.1	2840	1910	7.25	Baker Engineers, Dec 1989
14. San Domingo Wash	20.28	16	10.9	4237	1860	5.86	FCD-SS Jun 1989
15. Sand Tank Wash	157.77	46	21.4	3720	807	2.90	FCD-WSMB, Apr 1991
16 Scatter Wash	15.58	29	7.1	2100	1350	3.24	Kaminski Hubbard, May 1992
17. Scottsdale Alluvial F	32.54	29	13.1	4000	3100	5.27	FCD-AA/AMM, May 1991
18. Skunk Creek	23.78	38	11.2	2100	1180	5.28	Coo & Van Loo, Nov 1990
19. Tiger Wash	159.08	9	22.7	5681	1380	3.24	FCD-Waters, Jul 1991
20 Tonto Verde W.#10	6.66	5	10.2	3055	1550	15.62	Wiley & Associates, Jul 1992
21. Upper Cave Creek	109.23	63	16.7	5293	2000	2.55	CH2M Hill, Mar 1990
22. Upper Centennial W	451.53	40	34.5	4800	2040	2.64	URS Consultants, Apr 1990
23. Wagner Wash	42.07	83	13.5	1765	1240	4.33	FCD-WSMB, Jan 1991
24. Waterman Wash	401.57	18	37.1	3800	860	3.43	Cella Barr Associates,Sep 1988
25. White Tank #3 Wash	21.32	10	6.7	4083	1200	2.11	FCD-Rice/Plasencia, Oct 1989
26. Wittman	322.99	211	29.1	4250	1340	2.62	WLB Group modified by FCD
Total	2887.84	1170					

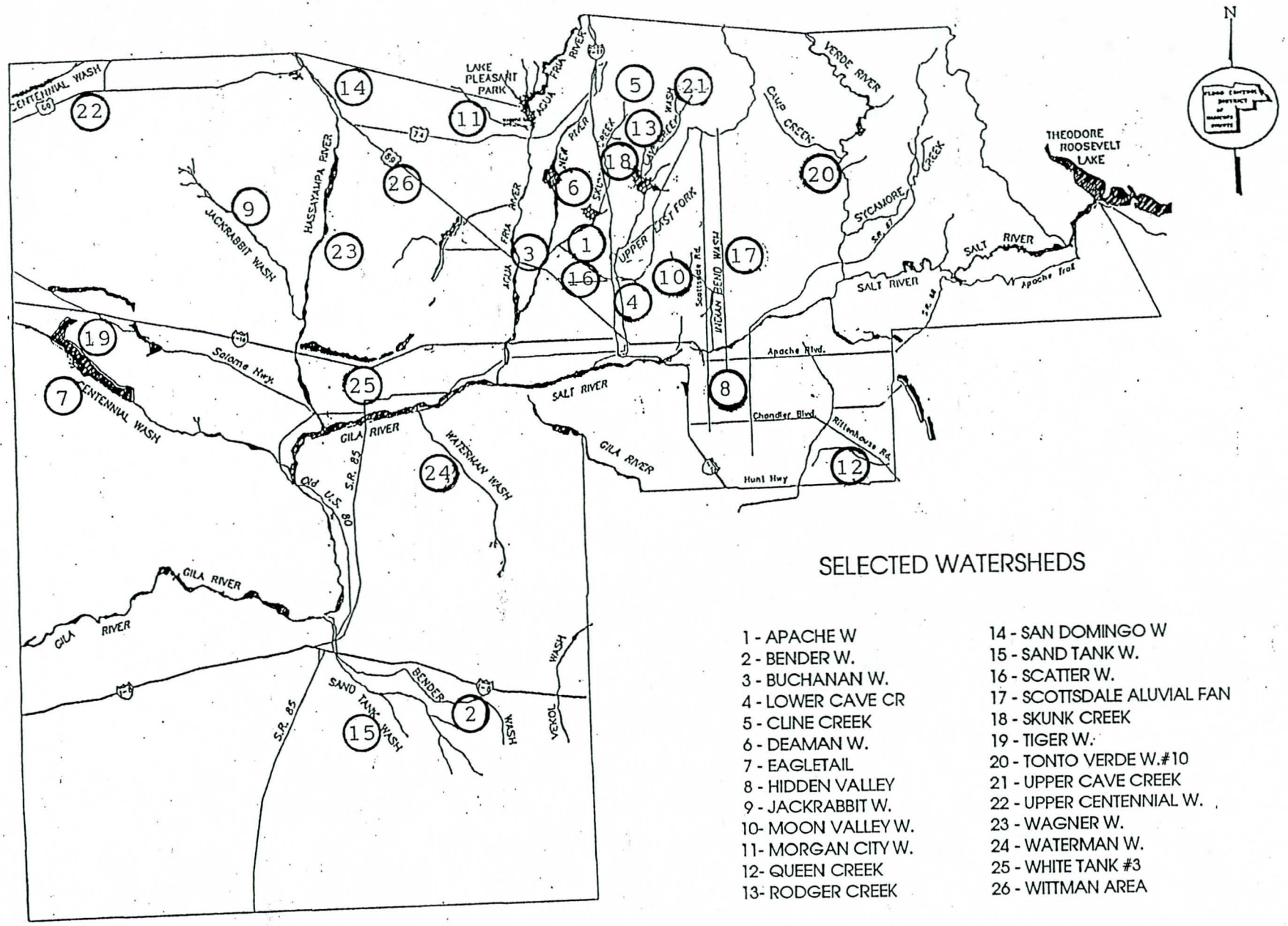
Notes: H.ELEV - highest elevation in feet
L.ELEV - lowest elevation

Recip.Bf = Reciprocal of Basin Factor defined by DA/L square

The length of watershed as measured from the hydrologic or drainage network map ranges from 4.1 to 37.1 miles. The magnitude of L2/A or reciprocal of the basin form factor is indicative of the elongation or circularity of the basin. This affects the lag time and ultimately the peak discharge.

HEC-1 MODEL PARAMETERS

The HEC-1 data file for the various watersheds have been re-run without any modification using Version 4 dated September 1990. Except for one watershed where RK record was slightly modified, no serious run errors were encountered. A data retrieval computer program in Fortran 77 was developed to summarized input parameters and compared with model parameters extracted from the HEC-1 output file. Table 2 shows the mean values of sub-basin area, areally reduced rainfall, and mean of loss parameters and some routing parameters. These were used to calculate the peak discharge at the concentration point of each delienated sub-basin.



SELECTED WATERSHEDS

1 - APACHE W
2 - BENDER W.
3 - BUCHANAN W.
4 - LOWER CAVE CR
5 - CLINE CREEK
6 - DEAMAN W.
7 - EAGLETAIL
8 - HIDDEN VALLEY
9 - JACKRABBIT W.
10- MOON VALLEY W.
11- MORGAN CITY W.
12- QUEEN CREEK
13- RODGER CREEK
14 - SAN DOMINGO W
15 - SAND TANK W.
16 - SCATTER W.
17 - SCOTTSDALE ALUVIAL FAN
18 - SKUNK CREEK
19 - TIGER W.
20 - TONTO VERDE W.#10
21 - UPPER CAVE CREEK
22 - UPPER CENTENNIAL W.
23 - WAGNER W.
24 - WATERMAN W.
25 - WHITE TANK #3
26 - WITTMAN AREA

Table 2 - Mean Sub-Basin Size, Rainfall, Loss Parameters, Lag Time or Unit Hydrograph Time to Peak and Unit Peak Q in Cfs/Sq.mile (Rainfall is for 100yr-24hr Storm in Inches)

WATERSHED	MEAN SB Area	RD.RFL	PATTERN	OPTION	DTHETA	XKSAT	RTIMP	INILOS	CNSLOS	CURNBR	SCSLAG	UHT2PK	UNIT PQ
1. Apache Wash	1.082	4.6	SCS TYpe II	PB			0.81	0.36		84.8	0.39		1729
2. Bender Wash	3.387	4.53	ditto	JD	0.28	0.16	4.19					1.87	127
3. Buchanan Wash	0.868	4.13	ditto	PB				0.34		85.5			233
4. Cave Creek(Lower)	0.964	3.96	ditto	PB			31.8	0.35	0.19		0.43		583
5. Cline Creek	1.232	4.08	ditto	JD			4.08	0.78	0.18		0.55		1028
6. Deadman Wash	0.639	4.33	ditto	PB			0.84			83.9			868
7. Eagletail	2.439	3.44	ditto	PB	0.28	0.38	3.81					6.09	28
8. Hidden Valley	0.316	3.78	ditto	PB	0.17	0.38	12.6				0.71		37
9. Jackrabbit Wash	4.177	4.2	ditto	JD	0.34	0.45	4.53					5.04	72
10. Moon Valley Wash	0.483	3.69	ditto	PB	0.3	0.28	35.7				0.44		628
11. Morgan City Wash	1.769	4.5	ditto	JD			30.1	0.89	0.37		0.65		617
12.Queen Creek	2.088	3.62	ditto	JD				0.56		77.9	2.01		48
13. Rodger Creek	1.718	4.8	ditto	PB									1202
14. San Domingo Wash	1.268	4.6	ditto	JD				0.57	0.08		0.38		1259
15. Sand Tank Wash	3.429	4.53	SCS Type II	JD	0.29	0.17						1.82	166
16 Scatter Wash	0.537	3.72	ditto	PB	0.29	0.68	19.46				0.39		302
17. Scottsdale Alluvial F	1.122	4.33	SCS Type IIA	PB	0.36	0.32	5.03					7.39	523
18. Skunk Creek	0.626	3.9	ditto	JD	0.31	0.27	19.58				0.88		283
19. Tiger Wash	17.675	3.45	SCS Type II	PB	0.26	0.27	8.08					5.61	205
20 Tonto Verde W.#10	1.332	4.35	FCD-Pattern	PB	0.34	0.15							397
21. Upper Cave Creek	1.734	4.25	SCS Type II	PB			0	0.67	0.11		0.51		372
22. Upper Centennial V	11.288	4.05	ditto	JD	0.31	0.29	0				2.12		48
23. Wagner Wash	0.507	3.28	FCD-Pattern	JD				0.79	0.23		0.58		374
24. Waterman Wash	22.309	3.98	SCS Type II	PB						79.13	4.46		80
25. White Tank #3 Wash	2.132	4.2	ditto	PB						82.2			409
26. Wittman	1.531	4.21	ditto	JD									30

NOTES: RD.RFL Is areally reduced rainfall (100yr-24hr storm)
UHT2PK Is unit hydrograph time to peak in hours

The rainfall depth indicated by either the PB or JD record have been extracted from the input file. Where a JD record is specified only the rainfall depth for the smallest drainage area is considered. The basic rainfall data was taken from the NOAA atlas The areally reduced 100 yr-24 hr rainfall depth varies from 3.28 inches for Wagner Wash to 4.8 inches for Rodger Creek.

Rainfall loss parameters that have been used in Maricopa County fall into 3 categories: initial-uniform loss rates using LU record, SCS curve number using LS record and Green and Ampt loss rate parameters using LG record. At FCD a Lotus 1-2-3 spreadsheet was developed for computation of the Green and Ampt parameters to facilitate watershed modeling. With the GIS system land use and soils area delineation have been facilitated. In addition, an slope factor adjustment is also included to account for effect of steep slopes. Green and Ampt parameters were used in 10 out of the 26 watersheds. No other loss rates have been used.

The unit graph or other kinematic data used includes the UI record with given unit graph ordinates, the UC record for Clark Unit Graph, the UD record for SCS Dimensionless Unit Graph and the UK/RK records for kinematic wave or Muskingum-Cunge routing method.

Based on review of the input data for most watersheds flow diversions have been retrieved back into the watershed, except for a few cases such as White Tank and Jackrabbit watershed. In general the effect of flow diversions have been neglected in the computation of watershed unit peak discharge.

HEC-1 MODEL OUTPUT

The results of HEC-1 modeling for each selected watershed with multiple R-square at least equal to 0.5 are summarized in Appendices 1 to 21. Each table includes the rainfall and its assumed distribution, the computation interval IT and input tabulation interval IN, the rainfall loss and some routing parameters and the peak discharge of each delineated sub-basin. Sub-basin names have been included for possible GIS applications of the results. The unit peak discharge and the the different measures of central tendencies, i.e. means have been calculated for purposes of comparative analysis and interpretation of results.

The appendix tables also show graphical comparison of the predicted value or regression estimate and the HEC-1 model generated unit peak discharge. Some watersheds have widely scattered points especially those with low multiple R-square.

Statistical analyses of the results have been done using a package called "STATIT" as released by Stateware (1990). This statistical software packge is a modular system for interactive users in UNIX environment.

MULTIPLE REGRESSION ANALYSIS

The unit peak flows generated using HEC-1 model is a function of the various parameters that have been determined from topographic, land use and soil maps. These parameters are assumed to be independent variables. In order to determine how much of the variability of peak flows has been accounted for due to the effect of the variables, multiple regression analysis was done for 23 watersheds with sufficient number of sub-basins. Table 3 shows the independent variables considered, the Multiple R-square, sometimes referred to as Coefficient of Multiple Determination and its adjusted value, the square root of mean square error (MSE) or simply the standard error of estimate and the F-ratio which is a criteria for significance of the regression line.

Table 3 - Regression Variables, R-square and Test Criteria

WATERSHED	UNIT PQ	Independent Varialbes Con	No.SUB-B	R-sq	Adj.R-sq	Sqr.MSE	F-Ratio
1. Apache Wash	1729	da, la, crvno,rtimp,scslag	30	0.839	0.805	332.21	24.92
2. Bender Wash	127	da, dtheta,xskat,rtimp,uht2p	23	0.799	0.74	172.28	13.53
3. Buchanan Wash	233	da, la, crvno, rtimp	13	0.83	0.773	250.48	14.66
4. Cave Creek(Lower)	583	da,inilos,cnslos,rtimp,scslag	36	0.932	0.921	126.07	82.25
5. Cline Creek	1028	da, inilos,cnslos,rtimp,scslag	13	0.988	0.979	32.24	114.59
6. Deadman Wash	868	da, cvrno, rtimp,tcl/ofl	51	0.296	0.235	449.09	4.83
7. Eagetail	28	da,dtheta,xksat,rtimp,uht2pl	55	0.809	0.789	89.97	41.38
8. Hidden Valley	37	da,dtheta,xksat,rtimp, tc	90	0.893	0.862	112.29	28.47
9. Jackrabbit Wash	72	da,dtheta,xksat,uht2pk	114	0.798	0.782	112.04	51.25
10. Moon Valley Wash	628	da,xksat,rtimp,tc	15	0.944	0.914	82.57	30.71
11. Morgan City Wash	617	da,la,cnslos,rtimp,scslag	13	0.986	0.976	36.48	97.02
12.Queen Creek	48	da,strtl, crvnbr,scslag	117	0.924	0.919	23.96	161.97
13. Rodger Creek	1202		3	* insufficent no. of sub-basins			
14. San Domingo Wash	1259	da,inilos,cnslos,scslag	16	0.988	0.983	40.56	217.37
15. Sand Tank Wash	166	da,dtheta,xksat,uht2pk	46	0.847	0.832	109.09	56.66
16 Scatter Wash	302	da,dtheta,xksat,rtimp,scslag	29	0.853	0.821	117.39	26.77
17. Scottsdale Alluvial F	573	da,dtheta,xksat,rtimp,uht2pl	29	0.849	0.823	168.37	33.65
18. Skunk Creek	283	da, dtheta, xksat, rtimp, tc	38	0.858	0.836	137.64	38.67
19. Tiger Wash	205	da,dtheta,xksat,rtimp	9	0.965	0.907	27.92	16.59
20 Tonto Verde W.#10	397		5	*insuffficient no. of sub-basins			
21. Upper Cave Creek	372	da,cnslos,scslag	63	0.854	0.846	241.03	114.62
22. Upper Centennial Wast	48	da,dtheta,xskat,scslag	40	0.867	0.852	55.88	57.22
23. Wagner Wash	374	da,inilos,cnslos,tc	83	0.723	0.702	705.27	33.35
24. Waterman Wash	80	da,crvno,scslag	18	0.866	0.838	24.71	30.26
25. White Tank #3 Wash	409		10	*contains 5 UD and 5 UI records			
26. Wittman	30	da, strtl	211	0.452	0.436	476.71	29.24

The F-ratios are all greater than F-tabulated from statistical tables even at 1% significance level. This implies that the regression function is a good predictor of the dependent variable.

With data from the 26 selected watersheds a countywide regional regression equaton was developed. The equation that resulted in highest multiple R-square has unit discharge expressed as a function of drainage area, areally reduced rainfall and basin length but with only 48.5% of the variability of unit peak

discharge accounted for by the assumed independent variables. The regression equation is given by

Unit PQ =-1391.64-0.74*DA+515.4*REDRFL -11.56*BLENGT

where DA = drainage area in sq. miles

REDRFL= Areally reduced rainfall
BLENGT= Basin Length in miles
Unit PQ= Unit peak discharge in cfs/sq.mile

R-square = 0.485 F-Ratio = 6.90

The tabulated F value from statistical table shows that at 1% significance level with numerator d.f.=3 and denominator d.f = 22 the F value equals 4.82. Since F computed = 6.90 is greater than F tabulated the regression function could be a good predictor of the dependent variable, i.e. the unit peak discharge in cfs/sq.mile.

CORRELATION COEFFICIENTS

The degree of correlation of the various HEC-1 parameters used to calculate the peak discharge have been determined for each watershed with adequate number of sub-basins. Table 4 shows the correlation coefficient between unit peak discharge and the selected parameters used in the regression analysis.

Table 4-Model Parameters Correlation Coefficient With Unit Peak Q

WATERSHED	NO.SB	SB-AREA	DTHETA	XKSAT	IA/INILOS	CNSLOS	CRVNBR	RTIMP	LAG/TC	UHT2PK
Apache W.	30	-0.14			-0.21		0.21	-0.01	-0.91	
Bender W.	23	-0.69	-0.31	-0.34				0.31		-0.85
Buchanan W.	13	-0.27			-0.72		0.75			
Lower Cave Cr	36	-0.41			0.12	-0.54	-0.37		-0.95	
Cline Creek	13	0.09			-0.47	-0.51		-0.02	-0.93	
Deadman W.	51	-0.53					0.09	0.01		
Eagletail	55	-0.24	0.59	-0.49				0.24		-0.85
Hidden Valley	90	-0.22	0.61	-0.32				0.53	-0.77	
Jackrabbit W.	114	-0.45	-0.27	-0.56						-0.79
Moon Valley W.	15	0.37	-0.09	-0.43				-0.03	-0.94	
Morgan City W.	13	-0.25			0.37	-0.28		0.06	-0.96	
Queen Creek	117	-0.49			-0.73		0.26		-0.79	
San Domingo W.	16	-0.21			-0.69	-0.76			-0.98	
Sand Tank W.	46	-0.63	-0.51	-0.55						-0.91
Scatter W.	29	-0.48	-0.79	-0.54				0.74	-0.81	
Scottsdale Al.Fan	29	-0.22	-0.27	0.23				0.52		-0.91
Skunk Creek	38	-0.33	-0.26	-0.44				0.31	-0.87	
Tiger W.	9	-0.56	-0.76	-0.68				0.27	-0.74	
Upper Cave Cr	63	-0.61				-0.47			-0.92	
Upper Centennial	40	-0.59	-0.06	-0.05					-0.91	
Wagner W.	83	-0.49			0.01	0.13			-0.84	
Waterman W.	18	-0.79					0.29		-0.91	
Wittman	211	-0.58			0.21					
TOTAL		-8.72	-2.06	-4.17	-2.11	-2.43	1.23	2.93	-13.23	-4.31
Mean		-0.38	-0.19	-0.37	-0.23	-0.41	0.21	0.24	-0.88	-0.86

RELIABILITY OF MODEL GENERATED PEAK FLOW

The reliability of peak flow estimate is important to any flood control structure design. In general, hydrologic models are calibrated using observed rainfall and instantaneous flood peak discharge data for a given watershed. In many places, however, this is not possible, hence the use of design storm. The relibility of the model can be improved by comparison with actual flood discharge data.

Thomas, Jr(1987) compared model generated peak flow with flood frequency estimates based on observed data. Results of analyses of data from 173 gaging stations in 10 states, show that for the 100 year flood the frequency analysis estimated flood is 12% larger than the synthetic flood estimates. Arizona is not included in the 10 states studied so that comparison cannot be made. He also noted that the diffferecne between the estimated and generated peak flow appear to be primarily related to infiltration parameters and to record length used in the analysis.

One of the important hydrologic component not included in the application of HEC-1 to watersheds in Maricopa County are channel transmission losses. Lane (1990) has presented some results of studies showing flood peaks from observed data and from applying a distributed watershed model. Calculations with the simulation model with and without transmission losses showed that for larger watersheds with extensive channel systems in arid or semi-arid areas the transmission losses can be as high as 30% in the flood peak and runoff volume. The HEC-1 model generated flood peaks are therefore more conservative estimates compared to observed flood peak discharges.

Some Consultant who have worked for the Flood Control District have attempted to compare model generated peak flows with results of frequency analysis of available peak discharge data. The length and period of record are issues which make the comparison unrealistic. In a flood insurance study for Waterman Wash by CBA(1988) several comparisons of the 100 yr flood near Buckeye (Gage No. 09514200) were made as follows:

1. Frequency analysis of 12 years data ..... 11800 cfs
2. Available regression equation (Roeske,1978). 16400
3. SCS TR55 model(Sub-basin 4,DA=29.15) 4975
4. HEC-1 model for Sub-basin 4 4040
5. Log Pearson Type F.A for 22 yrs record 9000
6. HEC-model for Waterman Wash at Gila River... 31800

Based on the above figures the 12 years or the 22 years record is not representative of the 100 year period. The cyclic pattern of hydrologic data may come into the picture. In a study of the cyclic behavior of runoff and precipitation in Arizona, Creighton(1990) raised questions on the validity of frequency analysis method being used in Arizona. He emphasized the need for assessment of the primary assumptions of randomness and non-cyclic

behavior of historical streamflow data. If the available record used for frequency analysis is in the wet cycle period, the estimated peak flow would be relatively higher than those in the dry cycle period.

The model generated peak flows resulting from assumed long term rainfall have been compared to results of frequency analysis of available streamflow data by USGS using log Pearson Type III method as reported by Garrett and Gelenback (1989). Table 5 shows data for 29 stations in Maricopa County (see next page). Table 6 shows statistical results showing comparison of the HEC-1 model generated 100yr-24hr unit peak discharges (cfs/sq mile) with the frequency analyses results as reported.

Table 6 - Statistical Comparison of Results

Item	HEC-1 Model Result	Freq. Analysis Result
No. of Samples	26	29
Mean	448	409
Standard Deviation	444	446

Pooled variance ... 198096.3

T- statistics: T (pooled) .....0.3244 df = 53
T (separate) ....0.3245 df = 52

Probability value for equality of population variances = 0.99114

The statistical results show that the model generated peak flows using HEC-1 are not significantly different from the results of the frequency analysis as reported by USGS for gaged watersheds in Maricopa County even at the 1% significance level. This may not be consistent with the effect of cyclic hydrologic pattern but could be useful in deciding for realiability of model generated peak flows in the county.

CONCLUSIONS AND RECOMMENDATIONS

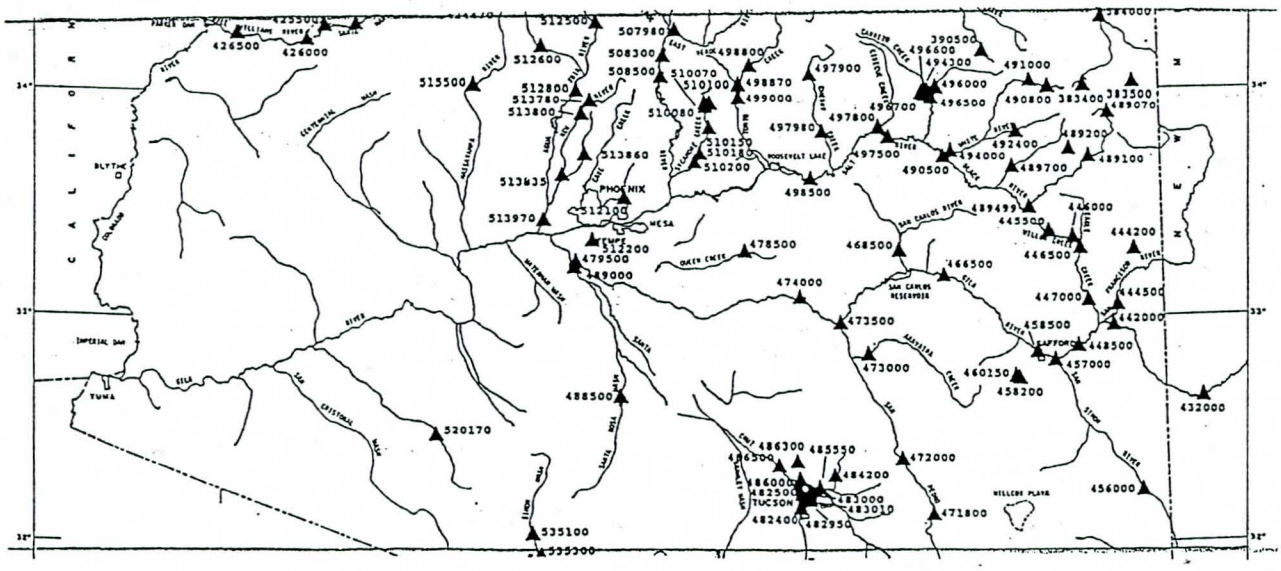
The results of HEC-1 modeling have been presented for 26 selected watersheds in Maricopa County. These models have been formulated by various Consultants of the Flood Control District and also by the District technical staff. Thus, the choice and quantification of the different variables that affect the peak discharge estimates could be assumed to be independent of each other. Statistical analysis was done to determine how much of the variability of peak discharge estimates have been accounted for by the chosen independent variables.

The results of multiple regression analysis of the results show that in most watersheds studied more than 80% of the variability in 100yr-24hr peak discharge have been accounted for by the chosen

Table 5 - Reported 100yr Peak Flow Estimates Using Log Pearson Type III Frequency Analysis Method (Ref: Garrett & Gellenbeck, 1989)

STA.NO	RIVER NAME	LOCATION	DA(sq.mi)	PERIOD	Q10	Q50	Q100	q100
510100	E. Fork Sycamore	Nr. Sunflower	5	61-86	428	1660	2670	534
510980	W.Fork Sycamore	Nr. Sunflower	10	62-74,78-89	1190	4920	8030	803
510150	Sycamore	Nr. Sunflower	52	62-76	8160	27800	42700	821
510170	Camp Creek	Nr. Sunflower	3	63-79	390	759	950	317
510180	Rock Creek	Nr. Sunflower	15	63-72	2130	4530	5790	386
510200	Sycamore Creek	Nr. Fort McDowell	164	60-89	12300	35500	51400	313
512100	Indian Bend Wash	At Scottsdale	139	43,61-70	2950	10600	16800	121
512300	Cave Creek	Nr. Cave Creek	121	58-79,81-86	6870	15200	20000	165
512800	Agua Fria	Nr. Rock Springs	1110	20,70-79	39700	122000	182000	164
513780	New River	Nr. Rock springs	67	62-89	10600	25600	34600	516
513800	New River	At New River	83	61-82	12600	28300	37500	452
513820	Deadman Wash	Nr. New River	11	60-79	1550	4300	6070	552
513835	New River	At Bell Rd,Peoria	185	63,65-84	11700	30500	41800	226
513860	Skunk Creek	Nr. Phoenix	65	60-89	6910	21200	31000	477
513890	New River	At.Grand Ave,Peoria	317	43,60-71	20800	54900	75000	237
513910	New River	Nr. Glendale	323	43,55,60-79	17500	37000	47100	146
513970	Agua Fria	At Avondale	633	60-82	15000	37000	49000	77
515500	Hassayampa	Nr Wickenburg	417	25,27,37-38,46-82	13900	32270	43000	103
514200	Waterman Wash	Nr Buckeye	420	64-78,80-89	3380	6240	7840	19
515800	Hartman	Nr. Wickenburg	6	64-79	1550	4960	7450	1242
516600	Ox Wash	Nr. Morristown	6	60,63-79	1240	3660	5330	888
516500	Hassayampa	Mr. Morristown	796	39-47,61-81,83-89	12200	31300	43900	55
517400	Winter Wash	Nr. Tonopah	48	62-79	2120	3720	4560	95
517000	Hassayampa	Nr. Arlington	1470	61-80,83-84,86-89	12900	34500	49300	34
519780	Windmill Wash	Nr. Gila bend	13	64-78	3120	16020	27600	2123
519750	Bender Wash	Nr. Gila Bend	69	63-79	3270	9040	12600	183
519760	Sauceda Wash	Nr. Gila Bend	106	63-79	33310	8350	11400	108
520100	Military Wash	Nr. Sentinel	9	63-79	946	3330	5220	580
520200	Black Gap Wash	Nr. Ajo	12	62-79	868	1300	1490	124

a- since Oct 1975, DA = 62 sq. miles
b-effective area, 2066 sq. miles minus DA above Lake pleasant
c-plus 20 sq. miles that contributes to another basin



variables. Only 3 watersheds have R-square less than 0.8 excluding 3 in which there are no sufficient samples or cases for regression analysis. The mean value of the R-square is 0.83.

Analysis of the correlation matrix shows that lag time, time of concentration or unit hydrograph time to peak have the highest correlation coefficient of 0.88 with the unit peak discharge. This parameter should be determined as accurately as possible in any HEC-1 modeling.

Two sample t-test statistics was used to compare the model generated peak discharges with results of frequency analysis done by USGS for 29 gaging stations in Maricopa County. There is no significant difference in means and variances of the estimates even at the 1% significance level. This results imply that the HEC-1 model generated peak discharges are as good as those derived by frequency analysis, at least for the 100yr-24 hr floods which are being used for floodplain delineation and design of landfil drainage facilities as required by the Department of Environmental Quality.

With peak discharge estimates for each identified sub-basin in each watershed and with the various HEC-1 model parameters already determined it is possible to facilitate future hydrologic studies using GIS methodologies.

Similar type of analysis could be done to include unit peak discharge of various return periods of 5, 10 25 and 50 years. This could be useful in the development iso-runoff lines for Maricopa County as a guide for hydrologic studies. The results can also be useful for flood control planners and decisions makers.

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Disclaimer:

The views and opinions expressed in this paper are those of the author and does not necessarily reflect those of the Flood Control District of Maricopa County.

APACHE.XLD

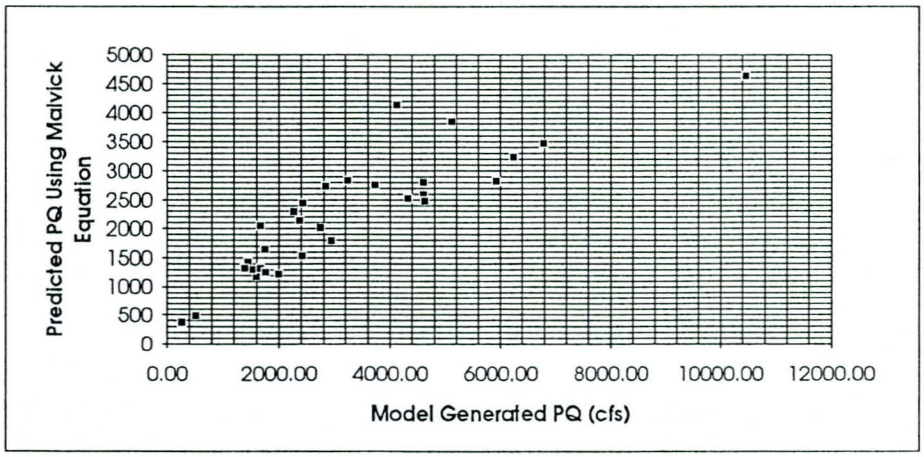
APACHE WASH **J. R. JONES & ASSOCIATES**

100YR-24HR STORM **PB=4.6** **IT=10**

SCS Type II DISTR **IN=30**

SUB-BASIN		DA(sq.mi)	IA	CRVNO	RTIMP	SCSLAG	PEAK Q	Unit PQ	Est. UPQ	DIFF
	70	2.20	0.36	84.90	1.00	0.59	5112.00	2323.64	2459.52	-135.88
	80	1.35	0.39	83.60	1.00	0.66	2835.00	2100.00	2150.16	-50.16
G		0.76	0.35	85.10	5.00	0.22	2937.00	3864.47	3758.99	105.49
	60	0.44	0.41	83.00	1.00	0.24	1600.00	3636.36	3591.15	45.21
	50	1.15	0.37	84.30	1.50	0.66	2432.00	2114.78	2141.99	-27.21
	44	0.62	0.36	84.70		0.21	2422.00	3906.45	3688.02	218.43
	43	1.39	0.35	85.20	1.00	0.33	4604.00	3312.23	3328.95	-16.72
	42	0.11	0.48	80.50	1.00	0.53	266.00	2418.18	2473.32	-55.14
	41	0.89	0.39	83.70	1.50	0.38	2745.00	3084.27	3133.31	-49.04
	40	0.56	0.43	82.20	2.00	0.46	1457.00	2601.79	2820.23	-218.44
	30	0.50	0.37	84.30	1.20	0.39	1526.00	3052.00	3058.21	-6.21
F		2.45	0.36	84.90	1.00	0.90	4127.00	1684.49	1361.99	322.50
	25	1.41	0.33	85.70	1.00	0.17	5932.00	4207.09	3897.77	309.32
	24	2.91	0.30	86.80	1.00	0.26	10463.00	3595.53	3661.66	-66.13
	23	1.71	0.34	85.50	1.00	0.25	6245.00	3652.05	3636.83	15.22
	22	0.51	0.34	85.50	1.00	0.34	1677.00	3288.24	3219.23	69.00
	21	0.51	0.35	85.10	2.00	0.45	1394.00	2733.33	2849.99	-116.65
	20	0.68	0.40	83.40		0.49	1751.00	2575.00	2690.20	-115.20
	14	1.25	0.31	86.70		0.25	4608.00	3686.40	3551.38	135.02
	13	0.15	0.53	78.90		0.24	521.00	3473.33	3434.22	39.11
	12	1.89	0.31	86.40		0.26	6797.00	3596.30	3573.70	22.59
	11	1.36	0.34	85.60		0.45	3729.00	2741.91	2866.76	-124.85
	10	0.96	0.33	85.70	1.00	0.55	2378.00	2477.08	2493.59	-16.51
E		1.42	0.36	84.60		0.60	3241.00	2282.39	2346.09	-63.70
D		1.20	0.30	86.80		0.26	4330.00	3608.33	3508.42	99.92
C		1.17	0.32	86.30		0.21	4632.00	3958.97	3700.55	258.42
	2	1.06	0.28	87.70		0.26	2264.00	2135.85	3466.13	-1330.28
	1	0.91	0.34	85.50		0.80	1673.00	1838.46	1572.62	265.84
B		0.46	0.30	87.00		0.15	2003.00	4354.35	3840.86	513.49
A		0.48	0.36	84.70		0.24	1772.00	3691.67	3569.04	122.63
TOTAL		31.52					54525.00	1729.85		
The total excludes A and B										
Arith.Mean		1.08	0.36	84.8	0.81	0.39		3066		
Geom.Mean		0.87	0.36	84.8	0	0.39		2991		
Harm.Mean		0.63	0.35	84.8	0	0.32		2871		
Median		1.01	0.35	85.1	1	0.34		3186		

Est. UPQ = 45369.38 + 77.76*DA - 14697.88*IA - 421.05*CRVENO + 20.28*RTIMP - 3603.14*SCSLAG
R-square= 0.84



BENDER WASH - FCD (Rice & Granillo)

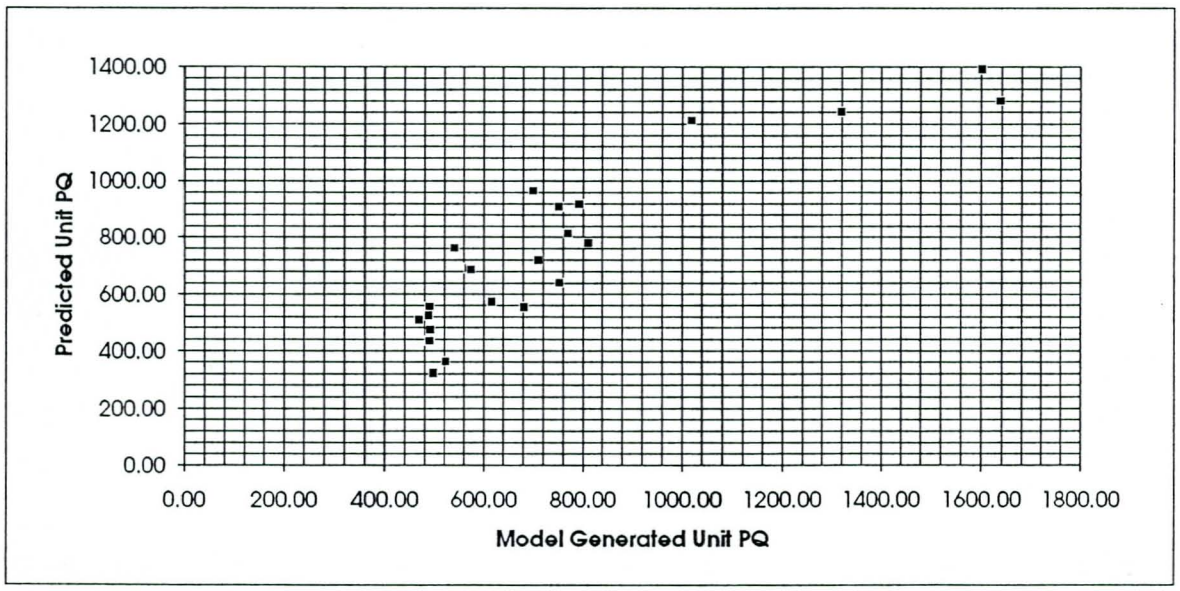
100YR-24HR STORM JD 4.53 .01 IT=10

SCS Type II JD 4.30 10 IN=15

JD 4.00 50

SUB-BASIN	DA(sq.mi)	DTHETA	XKSAT	RTIMP	UIT2PQ	UIPQ	PEAK Q	Unit PQ	Est. UPQ	DIFF
SUB1	2.10	0.34	0.29	0.80	1.75	1277.00	1493.00	710.95	716.97	-6.01
SUB2	3.83	0.35	0.27	0.00	2.25	1524.00	1795.00	468.67	508.26	-39.59
SUB3	2.10	0.25	0.13	6.40	1.50	1010.00	1468.00	699.05	966.63	-267.58
SUB4	0.34	0.33	0.24	0.00	0.50	549.00	557.00	1638.24	1282.77	355.46
SUB5	3.91	0.28	0.16	3.80	2.00	1718.00	2231.00	570.59	691.85	-121.26
SUB6	5.55	0.26	0.16	7.00	2.00	2654.00	3791.00	683.06	553.79	129.27
SUB7	3.78	0.22	0.07	10.70	1.50	2143.00	2998.00	793.12	916.97	-123.84
SUB8	6.88	0.25	0.14	7.10	1.75	3172.00	4243.00	616.72	571.16	45.55
SUB9	0.62	0.21	0.04	9.20	0.75	776.00	993.00	1601.61	1391.21	210.41
SUB10	4.11	0.32	0.22	0.00	2.25	1629.00	2015.00	490.27	554.57	-64.31
SUB11	1.08	0.30	0.19	2.00	0.75	887.00	1100.00	1018.52	1214.08	-195.56
SUB12	4.69	0.20	0.02	10.00	2.50	1989.00	3535.00	753.73	639.40	114.33
SUB13	2.19	0.20	0.02	10.00	1.00	1888.00	2888.00	1318.72	1241.01	77.71
SUB14	2.76	0.29	0.18	0.00	2.00	1220.00	1497.00	542.39	759.59	-217.20
SUB15	4.57	0.30	0.22	0.00	2.75	1802.00	2393.00	523.63	361.37	162.26
SUB16	5.14	0.27	0.15	4.20	2.50	1762.00	2524.00	491.05	473.61	17.44
SUB17	5.30	0.29	0.17	3.30	2.25	1896.00	2589.00	488.49	524.03	-35.54
SUB18	2.90	0.25	0.13	7.50	1.50	1642.00	2179.00	751.38	909.89	-158.51
SUB19	4.67	0.29	0.18	3.70	3.00	1695.00	2325.00	497.86	321.04	176.82
SUB20	3.28	0.31	0.23	0.00	2.75	1190.00	1610.00	490.85	432.64	58.21
SUB21	4.77	0.26	0.12	4.80	2.00	1964.00	2746.00	575.68	686.25	-110.56
SUB22	2.90	0.29	0.20	2.10	1.75	1743.00	2352.00	811.03	777.18	33.85
SUB23	0.54	0.30	0.22	3.80	2.00	256.00	416.00	770.37	813.53	-43.16
G-TOTAL	77.90						9878.00	126.80		
Arith.Mean	3.39	0.28	0.16	4.19	1.87			752		
Geom.Mean	2.73	0.27	0.14	0	1.72			699		
Harm.Mean	1.81	0.26	0.09	0	1.53			659		
Median	3.78	0.29	0.17	3.8	2			683		

Est. UPQ = 1609.55 - 62.66*DA -803.02*DTHETA - 1758.95*XKSAT - 6.01*RTIMP -296.64*UI2PK
R-square= 0.80

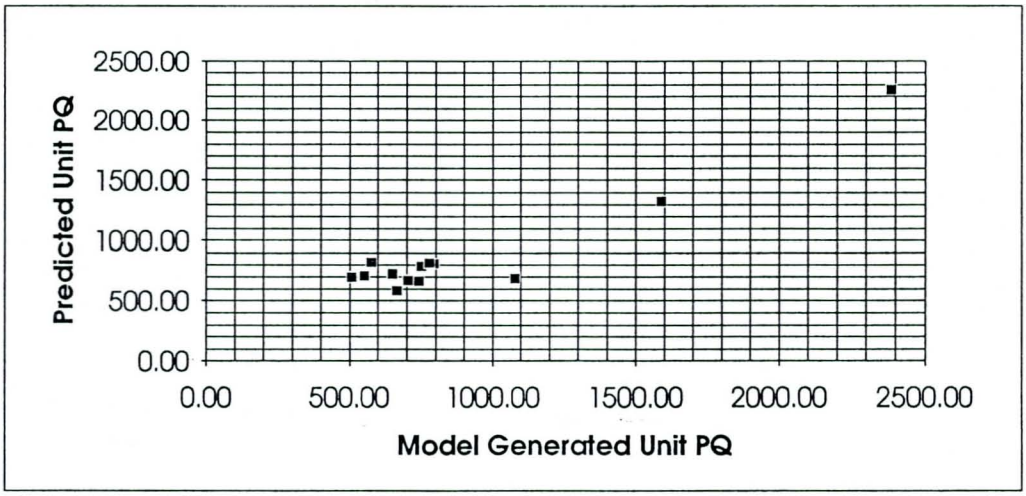


BUCHANAN WASH

100YR-24HR STORM **PB=4.13** **IT=5**
SCS Type II DISTR **IN=30**
KINEMATIC WAVE **UK/RK**

SUB-BASIN	DA(sq.mi)	IA	CRVNO	RTIMP	PEAK Q	Unit PQ	Est. UPQ	DIFF
SUB1	0.77	0.33	86.00	0.00	612.00	794.81	806.91	-12.11
SUB1A	0.37	0.35	85.00	0.00	278.00	751.35	786.95	-35.59
SUB2	1.39	0.33	86.00	0.00	905.00	651.08	723.74	-72.66
SUB2A	0.50	0.50	80.00	0.00	254.00	508.00	695.44	-187.44
SUB3	0.58	0.50	80.00	0.00	626.00	1079.31	684.71	394.60
SUB3A	0.68	0.33	86.00	0.00	392.00	576.47	818.98	-242.51
SUB3B	0.46	0.44	82.00	0.00	324.00	704.35	668.75	35.59
SUB4	0.72	0.33	86.00	0.00	560.00	777.78	813.62	-35.84
SUB4A	0.57	0.38	84.00	0.00	314.00	550.88	705.16	-154.29
SUB9	3.12	0.30	87.00	0.00	2079.00	666.35	583.32	83.03
SUB6	0.43	0.11	95.00	0.00	1026.00	2386.05	2257.99	128.05
SUB7	0.39	0.22	90.00	0.00	620.00	1589.74	1326.63	263.11
SUB8	1.30	0.35	85.00	0.00	966.00	743.08	662.19	80.89
TOTAL	11.28				2625.00	232.71		
Arith.Mean	0.87	0.34	85.5			906		
Geom.Mear	0.71	0.32	85.4			815		
Harm.Mean	0.61	0.3	85.3			757		
Median	0.58	0.33	86			743		

Est. UPQ = -82188.19 - 134.15*DA +28660.13*IA +857.58*CRVNO
R-square= 0.830



CAVE CREEK WATERSHED - FIS BY BURGESS & NIPPLE, INC CAVECRK.XLD

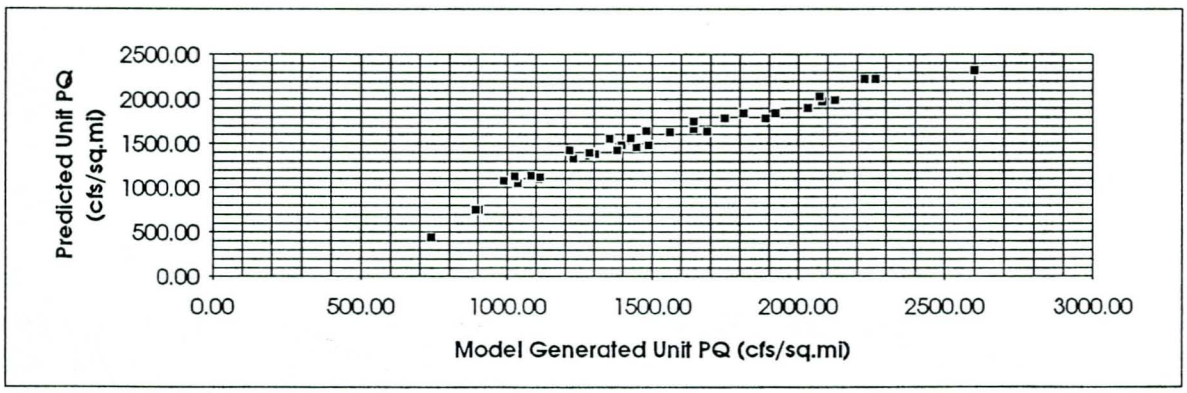
100YR-24HR STORM PB = 3.96 IT=5

PPTN: 5SM - 3.96 10SM =3.8 15 SM = 3.20 SM = 3.:35SM = 3.62 IN=15

SCS TYPE I DISTR 15 MIN INTERVAL

SUB-BAS	DA(sq.mi)	ILOSS	CNSLOS	RTIMP	SCSLAG	PEAK Q	Unit PQ	Est. PQ	DIFF
2A	0.87	0.37	0.20	19.60	0.25	1578.00	1813.79	1838.53	-24.74
2B	0.41	0.37	0.25	12.00	0.19	853.00	2080.49	1968.91	111.58
2C	1.18	0.32	0.25	53.30	0.61	1310.00	1110.17	1098.96	11.21
2E	1.10	0.33	0.22	39.70	0.42	1537.00	1397.27	1480.05	-82.78
2H	1.43	0.32	0.23	44.40	0.81	1293.00	904.20	747.72	156.48
2D	1.19	0.34	0.25	32.40	0.65	1234.00	1036.97	1044.79	-7.81
2P	0.59	0.31	0.25	55.70	0.53	725.00	1228.81	1331.13	-102.32
2F	0.95	0.33	0.23	58.40	0.45	1313.00	1382.11	1422.98	-40.88
2G	0.92	0.33	0.16	29.20	0.39	1362.00	1480.43	1636.03	-155.59
2J	0.70	0.37	0.20	24.60	0.71	692.00	988.57	1074.91	-86.33
2I	0.99	0.37	0.24	40.30	0.48	1272.00	1284.85	1361.71	-76.86
2K	1.34	0.36	0.24	42.30	0.38	1994.00	1488.06	1476.91	11.15
2L	0.60	0.31	0.25	66.20	0.33	986.00	1643.33	1660.45	-17.12
2M	1.17	0.34	0.21	40.60	0.24	2210.00	1888.89	1783.37	105.52
2O	0.64	0.31	0.23	38.10	0.67	657.00	1026.56	1123.58	-97.01
2N	0.48	0.31	0.16	33.30	0.20	995.00	2072.92	2033.04	39.88
1A	0.90	0.48	0.13	0.00	0.53	1095.00	1216.67	1420.06	-203.39
1B	1.60	0.48	0.21	0.00	0.29	2703.00	1689.38	1630.67	58.71
1C	1.49	0.50	0.20	0.60	0.45	1943.00	1304.03	1379.59	-75.57
1D	0.96	0.45	0.18	6.30	0.28	1679.00	1748.96	1785.43	-36.47
3A	1.11	0.43	0.14	2.30	0.32	1823.00	1642.34	1745.94	-103.60
3C	1.56	0.38	0.20	31.60	0.40	2257.00	1446.79	1455.87	-9.07
3B	0.94	0.39	0.25	31.50	1.02	695.00	739.36	439.74	299.63
3D	0.41	0.43	0.24	18.20	0.17	871.00	2124.39	1990.57	133.82
4A	1.26	0.32	0.19	46.80	0.85	1124.00	892.06	747.61	144.46
4B	0.68	0.30	0.20	79.40	0.24	1307.00	1922.06	1844.71	77.35
4C	1.03	0.31	0.24	39.70	0.62	1117.00	1084.47	1133.66	-49.19
5G	0.43	0.38	0.05	3.30	0.17	957.00	2225.58	2222.36	3.22
5C	0.51	0.34	0.05	14.60	0.16	1155.00	2264.71	2226.27	38.44
5A	1.27	0.27	0.17	25.50	0.21	2582.00	2033.07	1897.06	136.01
5B	0.69	0.30	0.25	38.40	0.40	985.00	1427.54	1557.69	-130.15
5D	0.55	0.39	0.05	2.10	0.10	1431.00	2601.82	2321.01	280.81
5E	1.59	0.27	0.11	39.80	0.37	2483.00	1561.64	1622.36	-60.73
5F	1.52	0.26	0.14	28.30	0.50	1952.00	1284.21	1393.71	-109.50
6A	0.46	0.33	0.20	43.80	0.45	623.00	1354.35	1549.43	-195.08
6B	1.14	0.32	0.20	61.50	0.63	1272.00	1115.79	1116.93	-1.14
HC 13 TOT	34.66					20210.00	583.09		
Arith.Mean	0.96	0.35	0.19	31.8	0.43		1511		
Geom.Mec	0.89	0.35	0.18	0	0.38		1450		
Harm.Mear	0.81	0.34	0.16	0	0.32		1387		
Median	0.96	0.34	0.2	32.9	0.4		1442		

Est PQ = 2747.08 - 161.24*DA - 282.77*ILOS - 1082.05*CNSLOS - 1.026*RTIMP - 1708.08*SCSLAG
R-Square=0.92



CLINE CREEK FPD STUDY BY BAKER ENGINEERS JUNE AND 1990

100YR-24HR STORM IT= 6

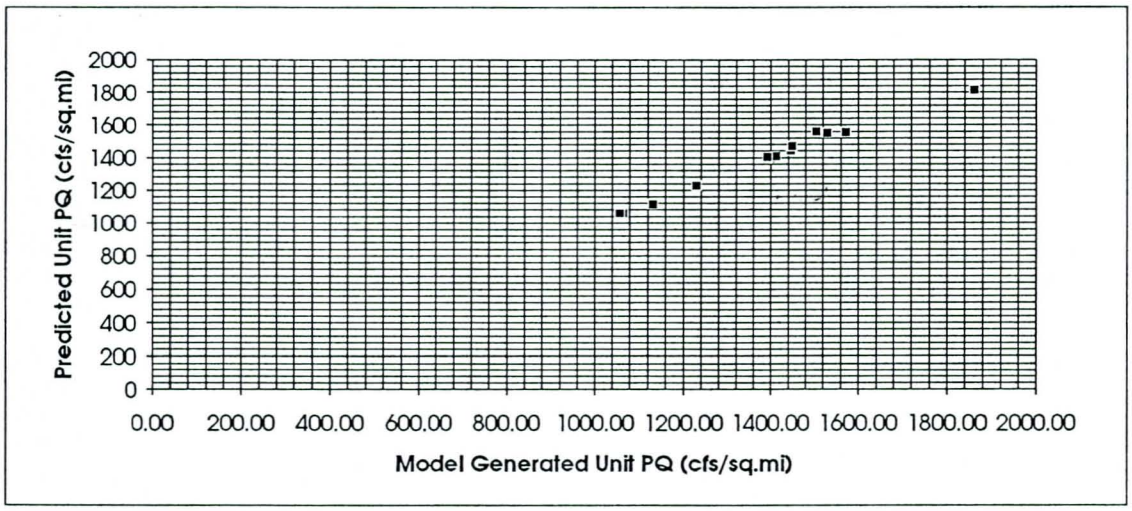
SCS Type RM BY 15 MIN INCR IN=15

SUB-BASIN	DA(sq.mi)	ILOSS	CNSLOSS	RTIMP	SCSLAG	PEAK Q	Unit PQ	Est. PQ	DIFF
X1SUB	0.60	0.88	0.21	15.95	0.44	943.00	1571.67	1555.638	16.03
X2SUB	0.43	0.90	0.29	5.78	0.73	458.00	1065.12	1056.07	9.05
X3SUB	0.56	0.93	0.35	0.76	0.69	592.00	1057.14	1059.487	-2.34
X4SUB	0.28	0.89	0.28	0.00	0.47	405.00	1446.43	1442.838	3.59
X5SUB	0.38	0.93	0.35	0.00	0.47	532.00	1400.00	1394.684	5.32
SUBC1	1.26	0.55	0.01	0.00	0.36	2345.00	1861.11	1813.058	48.05
SUBC2	2.15	0.63	0.09	0.00	0.76	2435.00	1132.56	1112.548	20.01
SUBC3	1.25	0.61	0.06	0.00	0.50	1882.00	1505.60	1559.19	-53.59
SUBC4	2.55	0.55	0.01	0.00	0.50	3900.00	1529.41	1550.884	-21.47
SUBC5	3.38	0.56	0.02	0.00	0.57	4775.00	1412.72	1404.318	8.40
SUBC7	1.18	0.87	0.18	17.70	0.54	1642.00	1391.53	1403.513	-11.99
SUBC8	1.42	0.85	0.18	8.80	0.64	1746.00	1229.58	1224.636	4.94
SUBC9	0.53	0.83	0.24	3.90	0.48	768.00	1449.06	1469.719	-20.66
TOTAL	15.97					16413.00	1027.74		
Arith. Mean	1.23	0.78	0.18	4.08	0.55		1389		
Geom.Mea	0.93	0.75	0.1	0	0.54		1371		
Harm. Mear	0.72	0.73	0.04	0	0.53		1354		
Median	1.18	0.85	0.18	0	0.5		1412		

EsT. PQ = 2628.69 - 40.32*DA - 400.73*ILOSS - 401.33*CNSLOSS + 3.045*RTIMP -1501.15*SCSLAG

R - Sq. = Coefficient of Multiple Determination (square of multiple correlation coeff)

= 0.98



EAGLETAIL WATERSHED FCD -Garre/Lehman/ EAGLETIL.XLD

100YR-24HR STORM w/ distr per FCD manual IT=5

Rainfall Depth of 4.10 spatially reduced by 0.84 = Pb = 3..444 IN=30

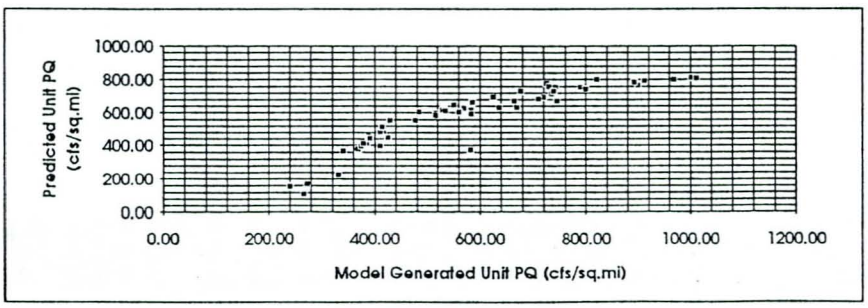
Phoenix Valley S-Graph was used for all sub-basins

PC Record used a 24hr SCS TYpe II Rainfall Distr

SUB-BASIN	DA(Sq.mi)	DTHETA	XKSAT	RTIMP	UIT2PQK	UIPQ	PEAK Q	Unit PQ	Est UPQ	DIFF
Sub1	15.35	0.35	0.33	6.74	8.00	7701.00	6285.00	409.45	397.56	11.88
Sub3	1.79	0.35	0.38	4.45	3.50	2117.00	1286.00	718.44	694.49	23.95
Sub4	1.78	0.35	0.40	2.01	4.50	1715.00	1038.00	583.15	617.07	-33.93
Sub2	4.84	0.35	0.36	0.00	7.00	2904.00	2012.00	415.70	488.13	-72.43
Sub8	1.62	0.35	0.33	0.00	5.50	1231.00	861.00	531.48	619.79	-88.31
Sub5	2.00	0.35	0.37	0.00	6.00	1449.00	953.00	476.50	554.94	-78.44
Sub7	2.18	0.35	0.37	0.00	6.00	1580.00	933.00	427.98	553.62	-125.64
Sub6	2.70	0.35	0.34	7.21	5.50	2134.00	1536.00	568.89	619.14	-50.25
Sub11	1.82	0.35	0.38	0.00	4.50	1695.00	1037.00	569.78	629.70	-59.92
Sub12	2.56	0.26	0.39	0.00	5.50	2024.00	1355.00	529.30	616.19	-86.89
Sub9	2.53	0.35	0.35	31.06	3.00	2843.00	2078.00	821.34	801.21	20.13
Sub10	2.91	0.35	0.32	2.34	6.00	2066.00	1502.00	516.15	596.84	-80.69
Sub13	1.62	0.35	0.41	0.00	4.50	1529.00	907.00	559.88	605.13	-45.25
Sub14	2.00	0.21	0.36	0.27	4.50	1930.00	1354.00	677.00	732.38	-55.38
Sub15	5.63	0.35	0.31	9.33	4.50	5334.00	3998.00	710.12	683.21	26.92
Sub16	3.68	0.36	0.26	6.08	4.00	3746.00	2731.00	742.12	754.87	-12.76
Sub17	1.75	0.35	0.31	0.00	2.50	2900.00	1694.00	968.00	800.44	167.56
Sub40	1.87	0.35	0.36	15.26	3.00	2147.00	1362.00	728.34	762.49	-34.14
Sub41	4.53	0.35	0.33	9.27	4.50	4228.00	3010.00	664.46	673.75	-9.29
Sub42	1.35	0.35	0.37	23.61	3.00	1358.00	978.00	724.44	776.03	-51.59
Sub43	1.46	0.35	0.34	17.08	2.50	2237.00	1463.00	1002.05	814.22	187.83
Sub44	0.31	0.35	0.37	4.00	2.50	533.00	279.00	900.00	767.72	132.28
Sub27	1.57	0.36	0.26	12.82	4.50	1510.00	1145.00	729.30	757.78	-28.48
Sub28	3.50	0.35	0.37	27.49	6.00	2084.00	1691.00	483.14	604.66	-121.51
Sub29	0.58	0.35	0.33	0.00	2.50	864.00	529.00	912.07	791.63	120.44
Sub26	3.16	0.37	0.25	4.83	6.00	2292.00	1738.00	550.00	648.94	-98.94
Sub18	1.19	0.35	0.35	0.00	3.50	1451.00	875.00	735.29	715.07	20.22
Sub19	2.00	0.28	0.39	0.00	4.50	1742.00	1171.00	585.50	662.73	-77.23
Sub20	1.00	0.35	0.30	0.00	4.00	1077.00	738.00	738.00	732.46	5.54
Sub21	4.17	0.35	0.31	0.16	8.00	2272.00	1707.00	409.35	482.01	-72.65
Sub22	1.00	0.35	0.30	0.00	3.00	1430.00	892.00	892.00	787.21	104.79
Sub24	0.75	0.17	0.41	0.00	5.00	635.00	469.00	625.33	694.75	-69.41
Sub25	2.96	0.31	0.34	0.00	7.50	1608.00	1224.00	413.51	516.42	-102.91
Sub30	1.00	0.35	0.34	0.00	3.00	1217.00	790.00	790.00	752.51	37.49
Sub31	0.50	0.35	0.31	0.00	2.50	862.00	506.00	1012.00	809.56	202.44
Sub32	0.50	0.00	0.46	0.00	10.50	208.00	194.00	388.00	456.57	-68.57
Sub33	0.50	0.00	0.51	0.00	10.50	202.00	192.00	384.00	413.19	-29.19
Sub34	0.50	0.00	0.55	0.00	10.50	208.00	184.00	368.00	378.49	-10.49
Sub35	0.50	0.00	0.53	0.00	10.50	206.00	187.00	374.00	395.84	-21.84
Sub36	0.50	0.00	0.51	0.00	10.50	206.00	189.00	378.00	413.19	-35.19
Sub37	1.00	0.00	0.57	0.00	15.00	292.00	266.00	266.00	111.12	154.88
Sub38	1.00	0.00	0.50	0.00	15.00	285.00	272.00	272.00	171.85	100.15
Sub39	1.59	0.35	0.37	0.00	5.00	1325.00	849.00	533.96	612.68	-78.72
Sub45	1.53	0.35	0.44	0.00	3.50	1878.00	974.00	636.60	634.51	2.09
Sub46	1.00	0.35	0.35	0.00	3.00	1351.00	800.00	800.00	743.83	56.17
Sub47	0.50	0.35	0.56	0.00	2.50	833.00	292.00	584.00	592.67	-8.67
Sub48	0.50	0.35	0.47	0.00	2.50	863.00	372.00	744.00	670.75	73.25
Sub49	1.00	0.35	0.48	0.00	3.00	1379.00	669.00	669.00	631.05	37.95
Sub50	1.00	0.09	0.53	0.00	8.50	513.00	390.00	390.00	446.37	-56.37
Sub51	0.50	0.00	0.44	0.00	12.50	175.00	170.00	340.00	364.42	-24.42
Sub52	1.12	0.04	0.46	0.00	15.50	253.00	269.00	240.18	153.71	86.46
Sub53	16.05	0.35	0.36	7.12	10.50	6604.00	5311.00	330.90	230.39	100.51
Sub54	4.08	0.35	0.29	1.80	6.50	2710.00	2102.00	515.20	585.76	-70.56
Sub55	6.51	0.35	0.32	8.73	8.50	3285.00	2763.00	424.42	447.79	-23.36
Sub56	4.62	0.35	0.29	7.79	10.50	3422.00	2692.00	582.68	376.04	206.64
Total	134.15	0.28					3748.00	27.94		
Arith Mean	2.44	0.28	0.38	3.81	6.09			587.89		
Geom. Mean	1.61	0.00	0.37	0.00	5.27			554.91		
Harm. Mean	1.15	0	0.37	0	4.63			521.35		
Median	1.62	0.35	0.36	0	5			570		

Est_UPQ = 1434.16 -7.3*DA -614.66*DTHETA -867.6*XKSAT +2.21*RTIMP -54.75*UNITT2PQ

R-Square=0.81



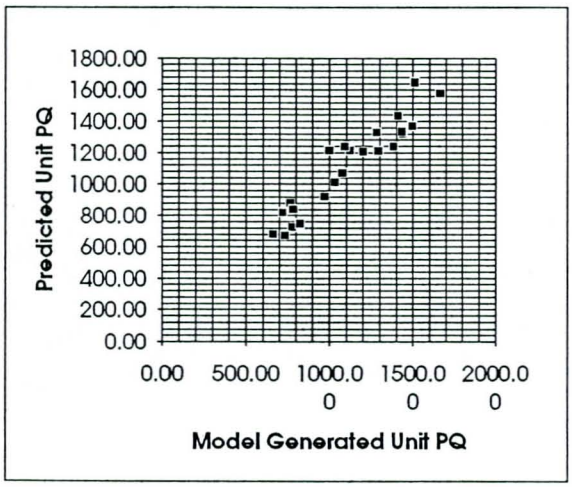
HIDDEN VALLEY WATERSHED - CHAMPION DRAIN **LAVEEN ADMS** **IT=5**
100YR-24HR STORM PB=4.074 3 PB = 3.78 **IN=30**
SCS Type II DISTR

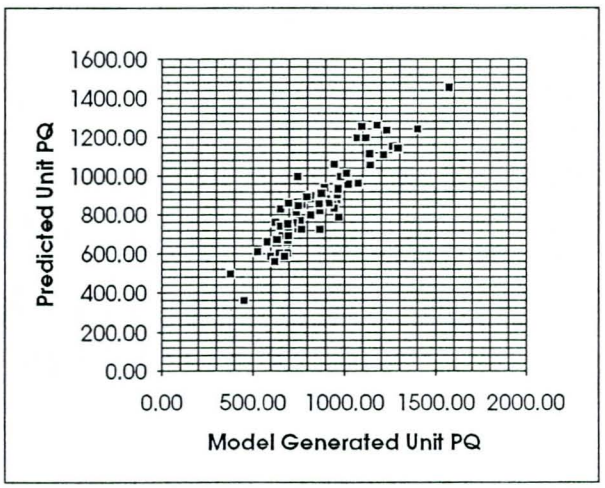
SUB-BASIN	DA(sq.mi)	DTHETA	XKSAT	RTIMP	TC	STOR.K	PEAK Q	Unit PQ	Est. UPQ	DIFF
WC16B	0.02	0.26	0.10	0.00	0.23	0.27	33.00	1434.78	1319.57	115.22
WC17B	0.04	0.28	0.30	5.00	0.27	0.42	35.00	1000.00	1215.97	-215.97
WC18B	0.06	0.27	0.20	0.00	0.30	0.34	72.00	1200.00	1202.66	-2.66
WC19B	0.21	0.28	0.20	40.00	0.22	0.16	350.00	1666.67	1583.28	83.39
PM3B	0.06	0.35	0.90	5.00	0.28	0.27	46.00	766.67	884.06	-117.39
WC20B	0.01	0.25	0.00	0.00	0.23	0.26	21.00	1500.00	1366.83	133.17
WC21B	0.02	0.27	0.20	0.00	0.28	0.38	27.00	1125.00	1215.38	-90.38
PM4B	0.14	0.33	0.70	15.00	0.28	0.19	151.00	1078.57	1068.12	10.45
WC22B	0.01	0.26	0.10	0.00	0.22	0.30	9.00	1285.71	1330.52	-44.81
WC23B	0.40	0.30	0.20	60.00	0.30	0.25	604.00	1510.00	1646.50	-136.50
PM5B	0.13	0.31	0.50	15.00	0.43	0.31	134.00	1030.77	1011.91	18.86
A43A2B	0.09	0.28	0.10	30.00	0.32	0.27	127.00	1411.11	1434.66	-23.55
NWSM1B	0.13	0.35	1.10	60.00	0.27	0.23	168.00	1292.31	1206.42	85.89
A43A1B	0.17	0.29	0.40	15.00	0.28	0.15	235.00	1382.35	1236.96	145.40
ED47B	0.81	0.09	0.60	10.00	0.28	0.11	1159.00	1430.86	1336.34	94.53
IR59B	0.66	0.00	0.60	0.00	0.88	0.61	435.00	659.09	684.29	-25.20
IR55B	0.53	0.08	0.50	5.00	0.85	0.55	415.00	783.02	724.90	58.12
IR62B	0.55	0.00	0.30	0.00	0.85	0.59	431.00	783.64	838.37	-54.74
DR43C	0.94	0.05	0.30	20.00	0.62	0.33	1025.00	1090.43	1239.49	-149.06
DA51B	1.37	0.10	0.30	10.00	0.88	0.32	1334.00	973.72	919.78	53.94
ER55B	0.25	0.00	0.10	0.00	0.98	0.67	207.00	828.00	747.30	80.70
ER59B	0.28	0.00	0.40	0.00	0.93	0.59	206.00	735.71	668.78	66.94
IR63B	0.13	0.00	0.40	0.00	0.77	0.65	94.00	723.08	821.28	-98.21
CDIVER-TOT	7.01						481.00	68.62		
SA19C	0.48	0.09	0.40	5.80	0.70	0.60	316.00	658.33	829.64	-171.30
CR23C	0.58	0.11	0.20	3.30	0.43	0.21	734.00	1265.52	1153.63	111.89
RR27C	0.48	0.04	0.40	0.00	0.63	0.31	460.00	958.33	878.06	80.27
BR19C	0.39	0.03	0.60	3.30	0.52	0.32	364.00	933.33	851.55	81.79
SA27C	0.62	0.00	0.40	0.00	0.68	0.44	513.00	823.43	882.99	-59.55
SM5C	0.20	0.35	0.50	18.00	0.38	0.36	164.00	820.00	901.73	-81.73
SMA15C	0.36	0.05	0.50	0.00	0.42	0.29	368.00	1022.22	957.92	64.30
SMA19C	0.16	0.00	0.70	0.00	0.83	1.21	59.00	378.21	498.10	-119.89
SM1C	1.84	0.35	0.60	50.00	0.45	0.22	2160.00	1173.91	1259.92	-86.01
SM1AC	0.28	0.34	0.50	10.00	0.37	0.29	253.00	903.57	885.81	17.76
SM2C	2.19	0.35	0.80	86.00	0.38	0.13	3451.00	1575.80	1452.17	123.63
SM3C	0.48	0.35	0.60	1.50	0.33	0.16	455.00	947.92	835.42	112.50
SM4C	0.24	0.35	0.50	14.40	0.42	0.39	168.00	700.00	861.38	-161.38
DRW2C	0.53	0.34	0.80	30.00	0.52	0.38	401.00	756.60	742.47	14.13
DRWC1C	0.12	0.00	0.72	0.00	0.60	0.72	70.00	583.33	660.25	-76.91
DR1C	0.16	0.27	0.10	0.00	0.42	0.44	152.00	950.00	1057.52	-107.52
WC1A	0.25	0.26	0.20	40.00	0.40	0.40	274.00	1096.00	1252.60	-156.60
DR2C	0.05	0.33	0.42	0.00	0.35	0.32	46.00	920.00	860.57	59.43
BR27C	0.78	0.00	0.60	0.00	0.70	0.42	594.00	761.54	773.27	-11.73
RR35C	1.89	0.00	0.30	0.00	0.98	0.31	1694.00	896.30	935.15	-38.86
SA37C	0.59	0.13	0.30	15.00	0.75	0.34	571.00	967.80	905.52	62.28
AVR43C	1.03	0.06	0.30	6.25	0.72	0.32	1009.00	979.61	995.43	-15.81
WC2A	0.08	0.25	0.00	0.00	0.84	0.53	78.00	975.00	785.88	189.12
WC2.1A	0.08	0.29	0.50	0.00	0.35	0.31	70.00	875.00	834.25	40.75
WC3A	0.01	0.25	0.00	0.00	0.30	0.47	15.00	1071.43	1192.48	-121.05
WC4A	0.36	0.30	0.50	25.00	0.38	0.27	269.00	747.22	996.55	-249.33
DR27C	0.23	0.35	0.60	0.00	0.47	0.35	157.00	682.61	679.36	3.25
BR35C2	0.73	0.00	0.40	0.00	0.87	0.69	460.00	630.14	758.96	-128.83
BR35C1	0.55	0.00	0.30	0.00	0.93	0.67	361.00	656.36	738.12	-81.75
WC5A	0.42	0.35	1.00	28.00	0.50	0.36	290.00	690.48	597.68	92.80
WC6A	0.01	0.27	0.20	0.00	0.23	0.26	17.00	1214.29	1110.02	104.26
WC7A	0.05	0.27	0.10	0.00	0.32	0.33	57.00	1140.00	1113.22	26.78
WC8A	0.35	0.32	0.60	30.00	0.43	0.37	307.00	877.14	909.96	-32.82
WC9A	0.03	0.25	0.00	0.00	0.30	0.42	28.00	1120.00	1194.41	-74.41
WC10A	0.02	0.26	0.00	0.00	0.23	0.29	28.00	1400.00	1240.39	159.61
WC11A	0.29	0.34	0.70	53.00	0.37	0.36	295.00	1017.24	1012.21	5.03

WC12A	0.26	0.32	0.60	28.00	0.33	0.22	280.00	1076.92	960.90	116.03
WC15A	0.36	0.32	0.70	50.00	0.32	0.25	411.00	1141.67	1054.02	87.64
PM2A	0.07	0.33	0.50	15.00	0.30	0.28	68.00	971.43	934.99	36.44
WC13A	0.01	0.25	0.00	0.00	0.25	0.34	16.00	1230.77	1231.12	-0.35
WC14A	0.05	0.29	0.50	0.00	0.37	0.43	37.00	740.00	815.77	-75.77
PM1A	0.07	0.10	0.60	2.00	0.38	0.28	54.00	771.43	855.75	-84.32
DR35C	0.60	0.22	0.40	0.00	0.72	0.44	435.00	725.00	738.52	-13.52
SMA43C	0.13	0.00	0.20	0.00	0.40	0.26	168.00	1292.31	1140.08	152.22
BR43C	0.85	0.00	0.20	0.00	0.88	0.54	680.00	800.00	891.82	-91.82
VR47C	0.89	0.00	0.30	0.00	0.93	0.41	727.00	816.85	797.96	18.89
AVR51C	0.28	0.00	0.30	0.00	0.77	0.46	244.00	871.43	819.47	51.95
BR51C	0.70	0.00	0.40	0.00	0.90	0.32	505.00	721.43	728.06	-6.63
AVR55C	0.23	0.00	0.20	0.00	0.92	0.62	166.00	721.74	756.29	-34.55
VR59C	0.25	0.00	0.20	0.00	0.97	0.63	176.00	704.00	720.99	-16.99
BR159C	0.68	0.00	0.40	0.00	0.98	0.53	468.00	688.24	660.10	28.13
SM51C	0.50	0.00	0.30	0.00	1.02	0.60	347.00	694.00	664.10	29.90
BR259C	1.00	0.00	0.40	0.00	0.97	0.51	700.00	700.00	728.85	-28.85
DA55C	0.25	0.00	0.40	0.00	0.80	0.47	193.00	772.00	726.50	45.50
DR57C	0.12	0.00	0.40	0.00	0.95	0.70	72.00	600.00	587.16	12.84
DR59C	0.11	0.00	0.40	0.00	0.82	0.63	73.00	663.64	688.66	-25.02
BR163C	0.26	0.00	0.40	0.00	0.97	0.64	168.00	646.15	598.60	47.55
BR263C	0.50	0.00	0.40	0.00	0.93	0.64	319.00	638.00	667.24	-29.24
BR67C	0.13	0.22	0.30	15.00	0.67	0.45	98.00	753.85	842.56	-88.71
CD1C	0.47	0.00	0.30	0.00	0.93	0.37	407.00	865.96	724.04	141.92
CD2C	0.58	0.00	0.20	0.00	0.87	0.45	500.00	862.07	856.72	5.35
IR65C	0.17	0.00	0.40	0.00	0.93	0.87	90.00	529.41	609.16	-79.74
IRDC	0.52	0.00	0.40	0.00	1.33	0.97	235.00	451.92	360.21	91.72
IRSMC	0.25	0.18	0.40	0.00	0.65	0.47	173.00	692.00	751.63	-59.63
A67AC	0.61	0.00	0.40	0.00	1.10	0.63	379.00	621.31	556.94	64.37
CD4C	0.19	0.00	0.40	0.00	0.97	0.55	129.00	678.95	586.28	92.67
CD3C	0.48	0.00	0.30	0.00	0.98	0.58	337.00	702.08	686.98	15.11
CPCD3C-TO1	28.48						1057.00	37.11		
Arith.Mean	0.37	0.17	0.38	12.61	0.71			986		
Geom.Mean	0.19	0	0	0	0.49			952		
Harm.Mean	0.08 ?	?			0.44			918		
Median	0.22	0.18	0.35	5	0.48			955		

First 23 Sub-B: Est. UPQ = 1784.84 +140.125*DA - 705.62*DHTETA - 449.99*XKSAT + 7.015*RTIMP -1045.34*TC
R-square = 0.893

Remaining SB: Est UPQ = 1551.91 + 176.012*DA - 515.93*DTHETA - 620.77*XKSAT + 5.69*RTIMP - 776.39*TC
R-square = 0.846





JACKRABBIT WASH

100YR-24HR STORM — **PC USED SCS TYPE II DISTR**

JD 4.20 0.01 — **RTIMP all = 0.0**

JD 4.12 5.0

JD 3.99 10.0

JD 3.70 50.0

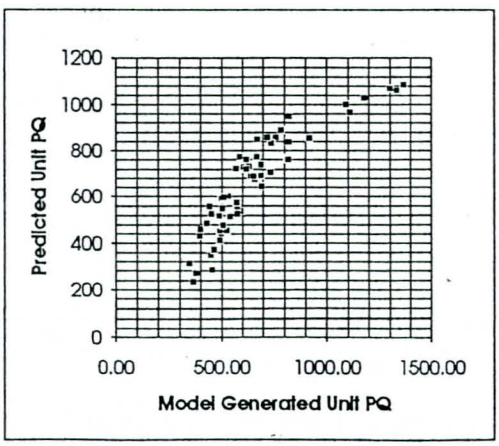
SUB-BASIN	DA(sq.mi)	DTHETA	XKSAT	UHT2PK	UHPQ	PEAK Q	Unit PQ	Est. UPQ	DIFF
1A	6.69	0.31	0.16	3.50	8158.00	7432.00	1110.91	965.30863	145.60
1B	5.70	0.31	0.17	3.00	7138.00	6707.00	1176.67	1027.4108	149.26
1C	0.81	0.36	0.23	2.50	1398.00	1106.00	1365.43	1087.4778	277.95
1D	3.27	0.29	0.14	3.00	4667.00	4360.00	1333.33	1060.4934	272.84
1E	1.11	0.36	0.26	2.50	1849.00	1446.00	1302.70	1069.0127	233.69
1F	3.06	0.34	0.29	4.00	2723.00	2329.00	761.11	856.96987	-95.86
1G	2.56	0.31	0.37	2.50	3613.00	2793.00	1091.02	999.75457	91.26
1H	7.55	0.34	0.40	4.00	7990.00	6146.00	814.04	766.50725	47.53
1I	6.88	0.35	0.40	5.50	4173.00	3424.00	497.67	588.02556	-90.35
1J	2.57	0.36	0.45	4.00	1980.00	1510.00	587.55	772.20044	-184.65
1K	5.02	0.34	0.42	5.50	3241.00	2524.00	502.79	589.70364	-86.91
1L	5.93	0.33	0.21	5.00	3958.00	3671.00	619.06	759.85296	-140.80
2A	7.76	0.36	0.28	4.00	6501.00	5739.00	739.56	830.58372	-91.02
2B	4.31	0.35	0.54	3.50	4313.00	2880.00	668.21	772.26547	-104.05
2C	3.82	0.35	0.75	3.00	4291.00	2173.00	568.85	721.33609	-152.49
2D	5.12	0.36	0.54	6.00	3068.00	2053.00	400.98	461.96854	-60.99
2E	2.09	0.35	0.47	3.00	2397.00	1644.00	786.60	886.49458	-99.89
2F	4.89	0.36	0.49	6.50	2645.00	1944.00	397.55	429.99128	-32.45
3A	5.97	0.32	0.27	5.00	4160.00	3621.00	606.53	726.84134	-120.31
3D	5.01	0.32	0.29	6.00	2888.00	2660.00	530.94	600.43832	-69.50
3B	6.25	0.33	0.41	6.00	3745.00	2824.00	451.84	526.1498	-74.31
3C	5.70	0.32	0.38	6.50	3084.00	2450.00	429.82	485.5126	-55.69
3E	2.90	0.35	0.57	4.00	3106.00	2134.00	735.86	704.33955	31.52
4A	7.43	0.35	0.37	8.50	3223.00	2725.00	366.76	235.14466	131.61
4B	4.07	0.35	0.34	6.50	2278.00	1988.00	488.45	517.91159	-29.46
4C	2.65	0.36	0.19	4.50	2553.00	2430.00	916.98	853.3009	63.68
5A	8.03	0.35	0.37	6.00	5503.00	4743.00	590.66	535.81686	54.84
5B	7.36	0.35	0.45	5.50	4809.00	3269.00	444.16	557.38457	-113.23
5C	3.56	0.35	0.48	4.50	3406.00	2282.00	641.01	688.32272	-47.31
6C	2.23	0.35	0.96	5.50	1862.00	773.00	346.64	312.15101	34.49
6A	3.66	0.36	0.21	4.50	3189.00	3015.00	823.77	835.55327	-11.78
6B	4.76	0.35	0.56	6.00	3262.00	2341.00	491.81	453.57712	38.23
6D	3.67	0.35	0.85	5.00	3143.00	1832.00	499.18	423.74554	75.44
7A	5.19	0.32	0.21	6.00	3557.00	3603.00	694.22	643.09998	51.12
7B	6.11	0.34	0.41	6.00	4434.00	3521.00	576.27	526.93022	49.34
7C	6.81	0.33	0.42	6.50	4566.00	3578.00	525.40	455.96677	69.44
7D	5.84	0.35	0.48	4.50	5389.00	3854.00	659.93	673.01708	-13.09
7F	2.63	0.35	0.51	5.50	1962.00	1514.00	575.67	556.23456	19.43
7E	8.30	0.35	0.38	8.00	4164.00	3787.00	456.27	284.7606	171.50
10A	2.01	0.33	0.32	4.00	1549.00	1350.00	671.64	847.72667	-176.08
10B	5.36	0.35	0.62	5.50	4226.00	2722.00	507.84	477.58682	30.25
10D	4.54	0.32	0.17	5.50	2900.00	2859.00	629.74	730.33843	-100.60
10E	2.72	0.36	0.51	4.00	2570.00	1876.00	689.71	738.29099	-48.59
10C	5.66	0.35	0.63	6.00	4084.00	2784.00	491.87	409.14917	82.72
10F	5.68	0.30	0.15	4.50	3916.00	4088.00	719.72	855.85191	-136.13
10G	4.28	0.35	0.42	5.50	2763.00	2180.00	509.35	594.51186	-85.17
10H	6.74	0.35	0.76	6.50	4182.00	2554.00	378.93	269.67038	109.26
10I	6.93	0.32	0.25	6.50	3765.00	3500.00	505.05	548.54436	-43.49
10J	7.08	0.34	0.61	6.50	4747.00	3177.00	448.73	349.80361	98.93
10L	6.34	0.35	0.69	6.00	4575.00	2938.00	463.41	371.68183	91.73
10M	6.17	0.32	0.17	5.50	3941.00	3824.00	619.77	719.39624	-99.62
10K	5.44	0.35	0.44	6.00	3639.00	2951.00	542.46	514.81728	27.65
10N	3.47	0.36	0.47	5.50	2464.00	1989.00	573.20	572.37124	0.83
10S	3.92	0.36	0.23	5.00	3406.00	3207.00	818.11	761.90039	56.21
10T	3.81	0.35	0.36	5.00	3181.00	2625.00	688.98	691.50947	-2.53
10U	4.26	0.36	0.47	4.50	3711.00	2786.00	653.99	688.94797	-34.96
10Q	2.61	0.32	0.24	3.50	2612.00	2149.00	823.37	948.66827	-125.30
10O	3.08	0.30	0.09	3.50	2892.00	3181.00	1032.79	997.24329	35.55
10P	6.15	0.32	0.23	5.50	3731.00	3464.00	563.25	609.33	-46.08
10R	6.15	0.32	0.23	5.50	3149.00	2662.00	432.85	609.33	-176.48
10V	3.12	0.35	0.46	5.00	2672.00	2060.00	660.26	658.46506	1.79
10W	5.30	0.30	0.11	5.00	3311.00	3751.00	707.74	736.28865	-28.55
10X	2.74	0.34	0.20	4.50	2034.00	1872.00	683.21	884.79822	-201.59
10Y	3.70	0.36	0.49	5.50	2428.00	1701.00	459.73	579.43875	-119.71
10Z	3.69	0.35	0.65	4.50	2905.00	1721.00	466.40	579.44972	-113.05
10AA	1.63	0.36	0.29	4.00	1420.00	1136.00	696.93	955.85334	-258.92
10AB	4.31	0.35	0.33	5.50	2828.00	2316.00	537.35	650.05678	-112.70
8A	6.27	0.35	0.57	7.50	3573.00	2776.00	442.74	187.50626	255.24
9A	4.64	0.35	0.38	5.00	3722.00	2721.00	586.42	670.48682	-84.06

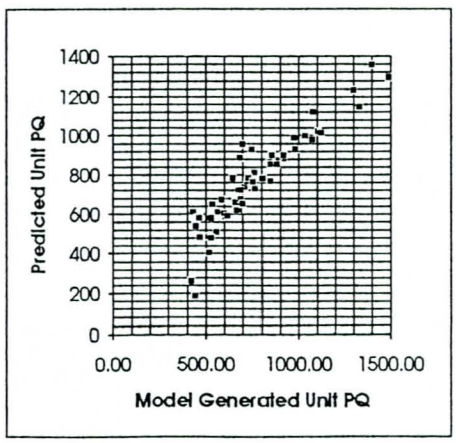
JACKRBIT.XLD

9B	8.49	0.35	0.36	5.00	5666.00	4497.00	529.68	579.67387	-49.99
9C	7.32	0.34	0.32	5.00	6112.00	4997.00	682.37	618.65965	63.71
9D	6.24	0.30	0.21	5.50	4026.00	3777.00	605.29	581.92537	23.36
9E	6.08	0.36	0.64	4.00	6511.00	3640.00	598.68	603.14744	-4.46
9F	1.75	0.35	0.58	2.50	2264.00	1312.00	749.71	928.58375	-178.87
9G	1.00	0.35	0.60	3.50	1189.00	764.00	764.00	810.48	-46.48
9I	4.81	0.35	0.51	3.50	5718.00	4079.00	848.02	767.22678	80.80
9H	1.47	0.35	0.81	2.50	1979.00	948.00	644.90	783.43986	-138.54
11A	2.18	0.35	0.50	4.50	1899.00	1477.00	677.52	719.87184	-42.35
12A	4.88	0.31	0.11	5.00	3514.00	3641.00	746.11	766.76959	-20.66
12B	4.79	0.34	0.58	7.00	2985.00	2028.00	423.38	264.30687	159.08
12C	3.64	0.34	0.48	6.00	2435.00	1875.00	515.11	486.89892	28.21
12D	5.29	0.34	0.35	5.50	3757.00	3263.00	616.82	591.15562	25.67
12E	7.54	0.35	0.38	6.50	4828.00	3916.00	519.36	404.42652	114.94
13A	0.90	0.35	0.38	2.00	1811.00	1199.00	1332.22	1146.9112	185.31
14A	0.09	0.35	0.38	1.00	362.00	134.00	1488.89	1293.9132	194.98
14B	0.03	0.35	0.38	0.50	210.00	42.00	1400.00	1358.0864	41.91
19A	0.06	0.35	0.57	0.50	293.00	78.00	1300.00	1231.12	68.88
19B	0.77	0.35	0.52	1.50	1441.00	829.00	1076.62	1120.0205	-43.40
16A	1.94	0.35	0.92	4.00	2040.00	1080.00	556.70	510.04222	46.66
17A	2.17	0.35	0.43	4.50	2076.00	1570.00	723.50	766.62046	-43.12
15A	3.59	0.35	0.99	3.50	4438.00	1903.00	530.08	481.50392	48.58
15B	2.08	0.35	0.50	4.00	1965.00	1517.00	729.33	785.12654	-55.80
15C	1.83	0.35	1.16	2.50	3158.00	817.00	446.45	541.31529	-94.87
15D	2.87	0.35	0.91	4.00	2711.00	1364.00	475.26	491.53756	-16.28
18A	0.25	0.35	1.50	1.50	636.00	117.00	468.00	483.38425	-15.38
18T	0.39	0.35	1.04	2.00	464.00	269.00	689.74	722.47657	-32.73
18B	1.81	0.35	0.46	3.50	2238.00	1662.00	918.23	881.53653	36.70
18C	1.90	0.35	0.42	4.50	1818.00	1526.00	803.16	780.5602	22.60
18M	1.50	0.33	0.31	5.00	1252.00	1131.00	754.00	763.61045	-9.61
18N	2.40	0.33	0.31	5.50	1791.00	1655.00	689.58	676.72615	12.86
18O	0.90	0.35	0.43	3.00	1127.00	877.00	974.44	988.61045	-14.17
18P	1.36	0.31	0.28	4.00	1376.00	1206.00	886.76	874.16608	12.60
18Q	1.13	0.35	0.37	3.00	1615.00	1248.00	1104.42	1022.2304	82.19
18R	2.17	0.34	0.34	6.00	1566.00	1447.00	666.82	619.59981	47.22
18S	1.35	0.34	0.38	3.50	1636.00	1327.00	982.96	927.96615	55.00
18D	3.60	0.35	0.45	5.00	3128.00	2518.00	699.44	652.12705	47.32
18E	3.83	0.35	0.42	4.50	3690.00	2930.00	765.01	728.37879	36.63
18F	0.80	0.35	0.45	3.00	1092.00	859.00	1073.75	978.03465	95.72
18G	2.03	0.35	0.29	4.50	1942.00	1713.00	843.84	863.36214	-19.52
18K	0.80	0.35	0.49	2.50	1381.00	898.00	1122.50	1014.0267	108.47
18H	2.63	0.35	0.40	3.50	3187.00	2413.00	917.49	899.20469	18.29
18I	2.57	0.35	0.31	4.00	2752.00	2198.00	855.25	898.03366	-42.78
18J	2.35	0.35	0.48	3.50	2794.00	1992.00	847.66	853.65705	-6.00
18L	2.40	0.35	0.48	3.50	2908.00	2119.00	882.92	852.3052	30.61
TOTAL	476.16					34050.00	71.51		
Arith.Mean	3.89	0.34	0.45	4.53			705		
Geom.Mean	3.19	0.34	0.41	4.23			669		
Harm.Mean	2.21	0.34	0.35	3.78			638		
Median	3.71	0.35	0.42	5.25			645		

First 57 Sub-basns: Est UPQ = 1529.48 - 6.71*DA - 15.94*DTHETA -548.37*XKSAT -121.88**UHT2PK
R-square= 0.798

Remaining 57 s ubB:Est UPQ = 1004.37 - 27.04*DA +1912.54*DTHETA - 663.98*XKSAT - 125.1*UHT2PK
R-square= 0.858

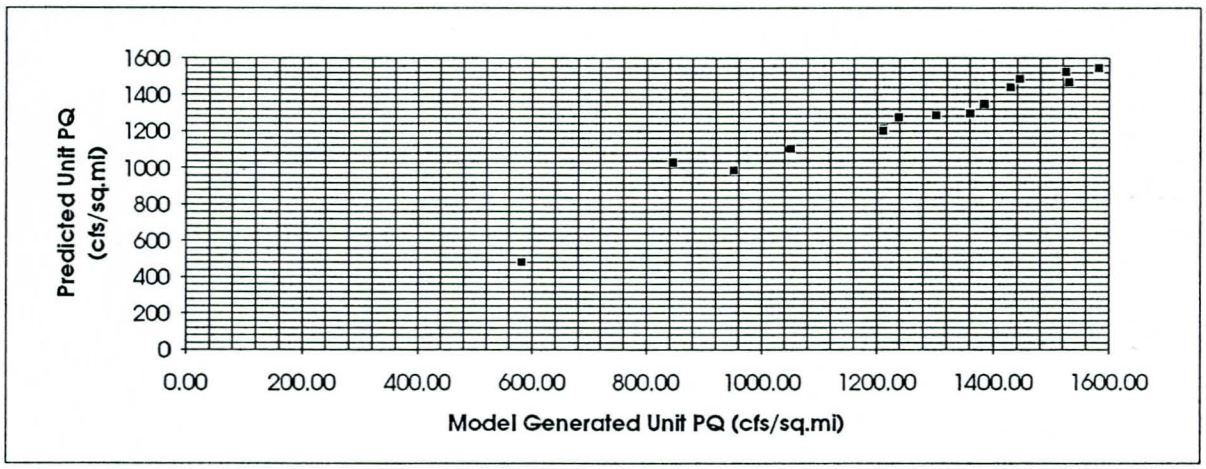




MOON VALLEY WASH WATERSHED **Kaminski Hubbard -ACDC ADMS**
100YR-24HR STORM **PB=3.686** **IT=4**
SCS TYPE II **IN=30**

SUB-BAS	DA(sq.mi)	DTHETA	XKSAT	RTIMP	TC	STOR.K	PEAK Q	Unit PQ	Est. UPQ	DIFF
200S	0.58	0.36	0.21	10.79	0.42	0.24	722.00	1238.42	1272.369	-33.95
202S	0.61	0.26	0.17	40.28	0.31	0.16	967.00	1582.65	1544.642	38.01
206S	0.68	0.34	0.29	37.67	0.69	0.44	648.00	951.54	987.8045	-36.26
203S	0.43	0.33	0.40	12.69	0.45	0.28	456.00	1050.69	1098.708	-48.02
204S	0.51	0.33	0.35	24.77	0.43	0.25	615.00	1213.02	1210.46	2.56
205S	0.32	0.31	0.18	23.33	0.38	0.22	438.00	1360.25	1295.806	64.44
207S	0.58	0.35	0.29	23.05	0.41	0.22	750.00	1302.08	1283.271	18.81
208S	0.79	0.27	0.25	35.17	0.33	0.16	1199.00	1525.45	1523.743	1.70
212S	0.41	0.27	0.34	46.61	0.27	0.16	626.00	1530.56	1468.932	61.63
211S	0.23	0.25	0.26	51.40	0.59	0.67	198.00	846.15	1028.867	-182.71
209S	0.32	0.28	0.36	45.95	0.97	0.98	188.00	582.04	481.0925	100.95
213S	0.22	0.28	0.25	47.18	0.28	0.24	313.00	1429.22	1437.877	-8.65
214S	0.47	0.30	0.27	47.24	0.40	0.23	649.00	1383.80	1348.674	35.12
210S	0.83	0.30	0.32	41.76	0.36	0.19	1199.00	1444.58	1484.26	-39.68
215S	0.27	0.25	0.30	47.21	0.45	0.33	326.00	1211.90	1197.817	14.08
TOTAL	7.25						4554.00	628.14		
Arith.Mean	0.48	0.3	0.28	35.67	0.44			1244		
Geom.Mean	0.45	0.29	0.27	32.47	0.42			1207		
Harm.Mean	0.41	0.29	0.27	28.41	0.4			1161		
Median	0.47	0.3	0.29	40.28	0.41			1302		

Est. UPQ = 1718.35 + 336.37*DA - 20.302 *DTHETA - 481.72*XKSAT + 3.134*RTIMP -1350.83*TC
R-square= =0.94



MORGAN CITY WASH MORGAN.XLD

100YR-24HR STORM SCS TyPE II

JD 4.5 0.01 **IT = 6**

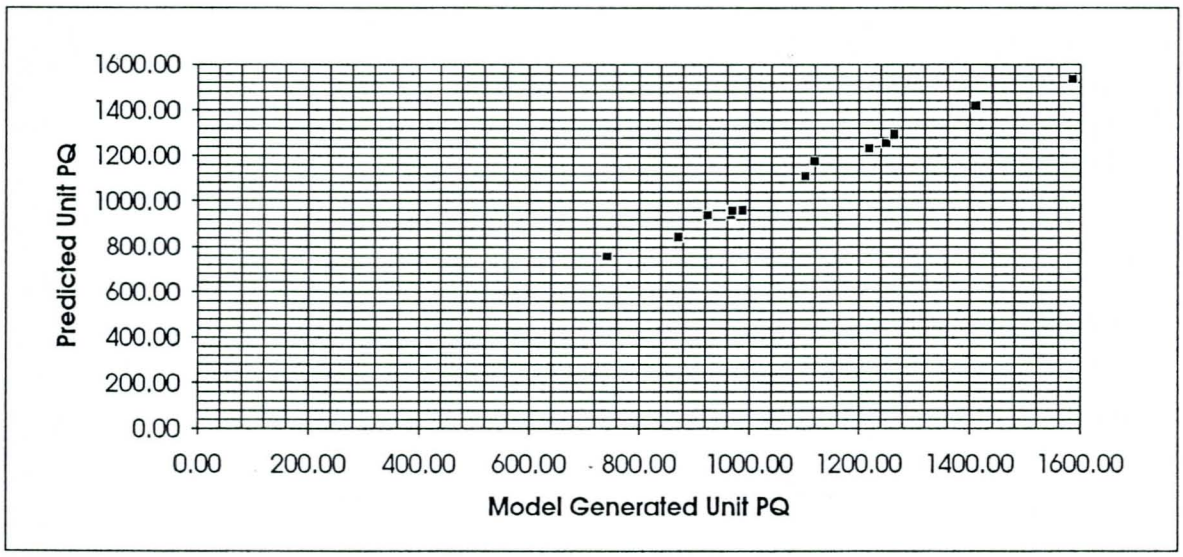
JD 4.28 10 **IN= 15**

JD 4.14 20

JD 4.05 30

SUB-BASIN	DA(sq.mi)	IA	UNI-LOSS	RTIMP	SCSLAG	PEAK Q	Unit PQ	Est. UPQ	DIFF
SUBM1	2.00	0.95	0.38	20.30	0.35	3173.00	1586.50	1533.61	52.89
SUBM2	1.56	0.92	0.28	32.60	0.46	2201.00	1410.90	1419.11	-8.22
SUBM3	1.89	0.95	0.40	35.00	0.63	2082.00	1101.59	1110.46	-8.87
SUBM5	1.74	0.95	0.38	34.60	0.53	2174.00	1249.43	1255.06	-5.64
SUBM4	2.67	0.95	0.40	34.90	0.61	2990.00	1119.85	1174.37	-54.52
SUBM6	2.61	0.93	0.32	34.60	0.89	2274.00	871.26	846.22	25.05
SUBM7	0.78	0.81	0.24	31.30	0.56	986.00	1264.10	1291.11	-27.01
SUBM8	2.39	0.84	0.37	34.40	0.80	2210.00	924.69	938.18	-13.49
SUBM9	1.76	0.87	0.55	29.20	0.69	1700.00	965.91	937.70	28.21
SUBM10	1.50	0.81	0.26	45.00	0.80	1482.00	988.00	962.87	25.13
SUBM11	0.97	0.85	0.45	21.50	0.51	1183.00	1219.59	1230.55	-10.96
SUBM12	1.29	0.81	0.27	35.20	0.80	1250.00	968.99	959.52	9.48
SUBM13	1.81	0.87	0.53	3.00	0.86	1345.00	743.09	756.38	-13.29
TOTAL	22.97					14168.00	616.80		
Arith.Mean	1.77	0.89	0.37	30.1	0.65		1109		
Geom. Mec	1.67	0.88	0.36	26.5	0.63		1086		
Harm.Mean	1.57	0.88	0.35	18.1	0.61		1065		
Median	1.76	0.87	0.38	34.3	0.63		1102		

Est. UPQ = 2350.1 + 46.59*DA -145.78*IA - 693.04*CNSLOS - 1.363*RTIMP - 1371.88*SCSLAG
R-square= 0.99



QUEEN CREEK - ADMS MAR 91 REV. IT=10
100YR=24HR STORM JD=3.62 0.01 IN=15
JD=3.53 18.0
JD=3.48 38

SUB-BAS	DA(sq.mi)	STRTL	CRVNBR	RTIMP	SCSLAG	PEAK Q	Unit PQ	Est. UPQ	DIFF
SUB100	0.23	0.60	77.00		1.25	667.00	2900.00		
SUB102	0.43	0.60	77.00		1.93	91.00	211.63	221.27	-9.64
SUB104	0.20	0.60	77.00		1.47	52.00	260.00	257.43	2.57
SUB108	1.16	0.60	77.00		1.99	239.00	206.03	226.62	-20.59
SUB110	1.37	0.60	77.00		1.97	284.00	207.30	231.36	-24.06
SUB116	0.68	0.53	79.00		3.01	114.00	167.65	158.97	8.68
SUB120	0.55	0.53	79.00		0.86	230.00	418.18	341.54	76.65
SUB124	1.85	0.60	77.00		2.52	318.00	171.89	191.08	-19.19
SUB126	0.63	0.56	78.00		1.29	190.00	301.59	292.59	8.99
SUB130	2.28	0.60	77.00		3.01	341.00	149.56	155.23	-5.67
SUB132	0.78	0.41	83.00		1.34	288.00	369.23	353.34	15.89
SUB140	0.75	0.38	84.00		1.13	326.00	434.67	382.61	52.06
SUB144	1.02	0.47	81.00		1.39	335.00	328.43	328.27	0.16
SUB148	2.02	0.60	77.00		2.98	305.00	150.99	154.06	-3.07
SUB150	2.33	0.60	77.00		2.93	356.00	152.79	162.81	-10.02
SUB154	2.62	0.60	77.00		2.83	411.00	156.87	175.56	-18.69
SUB156	1.01	0.50	80.00		1.16	360.00	356.44	335.29	21.14
SUB160	1.02	0.60	77.00		1.93	216.00	211.76	229.76	-17.99
SUB162	2.75	0.60	77.00		3.35	379.00	137.82	132.82	5.00
SUB166	1.82	0.60	77.00		2.81	288.00	158.24	165.77	-7.53
SUB168	1.52	0.60	77.00		2.51	262.00	172.37	187.19	-14.82
SUB172	1.01	0.56	78.00		2.50	185.00	183.17	194.26	-11.09
SUB180	1.09	0.47	81.00		2.03	270.00	247.71	274.37	-26.67
SUB184	1.02	0.41	83.00		1.21	405.00	397.06	367.94	29.12
SUB190	0.45	0.60	77.00		1.24	132.00	293.33	280.75	12.58
SUB196	1.91	0.27	88.00		2.23	593.00	310.47	349.05	-38.58
SUB200	0.30	0.60	77.00		1.56	75.00	250.00	251.14	-1.14
SUB206	0.87	0.22	90.00		1.47	397.00	456.32	419.91	36.41
SUB210	1.46	0.27	88.00		1.70	556.00	380.82	388.05	-7.23
SUB222	0.93	0.63	76.00		1.39	237.00	254.84	260.89	-6.05
SUB226	1.01	0.56	78.00		1.59	260.00	257.43	272.32	-14.90
SUB230	1.00	0.67	75.00		1.49	230.00	230.00	239.06	-9.06
SUB234	1.02	0.63	76.00		1.48	249.00	244.12	254.47	-10.35
SUB238	1.32	0.67	75.00		2.35	215.00	162.88	169.88	-7.01
SUB240	1.86	0.60	77.00		2.72	301.00	161.83	174.07	-12.24
SUB242	0.98	0.63	76.00		1.36	254.00	259.18	264.18	-5.00
SUB246	0.98	0.67	75.00		1.57	217.00	221.43	231.91	-10.48
SUB250	1.00	0.67	75.00		1.60	210.00	210.00	229.62	-19.62
SUB254	1.28	0.60	77.00		2.36	232.00	181.25	196.61	-15.36
SUB258	3.68	0.56	78.00		3.87	478.00	129.89	115.13	14.77
SUB260	0.98	0.67	75.00		1.21	261.00	266.33	262.79	3.54
SUB264	0.99	0.63	76.00		1.47	243.00	245.45	254.89	-9.44
SUB268	0.96	0.63	76.00		2.27	170.00	177.08	185.83	-8.75
SUB272	0.59	0.67	75.00		1.38	143.00	242.37	242.60	-0.23
SUB274	1.45	0.63	76.00		2.62	230.00	158.62	162.85	-4.23
SUB278	1.40	0.67	75.00		2.26	234.00	167.14	178.76	-11.61
SUB290	1.17	0.53	79.00		1.76	293.00	250.43	273.24	-22.82
SUB292	0.64	0.60	77.00		2.20	123.00	192.19	201.13	-8.94
SUB304	0.72	0.44	82.00		1.39	248.00	344.44	336.22	8.23
SUB306	0.95	0.50	80.00		2.04	224.00	235.79	258.94	-23.15
SUB310	1.16	0.60	77.00		2.45	204.00	175.86	187.16	-11.30
SUB314	1.14	0.67	75.00		3.08	151.00	132.46	104.67	27.78
SUB318	1.50	0.60	77.00		2.11	295.00	196.67	221.22	-24.55
SUB322	1.32	0.67	75.00		2.51	205.00	155.30	156.16	-0.86
SUB328	1.03	0.67	75.00		1.52	233.00	226.21	236.92	-10.70
SUB330	1.14	0.60	77.00		3.41	156.00	136.84	104.52	32.32
SUB338	1.04	0.67	75.00		1.91	199.00	191.35	203.60	-12.26
SUB342	0.50	0.82	71.00		1.75	81.00	162.00	148.55	13.45

SUB346	3.19	0.82	71.00	3.93	277.00	86.83	0.21	86.62
SUB354	1.38	0.50	80.00	3.12	235.00	170.29	303.39	-133.10
SUB356	4.57	0.67	75.00	4.94	420.00	91.90	-89.75	181.66
SUB360	4.87	0.53	79.00	4.12	632.00	129.77	129.81	-0.03
SUB364	5.79	0.63	76.00	5.39	524.00	90.50	-103.26	193.76
SUB368	3.48	0.67	75.00	4.19	363.00	104.31	-17.09	121.40
SUB372	3.77	0.67	75.00	4.60	366.00	97.08	-51.89	148.97
SUB378	2.23	0.67	75.00	3.22	285.00	127.80	74.32	53.48
SUB394	5.28	0.38	84.00	1.09	2337.00	442.61	575.89	-133.27
SUB396	2.25	0.30	87.00	0.52	1801.00	800.44	815.94	-15.50
SUB398	2.07	0.56	78.00	1.42	576.00	278.26	330.50	-52.24
SUB404	1.81	0.60	77.00	3.89	223.00	123.20	111.49	11.72
SUB408	1.34	0.56	78.00	3.82	177.00	132.09	165.85	-33.76
SUB412	5.79	0.50	80.00	1.36	1823.00	314.85	361.79	-46.93
SUB416	5.28	0.47	81.00	1.11	2009.00	380.49	433.37	-52.87
SUB420	2.31	0.56	78.00	1.07	785.00	339.83	352.36	-12.54
SUB424	2.36	0.56	78.00	5.18	245.00	103.81	49.47	54.34
SUB428	1.98	0.50	80.00	1.49	588.00	296.97	413.54	-116.57
SUB432	1.60	0.60	77.00	1.51	404.00	252.50	289.80	-37.30
SUB436	1.11	0.67	75.00	2.60	168.00	151.35	137.92	13.44
SUB440	0.79	0.67	75.00	2.27	132.00	167.09	167.32	-0.23
SUB444	1.26	0.60	77.00	2.74	203.00	161.11	204.86	-43.75
SUB448	1.19	0.60	77.00	2.14	232.00	194.96	250.09	-55.13
SUB452	2.58	0.17	92.00	1.03	1599.00	619.77	1038.49	-418.72
SUB454	1.02	0.27	88.00	0.37	1006.00	986.27	898.27	88.00
SUB458	0.98	0.67	75.00	1.69	205.00	209.18	206.89	2.29
SUB464	1.72	0.60	77.00	2.93	264.00	153.49	183.49	-30.01
SUB470	1.29	0.56	78.00	1.84	296.00	229.46	312.18	-82.73
SUB474	0.86	0.60	77.00	2.16	167.00	194.19	253.93	-59.74
SUB478	0.71	0.60	77.00	2.02	145.00	204.23	266.63	-62.41
SUB482	1.01	0.60	77.00	2.76	162.00	160.40	207.41	-47.02
SUB488	1.58	0.35	85.00	0.40	1357.00	858.86	735.06	123.80
SUB494	0.99	0.60	77.00	1.03	330.00	333.33	334.89	-1.56
SUB500	0.46	0.63	76.00	1.76	99.00	215.22	249.31	-34.10
SUB504	1.08	0.56	78.00	2.71	185.00	171.30	251.62	-80.32
SUB506	0.46	0.60	77.00	3.50	62.00	134.78	161.88	-27.09
SUB520	2.66	0.33	86.00	0.35	2527.00	950.00	771.17	178.83
SUB522	1.02	0.60	77.00	1.06	333.00	326.47	332.20	-5.73
SUB516	0.73	0.56	78.00	1.97	160.00	219.18	311.64	-92.46
SUB528	2.75	0.41	83.00	1.60	887.00	322.55	531.13	-208.58
SUB530	1.86	0.63	76.00	1.59	430.00	231.18	239.28	-8.10
SUB536	0.99	0.53	79.00	1.93	232.00	234.34	353.21	-118.86
SUB540	1.01	0.63	76.00	1.58	235.00	232.67	253.69	-21.02
SUB550	1.42	0.63	76.00	1.51	340.00	239.44	252.24	-12.80
SUB556	1.60	0.53	79.00	2.93	272.00	170.00	269.89	-99.89
SUB570	1.48	0.63	76.00	1.76	317.00	214.19	232.90	-18.71
SUB568	1.23	0.67	75.00	1.83	242.00	196.75	192.58	4.17
SUB574	0.91	0.63	76.00	1.79	193.00	212.09	239.87	-27.78
SUB580	0.58	0.50	80.00	1.24	198.00	341.38	454.45	-113.07
SUB584	0.96	0.63	76.00	0.89	335.00	348.96	305.21	43.75
SUB544	2.21	0.44	82.00	0.79	1116.00	504.98	552.32	-47.34
SUB546	1.22	0.41	83.00	0.52	827.00	677.87	635.13	42.74
SUB588	0.59	0.47	81.00	0.41	427.00	723.73	560.29	163.44
SUB590	0.77	0.35	85.00	0.43	645.00	837.66	745.89	91.77
SUB594	0.69	0.35	85.00	0.44	572.00	828.99	746.44	82.54
SUB598	0.58	0.38	84.00	0.23	621.00	1070.69	714.73	355.96
SUB602	0.69	0.33	86.00	0.28	757.00	1097.10	808.01	289.09
SUB606	0.63	0.35	85.00	0.37	554.00	879.37	752.55	126.81
SUB610	0.79	0.56	78.00	0.99	286.00	362.03	382.70	-20.68
TOTAL	244.34				11849.00	48.49		

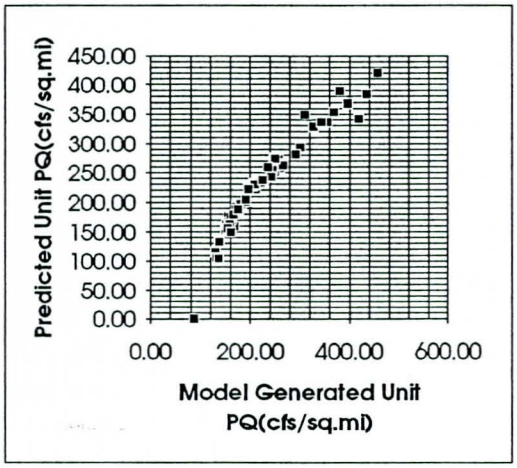
* Baseflow of 600cfs was specified for the sub-basin, all others have zero baseflow

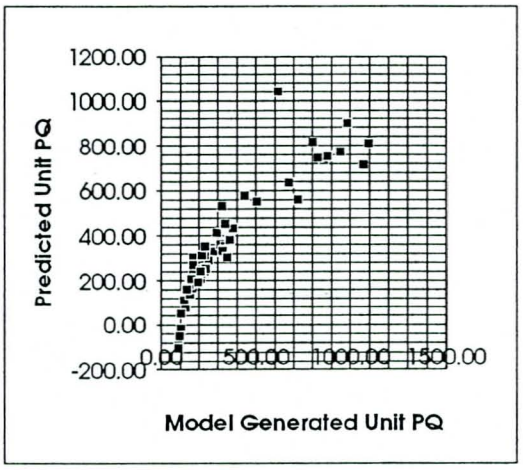
Arith.Mea	1.52	0.56	77.9	2	293
Geom.Me	1.26	0.53	76.6	1.71	246

Harm.Mec	1.05	0.52	70.6	1.44	214
Median	1.15	0.58	77.5	1.8	222

First 58 Sub-b: Est. UPQ = 608.8 + 14.38*DA - 402*STRTL + 0.156*CRVNBR - 85.79*SCSLAG
R-square = 0.924

Remaining : Est. UPQ = -7122.06 - 16.09*DA + 1373.15*STRTL + 87.38*CRVNBR - 73.5*SCSLAG
R-square = 0.825

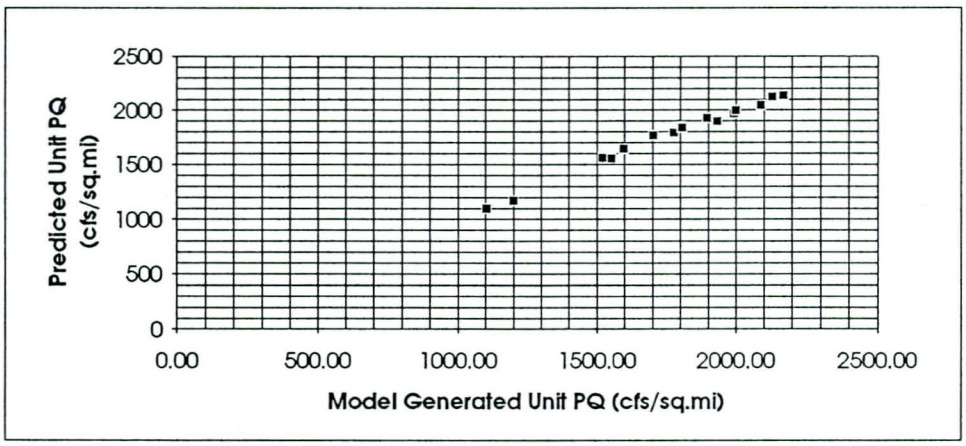




SAN DOMINGO WASH WATERSHED **FCD- SS** **IT=5**
100YR-24HR STORM **JD 4.60 0.01** **IN =15**
SCS DIMENSIONLESS uh **JD 4.37 10.0**

SUB-BAS	DA(sq.mi)	INILOS	CNSLOSS	SCSLAG	RTIMP	PEAK Q	Unit PQ	Est. UPQ	DIFF
SUB1	2.14	0.55	0.05	0.31	0.00	4135.00	1932.24	1895.929	36.31
SUB2	1.03	0.55	0.05	0.27	0.00	2152.00	2089.32	2044.873	44.45
SUB3	1.30	0.55	0.05	0.30	0.00	2590.00	1992.31	1966.285	26.02
SUB4	1.56	0.55	0.05	0.35	0.00	2818.00	1806.41	1846.491	-40.08
SUB5A	1.28	0.55	0.05	0.32	0.00	2426.00	1895.31	1925.668	-30.36
SUB5B	1.10	0.55	0.05	0.40	0.00	1872.00	1701.82	1769.091	-67.27
SUB6	0.82	0.55	0.05	0.30	0.00	1640.00	2000.00	1994.547	5.45
SUB7	0.63	0.55	0.05	0.24	0.00	1367.00	2169.84	2131.116	38.72
SUB8	1.21	0.59	0.11	0.42	0.00	1932.00	1596.69	1644.603	-47.91
SUB9A	2.16	0.55	0.05	0.36	0.00	3836.00	1775.93	1790.266	-14.34
SUB9B	1.35	0.61	0.14	0.44	0.00	2054.00	1521.48	1556.458	-34.98
SUB10	2.36	0.57	0.08	0.45	0.00	3663.00	1552.12	1552.309	-0.19
SUB11	0.41	0.55	0.05	0.25	0.00	874.00	2131.71	2123.173	8.53
SUB12	1.61	0.57	0.09	0.67	0.00	1933.00	1200.62	1167.353	33.27
SUB13	0.73	0.60	0.13	0.34	0.00	1318.00	1805.48	1836.297	-30.82
SUB14	0.59	0.62	0.18	0.71	0.00	652.00	1105.08	1094.48	10.60
TOTAL	20.28					25544.00	1259.57		
Arith.mean	1.27	0.57	0.08	0.38			1767		
Geom.Mea	1.14	0.57	0.07	0.36			1738		
Harm.Mean	1.01	0.57	0.06	0.35			1706		
Median	1.25	0.55	0.05	0.35			1805		

Est. UPQ = 6090.67 - 58.88*DA -6498.22*INILOS +3061.87*CNSLOS - 2089.7*SCSLAG
R-square= 0.988



SAND TANK WASH - SOUTHEAST OF GILA BEND FCD-WSMB

100YR-24HR STORM SCS TYPE II DISTR

JD 4.53 .01 IT=10

JD 4.30 10 IN=15

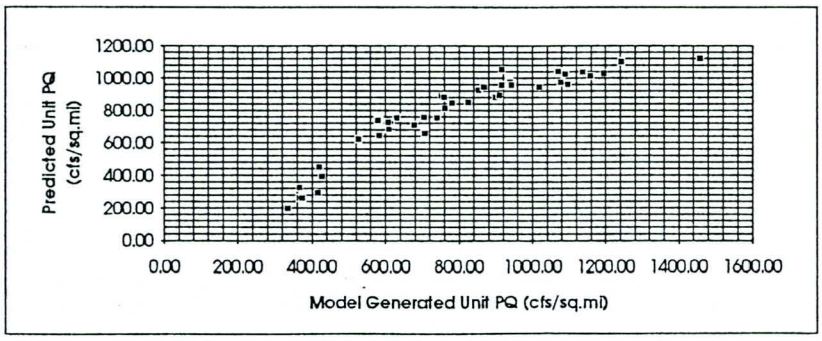
JD 4.00 50 UH = S-Graph

JD 3.85 100

SUB-BASIN	DA(sq.mi)	DTHETA	XKSAT	UIT2PQ	UIPQ	PEAK Q	Unit PQ	Est. UPQ	DIFF
101	1.13	0.29	0.16	1.25	963.00	1240.00	1097.35	962.64	134.70
102	1.75	0.20	0.02	1.00	1443.00	2092.00	1195.43	1031.20	164.23
103	0.75	0.20	0.02	0.75	660.00	933.00	1244.00	1102.28	141.72
104	1.00	0.30	0.17	1.75	603.00	826.00	826.00	850.81	-24.81
105	0.87	0.20	0.02	1.00	590.00	931.00	1070.11	1042.66	27.46
106	1.59	0.32	0.21	1.25	1368.00	1622.00	1020.13	947.67	72.46
107	2.19	0.20	0.02	1.25	1346.00	2071.00	945.66	967.41	-21.75
108	0.94	0.24	0.08	1.25	628.00	881.00	937.23	977.30	-40.06
109	1.40	0.34	0.23	1.00	1434.00	1623.00	1159.29	1013.39	145.90
110	1.16	0.20	0.02	1.00	946.00	1320.00	1137.93	1038.88	99.05
111	1.75	0.32	0.15	1.00	1322.00	1605.00	917.14	1053.92	-136.78
112	4.33	0.28	0.14	2.00	2348.00	3204.00	739.95	752.58	-12.62
115	2.20	0.32	0.21	1.50	1578.00	1980.00	900.00	881.66	18.34
116	1.62	0.20	0.02	1.25	969.00	1530.00	944.44	974.83	-30.39
113	3.31	0.32	0.21	2.25	1571.00	2038.00	615.71	693.03	-77.32
114	2.32	0.20	0.02	1.00	1765.00	2528.00	1089.66	1023.77	65.88
117	3.51	0.26	0.13	1.25	2373.00	2995.00	853.28	923.87	-70.59
118	2.92	0.25	0.10	1.25	1970.00	2533.00	867.47	945.72	-78.26
119	1.89	0.28	0.15	1.50	1352.00	1721.00	910.58	892.09	18.49
120	2.61	0.31	0.22	1.00	2240.00	2811.00	1077.01	973.09	103.92
121	4.65	0.23	0.07	2.00	1972.00	2940.00	632.26	752.21	-119.95
123	2.66	0.30	0.19	1.75	1622.00	2025.00	761.28	812.43	-51.15
122	6.52	0.25	0.11	2.25	3132.00	4610.00	707.06	658.22	48.84
124	7.40	0.26	0.11	2.00	3198.00	4540.00	613.51	715.79	-102.28
125	10.22	0.26	0.11	2.25	3623.00	5391.00	527.50	621.00	-93.51
126	12.59	0.33	0.28	3.25	4207.00	5236.00	415.89	292.25	123.64
127	2.47	0.27	0.13	0.50	3726.00	3603.00	1458.70	1122.56	336.14
128	5.10	0.27	0.13	2.00	2259.00	2977.00	583.73	739.96	-156.23
129	3.73	0.33	0.21	2.00	1968.00	2631.00	705.36	756.59	-51.23
130	2.65	0.35	0.35	3.50	821.00	974.00	367.55	326.93	40.62
201	5.57	0.28	0.14	2.00	2439.00	3236.00	580.97	736.43	-155.46
202	6.77	0.30	0.18	2.00	3591.00	4592.00	678.29	709.22	-30.94
203	2.21	0.25	0.11	1.50	1269.00	1663.00	752.49	888.53	-136.04
204	4.13	0.25	0.09	1.50	2362.00	3141.00	760.53	880.28	-119.75
205	0.90	0.35	0.25	1.25	666.00	826.00	917.78	956.05	-38.27
206	4.19	0.35	0.25	3.25	1306.00	1761.00	420.29	448.73	-28.45
207	5.18	0.35	0.25	4.00	1406.00	1900.00	366.80	261.66	105.13
208	0.91	0.32	0.19	1.25	672.00	856.00	940.66	973.28	-32.62
209	4.94	0.35	0.26	4.25	1260.00	1660.00	336.03	198.35	137.68
210	9.64	0.34	0.29	3.00	3259.00	4112.00	426.56	391.32	35.24
211	9.64	0.35	0.25	3.75	2717.00	3608.00	374.27	261.63	112.64
212	0.82	0.35	0.25	1.25	645.00	774.00	943.90	957.09	-13.19
213	1.78	0.32	0.19	1.75	1099.00	1392.00	782.02	845.84	-63.81
214	1.62	0.35	0.40	2.00	864.00	946.00	583.95	646.80	-62.84
215	0.93	0.34	0.35	2.00	500.00	567.00	609.68	686.71	-77.03
216	1.09	0.33	0.29	2.00	522.00	663.00	608.26	723.93	-115.68
TOTAL	157.55					26182.00	166.18		
Arith.Mean	3.43	0.29	0.17	1.82			791		
Geom.Mean	2.55	0.28	0.13	1.64			744		
Harm.Mean	1.95	0.28	0.08	1.48			694		
Median	2.4	0.3	0.17	1.62			772		

Est. UPQ = 1083.54 - 13.024*DA + 1097.23*DTHETA - 838.011*XKSAT -232.24*UHT2PK

R-square= 0.847



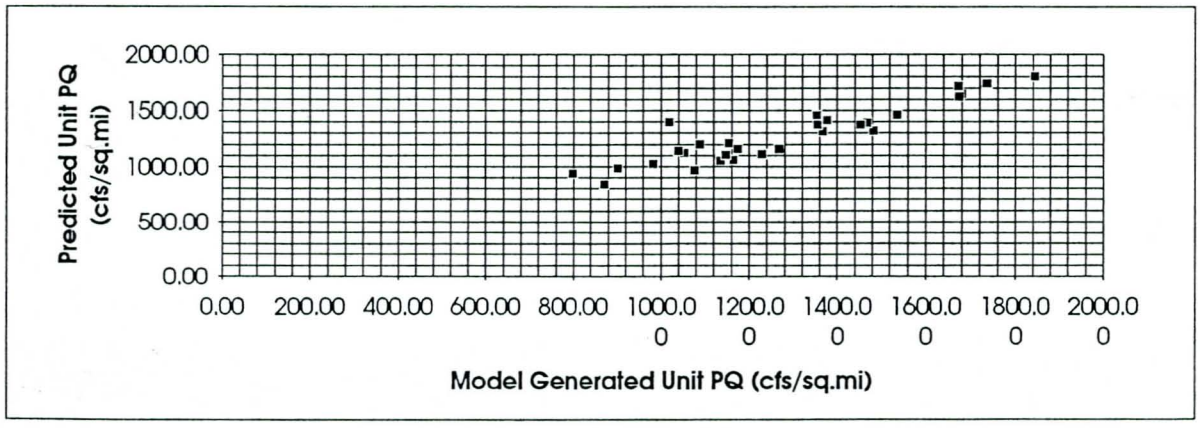
SCATTER WASH WATERSHED - kAMINSKI HUBBARD ENGINEERING (May 1992)

100yr-24 storm **PB = 3.74** **IT = 4**

SCS Type II **IN = 30**

SUB-BAS	DA(sq.mi)	DTHETA	XKSAT	RTIMP	SCSLAG	PEAK Q	UNIT PQ	Est.UPQ	DIFF
310	0.68	0.25	0.07	2.50	0.41	930.00	1367.65	1315.49	52.16
311	0.57	0.33	0.11	6.53	0.46	701.00	1229.82	1109.15	120.68
312	1.35	0.28	0.08	0.00	0.60	1423.00	1054.07	1121.85	-67.77
314	0.85	0.37	0.26	2.78	0.50	836.00	983.53	1023.08	-39.55
315	0.51	0.30	0.09	6.65	0.32	756.00	1482.35	1321.69	160.67
316	0.67	0.37	0.14	0.00	0.45	761.00	1135.82	1052.52	83.30
317	0.71	0.35	0.12	9.37	0.41	900.00	1267.61	1159.38	108.22
318	0.54	0.33	0.11	7.49	0.58	582.00	1077.78	962.56	115.22
319	0.34	0.39	0.20	0.00	0.38	396.00	1164.71	1056.84	107.86
320	1.11	0.35	0.12	7.45	0.50	1273.00	1146.85	1102.27	44.58
321	1.12	0.35	0.35	1.42	0.63	894.00	798.21	936.26	-138.04
322	0.35	0.34	0.35	7.52	0.34	404.00	1154.29	1208.82	-54.53
323	0.11	0.25	0.43	25.12	0.27	149.00	1354.55	1451.79	-97.24
325	0.50	0.33	0.37	7.02	0.43	520.00	1040.00	1137.65	-97.65
326	0.47	0.34	0.43	12.87	0.55	424.00	902.13	983.57	-81.44
327	0.22	0.29	0.31	47.32	0.31	323.00	1468.18	1392.58	75.61
330	0.31	0.27	0.33	36.43	0.35	420.00	1354.84	1370.17	-15.33
331	0.22	0.17	0.08	68.37	0.23	382.00	1736.36	1738.31	-1.95
332	0.09	0.19	0.05	48.74	0.10	166.00	1844.44	1803.12	41.33
333	0.53	0.35	0.20	10.71	0.66	462.00	871.70	836.87	34.83
334	0.66	0.23	0.08	32.97	0.21	1109.00	1680.30	1648.43	31.88
335	0.46	0.22	0.07	14.96	0.33	707.00	1536.96	1458.34	78.61
343	0.32	0.18	0.03	47.01	0.29	536.00	1675.00	1620.04	54.96
344	0.55	0.16	0.02	24.47	0.48	758.00	1378.18	1413.26	-35.07
345	0.30	0.30	0.21	35.40	0.30	436.00	1453.33	1374.22	79.11
346	0.40	0.31	0.21	24.66	0.46	470.00	1175.00	1156.84	18.16
347	1.11	0.33	0.34	20.32	0.47	1208.00	1088.29	1199.50	-111.21
348	0.05	0.31	0.77	21.67	0.22	51.00	1020.00	1393.85	-373.85
349	0.37	0.10	0.01	34.46	0.31	619.00	1672.97	1717.16	-44.19
TOTAL-	15.58					4702.00	301.80		
Arith.Mean	0.53	0.29	0.68	19.46	0.39		1280		
Geom.Mea	0.43	0.28	0.16	0	0.37		1251		
Harm.Mear	0.3	0.26	0.08	0	0.34		1222		
Median	0.5	0.31	0.2	12.87	0.41		1230		

Est..UPQ=2145.11 + 137.38 *DA - 1740.09*DTHETA +4.057*XKSAT +1.977*RTIMP - 1203.03*SCSLAG
R-square= 0.853



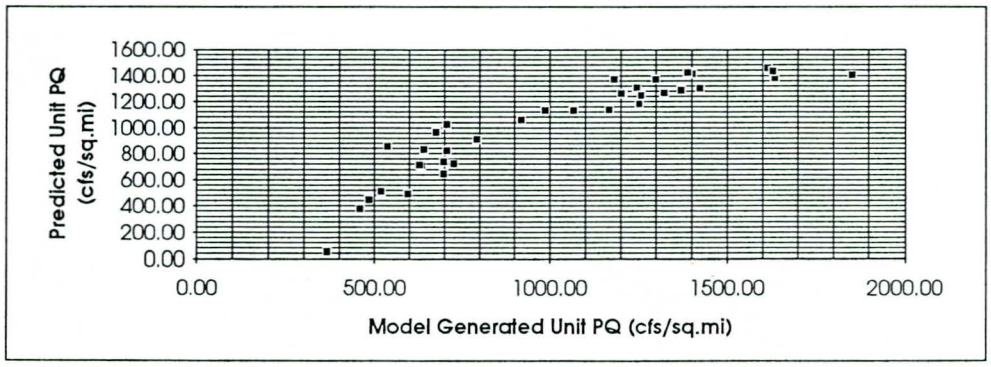
SCOTSDALE ALLUVIAL FAN WATERSHED **IT=5**

100YR-24HR STORM **SCS TYPE IIA DISTR** **IN=30**

PB = 4.33 4.38 4.39 4.32 4.49 4.62 4.61 4.59 4.52 4.78 4.74 4.76 4.73

SUB-BASIN	DA(sq.mi)	DTHETA	XKSAT	RTIMP	UHT2PK	UHPQ	PEAK Q	Unit PQ	Est. UPQ	DIFF
S2040	0.93	0.35	0.45	17.69	3.00	1055.00	1304.00	1402.15	1411.94	-9.79
S2050	0.86	0.35	0.46	15.36	3.50	831.00	1016.00	1181.40	1366.67	-185.27
S2070	1.46	0.35	0.44	20.00	2.50	1980.00	2359.00	1615.75	1455.18	160.57
STRM1-TOT	3.25						4573.00	1407.08		
S39	1.93	0.36	0.24	2.40	9.50	749.00	1239.00	641.97	830.15	-188.18
S40	0.58	0.35	0.37	3.59	3.50	565.00	723.00	1246.55	1301.80	-55.25
S41	0.79	0.35	0.42	5.54	10.00	290.00	425.00	537.97	853.39	-315.41
S42	0.58	0.35	0.29	3.87	4.00	500.00	699.00	1205.17	1258.71	-53.54
S43	1.07	0.35	0.27	2.82	3.50	1067.00	1467.00	1371.03	1285.01	86.02
S44	0.84	0.37	0.22	0.87	6.00	506.00	773.00	920.24	1055.05	-134.81
S45	0.20	0.35	0.39	4.14	2.50	276.00	327.00	1635.00	1379.36	255.64
S45A	0.17	0.35	0.39	1.01	2.00	283.00	315.00	1852.94	1400.14	452.80
S46	0.93	0.35	0.44	20.66	3.00	1025.00	1293.00	1390.32	1424.98	-34.66
S47	0.38	0.35	0.28	4.73	4.00	328.00	457.00	1202.63	1262.55	-59.91
S48	0.04	0.35	0.29	4.14	3.50	39.00	57.00	1425.00	1297.83	127.17
S50	0.36	0.35	0.39	17.46	3.50	355.00	468.00	1300.00	1371.03	-71.03
S2000	0.80	0.35	0.41	15.80	2.50	1082.00	1304.00	1630.00	1434.62	195.38
STRM2-TOT	8.68						5635.00	649.19		
S35N *	0.41	0.35	0.27	5.94	4.00	346.00	543.00	1324.39	1267.08	57.31
S16	1.46	0.37	0.23	0.45	14.50	378.00	708.00	484.93	446.93	38.00
S17	1.19	0.38	0.21	5.18	8.00	543.00	944.00	793.28	911.61	-118.33
S18	1.26	0.38	0.22	7.75	5.00	900.00	1470.00	1166.67	1138.07	28.60
S`15	1.37	0.37	0.20	0.03	20.00	256.00	500.00	364.96	50.76	314.20
S19	0.19	0.35	0.27	1.03	4.00	151.00	239.00	1257.89	1244.59	13.30
S20	0.57	0.38	0.22	8.48	4.50	453.00	714.00	1252.63	1180.01	72.63
S21	3.67	0.35	0.37	2.29	8.00	1568.00	2480.00	675.75	962.55	-286.80
S22	1.39	0.35	0.25	0.93	5.50	909.00	1483.00	1066.91	1130.18	-63.28
S23	0.39	0.38	0.22	0.30	9.00	160.00	276.00	707.69	821.69	-114.00
S24	0.49	0.35	0.42	3.42	7.50	227.00	347.00	708.16	1022.37	-314.21
S25N	0.78	0.38	0.22	2.70	13.50	217.00	405.00	519.23	511.39	7.84
S25S	0.63	0.36	0.24	4.43	5.50	364.00	622.00	987.30	1129.81	-142.51
STRM4-TOT	13.38						7285.00	544.47		
1380	0.93	0.35	0.28	2.52	12.50	322.00	650.00	698.92	645.08	53.84
S139N	0.56	0.35	0.44	4.08	12.00	204.00	355.00	633.93	707.34	-73.42
1390S	0.43	0.35	0.36	4.97	11.50	165.00	300.00	697.67	738.84	-41.17
1430	1.43	0.35	0.48	2.01	16.50	380.00	657.00	459.44	378.16	81.28
1440	1.89	0.35	0.28	0.88	14.50	568.00	1126.00	595.77	490.98	104.79
1470	0.30	0.34	0.24	0.00	11.50	108.00	218.00	726.67	721.56	5.11
S1475	1.69	0.35	0.46	5.30	12.00	611.00	1064.00	629.59	710.63	-81.04
STRM56-TOT	7.23						3784.00	523.37		
Arith.Mean	3.09	0.36	0.32	5.03	7.39		1009			
Geom.Mean	0.78	0.36	0.31	0	6.05		927			
Harm.Mean	0.43	0.36	0.29		5.01		846			
Median	0.83	0.35	0.29	3.98	5.5		1027			

Est. UPQ = 2164.87 - 4.196*DA - 1913.514*DTHETA +110.67*XKSAT +4.77*RTIMP - 71.13*UHT2PK
R-square = 0.849



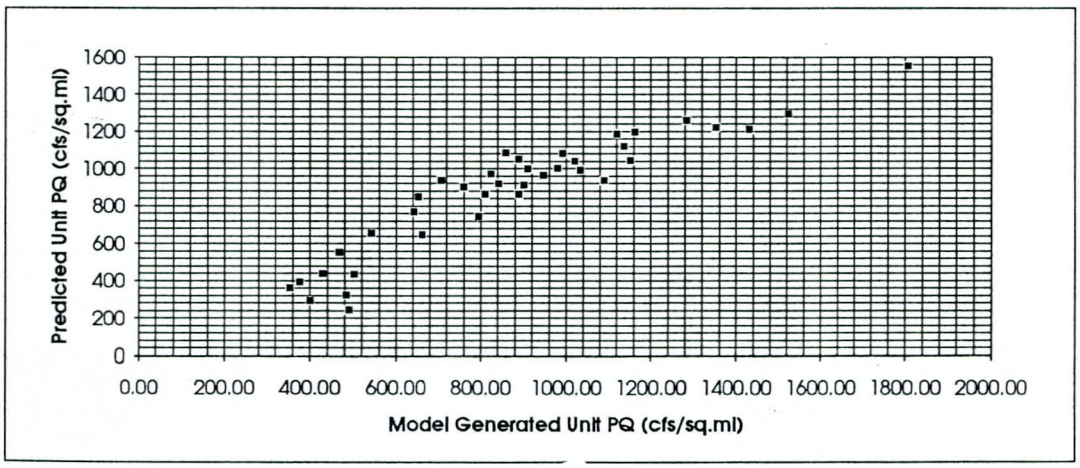
SKUNKCRK.XLD

SKUNK CREEK WATERSHED (between ACDC and CAP)
100yr-24hr storm
SCS TYPE II

Coo & Van Loo

SUB-BAS	DA(SQ.MI)	DTHETA	XKSAT	RTIMP	TC	STOR.K	PEAK Q	Unit PQ	Est. UPQ	DIFF
5S	1.33	0.27	0.16	4.00	0.52	0.16	1906.00	1430.93	1207.527	223.40
20S	1.38	0.29	0.17	0.00	0.75	0.35	1408.00	1021.03	1038.415	-17.38
35S	1.51	0.31	0.23	0.00	0.87	0.45	1275.00	842.14	916.7028	-74.56
40S	0.55	0.26	0.12	6.00	0.52	0.25	737.00	1352.29	1217.713	134.58
55S	0.59	0.32	0.29	0.00	0.77	0.60	416.00	707.48	932.7442	-225.26
60S	1.20	0.27	0.15	8.00	0.93	0.49	1084.00	901.83	908.2719	-6.44
90S	1.23	0.32	0.35	1.00	1.10	0.73	666.00	542.79	654.2016	-111.41
95S	0.97	0.27	0.15	5.00	0.85	0.46	916.00	946.28	962.1603	-15.88
140S	1.23	0.33	0.43	1.00	1.38	1.07	466.00	377.94	390.1565	-12.22
145S	0.38	0.31	0.27	0.00	0.58	0.35	380.00	992.17	1080.248	-88.08
175S	0.30	0.29	0.19	75.00	0.68	0.77	257.00	859.53	1082.481	-222.95
195S	0.40	0.31	0.31	80.00	0.53	0.45	454.00	1137.84	1117.858	19.99
235S	0.06	0.31	0.02	74.00	0.23	0.17	112.00	1806.45	1552.441	254.01
250S	1.10	0.32	0.26	26.00	1.08	0.53	878.00	796.01	744.3485	51.66
255S	0.62	0.32	0.23	10.00	1.50	1.23	265.00	430.89	438.1184	-7.22
280S	0.74	0.33	0.32	13.00	0.80	0.52	566.00	760.75	900.943	-140.19
295S	0.35	0.34	0.33	11.00	1.67	1.04	173.00	491.48	241.2904	250.19
325S	0.65	0.34	0.44	9.00	1.50	1.13	261.00	401.54	289.8508	111.69
340S	0.09	0.35	0.66	13.00	0.33	0.25	89.00	1034.88	991.3095	43.57
350S	0.26	0.32	0.25	23.00	0.33	0.13	401.00	1524.71	1293.484	231.23
375S	0.98	0.33	0.38	18.00	0.80	0.38	875.00	889.23	862.119	27.11
380S	1.41	0.33	0.43	8.00	1.48	0.79	681.00	484.70	321.6395	163.06
390S	0.80	0.34	0.34	23.00	0.75	0.28	872.00	1091.36	933.2455	158.12
405S	1.78	0.33	0.28	20.00	1.50	1.03	894.00	503.38	432.3144	71.06
425S	1.72	0.30	0.16	39.00	1.45	1.37	807.00	468.37	550.8316	-82.46
440S	0.85	0.30	0.06	20.00	0.67	0.42	948.00	1120.57	1183.758	-63.19
465S	1.36	0.31	0.10	57.00	0.92	0.59	1238.00	909.63	996.5147	-86.89
475S	0.59	0.31	0.03	18.00	0.60	0.37	758.00	1284.75	1258.16	26.59
490S	1.12	0.29	0.09	26.00	1.20	0.89	716.00	642.15	768.0651	-125.91
515S	0.48	0.34	0.28	32.00	0.92	0.82	311.00	653.36	848.9461	-195.58
545S	0.30	0.33	0.46	15.00	0.70	0.46	240.00	810.81	861.2904	-50.48
560S	0.19	0.35	0.28	21.00	0.45	0.33	221.00	1163.16	1194.921	-31.76
580S	0.91	0.34	0.33	25.00	0.62	0.26	1054.00	1153.17	1040.815	112.36
595S	0.30	0.34	0.42	13.00	1.42	1.49	107.00	354.30	359.2912	-4.99
600S	1.03	0.25	0.38	8.00	1.03	0.58	679.00	661.15	645.3175	15.83
610S	0.69	0.27	0.18	19.00	0.77	0.42	676.00	979.71	998.8816	-19.17
630S	0.34	0.32	0.26	19.00	0.65	0.49	299.00	889.88	1047.183	-157.30
650S	0.13	0.35	0.49	4.00	0.53	0.40	103.00	824.00	968.3616	-144.36
TOTAL	**23.78**						6722.00	282.67		
Arith.Mean	0.79	0.31	0.27	19.58	0.88			875		
Geom.Mean	0.61	0.31	0.23	0	0.8			810		
Harm.Mean	0.4	0.31	0.15 o		0.71			744		
Median	0.72	0.32	0.28	14	0.79			874		

Est. UPQ = 1545.82 + 19.82*DA + 529.15*DTHETA - 757.93*XKSAT +0.379*RTIMP - 745.79*TC
R-square= 0.858

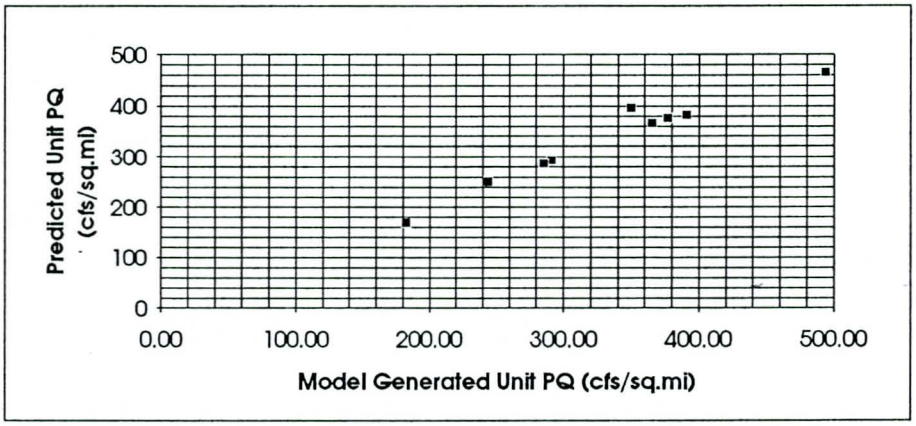


TIGER WASH

100YR-24HR STORM PB = 3.45 PB=3.49 for 3,5,6 IT=10
SCS Type II Distr Over entire watershed IN=30

SUB-BASIN	DA(sq.mi)	DTHETA	XKSAT	RTIMP	UHT2PK	UHPQ	PEAK Q	Unit PQ	Est. UPQ	DIFF
SUB1	21.30	0.31	0.19	1.70	6.50	6608.00	6202.00	291.17	292.151	-0.98
SUB2	14.18	0.36	0.51	14.00	5.50	4652.00	3467.00	244.50	251.0736	-6.57
SUB3	18.76	0.15	0.13	8.60	5.50	6154.00	6565.00	349.95	395.3796	-45.43
SUB4	10.94	0.36	0.55	15.40	4.50	4306.00	3125.00	285.65	286.1429	-0.49
SUB5	19.92	0.08	0.09	15.00	5.50	6285.00	7785.00	390.81	382.1352	8.68
SUB6	11.31	0.12	0.11	11.60	4.00	4736.00	5585.00	493.81	464.3954	29.42
SUB8	8.04	0.34	0.30	2.30	5.50	3581.00	3031.00	376.99	375.2582	1.73
SUB7	20.73	0.25	0.15	4.10	4.50	7146.00	7575.00	365.41	365.4072	0.01
SUB9	34.61	0.36	0.37	0.00	9.00	8203.00	6311.00	182.35	169.1526	13.19
TOTAL	159.08						32645.00	205.21		
Arith.Mean	17.75	0.26	0.27	8.08	5.61			331		
Geom.Mea	16.29	0.23	0.22	0	5.46			319		
Harm.Mean	14094	0.2	0.18	?	5.33			307		
Median	18.76	0.31	0.19	8.6	5.5			350		

Est. UPQ = 820.47 - 5.35*DA - 911.77*DTHETA + 199.32*XKSAT - 9.83*RTIMP - 23.53*UHT2PK
R-square= 0.95



UPCAVECR.XLD

UPPER CAVE CREEK WATERSHED **CH2M HILL FDS - MARCH 1990**

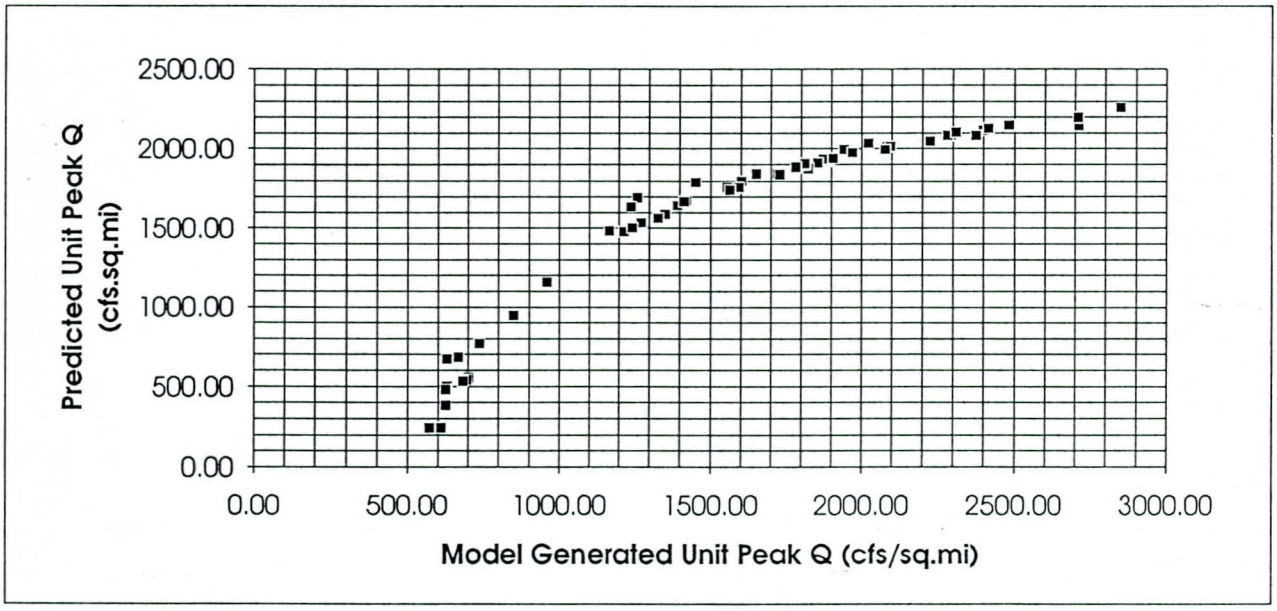
100YR-24HR STORM **PB=4.25** **AREA RED. = 85%** **IT=5**

SCS Type II DISTR **IN=15**

SUB-BASIN	DA(sq.mi)	IA	CNSLOSS	RTIMP	SCSLAG	PEAK Q	Unit PQ	Est. UPQ	DIFF
A1	15.75	0.88	0.13	0.00	1.42	9918.00	629.71	671.51	-41.79
A2	10.69	0.65	0.13	0.00	1.61	6123.00	572.78	243.35	329.43
A3	4.75	0.65	0.13	0.00	1.49	2896.00	609.68	242.25	367.43
A4	10.47	0.65	0.13	0.00	1.43	6597.00	630.09	499.97	130.12
A5	3.43	0.65	0.13	0.00	1.25	2405.00	701.17	553.89	147.28
A6	3.50	0.65	0.13	0.00	1.26	2437.00	696.29	541.35	154.94
A7	11.62	0.65	0.13	0.00	1.33	7758.00	667.64	680.34	-12.70
E1	0.51	0.75	0.14	0.00	0.25	964.00	1890.20	1922.00	-31.81
B3	1.33	0.75	0.08	0.00	0.82	1276.00	959.40	1155.44	-196.05
B2	0.31	0.75	0.08	0.00	0.19	690.00	2225.81	2046.16	179.64
B4	0.56	0.75	0.08	0.00	0.22	1167.00	2083.93	2009.74	74.19
B1	6.11	0.75	0.08	0.00	0.55	7708.00	1261.54	1692.23	-430.70
B5	0.49	0.75	0.08	0.00	0.22	1021.00	2083.67	2007.65	76.02
B6	0.82	0.75	0.08	0.00	0.37	1315.00	1603.66	1798.17	-194.51
B7	0.44	0.75	0.09	0.00	0.27	831.00	1888.64	1929.54	-40.90
E2	0.50	0.65	0.06	0.00	0.28	937.00	1874.00	1934.36	-60.36
E3	0.42	0.65	0.06	0.00	0.59	511.00	1216.67	1478.78	-262.11
E4	2.05	0.65	0.09	0.00	0.23	4147.00	2022.93	2032.33	-9.41
E5	0.19	0.65	0.08	0.00	0.14	456.00	2400.00	2115.70	284.30
E6A	1.00	0.65	0.06	0.00	0.25	1942.00	1942.00	1993.08	-51.08
E6	0.19	0.65	0.06	0.00	0.17	436.00	2294.74	2085.97	208.77
E7	0.37	0.65	0.08	0.00	0.29	678.00	1832.43	1901.75	-69.32
E8	0.36	0.65	0.09	0.00	0.28	668.00	1855.56	1909.01	-53.45
E10	2.16	0.65	0.09	0.00	0.61	2525.00	1168.98	1480.06	-311.08
E9	0.42	0.65	0.08	0.00	0.39	654.00	1557.14	1757.04	-199.90
E11	0.47	0.65	0.14	0.00	0.28	857.00	1823.40	1876.96	-53.55
E12	0.43	0.65	0.07	0.00	0.46	609.00	1416.28	1662.07	-245.79
D1	0.56	0.65	0.09	0.00	0.24	1103.00	1969.64	1973.43	-3.79
D2	0.32	0.65	0.09	0.00	0.26	610.00	1906.25	1937.06	-30.81
F2C	0.53	0.65	0.06	0.00	0.30	962.00	1815.09	1906.02	-90.92
F2D	0.23	0.65	0.10	0.00	0.53	293.00	1273.91	1532.59	-258.68
F2F	0.17	0.65	0.06	0.00	0.22	356.00	2094.12	2012.27	81.84
F2A	0.29	0.65	0.06	0.00	0.30	526.00	1813.79	1898.88	-85.09
F2B	0.43	0.65	0.06	0.00	0.30	780.00	1813.95	1903.04	-89.09
F2E	0.23	0.65	0.06	0.00	0.31	410.00	1782.61	1882.48	-99.87
F2	0.33	0.65	0.10	0.00	0.32	569.00	1724.24	1846.11	-121.86
F1	1.65	0.65	0.08	0.00	0.97	1404.00	850.91	945.66	-94.75
F3	0.89	0.65	0.14	0.00	1.21	608.00	683.15	529.81	153.33
F4	0.16	0.65	0.15	0.00	0.35	255.00	1593.75	1758.34	-164.59
E13	0.04	0.65	0.06	0.00	0.05	114.00	2850.00	2256.94	593.06
E14	0.86	0.65	0.06	0.00	0.35	1423.00	1652.73	1842.76	-190.03
G2A	0.61	0.65	0.14	0.00	0.31	1055.00	1729.51	1837.26	-107.75
G2B	0.15	0.65	0.14	0.00	0.47	203.00	1353.33	1589.67	-236.34
G1	0.61	0.65	0.08	0.00	0.17	1393.00	2283.61	2084.32	199.29
G2	1.17	0.65	0.14	0.00	0.43	1662.00	1420.51	1678.47	-257.95
G3	0.85	0.65	0.23	0.00	0.50	1057.00	1243.53	1503.04	-259.51
I1	4.98	0.65	0.07	0.00	0.57	6177.00	1240.36	1636.48	-396.11

I2	0.62	0.65	0.08	0.00	0.47	864.00	1393.55	1646.03	-252.48
I3	1.07	0.65	0.15	0.00	0.43	1513.00	1414.02	1668.43	-254.41
H1E	0.13	0.65	0.06	0.00	0.13	323.00	2484.62	2142.66	341.95
H1F	0.12	0.65	0.06	0.00	0.14	290.00	2416.67	2127.74	288.92
H1	0.24	0.65	0.06	0.00	0.13	596.00	2483.33	2145.93	337.40
H1C	0.25	0.65	0.06	0.00	0.16	578.00	2312.00	2102.37	209.63
H1D	0.09	0.65	0.12	0.00	0.14	214.00	2377.78	2084.47	293.31
H1A	3.48	0.65	0.06	0.00	0.44	5057.00	1453.16	1789.02	-335.85
H1B	0.32	0.65	0.09	0.00	0.22	665.00	2078.13	1995.54	82.59
H	0.68	0.65	0.23	0.00	1.00	502.00	738.24	767.00	-28.77
H2	0.21	0.65	0.16	0.00	0.48	279.00	1328.57	1562.71	-234.14
H3	0.35	0.65	0.14	0.00	0.37	548.00	1565.71	1741.81	-176.10
I5	4.98	0.65	0.16	0.00	1.32	3113.00	625.10	476.42	148.68
I6	1.82	0.65	0.16	0.00	1.32	1138.00	625.27	382.51	242.77
I9	0.26	0.65	0.19	0.00	0.07	705.00	2711.54	2142.40	569.14
E15	0.21	0.65	0.07	0.00	0.09	569.00	2709.52	2196.45	513.07
72-TOTAL	109.23					40643.00	372.09		
Arith.Mean	1.73		0.1		0.5		1615		
Geom.Mean	0.67		0.09		0.37		1478		
Harm.Mean	0.35		0.09		0.27		1323		
Median	0.5		0.09		0.32		1724		

Est. UPQ = 2371.24 + 29.72*DA - 706.46*CNSLOSS - 1461.96*SCSLAG
R-square= 0.85



GRASSW.XLD

UPPER CENTENNIAL WASH (GRASS WASH) URS, 1990

100yr - 24 hr storm with SCS type Distr

JD = 4.05 .1

JD =3.85 10 RTIMP=0 or 1

JD = 3.73 20 SCSLag(hrs)

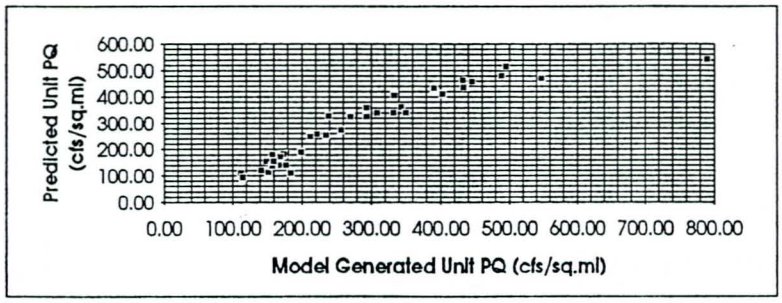
JD = 3.65 30

JD = 3.48 70

SUB-BASIN	DA(SQ.MI)	DTHETA	XKSAT	SCSLAG	PEAK Q	Unit PQ	Est. UPQ	DIFF
Sub1	3.48	0.27	0.20	1.05	1701.00	489.36	479.80	9.55
Sub2A	5.21	0.33	0.32	1.07	2267.00	435.04	436.33	-1.29
Sub2B	6.98	0.30	0.24	2.20	1645.00	235.57	253.34	-17.77
Sub3	3.63	0.29	0.20	1.63	1205.00	332.23	340.39	-8.16
Sub4	4.59	0.29	0.21	2.07	1180.00	257.36	272.24	-14.88
Sub5A	2.01	0.35	0.40	0.49	1591.00	790.36	540.97	249.40
Sub5B	5.44	0.32	0.28	1.60	1681.00	309.18	339.81	-30.63
Sub6	8.57	0.27	0.22	3.08	1454.00	169.62	150.51	19.11
Sub7A	2.25	0.32	0.29	0.85	1231.00	547.84	469.73	78.11
Sub7B	4.95	0.32	0.33	1.39	1649.00	333.33	406.25	-72.92
Sub8	2.13	0.31	0.31	1.08	923.00	432.52	461.73	-29.21
Sub9	5.34	0.32	0.31	1.79	1449.00	271.40	325.33	-53.93
Sub10	6.34	0.24	0.14	3.34	1168.00	184.17	110.45	73.72
sub11	3.12	0.30	0.25	1.14	1352.00	433.06	435.65	-2.60
Sub12	2.59	0.32	0.29	1.20	1046.00	403.24	409.79	-6.55
Sub13	3.92	0.22	0.09	1.91	1349.00	344.04	361.66	-17.61
Sub100	58.27	0.35	0.40	3.61	6549.00	112.39	109.25	3.14
Sub101	9.37	0.32	0.28	2.52	1868.00	199.44	188.07	11.37
Sub102	5.25	0.32	0.28	1.69	1544.00	294.15	323.86	-29.71
Sub103	13.66	0.32	0.29	2.88	2322.00	170.02	140.22	29.80
Sub104	28.20	0.32	0.31	3.23	3993.00	141.62	120.08	21.54
Sub105	19.80	0.31	0.27	2.73	3525.00	178.08	185.27	-7.19
Sub106	5.75	0.35	0.40	1.15	2247.00	391.05	433.88	-42.83
Sub107	10.92	0.35	0.38	1.57	3206.00	293.62	358.72	-65.11
Sub108	2.69	0.28	0.26	0.95	1331.00	495.72	513.18	-17.47
Sub109	49.05	0.35	0.39	3.57	5682.00	115.85	92.17	23.67
Sub110	18.84	0.34	0.39	2.84	2979.00	158.14	179.92	-21.78
Sub111	2.41	0.34	0.38	1.02	1073.00	445.97	457.17	-11.20
Sub112	15.40	0.28	0.23	2.90	2674.00	173.65	181.43	-7.78
Sub200	4.24	0.28	0.16	1.61	1486.00	350.22	339.86	10.37
Sub201	14.68	0.34	0.38	1.91	3505.00	238.84	326.73	-87.89
Sub202	14.98	0.34	0.35	3.04	2288.00	152.72	113.03	39.69
Sub203	11.41	0.31	0.26	2.87	2026.00	177.53	138.64	38.89
Sub204	12.76	0.29	0.26	2.92	2158.00	169.12	171.85	-2.73
Sub205	25.65	0.33	0.34	3.00	3825.00	149.15	153.96	-4.81
Sub206	8.83	0.32	0.30	2.18	1966.00	222.62	258.33	-35.70
Sub207	7.49	0.32	0.30	2.22	1592.00	212.61	248.81	-36.20
Sub208	12.62	0.34	0.37	2.74	2143.00	169.86	172.82	-2.96
Sub209	11.82	0.34	0.38	2.97	1871.00	158.24	137.67	20.57
Sub210	16.93	0.35	0.39	2.85	2701.00	159.54	154.87	4.67
TOTAL	451.53				21730.00	48.13		
Arith.Mean	11.29	0.31	0.29	2.12		282		
Geom.Mear	7.75	0.31	0.28	1.91		252		
Harm.Mean	5.68	0.31	0.27	1.69		227		
Median	7.24	0.31	0.3	2.13		237		

Est. UPQ = 1060.96 + 1.93*DA - 1963.31*DTHETA +620.44*XKSAT - 173.17*SCSLAG

R-square= 0.867



WAGNER.XLD

WAGNER WASH WATERSHED **FCD** **Jun-90** **IT = 3**
100YR-6HR STORM **IN = 15**
JD 3.28 0.5 **JD 3.21 2.8** **JD 3.02 16** **JD 2.66 90**
AREAL RED. BASED ON MCUHP1

SUB-BASIN	DA(sq.mi)	INILOS	CNSLOSS	TC	STOR.K	PEAK Q	Unit PQ	Est. UPQ	DIFF
SUBPa	0.82	0.77	0.16			1073.00	1308.54		
SUBPb	0.99	0.77	0.16			1170.00	1181.82		
SUBPc	1.90	0.77	0.16			1652.00	869.47		
SUBQa	1.00	0.79	0.20			1121.00	1121.00		
Qb	1.50	0.79	0.20			1570.00	1046.67		
SUBQc	0.80	0.79	0.20			815.00	1018.75		
SUBRa	1.40	0.79	0.20			1382.00	987.14		
SUBRb	2.20	0.79	0.20			2025.00	920.45		
SUBA	0.22	0.84	0.29			256.00	1163.64		
SUBA1	1.06	0.81	0.25			1055.00	995.28		
SUBB1	1.25	0.80	0.25			1322.00	1057.60		
SUBC1	0.85	0.81	0.25			1072.00	1261.18		
SUBD1	0.34	0.80	0.35			325.00	955.88		
SUBG1	0.19	0.80	0.28			183.00	963.16		
SUBS	0.55	0.78	0.20			751.00	1365.45		
SUBH1	0.25	0.81	0.26			473.00	1892.00		
SUBI1	0.18	0.81	0.26			211.00	1172.22		
SUBT	0.49	0.79	0.21			678.00	1383.67		
SUBB	0.07	0.82	0.26			108.00	1542.86		
SUBCU	0.51	0.64	0.10	0.37	0.29	1138.00	2231.37	3262.55	-1031.18
SUBC	0.53	0.83	0.26	0.63	0.57	692.00	1305.66	1785.30	-479.64
SUBD	0.27	0.82	0.27	0.67	0.70	336.00	1244.44	1490.06	-245.61
SUBE	0.11	0.80	0.24	0.68	0.99	120.00	1090.91	1306.13	-215.22
SUBF	0.06	0.79	0.22	0.40	0.44	138.00	2300.00	2742.29	-442.29
SUBG	0.04	0.81	0.25	0.32	0.36	114.00	2850.00	3172.07	-322.07
SUBH	0.02	0.81	0.25	0.37	0.59	43.00	2150.00	2899.71	-749.71
SUBIUa	0.98	0.78	0.16	0.78	0.16	1112.00	1134.69	1220.82	-86.12
SUBIUb	0.57	0.78	0.16	0.38	0.19	1424.00	2498.25	3055.70	-557.45
SUBI	0.85	0.79	0.19	0.67	0.56	1064.00	1251.76	1761.20	-509.44
SUBJ	0.26	0.81	0.25	0.72	0.79	298.00	1146.15	1212.10	-65.95
SUBK	0.12	0.81	0.25	0.77	1.21	108.00	900.00	870.64	29.36
SUBL	1.36	0.80	0.22	0.87	0.83	1190.00	875.00	1037.37	-162.37
SUBU1	0.39	0.77	0.18			591.00	1515.38		
SUBU	0.03	0.77	0.15	0.40	0.32	95.00	3166.67	2659.06	507.61
SUBVI	0.45	0.79	0.21	0.90	0.66	526.00	1168.89	344.16	824.73
SUBV	0.11	0.79	0.22	0.55	0.45	220.00	2000.00	1988.58	11.42
SUBM	1.56	0.79	0.24	0.98	0.93	1227.00	786.54	593.70	192.84
SUBW1	0.04	0.81	0.25	0.40	0.50	88.00	2200.00	2739.08	-539.08
SUBW	0.10	0.82	0.26	0.67	0.67	145.00	1450.00	1377.74	72.26
SUBX1	0.04	0.81	0.25	0.35	0.43	99.00	2475.00	2999.91	-524.91
SUBX	0.08	0.82	0.26	0.72	0.79	105.00	1312.50	1105.39	207.11
SUBN	0.89	0.78	0.22			972.00	1092.13		
SUBY1	0.35	0.80	0.23			510.00	1457.14		
SUBY	0.15	0.80	0.22	0.77	0.84	176.00	1173.33	862.15	311.19
SUBOU	0.84	0.77	0.13	0.42	0.28	1640.00	1952.38	3008.07	-1055.69
SUBO	1.61	0.78	0.19	1.08	0.95	1261.00	783.23	46.24	736.99
SUBZ1	0.08	0.81	0.25	0.57	0.55	143.00	1787.50	1890.94	-103.44
SUBZ	0.16	0.81	0.25	0.68	0.67	221.00	1381.25	1331.88	49.37
SUB31	1.29	0.75	0.12	0.87	0.93	1121.00	868.99	940.24	-71.25
SUB30	0.01	0.81	0.32	0.15	0.11	65.00	6500.00	4126.84	2373.16
SUB29	0.01	0.81	0.32	0.38	0.91	16.00	1600.00	2911.35	-1311.35
SUB28	0.01	0.81	0.32	0.18	0.18	53.00	5300.00	3954.69	1345.31
SUB26	0.08	0.81	0.32	0.48	0.58	139.00	1737.50	2430.00	-692.50
SUB25	0.06	0.81	0.32	0.48	0.57	109.00	1816.67	2418.48	-601.82
SUB24	0.03	0.81	0.32	0.30	0.29	101.00	3366.67	3355.85	10.81
SUB23	1.23	0.72	0.08	0.88	0.93	1097.00	891.87	816.95	74.92
SUB21	0.02	0.71	0.05	0.57	0.55	44.00	2200.00	1742.76	457.24

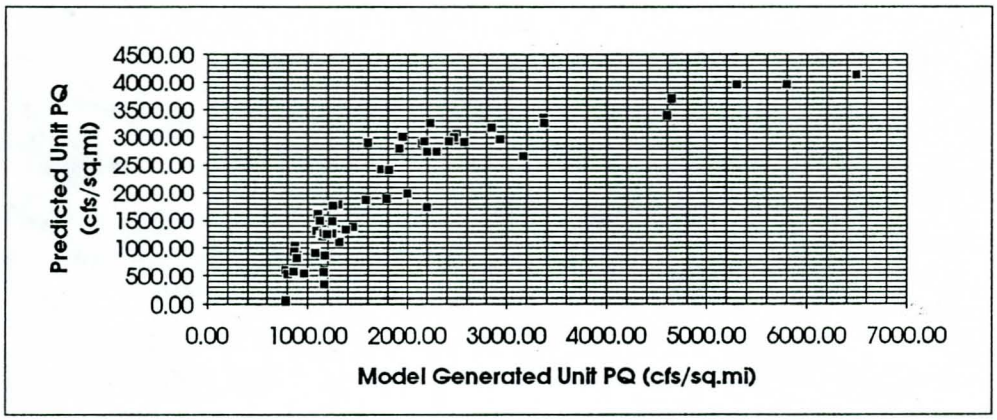
WAGNER.XLD

SUB20	0.03	0.71	0.05	0.33	0.39	88.00	2933.33	2969.22	-35.89
SUB19	0.66	0.71	0.05			872.00	1321.21		
SUB18	0.02	0.71	0.05	0.25	0.20	92.00	4600.00	3396.45	1203.55
SUB16U	1.08	0.81	0.25			1158.00	1072.22		
SUB16	0.27	0.75	0.19	0.42	0.42	517.00	1914.81	2801.15	-886.34
SUB14	0.01	0.81	0.32	0.18	0.14	58.00	5800.00	3954.69	1845.31
SUB13	0.04	0.81	0.32	0.38	0.50	87.00	2175.00	2928.63	-753.63
SUB11	0.05	0.81	0.32	0.38	0.42	121.00	2420.00	2934.39	-514.39
SUB10	0.14	0.74	0.13	0.37	0.32	361.00	2578.57	2918.11	-339.54
SUB9	0.02	0.81	0.32	0.23	0.18	93.00	4650.00	3699.61	950.39
SUB7	0.62	0.77	0.19	0.88	0.85	600.00	967.74	536.85	430.89
SUB6	0.95	0.74	0.14	0.92	1.08	764.00	804.21	529.87	274.35
SUB5	0.04	0.81	0.25	0.30	0.27	135.00	3375.00	3260.75	114.25
SUB3	0.18	0.81	0.25	0.58	0.56	285.00	1583.33	1865.06	-281.73
SUB2	0.06	0.81	0.25	0.62	1.07	66.00	1100.00	1618.58	-518.58
SUB1	0.54	0.79	0.22			610.00	1129.63		
SUB4	1.32	0.80	0.24			1158.00	877.27		
SUB8	0.78	0.82	0.29	0.90	0.55	909.00	1165.38	597.12	568.26
SUB12	0.34	0.82	0.32	0.73	0.64	423.00	1244.12	1258.12	-14.00
SUB15	0.12	0.81	0.32	0.67	0.91	135.00	1125.00	1493.17	-368.17
SUB17	0.69	0.71	0.05	0.87	0.70	801.00	1160.87	563.64	597.23
SUB22	0.23	0.80	0.29	0.85	1.12	199.00	865.22	576.10	289.11
SUB27	0.34	0.81	0.32	0.73	0.71	395.00	1161.76	1275.58	-113.81
SUB32	0.32	0.81	0.26	0.78	0.80	345.00	1078.13	916.77	161.36
SUB33	1.36	0.80	0.24			996.00	732.35		
SUB34	0.50	0.74	0.28	0.77	0.66	596.00	1192.00	1254.92	-62.92
TOTAL	42.07					15747.00	374.30		

NOTE: CLARK UNIT HYDROGRAPH PLUS S-GRAPH W/ AREA REDUCTION FACTOR
FOR SUB-BASINS WITH TC & STOR.K, THE MEANS ARE AS FOLLOWS:

Arith.Mean	0.35	0.79	0.23	0.58	1978
Geom.Mec	0.14	0.78	0.21	0.53	1686
Harm.Mear	0.05	0.79	0.18	0.47	1484
Median	0.13	0.81	0.25	0.61	1517

The regression equation for the Sub-basins with Tc:
Est. UPQ = 5856.51 + 575.94*DA - 1745.72*INILOS + 1440.93*CNSLOS - 5216.67*TC
R-square= 0.723

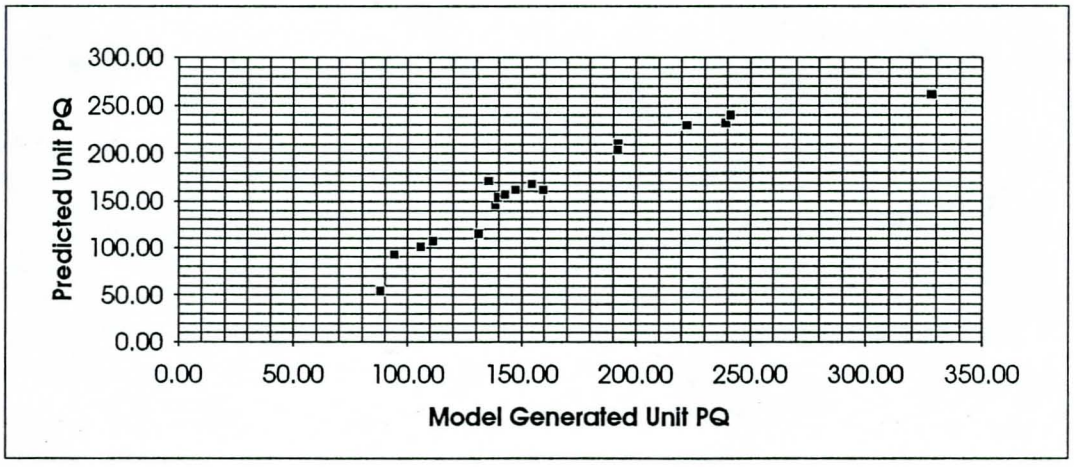


WATERMAN.XLD

WATERMAN WASH WATERSHED

100YR-24HR STORM **PB=3.98** **IT=30**

SCS TYpe II Distr **Rtimp=0** **IN=15**

SUB-BASIN	DA(sq.mi)	IA	CRVNO	RTIMP	SCSLAG	Peak Q	Unit PQ	Est. UPQ	DIFF
Sub1	34.01	0.00	79.00	0.00	8.56	2999.00	88.18	53.93	34.25
Sub2	11.50	0.00	79.00	0.00	2.20	2749.00	239.04	231.83	7.22
Sub3	14.30	0.00	79.80	0.00	3.18	2752.00	192.45	209.97	-17.52
Sub4	29.15	0.00	79.80	0.00	4.95	4040.00	138.59	146.02	-7.42
Sub5	12.32	0.00	78.00	0.00	4.60	1671.00	135.63	172.07	-36.43
Sub6	30.35	0.00	78.00	0.00	3.69	4850.00	159.80	161.78	-1.97
Sub7	4.95	0.00	79.00	0.00	1.35	1625.00	328.28	261.56	66.72
Sub8	23.13	0.00	78.00	0.00	7.40	2186.00	94.51	92.23	2.28
Sub9	18.29	0.00	80.50	0.00	3.35	3511.00	191.96	203.39	-11.43
Sub10	42.46	0.00	79.80	0.00	5.31	5572.00	131.23	115.70	15.53
Sub11	25.62	0.00	79.80	0.00	4.89	3577.00	139.62	153.28	-13.66
Sub12	25.25	0.00	79.40	0.00	4.45	3722.00	147.41	161.37	-13.97
Sub13	31.96	0.00	78.00	0.00	6.36	3389.00	106.04	100.28	5.76
Sub14	8.88	0.00	79.00	0.00	2.50	1972.00	222.07	229.63	-7.56
Sub15	25.20	0.00	78.00	0.00	4.30	3599.00	142.82	157.01	-14.19
Sub16	24.30	0.00	79.40	0.00	4.20	3757.00	154.61	168.48	-13.87
Sub17	31.50	0.00	79.40	0.00	6.47	3506.00	111.30	106.38	4.92
Sub18	8.40	0.00	80.50	0.00	2.44	2028.00	241.43	240.06	1.37
Total	401.57					31935.00	79.53		
Arith.mean	22.31	79.13			4.45		164.72		
Geom.Mear	19.47	79.13			4.06		155.26		
Harm.Mean	16.18	79.12			3.63		147		
Median	24.75	79.2			4.37		145		

Est. UPQ = -137.81 - 1.68*DA + 5.537*CRVNBR -22.02*SCSLAG
R-square= 0.866