APACHE WASH HYDROLOGY REPORT
FOR
APACHE WASH FLOOD INSURANCE STUDY

November 1991

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Prepared for:

Flood Control District of Maricopa County, Arizona
Contract FCDMC 98-66 87-66
JJA/DEA Job No. MARI0001

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TABLE 4
HEC-1, APACHE WASH
100-YEAR FLOW CUMULATIVE VALUES

Basin		HEC-1 Station	Sub-basin (cfs)	Total (cfs)
1.	Jonathan Wash			
		70	1899	
		80	1107	
	70+80	80T		3006
		G	1463	
	80T+GT	GT		3406
		60	836	
	Total for Jonathan Wash 60+GT	60T		3749
2.	West Branch Desert Hills Wash			
		50	1023	
	Jonathan Wash + W. B Desert Hills Wash 60T+50	50T		4772
3.	Desert Hills Wash Upstream Sub-basins 44 to 40	44	898	
		43	1787	
		42	218	
	44+43+42	42T		2692
		41	1095	
	42T+41	41T		3669
		40	641	
	41T+40	40T		4143
	Desert Hills Wash Mainline 50T+40T	40MT		8890
		F1	482	
	40MT+F1	F1T		8833
		F2	488	
	F1T+F2	F2T		9171
		30	539	
	F2T+30	30T		9560
		F3	467	
	30T+F3	F3T		9657
		F4	249	
	F3T+F4	F4T		9644
		F5	671	
	F4T+F5	F5T		10259

		F6	759	
	Desert Hills Wash Total F5T+F6	F6T		10221
4.	Paradise Wash	14	1590	
		13	199	
	14+13	13T		1701
	Ranieri Wash	12	2348	
	Paradise Wash 13T+12T	12T		4049
		11A	621	
	12T+11A	11AT		4179
		11	1092	
	11AT+11	11T		5232
		10	1093	
	11T+10	10T		5763
5.	Apache Wash			
	Upstream Sub-basin 25 to 20	25	2191	
		24	3853	
	24+25	24T		5927
		23	2314	
	24T+23	23T		7187
		22	712	
	23T+22	22T		7213
		21	581	
		20	757	
	22T+21+20	20T		7534
	Combined Flow:Desert Hills Wash and Apache Wash F6T+20T	20MT		13541
	Combined Flow:Apache Wash and Paradise Wash 20MT+10T	10MT		16962
		E	1262	
	Total Apache Wash 10MT+E	EMT		17136
6.	Mesquite Tank Wash			
		2	985	
		1	756	
	Total Mesquite Wash 142	1T		1305

NOTE: T-denotes combined hydrographs for total of sub-basins.
MT-denotes mainline total for combined hydrographs of major sub-basins along the main stream.

6. REFERENCES

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5. Flood Insurance Rate Map, Maricopa County, Arizona and Incorporated Areas. Panels 795 and 1210 of 4350, National Flood Insurance Program, April 15, 1988.

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8. City of Phoenix, Planning Department, General Plan Peripheral Areas C and D, October 1987.

9. Flood Control District of Maricopa County, Interoffice Memorandum on Flooding Problem of August 28, 1988, File: 80-9-00-9 09/88 by A.M.M., September 2, 1988.

10. Jerry R. Jones & Associates, Inc., Area Drainage Master Study: Apache Wash Drainage/Storm Drain Master Plan, Volumes I and II, July 1990.

11. Williams & Ellis, Inc., As-Built Drawings of Carefree Road, Black Canyon Freeway to Cave Creek, Project No. W.O. 07200, Sheets 3, 9-17 of 19, August 23, 1974.

12. Soil Conservation Service, U.S. Department of Agriculture, Soil Survey of Maricopa County, September, 1977.

13. Flood Control District of Maricopa County, Hydrologic Design Manual for Maricopa County, Phoenix, AZ, September, 1990.

14. McCuen, Richard H., A Guide to Hydrologic Analysis by SCS Methods, Prentice-Hall, Inc., New Jersey, 1982.

APPENDIX, APACHE WASH

1. Apache Wash Sub-Basin Characteristics

2. Drainage Basin Data

3. Rainfall Map

4. Soils Map

5. HEC-1 Input/Output File

APACHE WASH SUB-BASIN CHARACTERISTICS

Watershed Name Sub-Basin Station #	Sub-Basin Area (BA)	SCS Curve No. (LS)	% Impervious	USBR Log Time (hrs) (ud)
Jonathan Wash				
70	2.20	84.9	1	0.92
80	1.35	83.6	1	0.92
G	0.89	85.1	5	0.35
60	0.59	83.0	1	0.37
West Branch Desert Hills Wash				
50	1.15	84.3	1.5	0.85
Desert Hills Wash				
44	0.62	84.7	0	0.39
43	1.39	85.2	1	0.52
42	0.11	80.5	1	0.13
41	0.89	83.7	1.5	0.51
40	0.58	82.2	2	0.54
F1	0.26	85.7	1	0.25
F2	0.46	82.7	0	0.59
30	0.50	84.3	1.2	0.65
F3	0.27	84.3	1	0.28
F4	0.14	84.3	0	0.22
F5	0.68	86.8	0	0.84
F6	0.49	84.3	0	0.35
Apache Wash				
25	1.41	85.7	1	0.38
24	2.91	86.3	1	0.53
23	1.71	85.5	1	0.49
22	0.51	85.5	1	0.46
21	0.51	85.1	2	0.63
20	0.68	83.4	0	0.56
E	1.11	84.6	0	0.60
Paradise Wash				
14	1.25	86.7	0	0.56
13	0.15	78.9	0	0.31
12	1.89	86.4	0	0.57
11A	0.37	83.4	0	0.28
11	0.99	85.6	0	0.67
10	0.96	85.7	1	0.65
Mesquite Tank Wash				
2	1.06	87.7	0	0.96
1	0.66	85.5	0	0.63

DRAINAGE BASIN DATA

Area	Total Acreage	Length Ft.	Slope Ft./Ft.
1	422	17000	0.0080
2	678	21000	0.0120
E	710	15000	0.0100
F	1472	14500	0.0040
G	570	8000	0.0190
10	614	11500	0.0081
11	870	14250	0.0169
12	1210	12500	0.0400
13	95	5000	0.0140
14	800	12000	0.0490
20	437	9750	0.0090
21	323	12500	0.0140
22	329	7875	0.0110
23	1095	11500	0.0350
24	1862	16000	0.0340
25	902	9880	0.0490
30	317	12250	0.0110
40	371	9000	0.0100
41	569	10500	0.0126
42	70	1500	0.0133
43	890	14000	0.0194
44	397	9000	0.0340
50	736	17500	0.0123
60	378	7500	0.0200
70	1408	23000	0.0220
80	864	21500	0.0170

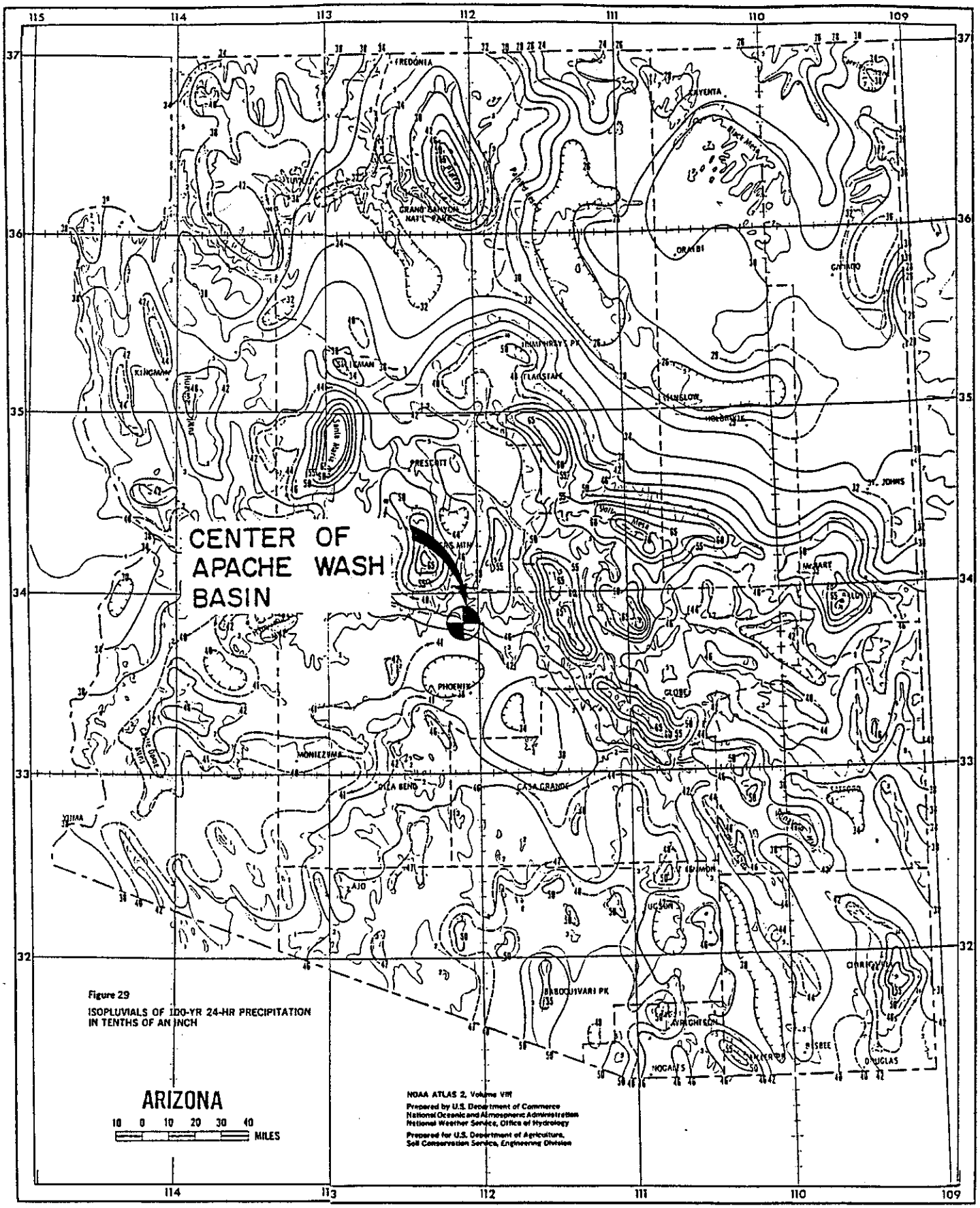

Figure 29

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

RAINFALL MAP

```
****************************************
*                                      *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*     BY THE COE IN FEBRUARY 1981      *
*          REVISED 02 AUG 88           *
*                                      *
* RUN DATE 04/15/1991  TIME  14:45:13  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*     DODSON AND ASSOCIATES, INC.      *
*   HYDROLOGIST AND CIVIL ENGINEERS    *
*      7015 W TIDWELL SUITE 107        *
*        HOUSTON, TEXAS  77092         *
*           (713) 895-8322             *
*                                      *
****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X       X     X        XX
X     X  X       X              X
XXXXXXX  XXXX    X       XXXXX  X
X     X  X       X              X
X     X  X       X     X        X
X     X  XXXXXXX   XXXXX        XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID   APACHE WASH FILE AWT.DAT                                   REVISED 1-31-91
  2           ID   EXISTING CONDITIONS                                 CHANGED COMBINATONS
  3           ID   FLOOD INSURANCE STUDY
              *DIAGRAM
  4           IT      10  1JUN90            145
  5           IO       5       0

  6           KK      70
  7           KM   RUNOFF FROM 70
  8           KO       3
  9           BA     2.2
 10           IN      30
 11           PB     4.6
 12           PC       0   0.005   0.009    0.01   0.013   0.019   0.021   0.028   0.032   0.044
 13           PC   0.057     0.1    0.66   0.745   0.776     0.8   0.816    0.83    0.84    0.85
 14           PC   0.861   0.868   0.878   0.884   0.891     0.9   0.905   0.912   0.919   0.923
 15           PC    0.93   0.934   0.939   0.944    0.95   0.958   0.961   0.963   0.969   0.971
 16           PC   0.974   0.979   0.981   0.985   0.989   0.991   0.993   0.996     1.0
 17           LS       0    84.9       1
 18           UD    0.92

 19           KK      80
 20           KM   RUNOFF FROM 80
 21           KO       3
 22           BA    1.35
 23           PB     4.6
 24           LS       0    83.6       1
 25           UD    0.92

 26           KK     80T
 27           KM   COMBINE 70,80
 28           HC       2

 29           KK       G
 30           KM   ROUTE 80T TO G
 31           RK    3000   0.005    0.03           TRAP       0      50

 32           KK       G
 33           KM   RUNOFF FROM G
 34           KO       3
 35           BA    0.89
 36           PB     4.6
 37           LS       0    85.1       5
 38           UD    0.35

 39           KK      GT
 40           KM   COMBINE 80T+G
 41           HC       2

 42           KK      60
 43           KM   RUNOFF FROM 60
 44           KO       3
 45           BA    0.59
 46           PB     4.6
 47           LS       0      83       1
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  48          UD    0.37

  49          KK     60T
  50          KM   COMBINE GT+60
  51          HC       2

  52          KK      50
  53          KM   RUNOFF FROM 50
  54          KO       3
  55          BA    1.15
  56          PB     4.6
  57          LS       0     84.3      1.5
  58          UD    0.85

  59          KK     50T
  60          KM   COMBINE 60T+50
  61          HC       2

  62          KK    40MT
  63          KM   ROUTE 50T  TO 40
  64          RK    1000   0.005    0.03            TRAP      10       25

  65          KK      44
  66          KM   RUNOFF FROM 44
  67          BA    0.62
  68          PB     4.6
  69          LS       0     84.7
  70          UD    0.39

  71          KK     42T
  72          KM   ROUTE TO 42T
  73          RK    2000   0.016   0.035            TRAP       5       10

  74          KK      43
  75          KM   RUNOFF FROM 43
  76          BA    1.39
  77          PB     4.6
  78          LS       0     85.2       1
  79          UD    0.52

  80          KK     42T
  81          KM   ROUTE 44 TO 42T
  82          RK    1500   0.016   0.035            TRAP       5       10

  83          KK      42
  84          KM   RUNOFF FROM 42
  85          BA    0.11
  86          PB     4.6
  87          LS       0     80.5       1
  88          UD    0.13
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  89          KK     42T
  90          KM   COMBINE 44T,43T,42T
  91          HC       3

  92          KK     41T
  93          KM   ROUTE TO 41T
  94          RK    4200    0.01   0.035           TRAP       5      50

  95          KK      41
  96          KM   RUNOFF FROM 41
  97          BA    0.89
  98          PB     4.6
  99          LS       0    83.7     1.5
 100          UD    0.51

 101          KK     41T
 102          KM   COMBINE 40T,42T
 103          HC       2

 104          KK     40T
 105          KM   ROUTE 41T TO 40
 106          RK    6500   0.006   0.035           TRAP       5      50

 107          KK      40
 108          KM   RUNOFF FROM 40
 109          BA    0.58
 110          PB     4.6
 111          LS       0    82.2       2
 112          UD    0.54

 113          KK     40T
 114          KM   COMBINE 40,41T
 115          HC       2

 116          KK    40MT
 117          KM    COMBINE WITH 50T
 118          HC       2

 119          KK     F1T
 120          KM   ROUTE 40MT TO F1
 121          RK    1600   0.003   0.035           TRAP      12      50

 122          KK      F1
 123          KM   RUNOFF FROM F1
 124          KO       3
 125          BA    0.26
 126          PB     4.6
 127          LS       0    85.7       1
 128          UD    0.25
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  129         KK     F1T
  130         KM   COMBINE 40MT+F1
  131         HC       2

  132         KK     F2T
  133         KM   ROUTE TO F2
  134         RK     500   0.003   0.035           TRAP      12      50

  135         KK      F2
  136         KM   RUNOFF FROM F2
  137         KO       3
  138         BA    0.46
  139         PB     4.6
  140         LS       0    82.7       0
  141         UD    0.59

  142         KK     F2T
  143         KM   COMBINE F1T+F2
  144         HC       2

  145         KK     30T
  146         KM   ROUTE F2T TO 30
  147         RK     800   0.003   0.035           TRAP      12      50

  148         KK      30
  149         KM   RUNOFF FROM 30
  150         KO       3
  151         BA     0.5
  152         PB     4.6
  153         LS       0    84.3     1.2
  154         UD    0.65

  155         KK     30T
  156         KM   COMBINE F2T+30
  157         HC       2

  158         KK     F3T
  159         KM   ROUTE TO F3
  160         RK    1000   0.003   0.035           TRAP      12      50

  161         KK      F3
  162         KM   RUNOFF FROM F3
  163         KO       3
  164         BA    0.27
  165         PB     4.6
  166         LS       0    84.3       1
  167         UD    0.28

  168         KK     F3T
  169         KM   COMBINE 30T+F3
  170         HC       2
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  171         KK     F4T
  172         KM   ROUTE TO F4
  173         RK    1500   0.003   0.035          TRAP      12      50

  174         KK      F4
  175         KM   RUNOFF FROM F4
  176         KO       3
  177         BA    0.14
  178         PB     4.6
  179         LS       0    84.3       0
  180         UD    0.22

  181         KK     F4T
  182         KM   COMBINE F3T+F4
  183         HC       2

  184         KK     F5T
  185         KM   ROUTE TO F5
  186         RK     500   0.003   0.035          TRAP      12      50

  187         KK      F5
  188         KM   RUNOFF FROM F5
  189         KO       3
  190         BA    0.68
  191         PB     4.6
  192         LS       0    86.8       0
  193         UD    0.84

  194         KK     F5T
  195         KM   COMBINE F4T+F5
  196         HC       2

  197         KK     F6T
  198         KM   ROUTE TO F6
  199         RK    2500   0.003   0.035          TRAP      12      50

  200         KK      F6
  201         KM   RUNOFF FROM F6
  202         KO       3
  203         BA    0.49
  204         PB     4.6
  205         LS       0    84.3       0
  206         UD    0.35

  207         KK     F6T
  208         KM   COMBINE F5T+F6
  209         HC       2

  210         KK      25
  211         KM   RUNOFF FROM 25
  212         BA    1.41
  213         PB     4.6
  214         LS       0    85.7       1
  215         UD    0.38
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  216         KK     24
  217         KM   RUNOFF FROM 24
  218         BA    2.91
  219         PB     4.6
  220         LS       0    86.3       1
  221         UD    0.53

  222         KK     24T
  223         KM   COMBINE 24,25
  224         HC       2

  225         KK     23T
  226         KM   ROUTE TO 23
  227         RK    9500  0.0092   0.065            TRAP       8      50

  228         KK      23
  229         KM   RUNOFF FROM 23
  230         BA    1.71
  231         PB     4.6
  232         LS       0    85.5       1
  233         UD    0.49

  234         KK     23T
  235         KM   COMBINE 24T,23
  236         HC       2

  237         KK     22T
  238         KM   ROUTE TO 22T
  239         RK    8000   0.007   0.065            TRAP       8      50

  240         KK      22
  241         KM   RUNOFF FROM 22
  242         BA    0.51
  243         PB     4.6
  244         LS       0    85.5       1
  245         UD    0.46

  246         KK     22T
  247         KM   COMBINE 22,23T
  248         HC       2

  249         KK     21T
  250         KM   ROUTE TO 20T
  251         RK    8500   0.005   0.065            TRAP      10      50

  252         KK      21
  253         KM   RUNOFF FROM 21
  254         BA    0.51
  255         PB     4.6
  256         LS       0    85.1       2
  257         UD    0.63
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  258         KK     20T
  259         KM   ROUTE TO 20T
  260         RK    7000   0.005   0.035           TRAP      5      50

  261         KK      20
  262         KM   RUNOFF FROM 20
  263         BA    0.68
  264         PB     4.6
  265         LS       0    83.4
  266         UD    0.56

  267         KK     20T
  268         KM   COMBINE 21,22T,20
  269         HC       3

  270         KK    20MT
  271         KM   COMBINE WITH MAINLINE
  272         HC       2

  273         KK    10MT
  274         KM   ROUTE TO 10
  275         RK    1000   0.004    0.02           TRAP     12      25

  276         KK      14
  277         KM   RUNOFF FROM 14
  278         BA    1.25
  279         PB     4.6
  280         LS       0    86.7
  281         UD    0.56

  282         KK     13T
  283         KM   ROUTE TO 13T
  284         RK    5000   0.016   0.035           TRAP     12      50

  285         KK      13
  286         KM   RUNOFF FOM 13
  287         BA    0.15
  288         PB     4.6
  289         LS       0    78.9
  290         UD    0.31

  291         KK     13T
  292         KM   COMBINE 14,13
  293         HC       2

  294         KK      12
  295         KM   RUNOFF FROM 12
  296         BA    1.89
  297         PB     4.6
  298         LS       0    86.4
  299         UD    0.57
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  300         KK     12T
  301         KM   COMBINE 13T,12
  302         HC       2

  303         KK     11A
  304         KM   ROUTE TO 11
  305         RK    3000   0.016   0.155          TRAP      12      50

  306         KK     11A
  307         KM   RUNOFF FROM 11A
  308         BA    0.37
  309         PB     4.6
  310         LS       0    83.6       0
  311         UD    0.28

  312         KK    11AT
  313         KM   COMBINE 12T+11AT
  314         HC       2

  315         KK      11
  316         KM   RUNOFF FROM 11
  317         BA    0.99
  318         PB     4.6
  319         LS       0    85.6
  320         UD    0.67

  321         KK     11T
  322         KM   COMBINE 11,11AT
  323         HC       2

  324         KK     10T
  325         KM   ROUTE TO 10
  326         RK    7000   0.006   0.065          TRAP      12      50

  327         KK      10
  328         KM   RUNOFF FROM 10
  329         BA    0.96
  330         PB     4.6
  331         LS       0    85.7       1
  332         UD    0.65

  333         KK     10T
  334         KM   COMBINE 10,11T
  335         HC       2

  336         KK    10MT
  337         KM   COMBINE WITH MAINLINE
  338         HC       2
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 339          KK      ET
 340          KM   ROUTE TO E
 341          RK   13000   0.003   0.055            TRAP      12      50

 342          KK       E
 343          KM   RUNOFF FROM E
 344          KO       3
 345          BA    1.11
 346          PB     4.6
 347          LS       0    84.6
 348          UD    0.60

 349          KK      ET
 350          KM   COMBINE 10T,E
 351          HC       2

 352          KK       2
 353          KM   RUNOFF FROM 2
 354          KO       3
 355          BA    1.06
 356          PB     4.6
 357          LS       0    87.7
 358          UD    0.96

 359          KK      1T
 360          KM   ROUTE TO 1
 361          RK    9000   0.006   0.035            TRAP      12      50

 362          KK       1
 363          KM   RUNOFF FROM 1
 364          KO       3
 365          BA    0.66
 366          PB     4.6
 367          LS       0    85.5
 368          UD    0.63

 369          KK      IT
 370          KM   COMBINE 1,2
 371          HC       2
 372          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW
NO.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

 6          70
            .
            .
19          .          80
            .           .
            .           .
26        80T............
            V
            V
29          G
            .
            .
32          .           G
            .           .
            .           .
39         GT............
            .
            .
42          .          60
            .           .
            .           .
49        60T............
            .
            .
52          .          50
            .           .
            .           .
59        50T............
            V
            V
62        40MT
            .
            .
65          .          44
            .           V
            .           V
71          .         42T
            .           .
            .           .
74          .           .         43
            .           .          V
            .           .          V
80          .           .        42T
            .           .          .
            .           .          .
83          .           .          .         42
            .           .          .          .
            .           .          .          .
89          .         42T..........................
            .           V
            .           V
92          .         41T
            .           .
            .           .
95          .           .         41
            .           .          .
            .           .          .
101         .         41T............
            .           V
```

```
                .          V
104             .        40T
                .          .
                .          .
107             .          .          40
                .          .           .
                .          .           .
13              .        40T............
                .          .
                .          .
16           40MT............
                V
                V
19           F1T
                .
                .
122             .         F1
                .          .
                .          .
129          F1T............
                V
                V
132          F2T
                .
                .
135             .         F2
                .          .
                .          .
142          F2T............
                V
                V
145          30T
                .
                .
148             .         30
                .          .
                .          .
155          30T............
                V
                V
158          F3T
                .
                .
161             .         F3
                .          .
                .          .
168          F3T............
                V
                V
171          F4T
                .
                .
174             .         F4
                .          .
                .          .
181          F4T............
                V
                V
184          F5T
                .
                .
187             .         F5
                .          .
                .          .
194          F5T............
                V
```

```
                V
197           F6T
                .
                .
200                     F6
                .        .
                .        .
207           F6T........
                .
                .
210                     25
                .        .
                .        .
216                      .          24
                .        .           .
                .        .           .
222                     24T........
                .        V
                .        V
225                     23T
                .        .
                .        .
228                      .          23
                .        .           .
                .        .           .
234                     23T........
                .        V
                .        V
237                     22T
                .        .
                .        .
240                      .          22
                .        .           .
                .        .           .
246                     22T........
                .        V
                .        V
249                     21T
                .        .
                .        .
252                      .          21
                .        .           V
                .        .           V
258                      .          20T
                .        .           .
                .        .           .
261                      .           .          20
                .        .           .           .
                .        .           .           .
267                     20T........................
                .        .
                .        .
270           20MT.......
                V
                V
273           10MT
                .
                .
276                     14
                .        V
                .        V
282                     13T
                .        .
                .        .
285                      .          13
                .        .           .
```

```
                .          .          .
291             .        13T...........
                .          .
                .          .
294             .          .         12
                .          .          .
                .          .          .
00              .        12T...........
                .          V
                .          V
03              .        11A
                .          .
                .          .
06              .          .         11A
                .          .          .
                .          .          .
312             .        11AT..........
                .          .
                .          .
315             .          .         11
                .          .          .
                .          .          .
321             .        11T...........
                .          V
                .          V
324             .        10T
                .          .
                .          .
327             .          .         10
                .          .          .
                .          .          .
333             .        10T...........
                .          .
                .          .
336          10MT...........
                V
                V
339             ET
                .
                .
342             .          E
                .          .
                .          .
349             ET...........
                .
                .
352             .          2
                .          V
                .          V
359             .          1T
                .          .
                .          .
362             .          .          1
                .          .          .
                .          .          .
369             .          IT...........
```

***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
****************************************
*                                      *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*     BY THE COE IN FEBRUARY 1981      *
*          REVISED 02 AUG 88           *
*                                      *
*  RUN DATE  04/15/1991  TIME  14:45:13 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*     DODSON AND ASSOCIATES, INC.      *
*   HYDROLOGIST AND CIVIL ENGINEERS    *
*      7015 W TIDWELL SUITE 107        *
*        HOUSTON, TEXAS  77092         *
*           (713) 895-8322             *
*                                      *
****************************************
```

```
                    APACHE WASH FILE AWT.DAT                          REVISED 1-31-91
                    EXISTING CONDITIONS                          CHANGED COMBINATONS
                    FLOOD INSURANCE STUDY

  5 IO        OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                     NMIN         10  MINUTES IN COMPUTATION INTERVAL
                    IDATE     1JUN90  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        145  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     2JUN90  ENDING DATE
                   NDTIME       0000  ENDING TIME
                    ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL     .17 HOURS
                   TOTAL TIME BASE   24.00 HOURS

        ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT


** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  6 KK    *        70  *
          *            *
          **************

  8 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

 10 IN        TIME DATA FOR INPUT TIME SERIES
                    JXMIN         30  TIME INTERVAL IN MINUTES
                   JXDATE     1JUN90  STARTING DATE
                   JXTIME          0  STARTING TIME

            SUBBASIN RUNOFF DATA
```

```
 9 BA          SUBBASIN CHARACTERISTICS
                    TAREA        2.20  SUBBASIN AREA

               PRECIPITATION DATA

11 PB                STORM        4.60  BASIN TOTAL PRECIPITATION

12 PI            INCREMENTAL PRECIPITATION PATTERN
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .01       .01       .01       .19       .19       .19       .03       .03       .03       .01
                    .01       .01       .01       .01       .01       .01       .01       .01       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00

17 LS          SCS LOSS RATE
                    STRTL         .36  INITIAL ABSTRACTION
                   CRVNBR       84.90  CURVE NUMBER
                    RTIMP        1.00  PERCENT IMPERVIOUS AREA

18 UD          SCS DIMENSIONLESS UNITGRAPH
                     TLAG         .92  LAG

                                                  ***

                                                UNIT HYDROGRAPH
                                           30 END-OF-PERIOD ORDINATES
            81.      242.      495.      809.     1005.     1060.     1009.      887.      726.      529.
           396.      300.      235.      179.      136.      104.       79.       59.       46.       35.
            27.       21.       15.       12.       10.        8.        5.        4.        2.        0.

   ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION       70

   TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.59, TOTAL EXCESS =    3.01

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                 6-HR       24-HR       72-HR     24.00-HR
  1899.       6.83       (CFS)     581.        176.        176.        176.
                        (INCHES)   2.454       2.974       2.974       2.974
                         (AC-FT)   288.        349.        349.        349.

                     CUMULATIVE AREA =    2.20 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 19 KK    *        80  *
          *            *
          **************
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```
21 KO        OUTPUT CONTROL VARIABLES
                 IPRNT          3  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

           SUBBASIN RUNOFF DATA

22 BA        SUBBASIN CHARACTERISTICS
                 TAREA       1.35  SUBBASIN AREA

             PRECIPITATION DATA

3 PB             STORM       4.60  BASIN TOTAL PRECIPITATION

12 PI          INCREMENTAL PRECIPITATION PATTERN
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .01       .01       .01       .19       .19       .19       .03       .03       .03       .01
                 .01       .01       .01       .01       .01       .01       .01       .01       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00

24 LS        SCS LOSS RATE
                 STRTL        .39  INITIAL ABSTRACTION
                CRVNBR      83.60  CURVE NUMBER
                 RTIMP       1.00  PERCENT IMPERVIOUS AREA

25 UD        SCS DIMENSIONLESS UNITGRAPH
                 TLAG         .92  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          30 END-OF-PERIOD ORDINATES
          50.      149.      304.      496.      617.      650.      619.      544.      446.      324.
         243.      184.      144.      110.       84.       64.       48.       36.       28.       22.
          17.       13.        9.        7.        6.        5.        3.        2.        1.        0.

   ***          ***          ***          ***          ***

                 HYDROGRAPH AT STATION      80

  TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.71, TOTAL EXCESS =    2.89

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
 (CFS)        (HR)                 6-HR       24-HR       72-HR     24.00-HR
 1107.        6.83       (CFS)     340.        104.        104.        104.
                        (INCHES)   2.344       2.855       2.855       2.855
                         (AC-FT)   169.        206.        206.        206.

                 CUMULATIVE AREA =    1.35 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
              **************
              *            *
 32 KK        *         G  *
              *            *
              **************

 34 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

            SUBBASIN RUNOFF DATA

 35 BA          SUBBASIN CHARACTERISTICS
                      TAREA        .89  SUBBASIN AREA

                PRECIPITATION DATA

 36 PB                STORM       4.60  BASIN TOTAL PRECIPITATION

 12 PI            INCREMENTAL PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .01       .01       .01       .19       .19       .19       .03       .03       .03       .01
                      .01       .01       .01       .01       .01       .01       .01       .01       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00

 37 LS          SCS LOSS RATE
                      STRTL        .35  INITIAL ABSTRACTION
                     CRVNBR      85.10  CURVE NUMBER
                      RTIMP       5.00  PERCENT IMPERVIOUS AREA

 38 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG        .35  LAG

                                                  ***

                                                UNIT HYDROGRAPH
                                           12 END-OF-PERIOD ORDINATES
            290.      891.      952.      630.      316.      174.      93.       49.       26.       14.
             8.        4.

   ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION        G

  TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.51, TOTAL EXCESS =    3.09

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                 6-HR       24-HR       72-HR     24.00-HR
  1463.       6.17       (CFS)     245.         74.         74.         74.
                       (INCHES)   2.561       3.074       3.074       3.074
                       (AC-FT)    122.        146.        146.        146.
```

```
                    CUMULATIVE AREA =     .89 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
42 KK     *        60  *
          *            *
          **************

44 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

             SUBBASIN RUNOFF DATA

45 BA          SUBBASIN CHARACTERISTICS
                     TAREA        .59  SUBBASIN AREA

               PRECIPITATION DATA

46 PB                STORM       4.60  BASIN TOTAL PRECIPITATION

12 PI            INCREMENTAL PRECIPITATION PATTERN
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .01      .01      .01      .19      .19      .19      .03      .03      .03      .01
                     .01      .01      .01      .01      .01      .01      .01      .01      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00

47 LS          SCS LOSS RATE
                     STRTL        .41  INITIAL ABSTRACTION
                    CRVNBR      83.00  CURVE NUMBER
                     RTIMP       1.00  PERCENT IMPERVIOUS AREA

48 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG        .37  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          13 END-OF-PERIOD ORDINATES
            170.     538.     619.     445.     230.     129.      70.      39.      21.      12.
              7.       4.       1.

   ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION      60

  TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.77, TOTAL EXCESS =    2.83
```

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.00-HR
836.	6.17	(CFS)	148.	45.	45.	45.
		(INCHES)	2.331	2.817	2.817	2.817
		(AC-FT)	73.	89.	89.	89.

CUMULATIVE AREA = .59 SQ MI

*** ***

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              **************
              *            *
52 KK         *        50  *
              *            *
              **************

64 KO            OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

               SUBBASIN RUNOFF DATA

55 BA            SUBBASIN CHARACTERISTICS
                      TAREA       1.15  SUBBASIN AREA

                 PRECIPITATION DATA

56 PB                 STORM       4.60  BASIN TOTAL PRECIPITATION

12 PI              INCREMENTAL PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .01       .01       .01       .19       .19       .19       .03       .03       .03       .01
                      .01       .01       .01       .01       .01       .01       .01       .01       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00

57 LS            SCS LOSS RATE
                      STRTL        .37  INITIAL ABSTRACTION
                     CRVNBR      84.30  CURVE NUMBER
                      RTIMP       1.50  PERCENT IMPERVIOUS AREA

58 UD            SCS DIMENSIONLESS UNITGRAPH
                       TLAG        .85  LAG
```

***

UNIT HYDROGRAPH
27 END-OF-PERIOD ORDINATES

51.	154.	320.	497.	586.	591.	532.	447.	329.	238.
177.	136.	101.	76.	57.	42.	31.	23.	17.	13.
10.	7.	6.	5.	3.	2.	1.			

```
***          ***          ***          ***          ***

                HYDROGRAPH AT STATION      50

TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.64, TOTAL EXCESS =    2.96

AK FLOW     TIME                          MAXIMUM AVERAGE FLOW
(CFS)       (HR)                  6-HR      24-HR      72-HR     24.00-HR
1023.       6.67       (CFS)      299.        91.        91.         91.
                     (INCHES)    2.414      2.929      2.929       2.929
                      (AC-FT)     148.       180.       180.        180.

                     CUMULATIVE AREA =    1.15 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
122 KK    *        F1  *
          *            *
          **************

124 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

              SUBBASIN RUNOFF DATA

125 BA          SUBBASIN CHARACTERISTICS
                     TAREA        .26  SUBBASIN AREA

                PRECIPITATION DATA

26 PB                STORM       4.60  BASIN TOTAL PRECIPITATION

12 PI             INCREMENTAL PRECIPITATION PATTERN
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .01        .01        .01        .19        .19        .19        .03        .03        .03        .01
                     .01        .01        .01        .01        .01        .01        .01        .01        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                     .00        .00        .00        .00
127 LS          SCS LOSS RATE
                     STRTL        .33  INITIAL ABSTRACTION
                    CRVNBR      85.70  CURVE NUMBER
                     RTIMP       1.00  PERCENT IMPERVIOUS AREA

128 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG        .25  LAG
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                                                  ***

                                                UNIT HYDROGRAPH
                                            10 END-OF-PERIOD ORDINATES
          178.     379.     258.     106.      48.      21.       9.       4.       2.       0.

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION       F1

 TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.52, TOTAL EXCESS =    3.08

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
 (CFS)        (HR)                 6-HR       24-HR       72-HR     24.00-HR
  482.        6.17       (CFS)      72.         21.         21.         21.
                       (INCHES)    2.571       3.071       3.071       3.071
                        (AC-FT)     36.         43.         43.         43.

                     CUMULATIVE AREA =     .26 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
135 KK    *        F2  *
          *            *
          **************

137 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

             SUBBASIN RUNOFF DATA

138 BA          SUBBASIN CHARACTERISTICS
                     TAREA        .46  SUBBASIN AREA

                PRECIPITATION DATA

139 PB               STORM       4.60  BASIN TOTAL PRECIPITATION

 12 PI            INCREMENTAL PRECIPITATION PATTERN
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .01       .01       .01       .19       .19       .19       .03       .03       .03       .01
                     .01       .01       .01       .01       .01       .01       .01       .01       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00

140 LS          SCS LOSS RATE
                     STRTL        .42  INITIAL ABSTRACTION
                    CRVNBR      82.70  CURVE NUMBER
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                RTIMP        .00  PERCENT IMPERVIOUS AREA

1 UD        SCS DIMENSIONLESS UNITGRAPH
                TLAG        .59  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          20 END-OF-PERIOD ORDINATES
          47.     153.     287.     330.     299.     230.     145.      96.      66.      44.
          29.      19.      13.       9.       6.       4.       3.       2.       1.       0.

  ***          ***          ***          ***          ***

                HYDROGRAPH AT STATION      F2

 TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.81, TOTAL EXCESS =    2.79

AK FLOW     TIME                          MAXIMUM AVERAGE FLOW
 (CFS)      (HR)                  6-HR      24-HR      72-HR     24.00-HR
  488.      6.50        (CFS)     113.        34.        34.        34.
                      (INCHES)   2.279      2.765      2.765      2.765
                       (AC-FT)    56.        68.        68.        68.

                CUMULATIVE AREA =     .46 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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        *            *
148 KK  *        30  *
        *            *
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150 KO      OUTPUT CONTROL VARIABLES
                IPRNT          3  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL         0.  HYDROGRAPH PLOT SCALE

          SUBBASIN RUNOFF DATA

151 BA      SUBBASIN CHARACTERISTICS
                TAREA        .50  SUBBASIN AREA

            PRECIPITATION DATA

52 PB           STORM       4.60  BASIN TOTAL PRECIPITATION

12 PI         INCREMENTAL PRECIPITATION PATTERN
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .01      .01      .01      .19      .19      .19      .03      .03      .03      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
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                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00

3 LS        SCS LOSS RATE
                STRTL        .37  INITIAL ABSTRACTION
               CRVNBR      84.30  CURVE NUMBER
                RTIMP       1.20  PERCENT IMPERVIOUS AREA

154 UD      SCS DIMENSIONLESS UNITGRAPH
                TLAG        .65  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          21 END-OF-PERIOD ORDINATES
          41.      131.      260.      326.      319.      266.      188.      125.       87.       61.
          42.       29.       20.       14.        9.        7.        5.        3.        2.        1.
           1.

  ***           ***           ***           ***           ***

                  HYDROGRAPH AT STATION      30

  TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.65, TOTAL EXCESS =    2.95

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
 (CFS)        (HR)                 6-HR       24-HR       72-HR     24.00-HR
  539.        6.50       (CFS)     130.         39.         39.         39.
                        (INCHES)   2.426       2.930       2.930       2.930
                         (AC-FT)    65.         78.         78.         78.

                   CUMULATIVE AREA =     .50 SQ MI


** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
161 KK    *        F3  *
          *            *
          **************

163 KO      OUTPUT CONTROL VARIABLES
                IPRNT          3  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL         0.  HYDROGRAPH PLOT SCALE

          SUBBASIN RUNOFF DATA

164 BA      SUBBASIN CHARACTERISTICS
                TAREA        .27  SUBBASIN AREA

            PRECIPITATION DATA

165 PB          STORM       4.60  BASIN TOTAL PRECIPITATION

 12 PI        INCREMENTAL PRECIPITATION PATTERN
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .01       .01       .01       .19       .19       .19       .03       .03       .03       .01
                .01       .01       .01       .01       .01       .01       .01       .01       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
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                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00

166 LS        SCS LOSS RATE
                STRTL        .37  INITIAL ABSTRACTION
                CRVNBR     84.30  CURVE NUMBER
                RTIMP       1.00  PERCENT IMPERVIOUS AREA

167 UD        SCS DIMENSIONLESS UNITGRAPH
                TLAG         .28  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          10 END-OF-PERIOD ORDINATES
          146.     358.     288.     133.      65.      30.      14.       7.       3.       1.

   ***            ***            ***            ***            ***

                  HYDROGRAPH AT STATION       F3

  TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.65, TOTAL EXCESS =    2.95

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
   (CFS)       (HR)                 6-HR       24-HR      72-HR     24.00-HR
    467.       6.17       (CFS)      71.        21.        21.         21.
                        (INCHES)   2.448      2.939      2.939       2.939
                         (AC-FT)    35.        42.        42.         42.

                  CUMULATIVE AREA =     .27 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
174 KK    *        F4  *
          *            *
          **************

176 KO        OUTPUT CONTROL VARIABLES
                IPRNT          3  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL         0.  HYDROGRAPH PLOT SCALE

            SUBBASIN RUNOFF DATA

177 BA        SUBBASIN CHARACTERISTICS
                TAREA        .14  SUBBASIN AREA

              PRECIPITATION DATA

178 PB          STORM       4.60  BASIN TOTAL PRECIPITATION

 12 PI          INCREMENTAL PRECIPITATION PATTERN
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
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                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .01      .01      .01      .19      .19      .19      .03      .03      .03      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00

179 LS          SCS LOSS RATE
                     STRTL        .37  INITIAL ABSTRACTION
                    CRVNBR      84.30  CURVE NUMBER
                     RTIMP        .00  PERCENT IMPERVIOUS AREA

180 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG        .22  LAG

                                                    ***

                                                UNIT HYDROGRAPH
                                            9 END-OF-PERIOD ORDINATES
            127.     222.     115.      47.      19.       8.       3.       1.       0.

   ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION       F4

  TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.67, TOTAL EXCESS =    2.93

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
 (CFS)        (HR)                  6-HR       24-HR       72-HR     24.00-HR
   249.       6.00        (CFS)     37.         11.         11.         11.
                        (INCHES)   2.439       2.925       2.925       2.925
                         (AC-FT)   18.         22.         22.         22.

                      CUMULATIVE AREA =     .14 SQ MI


** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
187 KK    *        F5  *
          *            *
          **************

189 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

            SUBBASIN RUNOFF DATA

190 BA          SUBBASIN CHARACTERISTICS
                     TAREA        .68  SUBBASIN AREA

                PRECIPITATION DATA
```

```
191 PB              STORM        4.60  BASIN TOTAL PRECIPITATION

2 PI            INCREMENTAL PRECIPITATION PATTERN
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .01      .01      .01      .19      .19      .19      .03      .03      .03      .01
                  .01      .01      .01      .01      .01      .01      .01      .01      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                  .00      .00      .00      .00

192 LS          SCS LOSS RATE
                     STRTL        .30  INITIAL ABSTRACTION
                    CRVNBR      86.80  CURVE NUMBER
                     RTIMP        .00  PERCENT IMPERVIOUS AREA

193 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG        .84  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          27 END-OF-PERIOD ORDINATES
          31.      94.     195.     300.     352.     353.     315.     262.     190.     138.
         102.      78.      58.      43.      32.      24.      18.      13.      10.       7.
           5.       4.       3.       2.       2.       1.       0.

   ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION       F5

  TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.43, TOTAL EXCESS =    3.17

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                  6-HR       24-HR       72-HR     24.00-HR
   671.       6.67        (CFS)     191.        57.         57.         57.
                         (INCHES)  2.615      3.142       3.142       3.142
                         (AC-FT)    95.       114.        114.        114.

                      CUMULATIVE AREA =     .68 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
200 KK    *        F6  *
          *            *
          **************

202 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
```

SUBBASIN RUNOFF DATA

03 BA SUBBASIN CHARACTERISTICS

TAREA .49 SUBBASIN AREA

PRECIPITATION DATA

204 PB STORM 4.60 BASIN TOTAL PRECIPITATION

12 PI INCREMENTAL PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.01	.01	.01	.19	.19	.19	.03	.03	.03	.01
.01	.01	.01	.01	.01	.01	.01	.01	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00						

205 LS SCS LOSS RATE

STRTL .37 INITIAL ABSTRACTION

CRVNBR 84.30 CURVE NUMBER

RTIMP .00 PERCENT IMPERVIOUS AREA

206 UD SCS DIMENSIONLESS UNITGRAPH

TLAG .35 LAG

***

UNIT HYDROGRAPH

12 END-OF-PERIOD ORDINATES

160.	490.	524.	347.	174.	96.	51.	27.	15.	8.
5.	2.								

*** *** *** *** ***

HYDROGRAPH AT STATION F6

TOTAL RAINFALL = 4.60, TOTAL LOSS = 1.67, TOTAL EXCESS = 2.93

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.00-HR
759.	6.17	(CFS)	128.	38.	38.	38.
		(INCHES)	2.429	2.920	2.920	2.920
		(AC-FT)	63.	76.	76.	76.

CUMULATIVE AREA = .49 SQ MI

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*            *
*          E *
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342 KK

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KO          OUTPUT CONTROL VARIABLES
                 IPRNT          3  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

          SUBBASIN RUNOFF DATA

BA          SUBBASIN CHARACTERISTICS
                 TAREA       1.11  SUBBASIN AREA

            PRECIPITATION DATA

PB               STORM       4.60  BASIN TOTAL PRECIPITATION

PI            INCREMENTAL PRECIPITATION PATTERN
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .01       .01       .01       .19       .19       .19       .03       .03       .03       .01
                 .01       .01       .01       .01       .01       .01       .01       .01       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                 .00       .00       .00       .00

LS          SCS LOSS RATE
                 STRTL        .36  INITIAL ABSTRACTION
                CRVNBR      84.60  CURVE NUMBER
                 RTIMP        .00  PERCENT IMPERVIOUS AREA

UD          SCS DIMENSIONLESS UNITGRAPH
                 TLAG        .60  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          20 END-OF-PERIOD ORDINATES
          110.      354.      673.      785.      721.      564.      358.      239.      164.      110.
           74.       50.       33.       22.       15.       10.        7.        5.        3.        1.

   ***          ***          ***          ***          ***

                 HYDROGRAPH AT STATION        E

  TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.64, TOTAL EXCESS =    2.96

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                 6-HR       24-HR       72-HR     24.00-HR
  1262.       6.50       (CFS)     291.         88.         88.         88.
                       (INCHES)   2.440       2.940       2.940       2.940
                       (AC-FT)     144.        174.        174.        174.

                 CUMULATIVE AREA =    1.11 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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              **************
              *            *
352 KK        *         2  *
              *            *
              **************

354 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

              SUBBASIN RUNOFF DATA

355 BA          SUBBASIN CHARACTERISTICS
                     TAREA       1.06  SUBBASIN AREA

                PRECIPITATION DATA

356 PB               STORM       4.60  BASIN TOTAL PRECIPITATION

 2 PI             INCREMENTAL PRECIPITATION PATTERN
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .01       .01       .01       .19       .19       .19       .03       .03       .03       .01
                     .01       .01       .01       .01       .01       .01       .01       .01       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00

57 LS           SCS LOSS RATE
                     STRTL        .28  INITIAL ABSTRACTION
                    CRVNBR      87.70  CURVE NUMBER
                     RTIMP        .00  PERCENT IMPERVIOUS AREA

58 UD           SCS DIMENSIONLESS UNITGRAPH
                      TLAG        .96  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          31 END-OF-PERIOD ORDINATES
            35.      105.      214.      355.      456.      489.      481.      430.      364.      276.
           206.      158.      124.       96.       73.       57.       44.       34.       26.       20.
            15.       12.        9.        7.        5.        4.        4.        3.        2.        1.
             0.

   ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION       2

   TOTAL RAINFALL =    4.60, TOTAL LOSS =    1.34, TOTAL EXCESS =    3.26

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                  6-HR       24-HR       72-HR     24.00-HR
   985.       6.83        (CFS)     306.         92.         92.         92.
                         (INCHES)  2.686       3.226       3.226       3.226
```

```
                    (AC-FT)      152.        182.        182.        182.

                    CUMULATIVE AREA =    1.06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
362 KK    *         1  *
          *            *
          **************

364 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

             SUBBASIN RUNOFF DATA

365 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .66  SUBBASIN AREA

                PRECIPITATION DATA

366 PB               STORM        4.60  BASIN TOTAL PRECIPITATION

 12 PI            INCREMENTAL PRECIPITATION PATTERN
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .01       .01       .01       .19       .19       .19       .03       .03       .03       .01
                     .01       .01       .01       .01       .01       .01       .01       .01       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00

367 LS          SCS LOSS RATE
                     STRTL         .34  INITIAL ABSTRACTION
                    CRVNBR       85.50  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

368 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG         .63  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          21 END-OF-PERIOD ORDINATES
             58.      187.      367.      444.      424.      348.      234.      156.      108.       74.
             50.       34.       23.       16.       11.        8.        5.        4.        3.        1.
              0.

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION        1
```

TOTAL RAINFALL = 4.60, TOTAL LOSS = 1.55, TOTAL EXCESS = 3.05

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.00-HR
756.	6.50	(CFS)	179.	54.	54.	54.
		(INCHES)	2.516	3.023	3.023	3.023
		(AC-FT)	89.	106.	106.	106.

CUMULATIVE AREA = .66 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	70	1899.	6.83	581.	176.	176.	2.20		
HYDROGRAPH AT	80	1107.	6.83	340.	104.	104.	1.35		
2 COMBINED AT	80T	3006.	6.83	921.	280.	280.	3.55		
ROUTED TO	G	2957.	7.00	918.	278.	278.	3.55		
HYDROGRAPH AT	G	1463.	6.17	245.	74.	74.	.89		
2 COMBINED AT	GT	3406.	6.83	1156.	352.	352.	4.44		
HYDROGRAPH AT	60	836.	6.17	148.	45.	45.	.59		
2 COMBINED AT	60T	3749.	6.67	1304.	397.	397.	5.03		
HYDROGRAPH AT	50	1023.	6.67	299.	91.	91.	1.15		
2 COMBINED AT	50T	4772.	6.67	1602.	487.	487.	6.18		
ROUTED TO	40MT	4747.	6.67	1602.	487.	487.	6.18		
HYDROGRAPH AT	44	898.	6.17	164.	49.	49.	.62		
ROUTED TO	42T	880.	6.33	165.	49.	49.	.62		
HYDROGRAPH AT	43	1787.	6.33	375.	113.	113.	1.39		
ROUTED TO	42T	1744.	6.33	376.	113.	113.	1.39		
HYDROGRAPH AT	42	218.	6.00	25.	8.	8.	.11		
3 COMBINED AT	42T	2692.	6.33	565.	170.	170.	2.12		
ROUTED TO	41T	2638.	6.50	562.	169.	169.	2.12		
HYDROGRAPH AT	41	1095.	6.33	229.	69.	69.	.89		
2 COMBINED AT	41T	3669.	6.50	788.	238.	238.	3.01		
ROUTED TO	40T	3607.	6.67	780.	235.	235.	3.01		
HYDROGRAPH AT	40	641.	6.33	142.	43.	43.	.58		
2 COMBINED AT	40T	4143.	6.67	912.	278.	278.	3.59		
2 COMBINED AT	40MT	8890.	6.67	2512.	765.	765.	9.77		
ROUTED TO	F1T	8692.	6.67	2511.	764.	764.	9.77		
HYDROGRAPH AT	F1	482.	6.17	72.	21.	21.	.26		
2 COMBINED AT	F1T	8833.	6.67	2578.	785.	785.	10.03		
ROUTED TO	F2T	8758.	6.83	2579.	786.	786.	10.03		
HYDROGRAPH AT	F2	488.	6.50	113.	34.	34.	.46		

2 COMBINED AT	F2T	9171.	6.67	2691.	820.	820.	10.49
ROUTED TO	30T	9123.	6.83	2692.	820.	820.	10.49
HYDROGRAPH AT	30	539.	6.50	130.	39.	39.	.50
2 COMBINED AT	30T	9560.	6.83	2822.	859.	859.	10.99
ROUTED TO	F3T	9552.	6.83	2821.	859.	859.	10.99
HYDROGRAPH AT	F3	467.	6.17	71.	21.	21.	.27
2 COMBINED AT	F3T	9657.	6.83	2889.	880.	880.	11.26
ROUTED TO	F4T	9602.	6.83	2885.	879.	879.	11.26
HYDROGRAPH AT	F4	249.	6.00	37.	11.	11.	.14
2 COMBINED AT	F4T	9644.	6.83	2919.	890.	890.	11.40
ROUTED TO	F5T	9600.	6.83	2919.	890.	890.	11.40
HYDROGRAPH AT	F5	671.	6.67	191.	57.	57.	.68
2 COMBINED AT	F5T	10259.	6.83	3110.	948.	948.	12.08
ROUTED TO	F6T	10027.	7.00	3100.	944.	944.	12.08
HYDROGRAPH AT	F6	759.	6.17	128.	38.	38.	.49
2 COMBINED AT	F6T	10221.	6.83	3214.	982.	982.	12.57
HYDROGRAPH AT	25	2191.	6.17	388.	116.	116.	1.41
HYDROGRAPH AT	24	3853.	6.33	815.	244.	244.	2.91
2 COMBINED AT	24T	5927.	6.33	1203.	360.	360.	4.32
ROUTED TO	23T	5706.	6.83	1173.	352.	352.	4.32
HYDROGRAPH AT	23	2314.	6.33	467.	140.	140.	1.71
2 COMBINED AT	23T	7187.	6.67	1617.	492.	492.	6.03
ROUTED TO	22T	7024.	7.17	1597.	484.	484.	6.03
HYDROGRAPH AT	22	712.	6.33	139.	42.	42.	.51
2 COMBINED AT	22T	7213.	7.17	1701.	526.	526.	6.54
ROUTED TO	21T	7098.	7.67	1692.	517.	517.	6.54
HYDROGRAPH AT	21	581.	6.50	137.	41.	41.	.51
ROUTED TO	20T	566.	7.00	135.	41.	41.	.51
HYDROGRAPH AT	20	757.	6.50	171.	52.	52.	.68
3 COMBINED AT	20T	7534.	7.67	1930.	609.	609.	7.73
2 COMBINED AT	20MT	13541.	7.67	5144.	1591.	1591.	20.30
ROUTED TO	10MT	13433.	7.67	5145.	1591.	1591.	20.30
HYDROGRAPH AT	14	1590.	6.33	353.	106.	106.	1.25

ROUTED TO	13T	1587.	6.50	351.	105.	105.	1.25
HYDROGRAPH AT	13	199.	6.17	32.	10.	10.	.15
2 COMBINED AT	13T	1701.	6.50	382.	115.	115.	1.40
HYDROGRAPH AT	12	2348.	6.50	529.	158.	158.	1.89
2 COMBINED AT	12T	4049.	6.50	910.	273.	273.	3.29
ROUTED TO	11A	3967.	6.67	902.	270.	270.	3.29
HYDROGRAPH AT	11A	621.	6.17	94.	28.	28.	.37
2 COMBINED AT	11AT	4179.	6.67	985.	299.	299.	3.66
HYDROGRAPH AT	11	1092.	6.50	269.	81.	81.	.99
2 COMBINED AT	11T	5232.	6.67	1253.	379.	379.	4.65
ROUTED TO	10T	5070.	7.00	1239.	374.	374.	4.65
HYDROGRAPH AT	10	1093.	6.50	263.	79.	79.	.96
2 COMBINED AT	10T	5763.	7.00	1475.	453.	453.	5.61
2 COMBINED AT	10MT	16962.	7.00	6620.	2044.	2044.	25.91
ROUTED TO	ET	16861.	7.67	6515.	2002.	2002.	25.91
HYDROGRAPH AT	E	1262.	6.50	291.	88.	88.	1.11
2 COMBINED AT	ET	17136.	7.67	6636.	2090.	2090.	27.02
HYDROGRAPH AT	2	985.	6.83	306.	92.	92.	1.06
ROUTED TO	1T	979.	7.33	303.	91.	91.	1.06
HYDROGRAPH AT	1	756.	6.50	179.	54.	54.	.66
2 COMBINED AT	IT	1305.	7.17	473.	144.	144.	1.72

SUMMARY OF KINEMATIC WAVE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
G	3	1.48	3003.59	415.69	2.92	10.00	2957.17	420.00	2.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= 554.538 EXCESS= .000 OUTFLOW= 552.860 BASIN STORAGE= 1.488 PERCENT ERROR= .034

40MT	3	.62	4771.58	401.22	2.93	10.00	4747.14	400.00	2.93

NTINUITY SUMMARY (AC-FT) - INFLOW= 966.267 EXCESS= .000 OUTFLOW= 965.663 BASIN STORAGE= .542 PERCENT ERROR= .006

42T	3	1.09	896.75	372.89	2.96	10.00	879.65	380.00	2.97

NTINUITY SUMMARY (AC-FT) - INFLOW= 97.735 EXCESS= .000 OUTFLOW= 98.010 BASIN STORAGE= .130 PERCENT ERROR= -.414

42T	3	.68	1784.20	381.28	3.01	10.00	1743.78	380.00	3.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= 223.457 EXCESS= .000 OUTFLOW= 223.253 BASIN STORAGE= .170 PERCENT ERROR= .015

41T	3	1.85	2691.50	387.43	2.96	10.00	2638.23	390.00	2.96

NTINUITY SUMMARY (AC-FT) - INFLOW= 336.968 EXCESS= .000 OUTFLOW= 335.079 BASIN STORAGE= 1.306 PERCENT ERROR= .173

40T	3	1.61	3657.58	404.73	2.91	10.00	3607.43	400.00	2.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= 471.744 EXCESS= .000 OUTFLOW= 467.572 BASIN STORAGE= 3.243 PERCENT ERROR= .197

F1T	3	1.37	8863.40	403.57	2.91	10.00	8691.56	400.00	2.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= 1517.886 EXCESS= .000 OUTFLOW= 1515.293 BASIN STORAGE= 1.894 PERCENT ERROR= .046

F2T	3	.43	8831.46	401.09	2.91	10.00	8757.89	410.00	2.91

ONTINUITY SUMMARY (AC-FT) - INFLOW= 1557.937 EXCESS= .000 OUTFLOW= 1557.271 BASIN STORAGE= .569 PERCENT ERROR= .006

30T	3	.68	9168.82	401.69	2.90	10.00	9123.46	410.00	2.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= 1626.067 EXCESS= .000 OUTFLOW= 1624.981 BASIN STORAGE= .945 PERCENT ERROR= .009

F3T	3	.84	9559.48	411.56	2.90	10.00	9551.84	410.00	2.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= 1704.221 EXCESS= .000 OUTFLOW= 1702.528 BASIN STORAGE= 1.229 PERCENT ERROR= .027

F4T	3	1.25	9639.20	411.69	2.90	10.00	9601.81	410.00	2.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= 1746.116 EXCESS= .000 OUTFLOW= 1743.638 BASIN STORAGE= 1.894 PERCENT ERROR= .033

F5T	3	.42	9642.92	410.85	2.90	10.00	9600.01	410.00	2.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= 1765.501 EXCESS= .000 OUTFLOW= 1764.632 BASIN STORAGE= .642 PERCENT ERROR= .013

F6T	3	1.54	10255.95	414.57	2.91	10.00	10027.05	420.00	2.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= 1879.714 EXCESS= .000 OUTFLOW= 1873.689 BASIN STORAGE= 3.989 PERCENT ERROR= .108

23T	3	1.66	5901.79	406.11	3.05	10.00	5705.73	410.00	3.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= 714.419 EXCESS= .000 OUTFLOW= 703.669 BASIN STORAGE= 9.270 PERCENT ERROR= .207

22T	3	1.67	7148.75	423.42	2.99	10.00	7024.40	430.00	2.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= 976.277 EXCESS= .000 OUTFLOW= 962.074 BASIN STORAGE= 12.884 PERCENT ERROR= .135

21T	3	1.68	7150.67	459.19	2.94	10.00	7098.12	460.00	2.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= 1042.579 EXCESS= .000 OUTFLOW= 1023.940 BASIN STORAGE= 17.331 PERCENT ERROR= .125

20T	3	3.26	575.74	417.54	2.97	10.00	565.58	420.00	2.97

CONTINUITY SUMMARY (AC-FT) - INFLOW= 82.073 EXCESS= .000 OUTFLOW= 80.800 BASIN STORAGE= 1.000 PERCENT ERROR= .333

10MT	3	.38	13530.48	460.81	2.91	10.00	13432.91	460.00	2.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= 3156.599 EXCESS= .000 OUTFLOW= 3155.174 BASIN STORAGE= 1.111 PERCENT ERROR= .010

13T	3	2.64	1587.73	387.86	3.12	10.00	1586.90	390.00	3.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= 209.371 EXCESS= .000 OUTFLOW= 208.094 BASIN STORAGE= .841 PERCENT ERROR= .208

11A	3	1.91	4029.99	402.55	3.06	10.00	3966.73	400.00	3.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= 541.104 EXCESS= .000 OUTFLOW= 536.934 BASIN STORAGE= 3.434 PERCENT ERROR= .136

10T	3	1.79	5204.37	424.08	2.99	10.00	5070.08	420.00	2.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= 752.292 EXCESS= .000 OUTFLOW= 742.268 BASIN STORAGE= 8.981 PERCENT ERROR= .139

ET	3	1.37	16960.74	458.32	2.88	10.00	16861.10	460.00	2.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= 4054.182 EXCESS= .000 OUTFLOW= 3975.912 BASIN STORAGE= 79.873 PERCENT ERROR= -.040

1T	3	2.81	983.43	438.52	3.18	10.00	979.48	440.00	3.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= 182.373 EXCESS= .000 OUTFLOW= 179.560 BASIN STORAGE= 2.353 PERCENT ERROR= .252

*** NORMAL END OF HEC-1 ***

TABLE OF CONTENTS

		PAGE
1.	INTRODUCTION	1
2.	OBJECTIVE	1
3.	PROJECT DESCRIPTION	2
4.	PROCEDURES	5
	4.1 HEC-1 Analysis	5
	4.2 Recent Flood Events	7
	4.3 Historic Streamflow Comparison	8
	A. Cave Creek	8
	B. USGS 100-Year Peak Discharge Values	11
5.	RESULTS	13
6.	REFERENCES	18

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TABLES

		PAGE
1.	Runoff Curve Values, Hydrologic Soil Type	6
2.	Basin Length and Slope Characteristics	10
3.	Real Time to Peak for Apache Wash Sub-Basins	10
4.	HEC-1, Apache Wash 100-Year Flow Cumulative Values	16

FIGURES

1.	Location Map	4
2.	Apache Wash Regional Correlation of Discharge vs. Drainage Area	12
3.	Apache Wash Drainage Network Schematic for HEC-1 Model	15
4.	Watershed Map (Folder)	

APPENDIX

1. Apache Wash Sub-Basin Characteristics
2. Drainage Basin Data
3. Rainfall Map
4. Soil Maps
5. HEC-1 Input/Output Files

Apache Wash Hydrology Technical Data Notebook (By Separate Cover)

1. INTRODUCTION

The Apache Wash Basin is located in northern Maricopa County, Arizona. The total basin area is 29 square miles of which 9 square miles lies within the incorporated limit of the City of Phoenix and 20 square miles lie within unincorporated Maricopa County. Under the authority of the Flood Control District of Maricopa County (FCDMC) and in cooperation with the City of Phoenix, the basin hydrology for the upper 27 square miles was studied as part of a Federal Emergency Management Agency (FEMA) flood insurance study. This basin hydrology study utilizes a previous basin study prepared by Jerry R. Jones & Associates, Inc. (JJA/DEA). The U.S. Army Corps of Engineers' HEC-1, 1988 Kinematic Wave Routing Method was utilized in the study to determine the 100-year, 24-hour peak discharges for existing conditions along Apache Wash and its tributaries, Jonathan Wash, West Branch of Desert Hills Wash, Desert Hills Wash, Paradise Wash, and Ranieri Wash. Additionally, Mesquite Tank Wash was studied as a separate basin. (The wash names are presently under review by the U.S. Geological Survey for approval.)

2. OBJECTIVE

The objective of this study is to determine the 100-year peak flow values at key concentration points for use in floodplain mapping and floodway delineation for the Apache Wash Flood Insurance Rate Study. For this study, the Arizona Department of Water Resources (ADWR) provided the critical input information for modelling the Apache Wash Basin hydrology. The ADWR has previously reviewed and approved the

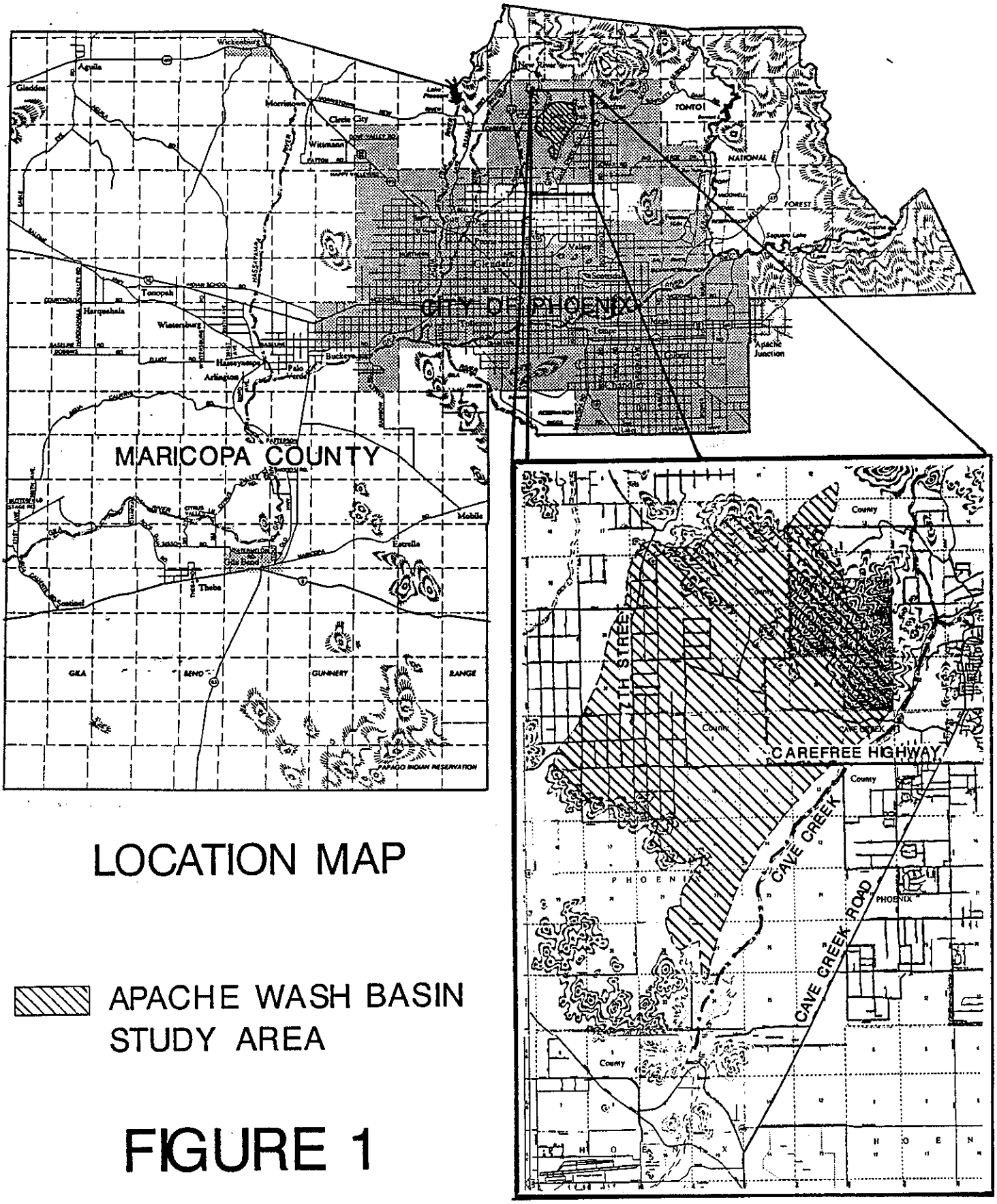
methodology and discharge values of this study. The approval letter from ADWR dated December 6, 1990 and from the City of Phoenix dated December 19, 1991 are contained in the Apache Wash Hydrology Technical Data Notebook (by separate cover).

3. PROJECT DESCRIPTION

The Apache Wash Basin is located north of Phoenix and west of Cave Creek Basin as shown on the Location Map. The basin is generally rural vacant land with typical Sonoran Desert vegetation. The Apache Wash Basin is within the Basin and Range Geologic Zone resulting in steep upland topography in the Cave Creek Recreation Area and Apache Peak areas with slopes of 2% to 5% and relatively flat valley floors with slopes of 0.4% to 1%. Differences in terrain, slope and vegetation were utilized in establishing sub-basins for the HEC-1 flood routing.

The Apache Wash Basin was previously studied by JJA/DEA for the City of Phoenix as part of an Area Drainage Master Study, Apache Wash Drainage/Storm Drain Master Plan. The purpose of this original study was to determine a master plan to accommodate runoff for existing and future watershed conditions. Additionally, a flood damage mitigation plan and capital improvement plan was developed. Since the purpose of the study was to determine alternative conditions and to establish design criteria for capital improvements, five alternative cases for computing 100-year runoff values were utilized. This current study applies the same basin characteristics as used in the Phoenix Study; however, a different method for lag time calculations was used, per FCDMC and

ADWR. As a result, the 100-year runoff values may differ from the original studies. This current study is intended to develop acceptable 100-year flood peak values for existing condition to prepare FEMA floodplain limits.



LOCATION MAP

APACHE WASH BASIN STUDY AREA

FIGURE 1

4. PROCEDURES

4.1 HEC-1 Analysis

Field investigations and site reconnaissance visits were undertaken to verify flow patterns, vegetative cover densities, basin roughness values, channel slopes and parameters, drainage structures, and level of "man-made improvement and encroachments". The watershed boundaries were also field verified and checked against the adjacent basin boundaries for Skunk Creek, East Biscuit Flat, and Cave Creek. The effect of stock tanks were not directly utilized in this study since their detention effect is negligible; however, the stock tanks were accounted for with channel roughness values.

The U.S. Army Corps of Engineers HEC-1 computer program was utilized to route and quantify flows for a 24-hour, 100-year storm. The HEC-1 Kinematic Wave Routing was performed using a finite difference algorithm, 1988 version. The Soil Conservation Service Type II rainfall distribution with a 30 minute computational interval and the SCS Hydrologic Method and basin characteristic parameters were used. The Runoff Curve Number (RCN's) were obtained from the SCS-TR-55 (1986). From field investigations, a poor cover density rating was chosen for the Desert Shrub RCN classification. Impervious values were determined from the field investigation and are reflected in the SCS curve number loss rate in the HEC-1 model. Where applicable, RCN values were also taken from the Residential District Classification and the Western Desert Urban Area Classification. RCN values are listed in Table 1.

TABLE 1: RUNOFF CURVE NUMBERS HYDROLOGIC SOIL TYPE			
TYPE	B	C	D
Desert Shrub	77	85	88
Residential District (1 RAC)	68	79	84
Western Desert Urban Area: Natural Desert Landscaping	77	85	88

The RCN's for the Residential District have correspondingly lower runoff values than the Desert Shrub and Western Desert Urban Area Classification. The higher RCN's from the Desert Shrub Classification were chosen for their conservative results. The Desert Shrub classification is also the only one of the three classification which accounts for varying vegetative cover densities. Lag time calculations utilized the U.S. Bureau of Reclamation Method as provided in the Hydrologic Manual for Maricopa County, eq-11, pg 79, where:

$$Lag = c\left(\frac{LL_{ca}}{S^{p}}\right)^{M}$$

Lag	=	Basin lag in hours
L	=	Length of longest watercourse, in miles
L_{ca}	=	Length along watercourse to a point opposite the centroid in miles
S	=	Watercourse sloped in feet per mile
C	=	26 Kn
Kn	=	Estimated mean Manning's "n" = hydraulic efficiency
M	=	0.33
P	=	0.5

In consultation with the Arizona Department of Water Resources (ADWR) the results of the previous City of Phoenix study were reviewed. Adjustments were made to the HEC-1 model to account for basin Manning "n" values as approved by ADWR and the Flood Control District for the Flood Insurance Study and the basin lag times. These "n" values are averages of the channel "n" values which vary from 0.022 to 0.059 and the overbank "n" values which vary from 0.032 to 0.070. In the previous study for the City of Phoenix, the lag times utilized in the HEC-1 models were either the SCS lag method (Model 1.1) or the Pima County Time of Concentration Method (Model 1.2). For this HEC-1 Model for the FIS, the USBR lag time method was utilized as described in the Hydrologic Design Manual for Maricopa County, Arizona. For the current study, the latter results are utilized.

4.2 Recent Flood Events

The Flood Control District has on file a report concerning a flood event of August 28, 1988. This report is the most comprehensive record of flooding problems in the Apache Wash Study area. The flows from the August 28, 1988 event were generated by approximately a 10-year storm event. Several field investigations were made to verify the report and check the flood prone areas. The City of Phoenix does not have any flooding complaints on file in the Apache Wash Area.

4.3 Historic Streamflow Comparison

As part of the HEC-1 model analyses verification, the results from the HEC-1 model were compared to similar watersheds in Central Arizona and their corresponding historic peak flow.

A. Cave Creek

The Flood Control District had prepared an analysis of the peak flow prediction for Cave Creek using their Hydrologic Design Manual method (HDM method), the SCS method, and the flow frequency analysis using thirty years of stream flow values.

The results of the Hydrologic Design Manual compared closely with the thirty years of stream flow analysis. The SCS method provided peak values that were approximately 30% higher for the entire 126 square mile basin, but for sub-basins of 25 square miles or less (similar in size to the Apache Wash basin size of 27 square miles) the SCS method peak values are approximately 10.7% higher than the HDM peak values. For smaller watersheds the methods compared fairly well. Since Apache Wash Basin is adjacent to the Cave Creek Basin, peak values from the HEC-1 model for Apache Wash were compared to the Cave Creek peak values obtained from the SCS method and the HDM method. The initial HEC-1 values for Apache Wash provide 1.06 cfs/acre of runoff for a 25 square mile basin as compared to 0.88 cfs/acre, from SCS Method, and 0.78 cfs/acre from the HDM method; and 1.33 cfs/acre for a 10 square mile basin as compared to 1.05 cfs/acre, from the SCS Method, and 0.94 cfs/acre from the HDM

method. The smaller sized basins of 5 square miles or less match well for all three methods.

The Apache Wash HEC-1 routing was then modified so that for the 27 square mile basin the runoff rate was 0.97 cfs/acre and for the 10 square mile basin the runoff values were 1.33 cfs/ac. The difference in runoff value per acre between Cave Creek and Apache Wash may be due in part to the difference in basin shapes and configuration. A comparison of small basins less than 1 square mile in size and basins 1 square mile to 4 square miles shows that the Apache Wash sub-basins have generally shorter channel lengths and therefore shorter lag times and higher peak flows.

Apache Wash has a basin area of 27 square miles and may be impacted basin wide by a single convective storm cell. This study utilizes the 24-hour, 100-year storm of 4.6 inches. Cave Creek has a basin area of 126 square miles and, therefore, it is unlikely that a storm event would impact the entire basin at one time. FCDMC utilized a 6-hour, 100-year storm of 3.6 inches.

TABLE 2: BASIN LENGTH AND SLOPE CHARACTERISTICS				
	1 Sq. Mile		4 Sq. Mile	
	L(ft)	S (ft/ft)	L (ft)	S (ft/ft)
Cave Creek	15000	0.018	44,000	0.022
Apache Wash	12152	0.020	28,933	0.0195

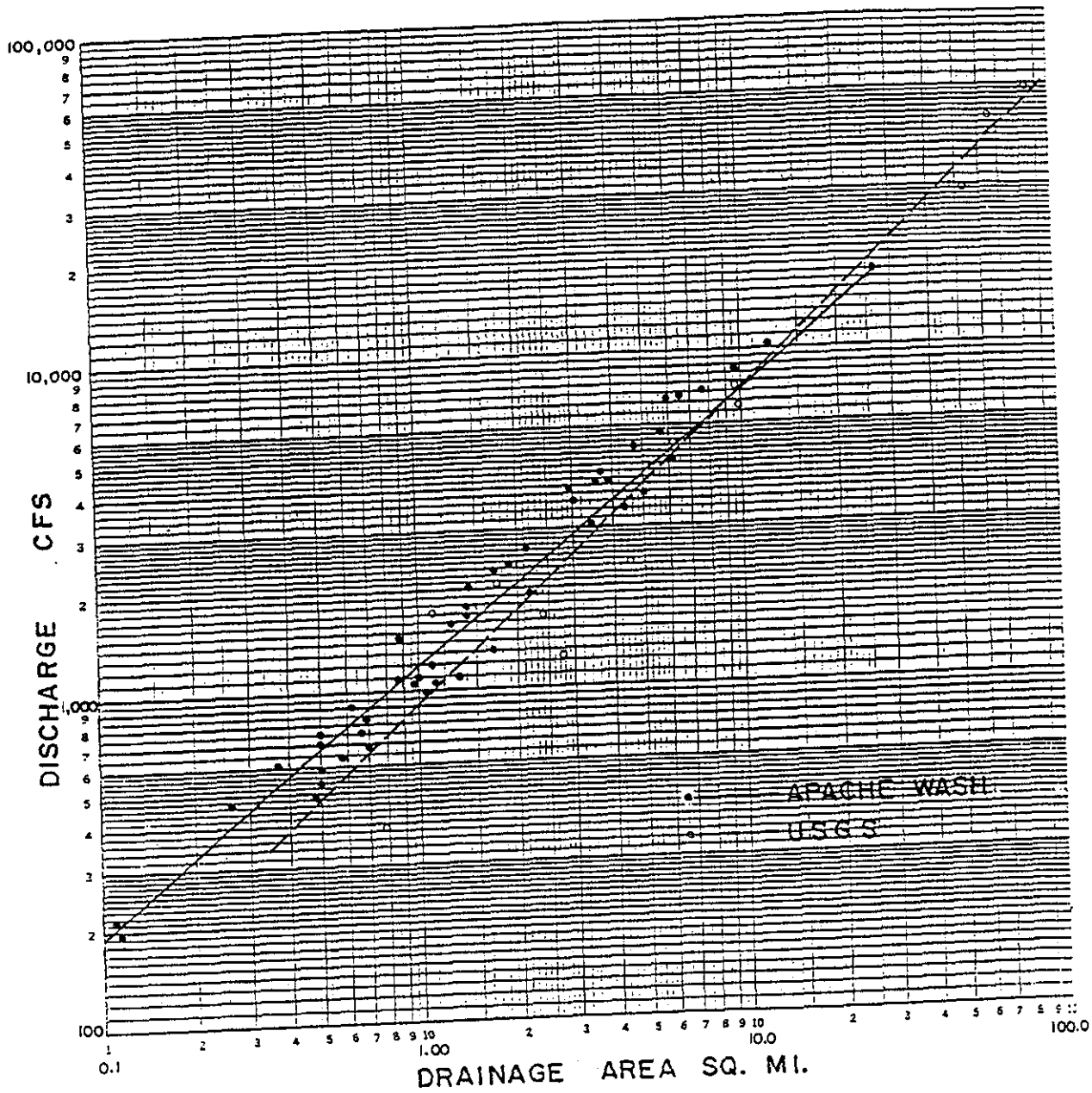
Additionally, the shape and configuration of the larger sub-basins, Desert Hills Wash, upper Apache Wash, and Paradise Wash cause the peak discharge from all of these three major sub-basins to arrive at the Apache Wash downstream channel at similar times. This overlap of the time of concentration for the three basins results in higher downstream peak flows than are typical for Cave Creek.

TABLE 3: REAL TIME TO PEAK FOR APACHE WASH SUB-BASIN		
HEC-1 WASH	TIME OF PEAK STA.	HRS.
Apache, Upstream	20T	7.67
Desert Hills	F6T	6.83
Paradise	10T	7.0

B. USGS 100-Year Peak Discharge Values

In addition to reviewing the Cave Creek data, stream gage data for small basins obtained from the USGS for streams within Maricopa County was reviewed. The USGS 100-year peak runoff result was a 1.23 cfs/acre compared to 1.33 cfs/acre for the Apache Wash HEC-1 results. A larger sample of stream flow data was obtained from the USGS for stream gage data published to 1988 and from Rod Roeske's, 1979 Report on 100-year discharges for small basins in Arizona computed using the Log Pearson Type III method. The peak discharge data for these basins is quite scattered. However, when stream flow records of basins with less than 20 years of stream flow data were eliminated, a better correlation between basin size and peak discharge values was obtained as shown on the attached figure of discharge versus drainage area plotted on log-log papers.

The results for basins larger than 1 square mile showed good correlation between the USGS values and the Apache Wash HEC-1 values. However, basins less than 1 square mile in size provided scattered data points. These smaller basins have a wide variation in slopes, from 0.4% to 4.9%, which accounts for the wide variation of runoff values.



APACHE WASH: REGIONAL CORRELATION OF DISCHARGE VS DRAINAGE AREA

5. RESULTS

The final HEC-1 model results after calibration are shown on the Basin Map and Flow Schematic Diagram. Individual sub-basins have been modelled in greater detail than in the City of Phoenix study. This is especially true for sub-basin F which has been subdivided into 6 individual basins to provide greater detail along Desert Hills Wash. The individual sub-basins' 100-year peak flow and the cumulative 100-year peak flow are listed in Table 4 and shown on the Basin Map.

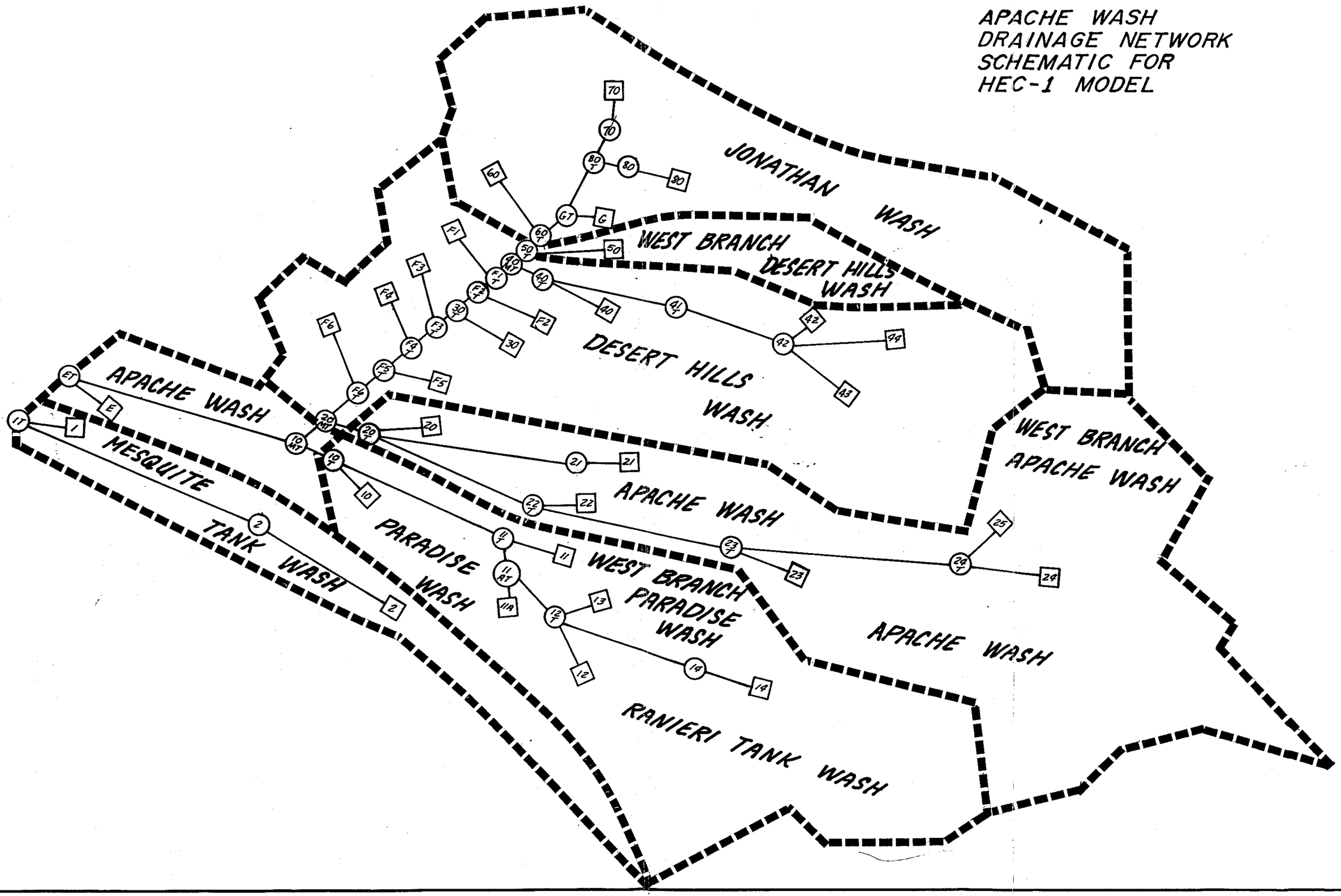
The Apache Wash watershed hydrology was modelled for the Flood Insurance Study (FIS) using the HEC-1 model with Kinematic Wave Routing. Adjustments and calibrations were made based upon:

1) Manning "n" values as accepted by the Flood Control District and ADWR for the FIS, HEC-2 floodplain delineation;

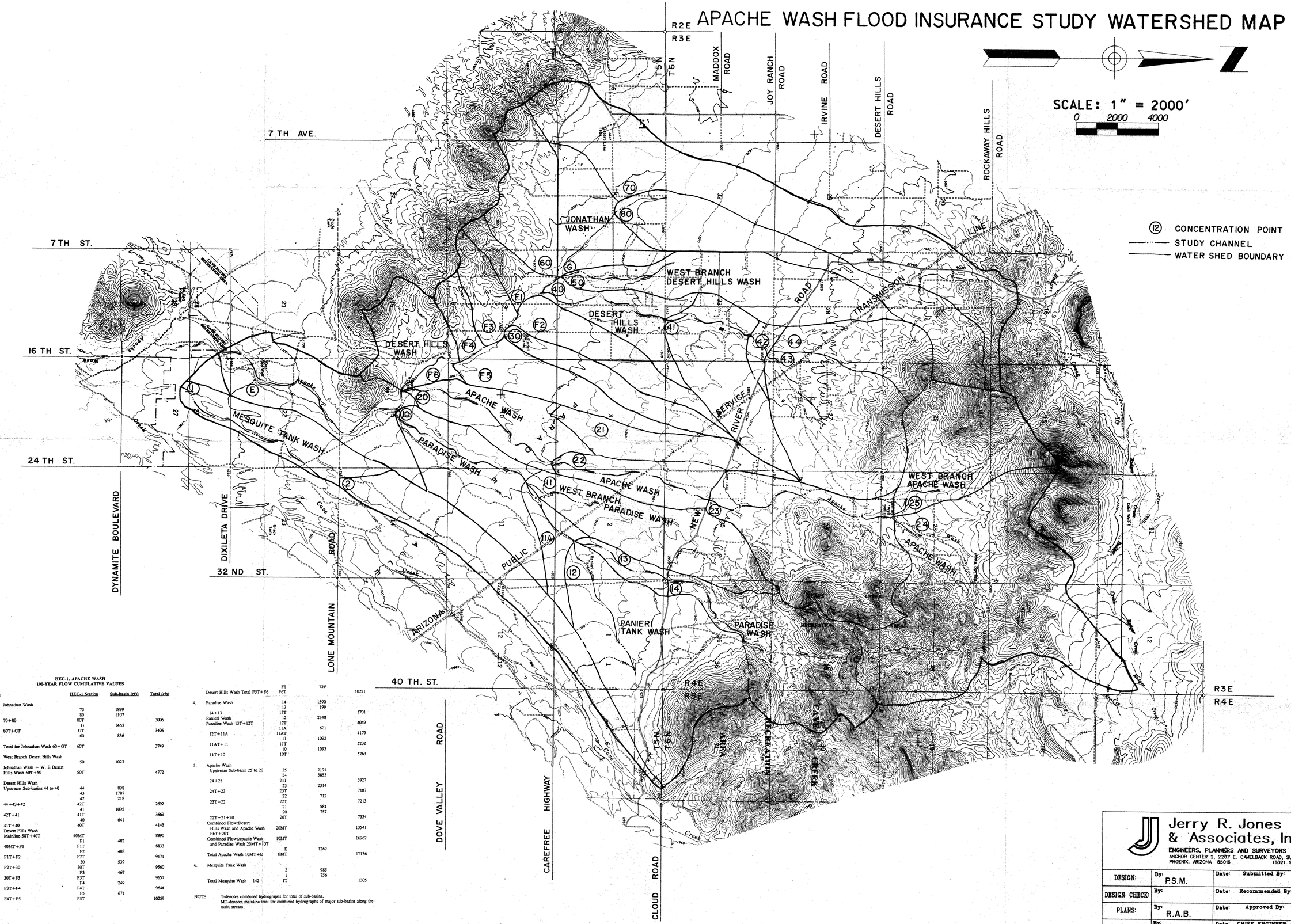
2) The U.S.B.R. lag time method as outlined in the Hydrologic Design Manual for Maricopa County was utilized since the HDM method for computation of peak flow is closely correlated to flood frequencies analyses derived from Log Pearson Type II;

3) Apache Wash HEC-1 peak flows were compared to USGS stream flow gauge data and peak flow analyses for calibration of the model; and

4) While the Apache Wash HEC-1 results typically provide higher runoff per acre values and higher peak discharge values the other basin of comparable size, the unique basin characteristic for Apache Wash would account for these higher values. Specific watershed characteristics include upstream basin with short flow path and steep gradients of up to 4.9%, and that the major sub-basins, Upper Apache Wash, Desert Hills Wash and Paradise Wash, all join at a central downstream point with similar real time for peak flows.


APACHE WASH
DRAINAGE NETWORK
SCHEMATIC FOR
HEC-1 MODEL
JONATHAN WASH
WEST BRANCH DESERT HILLS WASH
DESERT HILLS WASH
APACHE WASH
MESQUITE TANK WASH
PARADISE WASH
WEST BRANCH PARADISE WASH
APACHE WASH
WEST BRANCH APACHE WASH
APACHE WASH
RANIERI TANK WASH

APACHE WASH FLOOD INSURANCE STUDY WATERSHED MAP



HEC-1, APACHE WASH
100-YEAR FLOW CUMULATIVE VALUES

Basin	HEC-1 Station	Sub-basin (cfs)	Total (cfs)
1. Johnathan Wash			
	70	1899	
	80	1107	
70+80	80T		3006
	G	1463	
80T+GT	GT		3406
	60	836	
Total for Johnathan Wash 60+GT	60T		3749
2. West Branch Desert Hills Wash			
	50	1023	
Johnathan Wash + W. B Desert Hills Wash 60T+50	50T		4772
3. Desert Hills Wash			
Upstream Sub-basins 44 to 40	44	898	
	43	1787	
	42	218	
44+43+42	42T		2692
	41	1095	
42T+41	41T		3669
	40	641	
41T+40	40T		4143
Desert Hills Wash Mainline 50T+40T	40MT		8890
	F1	482	
40MT+F1	F1T		8833
	F2	488	
F1T+F2	F2T		9171
	30	539	
F2T+30	30T		9560
	F3	467	
30T+F3	F3T		9657
	F4	249	
F3T+F4	F4T		9644
	F5	671	
F4T+F5	F5T		10259
	F6	759	
Desert Hills Wash Total F5T+F6	F6T		10221
4. Paradise Wash	14	1590	
	13	199	
14+13	13T		1701
Ranieri Wash	12	2348	
Paradise Wash 13T+12T	12T		4049
	11A	621	
12T+11A	11AT		4179
	11	1092	
11AT+11	11T		5232
	10	1093	
11T+10	10T		5763
5. Apache Wash			
Upstream Sub-basin 25 to 20	25	2191	
	24	3853	
24+25	24T		5927
	23	2314	
24T+23	23T		7187
	22	712	
23T+22	22T		7213
	21	581	
	20	757	
22T+21+20	20T		7534
Combined Flow:Desert Hills Wash and Apache Wash F6T+20T	20MT		13541
Combined Flow:Apache Wash and Paradise Wash 20MT+10T	10MT		16962
	E	1262	
Total Apache Wash 10MT+E	EMT		17136
6. Mesquite Tank Wash			
	2	985	
	1	756	
Total Mesquite Wash 142	1T		1305

NOTE: T-denotes combined hydrographs for total of sub-basins.
MT-denotes mainline total for combined hydrographs of major sub-basins along the main stream.

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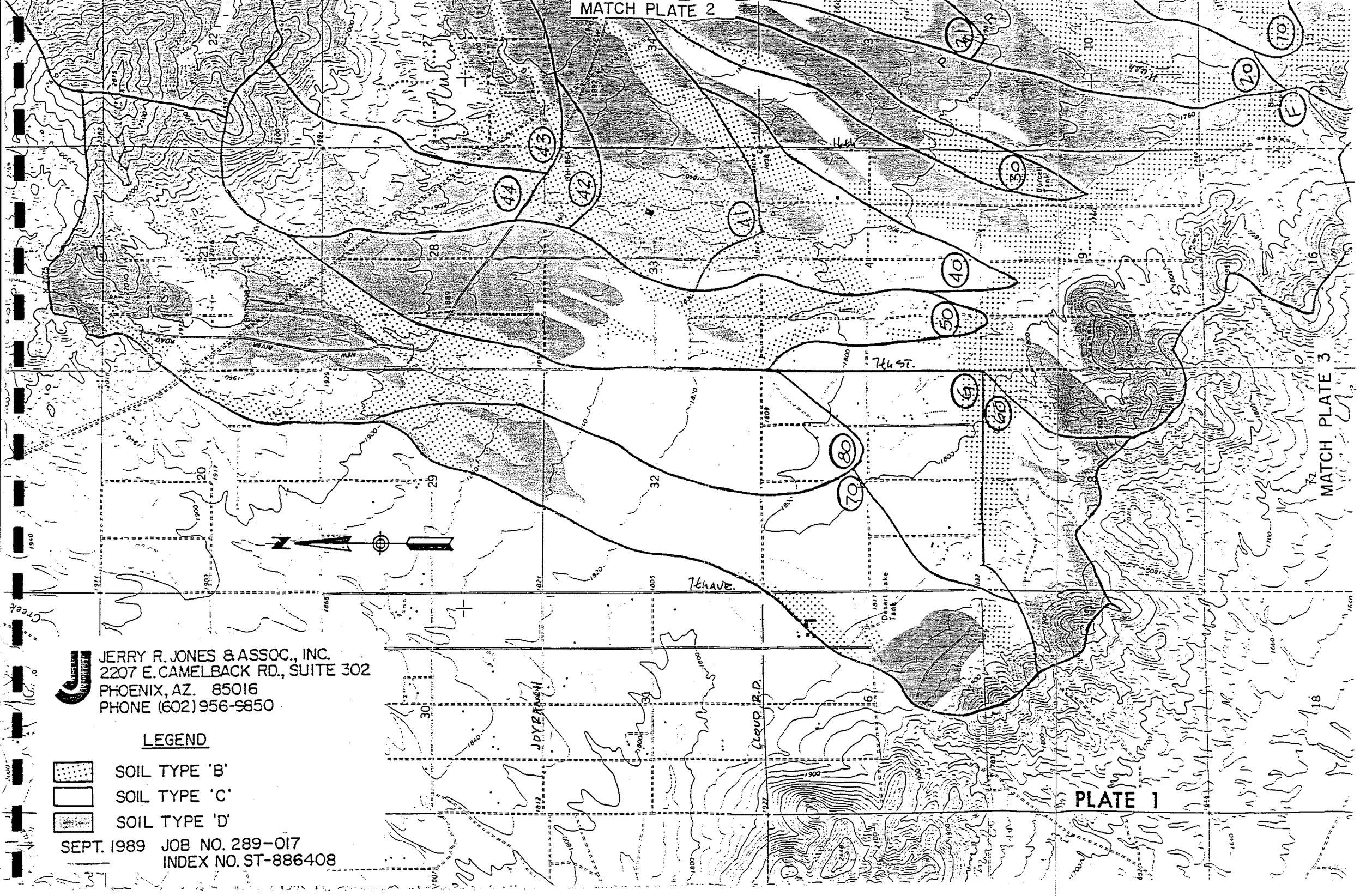
DESIGN:	By: P.S.M.	Date:	Submitted By:	Date:
DESIGN CHECK:	By:	Date:	Recommended By:	Date:
PLANS:	By: R.A.B.	Date:	Approved By:	Date:
PLANS CHECK:	By:	Date:	CHIEF ENGINEER AND GENERAL MANAGER	

SHEET: OF:


MATCH PLATE 2
MATCH PLATE 3
PLATE 1
74 ST.
74 AVE.
CLOUD RD.
JOY RANCH
Desert Lake Tank
Tucker Tank
NEW RIVER ROAD
Creek
LEGEND
SOIL TYPE 'B'
SOIL TYPE 'C'
SOIL TYPE 'D'
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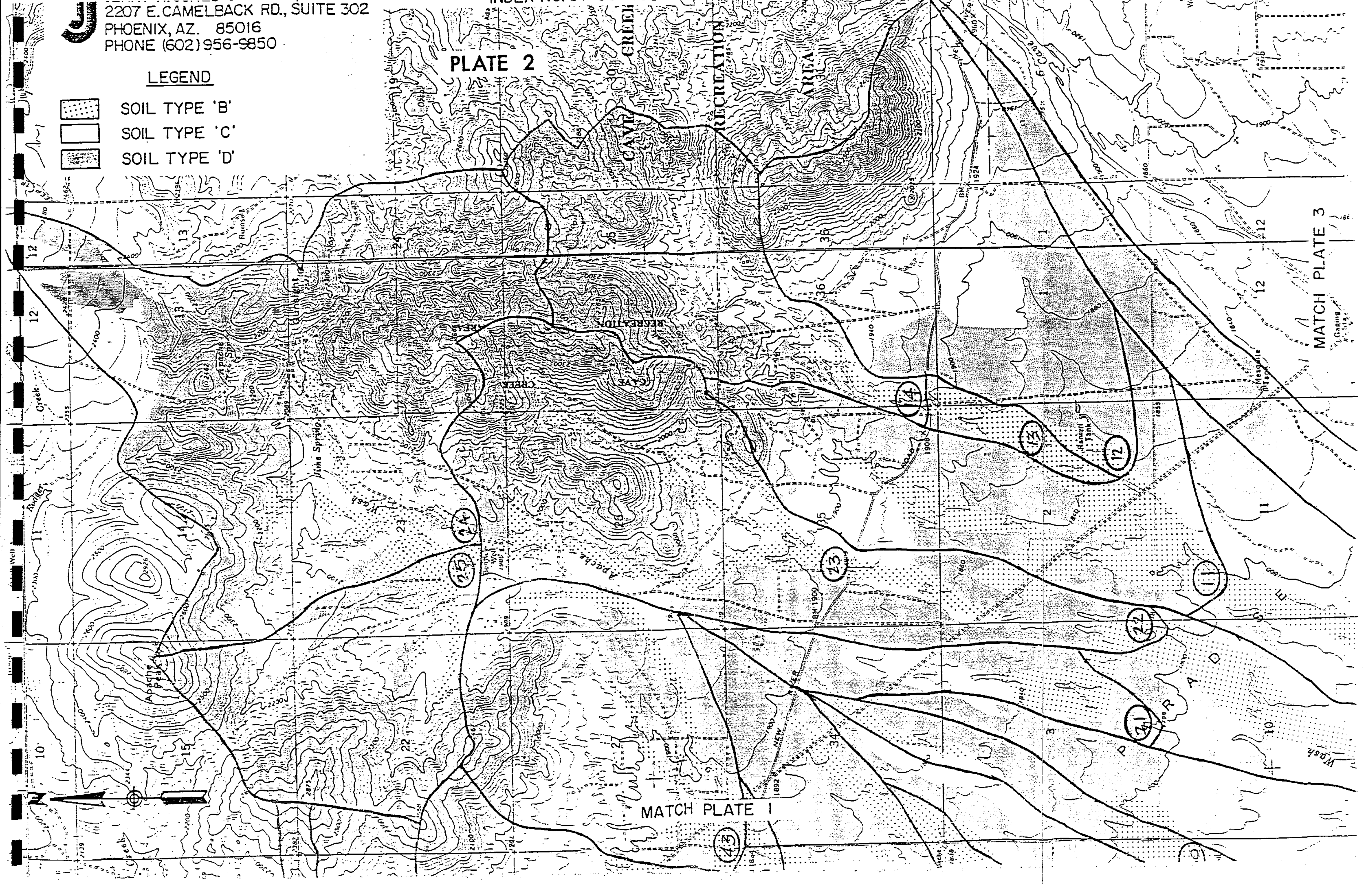
SEPT. 1989 JOB NO. 289-017
INDEX NO. ST-886408



2207 E. CAMELBACK RD., SUITE 302
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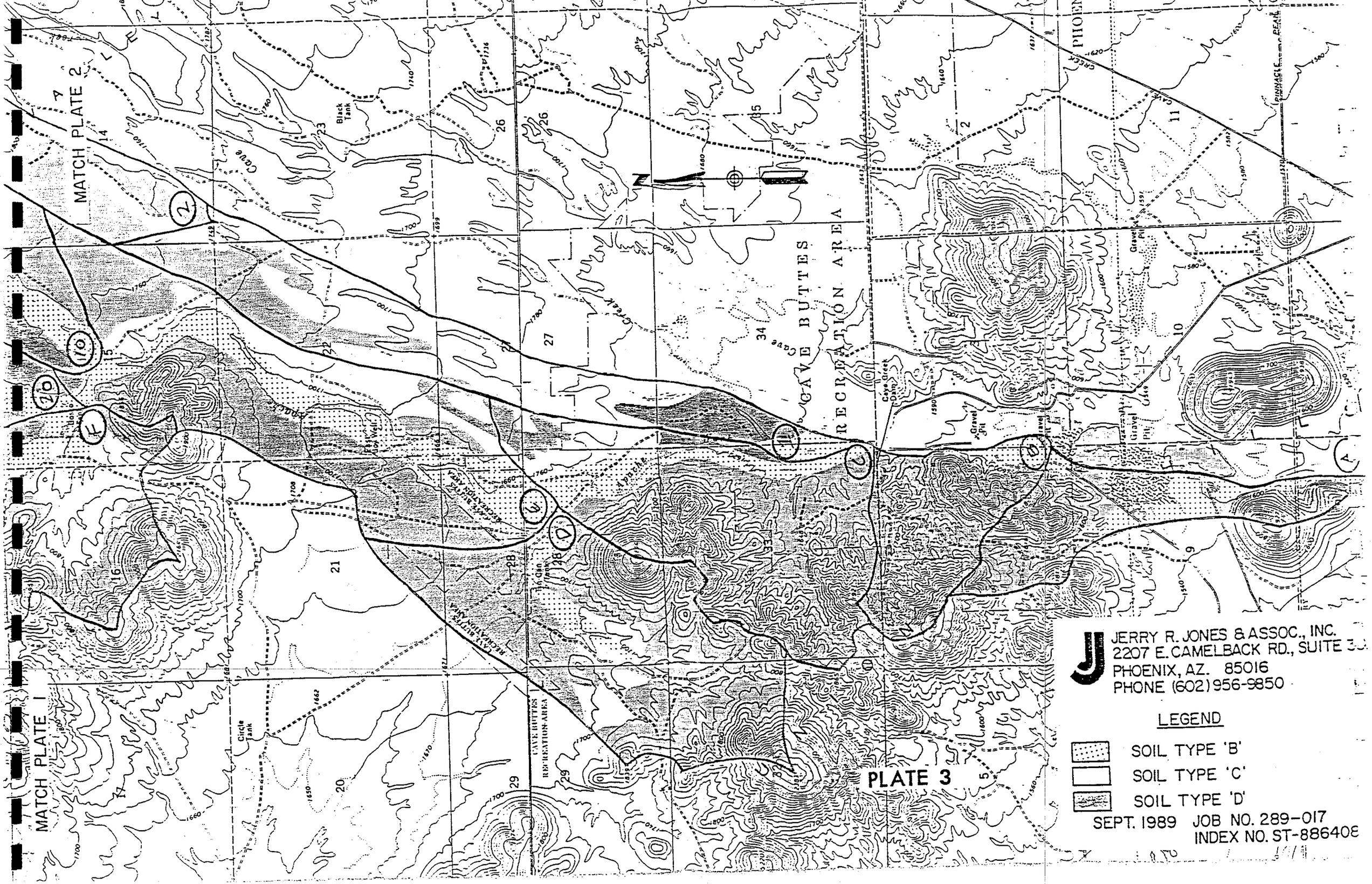
PHONE (602) 956-9850
PLATE 2
LEGEND
SOIL TYPE 'B'
SOIL TYPE 'C'
SOIL TYPE 'D'
CAVE CREEK RECREATION AREA
MATCH PLATE 3
MATCH PLATE 1
Apache Peak
Apache Sp
Apache Wash
PARADISE
14
13
12
11
21
22
23
24
25
43


MATCH PLATE 2
MATCH PLATE 1
CAVE BUTTES RECREATION AREA
Black Tank
Circle Tank
Cave Creek Dam
Gravel Pit
PHOENIX
PLATE 3
JERRY R. JONES & ASSOC., INC.
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LEGEND
SOIL TYPE 'B'
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