STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION TITLE PAGE

ENT & PROJECT	PAGE 1 OF 66
PFSLLC / PRIVATE FUEL STORAGE FACILITY	
CALCULATION TITLE **PFSF Rail Line - Runoff Analysis and Culvert Sizing**	QA CATEGORY (X) ___ I - NUCLEAR SAFETY RELATED ___ II _X_ III ___ OTHER

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
05996.02	CIVIL	SY-11	NA	NA

APPROVALS - SIGNATURE & DATE			REV. NO. OR NEW CALC. NO	SUPERSEDES CALC. NO. OR REV. NO.	CONFIRMATION REQUIRED (X)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
Timothy Hughes 8/23/1999 Timothy Hughes	Yung Shen 8/24/1999 YShen	N/A	0	NA		X

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CALCULATION SHEET

J.O./W.O./CALCULATION NO.	REVISION	PAGE
05996.02-SY-11	0	2

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER
Timothy Hughes 8/23/1999	Yung Shen 8/24/1999	N/A

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
SF Rail Line – Runoff Analysis and Culvert Sizing	III

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(Revisions, Additions, Deletions, Etc.)

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RECORD OF REVISIONS

REVISION 0

Original Issue

CALCULATION SUMMARY

OBJECTIVE OF CALCULATION:

The purpose of this calculation is to calculate peak surface runoff rates for the basins described in Calculation SY-10 and to estimate the numbers and sizes of culverts to handle the peaks.

CALCULATION METHOD/ASSUMPTIONS:

25-Yr, 24-Hr and 100-Yr, 24-Hr storms were considered. Watercourse lengths, slopes, and areas from Calculation SY-10 were used. Storm precipitation values were obtained from NOAA Atlas 2, Volume VI. Peak runoff rates were calculated using the HydroCAD computer program, which uses TR-20 methodology. Soil Conservation Service CN=70 was assumed, based on Calculations G(B)-12 and G(B)-16. Culvert sizes considered were 2'-, 3'- and 4'-diameter CMP. Preliminary culvert sizing was done using the Hydrocalc computer program, assuming a 1 percent slope and a maximum headwater of about a foot over the inlet crown.

SOURCES OF DATA/EQUATIONS:

1. Calculation SY-10, J.O. #05996.02, "PFSF Rail Line - Determination of Drainage Basin Areas", Stone & Webster, 8/10/1999.

2. Calculation G(B)-12, J.O. #05996.02, "PFSF Flood Analysis with Larger Drainage Basin", Stone & Webster, 3/22/1999.

3. Calculation G(B)-16, J.O. # 05996.02, "PFSF Flood Analysis at 3-mile-long Portion of Rail Spur", Stone & Webster, 3/9/1999.

4. Precipitation Frequency Atlas of the Western United States, NOAA Atlas 2, Volume VI, Utah, U.S. Dept. of Commerce, Silver Spring, MD, 1973.

5. HydroCAD Stormwater Modeling System, Version 4.52, Applied Microcomputer Systems, Chocorua, NH.

6. HYDROCALC Hydraulics for Windows, Version 1.1, Dodson & Associates, Houston, TX.

CONCLUSIONS:

Peak runoff rates and preliminary culvert numbers and sizes are summarized on page 66.

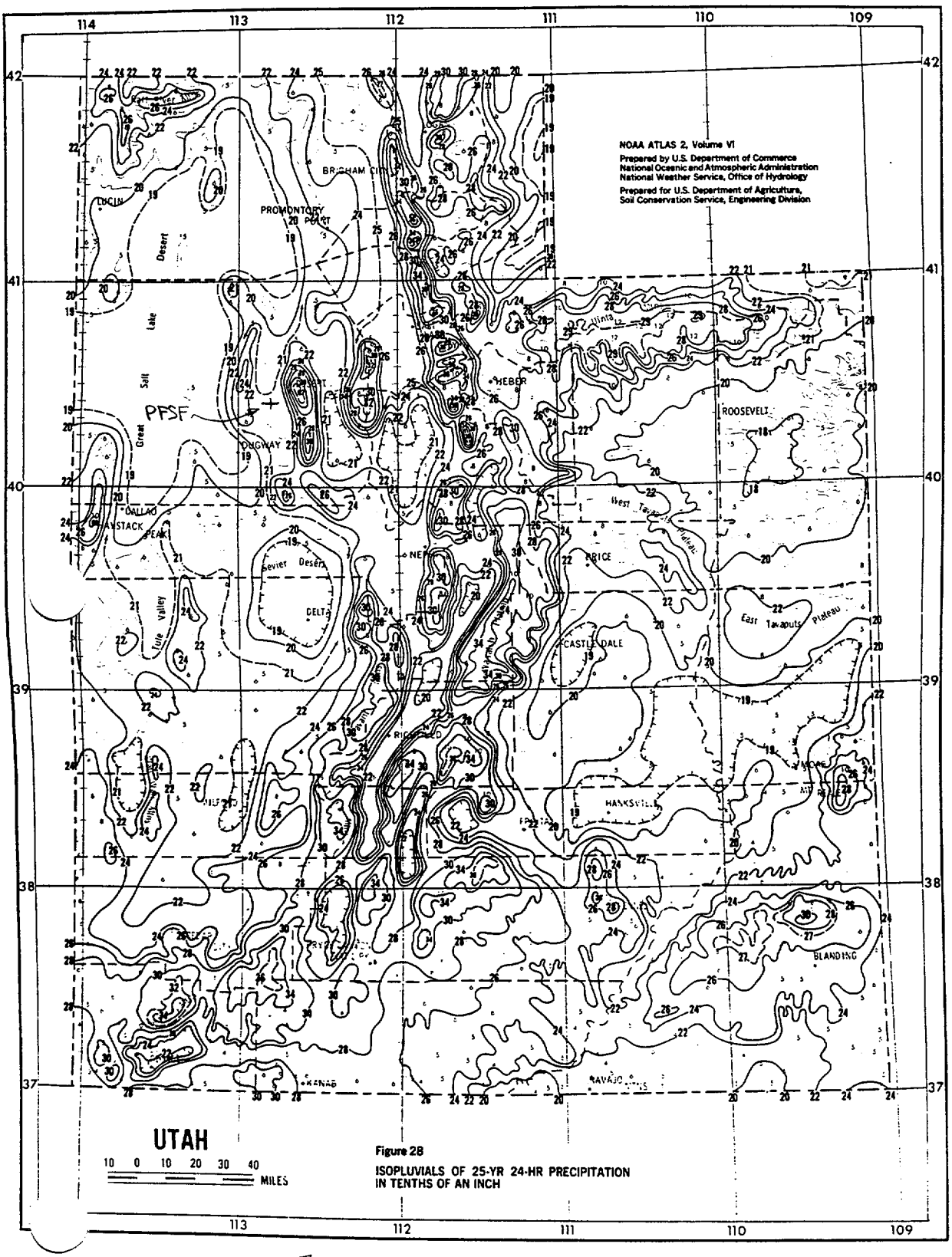


Figure 28

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

FROM REF. 4

CALC. 05990.02-SY.11 Rev 0 PAGE 5

Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
HydroCAD 4.52 001065 (c) 1986-1996 Applied Microcomputer Systems

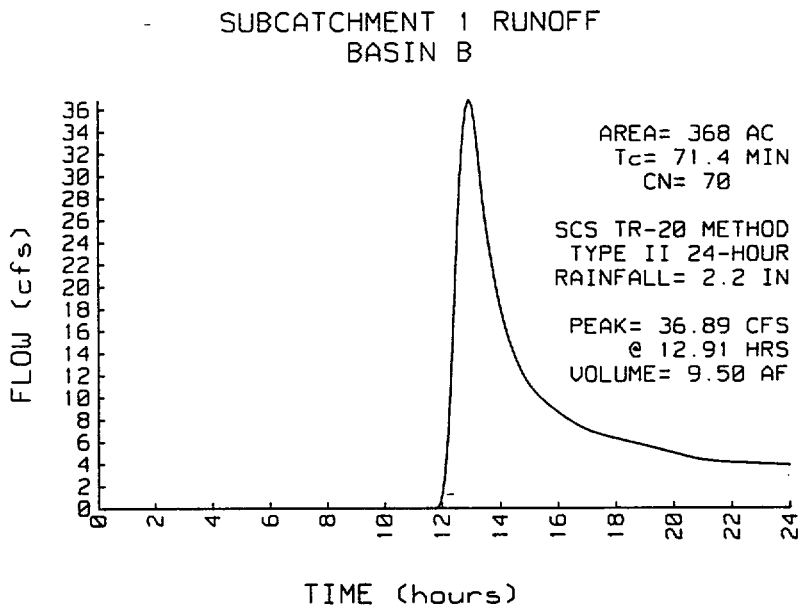
SUBCATCHMENT 1 **BASIN B**

PEAK= 36.89 CFS @ 12.91 HRS, VOLUME= 9.50 AF

ACRES	CN
368.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	71.4
L=6772' s=.0753 '/'		



Basin Area & Slope from
p. 7, Calc. 05996.02-SY-10

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TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
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SUBCATCHMENT 2 **BASIN C**

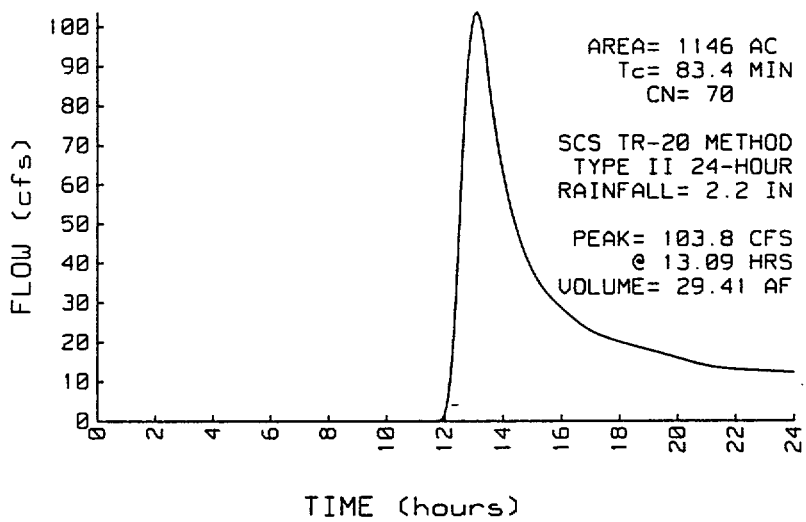
PEAK= 103.8 CFS @ 13.09 HRS, VOLUME= 29.41 AF

ACRES	CN
1146.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	83.4
L=7801' / s=.0692 '/'		

SUBCATCHMENT 2 RUNOFF
BASIN C



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
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Prepared by Applied Microcomputer Systems
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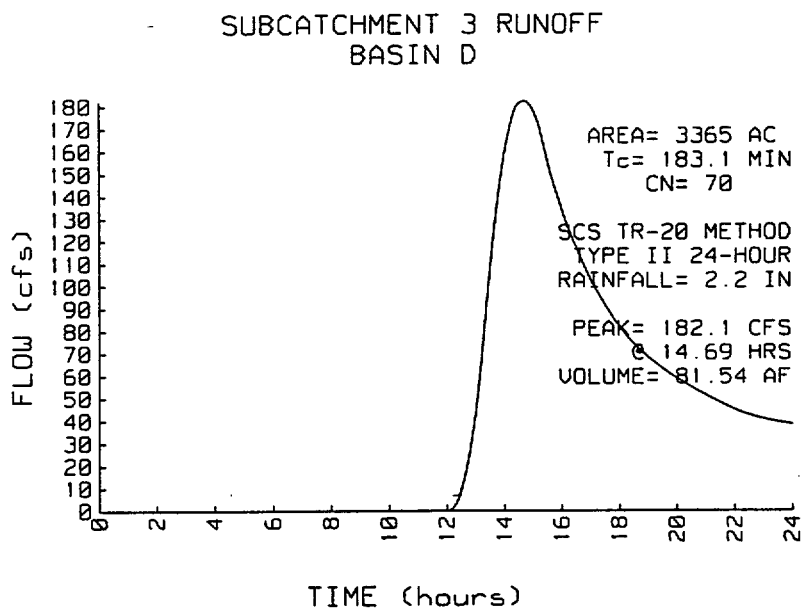
SUBCATCHMENT 3 **BASIN D**

PEAK= 182.1 CFS @ 14.69 HRS, VOLUME= 81.54 AF

ACRES	CN
3365.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	183.1
L=24040' / s=.0869 1/'		



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TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
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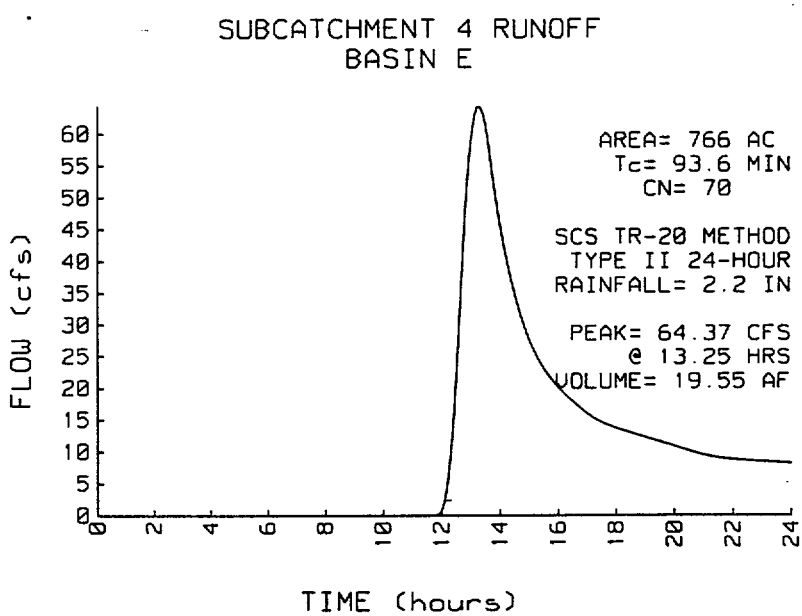
SUBCATCHMENT 4 **BASIN E**

PEAK= 64.37 CFS @ 13.25 HRS, VOLUME= 19.55 AF

ACRES	CN
766.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	93.6
L=9317' s=.073 '/'		



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
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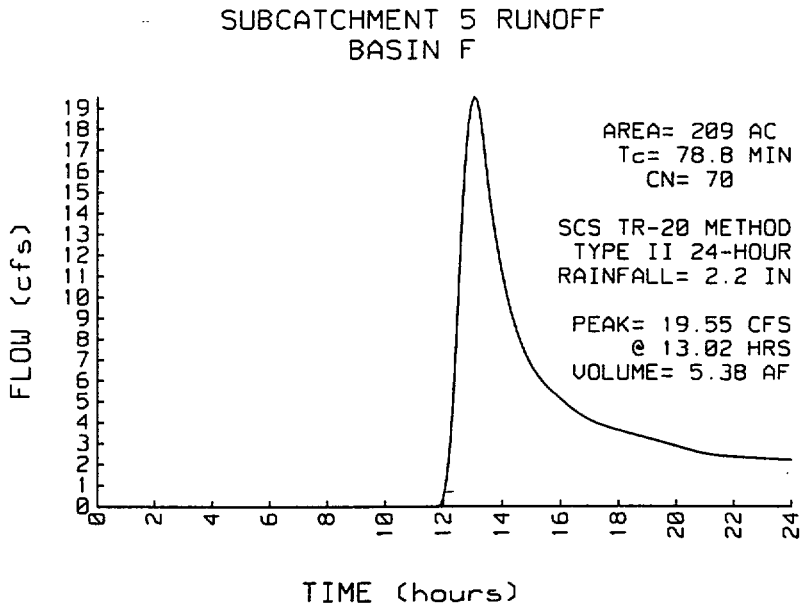
SUBCATCHMENT 5 **BASIN F**

PEAK= 19.55 CFS @ 13.02 HRS, VOLUME= 5.38 AF

ACRES	CN
209.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	78.8
L=7303' s=.0698 '/'		



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TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems
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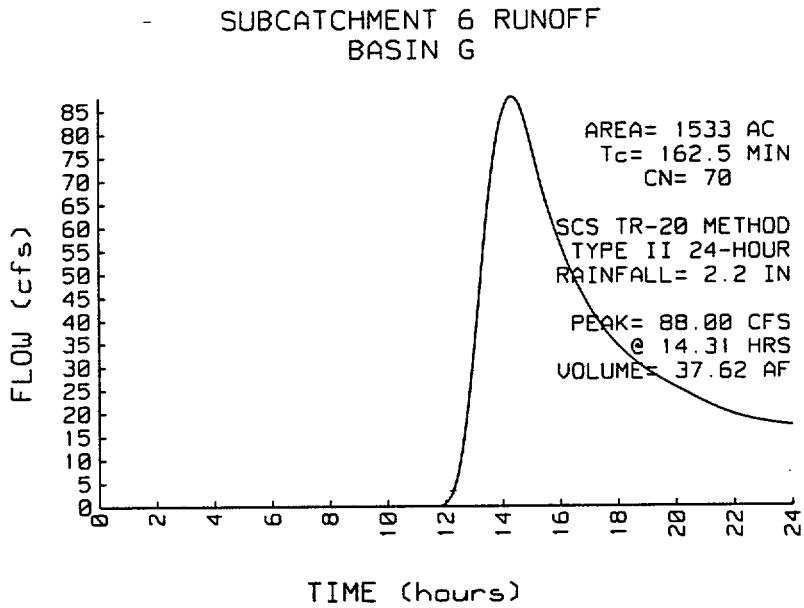
SUBCATCHMENT 6 **BASIN G**

PEAK= 88.00 CFS @ 14.31 HRS, VOLUME= 37.62 AF

ACRES	CN
1533.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	162.5
L=19983' s=.0821 1/'		



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems
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SUBCATCHMENT 7 **BASIN H(1)**

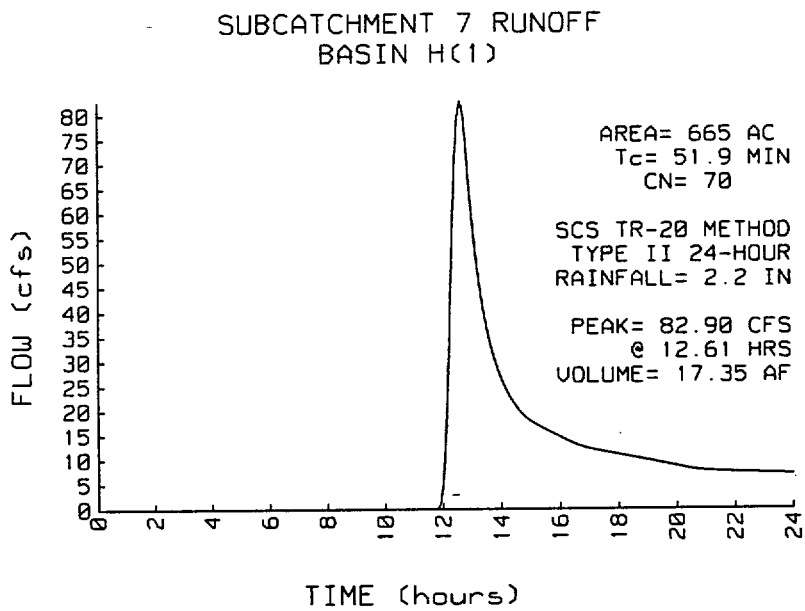
PEAK= 82.90 CFS @ 12.61 HRS, VOLUME= 17.35 AF

ACRES	CN
665.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	51.9

L=8644' s=.2106 '



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TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
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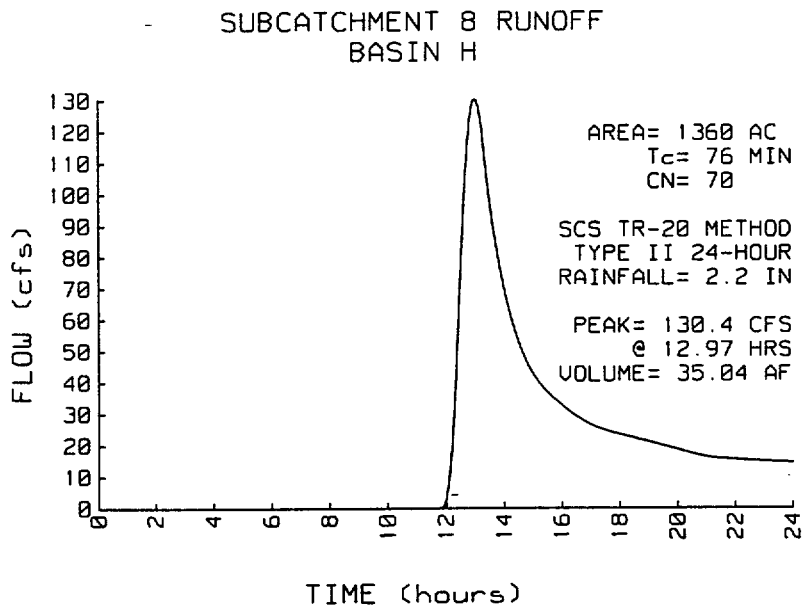
SUBCATCHMENT 8 **BASIN H**

PEAK= 130.4 CFS @ 12.97 HRS, VOLUME= 35.04 AF

ACRES	CN
1360.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	76.0
L=11398' s=.1527 '/'		



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TYPE II 24-HOUR RAINFALL= 2.2 IN
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SUBCATCHMENT 9 **BASIN J**

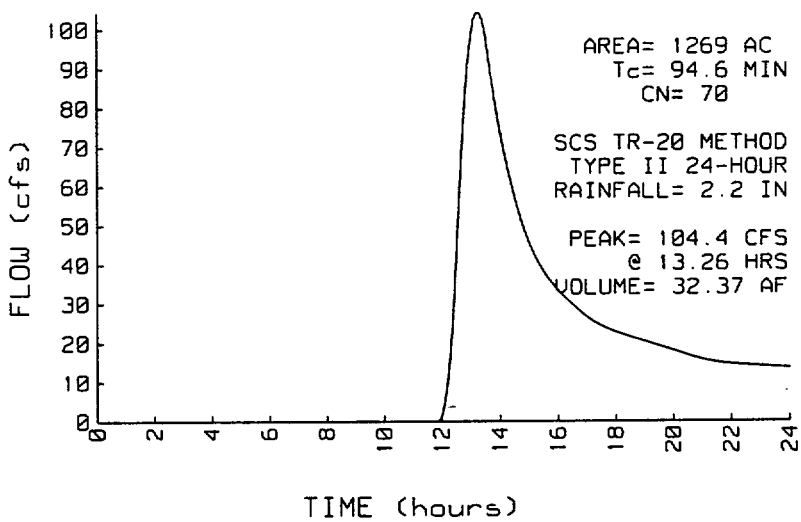
PEAK= 104.4 CFS @ 13.26 HRS, VOLUME= 32.37 AF

ACRES	CN
1269.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	94.6
L=13542' s=.13 '/'		

SUBCATCHMENT 9 RUNOFF
BASIN J



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TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
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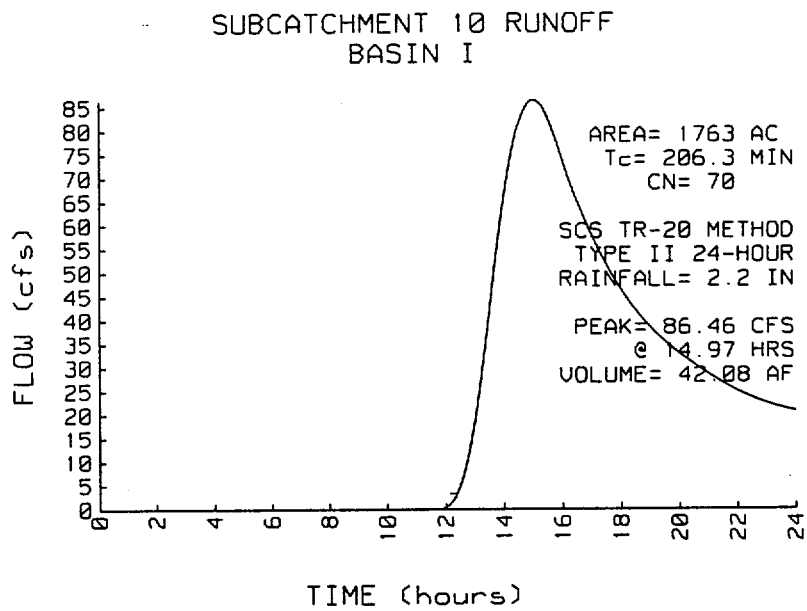
SUBCATCHMENT 10 **BASIN I**

PEAK= 86.46 CFS @ 14.97 HRS, VOLUME= 42.08 AF

ACRES	CN
1763.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	206.3
L=26164' s=.0784 '/'		



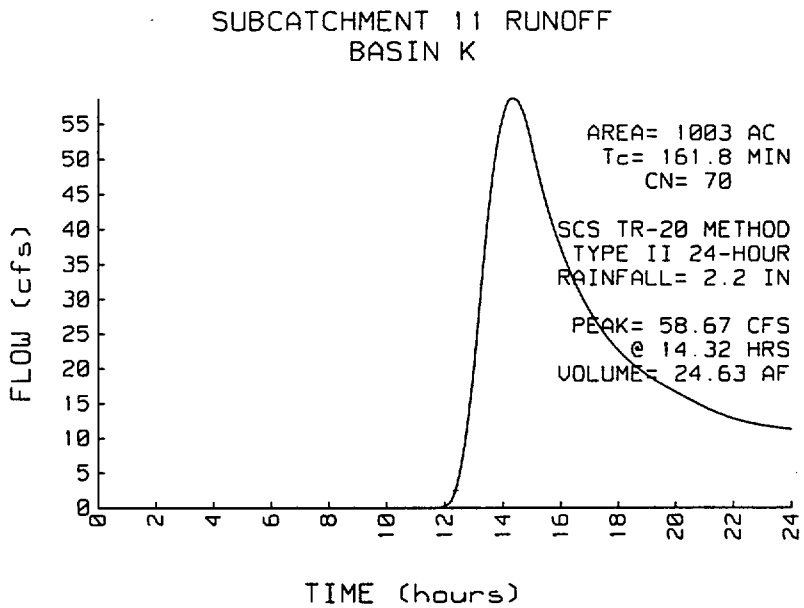
SUBCATCHMENT 11 **BASIN K**

PEAK= 58.67 CFS @ 14.32 HRS, VOLUME= 24.63 AF

ACRES	CN
1003.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	161.8
L=20201' s=.0842 '		



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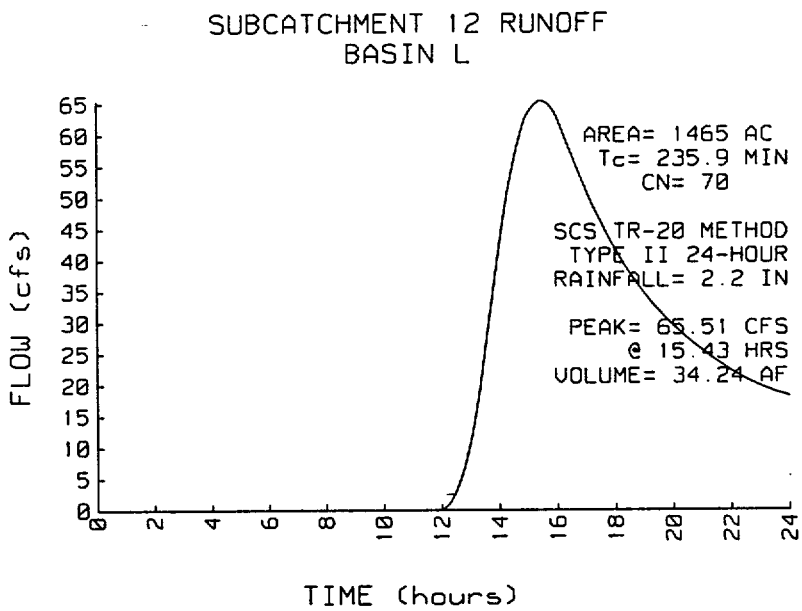
SUBCATCHMENT 12 **BASIN L**

PEAK= 65.51 CFS @ 15.43 HRS, VOLUME= 34.24 AF

ACRES	CN
1465.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	235.9
L=26860' s=.0625 '/'		



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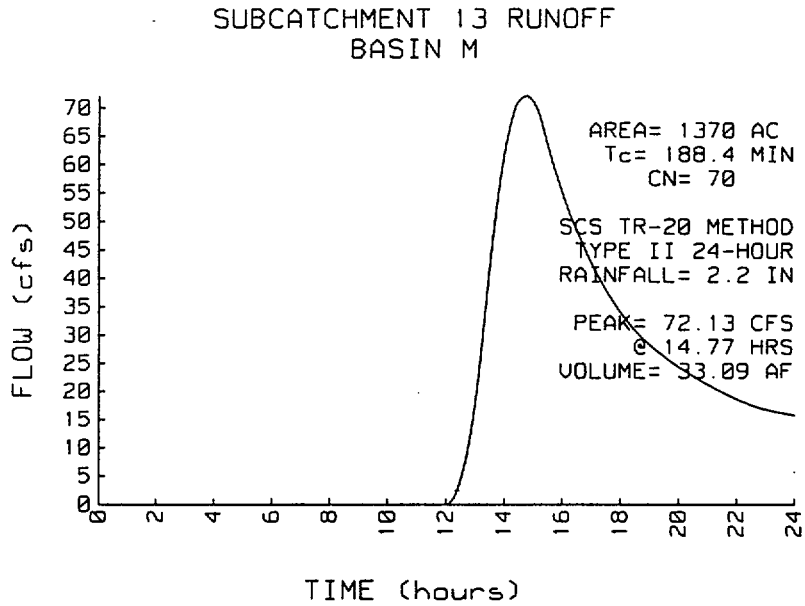
SUBCATCHMENT 13 **BASIN M**

PEAK= 72.13 CFS @ 14.77 HRS, VOLUME= 33.09 AF

ACRES	CN
1370.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	188.4
L=20785' s=.065 '		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.2 IN
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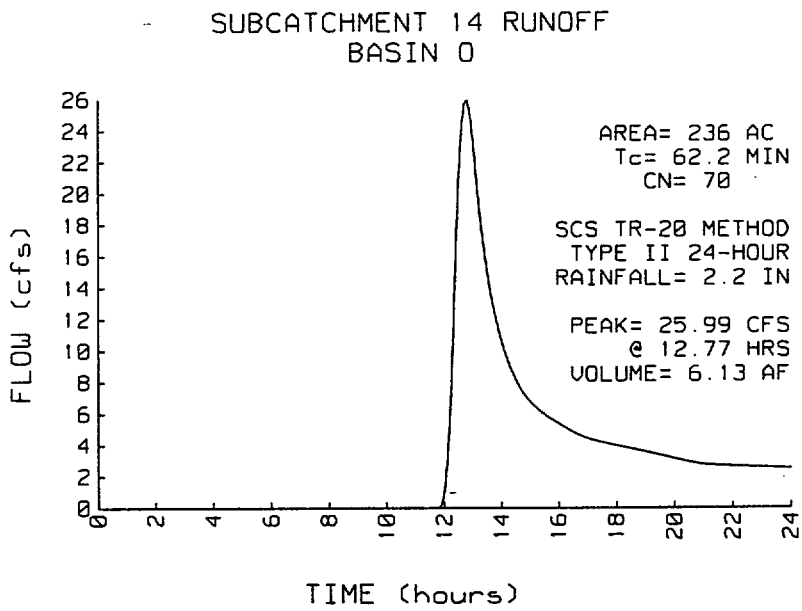
SUBCATCHMENT 14 **BASIN O**

PEAK= 25.99 CFS @ 12.77 HRS, VOLUME= 6.13 AF

ACRES	CN
236.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	62.2
L=6533' s=.0937 '		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.2 IN
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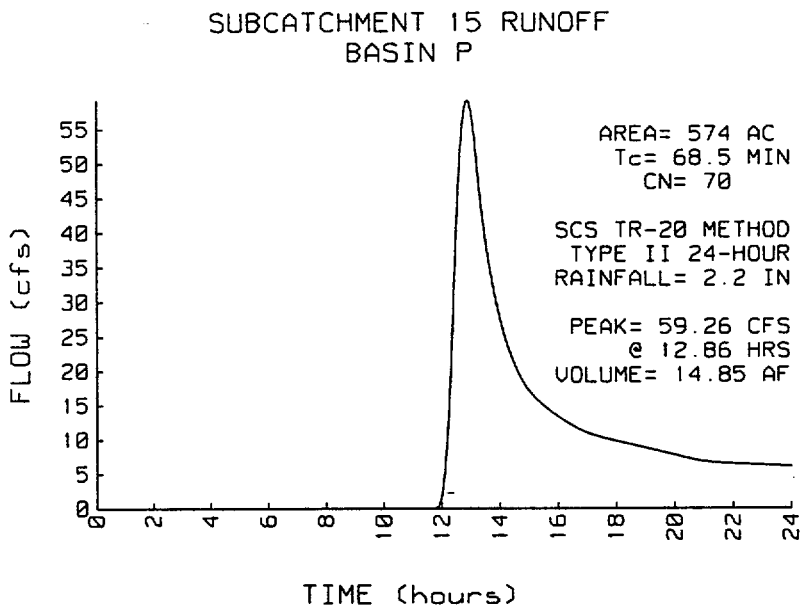
SUBCATCHMENT 15 **BASIN P**

PEAK= 59.26 CFS @ 12.86 HRS, VOLUME= 14.85 AF

ACRES	CN
574.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	68.5
L=7085' s=.0878 '/'		



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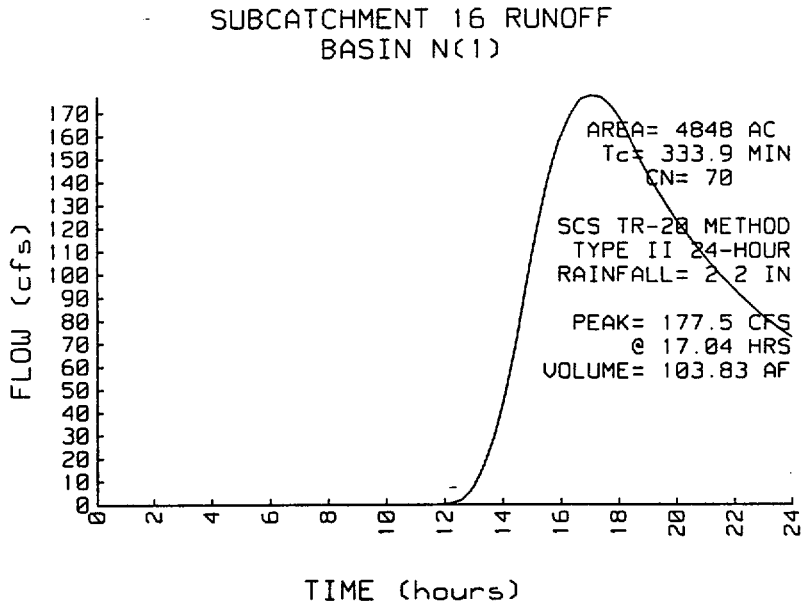
SUBCATCHMENT 16 **BASIN N(1)**

PEAK= 177.5 CFS @ 17.04 HRS, VOLUME=103.83 AF

ACRES	CN
4848.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	333.9
L=35108' s=.0479 '		



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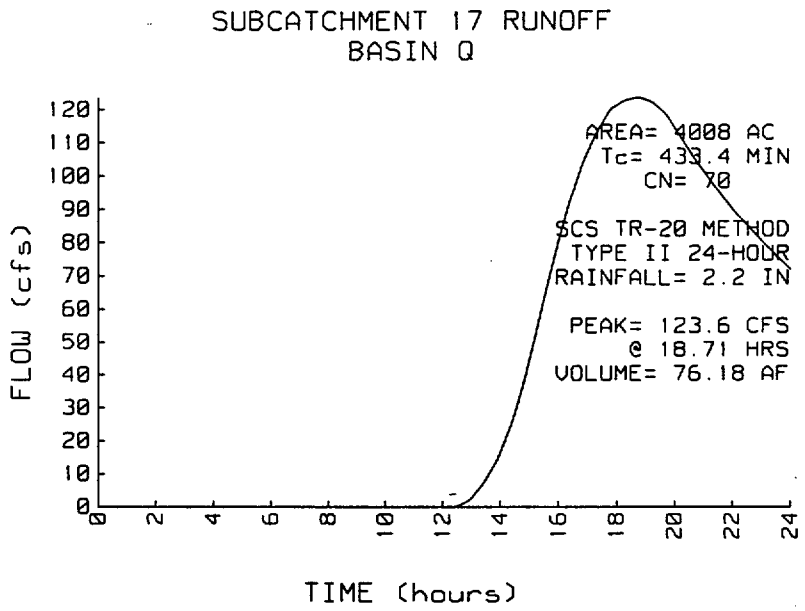
SUBCATCHMENT 17 **BASIN Q**

PEAK= 123.6 CFS @ 18.71 HRS, VOLUME= 76.18 AF

ACRES	CN
4008.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	433.4
L=43397' s=.0399 '/'		



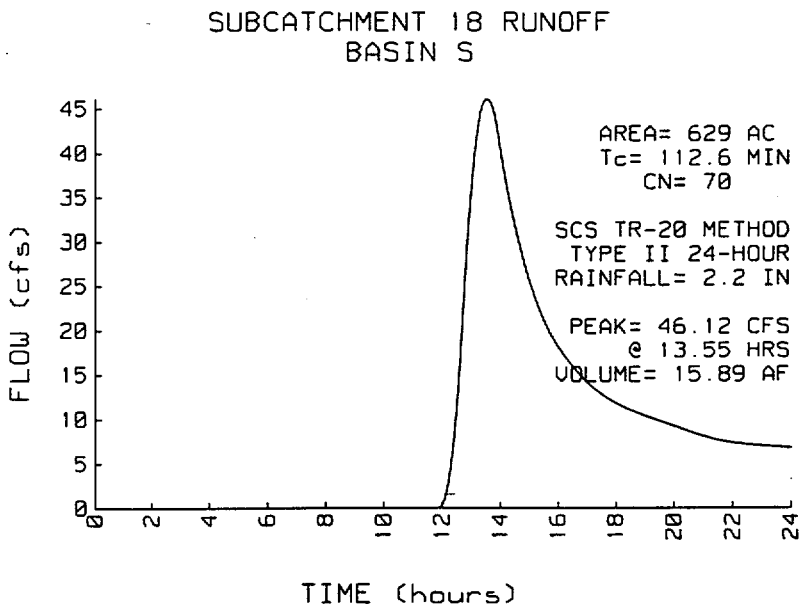
SUBCATCHMENT 18 **BASIN S**

PEAK= 46.12 CFS @ 13.55 HRS, VOLUME= 15.89 AF

ACRES	CN
629.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	112.6
L=10434' s=.0604		



SUBCATCHMENT 19 **BASIN T**

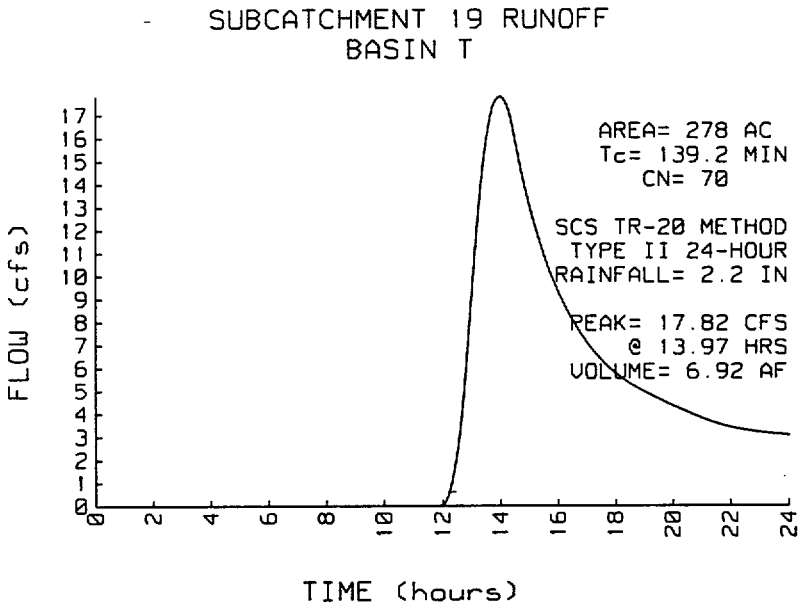
PEAK= 17.82 CFS @ 13.97 HRS, VOLUME= 6.92 AF

ACRES	CN
278.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	139.2

L=7968' s=.0257 '



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TYPE II 24-HOUR RAINFALL= 2.2 IN
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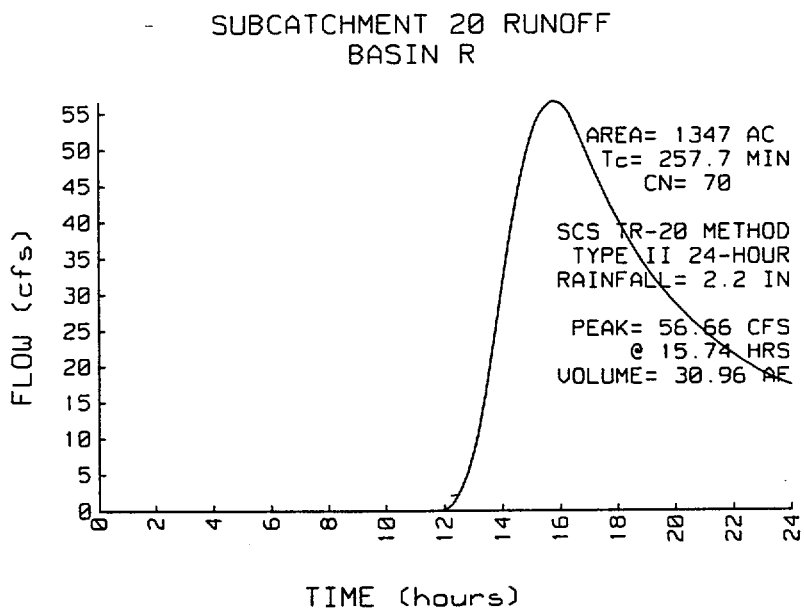
SUBCATCHMENT 20 **BASIN R**

PEAK= 56.66 CFS @ 15.74 HRS, VOLUME= 30.96 AF

ACRES	CN
1347.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	257.7
L=28629' / s=.058 ✓/'		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
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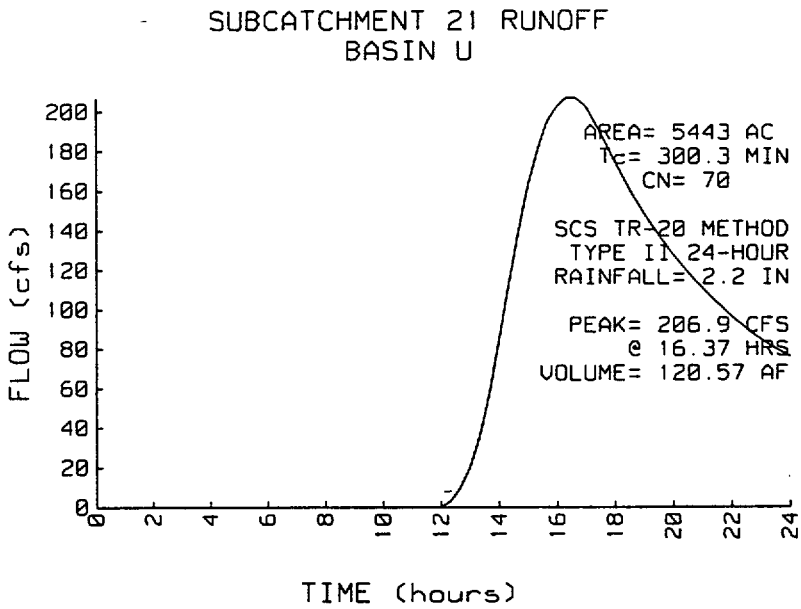
SUBCATCHMENT 21 **BASIN U**

PEAK= 206.9 CFS @ 16.37 HRS, VOLUME=120.57 AF

ACRES	CN
5443.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	300.3
L=33982' s=.0562 '		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
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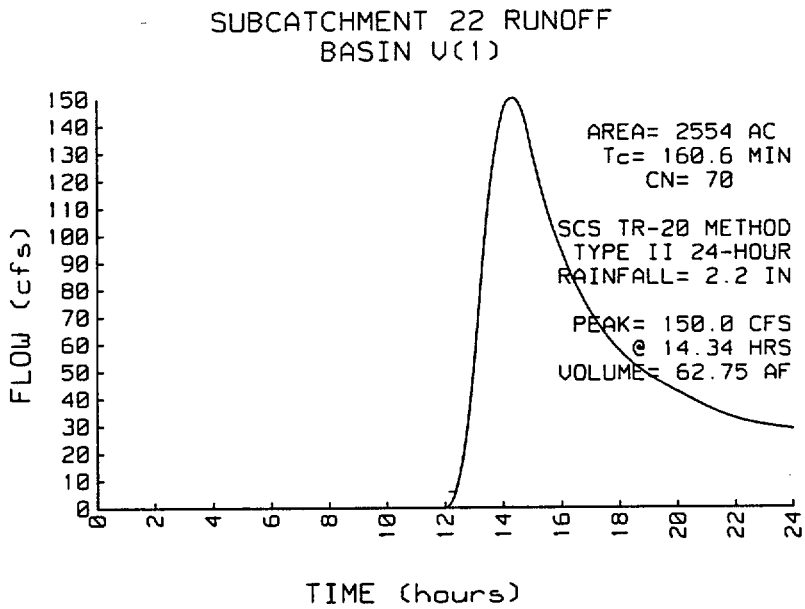
SUBCATCHMENT 22 **BASIN V(1)**

PEAK= 150.0 CFS @ 14.34 HRS, VOLUME= 62.75 AF

ACRES	CN
2554.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	160.6
L=14950' s=.0528 '/'		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
HydroCAD 4.52 001065 (c) 1986-1996 Applied Microcomputer Systems

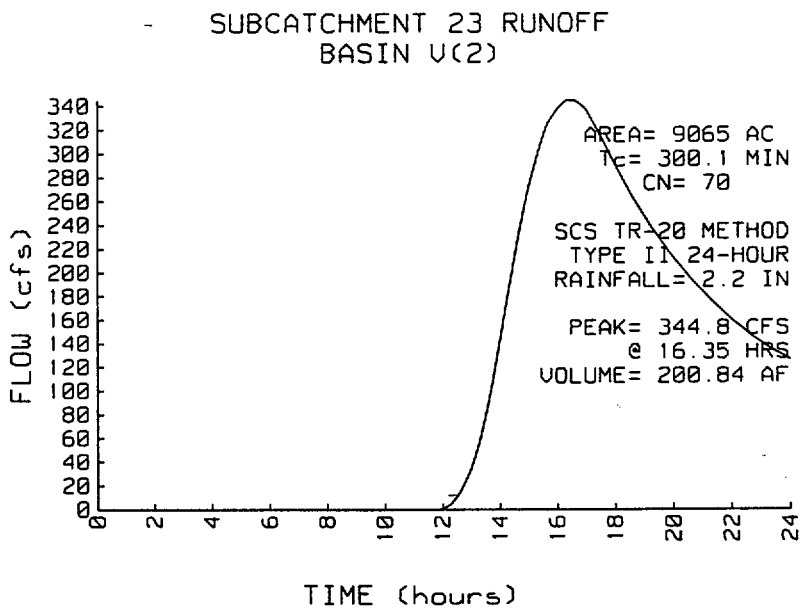
SUBCATCHMENT 23 **BASIN V(2)**

PEAK= 344.8 CFS @ 16.35 HRS, VOLUME=200.84 AF

ACRES	CN
9065.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	300.1
L=37960' s=.0672 '/'		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
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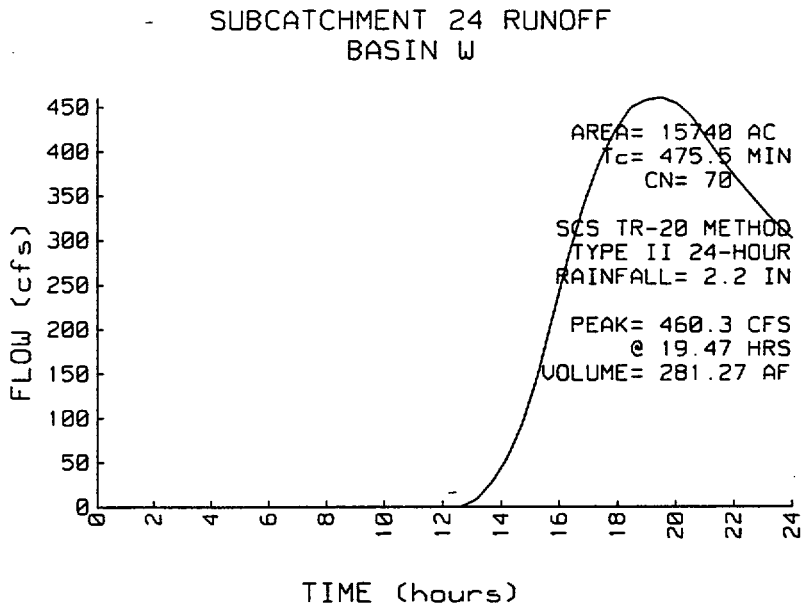
SUBCATCHMENT 24 **BASIN W**

PEAK= 460.3 CFS @ 19.47 HRS, VOLUME=281.27 AF

ACRES	CN
15740.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	475.5
L=51797' s=.044 '/'		



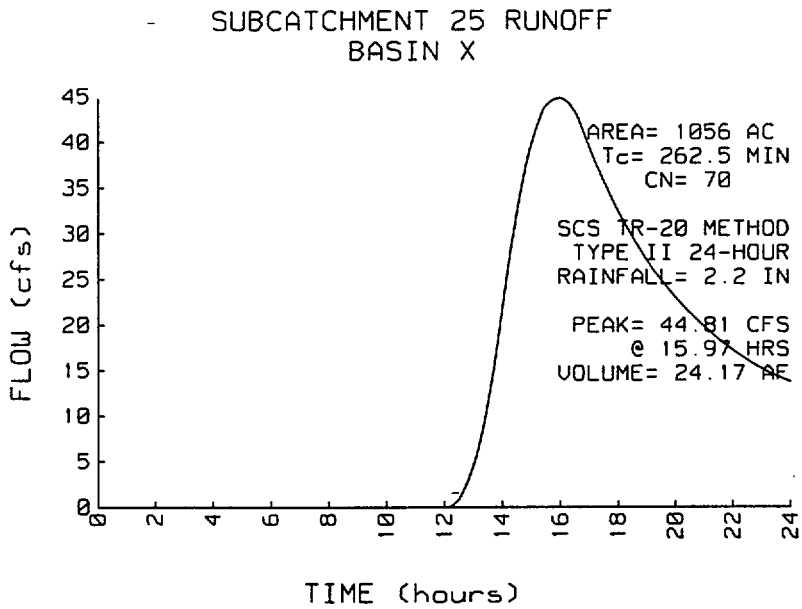
SUBCATCHMENT 25 **BASIN X**

PEAK= 44.81 CFS @ 15.97 HRS, VOLUME= 24.17 AF

ACRES	CN
1056.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	262.5
L=18289' s=.0273 '/'		



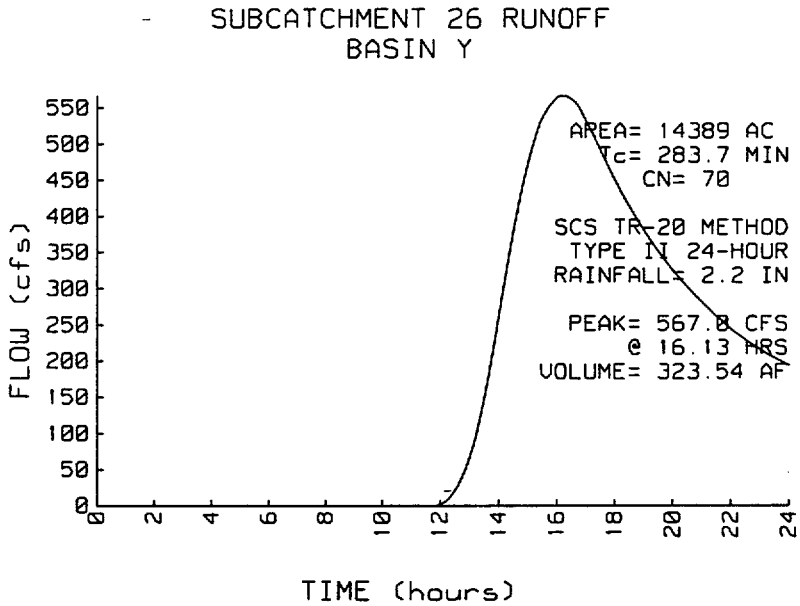
SUBCATCHMENT 26 **BASIN Y**

PEAK= 567.0 CFS @ 16.13 HRS, VOLUME=323.54 AF

ACRES	CN
14389.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	283.7
L=36235' s=.0698 '/'		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.2 IN
Prepared by Applied Microcomputer Systems 20 Aug 99
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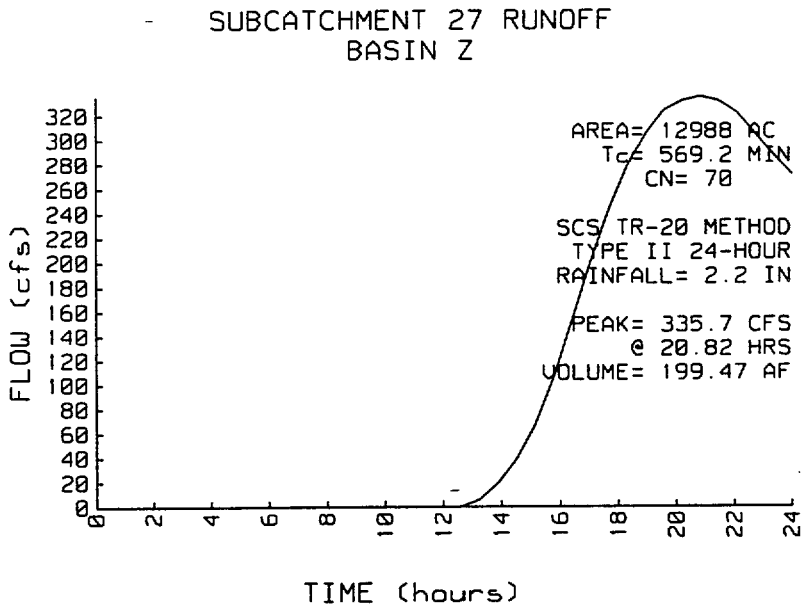
SUBCATCHMENT 27 **BASIN Z**

PEAK= 335.7 CFS @ 20.82 HRS, VOLUME=199.47 AF

ACRES	CN
12988.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.2 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	569.2
L=60247' s=.0391 '/'		



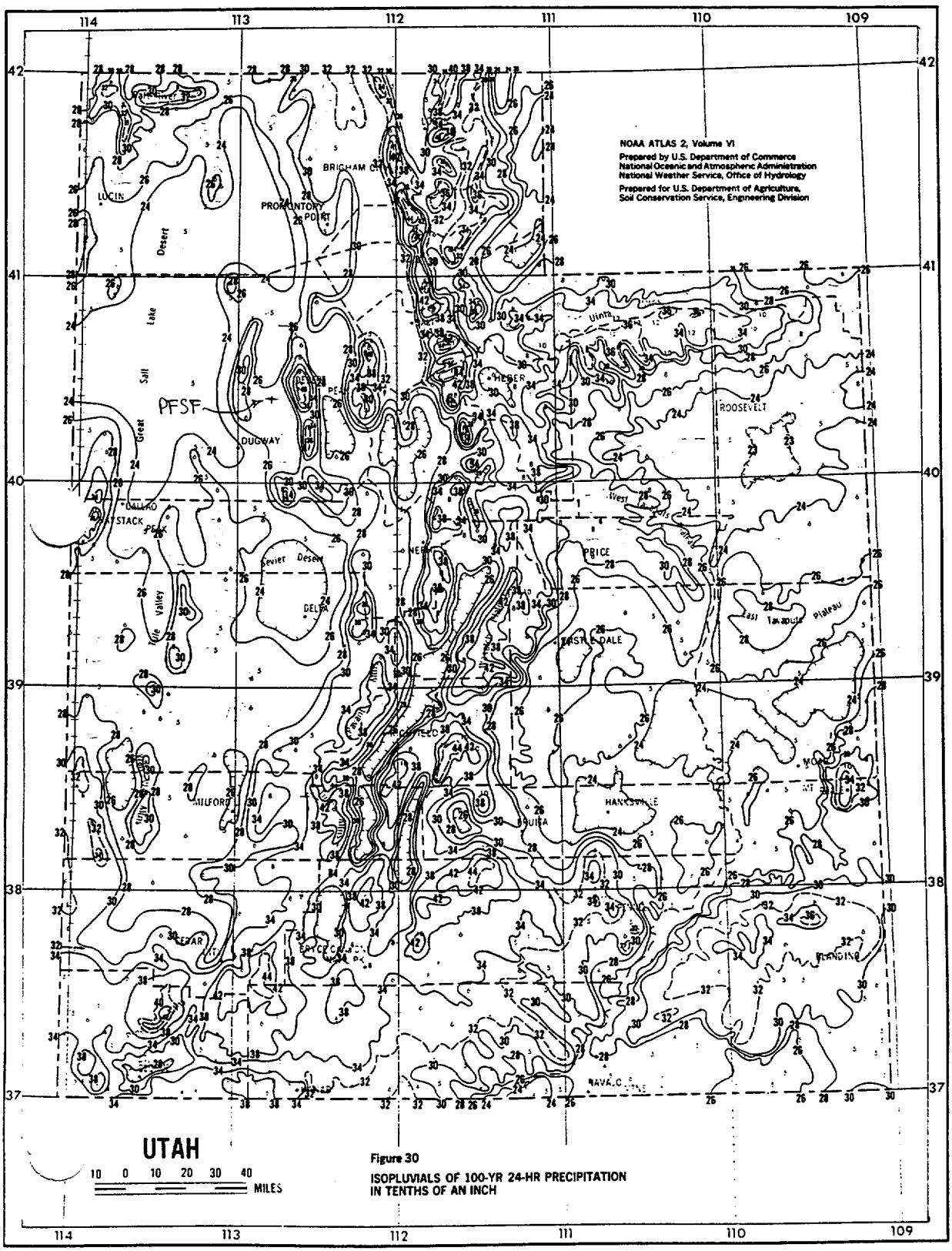


Figure 30

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

FROM REF. 4

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Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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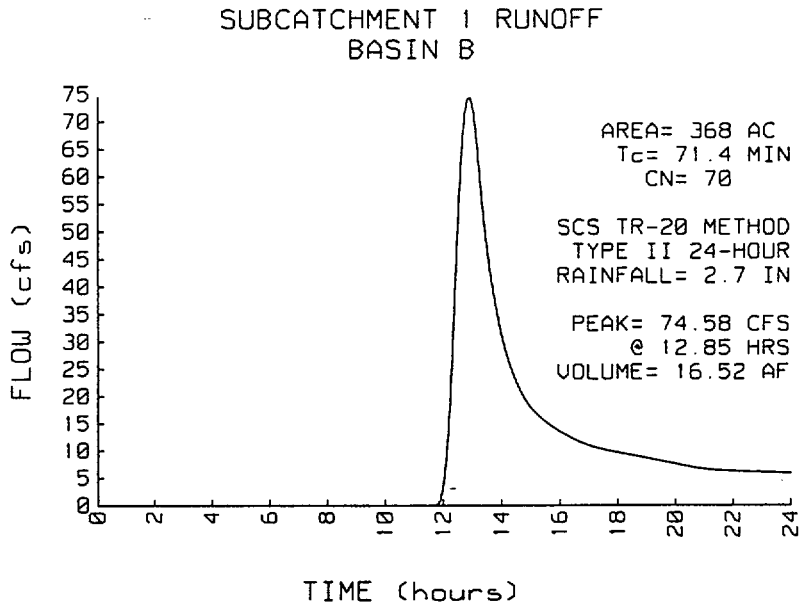
SUBCATCHMENT 1 **BASIN B**

PEAK= 74.58 CFS @ 12.85 HRS, VOLUME= 16.52 AF

ACRES	CN
368.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	71.4
L=6772 s=.0753		



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
HydroCAD 4.52 001065 (c) 1986-1996 Applied Microcomputer Systems

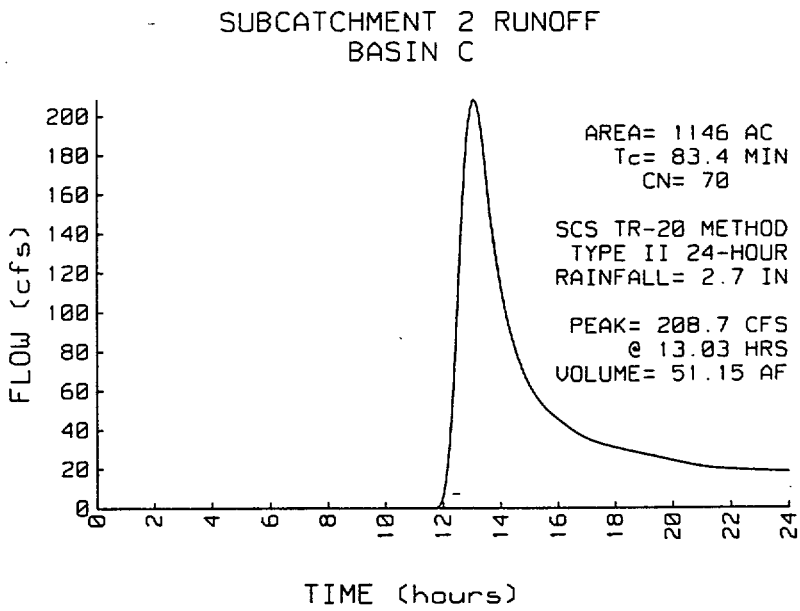
SUBCATCHMENT 2 **BASIN C**

PEAK= 208.7 CFS @ 13.03 HRS, VOLUME= 51.15 AF

ACRES	CN
1146.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	83.4
L=7801 s=.0692		



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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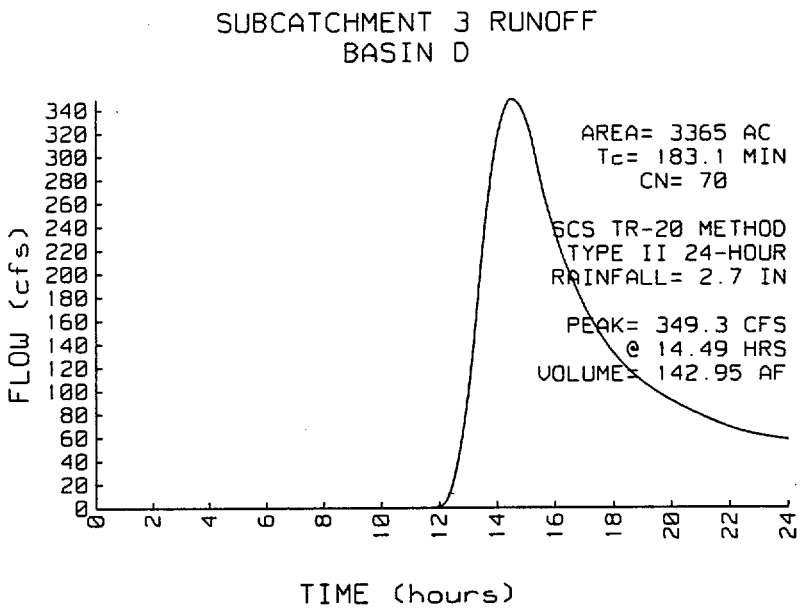
SUBCATCHMENT 3 **BASIN D**

PEAK= 349.3 CFS @ 14.49 HRS, VOLUME=142.95 AF

ACRES	CN
3365.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	183.1
L=24040' s=.0869 '		



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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SUBCATCHMENT 4 **BASIN E**

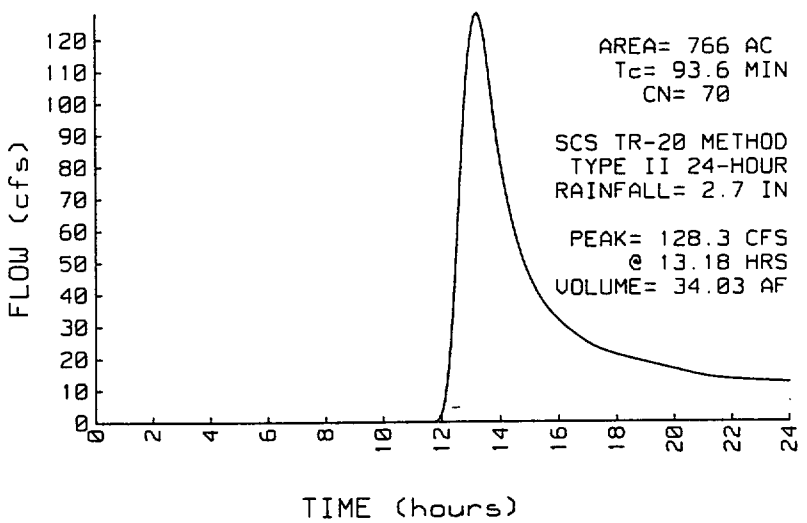
PEAK= 128.3 CFS @ 13.18 HRS, VOLUME= 34.03 AF

ACRES	CN
766.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	93.6
L=9317' s=.073 '/'		

SUBCATCHMENT 4 RUNOFF
BASIN E



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
HydroCAD 4.52 001065 (c) 1986-1996 Applied Microcomputer Systems

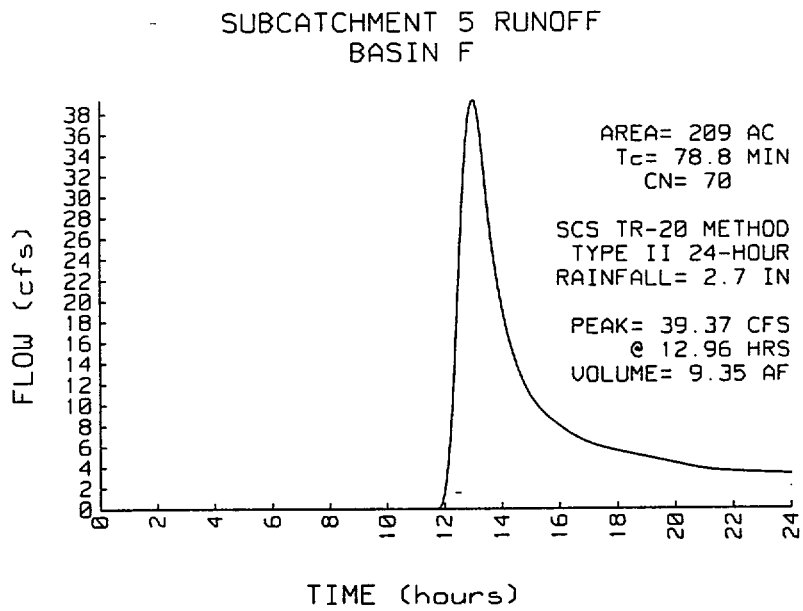
SUBCATCHMENT 5 **BASIN F**

PEAK= 39.37 CFS @ 12.96 HRS, VOLUME= 9.35 AF

ACRES	CN
209.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	78.8
L=7303' s=.0698'/'		



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
HydroCAD 4.52 001065 (c) 1986-1996 Applied Microcomputer Systems

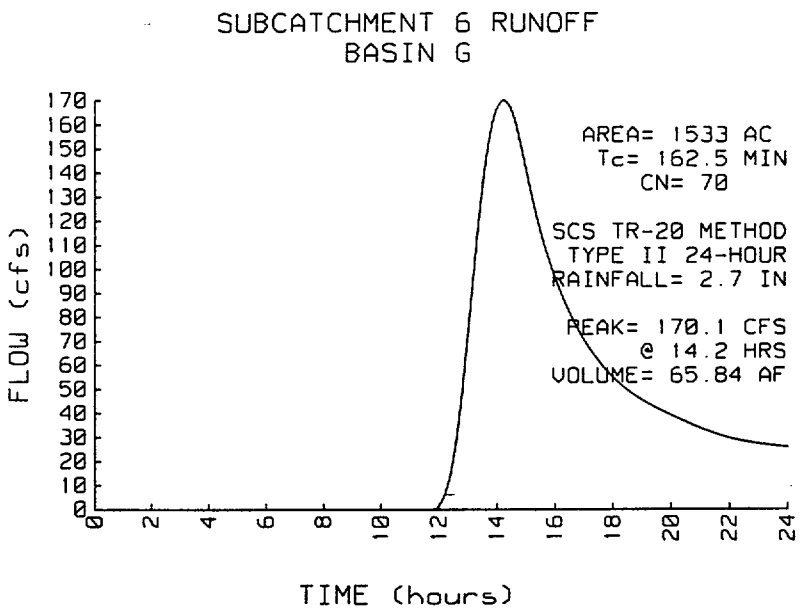
SUBCATCHMENT 6 **BASIN G**

PEAK= 170.1 CFS @ 14.20 HRS, VOLUME= 65.84 AF

ACRES	CN
1533.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	162.5
L=19983 s=.0821		



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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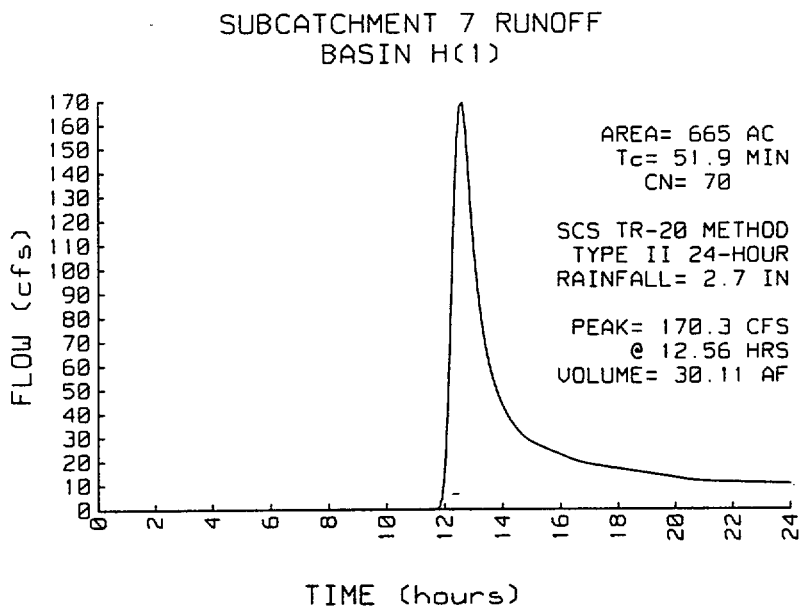
SUBCATCHMENT 7 **BASIN H(1)**

PEAK= 170.3 CFS @ 12.56 HRS, VOLUME= 30.11 AF

ACRES	CN
665.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	51.9
L=8644' s=.2106 '		



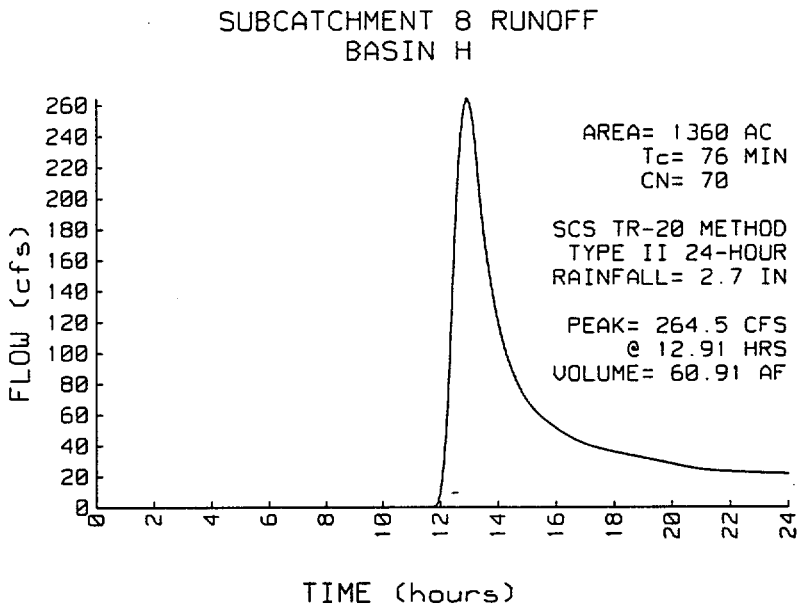
SUBCATCHMENT 8 **BASIN H**

PEAK= 264.5 CFS @ 12.91 HRS, VOLUME= 60.91 AF

ACRES	CN
1360.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	76.0
L=11398' s=.1527'/'		



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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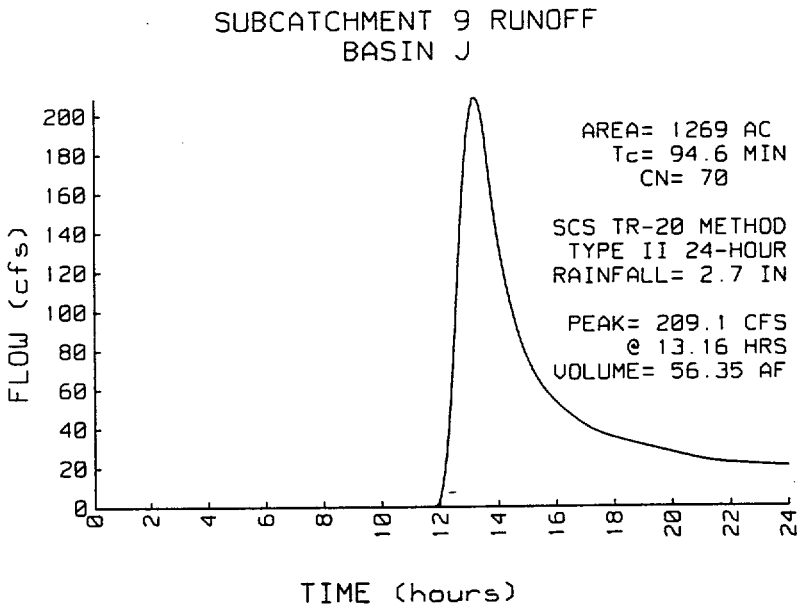
SUBCATCHMENT 9 **BASIN J**

PEAK= 209.1 CFS @ 13.16 HRS, VOLUME= 56.35 AF

ACRES	CN
1269.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	94.6
L=13542' s=.13 '/'		



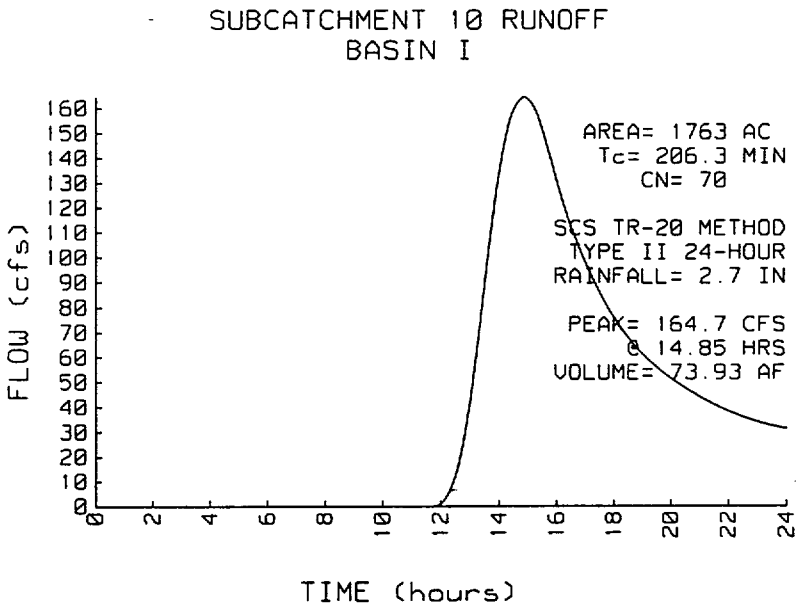
SUBCATCHMENT 10 **BASIN I**

PEAK= 164.7 CFS @ 14.85 HRS, VOLUME= 73.93 AF

ACRES	CN
1763.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	206.3
L=26164' s=.0784 '		



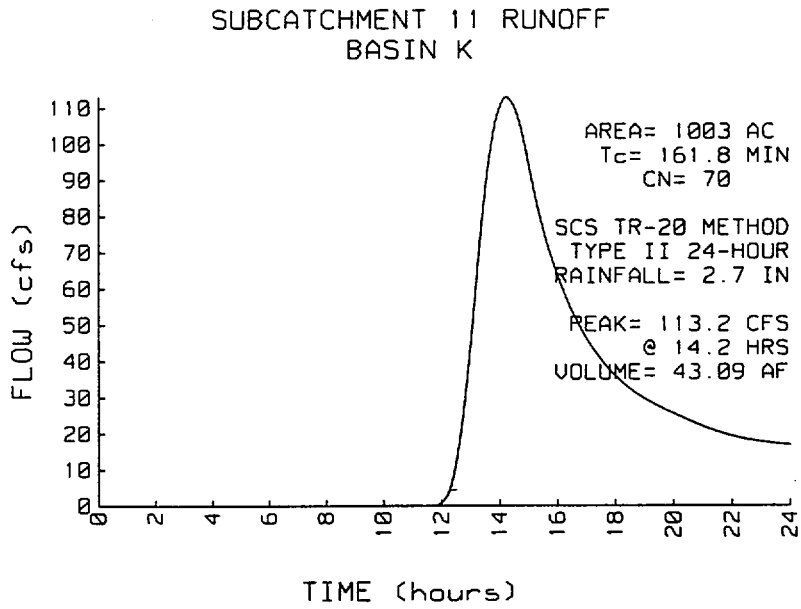
SUBCATCHMENT 11 **BASIN K**

PEAK= 113.2 CFS @ 14.20 HRS, VOLUME= 43.09 AF

ACRES	CN
1003.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	161.8
L=20201' s=.0842 '/'		



Data for **SKULL VALLEY PFSF - N DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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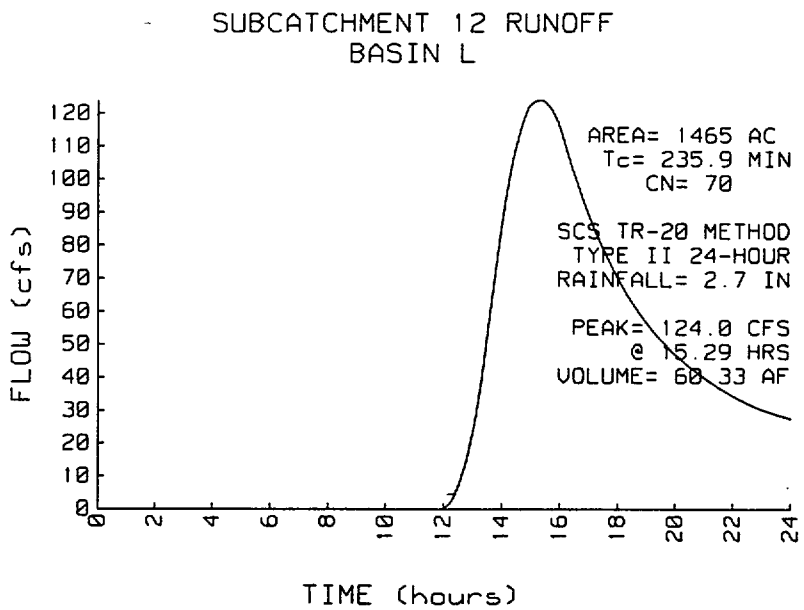
SUBCATCHMENT 12 **BASIN L**

PEAK= 124.0 CFS @ 15.29 HRS, VOLUME= 60.33 AF

ACRES	CN
1465.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	235.9
L=26860 s=.0625 '/'		



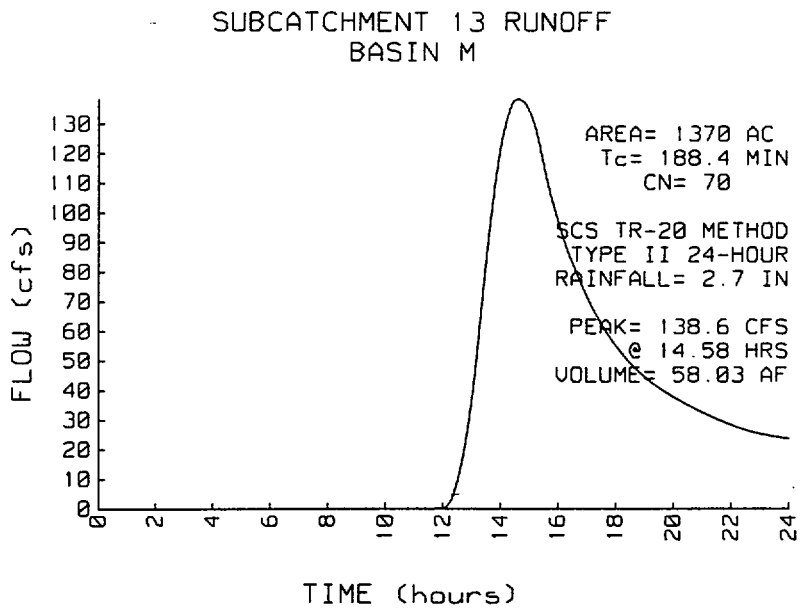
SUBCATCHMENT 13 **BASIN M**

PEAK= 138.6 CFS @ 14.58 HRS, VOLUME= 58.03 AF

ACRES	CN
1370.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	188.4
L=20785 s=.065 '/'		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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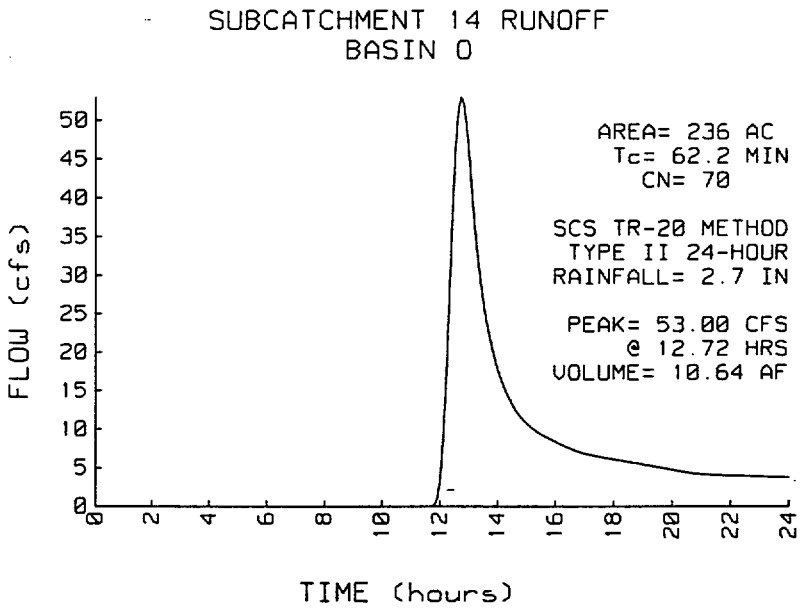
SUBCATCHMENT 14 **BASIN O**

PEAK= 53.00 CFS @ 12.72 HRS, VOLUME= 10.64 AF

ACRES	CN
236.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	62.2
L=6533' s=.0937 '/'		



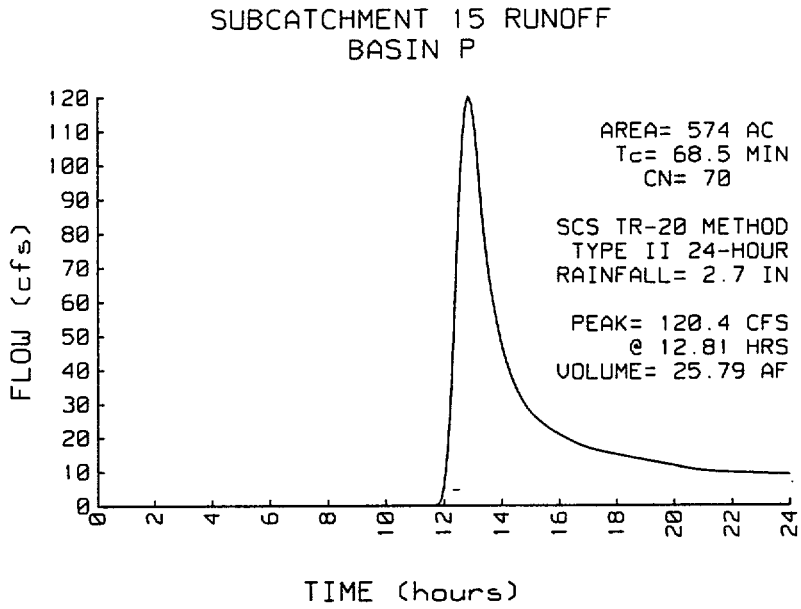
SUBCATCHMENT 15 **BASIN P**

PEAK= 120.4 CFS @ 12.81 HRS, VOLUME= 25.79 AF

ACRES	CN
574.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	68.5
L=7085 s=.0878		



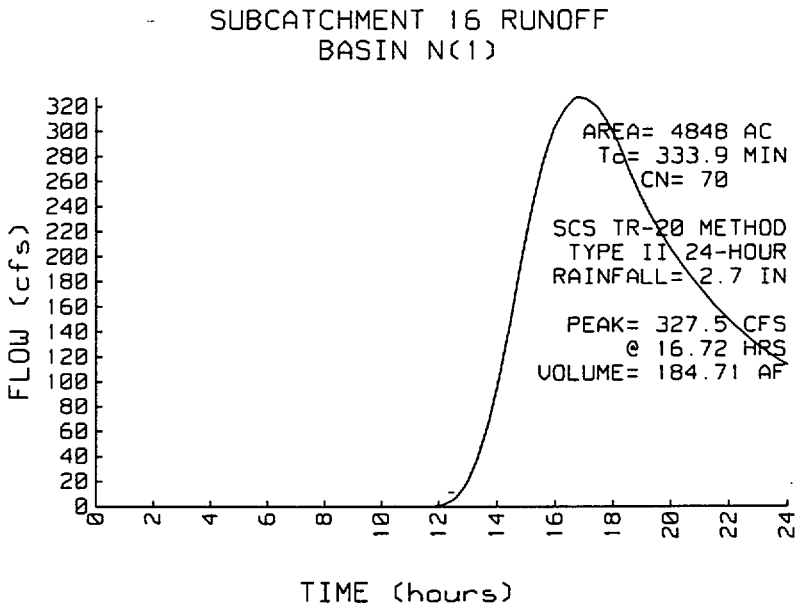
SUBCATCHMENT 16 **BASIN N(1)**

PEAK= 327.5 CFS @ 16.72 HRS, VOLUME=184.71 AF

ACRES	CN
4848.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	333.9
L=35108' s=.0479 '		



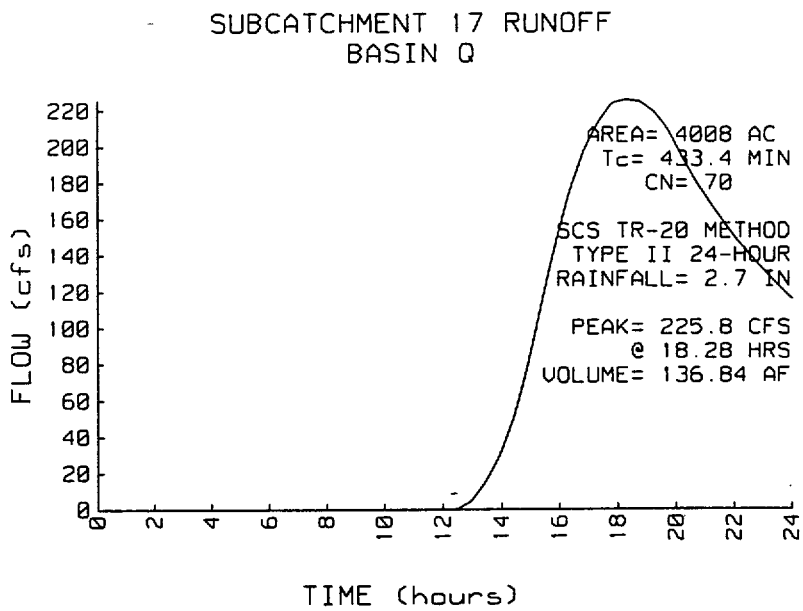
SUBCATCHMENT 17 **BASIN Q**

PEAK= 225.8 CFS @ 18.28 HRS, VOLUME=136.84 AF

ACRES	CN
4008.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	433.4
L=43397' s=.0399 '/'		



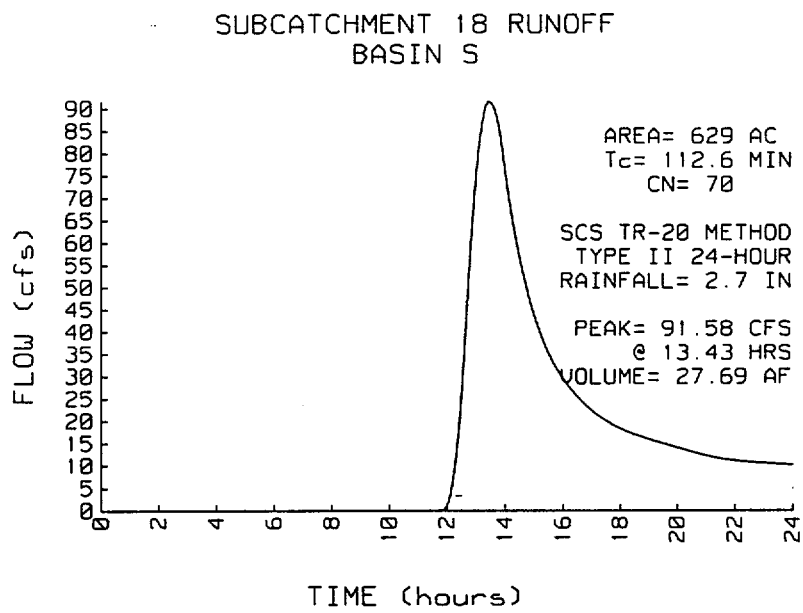
SUBCATCHMENT 18 **BASIN S**

PEAK= 91.58 CFS @ 13.43 HRS, VOLUME= 27.69 AF

ACRES	CN
629.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	112.6
L=10434' s=.0604 '/'		



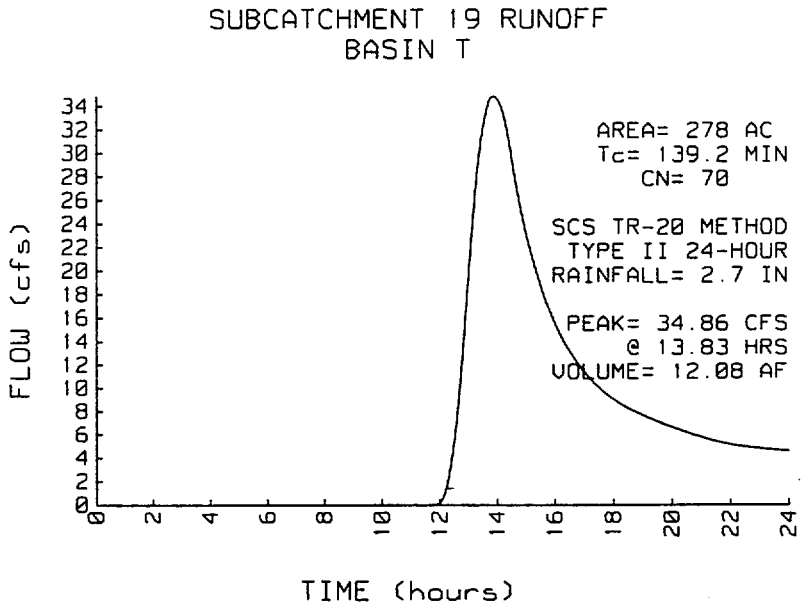
SUBCATCHMENT 19 **BASIN T**

PEAK= 34.86 CFS @ 13.83 HRS, VOLUME= 12.08 AF

ACRES	CN
278.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	139.2
L=7968' s=.0257'/'		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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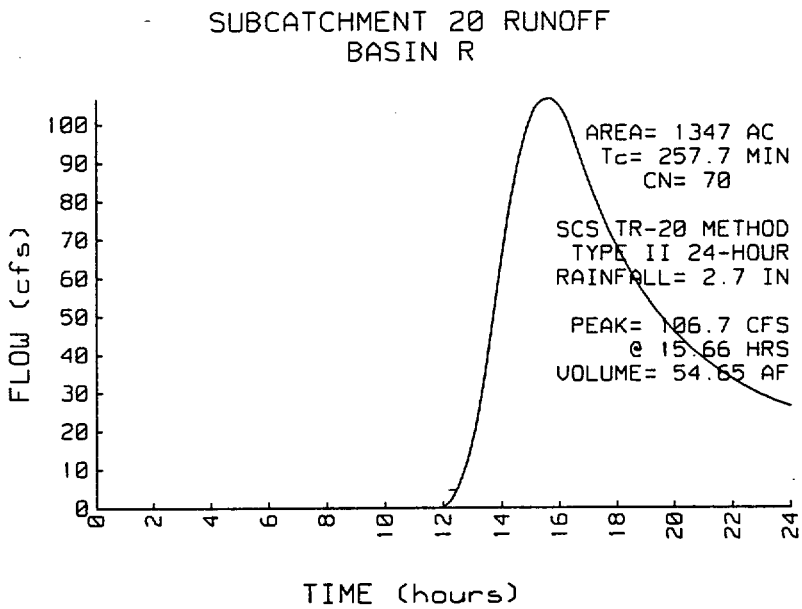
SUBCATCHMENT 20 **BASIN R**

PEAK= 106.7 CFS @ 15.66 HRS, VOLUME= 54.65 AF

ACRES	CN
1347.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	257.7
L=28629' s=.058 ft'		



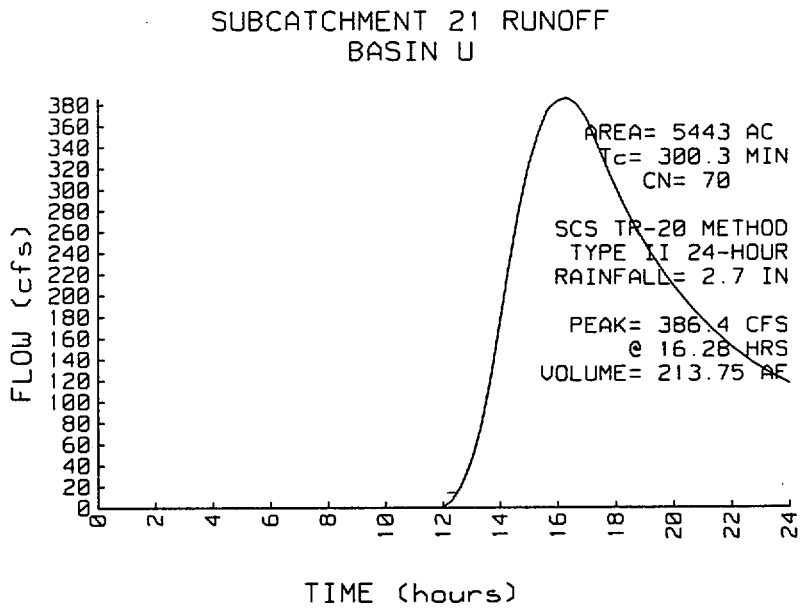
SUBCATCHMENT 21 **BASIN U**

PEAK= 386.4 CFS @ 16.28 HRS, VOLUME=213.75 AF

ACRES	CN
5443.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	300.3
L=33982' s=.0562 '/'		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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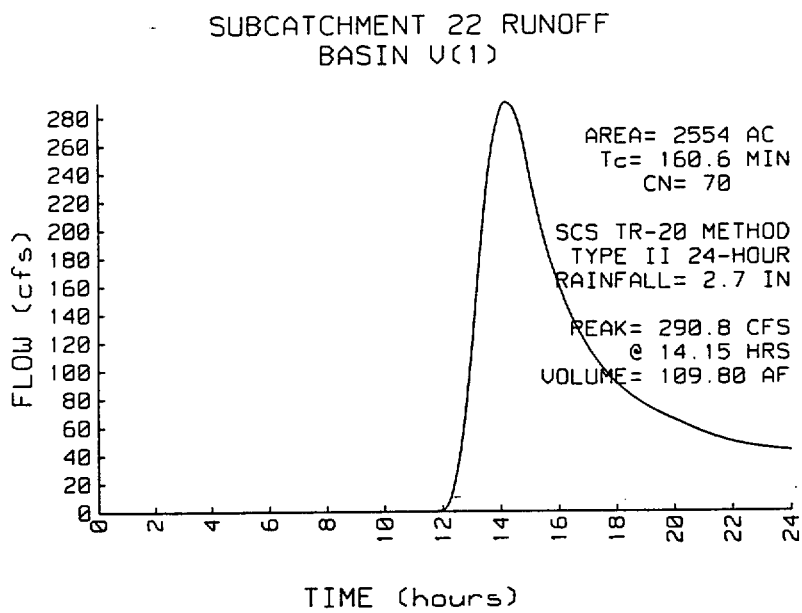
SUBCATCHMENT 22 **BASIN V(1)**

PEAK= 290.8 CFS @ 14.15 HRS, VOLUME=109.80 AF

ACRES	CN
2554.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	160.6
L=14950 s=.0528		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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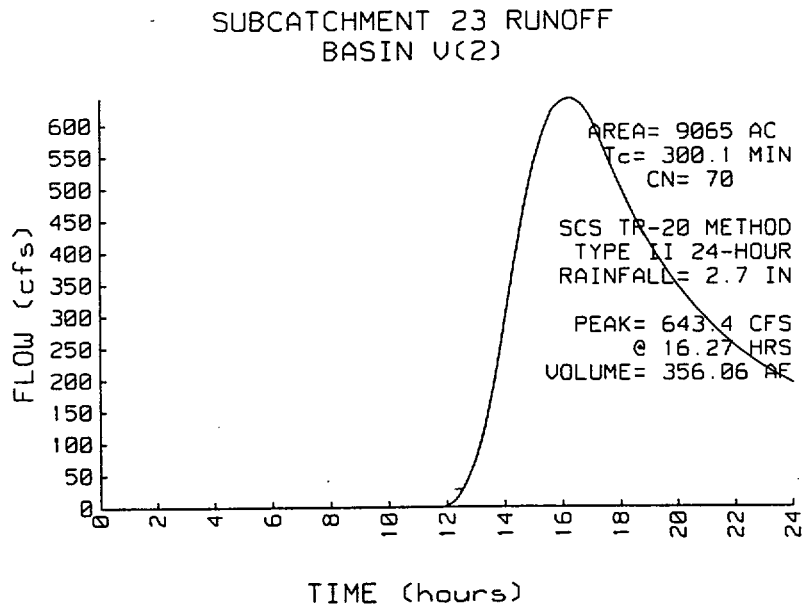
SUBCATCHMENT 23 **BASIN V(2)**

PEAK= 643.4 CFS @ 16.27 HRS, VOLUME=356.06 AF

ACRES	CN
9065.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	300.1
L=37960' s=.0672 '/'		



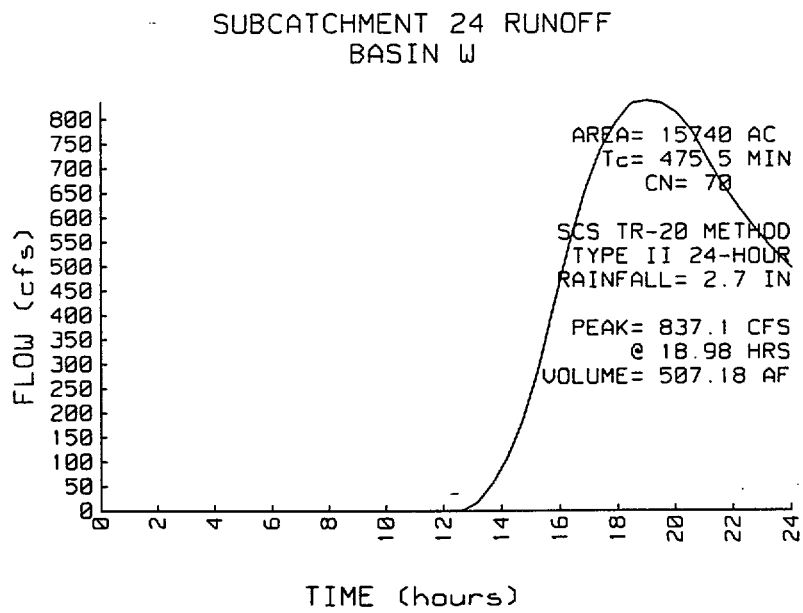
SUBCATCHMENT 24 **BASIN W**

PEAK= 837.1 CFS @ 18.98 HRS, VOLUME=507.18 AF

ACRES	CN
15740.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	475.5
L=51797' s=.044 '/'		



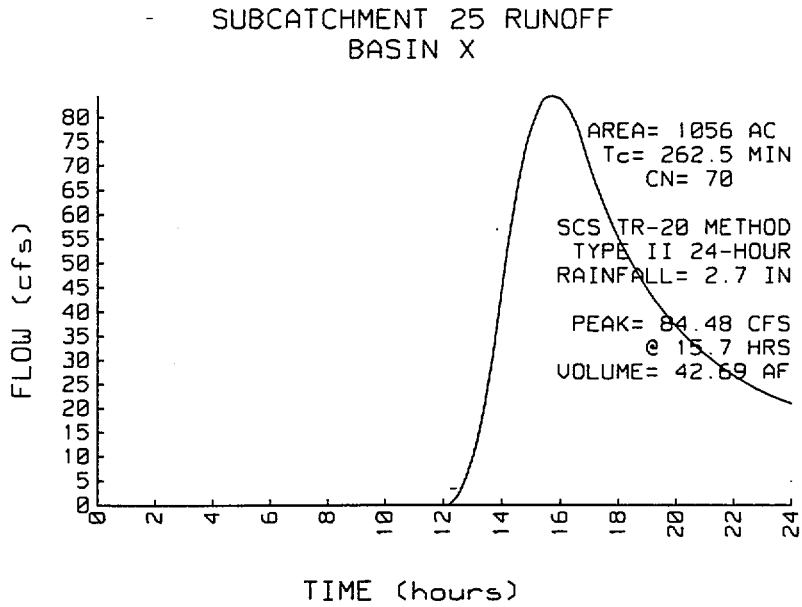
SUBCATCHMENT 25 **BASIN X**

PEAK= 84.48 CFS @ 15.70 HRS, VOLUME= 42.69 AF

ACRES	CN
1056.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	262.5
L=18289' s=.0273 '/'		



Data for **SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS**
TYPE II 24-HOUR RAINFALL= 2.7 IN
Prepared by Applied Microcomputer Systems 19 Aug 99
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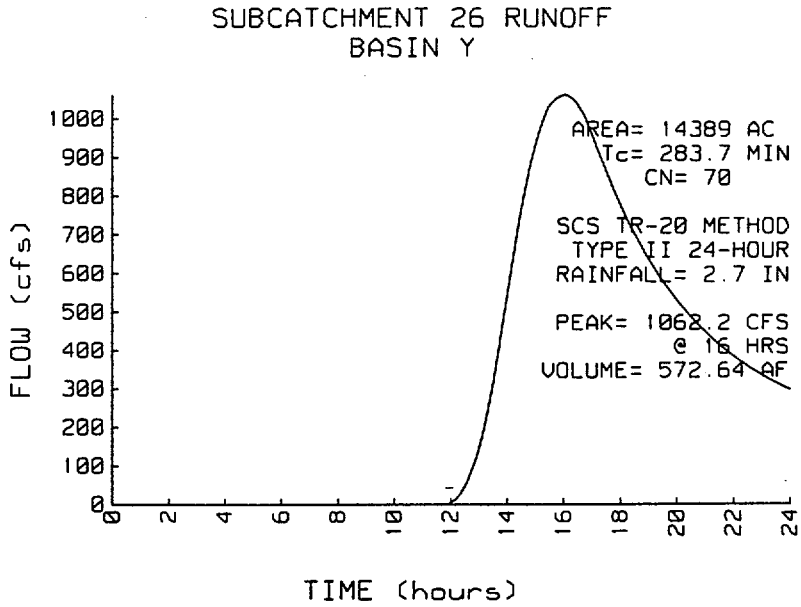
SUBCATCHMENT 26 **BASIN Y**

PEAK=1062.2 CFS @ 16.00 HRS, VOLUME=572.64 AF

ACRES	CN
14389.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	283.7
L=36235' s=.0698 ~~1~~'		



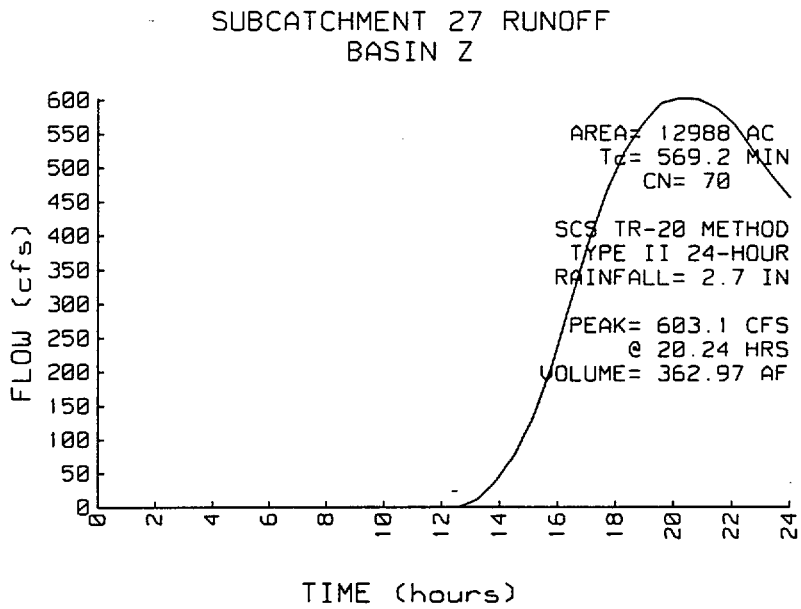
SUBCATCHMENT 27 **BASIN Z**

PEAK= 603.1 CFS @ 20.24 HRS, VOLUME=362.97 AF

ACRES	CN
12988.00	70

SCS TR-20 METHOD
TYPE II 24-HOUR
RAINFALL= 2.7 IN
SPAN= 0-24 HRS, dt=.1 HRS

Method	Comment	Tc (min)
CURVE NUMBER (LAG) METHOD	**Segment ID:**	569.2
L=60247' s=.0391 '		



PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 20, 1999

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	3
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.8
Culvert Length (ft)	100.0
Invert Elevation at Downstream end of Culvert (ft)	0.0
Invert Elevation at Upstream end of Culvert (ft)	1.0
Culvert Slope (ft/ft)	0.01
Starting Flow Rate (cfs)	1.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	25.0
Starting Tailwater Depth (ft)	0.5
Incremental Tailwater Depth (ft)	0.0
Ending Tailwater Depth (ft)	0.5

NO WINGWALLS

COMPUTATION RESULTS

Flow	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
1.0	0.5	0.46	0.54	0.39	0.34	0.5	1.63
2.0	0.5	0.67	0.78	0.55	0.49	0.5	3.26
3.0	0.5	0.85	0.96	0.67	0.6	0.6	3.75
4.0	0.5	1.01	1.13	0.79	0.7	0.7	4.07
5.0	0.5	1.15	1.27	0.89	0.79	0.79	4.35
6.0	0.5	1.29	1.41	0.99	0.87	0.87	4.6
7.0	0.5	1.43	1.54	1.08	0.94	0.94	4.83
8.0	0.5	1.56	1.66	1.18	1.01	1.01	5.05
9.0	0.5	1.69	1.78	1.27	1.07	1.07	5.26
10.0	0.5	1.81	1.9	1.37	1.13	1.13	5.45
11.0	0.5	1.94	2.02	1.48	1.19	1.19	5.65
12.0	0.5	2.07	2.15	1.6	1.24	1.24	5.84
13.0	0.5	2.19	2.29	1.78	1.3	1.3	6.03
14.0	0.5	2.32	2.45	2.0	1.35	1.35	6.22
15.0	0.5	2.45	2.37	2.0	1.4	2.0	4.77
16.0	0.5	2.61	2.68	2.0	1.44	1.44	6.6
17.0	0.5	2.77	2.99	2.0	1.49	1.49	6.79
18.0	0.5	2.89	3.3	2.0	1.53	1.53	6.99
19.0	0.5	3.09	3.62	2.0	1.57	1.57	7.19
20.0	0.5	3.31	3.96	2.0	1.61	1.61	7.4
21.0	0.5	3.54	4.32	2.0	1.64	1.64	7.61
22.0	0.5	3.78	4.68	2.0	1.68	1.68	7.83
23.0	0.5	4.03	5.05	2.0	1.71	1.71	8.06
24.0	0.5	4.3	5.44	2.0	1.74	1.74	8.29
25.0	0.5	4.57	5.85	2.0	1.76	1.76	8.53

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PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 20, 1999

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	3
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.8
Culvert Length (ft)	100.0
Invert Elevation at Downstream end of Culvert (ft)	0.0
Invert Elevation at Upstream end of Culvert (ft)	1.0
Culvert Slope (ft/ft)	0.01
Starting Flow Rate (cfs)	10.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	58.0
Starting Tailwater Depth (ft)	0.5
Incremental Tailwater Depth (ft)	0.0
Ending Tailwater Depth (ft)	0.5

No WINGWALLS

COMPUTATION RESULTS

Flow	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	0.5	1.43	1.61	1.08	1.0	1.0	4.85
12.0	0.5	1.59	1.78	1.19	1.1	1.1	5.11
14.0	0.5	1.75	1.94	1.3	1.19	1.19	5.35
16.0	0.5	1.9	2.08	1.4	1.28	1.28	5.58
18.0	0.5	2.05	2.23	1.5	1.36	1.36	5.79
20.0	0.5	2.19	2.36	1.59	1.44	1.44	5.99
22.0	0.5	2.33	2.49	1.69	1.51	1.51	6.18
24.0	0.5	2.47	2.62	1.79	1.58	1.58	6.36
26.0	0.5	2.61	2.75	1.88	1.65	1.65	6.54
28.0	0.5	2.75	2.88	1.98	1.71	1.71	6.72
30.0	0.5	2.89	3.0	2.09	1.77	1.77	6.89
32.0	0.5	3.03	3.13	2.2	1.84	1.84	7.06
34.0	0.5	3.16	3.25	2.31	1.89	1.89	7.23
36.0	0.5	3.3	3.39	2.45	1.95	1.95	7.4
38.0	0.5	3.44	3.52	2.63	2.01	2.01	7.56
40.0	0.5	3.58	3.67	3.0	2.06	2.06	7.73
42.0	0.5	3.71	3.83	3.0	2.11	2.11	7.9
44.0	0.5	3.91	4.02	3.0	2.16	2.16	8.07
46.0	0.5	4.09	3.65	3.0	2.21	3.0	6.51
48.0	0.5	4.22	3.89	3.0	2.26	3.0	6.79
50.0	0.5	4.37	4.14	3.0	2.3	3.0	7.07
52.0	0.5	4.6	4.37	3.0	2.34	3.0	7.36
54.0	0.5	4.83	4.63	3.0	2.39	3.0	7.64
56.0	0.5	5.08	4.89	3.0	2.43	3.0	7.92
58.0	0.5	5.33	5.14	3.0	2.47	3.0	8.21

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PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 20, 1999

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	100.0
Invert Elevation at Downstream end of Culvert (ft)	0.0
Invert Elevation at Upstream end of Culvert (ft)	1.0
Culvert Slope (ft/ft)	0.01
Starting Flow Rate (cfs)	10.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	58.0
Starting Tailwater Depth (ft)	0.5
Incremental Tailwater Depth (ft)	0.0
Ending Tailwater Depth (ft)	0.5

WINGWALLS

COMPUTATION RESULTS

Flow (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	0.5	1.37	1.52	1.08	1.0	1.0	4.85
12.0	0.5	1.51	1.68	1.19	1.1	1.1	5.11
14.0	0.5	1.65	1.83	1.3	1.19	1.19	5.35
16.0	0.5	1.79	1.97	1.4	1.28	1.28	5.58
18.0	0.5	1.91	2.1	1.5	1.36	1.36	5.79
20.0	0.5	2.04	2.23	1.59	1.44	1.44	5.99
22.0	0.5	2.16	2.36	1.69	1.51	1.51	6.18
24.0	0.5	2.28	2.48	1.79	1.58	1.58	6.36
26.0	0.5	2.4	2.61	1.88	1.65	1.65	6.54
28.0	0.5	2.52	2.73	1.98	1.71	1.71	6.72
30.0	0.5	2.64	2.85	2.09	1.77	1.77	6.89
32.0	0.5	2.76	2.97	2.2	1.84	1.84	7.06
34.0	0.5	2.87	3.09	2.31	1.89	1.89	7.23
36.0	0.5	2.99	3.22	2.45	1.95	1.95	7.4
38.0	0.5	3.11	3.35	2.63	2.01	2.01	7.56
40.0	0.5	3.22	3.5	3.0	2.06	2.06	7.73
42.0	0.5	3.34	3.65	3.0	2.11	2.11	7.9
44.0	0.5	3.53	3.83	3.0	2.16	2.16	8.07
46.0	0.5	3.71	3.45	3.0	2.21	3.0	6.51
48.0	0.5	3.84	3.68	3.0	2.26	3.0	6.79
50.0	0.5	3.95	3.9	3.0	2.3	3.0	7.07
52.0	0.5	4.11	4.12	3.0	2.34	2.34	8.77
54.0	0.5	4.27	4.36	3.0	2.39	2.39	8.95
56.0	0.5	4.43	4.6	3.0	2.43	2.43	9.14
58.0	0.5	4.61	4.82	3.0	2.47	2.47	9.33

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PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 20, 1999

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	4.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	3
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.8
Culvert Length (ft)	100.0
Invert Elevation at Downstream end of Culvert (ft)	0.0
Invert Elevation at Upstream end of Culvert (ft)	1.0
Culvert Slope (ft/ft)	0.01
Starting Flow Rate (cfs)	10.0
Incremental Flow Rate (cfs)	5.0
Ending Flow Rate (cfs)	130.0
Starting Tailwater Depth (ft)	0.5
Incremental Tailwater Depth (ft)	0.0
Ending Tailwater Depth (ft)	0.5

No WINGWALLS

COMPUTATION RESULTS

Flow	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	0.5	1.26	1.48	0.97	0.92	0.92	4.57
15.0	0.5	1.58	1.83	1.19	1.13	1.13	5.12
20.0	0.5	1.87	2.14	1.38	1.32	1.32	5.55
25.0	0.5	2.14	2.41	1.56	1.48	1.48	5.93
30.0	0.5	2.39	2.66	1.72	1.62	1.62	6.26
35.0	0.5	2.63	2.9	1.88	1.76	1.76	6.57
40.0	0.5	2.87	3.12	2.03	1.89	1.89	6.86
45.0	0.5	3.1	3.33	2.18	2.01	2.01	7.13
50.0	0.5	3.33	3.54	2.33	2.12	2.12	7.39
55.0	0.5	3.56	3.74	2.48	2.23	2.23	7.64
60.0	0.5	3.78	3.94	2.64	2.33	2.33	7.88
65.0	0.5	4.0	4.14	2.79	2.43	2.43	8.12
70.0	0.5	4.23	4.34	2.97	2.53	2.53	8.36
75.0	0.5	4.45	4.54	3.16	2.62	2.62	8.59
80.0	0.5	4.67	4.75	3.39	2.71	2.71	8.83
85.0	0.5	4.9	4.97	4.0	2.79	2.79	9.07
90.0	0.5	5.19	5.2	4.0	2.88	2.88	9.3
95.0	0.5	5.49	5.47	4.0	2.95	4.0	7.56
100.0	0.5	5.67	4.84	4.0	3.03	4.0	7.96
105.0	0.5	6.0	5.17	4.0	3.1	4.0	8.36
110.0	0.5	6.38	5.48	4.0	3.17	4.0	8.75
115.0	0.5	6.77	5.83	4.0	3.24	4.0	9.15
120.0	0.5	7.18	6.16	4.0	3.3	4.0	9.55
125.0	0.5	7.61	6.5	4.0	3.36	4.0	9.95
130.0	0.5	8.06	6.84	4.0	3.41	4.0	10.35

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PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 20, 1999

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	4.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	100.0
Invert Elevation at Downstream end of Culvert (ft)	0.0
Invert Elevation at Upstream end of Culvert (ft)	1.0
Culvert Slope (ft/ft)	0.01
Starting Flow Rate (cfs)	10.0
Incremental Flow Rate (cfs)	5.0
Ending Flow Rate (cfs)	130.0
Starting Tailwater Depth (ft)	0.5
Incremental Tailwater Depth (ft)	0.0
Ending Tailwater Depth (ft)	0.5

WINGWALLS

COMPUTATION RESULTS

Flow (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	0.5	1.23	1.39	0.97	0.92	0.92	4.57
15.0	0.5	1.53	1.72	1.19	1.13	1.13	5.12
20.0	0.5	1.79	2.01	1.38	1.32	1.32	5.55
25.0	0.5	2.03	2.27	1.56	1.48	1.48	5.93
30.0	0.5	2.26	2.51	1.72	1.62	1.62	6.26
35.0	0.5	2.47	2.73	1.88	1.76	1.76	6.57
40.0	0.5	2.68	2.94	2.03	1.89	1.89	6.86
45.0	0.5	2.88	3.14	2.18	2.01	2.01	7.13
50.0	0.5	3.07	3.34	2.33	2.12	2.12	7.39
55.0	0.5	3.27	3.53	2.48	2.23	2.23	7.64
60.0	0.5	3.46	3.72	2.64	2.33	2.33	7.88
65.0	0.5	3.65	3.91	2.79	2.43	2.43	8.12
70.0	0.5	3.84	4.1	2.97	2.53	2.53	8.36
75.0	0.5	4.03	4.3	3.16	2.62	2.62	8.59
80.0	0.5	4.22	4.5	3.39	2.71	2.71	8.83
85.0	0.5	4.41	4.71	4.0	2.79	2.79	9.07
90.0	0.5	4.68	4.94	4.0	2.88	2.88	9.3
95.0	0.5	4.98	5.19	4.0	2.95	2.95	9.55
100.0	0.5	5.15	4.55	4.0	3.03	4.0	7.96
105.0	0.5	5.39	4.85	4.0	3.1	4.0	8.36
110.0	0.5	5.64	5.12	4.0	3.17	4.0	8.75
115.0	0.5	5.91	5.44	4.0	3.24	4.0	9.15
120.0	0.5	6.2	5.73	4.0	3.3	4.0	9.55
125.0	0.5	6.49	6.04	4.0	3.36	4.0	9.95
130.0	0.5	6.8	6.34	4.0	3.41	4.0	10.35

outlet control

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BASIN RUNOFF AND CULVERT DESIGN

Basin ID	Subcatch-ment #	Area (acre)	Basin Flow Path Info Elev. chg.	Length	Slope	25-Yr, 24-Hr Runoff (cfs)	Number & Size of Culverts Req'd	100-Yr, 24-Hr Runoff (cfs)	Number & Size of Culverts Req'd
A	N/A	877	790	11,637	0.0679	N/A	N/A	N/A	N/A
B	1	368	510	6,772	0.0753	37	1@3' Diam.	75	1@4' Diam.
C	2	1,146	540	7,801	0.0692	104	2@4' Diam.	209	2@4' Diam.
D	3	3,365	2,090	24,040	0.0869	182	2@4' Diam.	349	4@4' Diam.
E	4	766	680	9,317	0.0730	64	1@4' Diam.	128	2@4' Diam.
F	5	209	510	7,303	0.0698	20	1@3' Diam.	39	1@3' Diam.
G	6	1,533	1,640	19,983	0.0821	88	1@4' Diam.	170	2@4' Diam.
H(1)	7	665	1,820	8,644	0.2106	83	1@4' Diam.	170	2@4' Diam.
H	8	1,360	1,740	11,398	0.1527	130	2@4' Diam.	265	3@4' Diam.
I	10	1,763	2,050	26,164	0.0784	86	1@4' Diam.	165	2@4' Diam.
J	9	1,269	1,760	13,542	0.1300	104	1@4' Diam.	209	2@4' Diam.
K	11	1,003	1,700	20,201	0.0842	59	1@4' Diam.	113	1@4' Diam.
L	12	1,465	1,680	26,860	0.0625	66	1@4' Diam.	124	2@4' Diam.
M	13	1,370	1,350	20,785	0.0650	72	1@4' Diam.	139	2@4' Diam.
N(1)	16	4,848	1,680	35,108	0.0479	178	2@4' Diam.	328	3@4' Diam.
O	14	236	612	6,533	0.0937	26	1@3' Diam.	53	1@4' Diam.
P	15	574	622	7,085	0.0878	59	1@4' Diam.	120	2@4' Diam.
Q	17	4,008	1,730	43,397	0.0399	124	2@4' Diam.	226	2@4' Diam.
R	20	1,347	1,660	28,629	0.0580	57	1@4' Diam.	107	1@4' Diam.
S	18	629	630	10,434	0.0604	46	1@3' Diam.	92	1@4' Diam.
	19	278	205	7,968	0.0257	18	1@3' Diam.	35	1@3' Diam.
	21	5,443	1,910	33,982	0.0562	207	2@4' Diam.	386	4@4' Diam.
V(1)	22	2,554	790	14,950	0.0528	150	2@4' Diam.	291	3@4' Diam.
V(2)	23	9,065	2,550	37,960	0.0672	345	4@4' Diam.	643	6@4' Diam.
W	24	15,740	2,280	51,797	0.0440	460	5@4' Diam.	837	8@4' Diam.
X	25	1,056	500	18,289	0.0273	45	1@3' Diam.	84	1@4' Diam.
Y	26	14,389	2,530	36,235	0.0698	567	6@4' Diam.	1062	10@4' Diam.
Z	27	12,988	2,355	60,247	0.0391	336	3@4' Diam.	603	6@4' Diam.

Runoff calculated using HydroCad (based on TR-20):
CN = 70
25-Yr, 24-Hr Precipitation = 2.2 inches
100-Yr, 24-Hr Precipitation = 2.7 inches

Approximate ranges per each CMP culvert:
2' Diameter: 0 - 17 cfs
3' Diameter: 18 - 46 cfs
4' Diameter: 47 - 100 cfs

(Based on allowing about 1 foot of water over the inlet crown of the culvert plus a 10 percent culvert flow margin added to the above, and assuming a 1 percent culvert slope; use wingwalls for 4' diameter culverts)

utlet velocities indicate the need for riprap or other outlet protection.