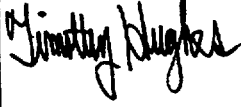



CALCULATION TITLE PAGE

ENT & PROJECT PFSLLC / PRIVATE FUEL STORAGE FACILITY				PAGE 1 OF 66	
CALCULATION TITLE PFSF Rail Line - Runoff Analysis and Culvert Sizing				QA CATEGORY (X) <input type="checkbox"/> I - NUCLEAR SAFETY RELATED <input checked="" type="checkbox"/> II <input checked="" type="checkbox"/> X <input type="checkbox"/> III <input type="checkbox"/> OTHER	
CALCULATION IDENTIFICATION NUMBER				OPTIONAL WORK PACKAGE NO.	
J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE		
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 	Yung Shen 8/24/1999 	N/A	0	NA	X
DISTRIBUTION					
GROUP	NAME & LOCATION	COPY SENT (X)	GROUP	NAME & LOCATION	COPY SENT (X)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	Orig. - Job Bk. R4.2 Fire File, Denver	X X			

PAGE NO.	DESCRIPTION	REVISION		REMARKS
		NO.	DATE	
1	Calculation Title Page			
2	Table of Contents and Historical Data			
3	Record of Revisions			
4	Objective of Calculation			
4	Calculation Method/Assumptions			
4	Sources of Data/Equations			
4	Conclusions			
5	25-Yr, 24-Hr Storm Precipitation			
32	25-Yr, 24-Hr Runoff Analysis			
33	100-Yr, 24-Hr Storm Precipitation			
34-60	100-Yr, 24-Hr Runoff Analysis			
61-65	Initial Estimate of Culvert Capacities			
66	Basin Runoff and Culvert Design Results			

CALCULATION SHEET

J.O.W.O./CALCULATION NO.

05996.02-SY-11

REVISION

0

PAGE

3

PREPARER/DATE

Timothy Hughes 8/23/1999

REVIEWER/CHECKER/DATE

Yung Shen 8/24/1999

INDEPENDENT REVIEWER

N/A

JECT/TITLE

SF Rail Line -- Runoff Analysis and Culvert Sizing

QA CATEGORY/CODE CLASS

III

RECORD OF REVISIONS**REVISION 0**

Original Issue

CALCULATION SHEET

J.O./W.O./CALCULATION NO.

05996.02-SY-11

REVISION

0

PAGE

4

PREPARER/DATE

Timothy Hughes 8/23/1999

REVIEWER/CHECKER/DATE

Yung Shen 8/24/1999

INDEPENDENT REVIEWER

N/A

SUBJECT/TITLE

SF Rail Line - Runoff Analysis and Culvert Sizing

QA CATEGORY/CODE CLASS

III

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.

TYPE II 24-HOUR RAINFALL= 2.2 IN

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SUBCATCHMENT 1

BASIN B

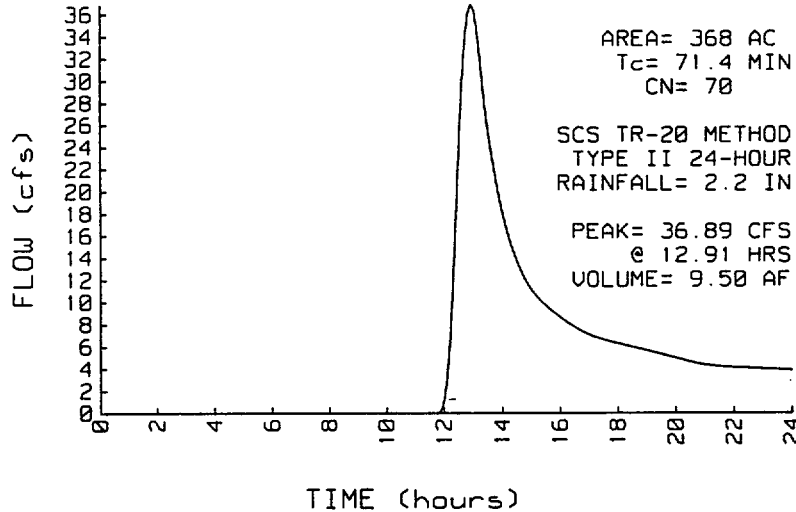
PEAK= 36.89 CFS @ 12.91 HRS, VOLUME= 9.50 AF

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 '/'		

SUBCATCHMENT 1 RUNOFF
BASIN B



Basin Area & Slope from
P. 7, Cal. 05996.02-SY-10

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SUBCATCHMENT 2

BASIN C

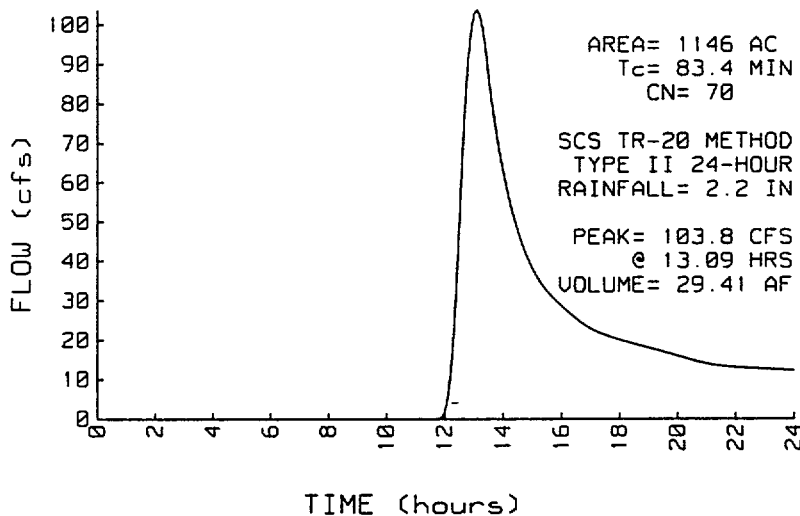
PEAK= 103.8 CFS @ 13.09 HRS, VOLUME= 29.41 AF

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



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SUBCATCHMENT 3

BASIN D

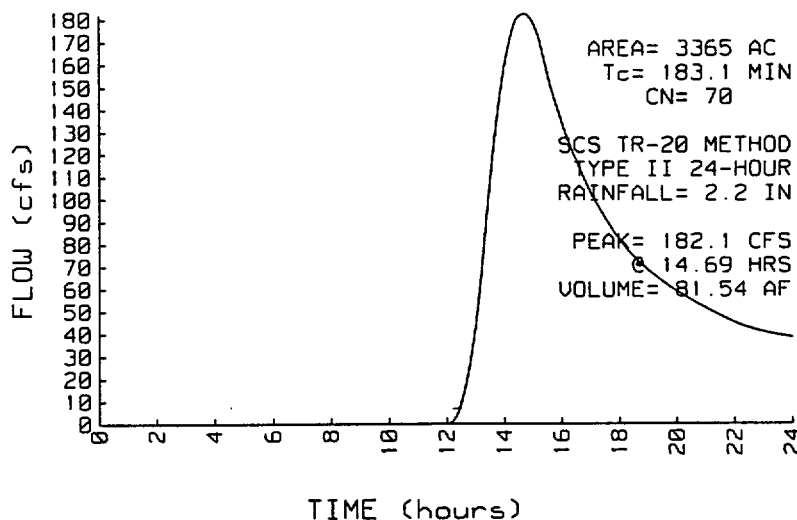
PEAK= 182.1 CFS @ 14.69 HRS, VOLUME= 81.54 AF

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		

SUBCATCHMENT 3 RUNOFF
 BASIN D



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SUBCATCHMENT 4

BASIN E

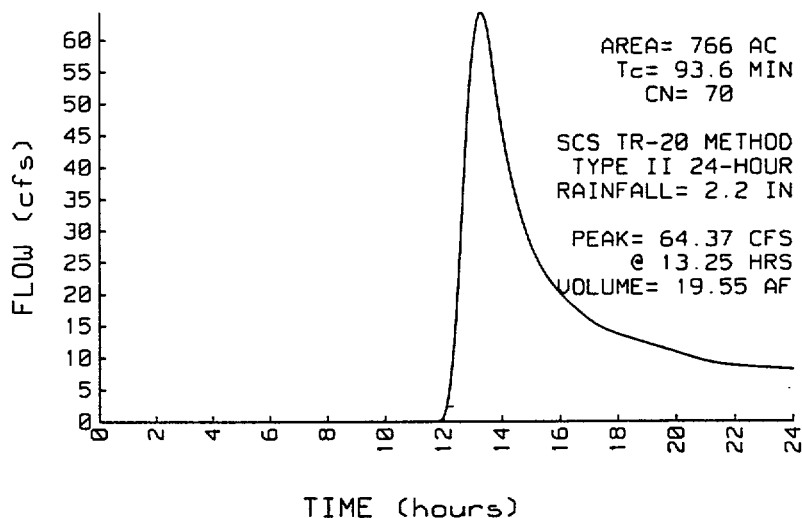
PEAK= 64.37 CFS @ 13.25 HRS, VOLUME= 19.55 AF

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		

SUBCATCHMENT 4 RUNOFF
 BASIN E



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SUBCATCHMENT 5

BASIN F

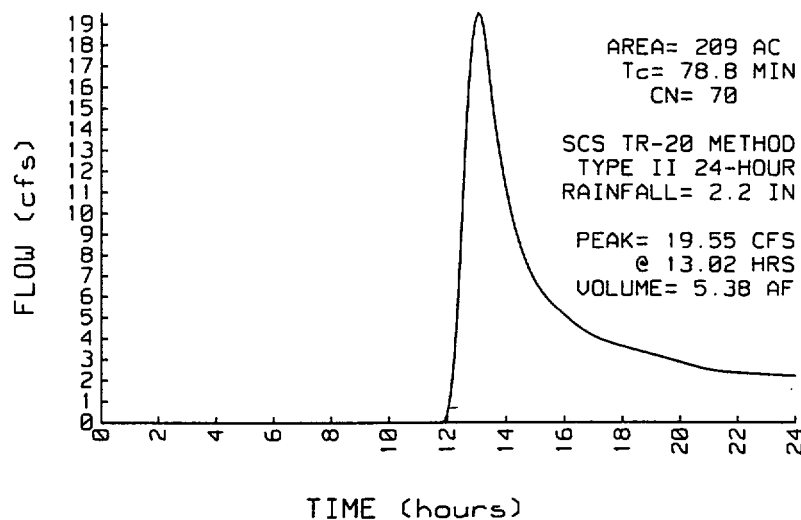
PEAK= 19.55 CFS @ 13.02 HRS, VOLUME= 5.38 AF

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 /		

SUBCATCHMENT 5 RUNOFF
 BASIN F



TYPE II 24-HOUR RAINFALL= 2.2 IN

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SUBCATCHMENT 6

BASIN G

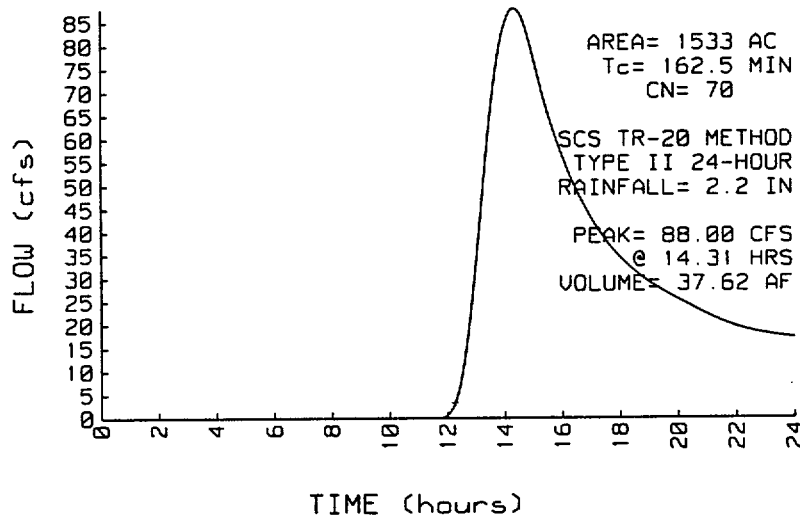
PEAK= 88.00 CFS @ 14.31 HRS, VOLUME= 37.62 AF

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		

SUBCATCHMENT 6 RUNOFF
 BASIN G



20 Aug 99

SUBCATCHMENT 7

BASIN H(1)

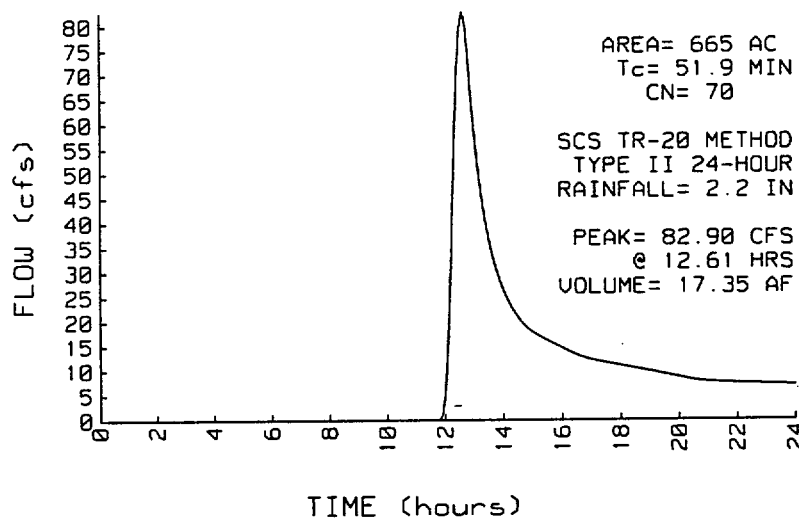
PEAK= 82.90 CFS @ 12.61 HRS, VOLUME= 17.35 AF

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 //		

SUBCATCHMENT 7 RUNOFF
 BASIN H(1)



TYPE II 24-HOUR RAINFALL= 2.2 IN

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SUBCATCHMENT 8

BASIN H

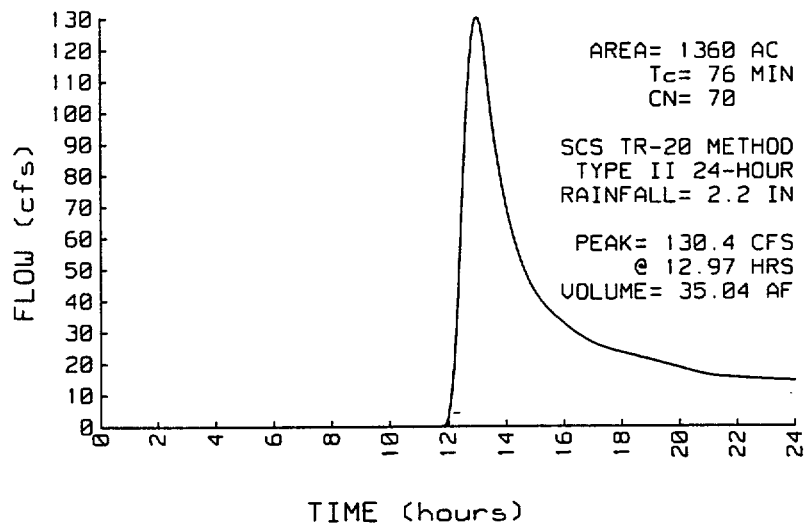
PEAK= 130.4 CFS @ 12.97 HRS, VOLUME= 35.04 AF

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		

SUBCATCHMENT 8 RUNOFF
BASIN H



TYPE II 24-HOUR RAINFALL= 2.2 IN

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SUBCATCHMENT 9

BASIN J

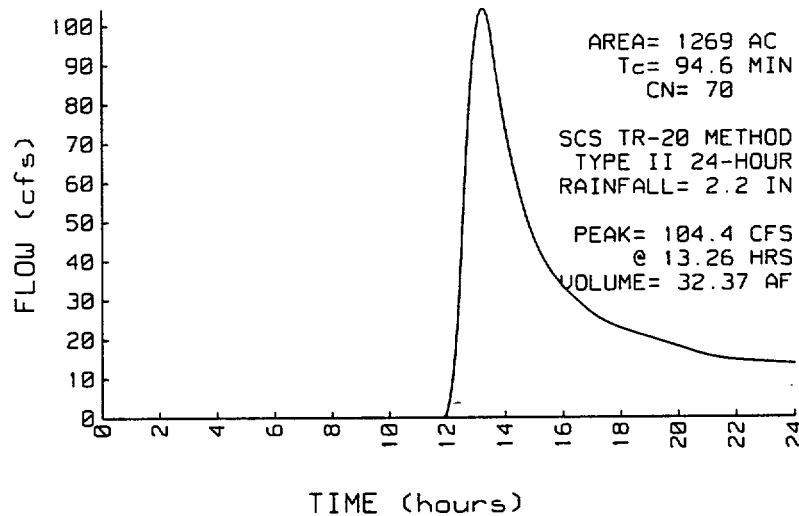
PEAK= 104.4 CFS @ 13.26 HRS, VOLUME= 32.37 AF

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



20 Aug 99

SUBCATCHMENT 10

BASIN I

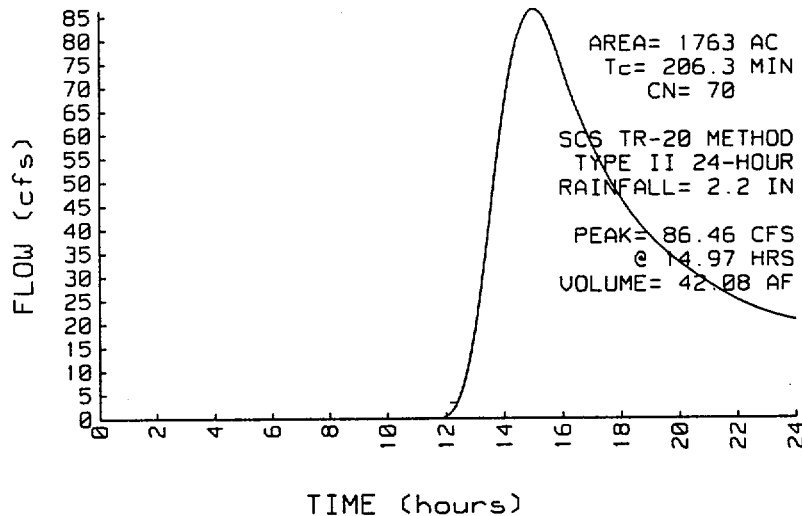
PEAK= 86.46 CFS @ 14.97 HRS, VOLUME= 42.08 AF

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 10 RUNOFF
BASIN I



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SUBCATCHMENT 11

BASIN K

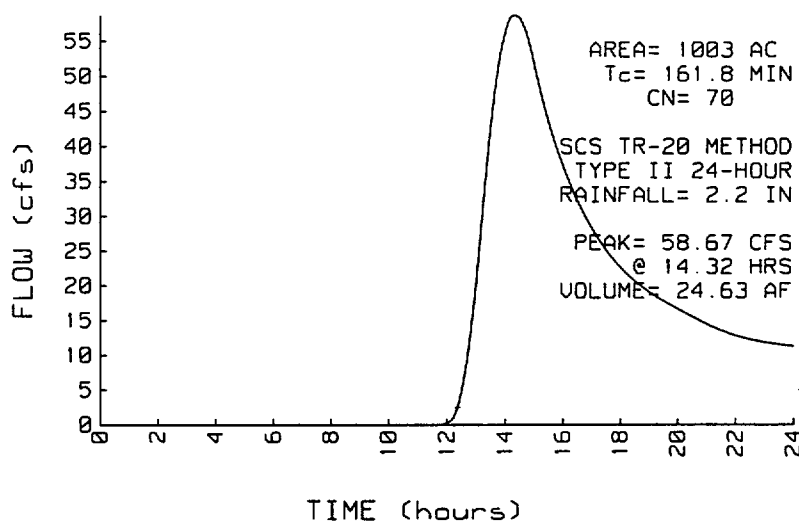
PEAK= 58.67 CFS @ 14.32 HRS, VOLUME= 24.63 AF

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		

SUBCATCHMENT 11 RUNOFF
BASIN K



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SUBCATCHMENT 12

BASIN L

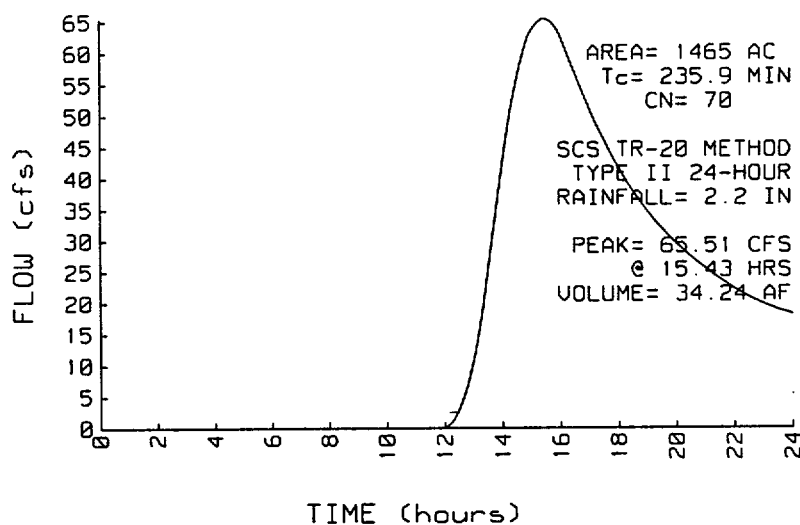
PEAK= 65.51 CFS @ 15.43 HRS, VOLUME= 34.24 AF

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		

SUBCATCHMENT 12 RUNOFF
 BASIN L



SUBCATCHMENT 13

BASIN M

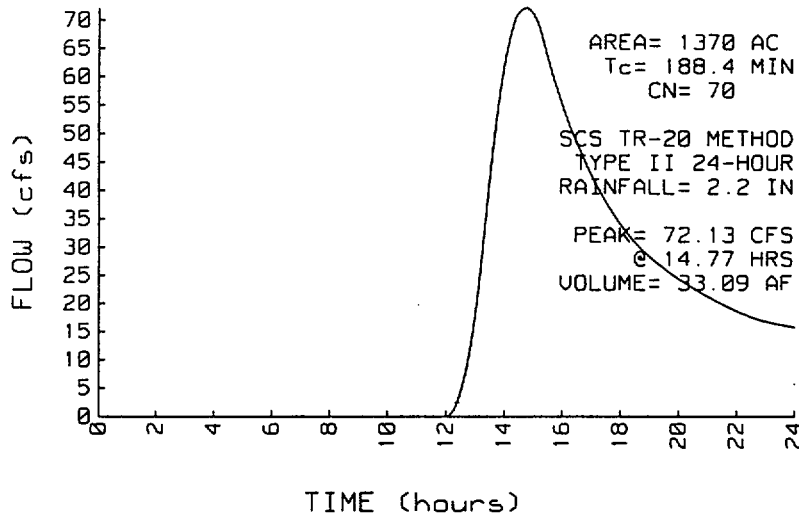
PEAK= 72.13 CFS @ 14.77 HRS, VOLUME= 33.09 AF

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		

SUBCATCHMENT 13 RUNOFF
BASIN M



SUBCATCHMENT 14

BASIN 0

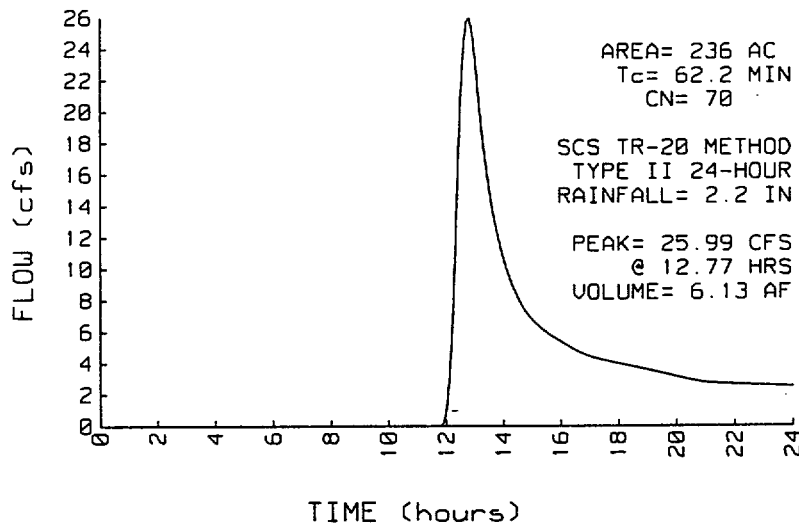
PEAK= 25.99 CFS @ 12.77 HRS, VOLUME= 6.13 AF

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		

SUBCATCHMENT 14 RUNOFF
BASIN 0



TYPE II 24-HOUR RAINFALL= 2.2 IN

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SUBCATCHMENT 15

BASIN P

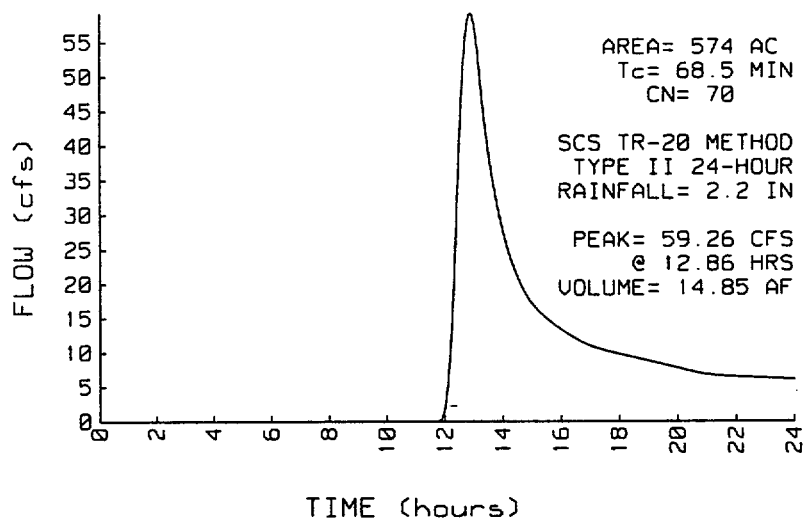
PEAK= 59.26 CFS @ 12.86 HRS, VOLUME= 14.85 AF

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		

SUBCATCHMENT 15 RUNOFF
 BASIN P



Data for SKULL VALLEY PFSF - S DRAINAGE TO CULVERTS

TYPE II 24-HOUR RAINFALL= 2.2 IN

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SUBCATCHMENT 16

BASIN N(1)

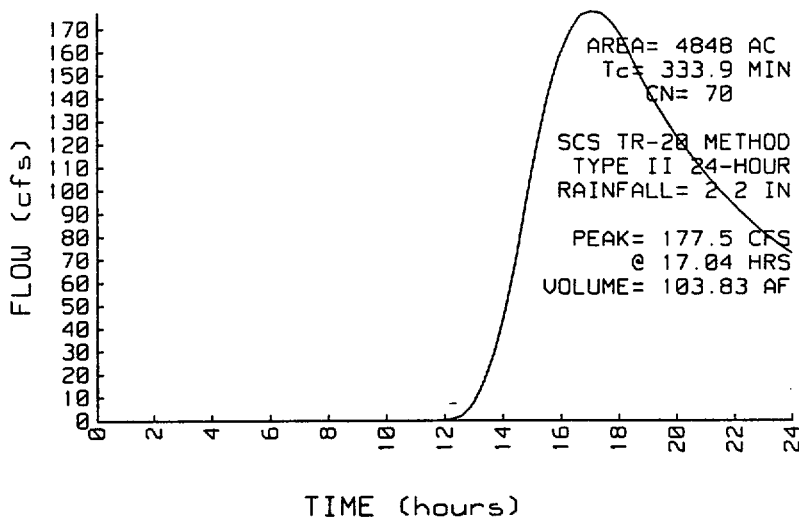
PEAK= 177.5 CFS @ 17.04 HRS, VOLUME=103.83 AF

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 /		

SUBCATCHMENT 16 RUNOFF
BASIN N(1)



TYPE II 24-HOUR RAINFALL= 2.2 IN

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SUBCATCHMENT 17

BASIN Q

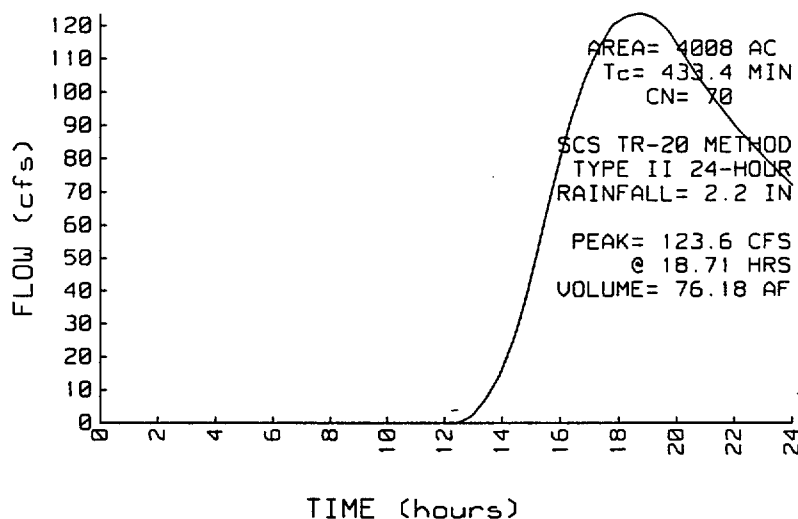
PEAK= 123.6 CFS @ 18.71 HRS, VOLUME= 76.18 AF

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 17 RUNOFF
BASIN Q



SUBCATCHMENT 18

BASIN S

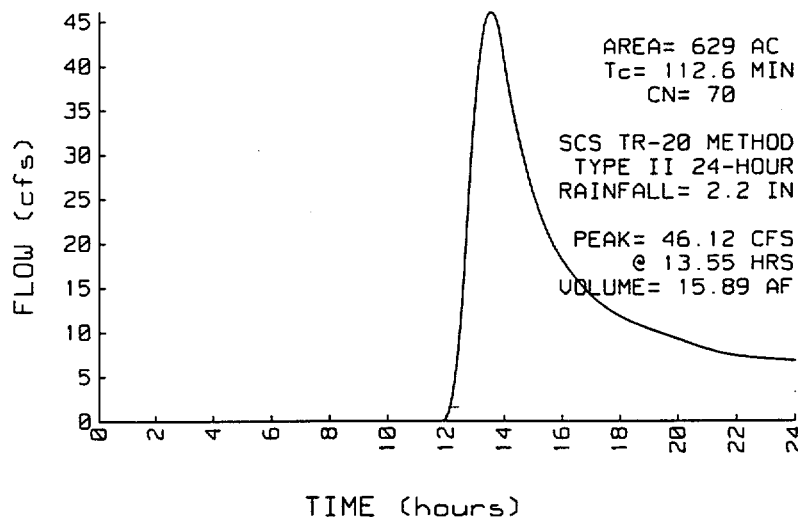
PEAK= 46.12 CFS @ 13.55 HRS, VOLUME= 15.89 AF

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 18 RUNOFF
BASIN S



20 Aug 99

SUBCATCHMENT 19

BASIN T

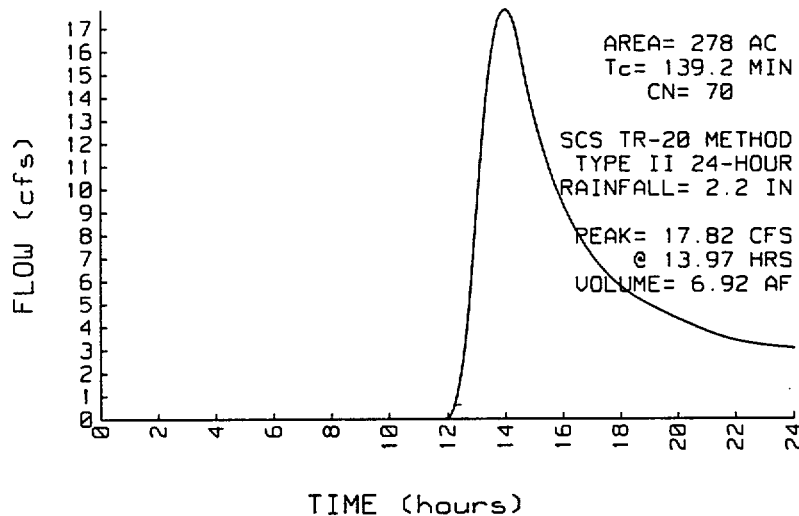
PEAK= 17.82 CFS @ 13.97 HRS, VOLUME= 6.92 AF

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		

SUBCATCHMENT 19 RUNOFF
 BASIN T



SUBCATCHMENT 20

BASIN R

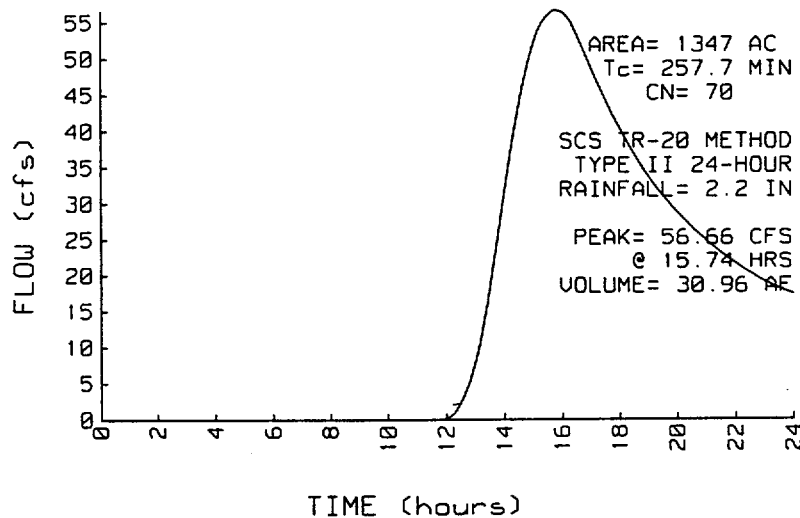
PEAK= 56.66 CFS @ 15.74 HRS, VOLUME= 30.96 AF

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 ✓		

SUBCATCHMENT 20 RUNOFF
BASIN R



SUBCATCHMENT 21

BASIN U

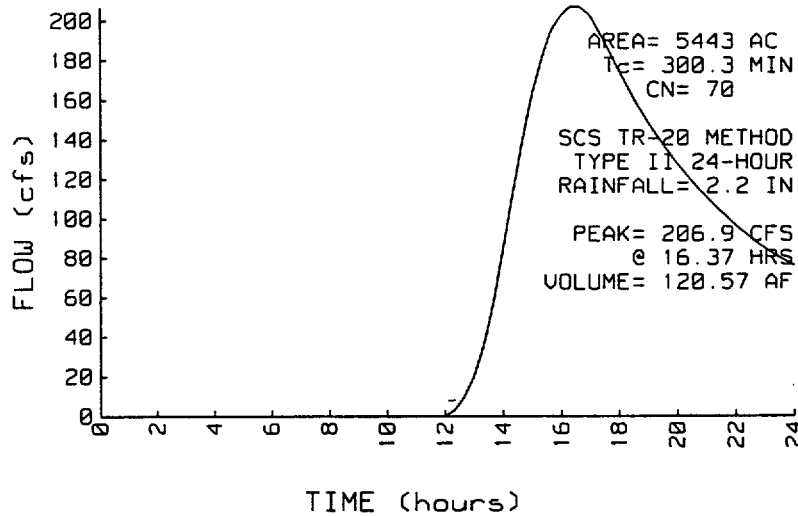
PEAK= 206.9 CFS @ 16.37 HRS, VOLUME=120.57 AF

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		

SUBCATCHMENT 21 RUNOFF
BASIN U



20 Aug 99

SUBCATCHMENT 22

BASIN V(1)

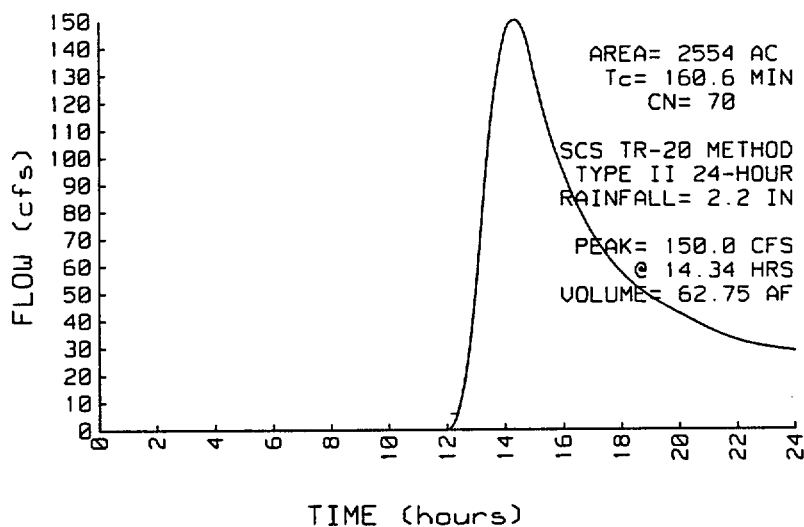
PEAK= 150.0 CFS @ 14.34 HRS, VOLUME= 62.75 AF

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		

SUBCATCHMENT 22 RUNOFF
 BASIN V(1)



TYPE II 24-HOUR RAINFALL= 2.2 IN

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SUBCATCHMENT 23

BASIN V(2)

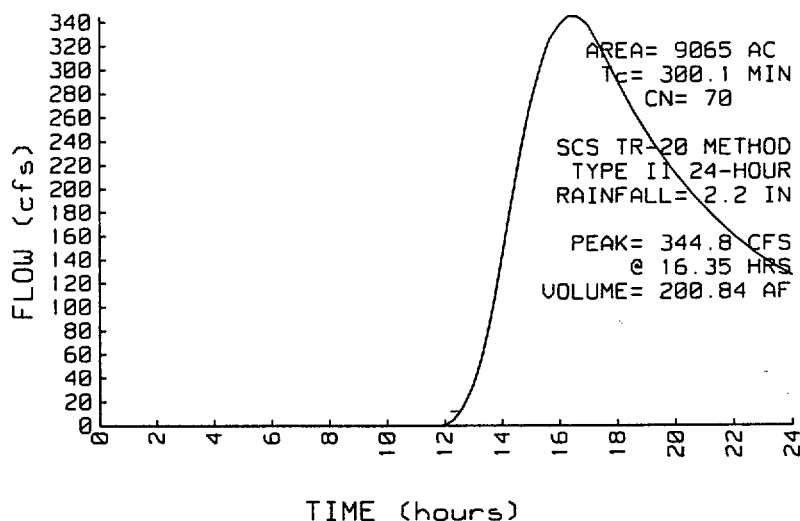
PEAK= 344.8 CFS @ 16.35 HRS, VOLUME=200.84 AF

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		

SUBCATCHMENT 23 RUNOFF
 BASIN V(2)



TYPE II 24-HOUR RAINFALL= 2.2 IN

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20 Aug 99

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SUBCATCHMENT 24

BASIN W

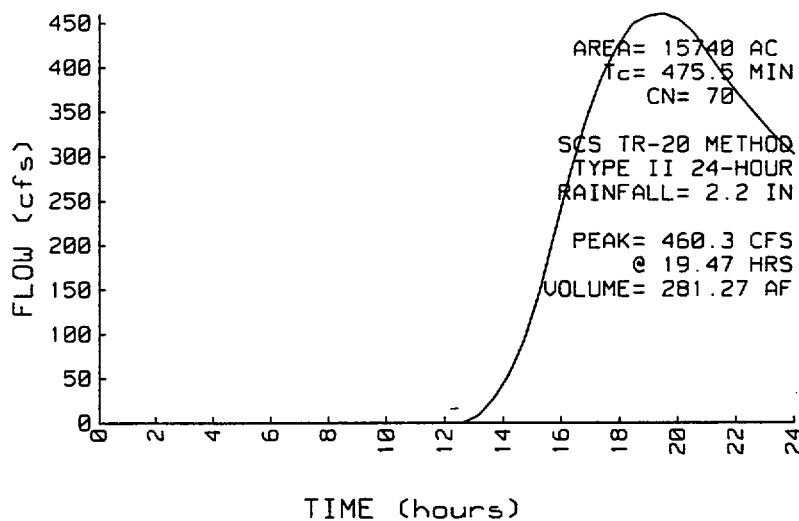
PEAK= 460.3 CFS @ 19.47 HRS, VOLUME=281.27 AF

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 24 RUNOFF
BASIN W



TYPE II 24-HOUR RAINFALL= 2.2 IN

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SUBCATCHMENT 25

BASIN X

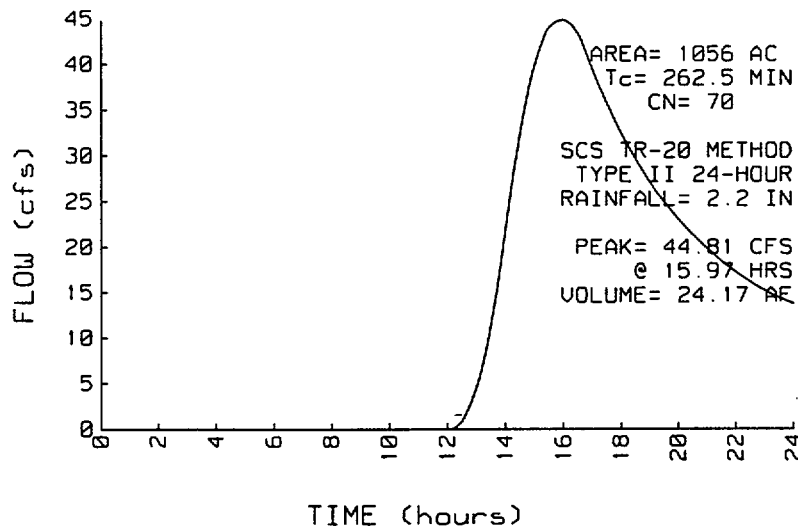
PEAK= 44.81 CFS @ 15.97 HRS, VOLUME= 24.17 AF

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 25 RUNOFF
BASIN X



SUBCATCHMENT 26

BASIN Y

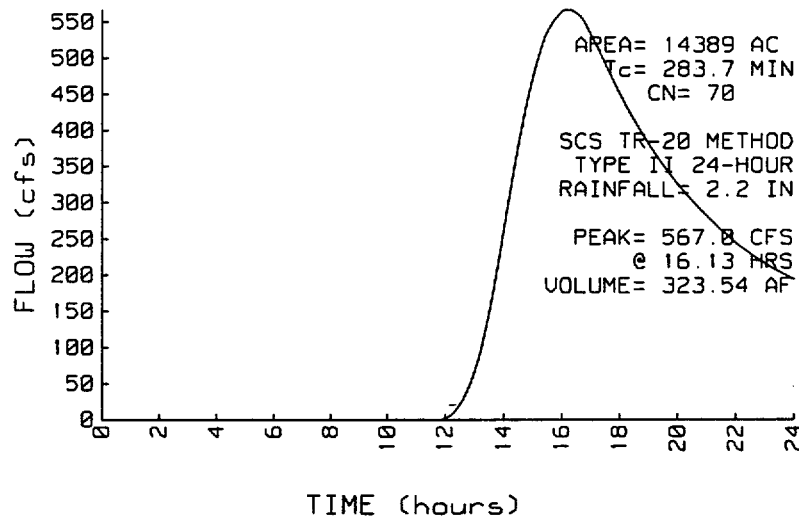
PEAK= 567.0 CFS @ 16.13 HRS, VOLUME=323.54 AF

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 ✓		

SUBCATCHMENT 26 RUNOFF
 BASIN Y



20 Aug 99

SUBCATCHMENT 27

BASIN Z

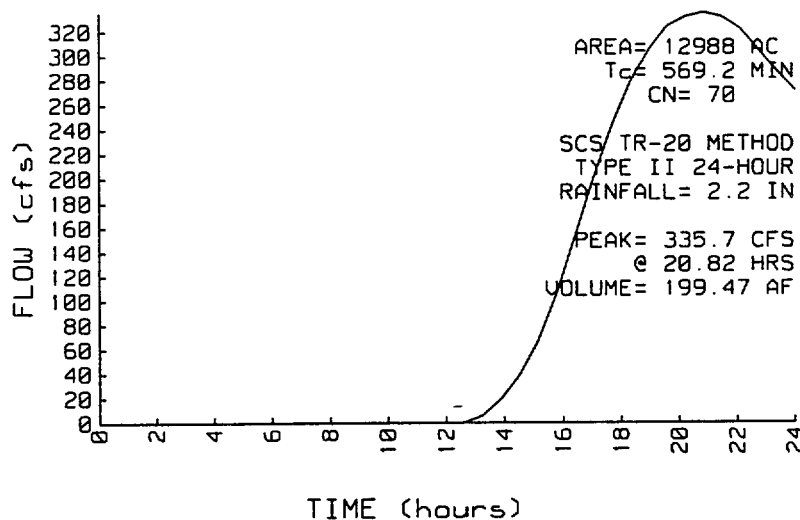
PEAK= 335.7 CFS @ 20.82 HRS, VOLUME=199.47 AF

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 /'		

SUBCATCHMENT 27 RUNOFF
 BASIN Z



TYPE II 24-HOUR RAINFALL= 2.7 IN

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19 Aug 99

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SUBCATCHMENT 1

BASIN B

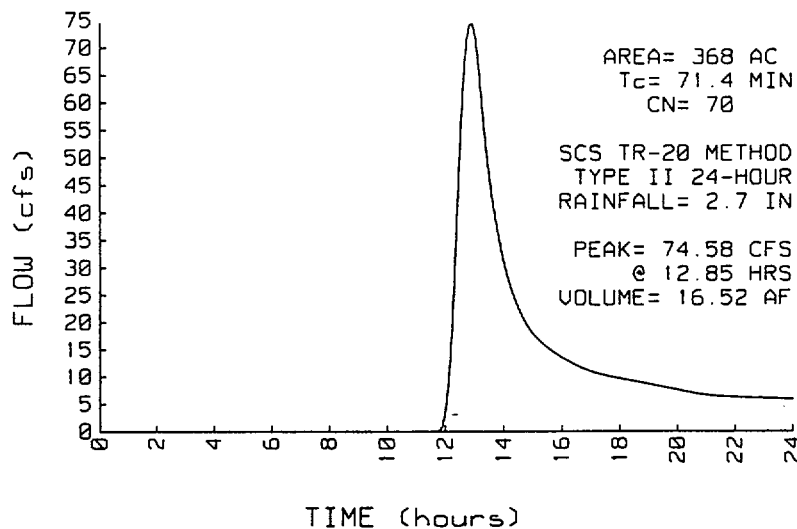
PEAK= 74.58 CFS @ 12.85 HRS, VOLUME= 16.52 AF

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 ✓		

SUBCATCHMENT 1 RUNOFF
BASIN B



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 2

BASIN C

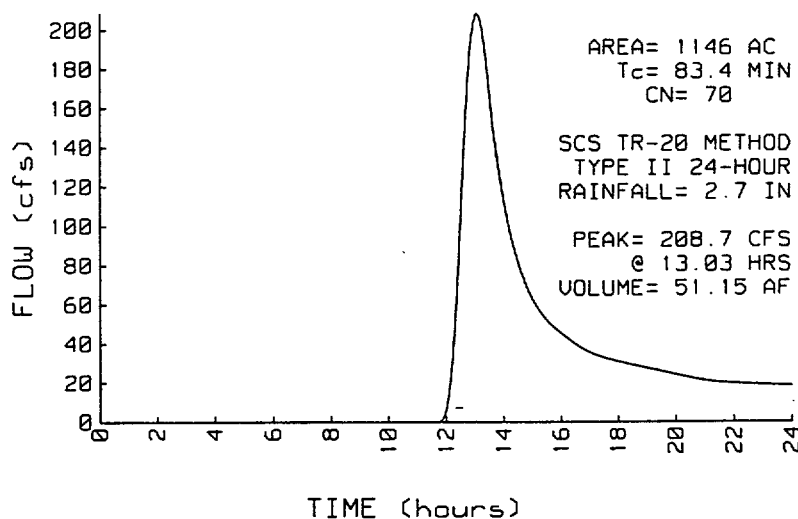
PEAK= 208.7 CFS @ 13.03 HRS, VOLUME= 51.15 AF

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 ✓		

SUBCATCHMENT 2 RUNOFF
BASIN C



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 3

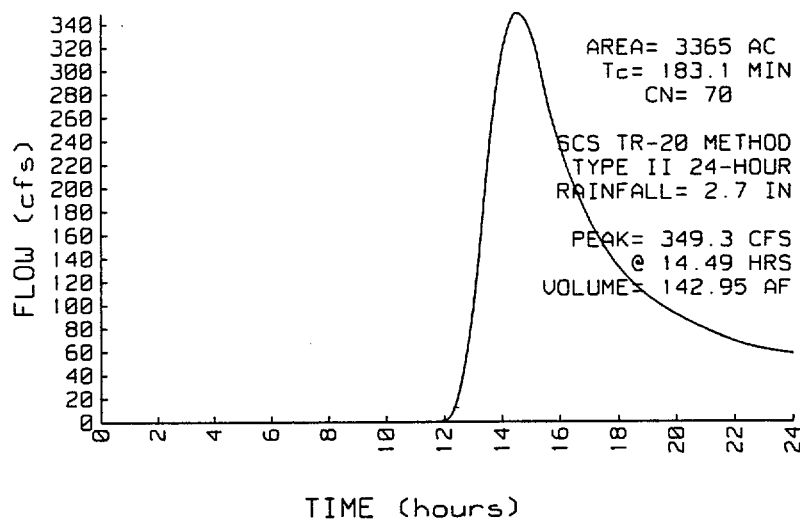
BASIN D

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		

SUBCATCHMENT 3 RUNOFF
BASIN D

SUBCATCHMENT 4

BASIN E

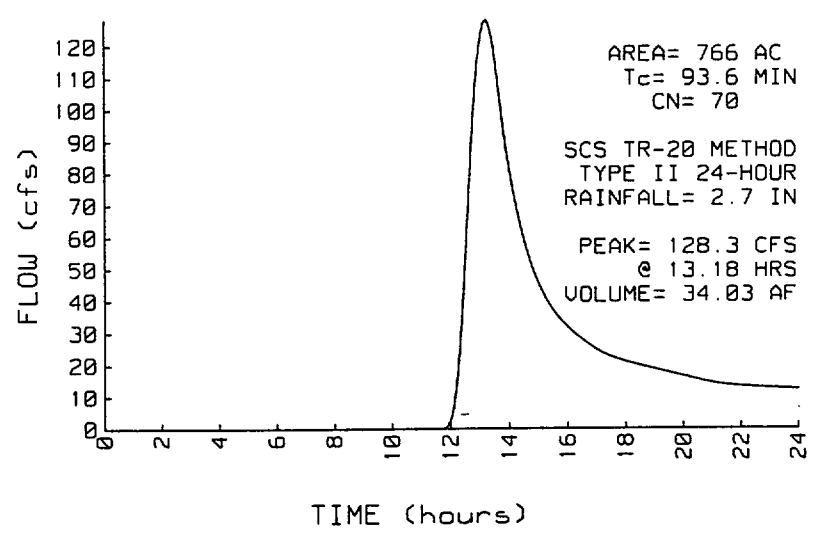
PEAK= 128.3 CFS @ 13.18 HRS, VOLUME= 34.03 AF

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



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 5

BASIN F

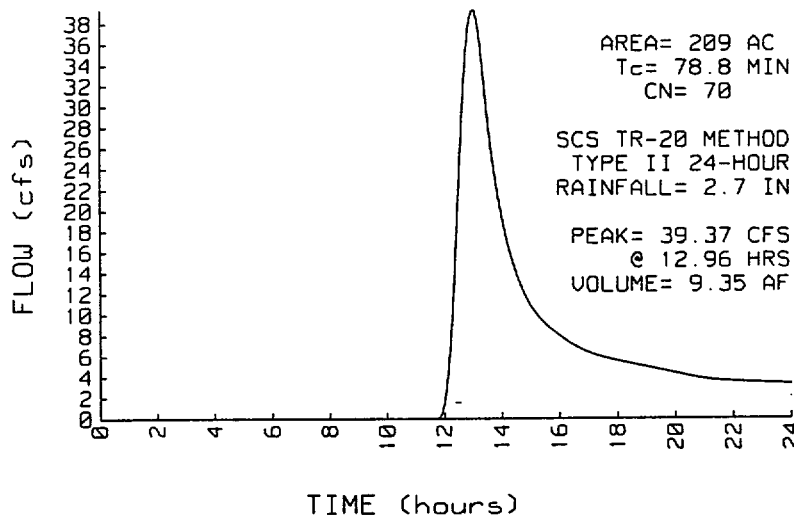
PEAK= 39.37 CFS @ 12.96 HRS, VOLUME= 9.35 AF

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		

SUBCATCHMENT 5 RUNOFF
BASIN F



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 6

BASIN G

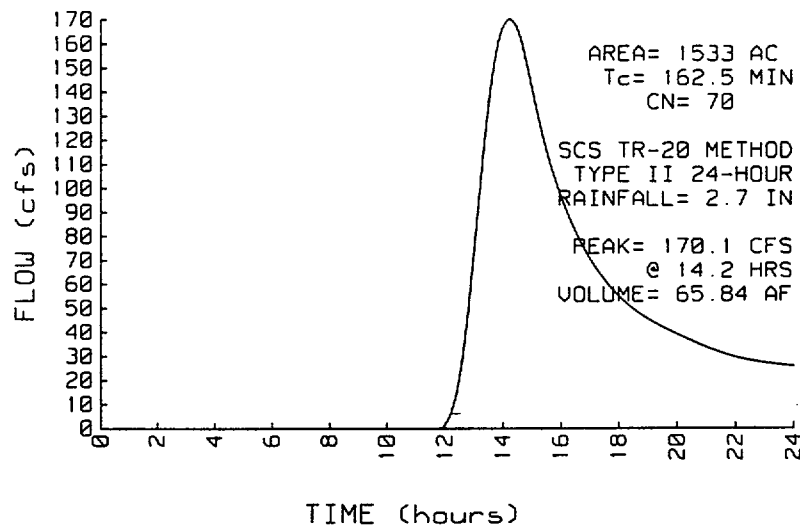
PEAK= 170.1 CFS @ 14.20 HRS, VOLUME= 65.84 AF

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 ✓		

SUBCATCHMENT 6 RUNOFF
BASIN G



TYPE II 24-HOUR RAINFALL= 2.7 IN

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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

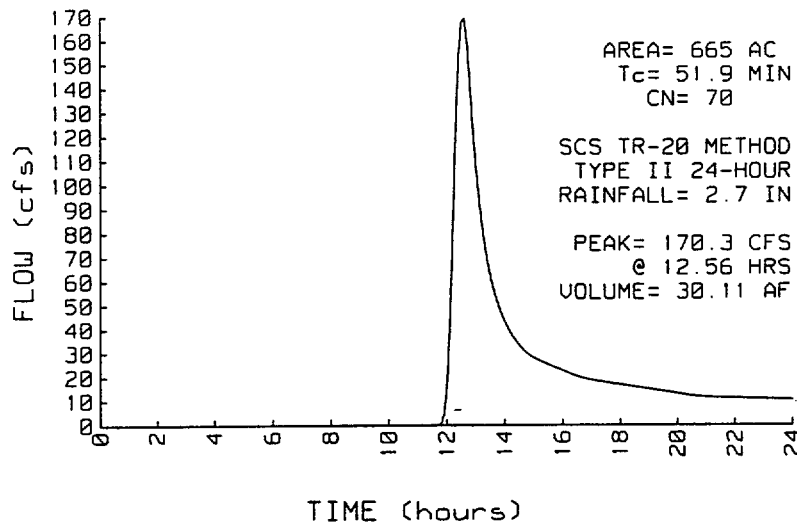
TYPE II 24-HOUR

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 7 RUNOFF
BASIN H(1)



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 8

BASIN H

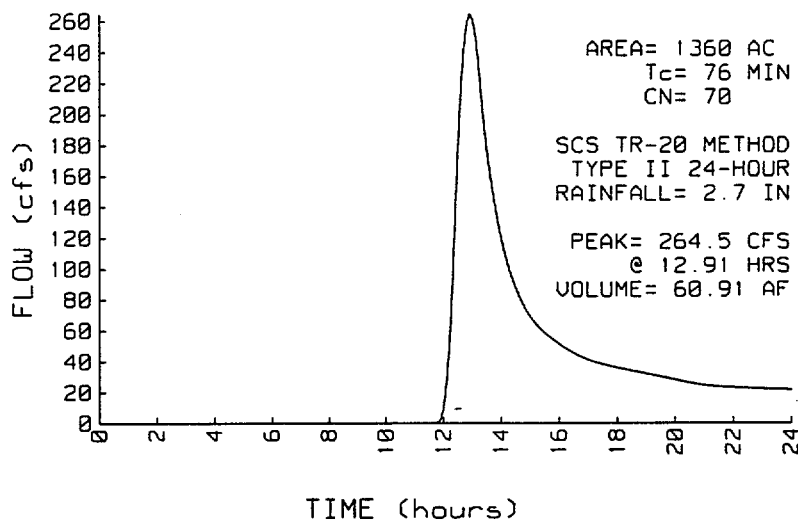
PEAK= 264.5 CFS @ 12.91 HRS, VOLUME= 60.91 AF

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'/'		

SUBCATCHMENT 8 RUNOFF
BASIN H



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 9

BASIN J

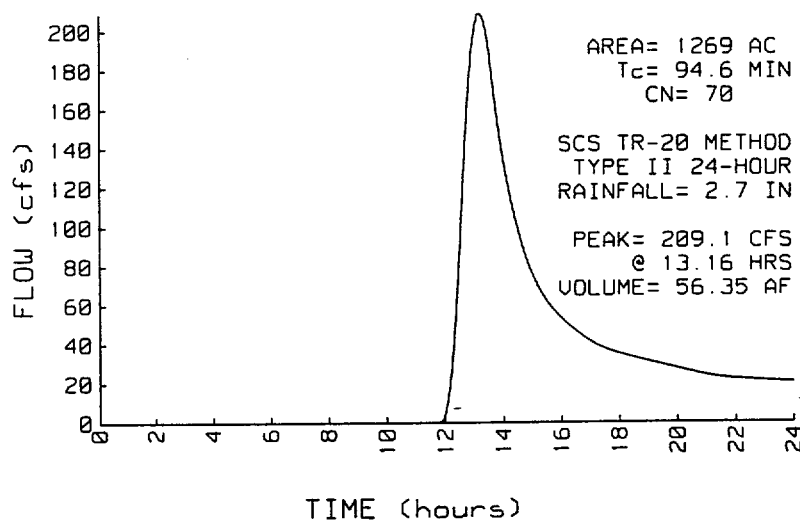
PEAK= 209.1 CFS @ 13.16 HRS, VOLUME= 56.35 AF

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 9 RUNOFF
BASIN J



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 10

BASIN I

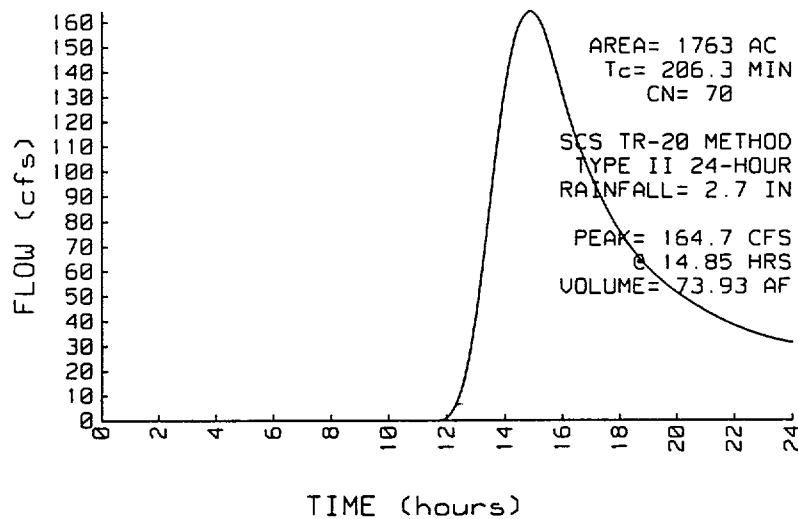
PEAK= 164.7 CFS @ 14.85 HRS, VOLUME= 73.93 AF

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 10 RUNOFF
BASIN I



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 11

BASIN K

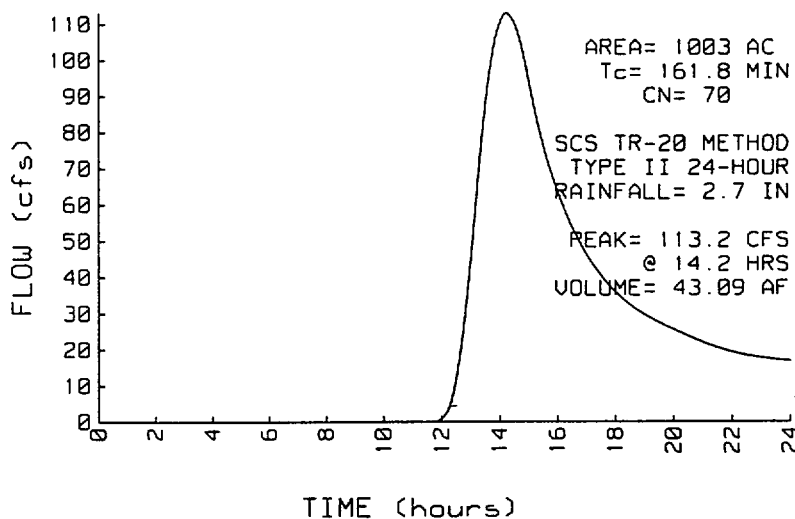
PEAK= 113.2 CFS @ 14.20 HRS, VOLUME= 43.09 AF

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'/'		

SUBCATCHMENT 11 RUNOFF
BASIN K



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 12

BASIN L

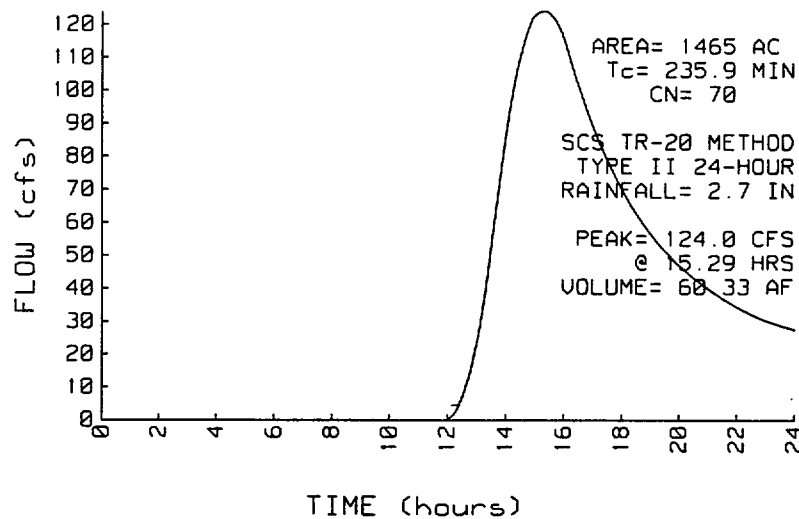
PEAK= 124.0 CFS @ 15.29 HRS, VOLUME= 60.33 AF

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 12 RUNOFF
BASIN L



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 13

BASIN M

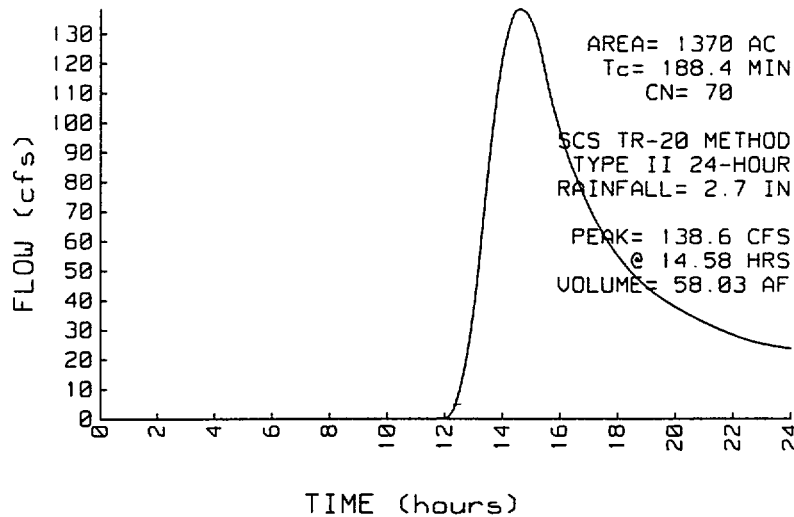
PEAK= 138.6 CFS @ 14.58 HRS, VOLUME= 58.03 AF

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 L=20785 s=.065	Segment ID:	188.4

SUBCATCHMENT 13 RUNOFF
BASIN M



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 14

BASIN 0

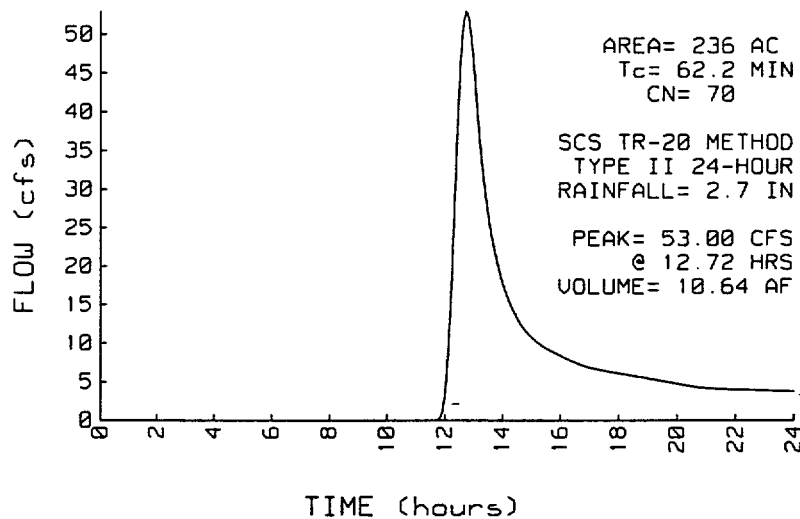
PEAK= 53.00 CFS @ 12.72 HRS, VOLUME= 10.64 AF

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 14 RUNOFF
BASIN 0



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 15

BASIN P

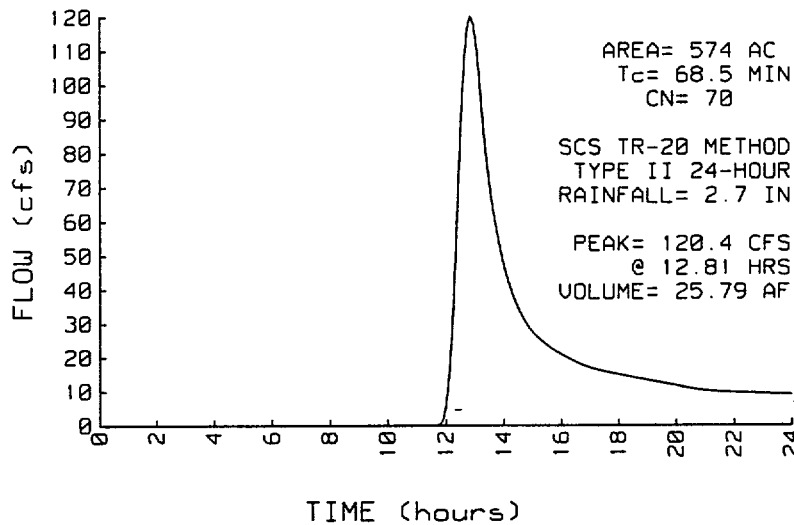
PEAK= 120.4 CFS @ 12.81 HRS, VOLUME= 25.79 AF

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 L=7085 s=.0878	Segment ID:	68.5

SUBCATCHMENT 15 RUNOFF
BASIN P



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 16

BASIN N(1)

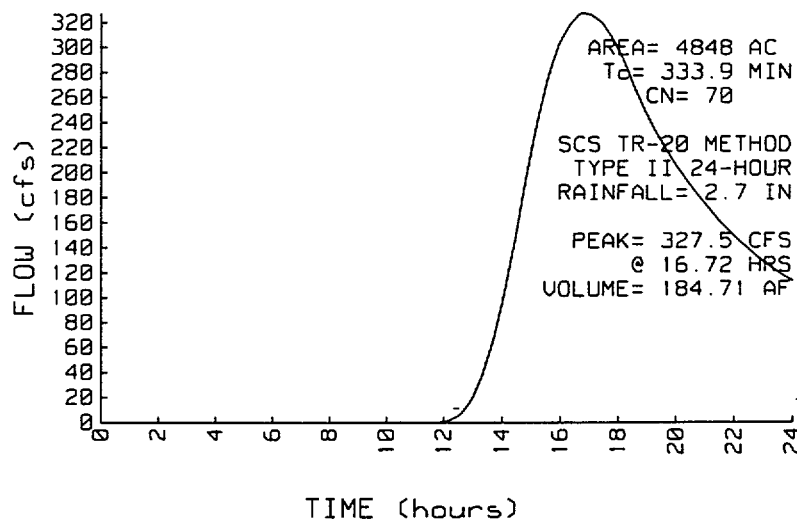
PEAK= 327.5 CFS @ 16.72 HRS, VOLUME=184.71 AF

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 16 RUNOFF
BASIN N(1)



SUBCATCHMENT 17

BASIN Q

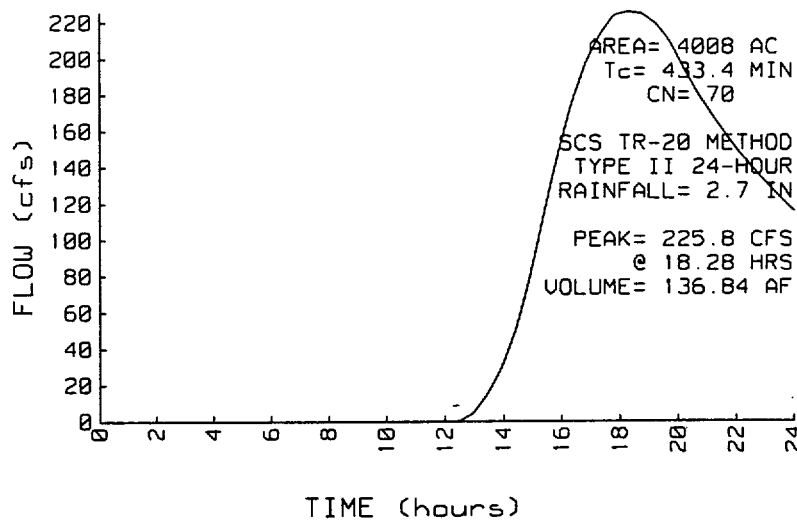
PEAK= 225.8 CFS @ 18.28 HRS, VOLUME=136.84 AF

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 17 RUNOFF
BASIN Q



TYPE II 24-HOUR RAINFALL= 2.7 IN

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CALC. 05996.02 - SY-11, REV. 0

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SUBCATCHMENT 18

BASIN S

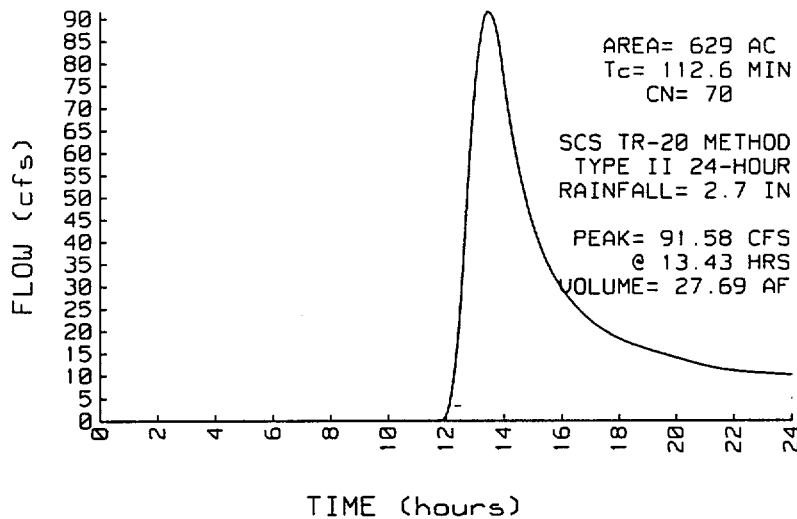
PEAK= 91.58 CFS @ 13.43 HRS, VOLUME= 27.69 AF

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 L=10434 s=.0604	Segment ID:	112.6

SUBCATCHMENT 18 RUNOFF
BASIN S



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 19

BASIN T

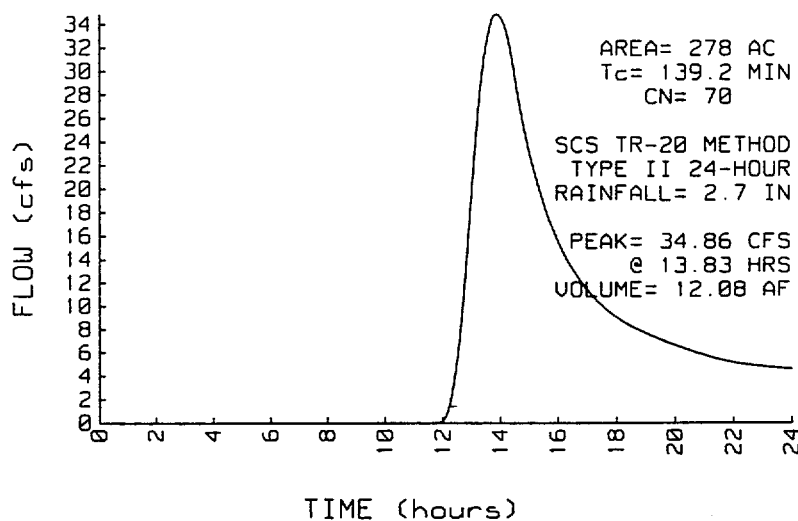
PEAK= 34.86 CFS @ 13.83 HRS, VOLUME= 12.08 AF

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 L=7968' s=.0257'/'	Segment ID:	139.2

SUBCATCHMENT 19 RUNOFF
BASIN T



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 20

BASIN R

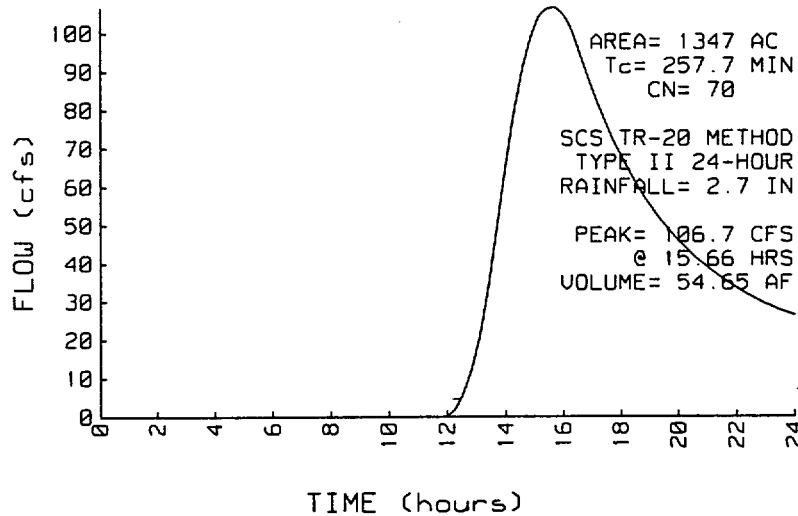
PEAK= 106.7 CFS @ 15.66 HRS, VOLUME= 54.65 AF

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		

SUBCATCHMENT 20 RUNOFF
BASIN R



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 21

BASIN U

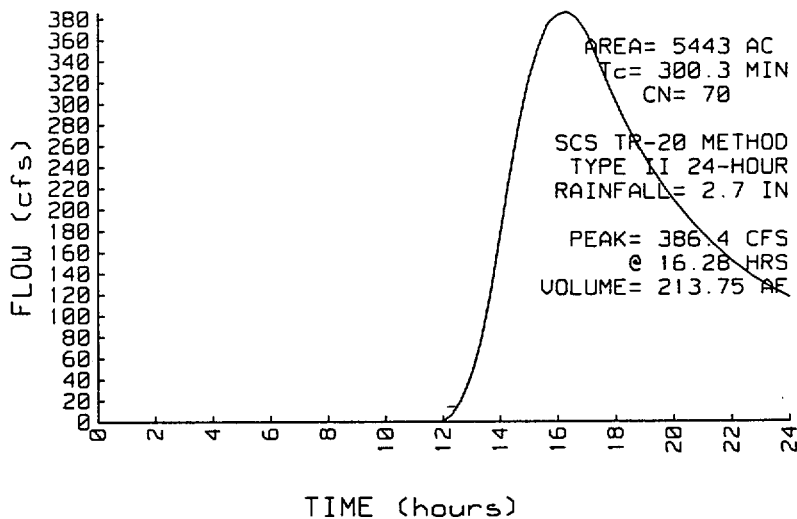
PEAK= 386.4 CFS @ 16.28 HRS, VOLUME=213.75 AF

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		

SUBCATCHMENT 21 RUNOFF
BASIN U



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 22

BASIN V(1)

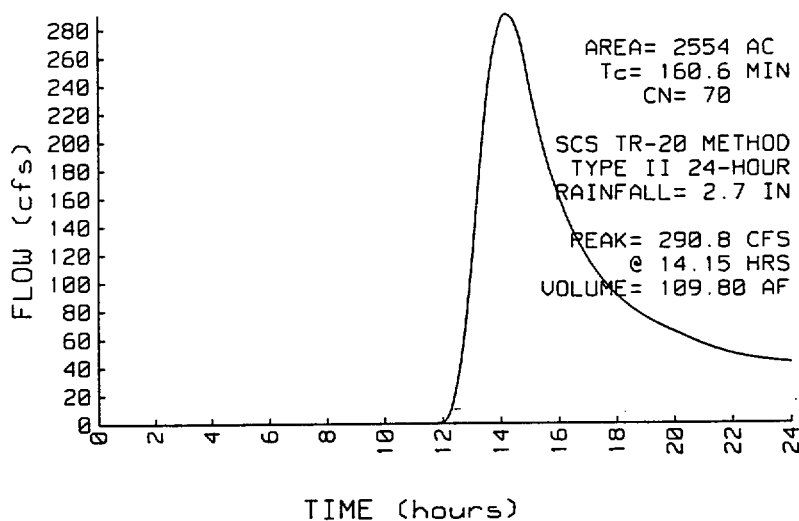
PEAK= 290.8 CFS @ 14.15 HRS, VOLUME=109.80 AF

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 L=14950 s=.0528	Segment ID:	160.6

SUBCATCHMENT 22 RUNOFF
BASIN V(1)



SUBCATCHMENT 23

BASIN V(2)

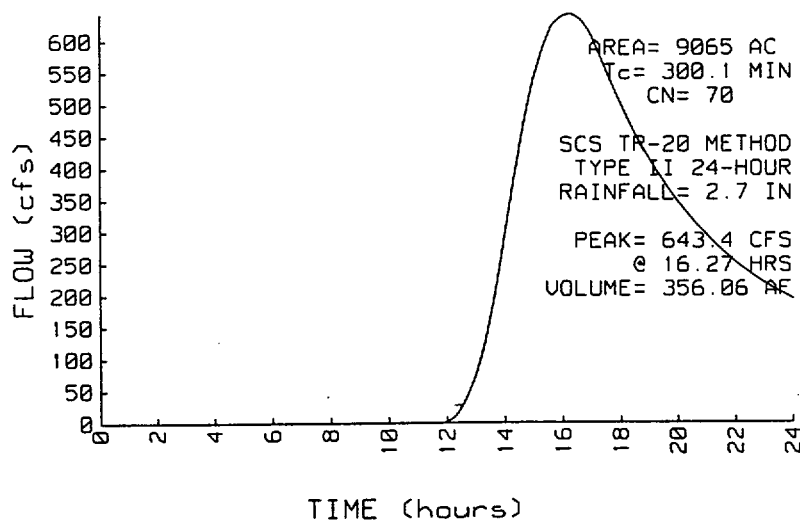
PEAK= 643.4 CFS @ 16.27 HRS, VOLUME=356.06 AF

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 23 RUNOFF
BASIN V(2)



TYPE II 24-HOUR RAINFALL= 2.7 IN

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SUBCATCHMENT 24

BASIN W

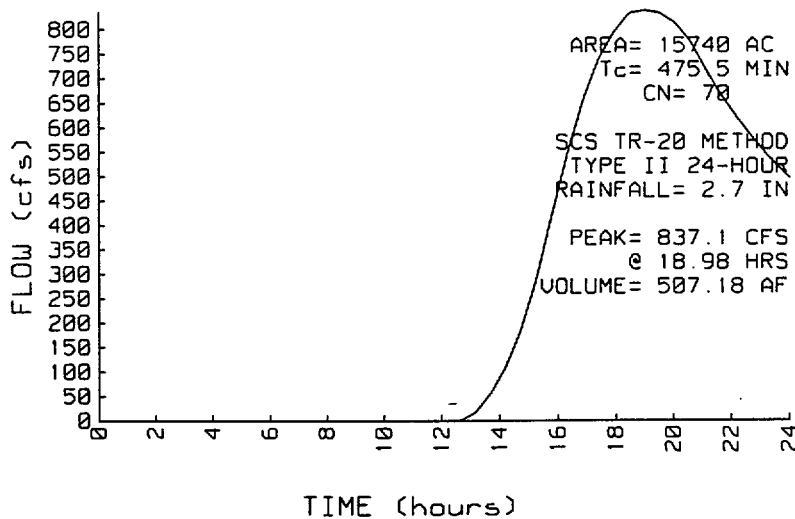
PEAK= 837.1 CFS @ 18.98 HRS, VOLUME=507.18 AF

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 24 RUNOFF
BASIN W



19 Aug 99

SUBCATCHMENT 25

BASIN X

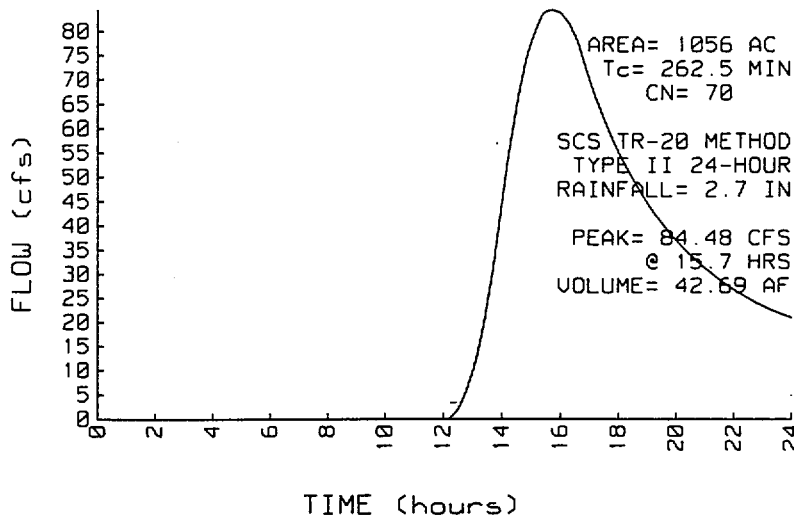
PEAK= 84.48 CFS @ 15.70 HRS, VOLUME= 42.69 AF

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		

SUBCATCHMENT 25 RUNOFF
 BASIN X



SUBCATCHMENT 26

BASIN Y

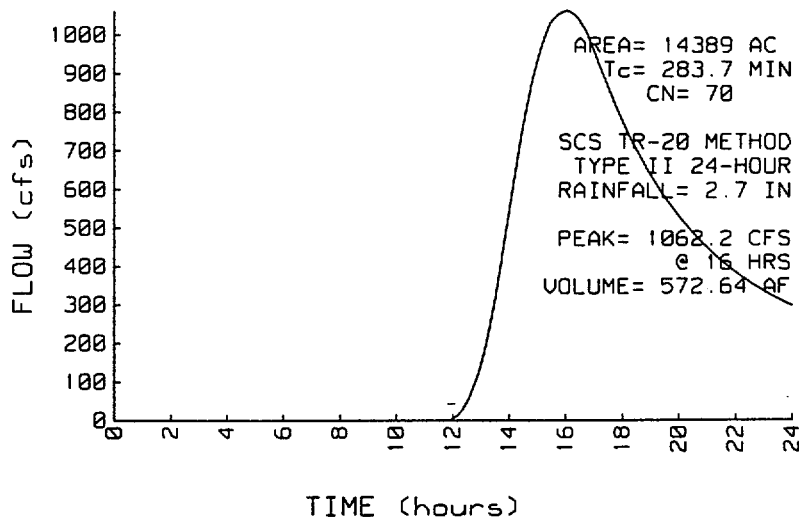
PEAK=1062.2 CFS @ 16.00 HRS, VOLUME=572.64 AF

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		

SUBCATCHMENT 26 RUNOFF
BASIN Y



TYPE II 24-HOUR RAINFALL= 2.7 IN

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19 Aug 99

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SUBCATCHMENT 27

BASIN Z

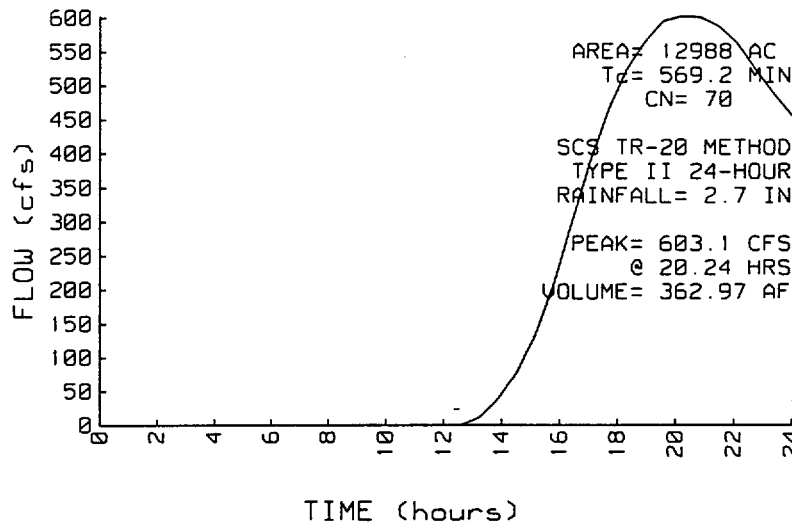
PEAK= 603.1 CFS @ 20.24 HRS, VOLUME=362.97 AF

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 L=60247 s=.0391	Segment ID:	569.2

SUBCATCHMENT 27 RUNOFF
BASIN Z



PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 20, 1999

PROGRAM INPUT DATA		VALUE
DESCRIPTION		
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 Rate (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)
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

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 WINGWAYS

COMPUTATION RESULTS							
Flow	Tailwater Depth (ft)	Headwater (ft) Inlet Control	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

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 20, 1999

PROGRAM INPUT DATA	
DESCRIPTION	VALUE
Culvert Diameter (ft).....	3.0
FWHA Chart Number.....	2
FWHA 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 P	Tailwater Depth (ft)	Headwater (ft) Inlet Control	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

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 WING WALLS

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

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	Tailwater	Headwater (ft)		Normal	Critical	Depth at	Outlet
	Depth	Inlet	Outlet	Depth	Depth	Outlet	Velocity
	(ft)	Control	Control	(ft)	(ft)	(ft)	(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

BASIN RUNOFF AND CULVERT DESIGN

Basin ID	Subcatchment #	Area (acre)	Basin Flow Path Info			25-Yr, 24-Hr Runoff (cfs)	Number & Size of Culverts Req'd	100-Yr, 24-Hr Runoff (cfs)	Number & Size of Culverts Req'd
			Elev. chg.	Length	Slope				
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)

Outlet velocities indicate the need for riprap or other outlet protection. ✓