5D
Part 2

Wenck
Engineers • Scientists
Business Professionals

Wenck Associates, Inc.
1802 Wooddale Drive
Suite 100
Woodbury, MN 55125-2937

(651) 294-4580
Fax (651) 228-1969
wenckmp@wenck.com
www.wenck.com

TECHNICAL MEMORANDUM

TO: Eric Hansen, PE, Westwood Professional Services

FROM: Joel Toso, PE

DATE: September 25, 2013

SUBJECT: EverStar Wetland Bank Hydrologic Analysis

This technical memo presents the hydrologic analysis performed for the EverStar Wetland Bank just north of the airport near Aitkin, Minnesota. The project involves modifying existing ditches on site to re-establish the hydrology that previously supplied the wetlands of the area.

We have analyzed the site runoff from three rain events; a typical 2-year storm of 2.6-inches, the 10-year flood event of 4.0-inches, and the 100-year flood event of 5.7 inches. Standard Natural Resources Conservation Service (NRCS) methods are used with the 24-hour Type II rainfall distribution. The site soils and primary watersheds draining to the ditches to be modified are shown in Figure 1. The soils are mostly sandy loam or loam. The model results are provided in the attached pages.

The analysis considers the pre-modification conditions created by the ditch in evaluated storm events and the post-modification conditions in the same storm events. The analysis is directed at determining whether the proposed modification of the drainage system will impair the utility of the drainage system or deprive affected land owners of its benefit. The analysis also considered whether the proposed modification of the drainage system would result in off-site impacts requiring flowage or other easements.

Modeling details are provided for both existing and proposed conditions, 56 numbered pages for each condition. Each set of results is preceded by a routing diagram that illustrates the modeled components of the site. Watershed names correspond to those shown in Figure 1.

The model results show that the existing drainage system conveys the 2-year storm efficiently, containing all the water within the ditch banks. The 100-year event exceeds the capacity of the drainage system resulting in overland flow. It should be noted that the 100-year event modeled for this report is that for the local drainage area. The 100-year event of the adjacent Mississippi River floods a significant portion of the site at approximately Elevation 1203 as shown on the attached Flood Insurance Rate Map (FIRM).

It is proposed that the majority of ditches on site be modified to re-establish pre-ditched grades. Ditches along the perimeter of the property that convey offsite storm water will be maintained. The runoff currently being conveyed to the modified ditches will flow overland in shallow swales toward the

river to the west. Since the 100-year runoff exceeds the capacity of the ditches for existing conditions and flows overland, similar flood levels are predicted for proposed conditions.

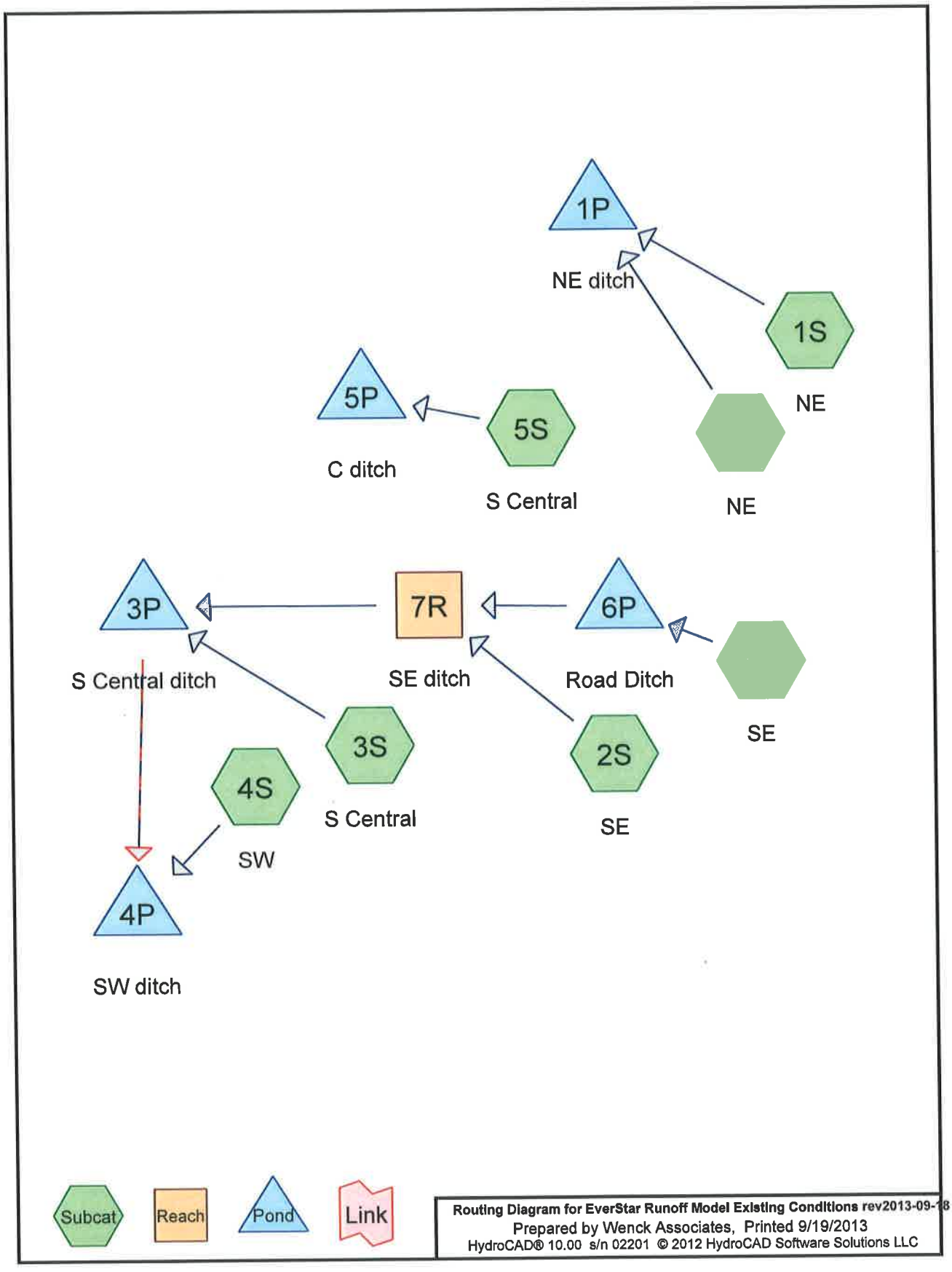
The result of the project is expected to re-establish the wetland hydrology of the area by maintaining perched water in the subsoil. Surface runoff will not be conveyed by ditches, but will flow overland allowing it to infiltrate and recharge perched water in the subsoil.

There will be no change to drainage offsite based on modeling of the post-modification conditions in the evaluated storm events. Offsite water that reaches the site from the east will be conveyed downstream as it does under existing conditions without increasing upstream flow levels. The flow arrows in Figure 1 show the flow paths for offsite water conveyance. The attached modeling for this project specifically partitions offsite drainage to assist with determining the effect of the proposed work. The site grading has been designed to accommodate the inflow of water from the benefited properties and roads to the east.

The offsite watershed northeast of the site drains into an onsite road ditch and is conveyed north through a 30-inch culvert (Node 1P in the attached model output). There will be no change to this drainage with exception of the diversion of a portion of onsite watershed through a new swale directed to the west. This will actual improve offsite drainage by providing increased capacity at the 30-inch culvert outlet.

Drainage from of the offsite portion of the Southeast watershed (Figure 1) drains into an onsite road ditch, and is controlled by an 18-inch culvert located just northwest of the bend in the roadway (Node 6P in the attached model output). The downstream ditch receiving the drainage will remain as is for approximately 500-feet and then be re-routed through a new swale to the northwest (Node 7R in the attached model output). The flow capacity of the new swale will significantly exceed the capacity of the existing ditch; compare the highlighted capacities on Page 10 of both the attached existing and proposed modeling results. Water levels at the downstream end of the 18-inch controlling culvert will not be increased; therefore offsite drainage will not be affected by the proposed wetland bank.

No additional water will be discharged to adjacent property. Any increase in groundwater levels will be confined to the project area. Surficial groundwater flows generally west to the river. The project site is mostly north and west of the adjacent property and itself, abuts the river. Groundwater flows from the project area north and west to the river, away from the adjacent property. There are no changes proposed to the drainage systems serving adjacent properties.



Routing Diagram for EverStar Runoff Model Existing Conditions rev2013-09-18
Prepared by Wenck Associates, Printed 9/19/2013
HydroCAD® 10.00 s/n 02201 © 2012 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
195.200	49	Pasture/grassland/range, Fair, HSG A (1S, 2S, 4S, 6S, 7S)
278.800	69	Pasture/grassland/range, Fair, HSG B (1S, 2S, 3S, 4S, 5S, 6S, 7S)
474.000	**61**	**TOTAL AREA**

Summary for Subcatchment 1S: NE

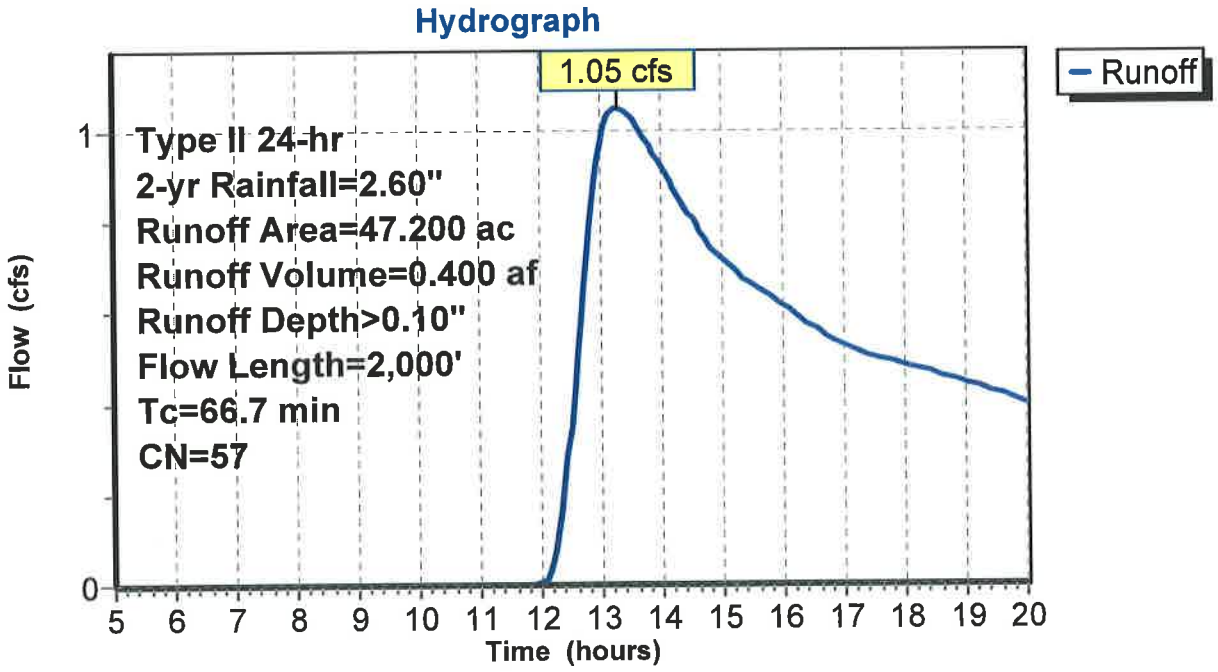
Runoff = 1.05 cfs @ 13.27 hrs, Volume= 0.400 af, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
28.300	49	Pasture/grassland/range, Fair, HSG A
18.900	69	Pasture/grassland/range, Fair, HSG B
47.200	57	Weighted Average
47.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 1S: NE



Summary for Subcatchment 2S: SE

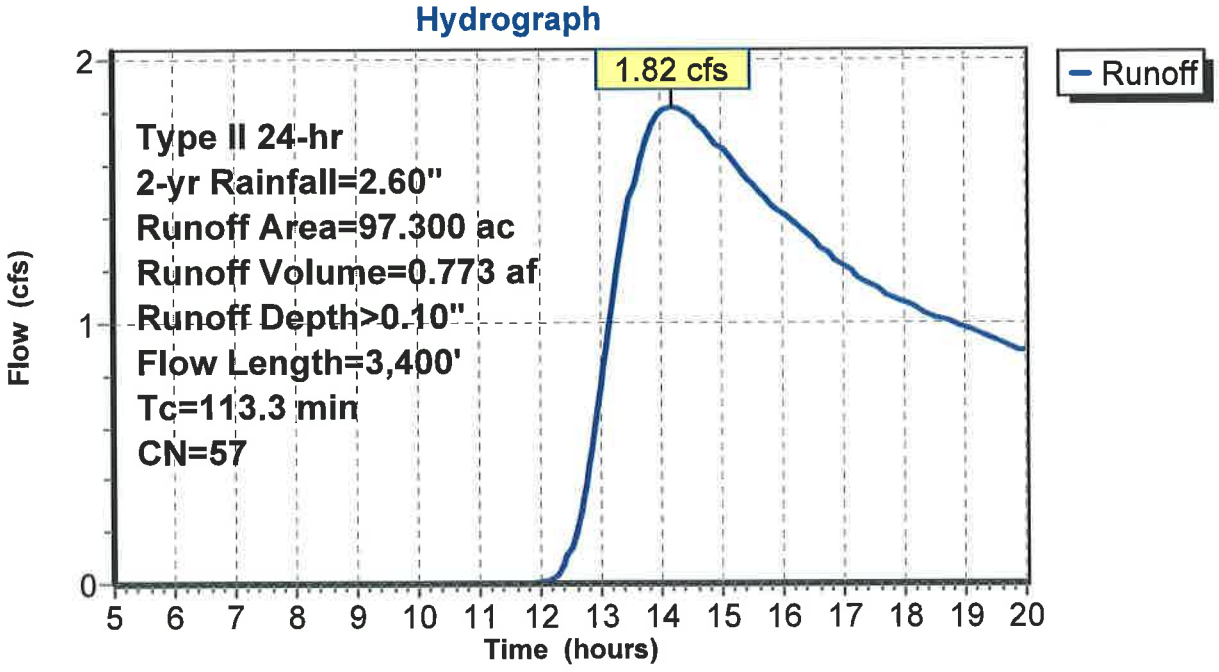
Runoff = 1.82 cfs @ 14.19 hrs, Volume= 0.773 af, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
58.400	49	Pasture/grassland/range, Fair, HSG A
38.900	69	Pasture/grassland/range, Fair, HSG B
97.300	57	Weighted Average
97.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
113.3	3,400		0.50		**Direct Entry,**

Subcatchment 2S: SE



Summary for Subcatchment 3S: S Central

Runoff = 13.84 cfs @ 12.63 hrs, Volume= 2.280 af, Depth> 0.40"

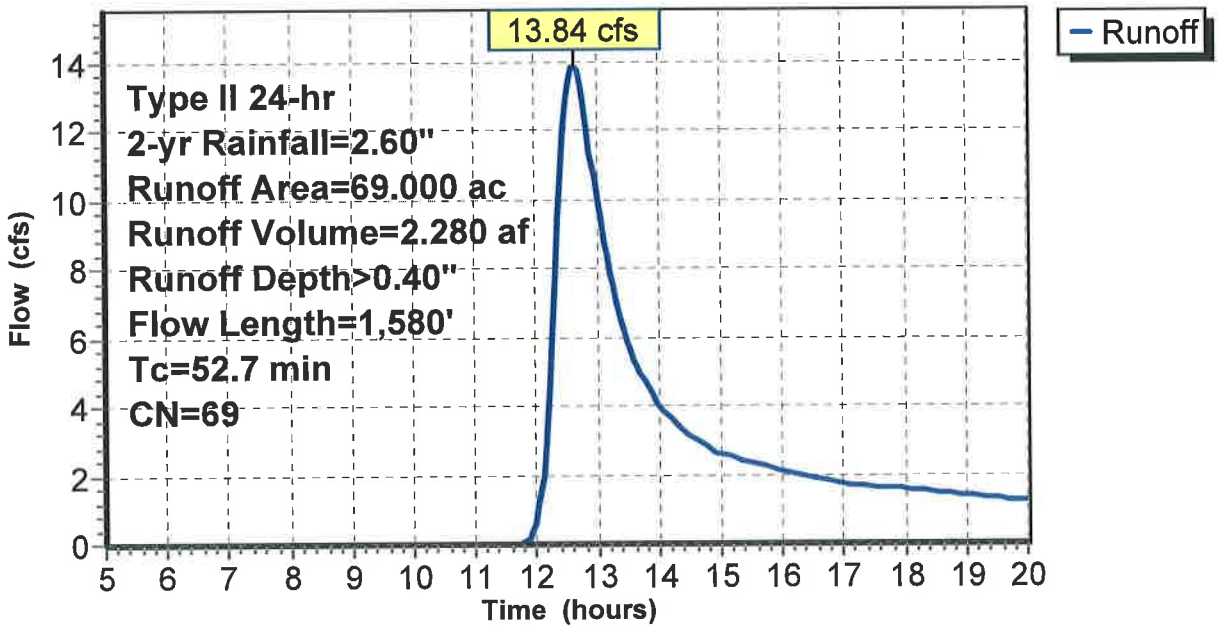
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
69.000	69	Pasture/grassland/range, Fair, HSG B
69.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.7	1,580		0.50		**Direct Entry,**

Subcatchment 3S: S Central

Hydrograph



Summary for Subcatchment 4S: SW

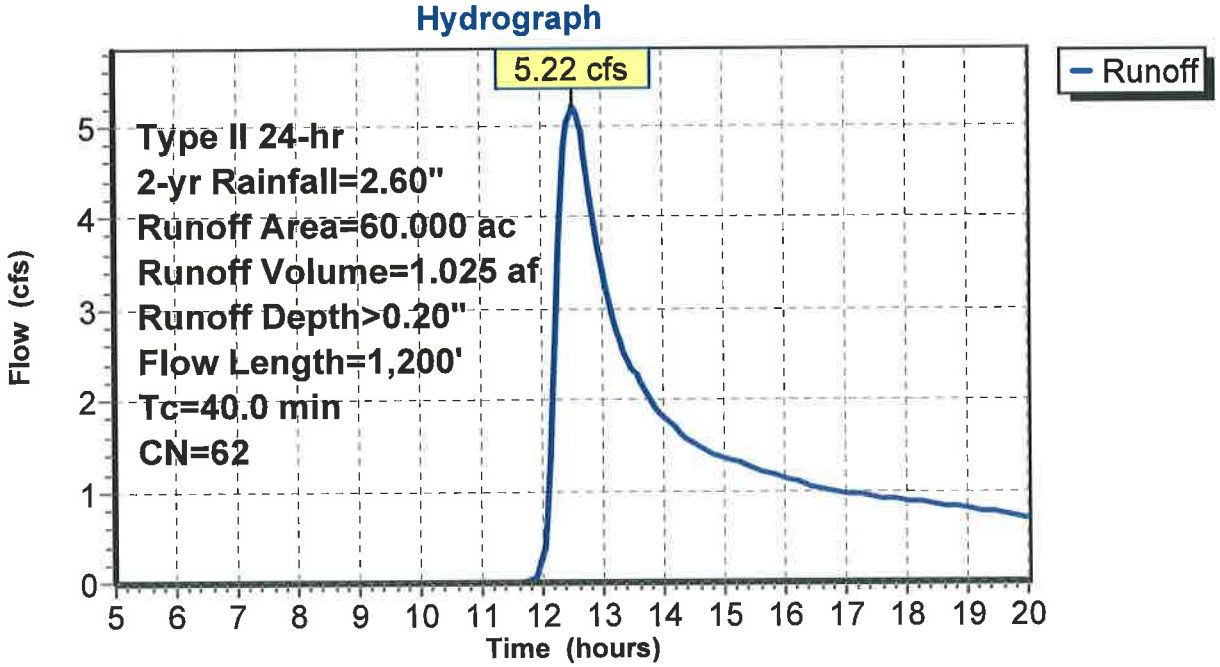
Runoff = 5.22 cfs @ 12.53 hrs, Volume= 1.025 af, Depth> 0.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
20.000	49	Pasture/grassland/range, Fair, HSG A
40.000	69	Pasture/grassland/range, Fair, HSG B
60.000	62	Weighted Average
60.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.0	1,200		0.50		**Direct Entry,**

Subcatchment 4S: SW



Summary for Subcatchment 5S: S Central

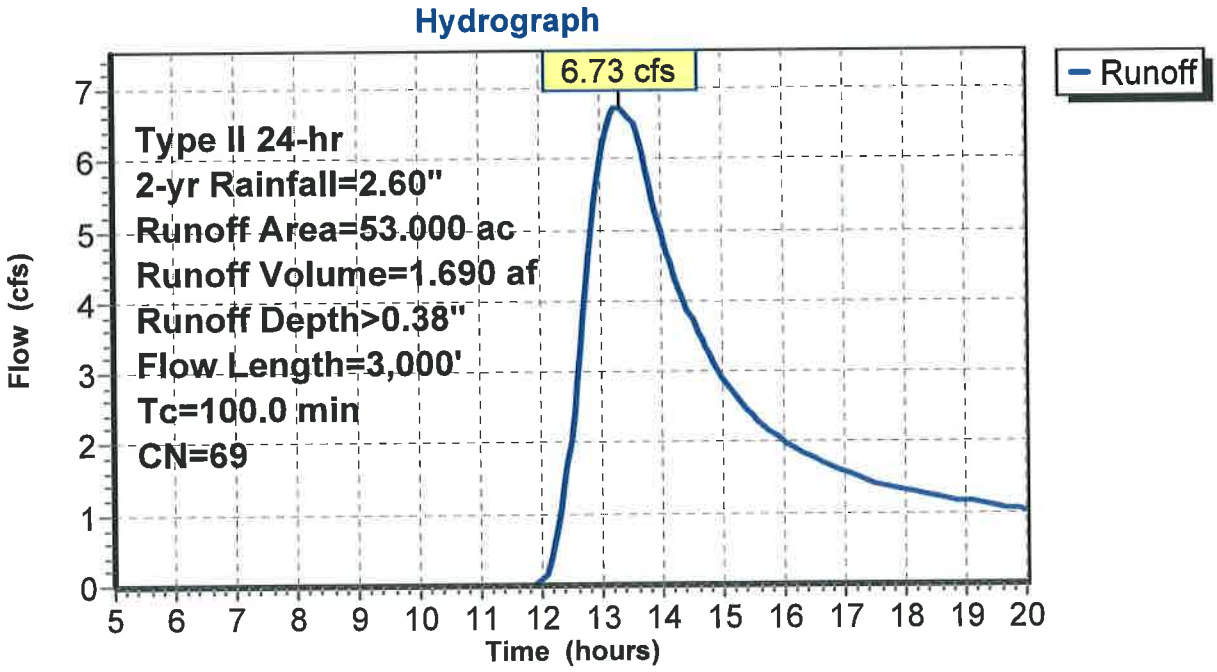
Runoff = 6.73 cfs @ 13.33 hrs, Volume= 1.690 af, Depth> 0.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
53.000	69	Pasture/grassland/range, Fair, HSG B
53.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.0	3,000		0.50		**Direct Entry,**

Subcatchment 5S: S Central



Summary for Subcatchment 6S: SE

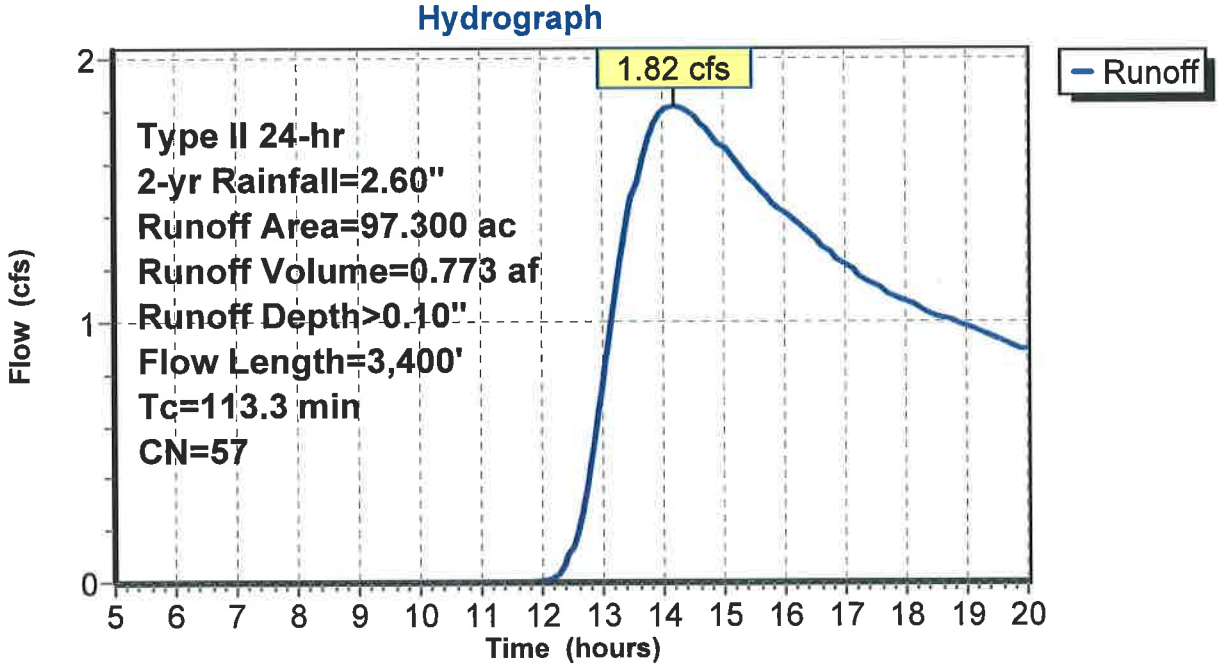
Runoff = 1.82 cfs @ 14.19 hrs, Volume= 0.773 af, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
58.400	49	Pasture/grassland/range, Fair, HSG A
38.900	69	Pasture/grassland/range, Fair, HSG B
97.300	57	Weighted Average
97.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
113.3	3,400		0.50		**Direct Entry,**

Subcatchment 6S: SE



Summary for Subcatchment 7S: NE

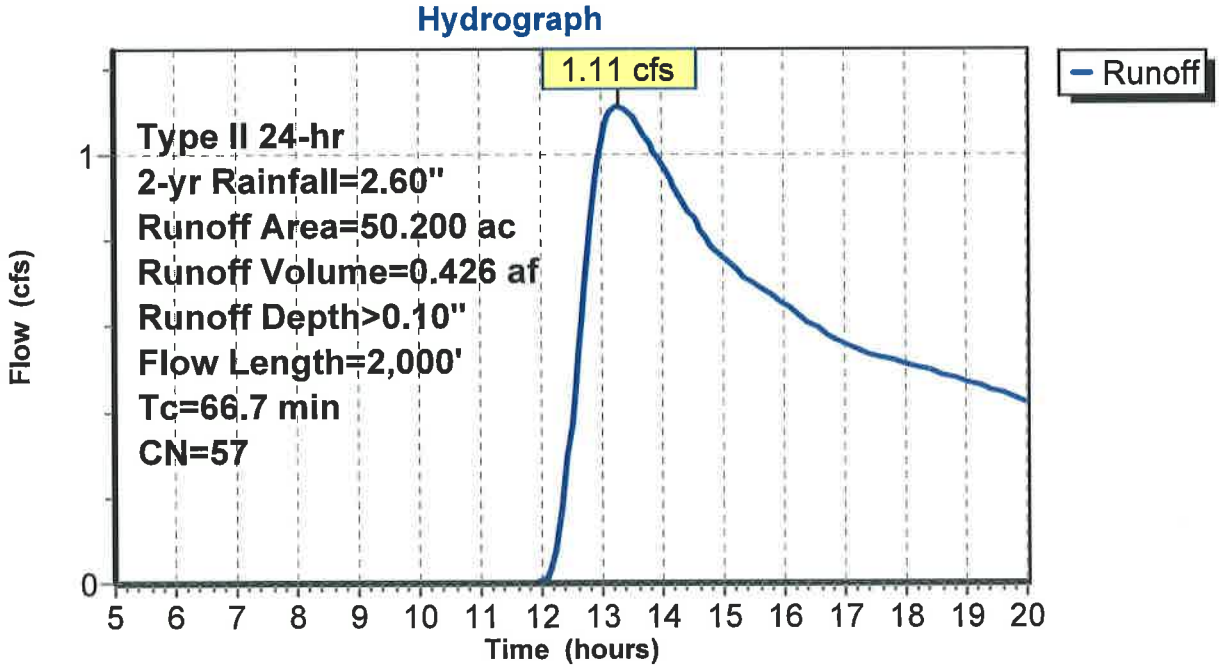
Runoff = 1.11 cfs @ 13.27 hrs, Volume= 0.426 af, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
30.100	49	Pasture/grassland/range, Fair, HSG A
20.100	69	Pasture/grassland/range, Fair, HSG B
50.200	57	Weighted Average
50.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 7S: NE



Summary for Reach 7R: SE ditch

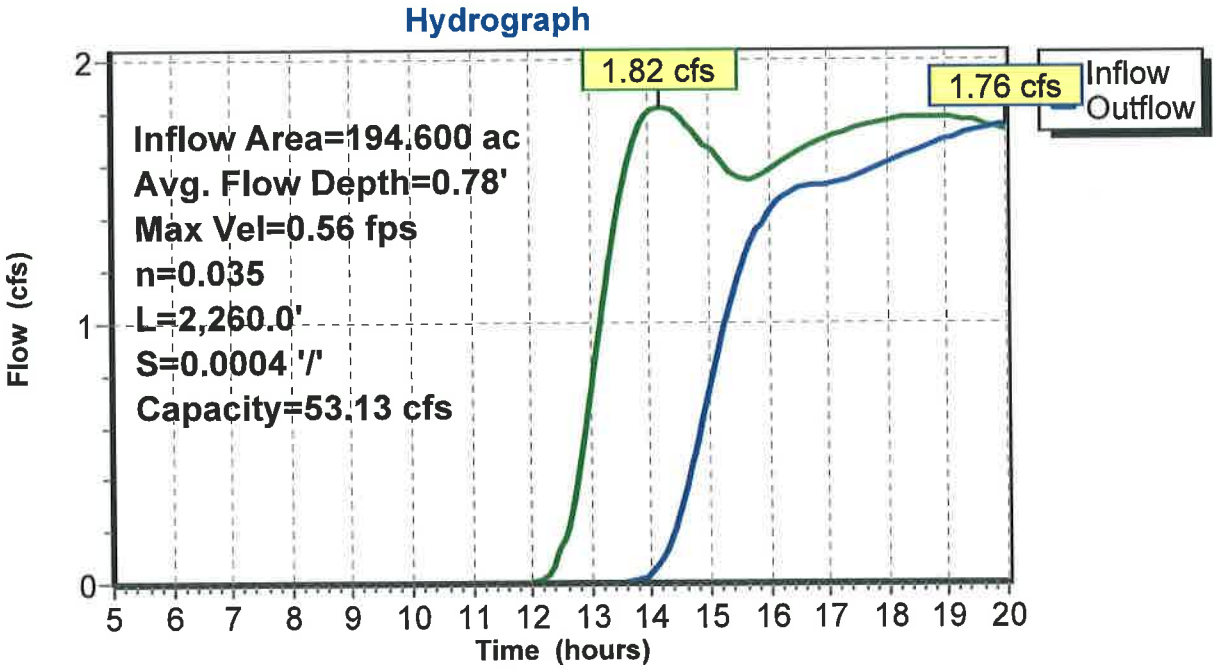
Inflow Area = 194.600 ac, 0.00% Impervious, Inflow Depth > 0.06" for 2-yr event
Inflow = 1.82 cfs @ 14.19 hrs, Volume= 0.987 af
Outflow = 1.76 cfs @ 20.00 hrs, Volume= 0.658 af, Atten= 4%, Lag= 348.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.56 fps, Min. Travel Time= 67.7 min
Avg. Velocity = 0.47 fps, Avg. Travel Time= 80.3 min

Peak Storage= 7,180 cf @ 19.50 hrs
Average Depth at Peak Storage= 0.78'
Bank-Full Depth= 3.50' Flow Area= 40.1 sf, Capacity= 53.13 cfs

2.00' x 3.50' deep channel, n= 0.035
Side Slope Z-value= 2.7 '/' Top Width= 20.90'
Length= 2,260.0' Slope= 0.0004 '/'
Inlet Invert= 1,196.40', Outlet Invert= 1,195.40'

Reach 7R: SE ditch



Summary for Pond 1P: NE ditch

Inflow Area = 97.400 ac, 0.00% Impervious, Inflow Depth > 0.10" for 2-yr event
Inflow = 2.16 cfs @ 13.27 hrs, Volume= 0.826 af
Outflow = 2.16 cfs @ 13.30 hrs, Volume= 0.824 af, Atten= 0%, Lag= 1.6 min
Primary = 2.16 cfs @ 13.30 hrs, Volume= 0.824 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,196.54' @ 13.30 hrs Surf.Area= 377 sf Storage= 167 cf

Plug-Flow detention time= 1.3 min calculated for 0.822 af (99% of inflow)
Center-of-Mass det. time= 0.8 min (939.5 - 938.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.65'	215,897 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

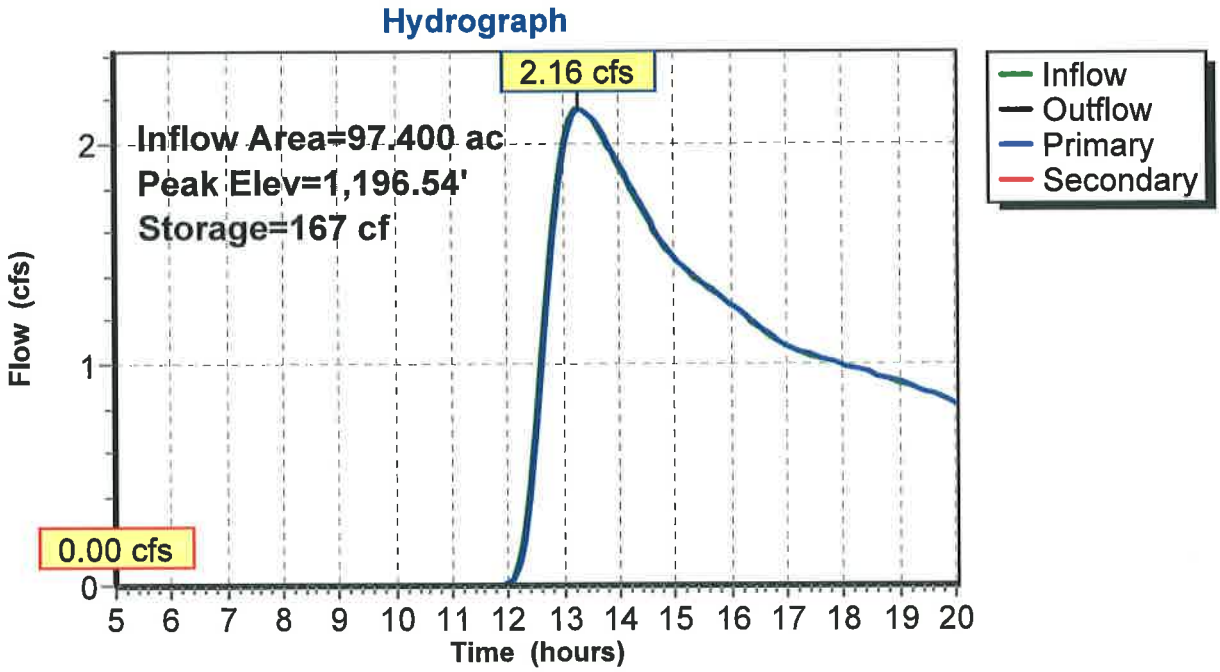
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.65	0	0	0
1,198.00	1,000	1,175	1,175
1,199.00	6,407	3,704	4,878
1,200.00	12,815	9,611	14,489
1,201.00	390,000	201,408	215,897

Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.65'	**30.0" Round Culvert** L= 24.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.65' / 1,195.65' S= 0.0000 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,200.20'	**150.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=2.16 cfs @ 13.30 hrs HW=1,196.54' (Free Discharge)
1=Culvert (Barrel Controls 2.16 cfs @ 2.07 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,195.65' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 1P: NE ditch



Summary for Pond 3P: S Central ditch

Inflow Area = 263.600 ac, 0.00% Impervious, Inflow Depth > 0.13" for 2-yr event
Inflow = 13.84 cfs @ 12.63 hrs, Volume= 2.938 af
Outflow = 11.44 cfs @ 12.90 hrs, Volume= 2.870 af, Atten= 17%, Lag= 16.1 min
Primary = 11.44 cfs @ 12.90 hrs, Volume= 2.870 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,197.40' @ 12.90 hrs Surf.Area= 11,280 sf Storage= 11,304 cf

Plug-Flow detention time= 15.9 min calculated for 2.870 af (98% of inflow)
Center-of-Mass det. time= 9.3 min (918.3 - 909.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.30'	74,844 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

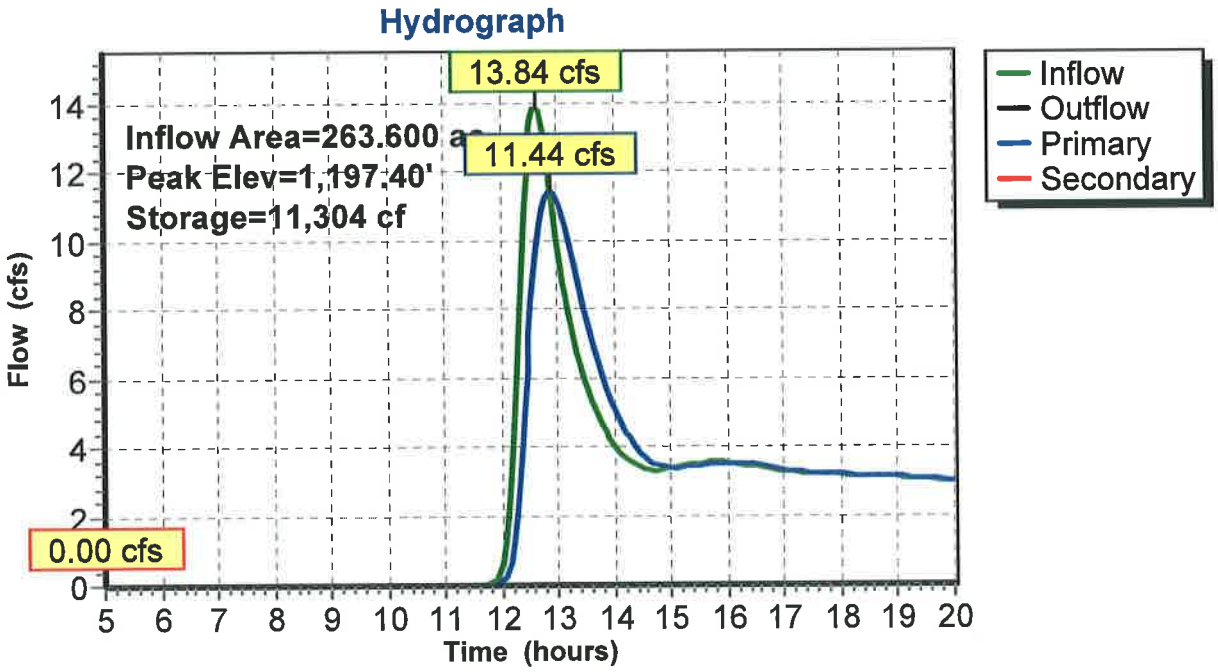
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.30	0	0	0
1,196.50	5,940	3,564	3,564
1,197.50	11,880	8,910	12,474
1,198.50	17,820	14,850	27,324
1,200.50	29,700	47,520	74,844

Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.48'	**30.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.37' / 1,195.48' S= -0.0055 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,197.80'	**180.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=11.43 cfs @ 12.90 hrs HW=1,197.40' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 11.43 cfs @ 3.66 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,195.30' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: S Central ditch



Summary for Pond 4P: SW ditch

Inflow Area = 323.600 ac, 0.00% Impervious, Inflow Depth > 0.14" for 2-yr event
Inflow = 15.41 cfs @ 12.81 hrs, Volume= 3.895 af
Outflow = 15.32 cfs @ 12.87 hrs, Volume= 3.895 af, Atten= 1%, Lag= 3.6 min
Primary = 15.32 cfs @ 12.87 hrs, Volume= 3.895 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,194.80' @ 12.87 hrs Surf.Area= 4,396 sf Storage= 1,311 cf

Plug-Flow detention time= 0.4 min calculated for 3.895 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (910.8 - 910.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1,194.20'	92,125 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

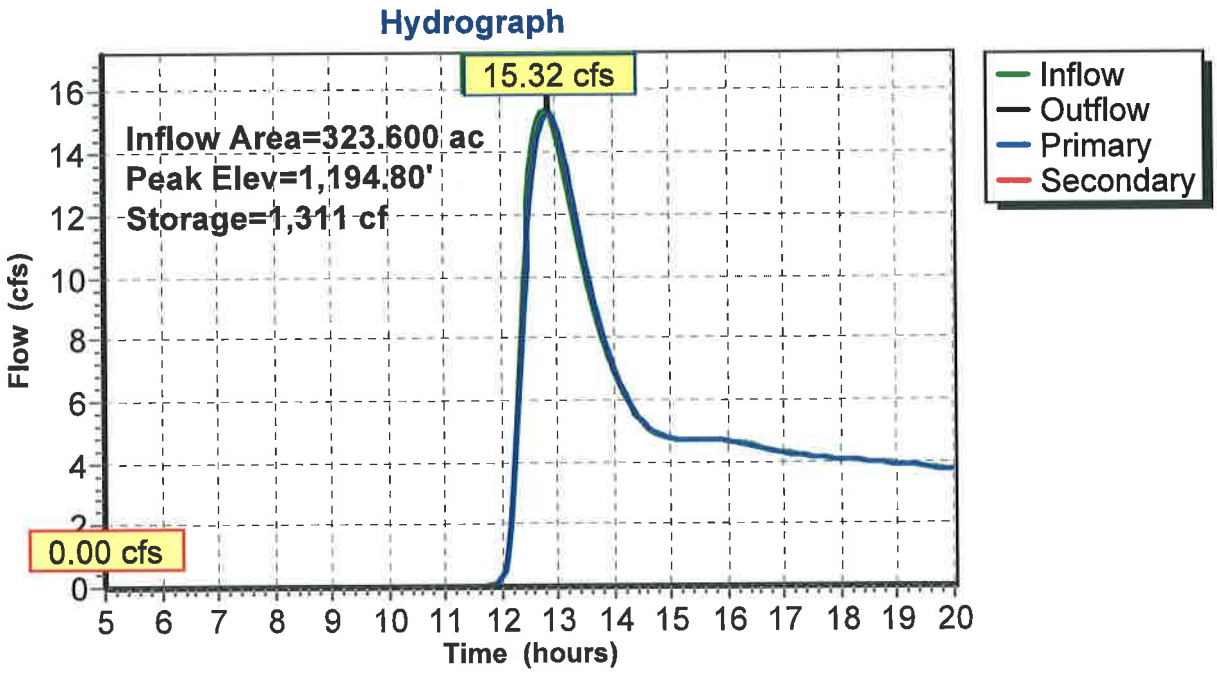
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,194.20	0	0	0
1,195.20	7,370	3,685	3,685
1,196.20	14,740	11,055	14,740
1,197.20	22,110	18,425	33,165
1,199.20	36,850	58,960	92,125

Device	Routing	Invert	Outlet Devices
#1	Primary	1,194.00'	**Special & User-Defined** Head (feet) 0.00 2.60 3.22 3.49 3.70 3.80 Disch. (cfs) 0.000 50.000 100.000 200.000 350.000 500.000
#2	Secondary	1,197.30'	**60.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=15.30 cfs @ 12.87 hrs HW=1,194.80' (Free Discharge)
↑—**1=Special & User-Defined** (Custom Controls 15.30 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,194.20' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: SW ditch



Summary for Pond 5P: C ditch

Inflow Area = 53.000 ac, 0.00% Impervious, Inflow Depth > 0.38" for 2-yr event
Inflow = 6.73 cfs @ 13.33 hrs, Volume= 1.690 af
Outflow = 6.73 cfs @ 13.33 hrs, Volume= 1.690 af, Atten= 0%, Lag= 0.1 min
Primary = 6.73 cfs @ 13.33 hrs, Volume= 1.690 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,187.87' @ 13.33 hrs Surf.Area= 51 sf Storage= 4 cf

Plug-Flow detention time= 0.0 min calculated for 1.690 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (898.9 - 898.9)

Volume	Invert	Avail.Storage	Storage Description
#1	1,187.70'	476,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

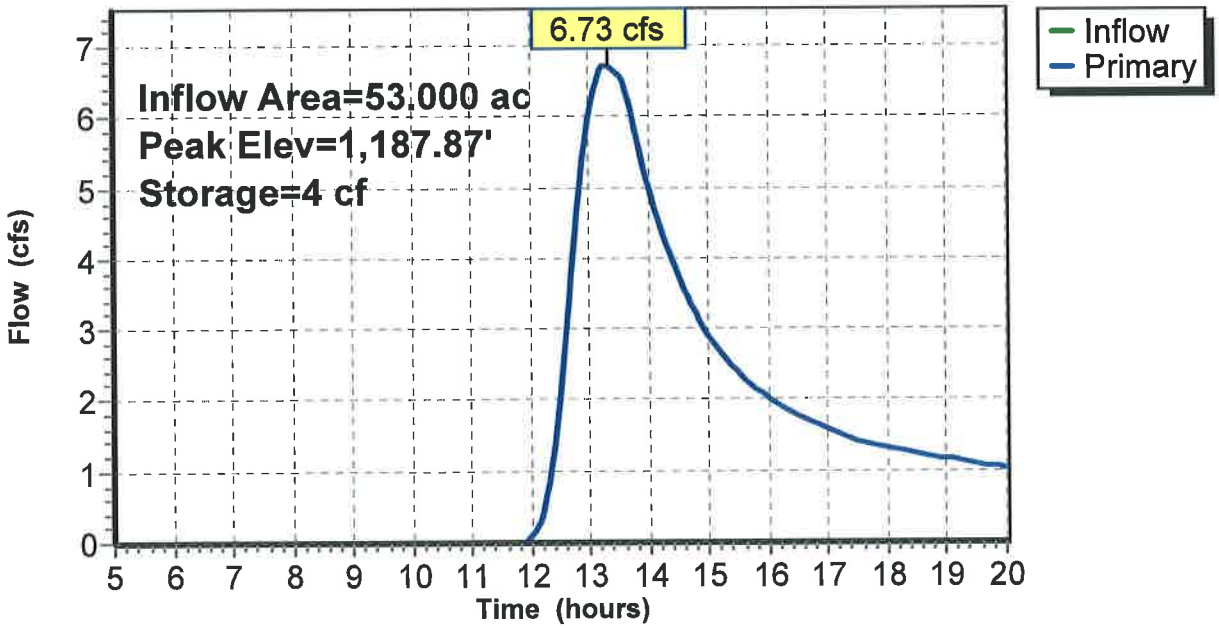
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,187.70	0	0	0
1,191.00	1,000	1,650	1,650
1,192.00	5,500	3,250	4,900
1,193.00	11,000	8,250	13,150
1,194.00	16,500	13,750	26,900
1,196.00	27,500	44,000	70,900
1,198.00	58,500	86,000	156,900
1,199.00	580,000	319,250	476,150

Device	Routing	Invert	Outlet Devices
#1	Primary	1,187.70'	**Ditch Flow** Head (feet) 0.00 1.00 2.00 3.00 4.00 Disch. (cfs) 0.000 40.000 133.000 300.000 550.000
#2	Primary	1,198.00'	**200.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=6.73 cfs @ 13.33 hrs HW=1,187.87' (Free Discharge)
1=Ditch Flow (Custom Controls 6.73 cfs)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 5P: C ditch

Hydrograph



Summary for Pond 6P: Road Ditch

Inflow Area = 97.300 ac, 0.00% Impervious, Inflow Depth > 0.10" for 2-yr event
Inflow = 1.82 cfs @ 14.19 hrs, Volume= 0.773 af
Outflow = 0.85 cfs @ 20.00 hrs, Volume= 0.214 af, Atten= 53%, Lag= 348.4 min
Primary = 0.85 cfs @ 20.00 hrs, Volume= 0.214 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,202.52' @ 20.00 hrs Surf.Area= 29,909 sf Storage= 24,328 cf

Plug-Flow detention time= 273.1 min calculated for 0.213 af (28% of inflow)
Center-of-Mass det. time= 134.9 min (1,099.2 - 964.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	263,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

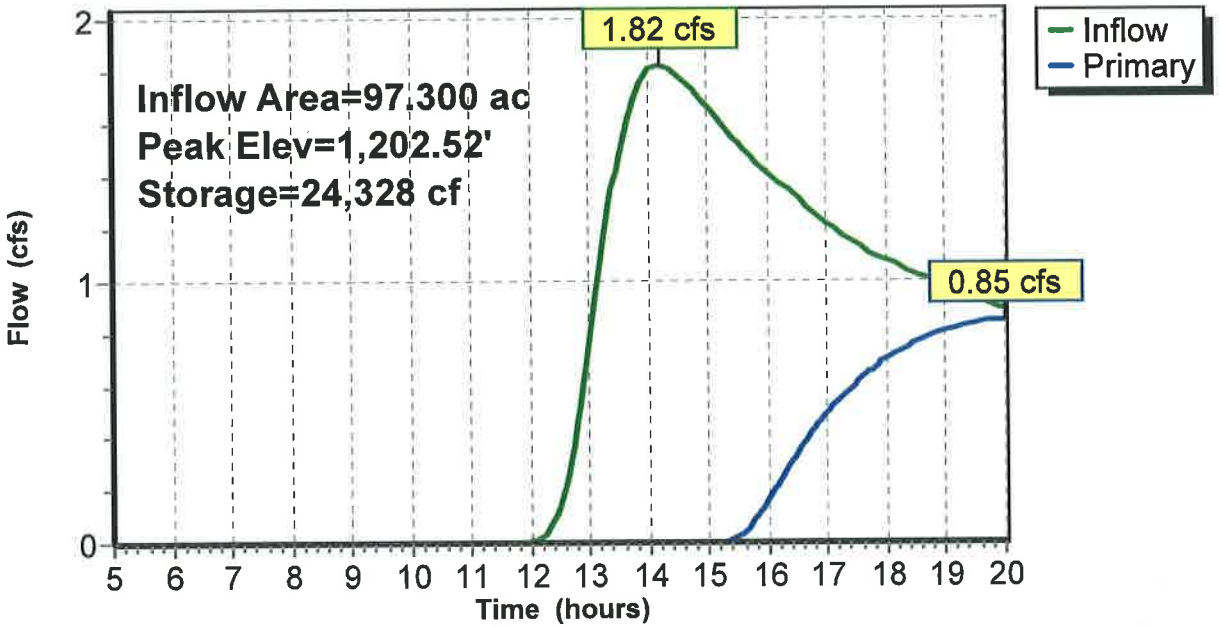
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	1,000	0	0
1,202.00	12,300	13,300	13,300
1,203.00	46,000	29,150	42,450
1,203.80	62,000	43,200	85,650
1,206.00	100,000	178,200	263,850

Device	Routing	Invert	Outlet Devices
#1	Primary	1,202.06'	**18.0" Round Culvert** L= 35.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,200.67' / 1,202.06' S= -0.0397 '/' Cc= 0.900 n= 0.024, Flow Area= 1.77 sf
#2	Primary	1,203.80'	**100.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.85 cfs @ 20.00 hrs HW=1,202.52' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.85 cfs @ 1.83 fps)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: Road Ditch

Hydrograph



Summary for Subcatchment 1S: NE

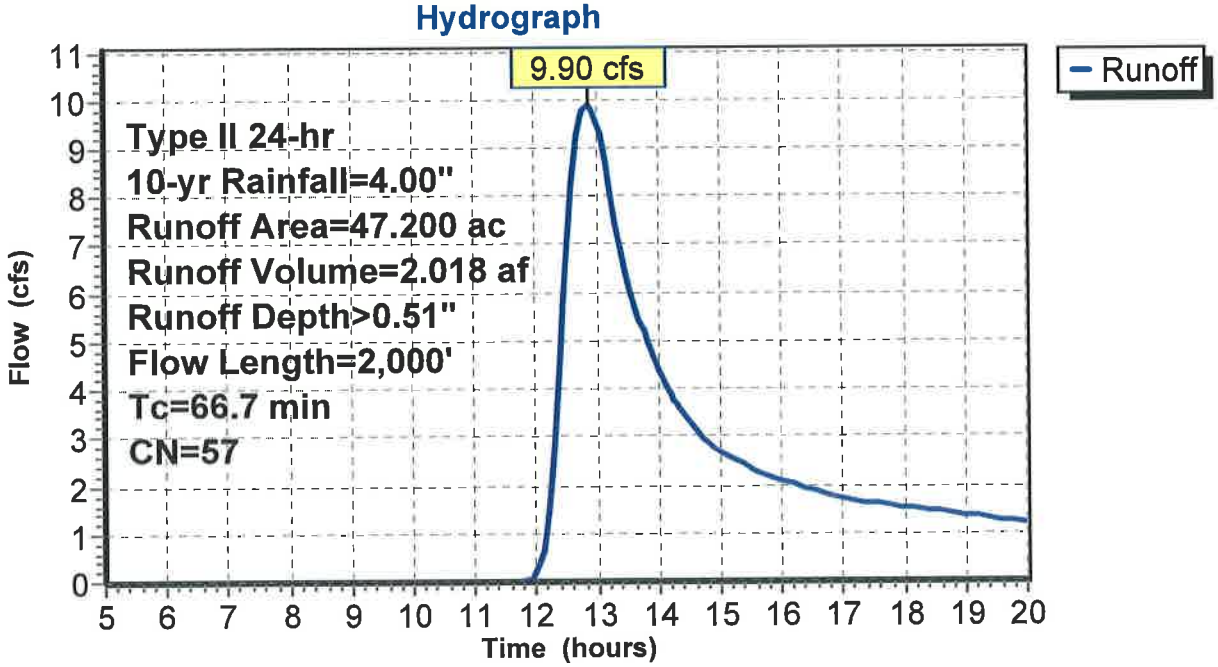
Runoff = 9.90 cfs @ 12.86 hrs, Volume= 2.018 af, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
28.300	49	Pasture/grassland/range, Fair, HSG A
18.900	69	Pasture/grassland/range, Fair, HSG B
47.200	57	Weighted Average
47.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 1S: NE



Summary for Subcatchment 2S: SE

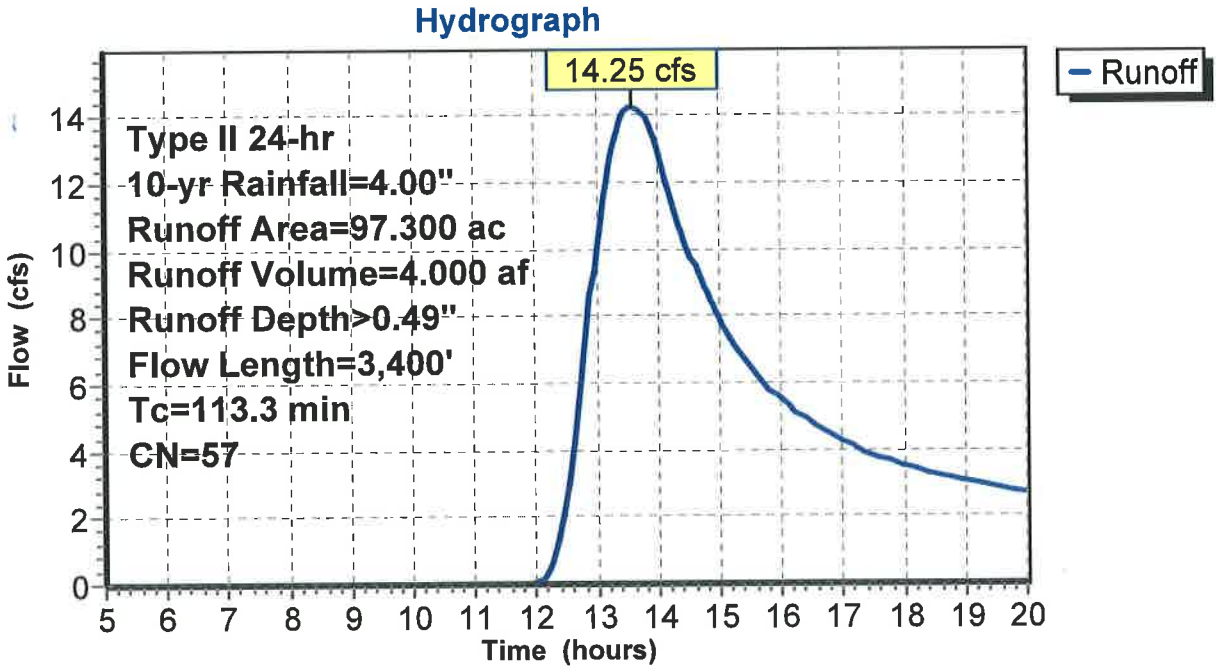
Runoff = 14.25 cfs @ 13.59 hrs, Volume= 4.000 af, Depth> 0.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
58.400	49	Pasture/grassland/range, Fair, HSG A
38.900	69	Pasture/grassland/range, Fair, HSG B
97.300	57	Weighted Average
97.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
113.3	3,400		0.50		**Direct Entry,**

Subcatchment 2S: SE



Summary for Subcatchment 3S: S Central

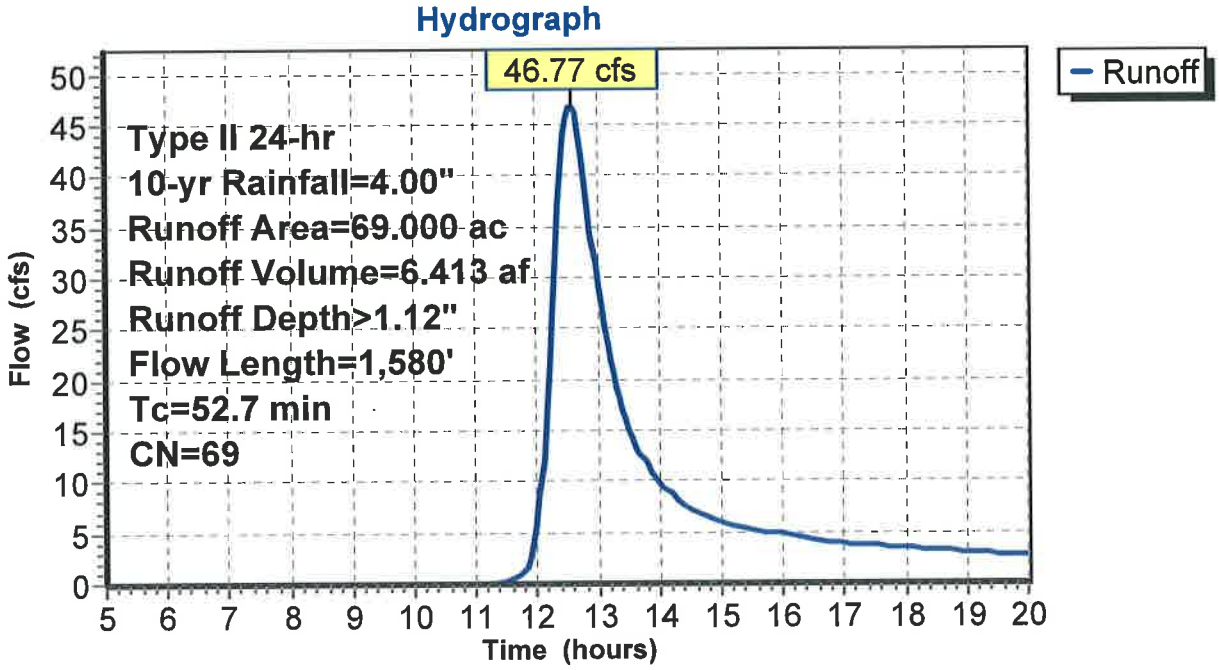
Runoff = 46.77 cfs @ 12.58 hrs, Volume= 6.413 af, Depth> 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
69.000	69	Pasture/grassland/range, Fair, HSG B
69.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.7	1,580		0.50		**Direct Entry,**

Subcatchment 3S: S Central



Summary for Subcatchment 4S: SW

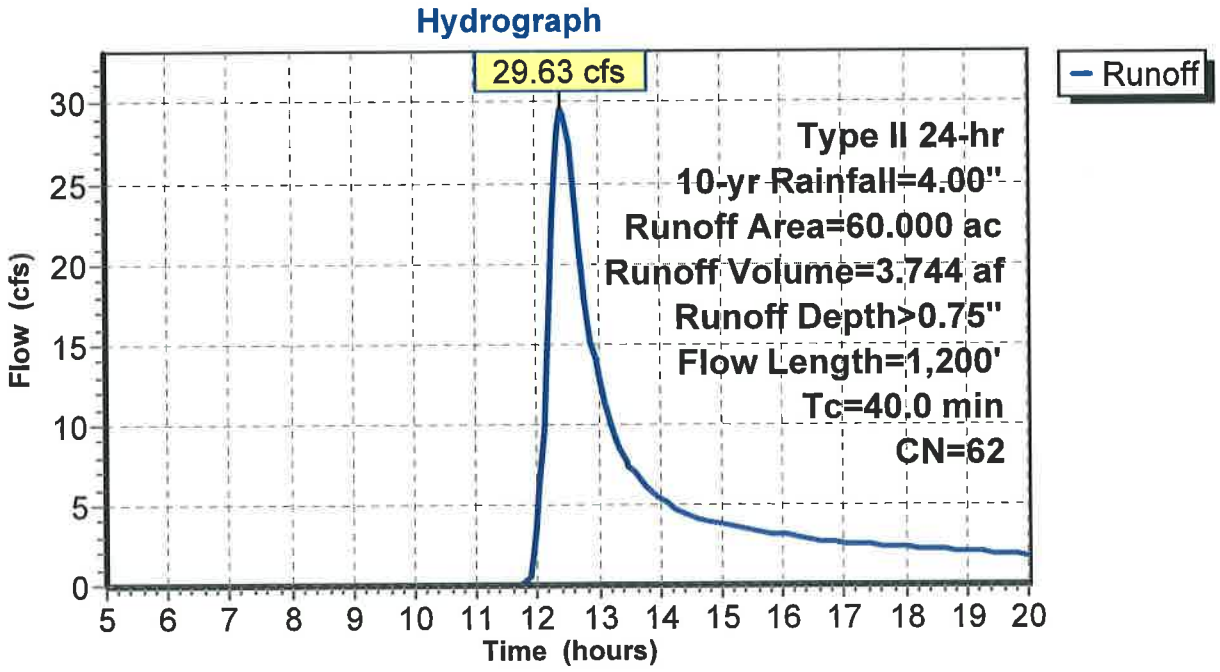
Runoff = 29.63 cfs @ 12.43 hrs, Volume= 3.744 af, Depth> 0.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
20.000	49	Pasture/grassland/range, Fair, HSG A
40.000	69	Pasture/grassland/range, Fair, HSG B
60.000	62	Weighted Average
60.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.0	1,200		0.50		**Direct Entry,**

Subcatchment 4S: SW



Summary for Subcatchment 5S: S Central

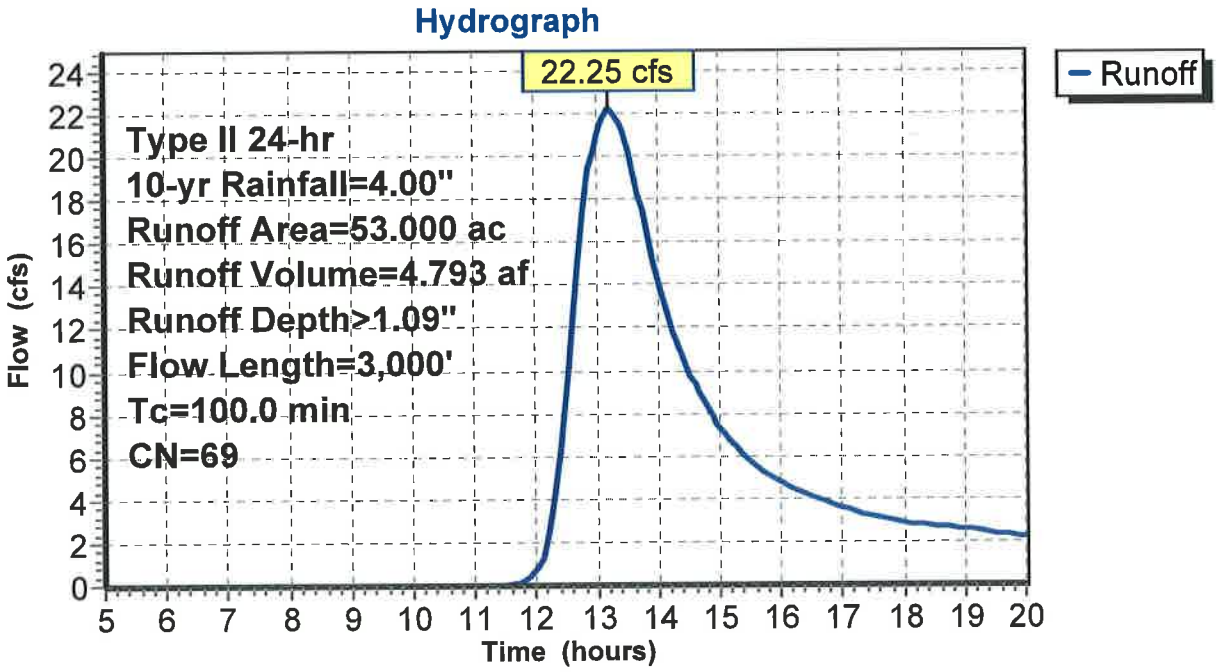
Runoff = 22.25 cfs @ 13.22 hrs, Volume= 4.793 af, Depth> 1.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
53.000	69	Pasture/grassland/range, Fair, HSG B
53.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.0	3,000		0.50		**Direct Entry,**

Subcatchment 5S: S Central



Summary for Subcatchment 6S: SE

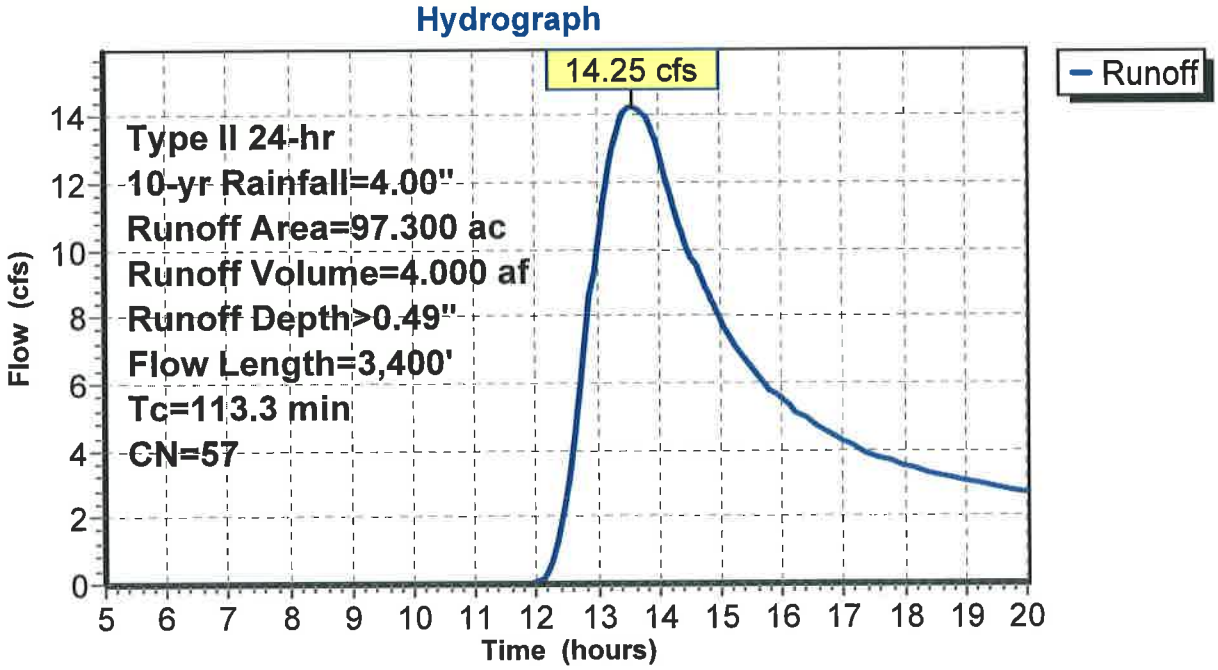
Runoff = 14.25 cfs @ 13.59 hrs, Volume= 4.000 af, Depth> 0.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
58.400	49	Pasture/grassland/range, Fair, HSG A
38.900	69	Pasture/grassland/range, Fair, HSG B
97.300	57	Weighted Average
97.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
113.3	3,400		0.50		**Direct Entry,**

Subcatchment 6S: SE



Summary for Subcatchment 7S: NE

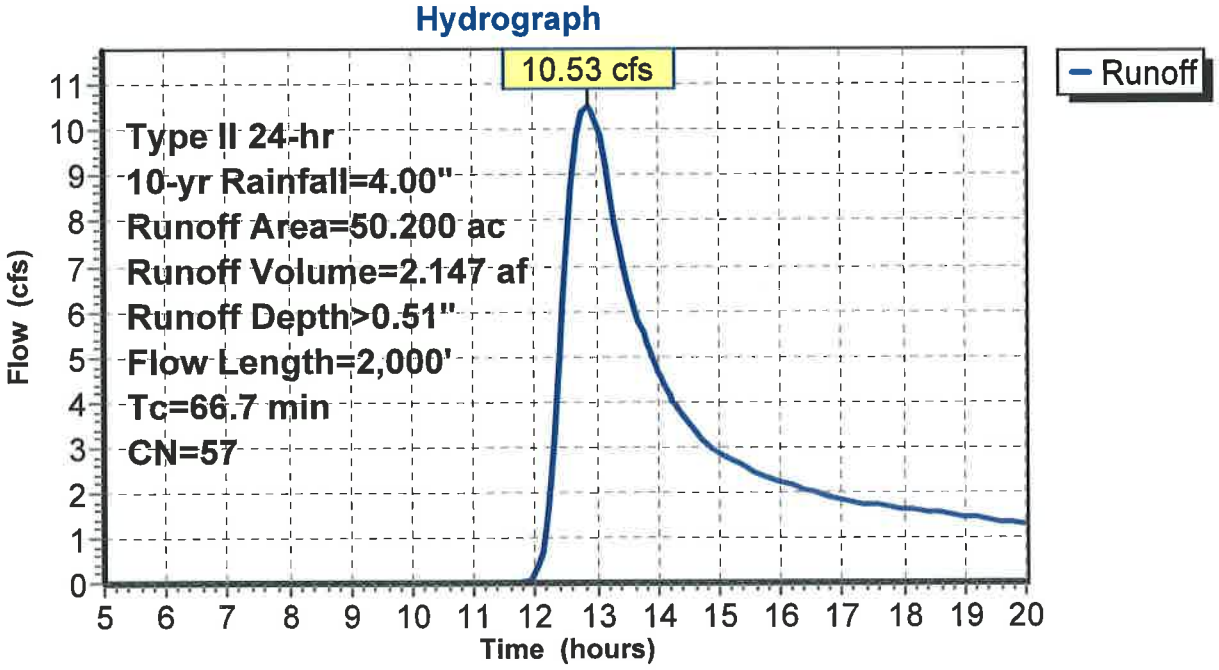
Runoff = 10.53 cfs @ 12.86 hrs, Volume= 2.147 af, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
30.100	49	Pasture/grassland/range, Fair, HSG A
20.100	69	Pasture/grassland/range, Fair, HSG B
50.200	57	Weighted Average
50.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 7S: NE



Summary for Reach 7R: SE ditch

Inflow Area = 194.600 ac, 0.00% Impervious, Inflow Depth > 0.42" for 10-yr event
Inflow = 17.45 cfs @ 13.85 hrs, Volume= 6.812 af
Outflow = 15.39 cfs @ 15.13 hrs, Volume= 5.930 af, Atten= 12%, Lag= 76.9 min

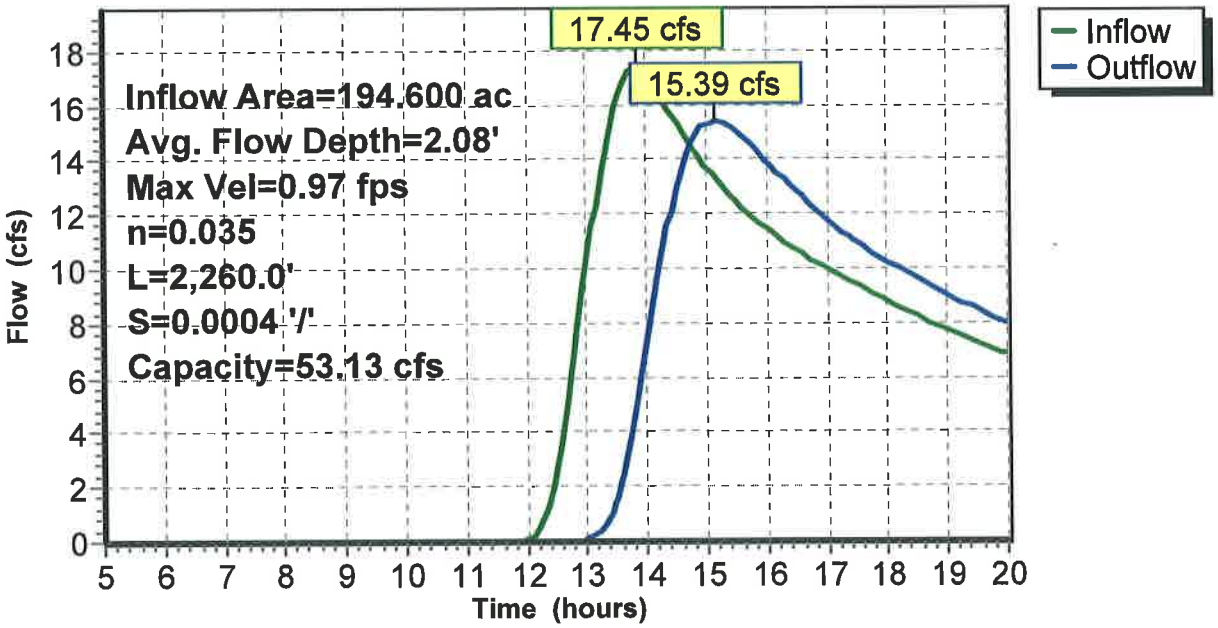
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.97 fps, Min. Travel Time= 38.8 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 47.3 min

Peak Storage= 35,827 cf @ 14.49 hrs
Average Depth at Peak Storage= 2.08'
Bank-Full Depth= 3.50' Flow Area= 40.1 sf, Capacity= 53.13 cfs

2.00' x 3.50' deep channel, n= 0.035
Side Slope Z-value= 2.7 '/' Top Width= 20.90'
Length= 2,260.0' Slope= 0.0004 '/'
Inlet Invert= 1,196.40', Outlet Invert= 1,195.40'

Reach 7R: SE ditch

Hydrograph



Summary for Pond 1P: NE ditch

Inflow Area = 97.400 ac, 0.00% Impervious, Inflow Depth > 0.51" for 10-yr event
Inflow = 20.42 cfs @ 12.86 hrs, Volume= 4.165 af
Outflow = 19.96 cfs @ 12.98 hrs, Volume= 4.161 af, Atten= 2%, Lag= 6.9 min
Primary = 19.96 cfs @ 12.98 hrs, Volume= 4.161 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,198.59' @ 12.98 hrs Surf.Area= 4,179 sf Storage= 2,698 cf

Plug-Flow detention time= 1.5 min calculated for 4.147 af (100% of inflow)
Center-of-Mass det. time= 1.1 min (884.3 - 883.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.65'	215,897 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

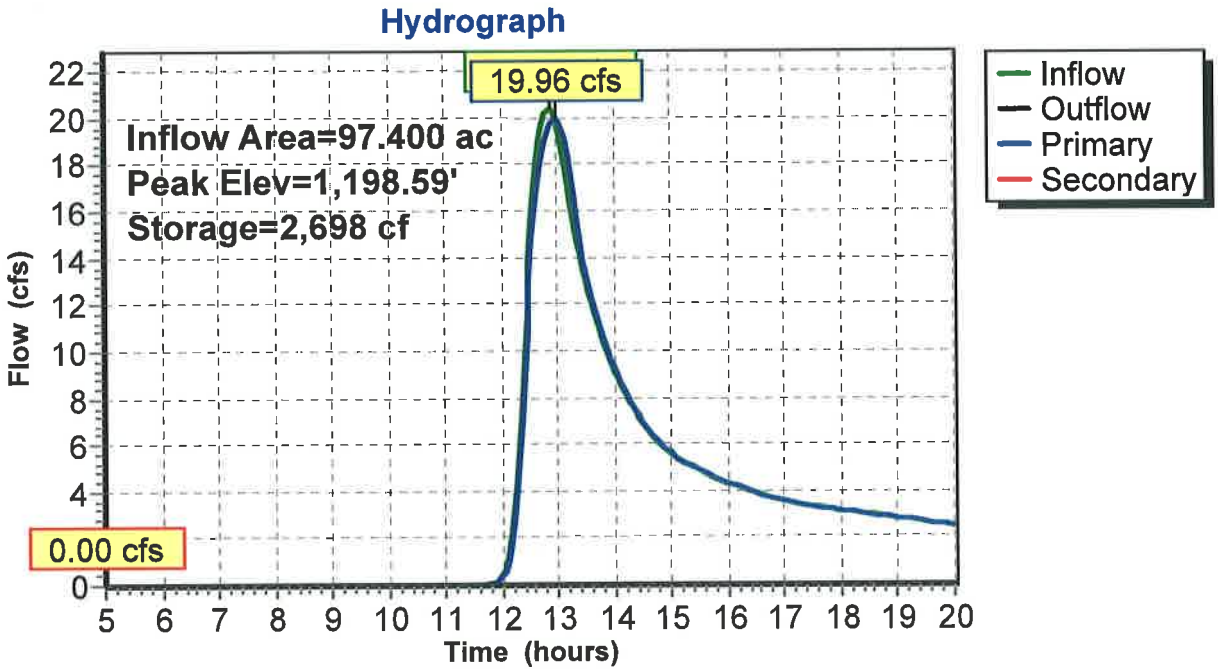
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.65	0	0	0
1,198.00	1,000	1,175	1,175
1,199.00	6,407	3,704	4,878
1,200.00	12,815	9,611	14,489
1,201.00	390,000	201,408	215,897

Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.65'	**30.0" Round Culvert** L= 24.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.65' / 1,195.65' S= 0.0000 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,200.20'	**150.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=19.94 cfs @ 12.98 hrs HW=1,198.59' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 19.94 cfs @ 4.36 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,195.65' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: NE ditch



Summary for Pond 3P: S Central ditch

Inflow Area = 263.600 ac, 0.00% Impervious, Inflow Depth > 0.56" for 10-yr event
Inflow = 46.77 cfs @ 12.58 hrs, Volume= 12.343 af
Outflow = 46.73 cfs @ 12.59 hrs, Volume= 12.094 af, Atten= 0%, Lag= 0.7 min
Primary = 17.06 cfs @ 12.59 hrs, Volume= 9.718 af
Secondary = 29.67 cfs @ 12.59 hrs, Volume= 2.376 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,197.96' @ 12.59 hrs Surf.Area= 14,586 sf Storage= 18,502 cf

Plug-Flow detention time= 13.8 min calculated for 12.054 af (98% of inflow)
Center-of-Mass det. time= 8.2 min (926.5 - 918.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.30'	74,844 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.30	0	0	0
1,196.50	5,940	3,564	3,564
1,197.50	11,880	8,910	12,474
1,198.50	17,820	14,850	27,324
1,200.50	29,700	47,520	74,844

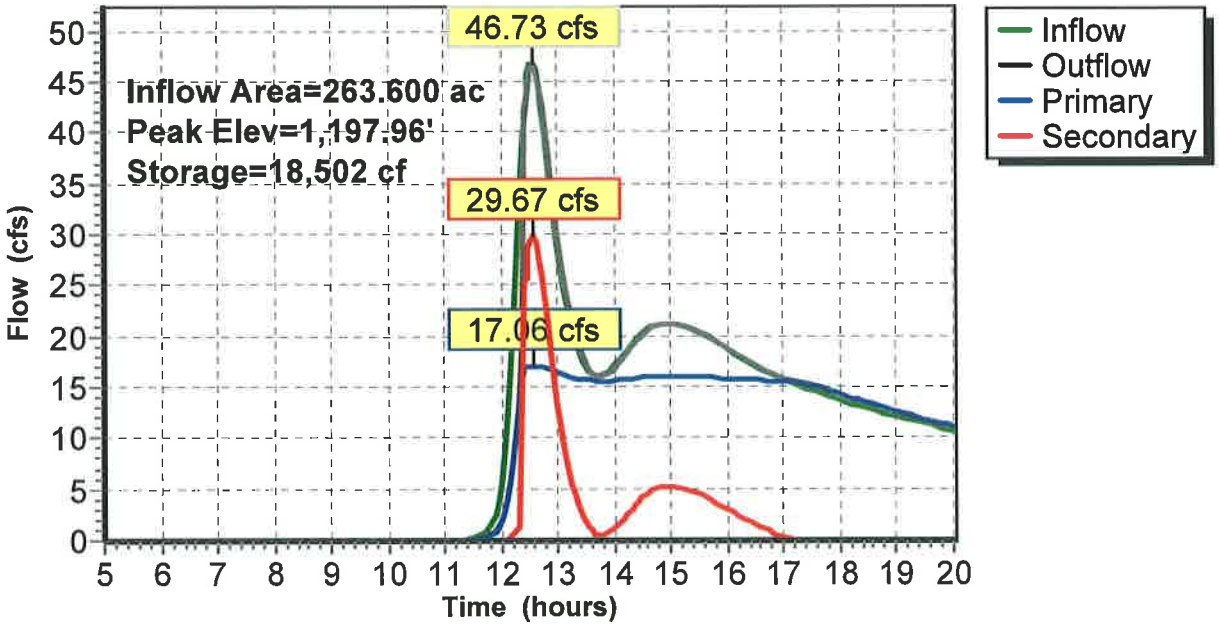
Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.48'	**30.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.37' / 1,195.48' S= -0.0055 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,197.80'	**180.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=17.06 cfs @ 12.59 hrs HW=1,197.96' (Free Discharge)
↑**1=Culvert** (Barrel Controls 17.06 cfs @ 4.18 fps)

Secondary OutFlow Max=29.52 cfs @ 12.59 hrs HW=1,197.96' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 29.52 cfs @ 1.06 fps)

Pond 3P: S Central ditch

Hydrograph



Summary for Pond 4P: SW ditch

Inflow Area = 323.600 ac, 0.00% Impervious, Inflow Depth > 0.59" for 10-yr event
Inflow = 74.44 cfs @ 12.52 hrs, Volume= 15.838 af
Outflow = 70.21 cfs @ 12.64 hrs, Volume= 15.820 af, Atten= 6%, Lag= 7.6 min
Primary = 70.21 cfs @ 12.64 hrs, Volume= 15.820 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,196.85' @ 12.64 hrs Surf.Area= 19,535 sf Storage= 25,889 cf

Plug-Flow detention time= 3.4 min calculated for 15.767 af (100% of inflow)
Center-of-Mass det. time= 3.0 min (911.6 - 908.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,194.20'	92,125 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

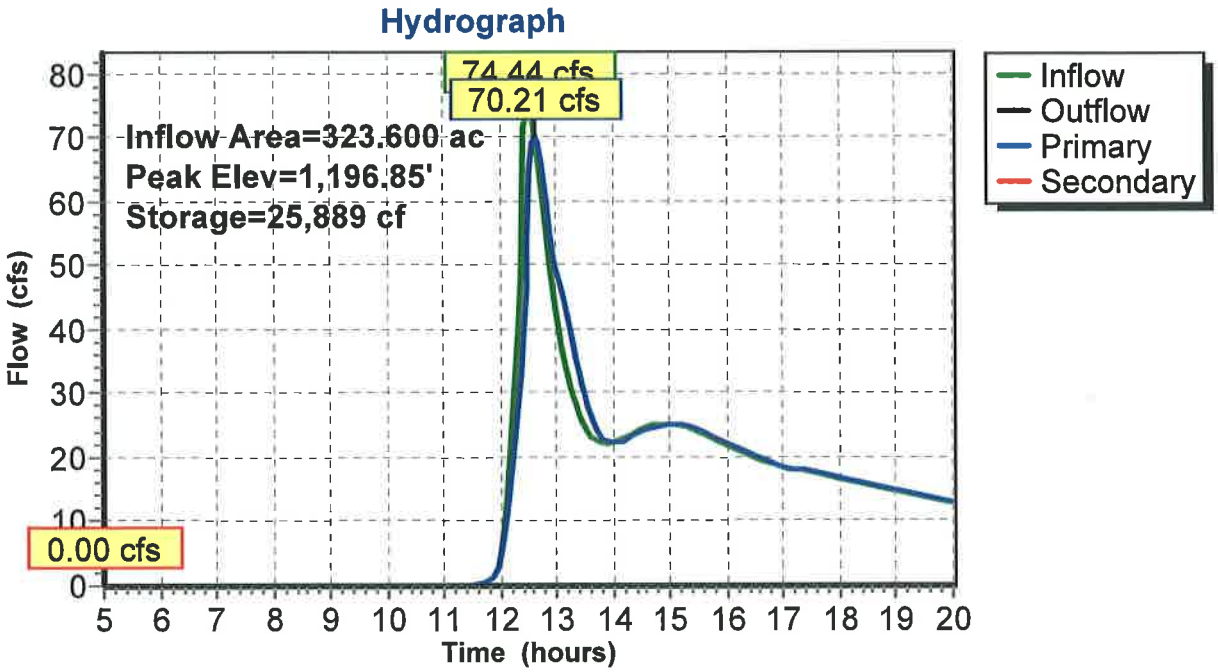
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,194.20	0	0	0
1,195.20	7,370	3,685	3,685
1,196.20	14,740	11,055	14,740
1,197.20	22,110	18,425	33,165
1,199.20	36,850	58,960	92,125

Device	Routing	Invert	Outlet Devices
#1	Primary	1,194.00'	**Special & User-Defined** Head (feet) 0.00 2.60 3.22 3.49 3.70 3.80 Disch. (cfs) 0.000 50.000 100.000 200.000 350.000 500.000
#2	Secondary	1,197.30'	**60.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=70.07 cfs @ 12.64 hrs HW=1,196.85' (Free Discharge)
↑**1=Special & User-Defined** (Custom Controls 70.07 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,194.20' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: SW ditch



Summary for Pond 5P: C ditch

Inflow Area = 53.000 ac, 0.00% Impervious, Inflow Depth > 1.09" for 10-yr event
Inflow = 22.25 cfs @ 13.22 hrs, Volume= 4.793 af
Outflow = 22.25 cfs @ 13.23 hrs, Volume= 4.793 af, Atten= 0%, Lag= 0.3 min
Primary = 22.25 cfs @ 13.23 hrs, Volume= 4.793 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,188.26' @ 13.23 hrs Surf.Area= 169 sf Storage= 47 cf

Plug-Flow detention time= 0.0 min calculated for 4.793 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (878.2 - 878.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,187.70'	476,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

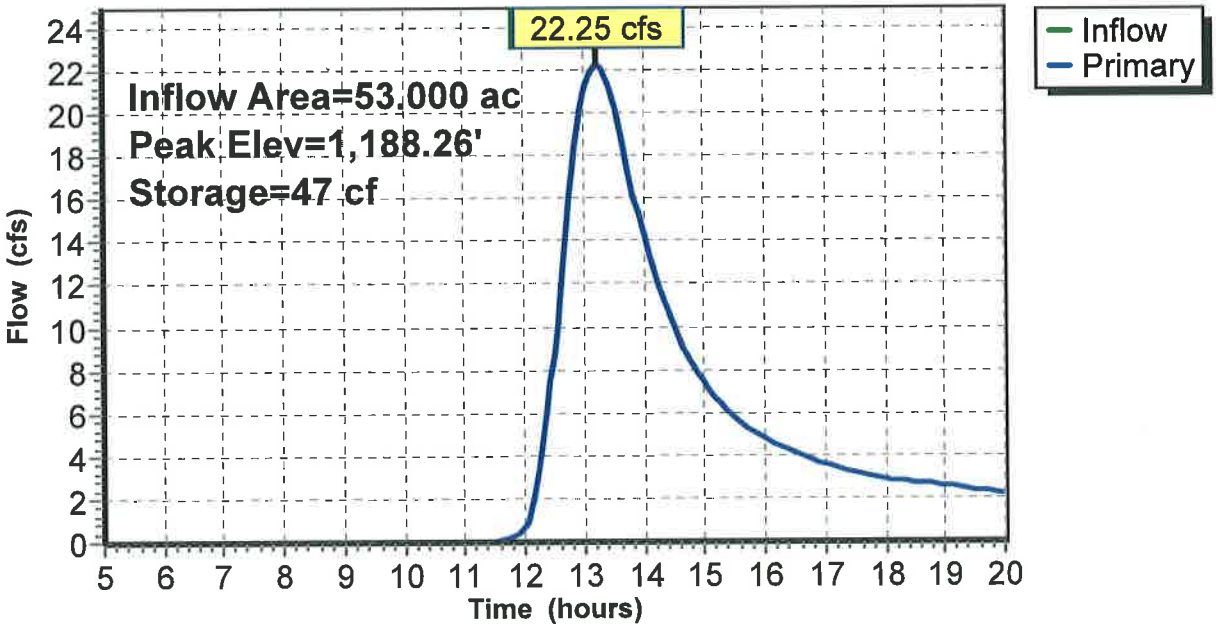
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,187.70	0	0	0
1,191.00	1,000	1,650	1,650
1,192.00	5,500	3,250	4,900
1,193.00	11,000	8,250	13,150
1,194.00	16,500	13,750	26,900
1,196.00	27,500	44,000	70,900
1,198.00	58,500	86,000	156,900
1,199.00	580,000	319,250	476,150

Device	Routing	Invert	Outlet Devices
#1	Primary	1,187.70'	**Ditch Flow** Head (feet) 0.00 1.00 2.00 3.00 4.00 Disch. (cfs) 0.000 40.000 133.000 300.000 550.000
#2	Primary	1,198.00'	**200.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=22.23 cfs @ 13.23 hrs HW=1,188.26' (Free Discharge)
↑—**1=Ditch Flow** (Custom Controls 22.23 cfs)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: C ditch

Hydrograph



Summary for Pond 6P: Road Ditch

Inflow Area = 97.300 ac, 0.00% Impervious, Inflow Depth > 0.49" for 10-yr event
Inflow = 14.25 cfs @ 13.59 hrs, Volume= 4.000 af
Outflow = 5.95 cfs @ 15.75 hrs, Volume= 2.812 af, Atten= 58%, Lag= 129.6 min
Primary = 5.95 cfs @ 15.75 hrs, Volume= 2.812 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,203.59' @ 15.75 hrs Surf.Area= 57,868 sf Storage= 73,269 cf

Plug-Flow detention time= 154.1 min calculated for 2.812 af (70% of inflow)
Center-of-Mass det. time= 88.1 min (1,002.2 - 914.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	263,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

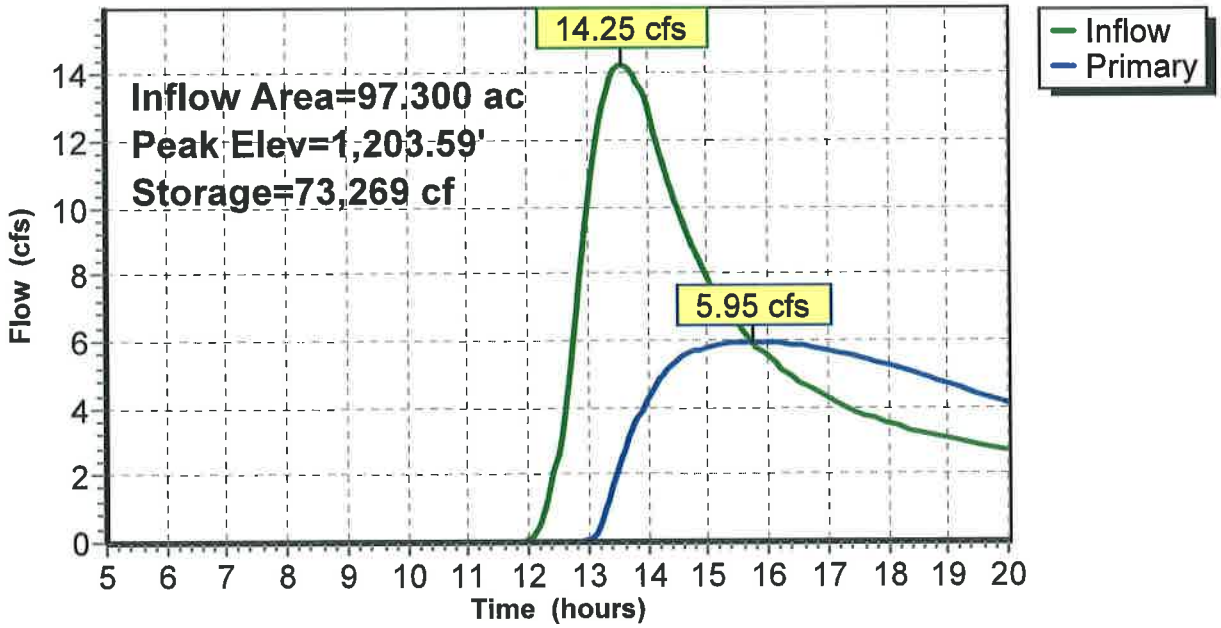
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	1,000	0	0
1,202.00	12,300	13,300	13,300
1,203.00	46,000	29,150	42,450
1,203.80	62,000	43,200	85,650
1,206.00	100,000	178,200	263,850

Device	Routing	Invert	Outlet Devices
#1	Primary	1,202.06'	**18.0" Round Culvert** L= 35.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,200.67' / 1,202.06' S= -0.0397 '/' Cc= 0.900 n= 0.024, Flow Area= 1.77 sf
#2	Primary	1,203.80'	**100.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.95 cfs @ 15.75 hrs HW=1,203.59' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 5.95 cfs @ 3.36 fps)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: Road Ditch

Hydrograph



Summary for Subcatchment 1S: NE

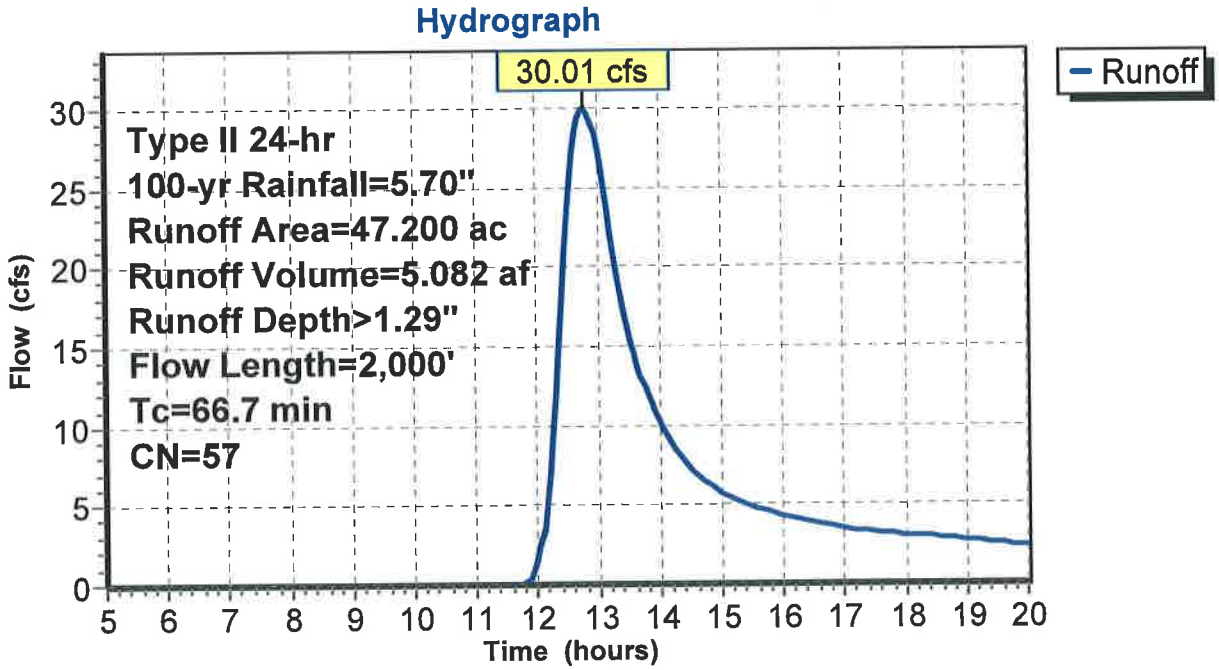
Runoff = 30.01 cfs @ 12.80 hrs, Volume= 5.082 af, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
28.300	49	Pasture/grassland/range, Fair, HSG A
18.900	69	Pasture/grassland/range, Fair, HSG B
47.200	57	Weighted Average
47.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 1S: NE



Summary for Subcatchment 2S: SE

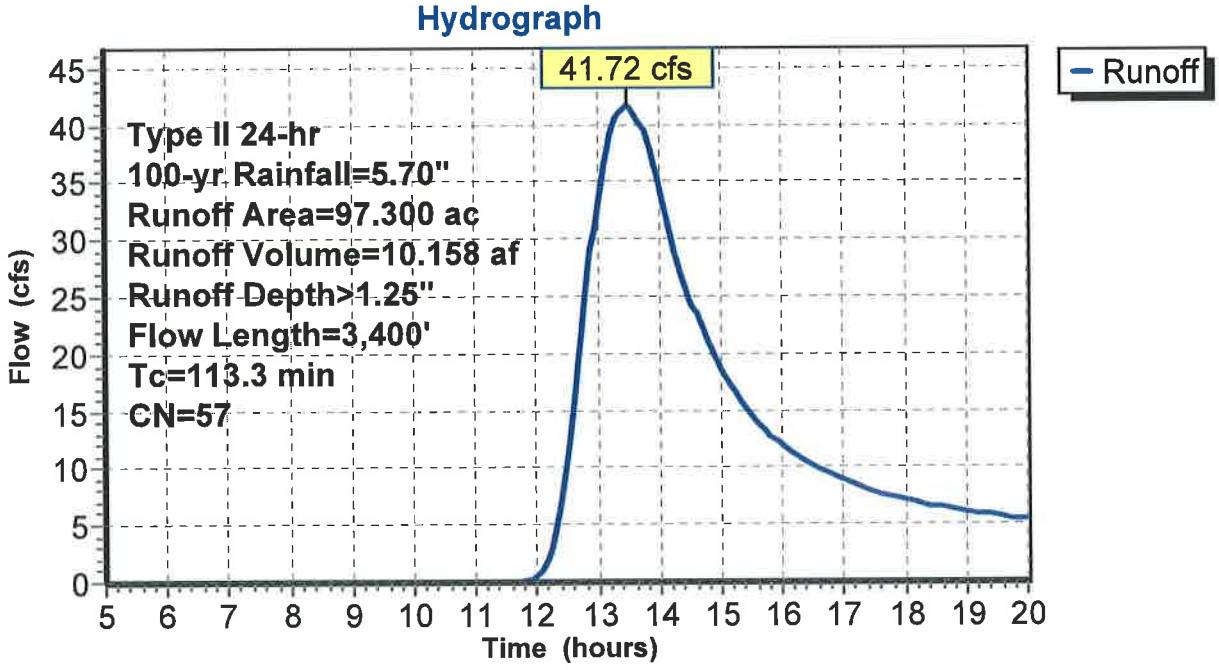
Runoff = 41.72 cfs @ 13.47 hrs, Volume= 10.158 af, Depth> 1.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
58.400	49	Pasture/grassland/range, Fair, HSG A
38.900	69	Pasture/grassland/range, Fair, HSG B
97.300	57	Weighted Average
97.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
113.3	3,400		0.50		**Direct Entry,**

Subcatchment 2S: SE



Summary for Subcatchment 3S: S Central

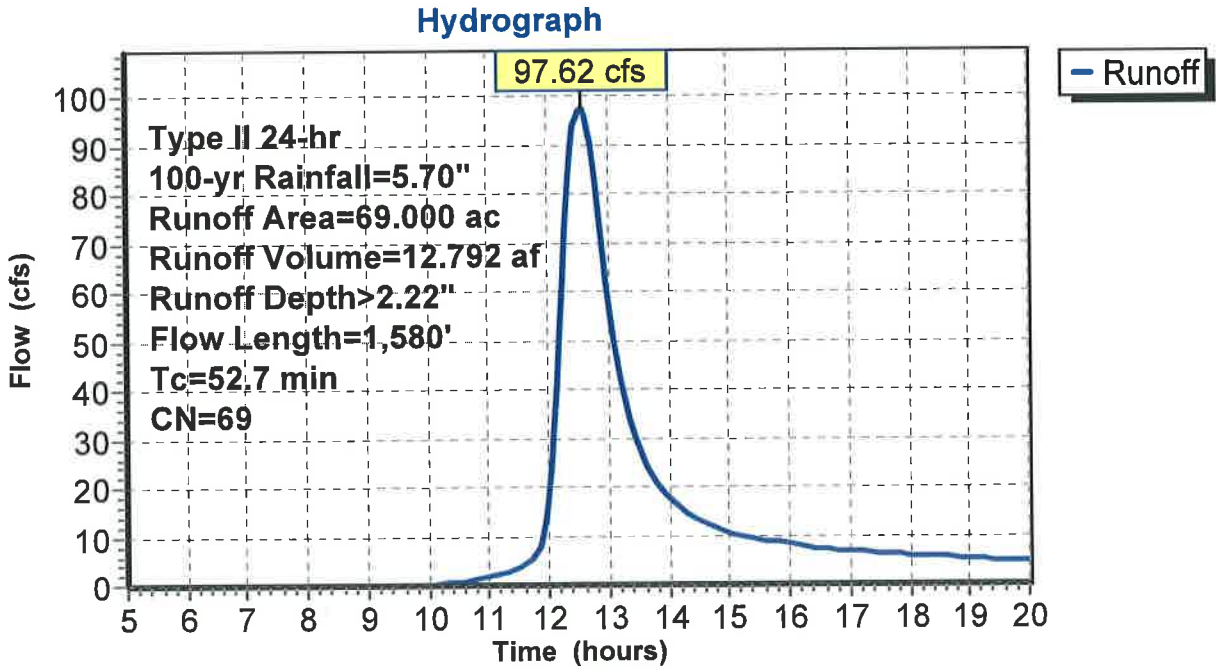
Runoff = 97.62 cfs @ 12.55 hrs, Volume= 12.792 af, Depth> 2.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
69.000	69	Pasture/grassland/range, Fair, HSG B
69.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.7	1,580		0.50		**Direct Entry,**

Subcatchment 3S: S Central



Summary for Subcatchment 4S: SW

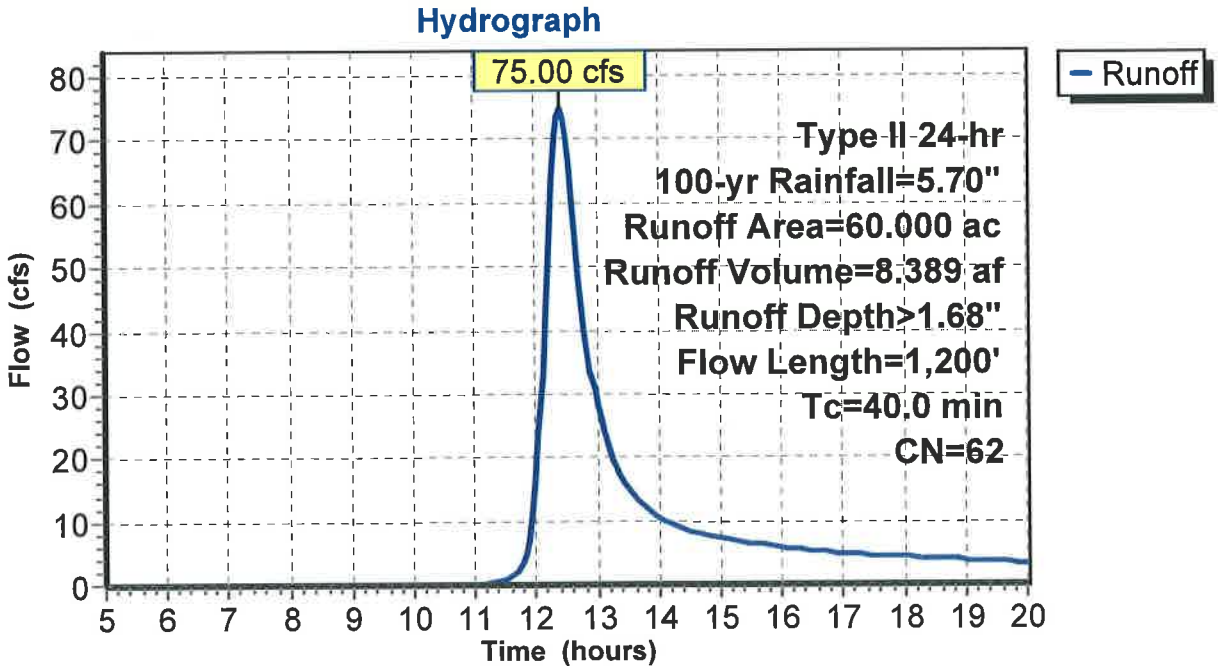
Runoff = 75.00 cfs @ 12.40 hrs, Volume= 8.389 af, Depth> 1.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
20.000	49	Pasture/grassland/range, Fair, HSG A
40.000	69	Pasture/grassland/range, Fair, HSG B
60.000	62	Weighted Average
60.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.0	1,200		0.50		**Direct Entry,**

Subcatchment 4S: SW



Summary for Subcatchment 5S: S Central

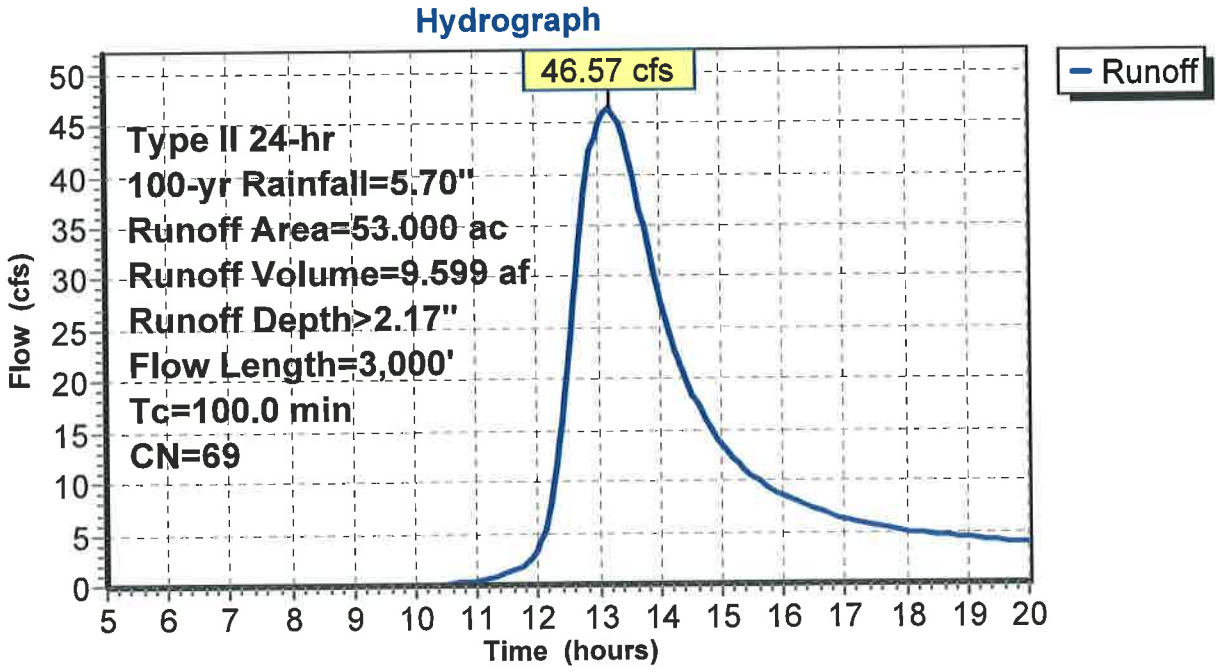
Runoff = 46.57 cfs @ 13.20 hrs, Volume= 9.599 af, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
53.000	69	Pasture/grassland/range, Fair, HSG B
53.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.0	3,000		0.50		**Direct Entry,**

Subcatchment 5S: S Central



Summary for Subcatchment 6S: SE

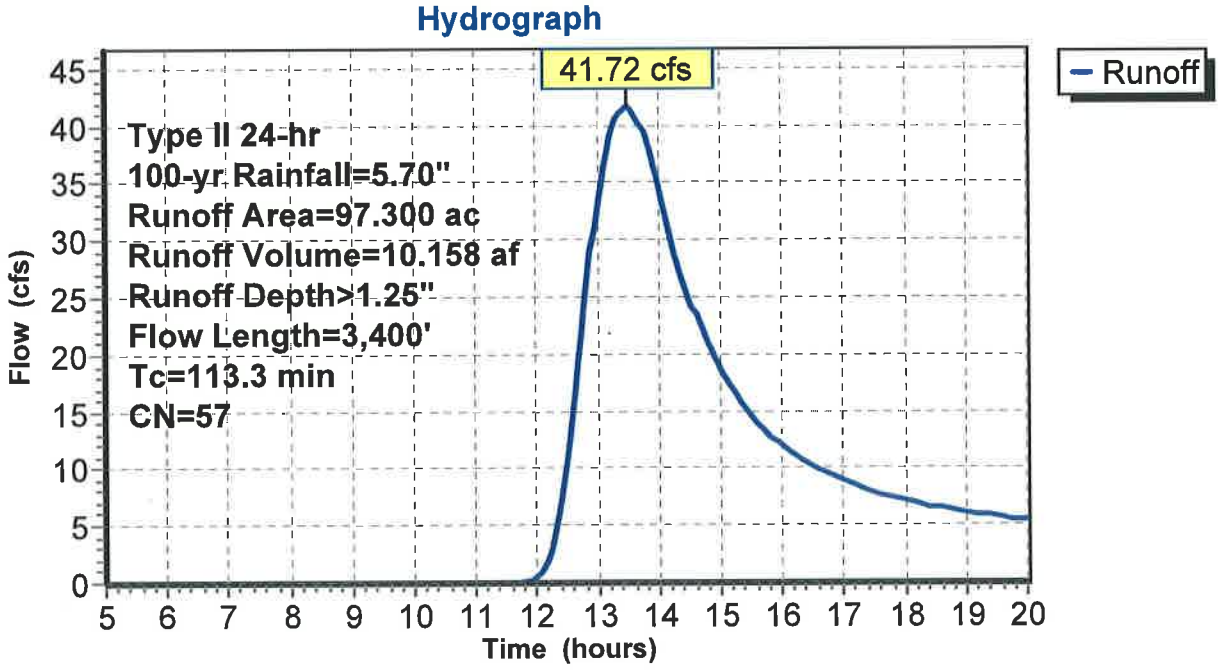
Runoff = 41.72 cfs @ 13.47 hrs, Volume= 10.158 af, Depth> 1.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
58.400	49	Pasture/grassland/range, Fair, HSG A
38.900	69	Pasture/grassland/range, Fair, HSG B
97.300	57	Weighted Average
97.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
113.3	3,400		0.50		**Direct Entry,**

Subcatchment 6S: SE



Summary for Subcatchment 7S: NE

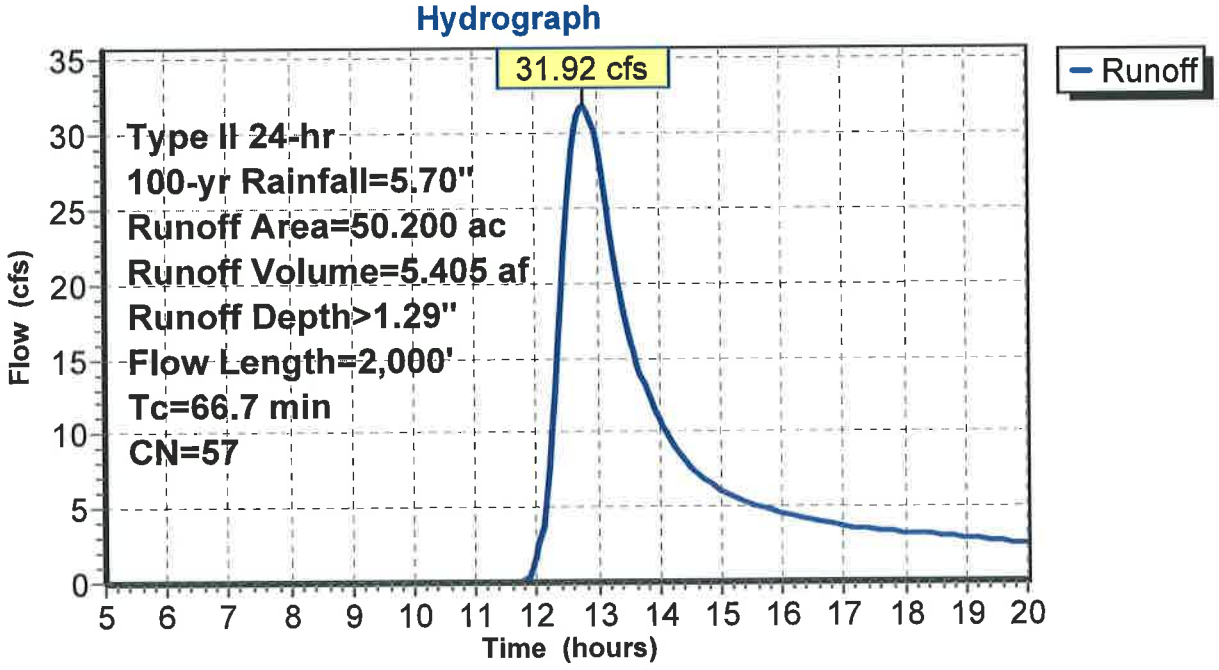
Runoff = 31.92 cfs @ 12.80 hrs, Volume= 5.405 af, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
30.100	49	Pasture/grassland/range, Fair, HSG A
20.100	69	Pasture/grassland/range, Fair, HSG B
50.200	57	Weighted Average
50.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 7S: NE



Summary for Reach 7R: SE ditch

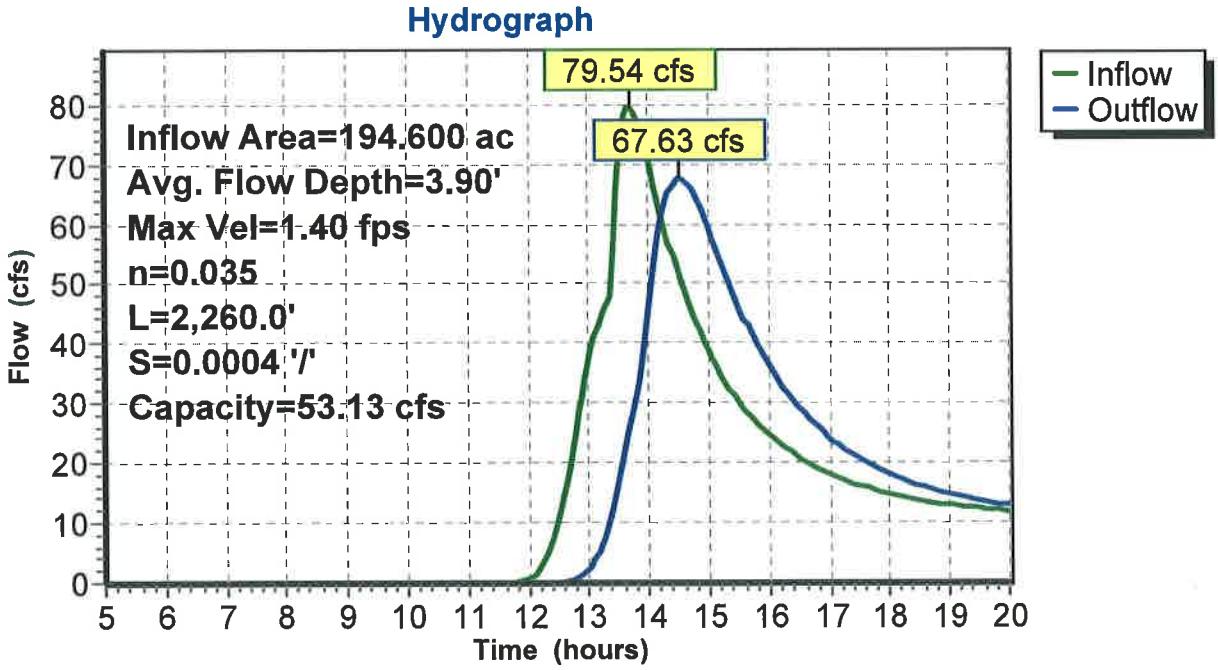
Inflow Area = 194.600 ac, 0.00% Impervious, Inflow Depth > 1.14" for 100-yr event
Inflow = 79.54 cfs @ 13.69 hrs, Volume= 18.430 af
Outflow = 67.63 cfs @ 14.53 hrs, Volume= 17.262 af, Atten= 15%, Lag= 50.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.40 fps, Min. Travel Time= 26.9 min
Avg. Velocity = 1.00 fps, Avg. Travel Time= 37.7 min

Peak Storage= 109,150 cf @ 14.08 hrs
Average Depth at Peak Storage= 3.90'
Bank-Full Depth= 3.50' Flow Area= 40.1 sf, Capacity= 53.13 cfs

2.00' x 3.50' deep channel, n= 0.035
Side Slope Z-value= 2.7 '/' Top Width= 20.90'
Length= 2,260.0' Slope= 0.0004 '/'
Inlet Invert= 1,196.40', Outlet Invert= 1,195.40'

Reach 7R: SE ditch



Summary for Pond 1P: NE ditch

Inflow Area = 97.400 ac, 0.00% Impervious, Inflow Depth > 1.29" for 100-yr event
Inflow = 61.93 cfs @ 12.80 hrs, Volume= 10.488 af
Outflow = 54.68 cfs @ 13.04 hrs, Volume= 10.479 af, Atten= 12%, Lag= 14.7 min
Primary = 34.63 cfs @ 13.04 hrs, Volume= 9.483 af
Secondary = 20.06 cfs @ 13.04 hrs, Volume= 0.996 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,200.34' @ 13.04 hrs Surf.Area= 142,437 sf Storage= 41,166 cf

Plug-Flow detention time= 7.1 min calculated for 10.444 af (100% of inflow)
Center-of-Mass det. time= 6.8 min (868.4 - 861.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.65'	215,897 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

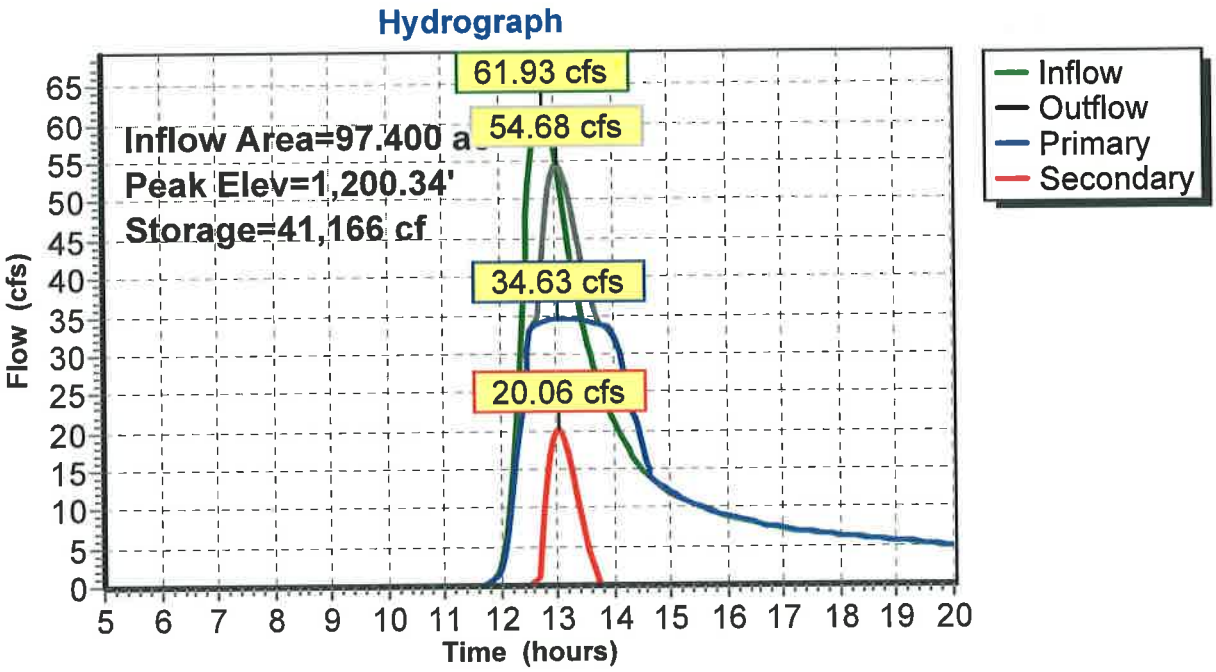
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.65	0	0	0
1,198.00	1,000	1,175	1,175
1,199.00	6,407	3,704	4,878
1,200.00	12,815	9,611	14,489
1,201.00	390,000	201,408	215,897

Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.65'	**30.0" Round Culvert** L= 24.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.65' / 1,195.65' S= 0.0000 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,200.20'	**150.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=34.63 cfs @ 13.04 hrs HW=1,200.34' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 34.63 cfs @ 7.05 fps)

Secondary OutFlow Max=19.80 cfs @ 13.04 hrs HW=1,200.34' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 19.80 cfs @ 0.92 fps)

Pond 1P: NE ditch



Summary for Pond 3P: S Central ditch

Inflow Area = 263.600 ac, 0.00% Impervious, Inflow Depth > 1.37" for 100-yr event
Inflow = 97.65 cfs @ 12.55 hrs, Volume= 30.055 af
Outflow = 97.62 cfs @ 12.56 hrs, Volume= 29.675 af, Atten= 0%, Lag= 0.6 min
Primary = 18.46 cfs @ 12.56 hrs, Volume= 11.397 af
Secondary = 79.16 cfs @ 12.56 hrs, Volume= 18.278 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,198.10' @ 12.56 hrs Surf.Area= 15,436 sf Storage= 20,650 cf

Plug-Flow detention time= 6.8 min calculated for 29.675 af (99% of inflow)
Center-of-Mass det. time= 3.1 min (903.2 - 900.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.30'	74,844 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.30	0	0	0
1,196.50	5,940	3,564	3,564
1,197.50	11,880	8,910	12,474
1,198.50	17,820	14,850	27,324
1,200.50	29,700	47,520	74,844

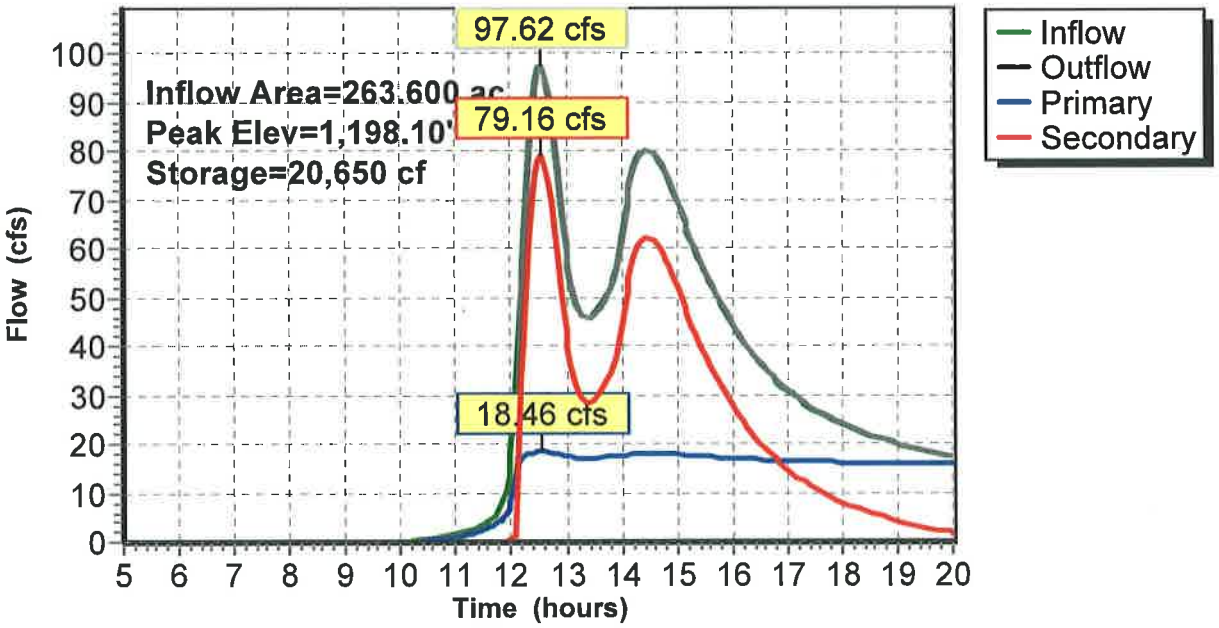
Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.48'	**30.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.37' / 1,195.48' S= -0.0055 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,197.80'	**180.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=18.45 cfs @ 12.56 hrs HW=1,198.10' (Free Discharge)
↑**1=Culvert** (Barrel Controls 18.45 cfs @ 4.29 fps)

Secondary OutFlow Max=78.89 cfs @ 12.56 hrs HW=1,198.10' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 78.89 cfs @ 1.47 fps)

Pond 3P: S Central ditch

Hydrograph



Summary for Pond 4P: SW ditch

Inflow Area = 323.600 ac, 0.00% Impervious, Inflow Depth > 1.41" for 100-yr event
Inflow = 167.16 cfs @ 12.48 hrs, Volume= 38.064 af
Outflow = 166.93 cfs @ 12.49 hrs, Volume= 37.998 af, Atten= 0%, Lag= 0.6 min
Primary = 162.57 cfs @ 12.49 hrs, Volume= 37.894 af
Secondary = 4.36 cfs @ 12.49 hrs, Volume= 0.104 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,197.39' @ 12.49 hrs Surf.Area= 23,503 sf Storage= 37,474 cf

Plug-Flow detention time= 5.2 min calculated for 37.998 af (100% of inflow)
Center-of-Mass det. time= 4.6 min (892.4 - 887.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,194.20'	92,125 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,194.20	0	0	0
1,195.20	7,370	3,685	3,685
1,196.20	14,740	11,055	14,740
1,197.20	22,110	18,425	33,165
1,199.20	36,850	58,960	92,125

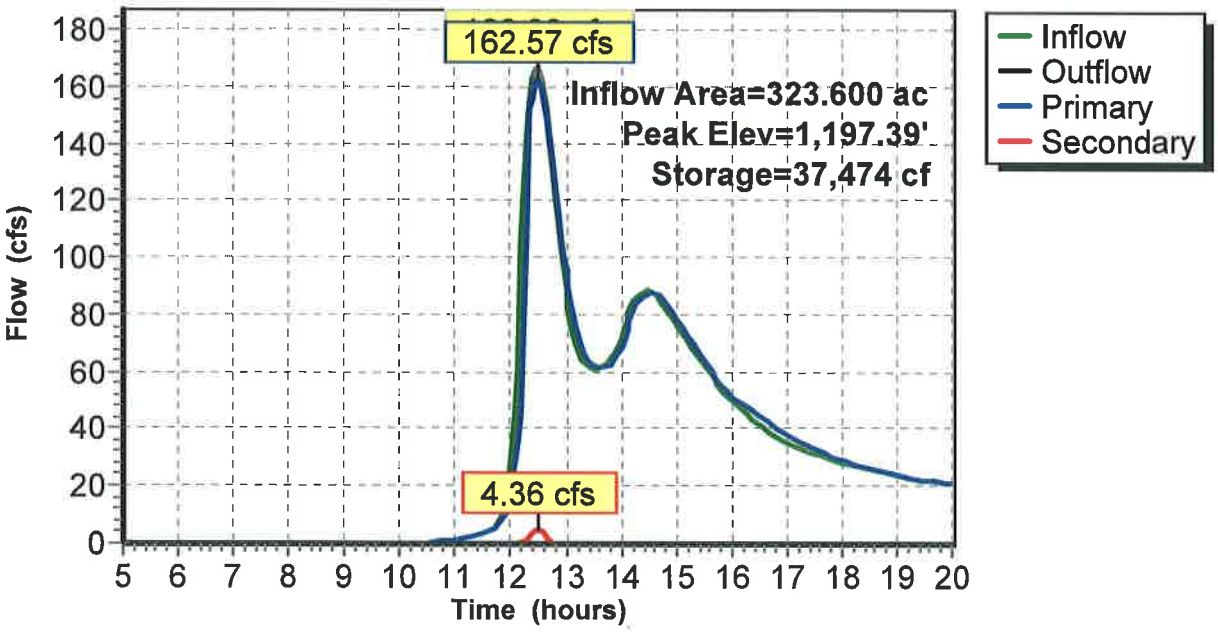
Device	Routing	Invert	Outlet Devices
#1	Primary	1,194.00'	**Special & User-Defined** Head (feet) 0.00 2.60 3.22 3.49 3.70 3.80 Disch. (cfs) 0.000 50.000 100.000 200.000 350.000 500.000
#2	Secondary	1,197.30'	**60.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=162.34 cfs @ 12.49 hrs HW=1,197.39' (Free Discharge)
↑—**1=Special & User-Defined** (Custom Controls 162.34 cfs)

Secondary OutFlow Max=4.22 cfs @ 12.49 hrs HW=1,197.39' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 4.22 cfs @ 0.80 fps)

Pond 4P: SW ditch

Hydrograph



Summary for Pond 5P: C ditch

Inflow Area = 53.000 ac, 0.00% Impervious, Inflow Depth > 2.17" for 100-yr event
Inflow = 46.57 cfs @ 13.20 hrs, Volume= 9.599 af
Outflow = 46.56 cfs @ 13.20 hrs, Volume= 9.599 af, Atten= 0%, Lag= 0.0 min
Primary = 46.56 cfs @ 13.20 hrs, Volume= 9.599 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,188.77' @ 13.20 hrs Surf.Area= 324 sf Storage= 174 cf

Plug-Flow detention time= 0.0 min calculated for 9.599 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (865.9 - 865.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,187.70'	476,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

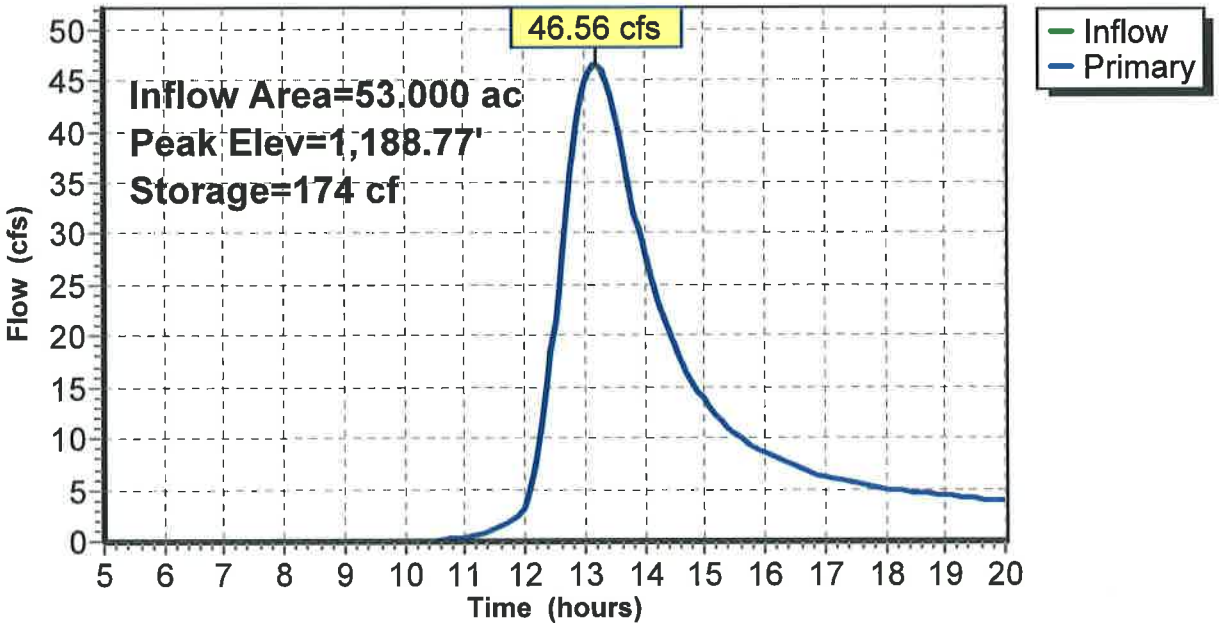
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,187.70	0	0	0
1,191.00	1,000	1,650	1,650
1,192.00	5,500	3,250	4,900
1,193.00	11,000	8,250	13,150
1,194.00	16,500	13,750	26,900
1,196.00	27,500	44,000	70,900
1,198.00	58,500	86,000	156,900
1,199.00	580,000	319,250	476,150

Device	Routing	Invert	Outlet Devices
#1	Primary	1,187.70'	**Ditch Flow** Head (feet) 0.00 1.00 2.00 3.00 4.00 Disch. (cfs) 0.000 40.000 133.000 300.000 550.000
#2	Primary	1,198.00'	**200.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=46.55 cfs @ 13.20 hrs HW=1,188.77' (Free Discharge)
↑—**1=Ditch Flow** (Custom Controls 46.55 cfs)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: C ditch

Hydrograph



Summary for Pond 6P: Road Ditch

Inflow Area = 97.300 ac, 0.00% Impervious, Inflow Depth > 1.25" for 100-yr event
Inflow = 41.72 cfs @ 13.47 hrs, Volume= 10.158 af
Outflow = 39.56 cfs @ 13.74 hrs, Volume= 8.271 af, Atten= 5%, Lag= 16.3 min
Primary = 39.56 cfs @ 13.74 hrs, Volume= 8.271 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,204.05' @ 13.74 hrs Surf.Area= 66,366 sf Storage= 101,875 cf

Plug-Flow detention time= 81.4 min calculated for 8.244 af (81% of inflow)
Center-of-Mass det. time= 36.4 min (931.1 - 894.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	263,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

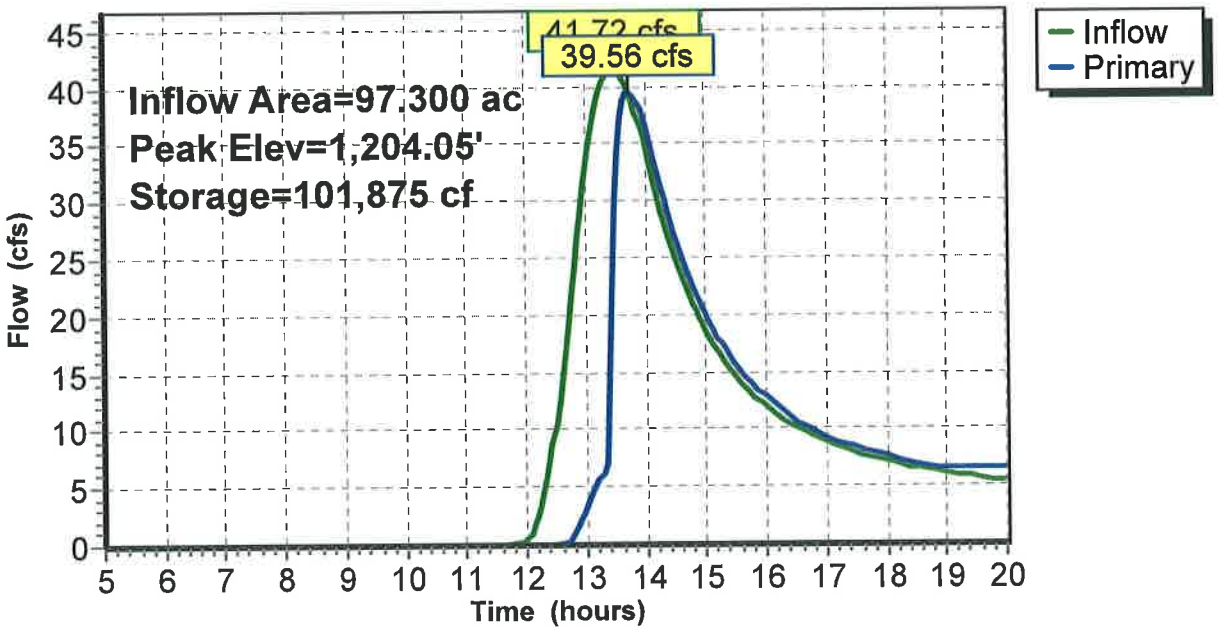
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	1,000	0	0
1,202.00	12,300	13,300	13,300
1,203.00	46,000	29,150	42,450
1,203.80	62,000	43,200	85,650
1,206.00	100,000	178,200	263,850

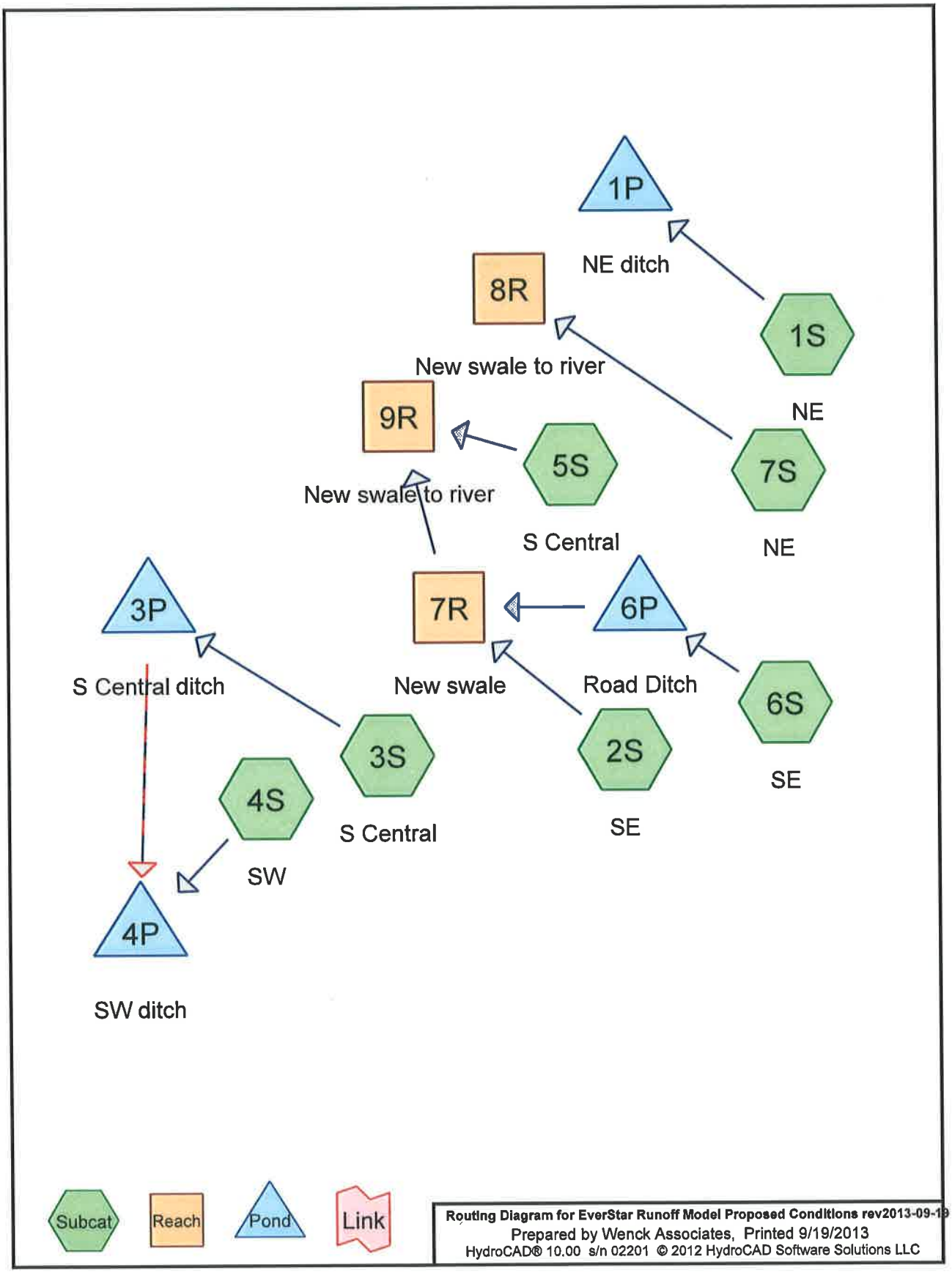
Device	Routing	Invert	Outlet Devices
#1	Primary	1,202.06'	**18.0" Round Culvert** L= 35.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,200.67' / 1,202.06' S= -0.0397 '/' Cc= 0.900 n= 0.024, Flow Area= 1.77 sf
#2	Primary	1,203.80'	**100.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=39.35 cfs @ 13.74 hrs HW=1,204.05' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 7.49 cfs @ 4.24 fps)
└—**2=Broad-Crested Rectangular Weir** (Weir Controls 31.86 cfs @ 1.26 fps)

Pond 6P: Road Ditch

Hydrograph




1P
NE ditch
8R
1S
New swale to river
NE
9R
5S
7S
New swale to river
S Central
NE
3P
7R
6P
S Central ditch
New swale
Road Ditch
6S
3S
2S
SE
4S
S Central
SE
SW
4P
SW ditch
Subcat
Reach
Pond
Link
Routing Diagram for EverStar Runoff Model Proposed Conditions rev2013-09-19
Prepared by Wenck Associates, Printed 9/19/2013
HydroCAD® 10.00 s/n 02201 © 2012 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
133.100	49	Pasture/grassland/range, Fair, HSG A (1S, 2S, 4S, 6S, 7S)
237.400	69	Pasture/grassland/range, Fair, HSG B (1S, 2S, 3S, 4S, 5S, 6S, 7S)
370.500	**62**	**TOTAL AREA**

Summary for Subcatchment 1S: NE

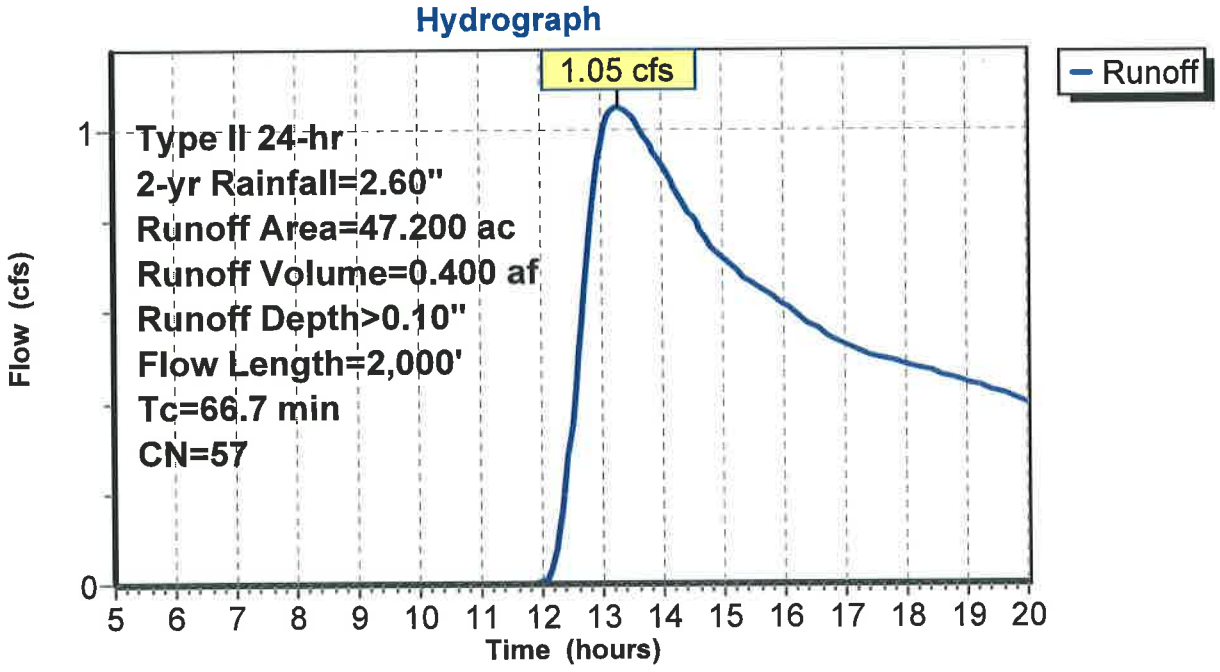
Runoff = 1.05 cfs @ 13.27 hrs, Volume= 0.400 af, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
28.300	49	Pasture/grassland/range, Fair, HSG A
18.900	69	Pasture/grassland/range, Fair, HSG B
47.200	57	Weighted Average
47.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 1S: NE



Summary for Subcatchment 2S: SE

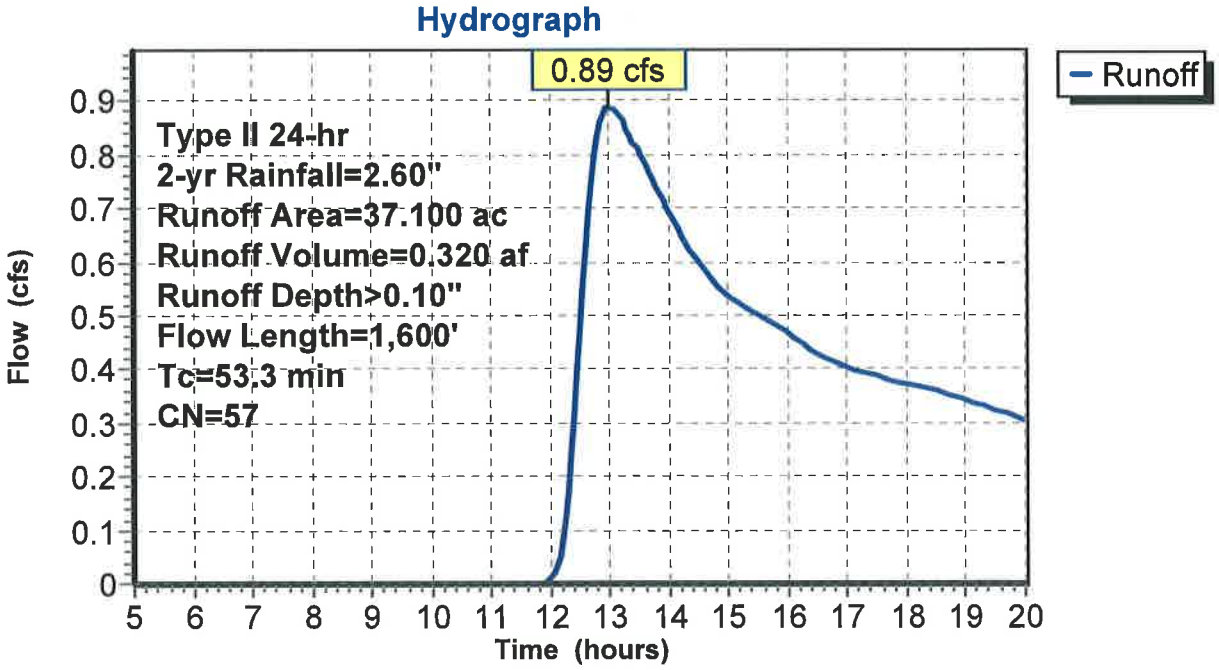
Runoff = 0.89 cfs @ 13.01 hrs, Volume= 0.320 af, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
22.300	49	Pasture/grassland/range, Fair, HSG A
14.800	69	Pasture/grassland/range, Fair, HSG B
37.100	57	Weighted Average
37.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
53.3	1,600		0.50		**Direct Entry,**

Subcatchment 2S: SE



Summary for Subcatchment 3S: S Central

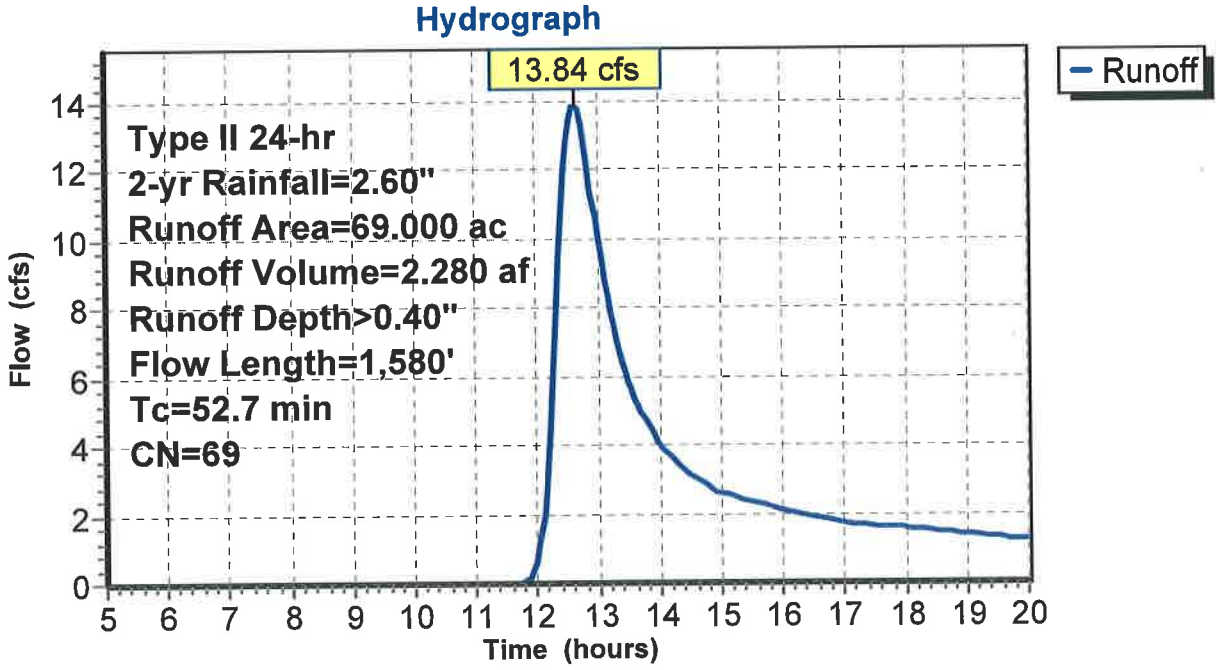
Runoff = 13.84 cfs @ 12.63 hrs, Volume= 2.280 af, Depth> 0.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
69.000	69	Pasture/grassland/range, Fair, HSG B
69.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.7	1,580		0.50		**Direct Entry,**

Subcatchment 3S: S Central



Summary for Subcatchment 4S: SW

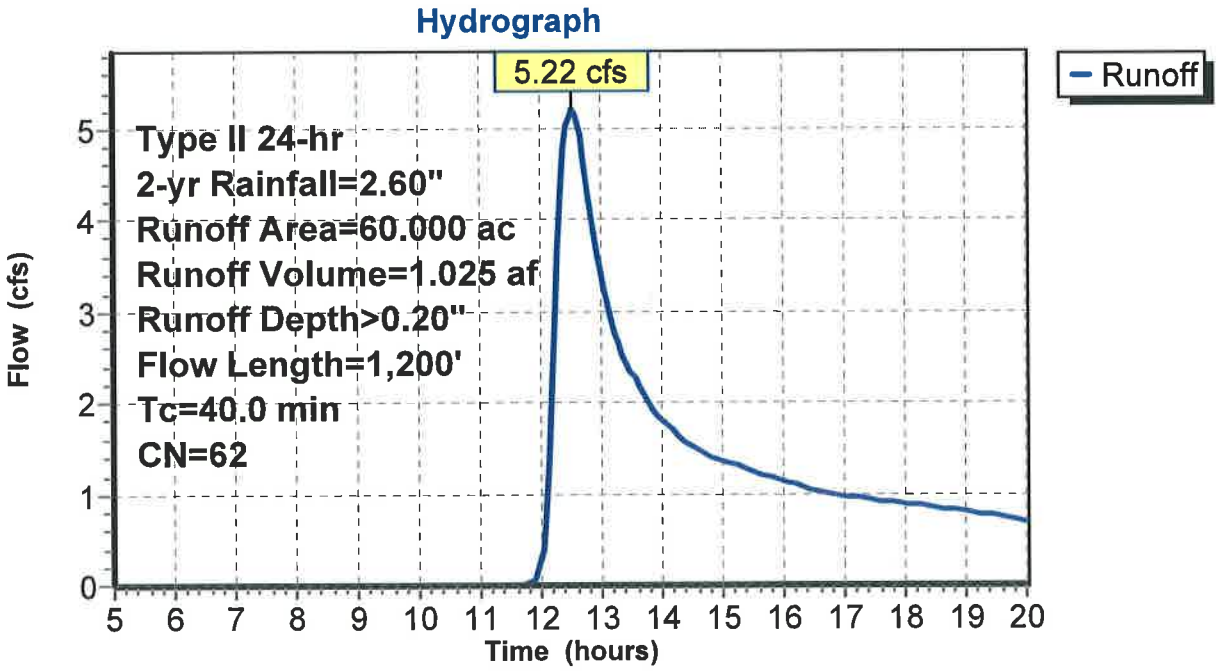
Runoff = 5.22 cfs @ 12.53 hrs, Volume= 1.025 af, Depth> 0.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
20.000	49	Pasture/grassland/range, Fair, HSG A
40.000	69	Pasture/grassland/range, Fair, HSG B
60.000	62	Weighted Average
60.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.0	1,200		0.50		**Direct Entry,**

Subcatchment 4S: SW



Summary for Subcatchment 5S: S Central

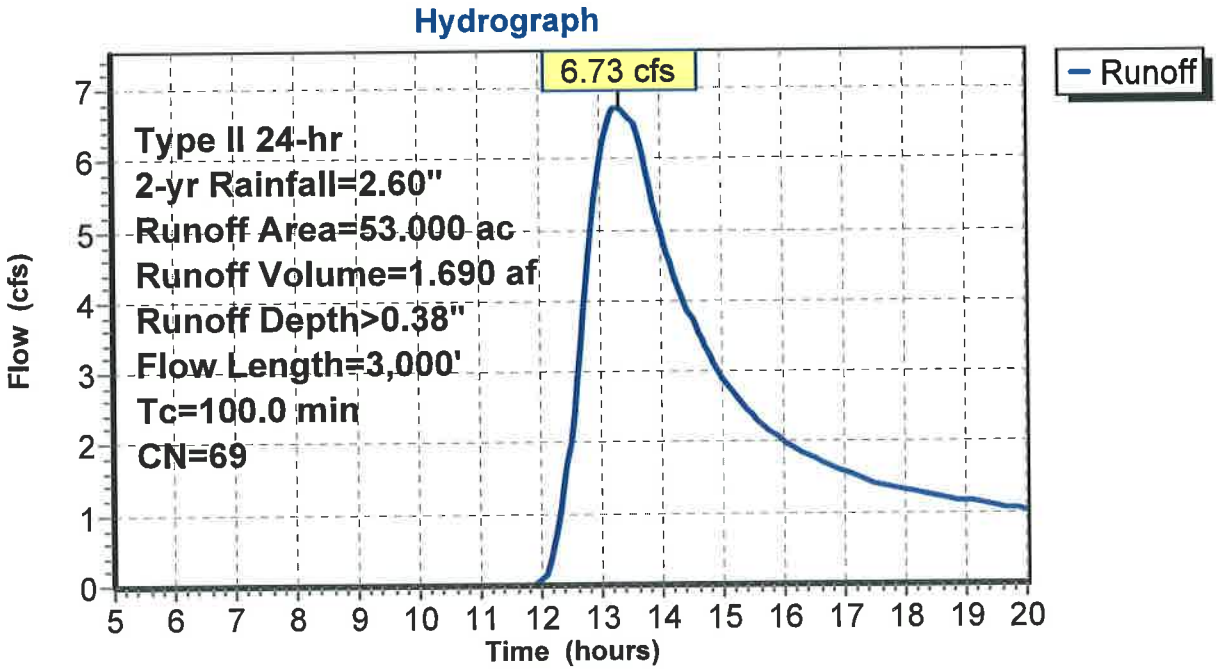
Runoff = 6.73 cfs @ 13.33 hrs, Volume= 1.690 af, Depth> 0.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
53.000	69	Pasture/grassland/range, Fair, HSG B
53.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.0	3,000		0.50		**Direct Entry,**

Subcatchment 5S: S Central



Summary for Subcatchment 6S: SE

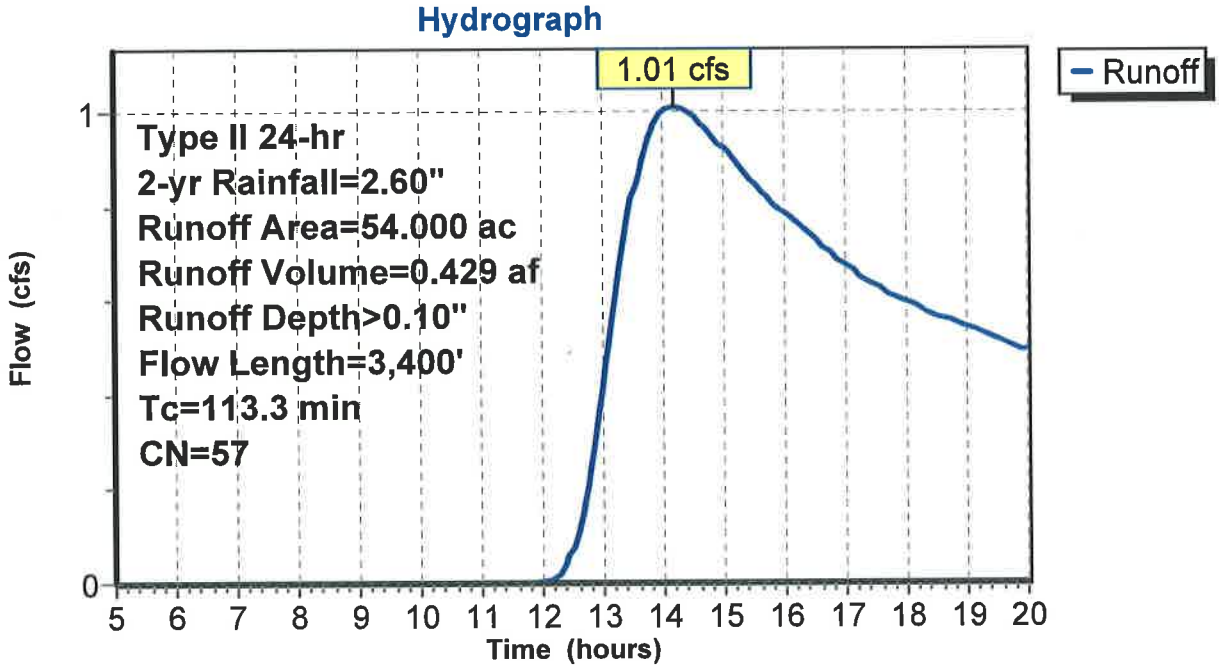
Runoff = 1.01 cfs @ 14.19 hrs, Volume= 0.429 af, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
32.400	49	Pasture/grassland/range, Fair, HSG A
21.600	69	Pasture/grassland/range, Fair, HSG B
54.000	57	Weighted Average
54.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
113.3	3,400		0.50		**Direct Entry,**

Subcatchment 6S: SE



Summary for Subcatchment 7S: NE

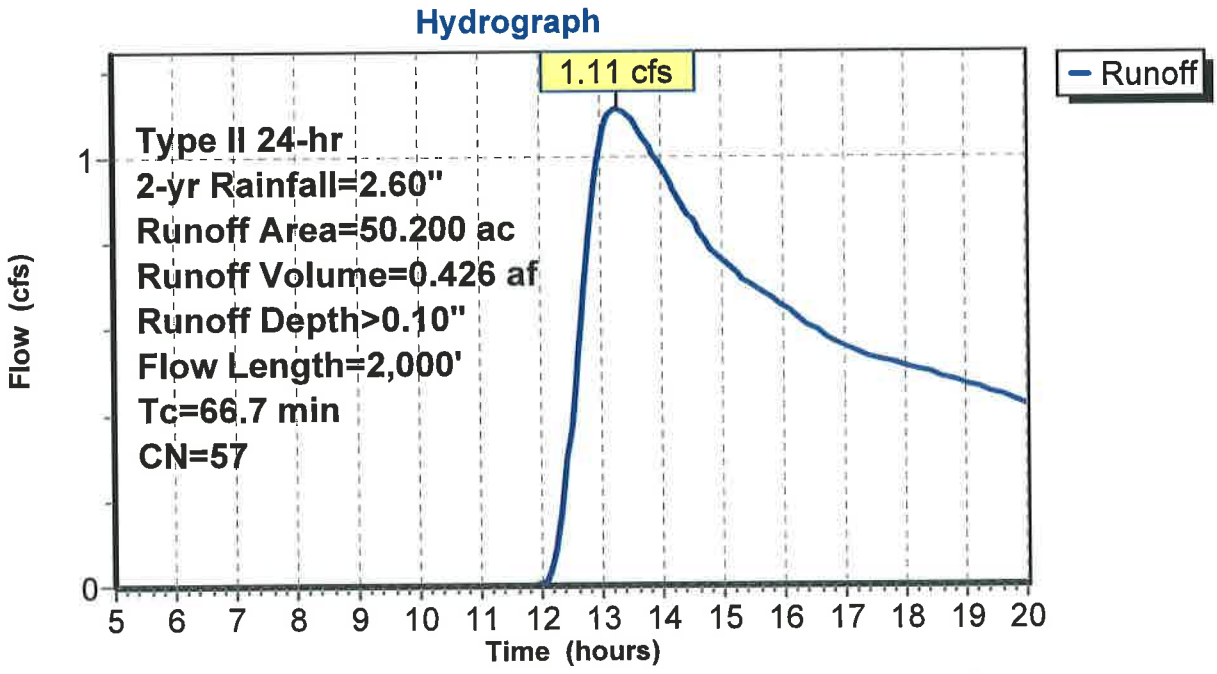
Runoff = 1.11 cfs @ 13.27 hrs, Volume= 0.426 af, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.60"

Area (ac)	CN	Description
30.100	49	Pasture/grassland/range, Fair, HSG A
20.100	69	Pasture/grassland/range, Fair, HSG B
50.200	57	Weighted Average
50.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 7S: NE



Summary for Reach 7R: New swale

Inflow Area = 91.100 ac, 0.00% Impervious, Inflow Depth > 0.04" for 2-yr event
Inflow = 0.89 cfs @ 13.01 hrs, Volume= 0.337 af
Outflow = 0.50 cfs @ 17.68 hrs, Volume= 0.174 af, Atten= 43%, Lag= 280.6 min

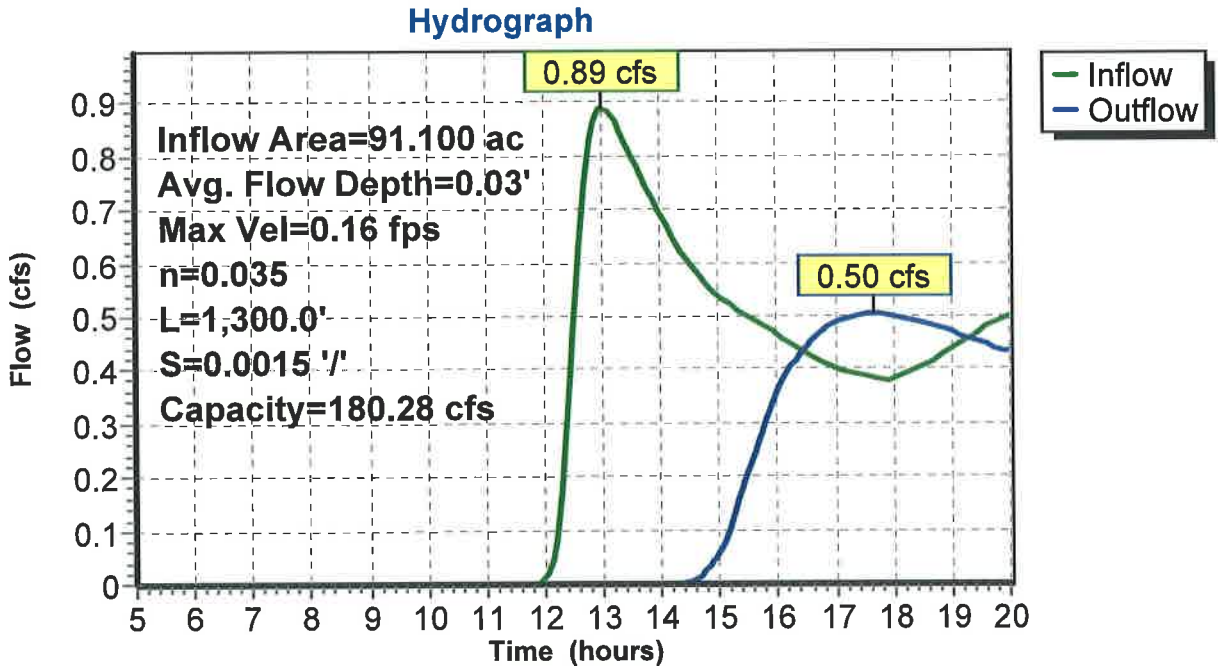
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.16 fps, Min. Travel Time= 132.9 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 151.3 min

Peak Storage= 4,012 cf @ 15.47 hrs
Average Depth at Peak Storage= 0.03'
Bank-Full Depth= 1.00' Flow Area= 120.0 sf, Capacity= 180.28 cfs

100.00' x 1.00' deep channel, n= 0.035
Side Slope Z-value= 20.0 '/' Top Width= 140.00'
Length= 1,300.0' Slope= 0.0015 '/'
Inlet Invert= 1,201.00', Outlet Invert= 1,199.00'

‡

Reach 7R: New swale



Summary for Reach 8R: New swale to river

Inflow Area = 50.200 ac, 0.00% Impervious, Inflow Depth > 0.10" for 2-yr event
Inflow = 1.11 cfs @ 13.27 hrs, Volume= 0.426 af
Outflow = 0.94 cfs @ 14.92 hrs, Volume= 0.358 af, Atten= 16%, Lag= 98.9 min

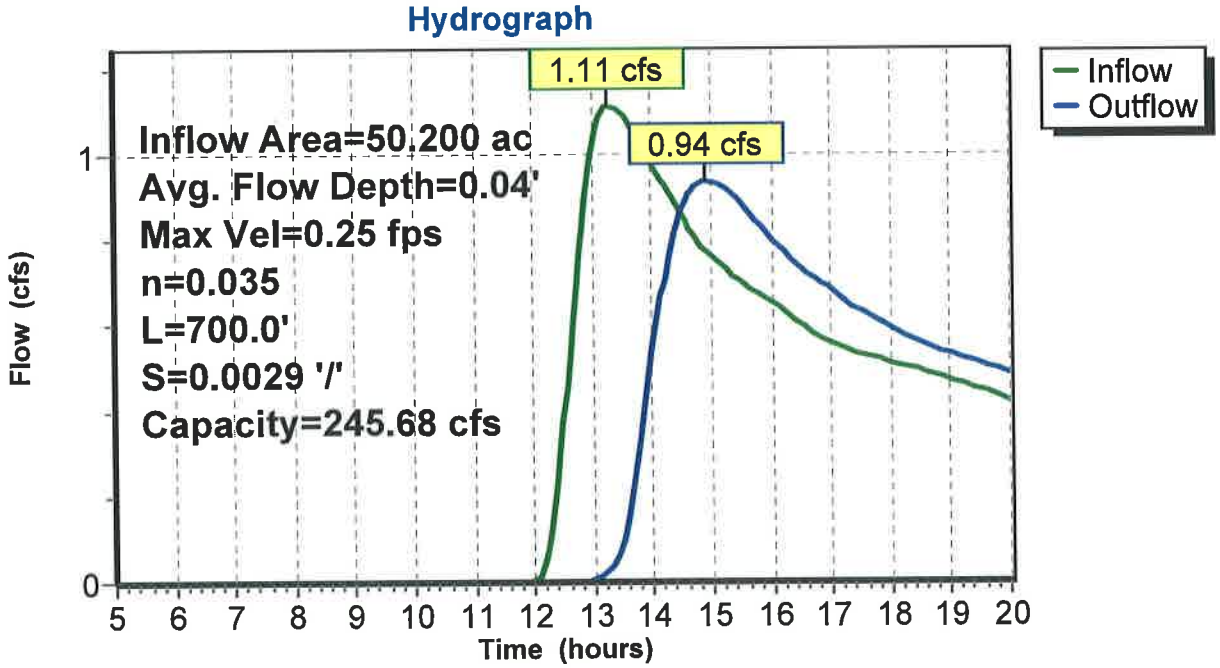
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.25 fps, Min. Travel Time= 46.2 min
Avg. Velocity = 0.21 fps, Avg. Travel Time= 56.8 min

Peak Storage= 2,606 cf @ 14.15 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 1.00' Flow Area= 120.0 sf, Capacity= 245.68 cfs

100.00' x 1.00' deep channel, n= 0.035
Side Slope Z-value= 20.0 '/' Top Width= 140.00'
Length= 700.0' Slope= 0.0029 '/'
Inlet Invert= 1,200.00', Outlet Invert= 1,198.00'

‡

Reach 8R: New swale to river



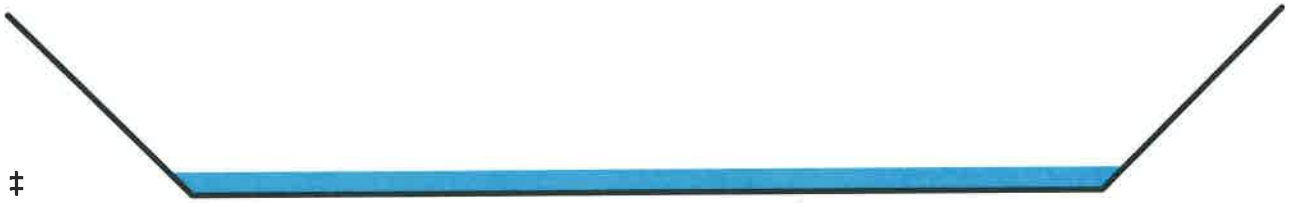
Summary for Reach 9R: New swale to river

Inflow Area = 144.100 ac, 0.00% Impervious, Inflow Depth > 0.16" for 2-yr event
Inflow = 6.73 cfs @ 13.33 hrs, Volume= 1.863 af
Outflow = 5.18 cfs @ 14.77 hrs, Volume= 1.572 af, Atten= 23%, Lag= 86.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.40 fps, Min. Travel Time= 50.3 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 71.0 min

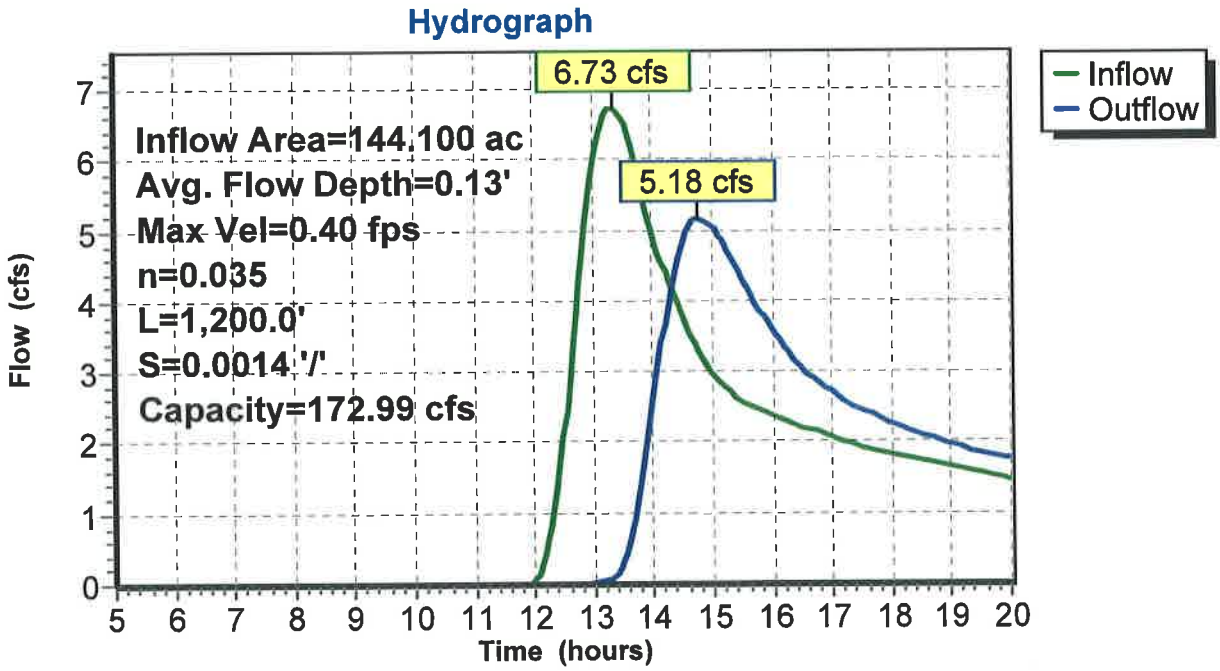
Peak Storage= 15,634 cf @ 13.94 hrs
Average Depth at Peak Storage= 0.13'
Bank-Full Depth= 1.00' Flow Area= 120.0 sf, Capacity= 172.99 cfs

100.00' x 1.00' deep channel, n= 0.035
Side Slope Z-value= 20.0 '/' Top Width= 140.00'
Length= 1,200.0' Slope= 0.0014 '/'
Inlet Invert= 1,198.70', Outlet Invert= 1,197.00'



‡

Reach 9R: New swale to river



Summary for Pond 1P: NE ditch

Inflow Area = 47.200 ac, 0.00% Impervious, Inflow Depth > 0.10" for 2-yr event
Inflow = 1.05 cfs @ 13.27 hrs, Volume= 0.400 af
Outflow = 1.05 cfs @ 13.30 hrs, Volume= 0.399 af, Atten= 0%, Lag= 1.6 min
Primary = 1.05 cfs @ 13.30 hrs, Volume= 0.399 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,196.29' @ 13.30 hrs Surf.Area= 271 sf Storage= 86 cf

Plug-Flow detention time= 1.5 min calculated for 0.398 af (99% of inflow)
Center-of-Mass det. time= 0.9 min (939.5 - 938.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.65'	215,897 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.65	0	0	0
1,198.00	1,000	1,175	1,175
1,199.00	6,407	3,704	4,878
1,200.00	12,815	9,611	14,489
1,201.00	390,000	201,408	215,897

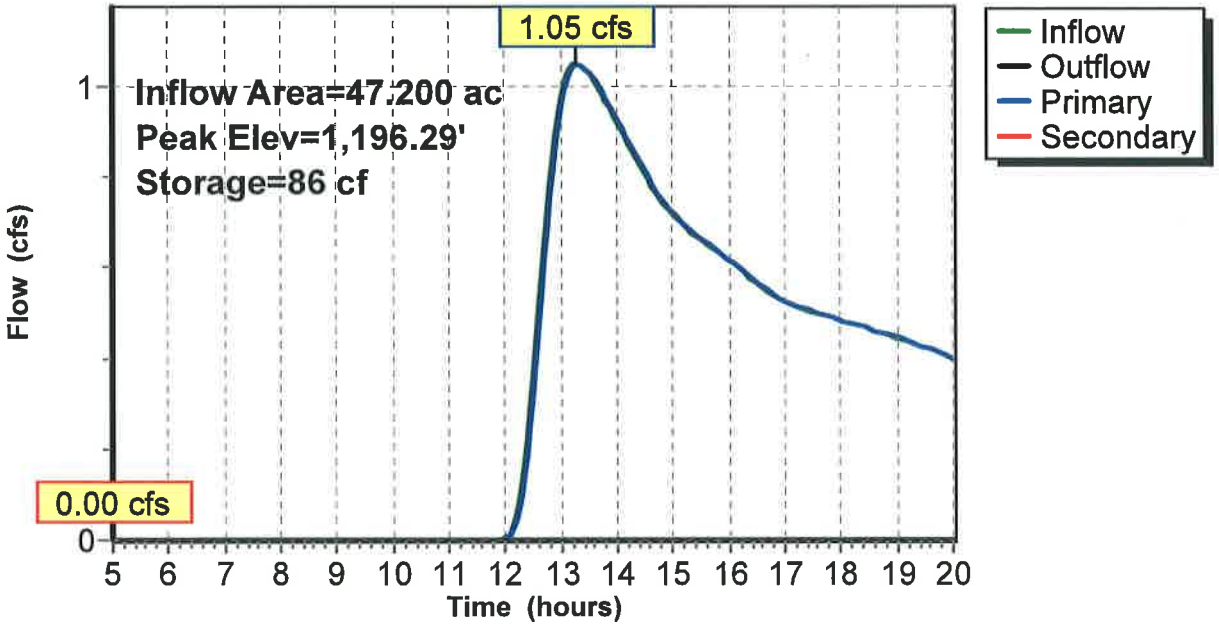
Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.65'	**30.0" Round Culvert** L= 24.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.65' / 1,195.65' S= 0.0000 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,200.20'	**150.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=1.05 cfs @ 13.30 hrs HW=1,196.29' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.05 cfs @ 1.60 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,195.65' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: NE ditch

Hydrograph



Summary for Pond 3P: S Central ditch

Inflow Area = 69.000 ac, 0.00% Impervious, Inflow Depth > 0.40" for 2-yr event
Inflow = 13.84 cfs @ 12.63 hrs, Volume= 2.280 af
Outflow = 11.44 cfs @ 12.90 hrs, Volume= 2.248 af, Atten= 17%, Lag= 16.1 min
Primary = 11.44 cfs @ 12.90 hrs, Volume= 2.248 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,197.40' @ 12.90 hrs Surf.Area= 11,280 sf Storage= 11,304 cf

Plug-Flow detention time= 16.4 min calculated for 2.248 af (99% of inflow)
Center-of-Mass det. time= 11.8 min (878.9 - 867.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.30'	74,844 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.30	0	0	0
1,196.50	5,940	3,564	3,564
1,197.50	11,880	8,910	12,474
1,198.50	17,820	14,850	27,324
1,200.50	29,700	47,520	74,844

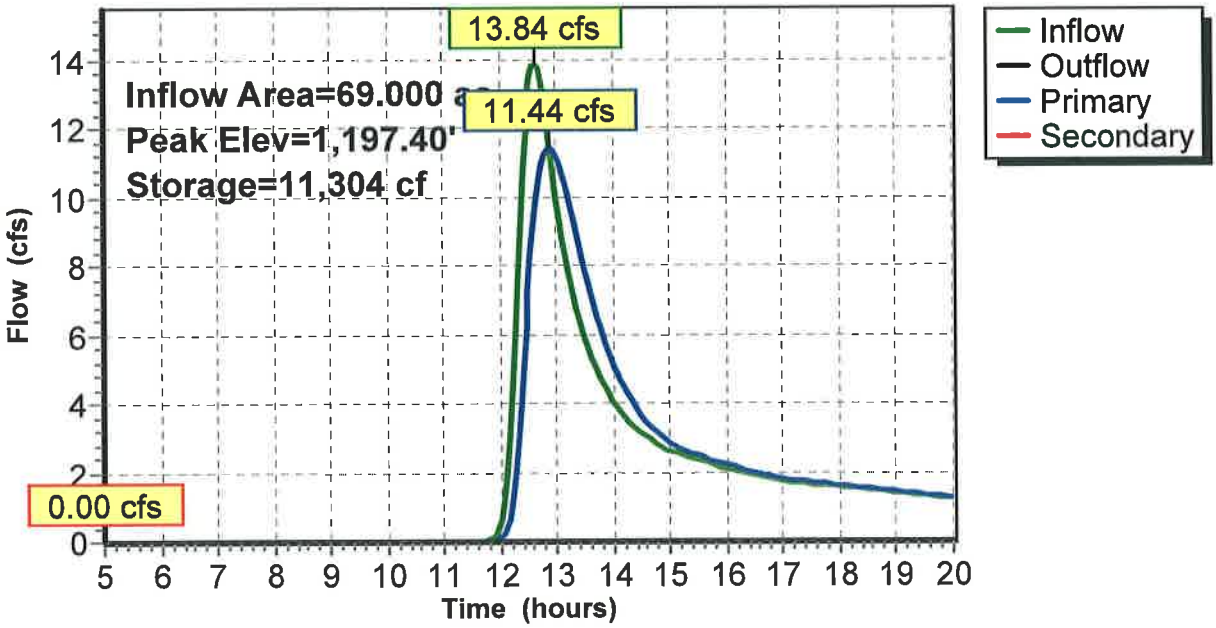
Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.48'	**30.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.37' / 1,195.48' S= -0.0055 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,197.80'	**180.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=11.43 cfs @ 12.90 hrs HW=1,197.40' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 11.43 cfs @ 3.66 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,195.30' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: S Central ditch

Hydrograph



Summary for Pond 4P: SW ditch

Inflow Area = 129.000 ac, 0.00% Impervious, Inflow Depth > 0.30" for 2-yr event
Inflow = 15.41 cfs @ 12.81 hrs, Volume= 3.273 af
Outflow = 15.32 cfs @ 12.87 hrs, Volume= 3.273 af, Atten= 1%, Lag= 3.6 min
Primary = 15.32 cfs @ 12.87 hrs, Volume= 3.273 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,194.80' @ 12.87 hrs Surf.Area= 4,396 sf Storage= 1,311 cf

Plug-Flow detention time= 0.5 min calculated for 3.262 af (100% of inflow)
Center-of-Mass det. time= 0.5 min (882.3 - 881.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,194.20'	92,125 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

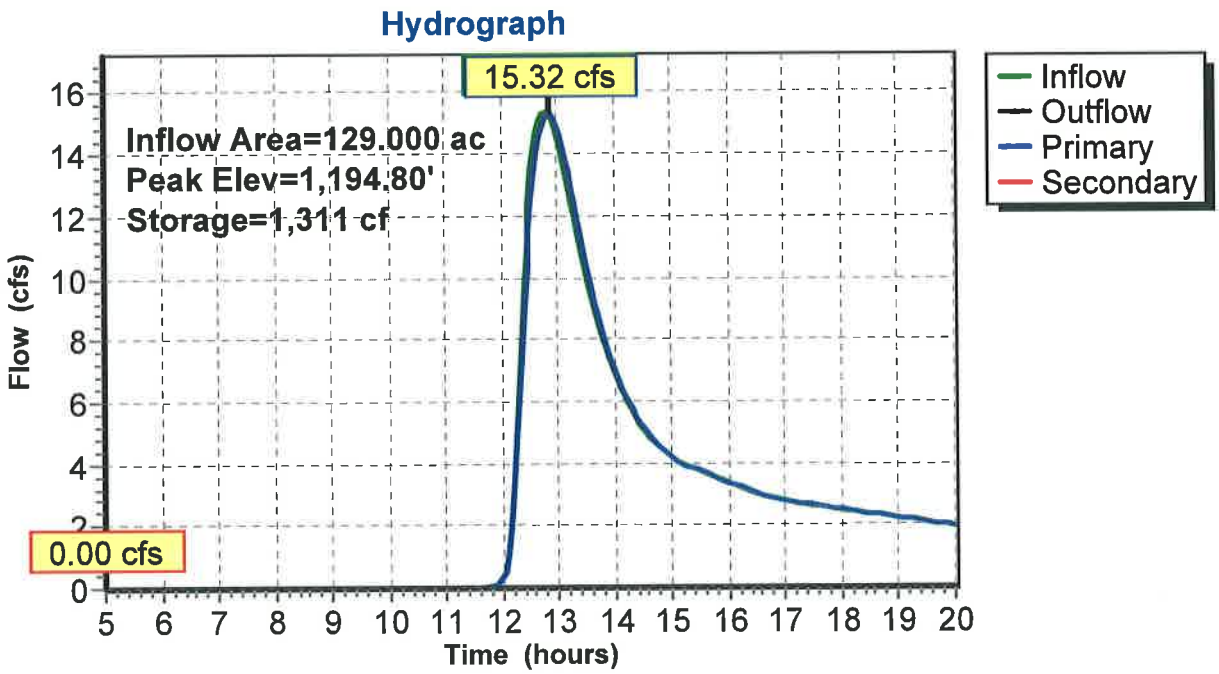
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,194.20	0	0	0
1,195.20	7,370	3,685	3,685
1,196.20	14,740	11,055	14,740
1,197.20	22,110	18,425	33,165
1,199.20	36,850	58,960	92,125

Device	Routing	Invert	Outlet Devices
#1	Primary	1,194.00'	**Special & User-Defined** Head (feet) 0.00 2.60 3.22 3.49 3.70 3.80 Disch. (cfs) 0.000 50.000 100.000 200.000 350.000 500.000
#2	Secondary	1,197.30'	**60.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=15.30 cfs @ 12.87 hrs HW=1,194.80' (Free Discharge)
↑—**1=Special & User-Defined** (Custom Controls 15.30 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,194.20' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: SW ditch



Summary for Pond 6P: Road Ditch

Inflow Area = 54.000 ac, 0.00% Impervious, Inflow Depth > 0.10" for 2-yr event
Inflow = 1.01 cfs @ 14.19 hrs, Volume= 0.429 af
Outflow = 0.19 cfs @ 20.00 hrs, Volume= 0.017 af, Atten= 81%, Lag= 348.4 min
Primary = 0.19 cfs @ 20.00 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,202.27' @ 20.00 hrs Surf.Area= 21,520 sf Storage= 17,926 cf

Plug-Flow detention time= 386.1 min calculated for 0.017 af (4% of inflow)
Center-of-Mass det. time= 196.2 min (1,160.4 - 964.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	263,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

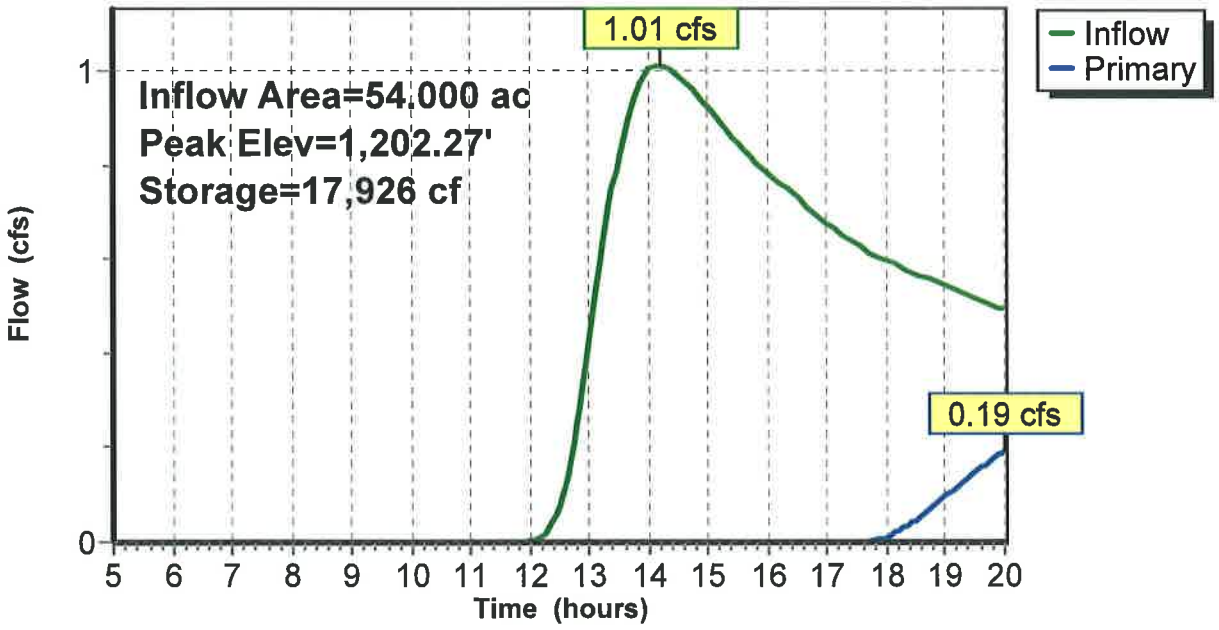
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	1,000	0	0
1,202.00	12,300	13,300	13,300
1,203.00	46,000	29,150	42,450
1,203.80	62,000	43,200	85,650
1,206.00	100,000	178,200	263,850

Device	Routing	Invert	Outlet Devices
#1	Primary	1,202.06'	**18.0" Round Culvert** L= 35.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,200.67' / 1,202.06' S= -0.0397 '/' Cc= 0.900 n= 0.024, Flow Area= 1.77 sf
#2	Primary	1,203.80'	**100.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.19 cfs @ 20.00 hrs HW=1,202.27' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.19 cfs @ 1.24 fps)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: Road Ditch

Hydrograph



Summary for Subcatchment 1S: NE

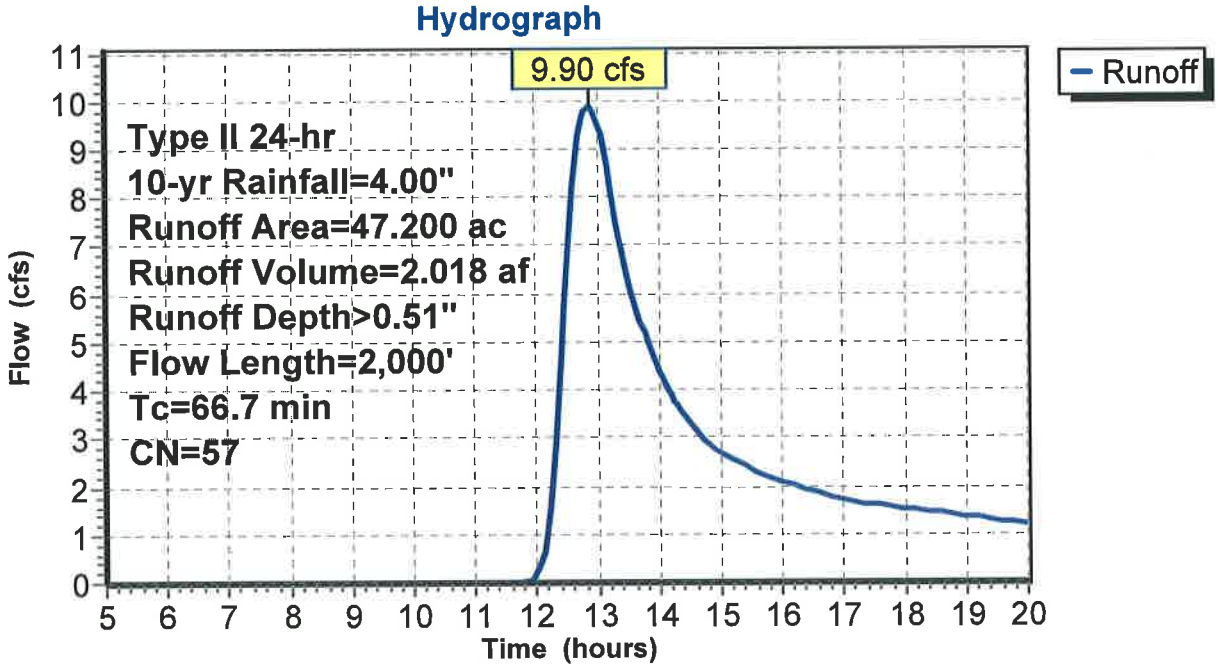
Runoff = 9.90 cfs @ 12.86 hrs, Volume= 2.018 af, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
28.300	49	Pasture/grassland/range, Fair, HSG A
18.900	69	Pasture/grassland/range, Fair, HSG B
47.200	57	Weighted Average
47.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 1S: NE



Summary for Subcatchment 2S: SE

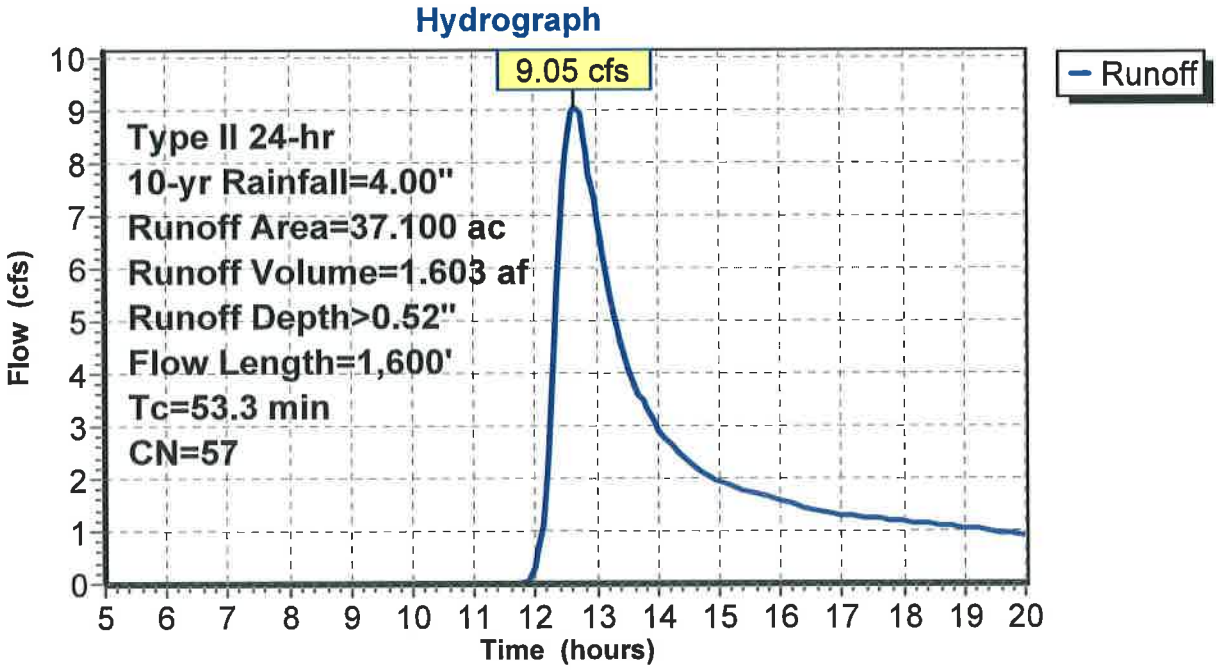
Runoff = 9.05 cfs @ 12.66 hrs, Volume= 1.603 af, Depth> 0.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
22.300	49	Pasture/grassland/range, Fair, HSG A
14.800	69	Pasture/grassland/range, Fair, HSG B
37.100	57	Weighted Average
37.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
53.3	1,600		0.50		**Direct Entry,**

Subcatchment 2S: SE



Summary for Subcatchment 3S: S Central

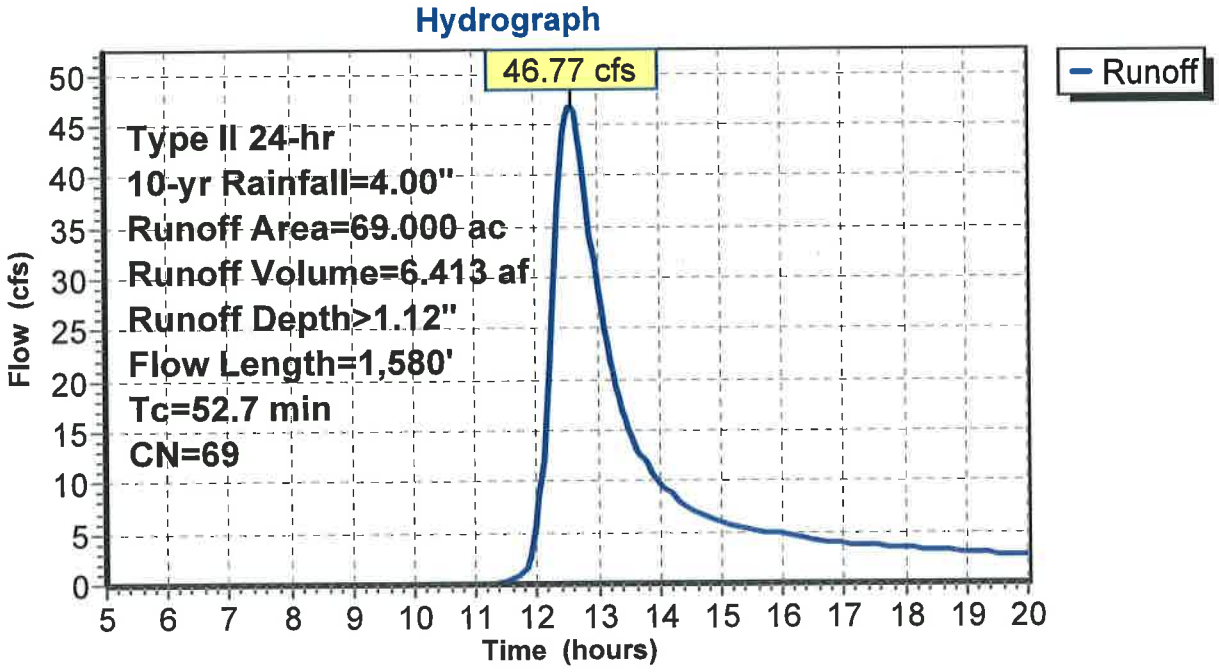
Runoff = 46.77 cfs @ 12.58 hrs, Volume= 6.413 af, Depth> 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
69.000	69	Pasture/grassland/range, Fair, HSG B
69.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.7	1,580		0.50		**Direct Entry,**

Subcatchment 3S: S Central



Summary for Subcatchment 4S: SW

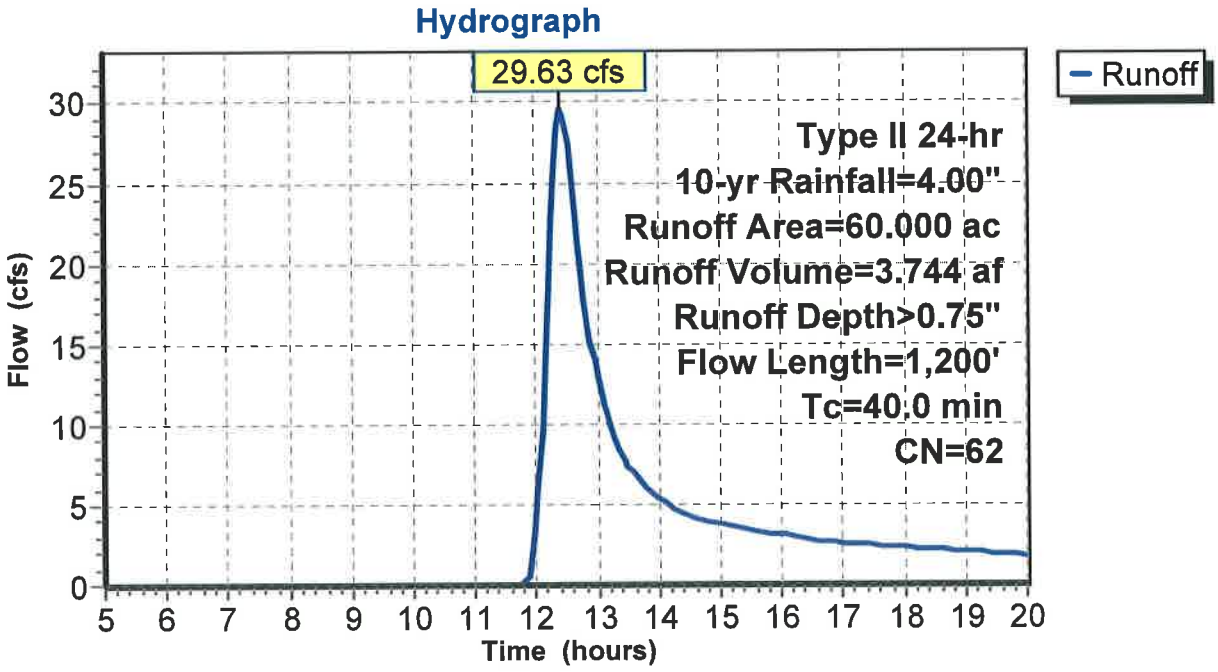
Runoff = 29.63 cfs @ 12.43 hrs, Volume= 3.744 af, Depth> 0.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
20.000	49	Pasture/grassland/range, Fair, HSG A
40.000	69	Pasture/grassland/range, Fair, HSG B
60.000	62	Weighted Average
60.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.0	1,200		0.50		**Direct Entry,**

Subcatchment 4S: SW



Summary for Subcatchment 5S: S Central

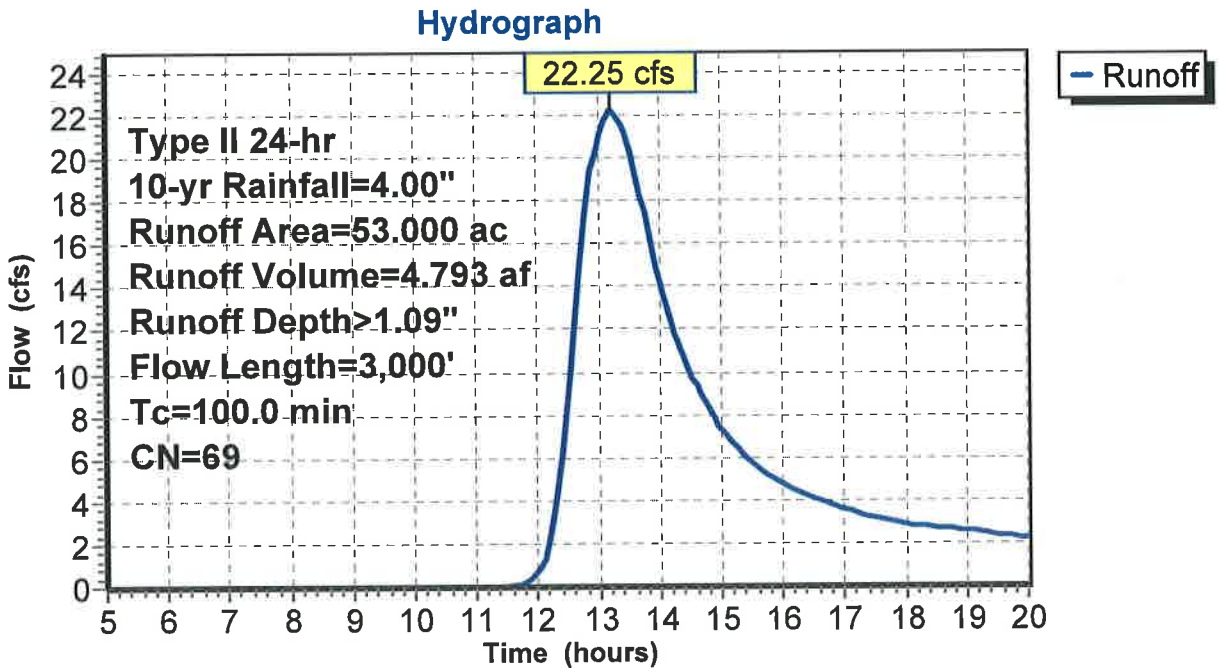
Runoff = 22.25 cfs @ 13.22 hrs, Volume= 4.793 af, Depth> 1.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
53.000	69	Pasture/grassland/range, Fair, HSG B
53.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.0	3,000		0.50		**Direct Entry,**

Subcatchment 5S: S Central



Summary for Subcatchment 6S: SE

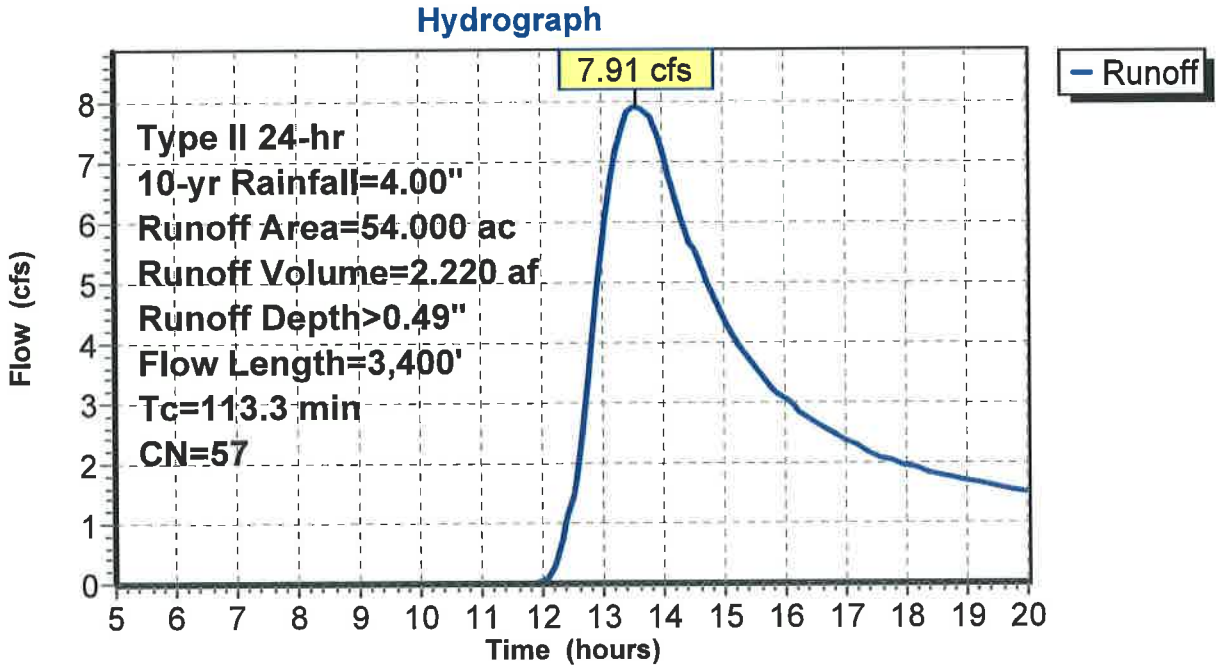
Runoff = 7.91 cfs @ 13.59 hrs, Volume= 2.220 af, Depth> 0.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
32.400	49	Pasture/grassland/range, Fair, HSG A
21.600	69	Pasture/grassland/range, Fair, HSG B
54.000	57	Weighted Average
54.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
113.3	3,400		0.50		**Direct Entry,**

Subcatchment 6S: SE



Summary for Subcatchment 7S: NE

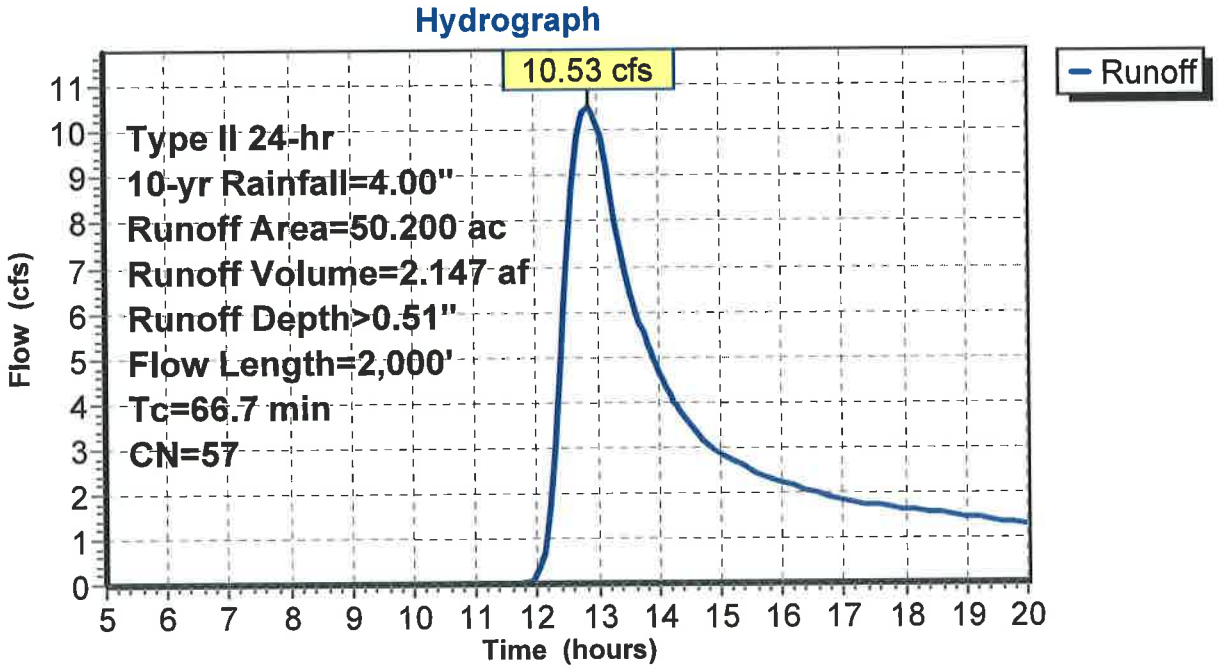
Runoff = 10.53 cfs @ 12.86 hrs, Volume= 2.147 af, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.00"

Area (ac)	CN	Description
30.100	49	Pasture/grassland/range, Fair, HSG A
20.100	69	Pasture/grassland/range, Fair, HSG B
50.200	57	Weighted Average
50.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 7S: NE



Summary for Reach 7R: New swale

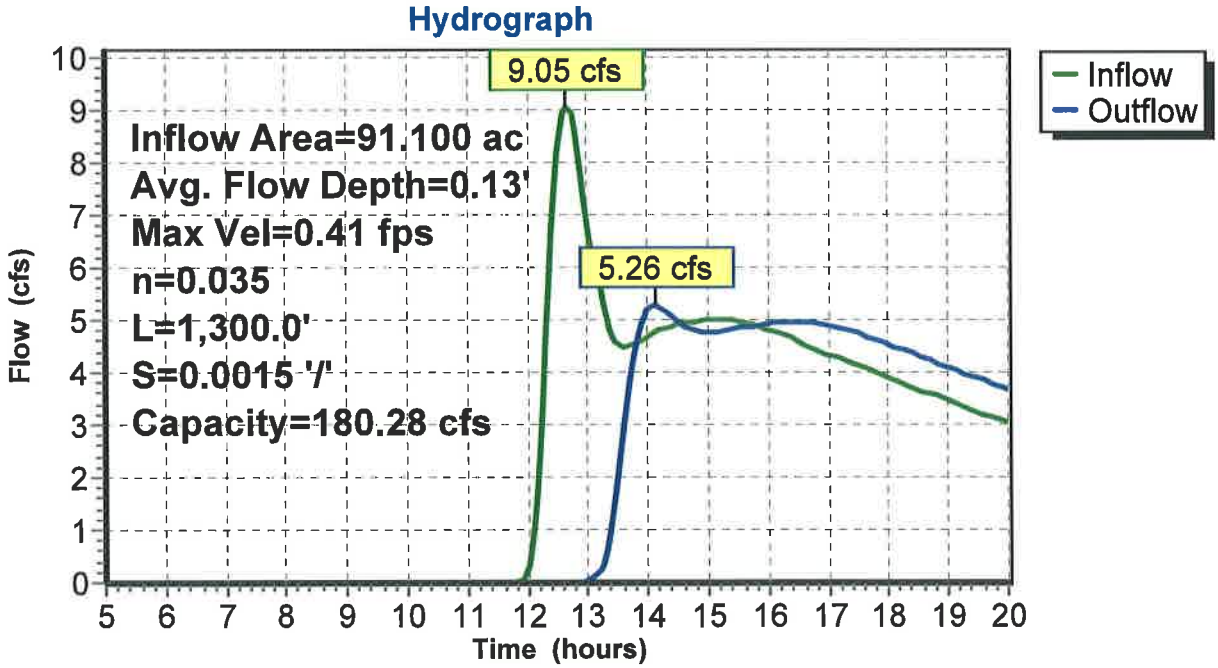
Inflow Area = 91.100 ac, 0.00% Impervious, Inflow Depth > 0.40" for 10-yr event
Inflow = 9.05 cfs @ 12.66 hrs, Volume= 3.025 af
Outflow = 5.26 cfs @ 14.14 hrs, Volume= 2.486 af, Atten= 42%, Lag= 88.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.41 fps, Min. Travel Time= 52.8 min
Avg. Velocity = 0.36 fps, Avg. Travel Time= 60.5 min

Peak Storage= 16,682 cf @ 13.25 hrs
Average Depth at Peak Storage= 0.13'
Bank-Full Depth= 1.00' Flow Area= 120.0 sf, Capacity= 180.28 cfs

100.00' x 1.00' deep channel, n= 0.035
Side Slope Z-value= 20.0 '/' Top Width= 140.00'
Length= 1,300.0' Slope= 0.0015 '/'
Inlet Invert= 1,201.00', Outlet Invert= 1,199.00'

Reach 7R: New swale



Summary for Reach 8R: New swale to river

Inflow Area = 50.200 ac, 0.00% Impervious, Inflow Depth > 0.51" for 10-yr event
Inflow = 10.53 cfs @ 12.86 hrs, Volume= 2.147 af
Outflow = 9.51 cfs @ 13.42 hrs, Volume= 2.037 af, Atten= 10%, Lag= 33.5 min

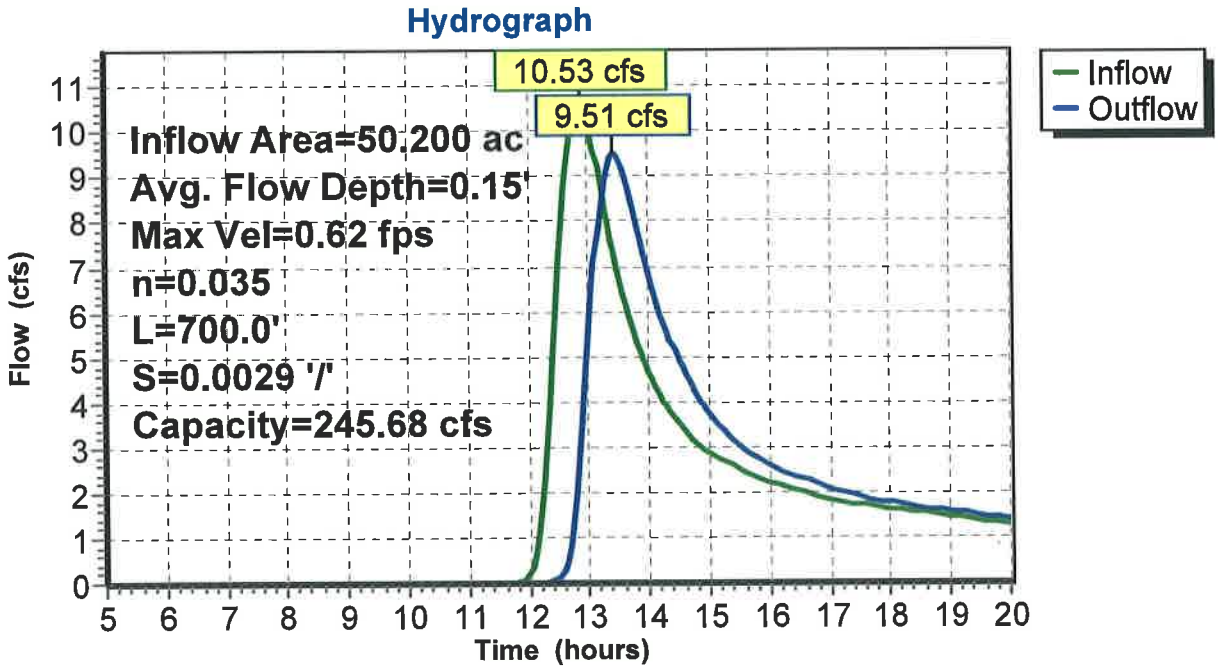
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.62 fps, Min. Travel Time= 18.7 min
Avg. Velocity = 0.37 fps, Avg. Travel Time= 31.2 min

Peak Storage= 10,678 cf @ 13.11 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 1.00' Flow Area= 120.0 sf, Capacity= 245.68 cfs

100.00' x 1.00' deep channel, n= 0.035
Side Slope Z-value= 20.0 '/' Top Width= 140.00'
Length= 700.0' Slope= 0.0029 '/'
Inlet Invert= 1,200.00', Outlet Invert= 1,198.00'

‡

Reach 8R: New swale to river



Summary for Reach 9R: New swale to river

Inflow Area = 144.100 ac, 0.00% Impervious, Inflow Depth > 0.61" for 10-yr event
Inflow = 22.83 cfs @ 13.45 hrs, Volume= 7.279 af
Outflow = 21.30 cfs @ 14.28 hrs, Volume= 6.618 af, Atten= 7%, Lag= 49.5 min

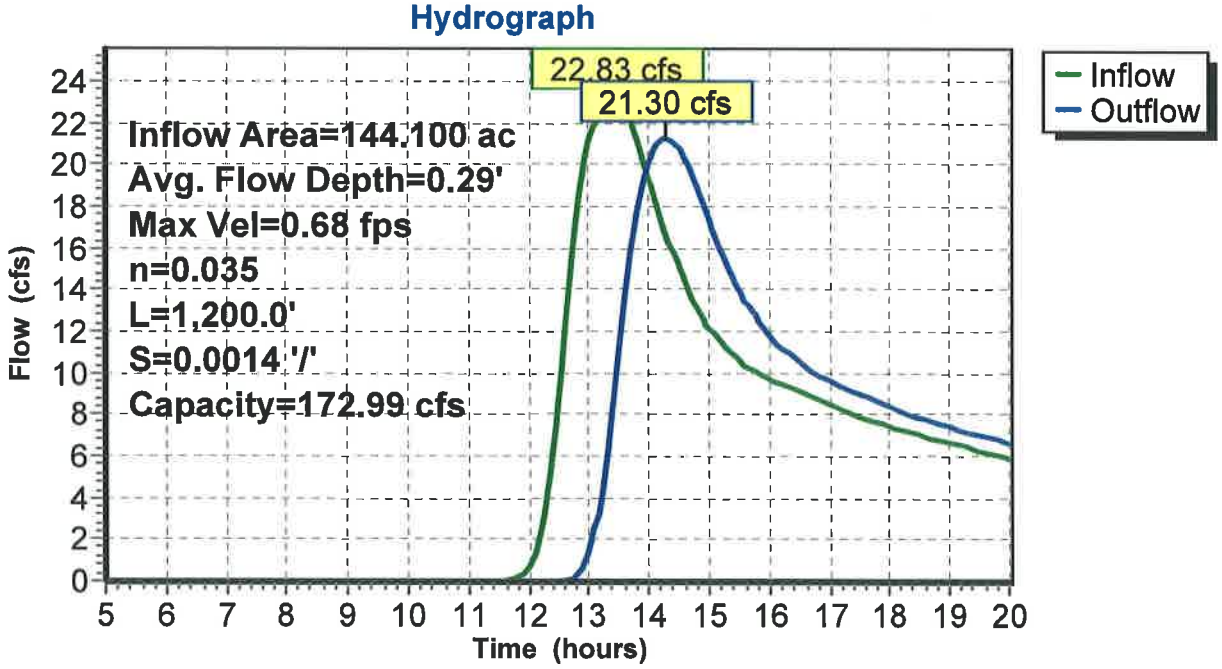
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.68 fps, Min. Travel Time= 29.3 min
Avg. Velocity = 0.46 fps, Avg. Travel Time= 43.9 min

Peak Storage= 37,449 cf @ 13.79 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 120.0 sf, Capacity= 172.99 cfs

100.00' x 1.00' deep channel, n= 0.035
Side Slope Z-value= 20.0 '/' Top Width= 140.00'
Length= 1,200.0' Slope= 0.0014 '/'
Inlet Invert= 1,198.70', Outlet Invert= 1,197.00'

‡

Reach 9R: New swale to river



Summary for Pond 1P: NE ditch

Inflow Area = 47.200 ac, 0.00% Impervious, Inflow Depth > 0.51" for 10-yr event
Inflow = 9.90 cfs @ 12.86 hrs, Volume= 2.018 af
Outflow = 9.88 cfs @ 12.89 hrs, Volume= 2.016 af, Atten= 0%, Lag= 1.6 min
Primary = 9.88 cfs @ 12.89 hrs, Volume= 2.016 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,197.54' @ 12.89 hrs Surf.Area= 806 sf Storage= 762 cf

Plug-Flow detention time= 1.3 min calculated for 2.010 af (100% of inflow)
Center-of-Mass det. time= 0.9 min (884.1 - 883.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.65'	215,897 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

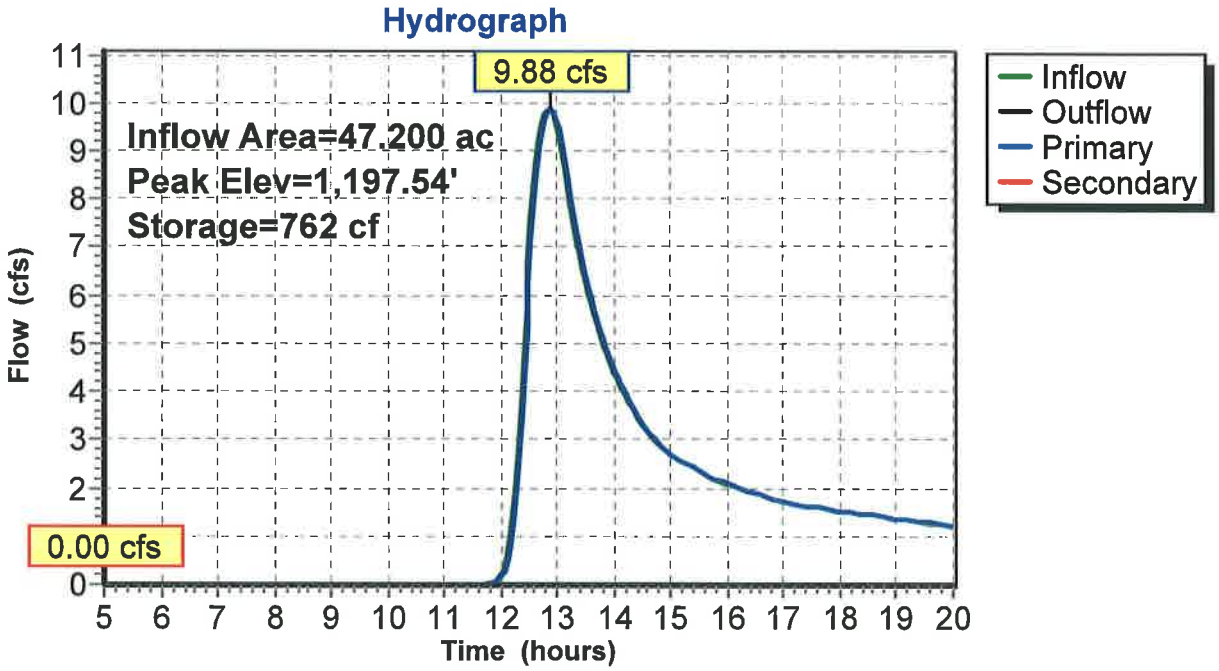
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.65	0	0	0
1,198.00	1,000	1,175	1,175
1,199.00	6,407	3,704	4,878
1,200.00	12,815	9,611	14,489
1,201.00	390,000	201,408	215,897

Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.65'	**30.0" Round Culvert** L= 24.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.65' / 1,195.65' S= 0.0000 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,200.20'	**150.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=9.87 cfs @ 12.89 hrs HW=1,197.54' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 9.87 cfs @ 3.43 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,195.65' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: NE ditch



Summary for Pond 3P: S Central ditch

Inflow Area = 69.000 ac, 0.00% Impervious, Inflow Depth > 1.12" for 10-yr event
Inflow = 46.77 cfs @ 12.58 hrs, Volume= 6.413 af
Outflow = 46.73 cfs @ 12.59 hrs, Volume= 6.352 af, Atten= 0%, Lag= 0.7 min
Primary = 17.06 cfs @ 12.59 hrs, Volume= 4.829 af
Secondary = 29.67 cfs @ 12.59 hrs, Volume= 1.523 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,197.96' @ 12.59 hrs Surf.Area= 14,586 sf Storage= 18,502 cf

Plug-Flow detention time= 12.6 min calculated for 6.331 af (99% of inflow)
Center-of-Mass det. time= 9.3 min (853.5 - 844.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.30'	74,844 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.30	0	0	0
1,196.50	5,940	3,564	3,564
1,197.50	11,880	8,910	12,474
1,198.50	17,820	14,850	27,324
1,200.50	29,700	47,520	74,844

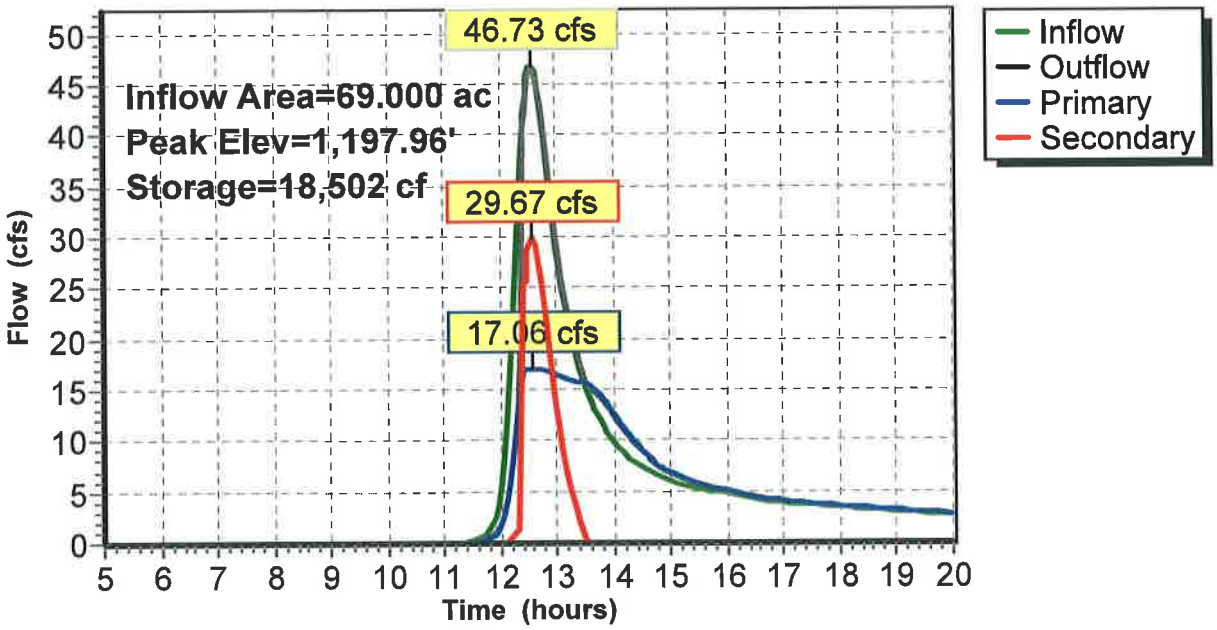
Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.48'	**30.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.37' / 1,195.48' S= -0.0055 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,197.80'	**180.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=17.06 cfs @ 12.59 hrs HW=1,197.96' (Free Discharge)
↑**1=Culvert** (Barrel Controls 17.06 cfs @ 4.18 fps)

Secondary OutFlow Max=29.52 cfs @ 12.59 hrs HW=1,197.96' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 29.52 cfs @ 1.06 fps)

Pond 3P: S Central ditch

Hydrograph



Summary for Pond 4P: SW ditch

Inflow Area = 129.000 ac, 0.00% Impervious, Inflow Depth > 0.94" for 10-yr event
Inflow = 74.44 cfs @ 12.52 hrs, Volume= 10.096 af
Outflow = 70.21 cfs @ 12.64 hrs, Volume= 10.096 af, Atten= 6%, Lag= 7.6 min
Primary = 70.21 cfs @ 12.64 hrs, Volume= 10.096 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,196.85' @ 12.64 hrs Surf.Area= 19,535 sf Storage= 25,889 cf

Plug-Flow detention time= 3.4 min calculated for 10.062 af (100% of inflow)
Center-of-Mass det. time= 3.4 min (855.8 - 852.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1,194.20'	92,125 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,194.20	0	0	0
1,195.20	7,370	3,685	3,685
1,196.20	14,740	11,055	14,740
1,197.20	22,110	18,425	33,165
1,199.20	36,850	58,960	92,125

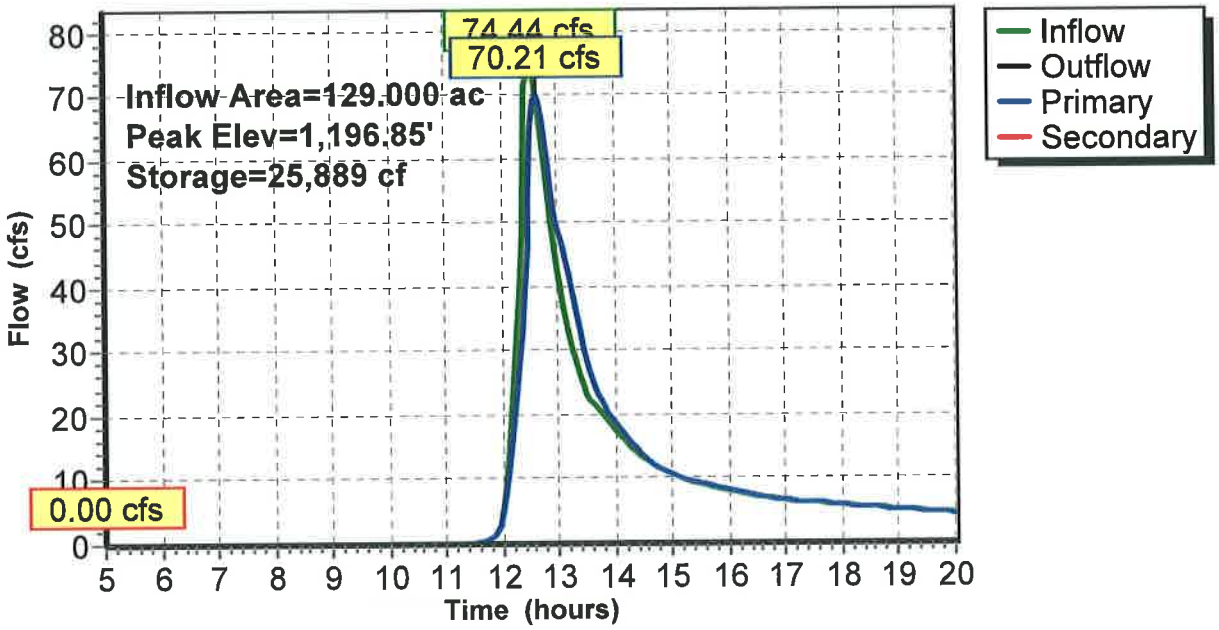
Device	Routing	Invert	Outlet Devices
#1	Primary	1,194.00'	**Special & User-Defined** Head (feet) 0.00 2.60 3.22 3.49 3.70 3.80 Disch. (cfs) 0.000 50.000 100.000 200.000 350.000 500.000
#2	Secondary	1,197.30'	**60.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=70.07 cfs @ 12.64 hrs HW=1,196.85' (Free Discharge)
↑—**1=Special & User-Defined** (Custom Controls 70.07 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,194.20' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: SW ditch

Hydrograph



Summary for Pond 6P: Road Ditch

Inflow Area = 54.000 ac, 0.00% Impervious, Inflow Depth > 0.49" for 10-yr event
Inflow = 7.91 cfs @ 13.59 hrs, Volume= 2.220 af
Outflow = 3.25 cfs @ 15.79 hrs, Volume= 1.422 af, Atten= 59%, Lag= 132.1 min
Primary = 3.25 cfs @ 15.79 hrs, Volume= 1.422 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,203.04' @ 15.79 hrs Surf.Area= 46,794 sf Storage= 44,292 cf

Plug-Flow detention time= 169.6 min calculated for 1.418 af (64% of inflow)
Center-of-Mass det. time= 94.0 min (1,008.1 - 914.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	263,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

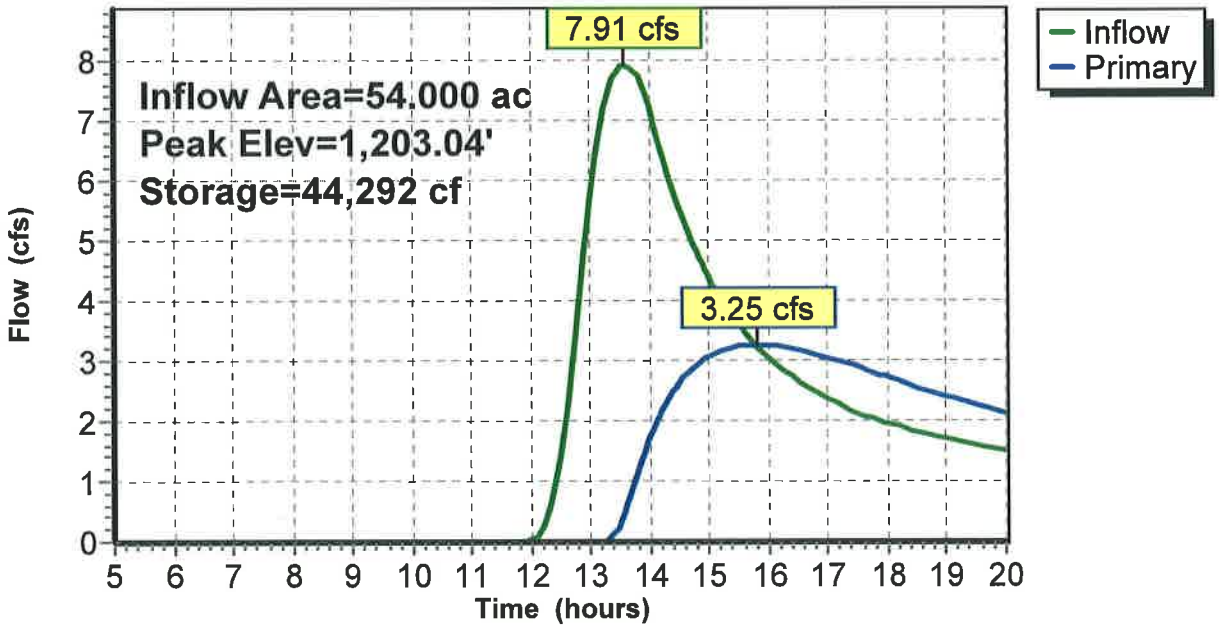
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	1,000	0	0
1,202.00	12,300	13,300	13,300
1,203.00	46,000	29,150	42,450
1,203.80	62,000	43,200	85,650
1,206.00	100,000	178,200	263,850

Device	Routing	Invert	Outlet Devices
#1	Primary	1,202.06'	**18.0" Round Culvert** L= 35.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,200.67' / 1,202.06' S= -0.0397 '/' Cc= 0.900 n= 0.024, Flow Area= 1.77 sf
#2	Primary	1,203.80'	**100.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=3.25 cfs @ 15.79 hrs HW=1,203.04' (Free Discharge)
1=Culvert (Inlet Controls 3.25 cfs @ 2.66 fps)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 6P: Road Ditch

Hydrograph



Summary for Subcatchment 1S: NE

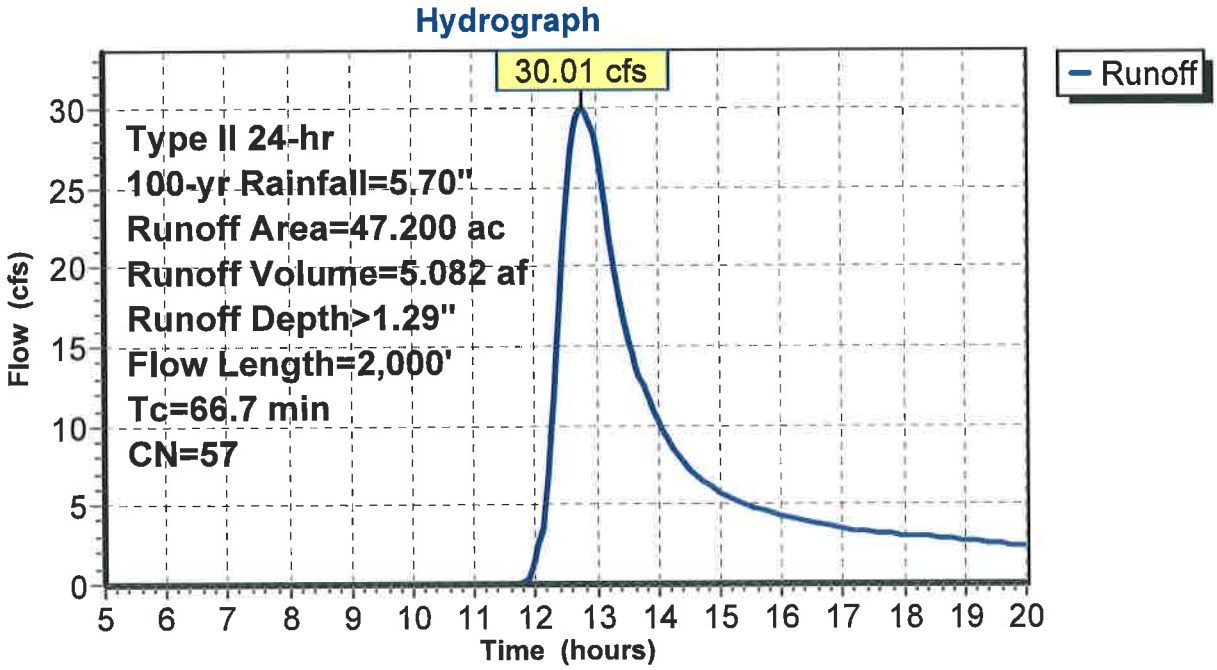
Runoff = 30.01 cfs @ 12.80 hrs, Volume= 5.082 af, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
28.300	49	Pasture/grassland/range, Fair, HSG A
18.900	69	Pasture/grassland/range, Fair, HSG B
47.200	57	Weighted Average
47.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 1S: NE



Summary for Subcatchment 2S: SE

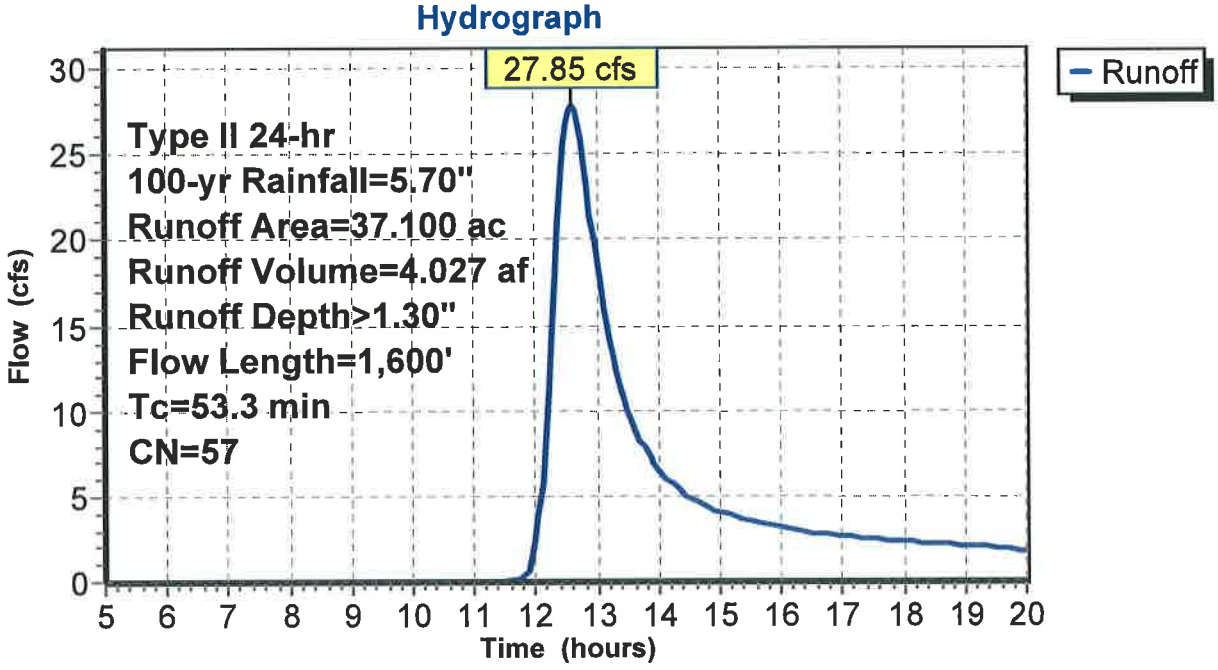
Runoff = 27.85 cfs @ 12.60 hrs, Volume= 4.027 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
22.300	49	Pasture/grassland/range, Fair, HSG A
14.800	69	Pasture/grassland/range, Fair, HSG B
37.100	57	Weighted Average
37.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
53.3	1,600		0.50		**Direct Entry,**

Subcatchment 2S: SE



Summary for Subcatchment 3S: S Central

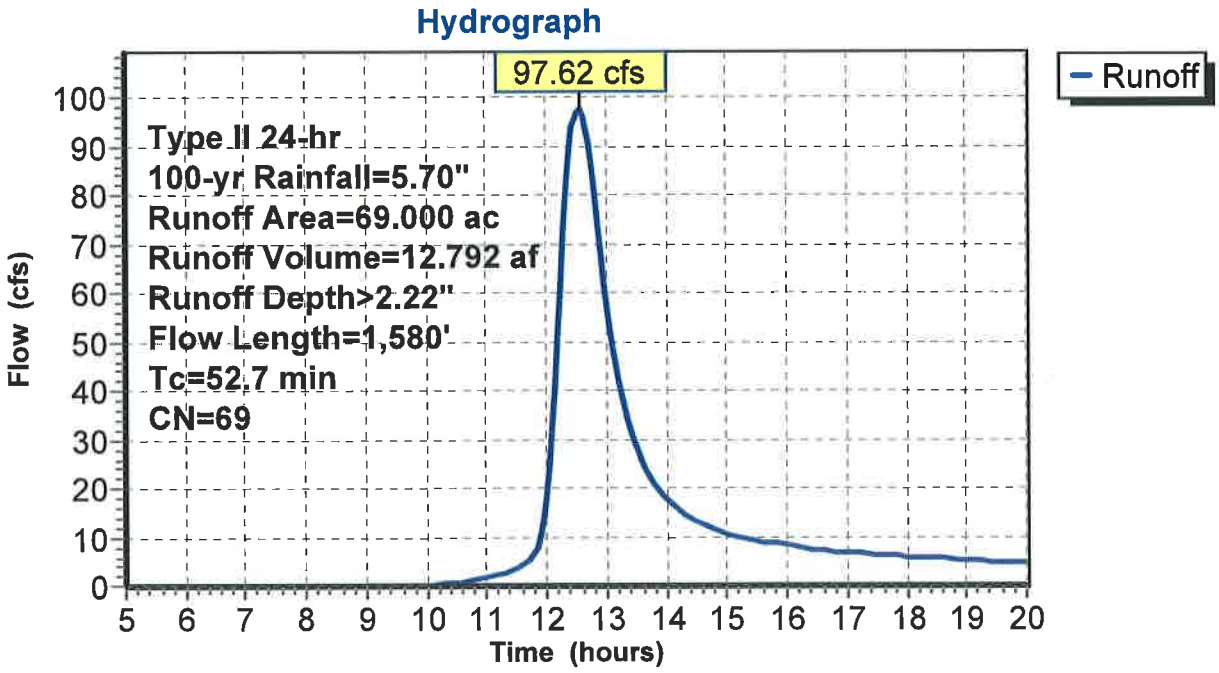
Runoff = 97.62 cfs @ 12.55 hrs, Volume= 12.792 af, Depth> 2.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
69.000	69	Pasture/grassland/range, Fair, HSG B
69.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
52.7	1,580		0.50		**Direct Entry,**

Subcatchment 3S: S Central



Summary for Subcatchment 4S: SW

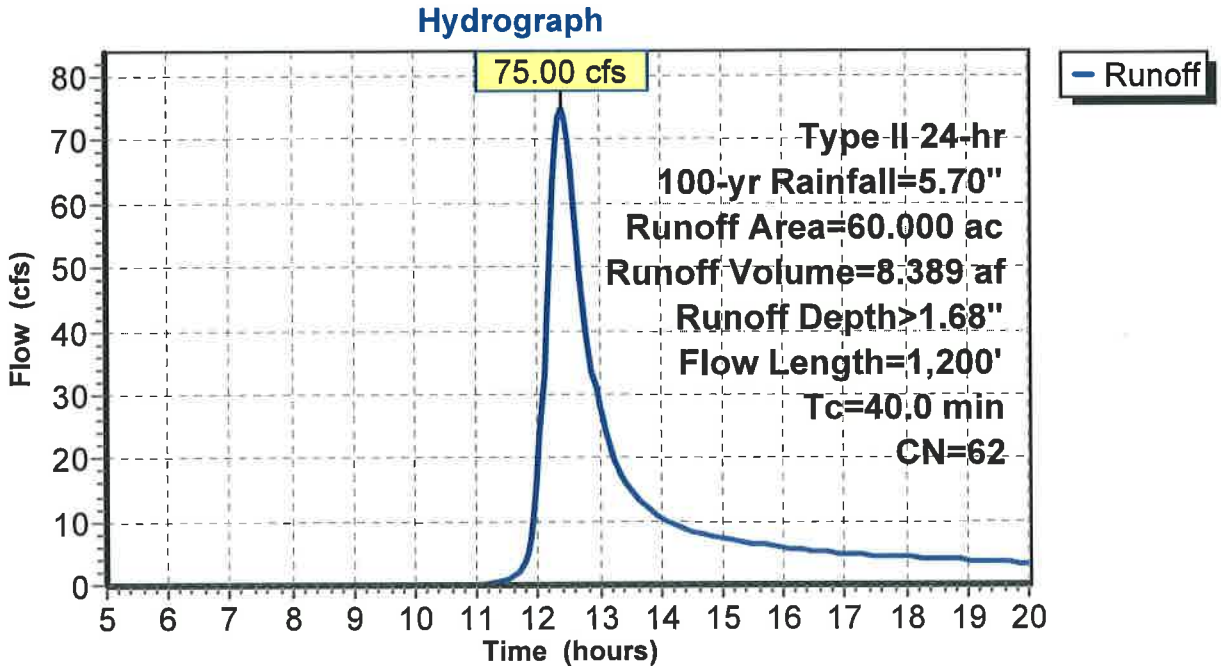
Runoff = 75.00 cfs @ 12.40 hrs, Volume= 8.389 af, Depth> 1.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
20.000	49	Pasture/grassland/range, Fair, HSG A
40.000	69	Pasture/grassland/range, Fair, HSG B
60.000	62	Weighted Average
60.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.0	1,200		0.50		**Direct Entry,**

Subcatchment 4S: SW



Summary for Subcatchment 5S: S Central

Runoff = 46.57 cfs @ 13.20 hrs, Volume= 9.599 af, Depth> 2.17"

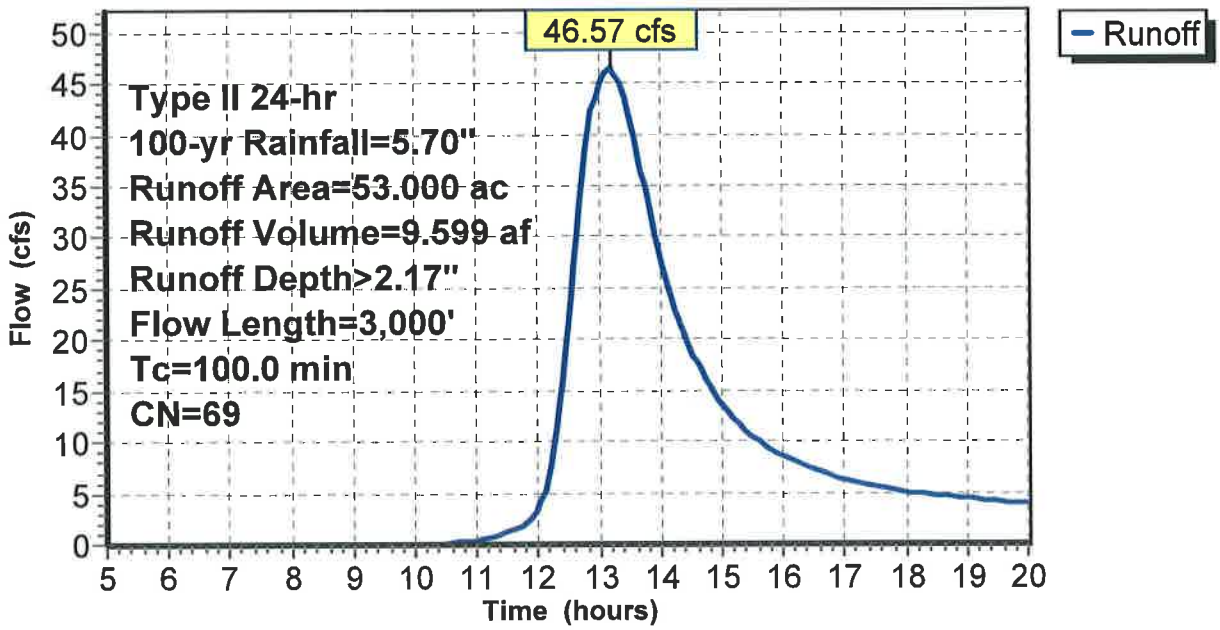
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
53.000	69	Pasture/grassland/range, Fair, HSG B
53.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.0	3,000		0.50		**Direct Entry,**

Subcatchment 5S: S Central

Hydrograph



Summary for Subcatchment 6S: SE

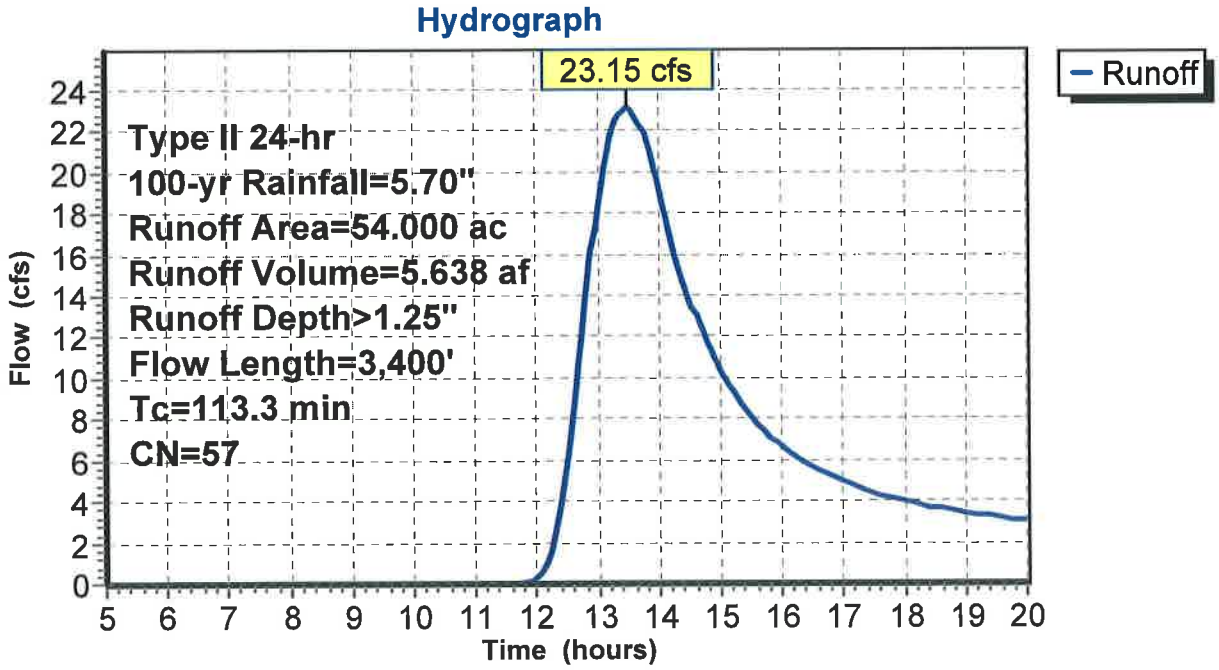
Runoff = 23.15 cfs @ 13.47 hrs, Volume= 5.638 af, Depth> 1.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
32.400	49	Pasture/grassland/range, Fair, HSG A
21.600	69	Pasture/grassland/range, Fair, HSG B
54.000	57	Weighted Average
54.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
113.3	3,400		0.50		**Direct Entry,**

Subcatchment 6S: SE



Summary for Subcatchment 7S: NE

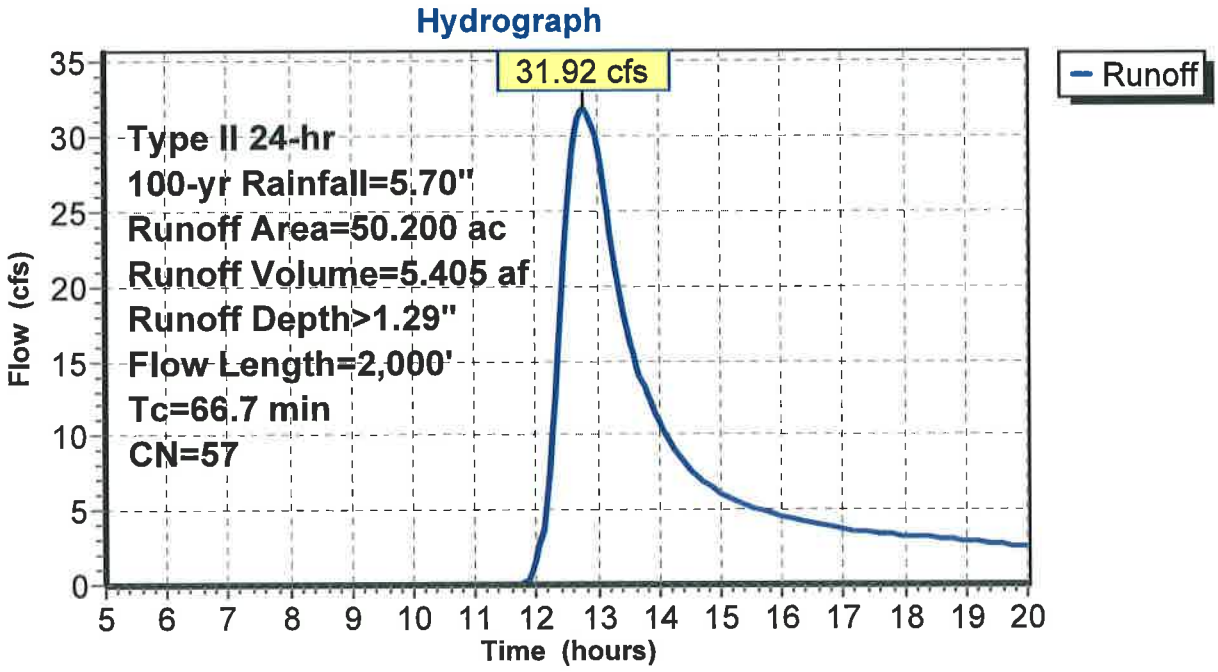
Runoff = 31.92 cfs @ 12.80 hrs, Volume= 5.405 af, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.70"

Area (ac)	CN	Description
30.100	49	Pasture/grassland/range, Fair, HSG A
20.100	69	Pasture/grassland/range, Fair, HSG B
50.200	57	Weighted Average
50.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.7	2,000		0.50		**Direct Entry,**

Subcatchment 7S: NE



Summary for Reach 7R: New swale

Inflow Area = 91.100 ac, 0.00% Impervious, Inflow Depth > 1.09" for 100-yr event
Inflow = 27.85 cfs @ 12.60 hrs, Volume= 8.285 af
Outflow = 19.91 cfs @ 13.51 hrs, Volume= 7.498 af, Atten= 28%, Lag= 54.5 min

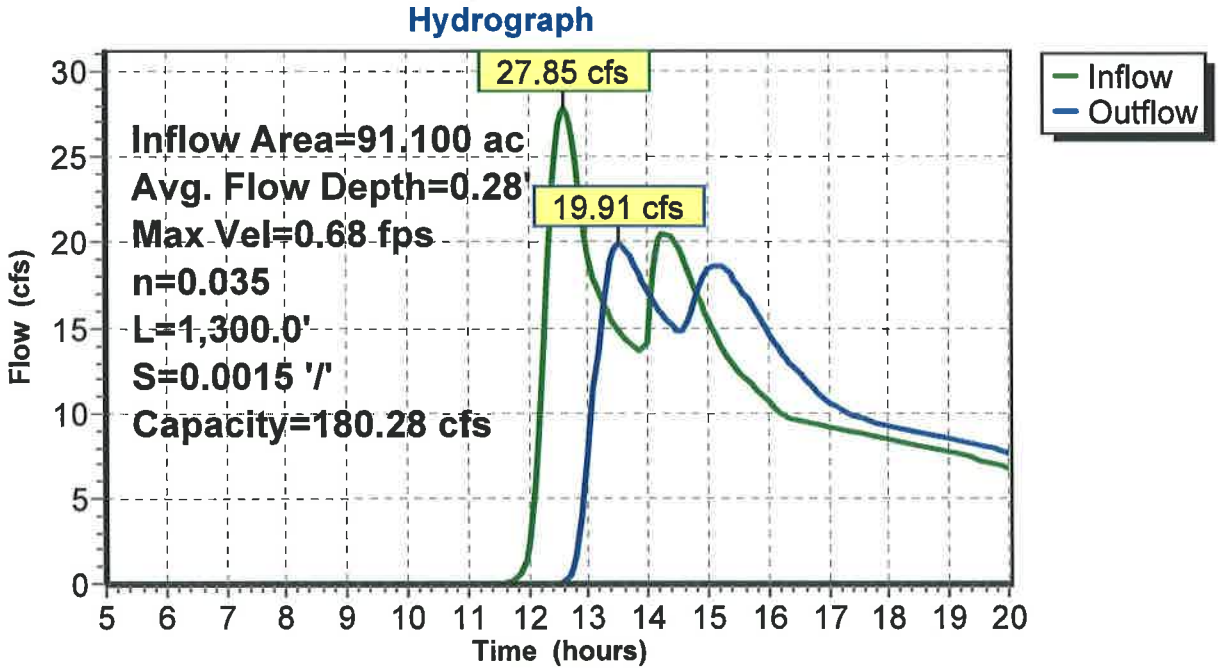
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.68 fps, Min. Travel Time= 31.7 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 41.8 min

Peak Storage= 37,926 cf @ 12.98 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 120.0 sf, Capacity= 180.28 cfs

100.00' x 1.00' deep channel, n= 0.035
Side Slope Z-value= 20.0 '/' Top Width= 140.00'
Length= 1,300.0' Slope= 0.0015 '/'
Inlet Invert= 1,201.00', Outlet Invert= 1,199.00'

‡

Reach 7R: New swale



Summary for Reach 8R: New swale to river

Inflow Area = 50.200 ac, 0.00% Impervious, Inflow Depth > 1.29" for 100-yr event
Inflow = 31.92 cfs @ 12.80 hrs, Volume= 5.405 af
Outflow = 30.45 cfs @ 13.14 hrs, Volume= 5.250 af, Atten= 5%, Lag= 20.6 min

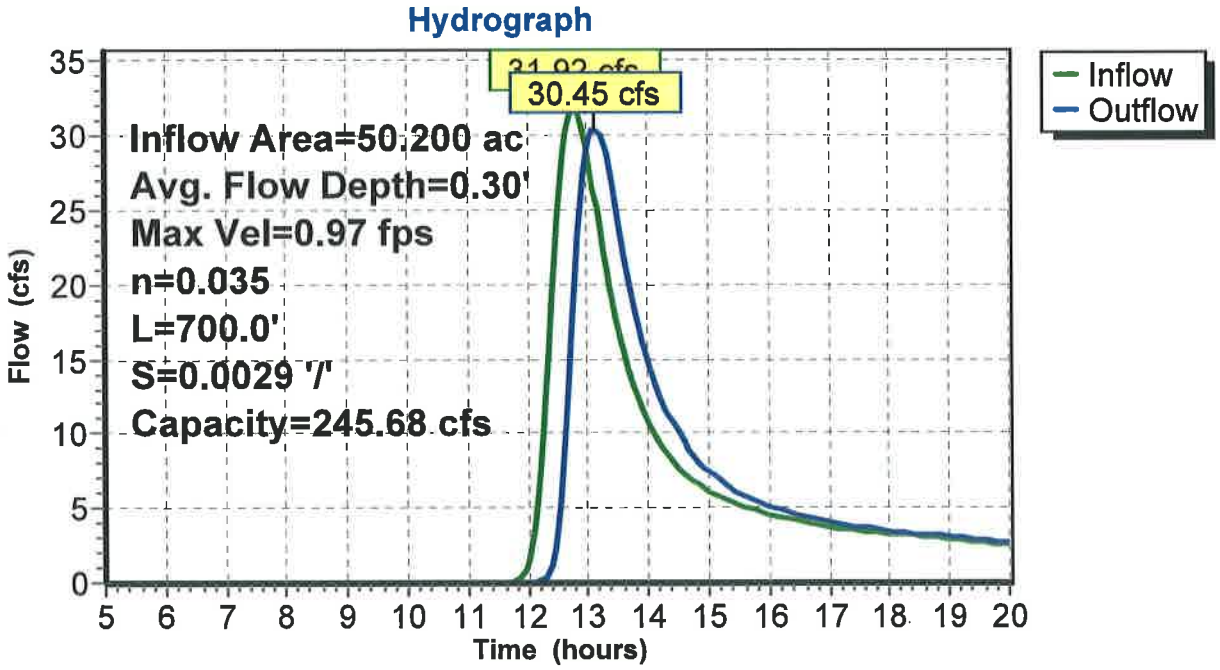
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.97 fps, Min. Travel Time= 12.0 min
Avg. Velocity = 0.51 fps, Avg. Travel Time= 23.0 min

Peak Storage= 21,935 cf @ 12.94 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 120.0 sf, Capacity= 245.68 cfs

100.00' x 1.00' deep channel, n= 0.035
Side Slope Z-value= 20.0 '/' Top Width= 140.00'
Length= 700.0' Slope= 0.0029 '/'
Inlet Invert= 1,200.00', Outlet Invert= 1,198.00'

‡

Reach 8R: New swale to river



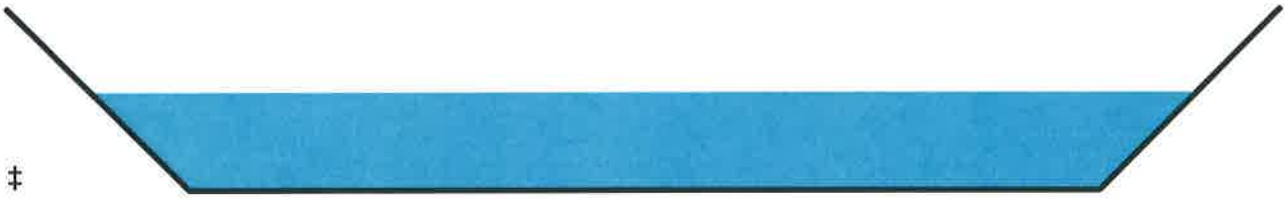
Summary for Reach 9R: New swale to river

Inflow Area = 144.100 ac, 0.00% Impervious, Inflow Depth > 1.42" for 100-yr event
Inflow = 63.92 cfs @ 13.35 hrs, Volume= 17.096 af
Outflow = 59.75 cfs @ 13.92 hrs, Volume= 16.160 af, Atten= 7%, Lag= 34.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.00 fps, Min. Travel Time= 20.1 min
Avg. Velocity = 0.55 fps, Avg. Travel Time= 36.2 min

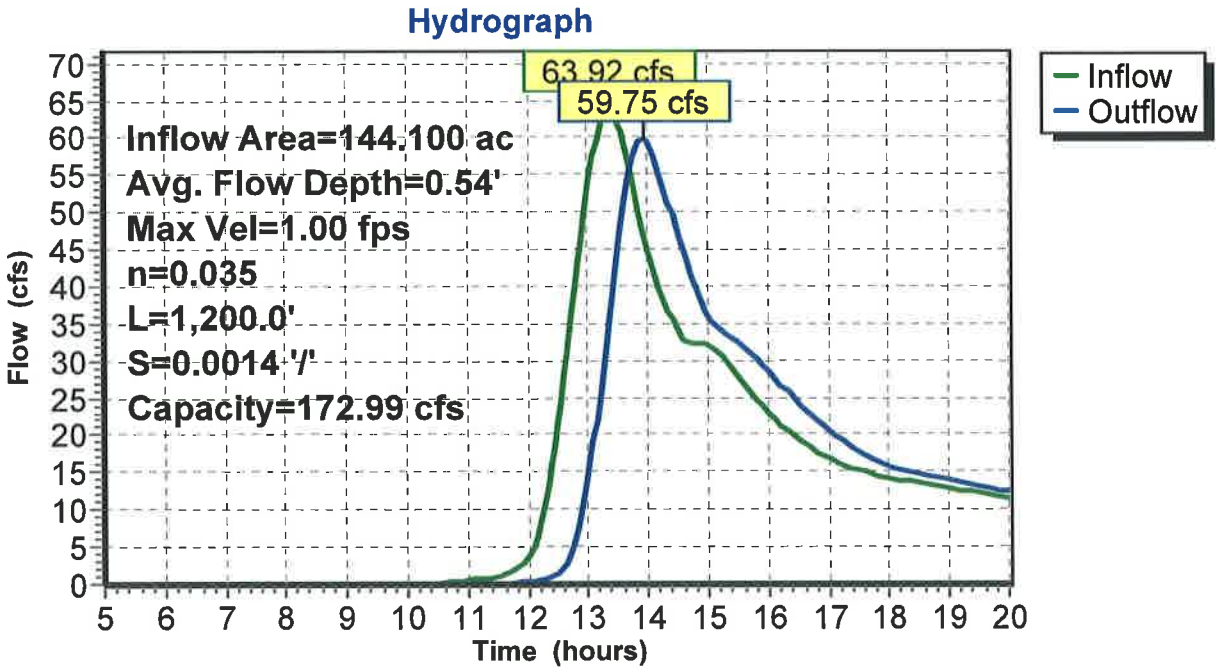
Peak Storage= 71,952 cf @ 13.58 hrs
Average Depth at Peak Storage= 0.54'
Bank-Full Depth= 1.00' Flow Area= 120.0 sf, Capacity= 172.99 cfs

100.00' x 1.00' deep channel, n= 0.035
Side Slope Z-value= 20.0 '/' Top Width= 140.00'
Length= 1,200.0' Slope= 0.0014 '/'
Inlet Invert= 1,198.70', Outlet Invert= 1,197.00'



‡

Reach 9R: New swale to river



Summary for Pond 1P: NE ditch

Inflow Area = 47.200 ac, 0.00% Impervious, Inflow Depth > 1.29" for 100-yr event
Inflow = 30.01 cfs @ 12.80 hrs, Volume= 5.082 af
Outflow = 27.89 cfs @ 12.98 hrs, Volume= 5.078 af, Atten= 7%, Lag= 10.9 min
Primary = 27.89 cfs @ 12.98 hrs, Volume= 5.078 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,199.48' @ 12.98 hrs Surf.Area= 9,499 sf Storage= 8,716 cf

Plug-Flow detention time= 2.5 min calculated for 5.061 af (100% of inflow)
Center-of-Mass det. time= 2.2 min (863.9 - 861.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.65'	215,897 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

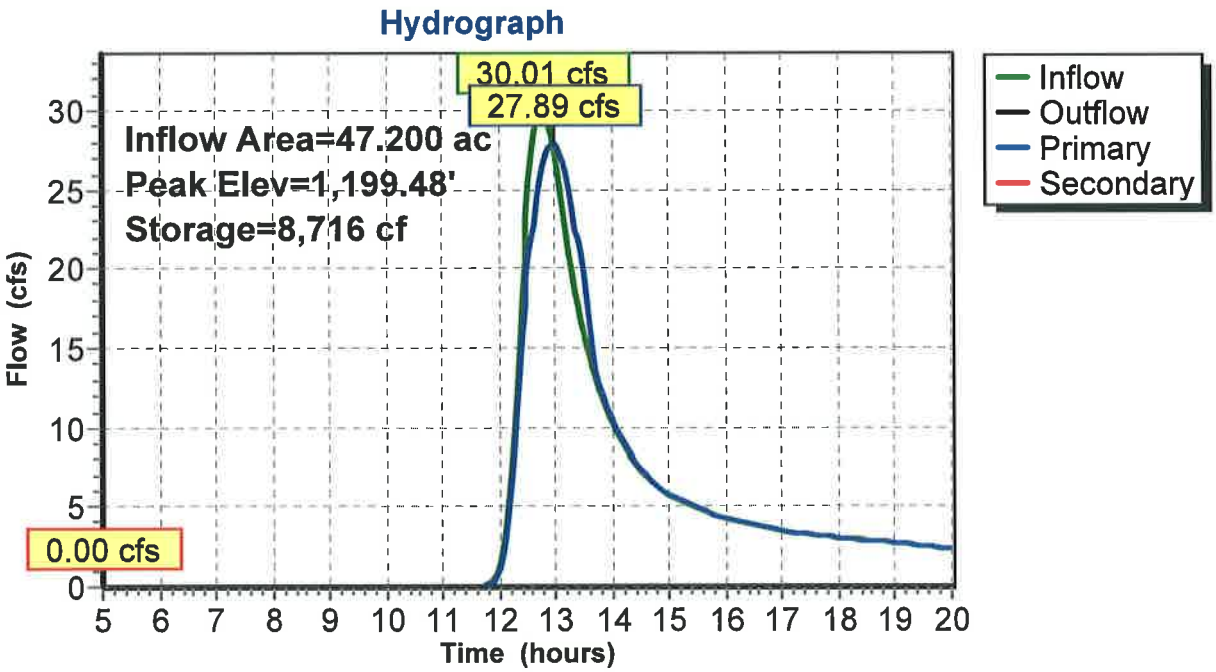
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.65	0	0	0
1,198.00	1,000	1,175	1,175
1,199.00	6,407	3,704	4,878
1,200.00	12,815	9,611	14,489
1,201.00	390,000	201,408	215,897

Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.65'	**30.0" Round Culvert** L= 24.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.65' / 1,195.65' S= 0.0000 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,200.20'	**150.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=27.87 cfs @ 12.98 hrs HW=1,199.48' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 27.87 cfs @ 5.68 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,195.65' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: NE ditch



Summary for Pond 3P: S Central ditch

Inflow Area = 69.000 ac, 0.00% Impervious, Inflow Depth > 2.22" for 100-yr event
Inflow = 97.62 cfs @ 12.55 hrs, Volume= 12.792 af
Outflow = 97.59 cfs @ 12.56 hrs, Volume= 12.692 af, Atten= 0%, Lag= 0.6 min
Primary = 18.46 cfs @ 12.56 hrs, Volume= 7.138 af
Secondary = 79.13 cfs @ 12.56 hrs, Volume= 5.554 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,198.10' @ 12.56 hrs Surf.Area= 15,435 sf Storage= 20,649 cf

Plug-Flow detention time= 9.4 min calculated for 12.650 af (99% of inflow)
Center-of-Mass det. time= 6.6 min (837.3 - 830.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,195.30'	74,844 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

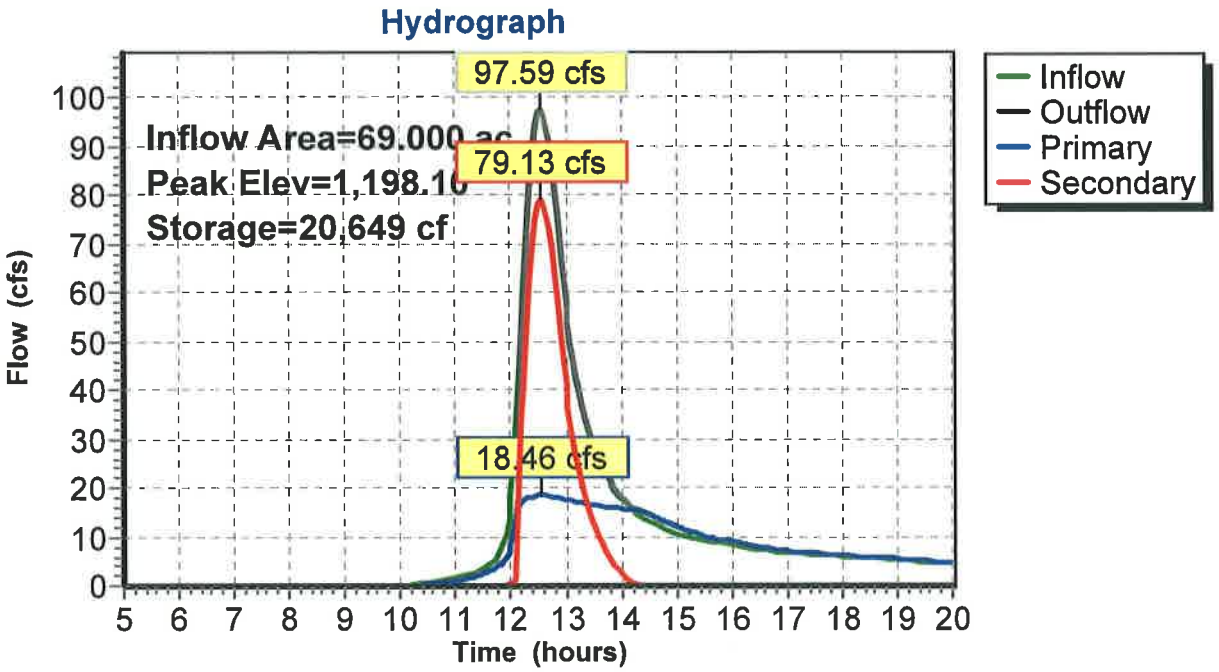
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,195.30	0	0	0
1,196.50	5,940	3,564	3,564
1,197.50	11,880	8,910	12,474
1,198.50	17,820	14,850	27,324
1,200.50	29,700	47,520	74,844

Device	Routing	Invert	Outlet Devices
#1	Primary	1,195.48'	**30.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,195.37' / 1,195.48' S= -0.0055 '/' Cc= 0.900 n= 0.024, Flow Area= 4.91 sf
#2	Secondary	1,197.80'	**180.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=18.45 cfs @ 12.56 hrs HW=1,198.10' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 18.45 cfs @ 4.29 fps)

Secondary OutFlow Max=78.86 cfs @ 12.56 hrs HW=1,198.10' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 78.86 cfs @ 1.47 fps)

Pond 3P: S Central ditch



Summary for Pond 4P: SW ditch

Inflow Area = 129.000 ac, 0.00% Impervious, Inflow Depth > 1.96" for 100-yr event
Inflow = 167.15 cfs @ 12.48 hrs, Volume= 21.081 af
Outflow = 166.92 cfs @ 12.49 hrs, Volume= 21.077 af, Atten= 0%, Lag= 0.6 min
Primary = 162.56 cfs @ 12.49 hrs, Volume= 20.973 af
Secondary = 4.36 cfs @ 12.49 hrs, Volume= 0.104 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,197.39' @ 12.49 hrs Surf.Area= 23,502 sf Storage= 37,474 cf

Plug-Flow detention time= 3.8 min calculated for 21.007 af (100% of inflow)
Center-of-Mass det. time= 3.7 min (839.3 - 835.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,194.20'	92,125 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

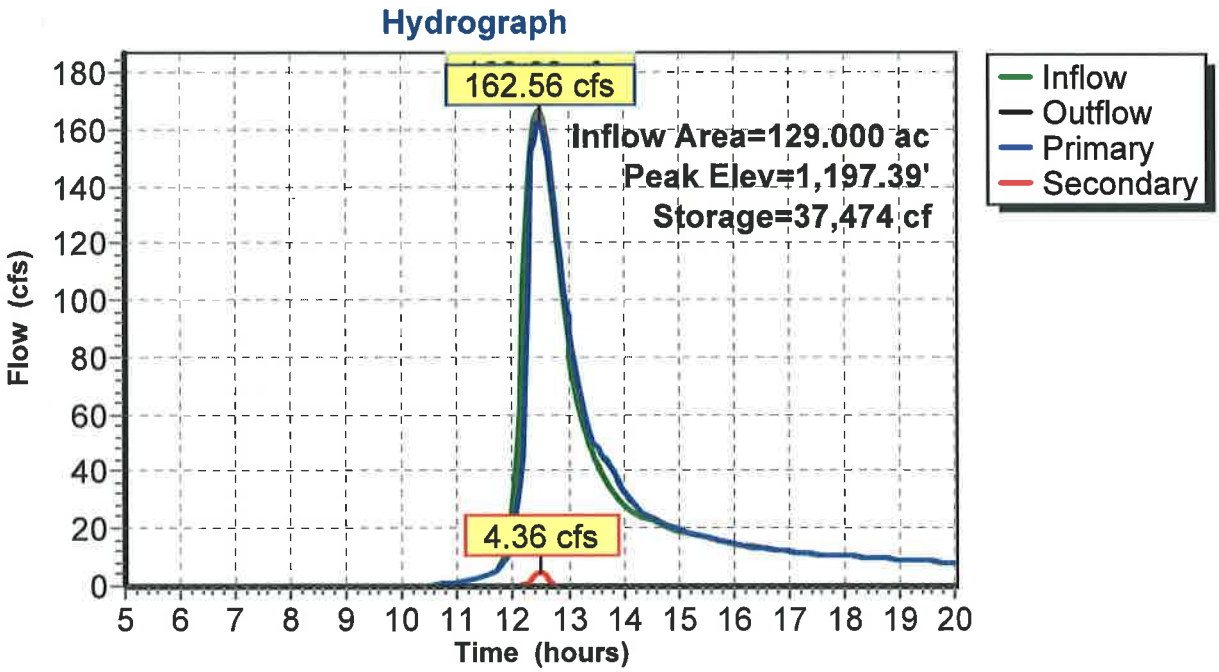
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,194.20	0	0	0
1,195.20	7,370	3,685	3,685
1,196.20	14,740	11,055	14,740
1,197.20	22,110	18,425	33,165
1,199.20	36,850	58,960	92,125

Device	Routing	Invert	Outlet Devices
#1	Primary	1,194.00'	**Special & User-Defined** Head (feet) 0.00 2.60 3.22 3.49 3.70 3.80 Disch. (cfs) 0.000 50.000 100.000 200.000 350.000 500.000
#2	Secondary	1,197.30'	**60.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=162.33 cfs @ 12.49 hrs HW=1,197.39' (Free Discharge)
↑—**1=Special & User-Defined** (Custom Controls 162.33 cfs)

Secondary OutFlow Max=4.22 cfs @ 12.49 hrs HW=1,197.39' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 4.22 cfs @ 0.80 fps)

Pond 4P: SW ditch



Summary for Pond 6P: Road Ditch

Inflow Area = 54.000 ac, 0.00% Impervious, Inflow Depth > 1.25" for 100-yr event
Inflow = 23.15 cfs @ 13.47 hrs, Volume= 5.638 af
Outflow = 15.27 cfs @ 14.34 hrs, Volume= 4.258 af, Atten= 34%, Lag= 52.0 min
Primary = 15.27 cfs @ 14.34 hrs, Volume= 4.258 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,203.90' @ 14.34 hrs Surf.Area= 63,776 sf Storage= 92,115 cf

Plug-Flow detention time= 133.1 min calculated for 4.258 af (76% of inflow)
Center-of-Mass det. time= 77.3 min (972.1 - 894.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	263,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

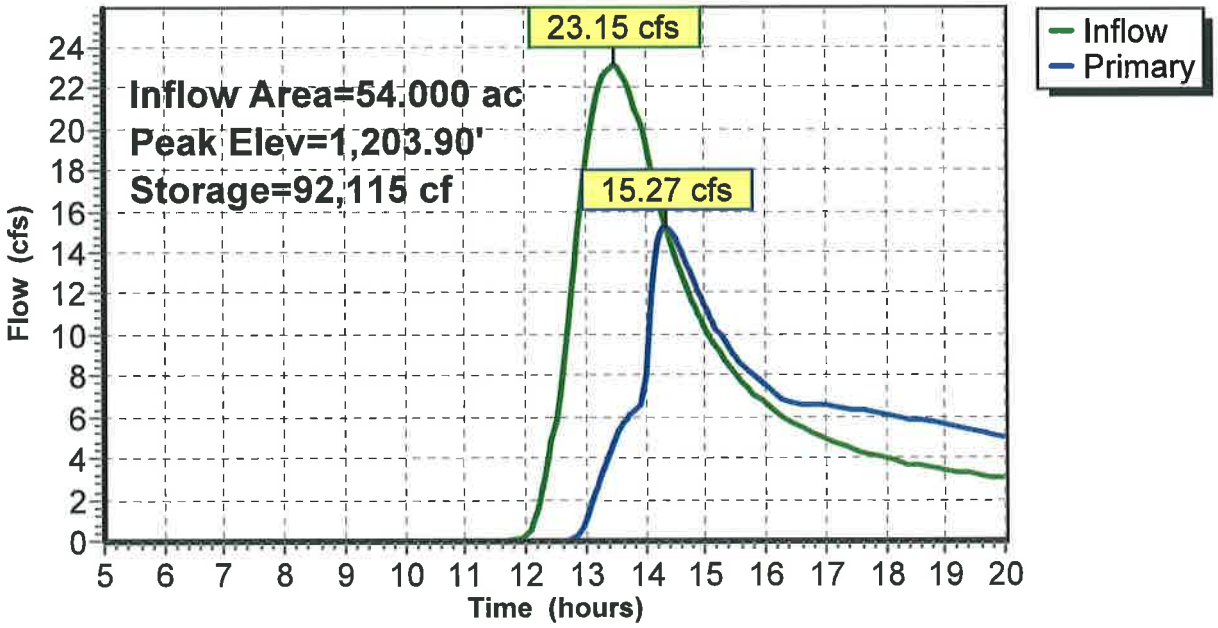
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	1,000	0	0
1,202.00	12,300	13,300	13,300
1,203.00	46,000	29,150	42,450
1,203.80	62,000	43,200	85,650
1,206.00	100,000	178,200	263,850

Device	Routing	Invert	Outlet Devices
#1	Primary	1,202.06'	**18.0" Round Culvert** L= 35.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,200.67' / 1,202.06' S= -0.0397 '/' Cc= 0.900 n= 0.024, Flow Area= 1.77 sf
#2	Primary	1,203.80'	**100.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=15.21 cfs @ 14.34 hrs HW=1,203.90' (Free Discharge)
1=Culvert (Inlet Controls 7.02 cfs @ 3.97 fps)
2=Broad-Crested Rectangular Weir (Weir Controls 8.19 cfs @ 0.80 fps)

Pond 6P: Road Ditch

Hydrograph



END OF DOCUMENT