PRELIMINARY
STORMWATER MANAGEMENT PLAN
FOR
ROCKIN' JUMP
(Case 16-010CU)

PROPOSED BY:

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WESTERVILLE, OHIO 43082
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PREPARED BY:

MARK R. SCHROEDER, P.E.

DATE:

FEBRUARY 12, 2016

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Telephone: (614) 252-0993 Fax: (614) 252-0444 E-mail: mschroeder@hockaden.com

The plan has been prepared in accordance with the regulations of the City of Dublin Stormwater Manual, in accordance with good engineering practices and principles for all stormwater works, including design high water elevations for all applicable storm events.

GENERAL SUMMARY

These calculations are part of a Conditional Use Application and are preliminary.

Site to be developed is an existing grass field at Parcel 273-001593 (Lot 3 Shamrock II – Franklin County Recorder - 2.279 Acres).

Building and parking lot will be placed on-site.

Site will discharge north to existing curb and gutter inlet in Shier Rings Road fronting the site. Outlet is shown to be unnamed tributary to South Fork Indian Run at

http://communityplan.dublinohiousa.gov/utilities/stormwater-management/

Release rates are based on allowable rates for sub-basins 230, 280, and 290.

Floodplain is not delineated at the site.

Ohio EPA NOI permit has been obtained 4GC05191*AG 1/4/2016 under OHC000004. Permit application shows up to 2.6 acres being disturbed.

Tributary area for dry detention basin is the site itself. There is no off-site tributary area. Properties to the east and south have been developed with their own storm system. Property to the west is owned by City of Dublin and is an existing pond.

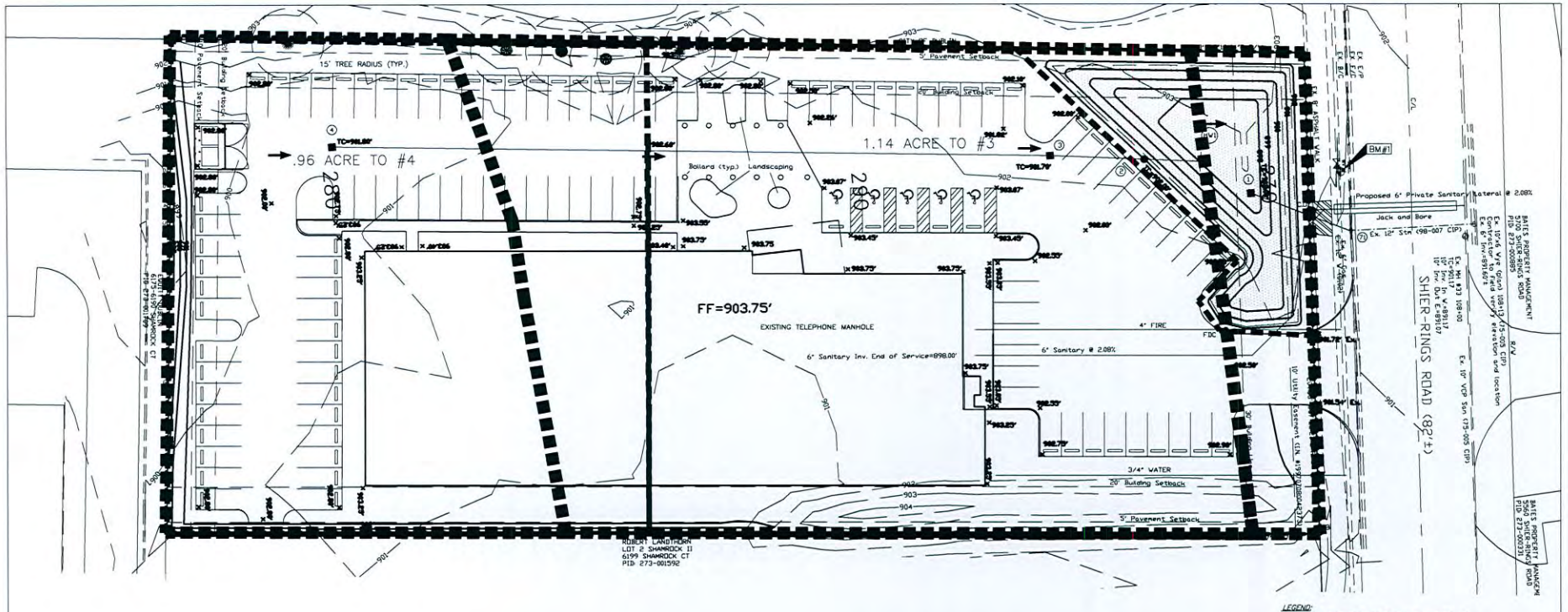
Critical year storm was determined to be 10 year storm.

Storm water will be piped towards an aquaswirl AS-3 device or approved equal that will treat the stormwater. Storm water will then be piped towards a detention basin that will provide water quantity. Basin is sloped at 2% towards an outlet structure. That structure will be piped north towards existing curb and gutter inlet # 71 south side of Shier-Rings Road fronting the site built as part of Emerald Parkway – Phase 7 in 2000. (98-007-CIP). 12" diameter pipe storm flows north across Shier-Rings Road from storm structure #71.

Flood routing from site heads north towards Shier-Rings Road.

Table C-6
City of Dublin
Stormwater Master Plan
South Fork Indian Run Watershed Release Rate Requirements

		Design Storm													
		1		2		5		10		25		50		100	
Sub-Basin	Area	Peak Flow	Rate	Peak Flow	Rate	Peak Flow	Rate	Peak Flow	Rate	Peak Flow	Rate	Peak Flow	Rate	Peak Flow	Rate
	(Acres)	(CFS)	(CFS/Ac)	(CFS)	(CFS/Ac)	(CFS)	(CFS/Ac)	(CFS)	(CFS/Ac)	(CFS)	(CFS/Ac)	(CFS)	(CFS/Ac)	(CFS)	(CFS/Ac)
10	8.3	6	0.7	7	0.9	11	1.3	16	1.9	24	2.8	34	4.1	43	5.2
20	3.1	2	0.8	3	1.0	4	1.3	5	1.7	7	2.4	10	3.3	13	4.2
30	4.1	6	1.6	9	2.3	14	3.4	17	4.1	20	5.0	24	5.9	27	6.7
40	7.1	5	0.7	6	0.8	7	1.0	9	1.2	11	1.6	15	2.1	18	2.6
50	9.9	10	1.0	12	1.3	17	1.7	22	2.2	30	3.0	40	4.1	50	5.0
60	0.8	1	1.5	2	1.9	2	2.7	3	3.4	3	4.3	4	5.4	5	6.4
70	5.6	10	1.8	13	2.3	17	3.0	21	3.7	26	4.6	31	5.5	36	6.4
80	9.0	16	1.8	21	2.4	28	3.1	34	3.7	41	4.6	50	5.5	58	6.4
90	0.4	0	0.9	0	1.1	1	1.4	1	1.8	1	2.5	1	3.4	2	4.4
100	1.7	1	0.6	1	0.7	1	0.9	2	1.1	3	1.6	4	2.4	6	3.3
110	32.8	15	0.5	19	0.6	23	0.7	27	0.8	32	1.0	50	1.5	79	2.4
120	11.1	11	1.0	13	1.2	17	1.5	20	1.8	27	2.4	36	3.2	45	4.1
130	1.9	4	2.0	5	2.7	7	3.6	8	4.2	9	5.0	11	5.9	13	6.7
140	6.0	12	1.9	16	2.7	21	3.5	25	4.1	30	5.0	35	5.9	40	6.7
150	14.9	27	1.8	38	2.5	51	3.4	60	4.1	73	4.9	87	5.8	99	6.7
160	5.4	10	1.9	14	2.6	19	3.5	22	4.1	27	4.9	32	5.9	36	6.7
170	7.8	13	1.7	19	2.4	26	3.3	31	4.0	38	4.8	45	5.8	52	6.6
180	1.7	3	1.5	3	2.0	6	3.4	7	4.2	9	5.2	11	6.4	13	7.4
190	4.5	7	1.4	8	1.8	14	3.1	17	3.9	22	4.8	27	5.9	31	6.9
200	16.6	24	1.4	30	1.8	41	2.5	52	3.1	68	4.1	86	5.2	102	6.1
210	79.3	33	0.4	40	0.5	50	0.6	58	0.7	71	0.9	96	1.2	125	1.6
220	92.7	74	0.8	92	1.0	114	1.2	137	1.5	177	1.9	230	2.5	291	3.1
230	5.0	7	1.3	8	1.6	11	2.2	14	2.8	18	3.7	24	4.8	29	5.7
240	4.6	7	1.5	9	2.0	13	2.8	16	3.5	21	4.5	25	5.5	30	6.4
250	3.3	6	1.8	8	2.3	11	3.3	13	4.0	16	4.8	19	5.7	22	6.6
260	2.8	4	1.5	6	2.0	8	3.0	10	3.7	13	4.7	16	5.7	18	6.6
270	2.1	3	1.4	4	1.9	6	2.8	7	3.5	9	4.4	12	5.5	14	6.5
280	6.7	8	1.2	10	1.5	16	2.4	21	3.1	28	4.1	35	5.3	42	6.2
290	3.8	3	0.8	4	1.1	5	1.3	6	1.7	9	2.3	12	3.2	15	4.1
300	31.8	4	0.1	5	0.2	7	0.2	9	0.3	13	0.4	20	0.6	28	0.9
310	21.5	2	0.1	3	0.1	4	0.2	8	0.4	18	0.8	32	1.5	50	2.3



AREA	ACRE
230	.178
280	.703
290	1.398

GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.

NOTE: TREE PROTECTION FENCING INFORMATION FOUND ON SHEET 6

LEGEND:
- EXISTING TELEPHONE MANHOLE
- EXISTING TELEPHONE PEDESTAL
- EXISTING ELECTRIC MANHOLE
- EXISTING LIGHTPOLE

DESCRIPTION: TRIBUTARY MAP

LOCATION: ROCKIN' JUMP
SHIER-RINGS ROAD
DUBLIN, OHIO

CLIENT: ARZANA DARUWALLA

PREPARED BY
HOCKADEN AND ASSOCIATES, INC.
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(614) 252-0993
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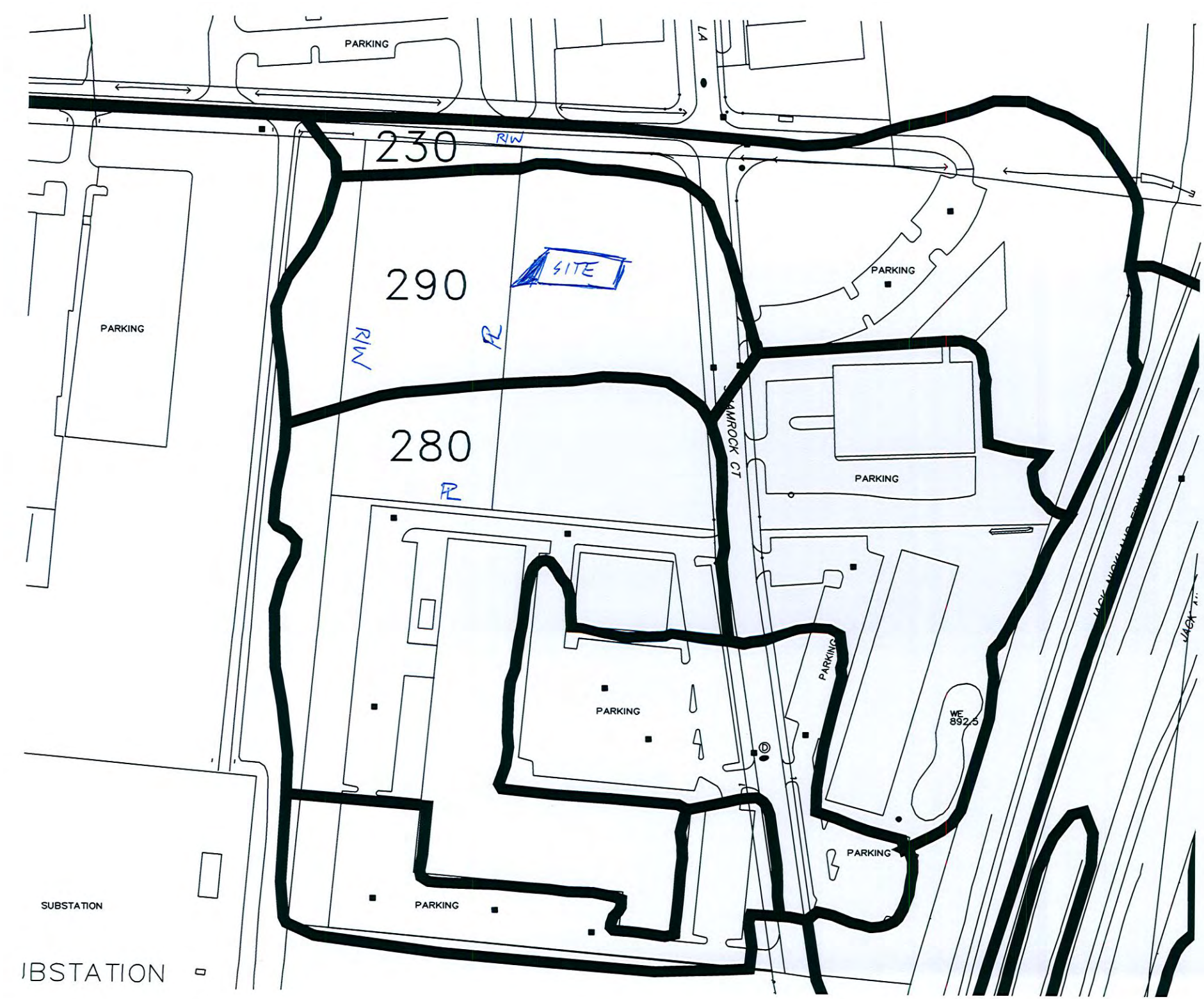
DRAWN BY: M.R.S.	CHECKED BY: M.R.S.	ORDER No.	AREA No.	SHEET
SCALE: 1"=20'	DATE: 2/15/16	42949		1 OF 1

42949.20.1


PARKING
230
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SUBSTATION
PARKING
IBSTATION

HOCKADEN AND ASSOCIATES, INC.
883 N. Cassady Avenue
Columbus, Ohio 43219

Project Name: ROCKIN' JUMP   Job No. 42949   By: M.R.S.   Date: 2/12/2016

Design Basis: 2YR
Runoff Coefficient: 0.76
Roughness Coefficient: 0.013
Sheet: 1 OF 1

Structure	Trib. Area Acres	Sum Area Acres	CA Acres	Sum CA Acres	Time Min.	Sum Time Min.	Rain Intensity In/Hr	Req'd Q I x Sum CA C.F.S.	Size In.	Slope %	Length Ft.	Mean Velocity F.P.S.	Just Full Capacity C.F.S.	c
4	0.96	0.96	0.73	0.73	10.0	10.0	3.90	**2.9**	18	0.26	300.00	3.0	**5.4**	
3	1.14	2.10	0.86	1.60	1.6	11.6	3.65	**5.8**	18	0.40	63.00	3.8	**6.7**	
HW1														

42949.20.1
ROCKIN JUMP
DUBLIN, OHIO

post-developed	**acre**	**c**	**cn*a**		
impervious	1.527	0.94	1.44	columbus table 2-5 impervious (CN=98)	
pervious	0.752	0.39	0.29	columbus table 2-5 - c soil - good grass (CN=74)	
total	2.279		1.73		
site		**0.76**	**(C value used in sizing storm pipe)**		

pre-developed
CN=79 (fair grass/pasture soil C)

CRITICAL YEAR DETERMINATION:

1 year pre-developed runoff volume (ac-ft):	0.122	from hydrocad
1 year post-developed runoff volume (ac-ft):	0.24	from hydrocad
% increase	96.7	(post-prev)/pre*100 (formula output)

critical year storm = 10 year (50% to 100%)

SUB-BASIN RELEASE RATES	**AREA (ACRE)**	**1 YR (CFS)**	**2 YR (CFS)**	**5 YR (CFS)**	**10 YR (CFS)**	**25 YR (CFS)**	**50 YR (CFS)**	**100 YR (CFS)**
230	0.178	0.23	0.28	0.39	0.50	0.66	0.85	1.01
280	0.703	0.84	1.05	1.69	2.18	2.88	3.73	4.36
290	1.398	1.12	1.54	1.82	2.38	3.22	4.47	5.73
TOTAL	2.279	**2.19**	**2.88**	**3.90**	**5.05**	**6.76**	**9.05**	**11.11**
ALLOWABLE		**2.19**	**2.19**	**2.19**	**2.19**	**6.76**	**9.05**	**11.11**
POST-DEVELOPED		**1.52**	**1.68**	**1.87**	**1.99**	**2.75**	**3.6**	**4.57**
PONDING ELEVATION (FT)		**899.12**	**899.55**	**900.08**	**900.47**	**900.9**	**901.18**	**901.45**

SEDIMENT POND

sediment settling pond volume = dewatering zone + sediment storage zone

dewatering zone (1800 cf/acre)	**4102**	CF	provided when skimmer placed at 6.5 inch orifice CB#1
sediment storage zone (1000 cf/acre)	**2279**	CF	provided when grading per erosion control plan (2636 cf provided)

Table 2-7

Runoff Curve Numbers (CN) for Typical Land Uses in Columbus (SCS, 1986 except as noted)

Cover Type and Hydrologic Condition	Average percent impervious area (6)	Curve Numbers for Hydrologic Soil Group			
		A	B	C	D
Fully developed urban areas (vegetation established) (1)					
Impervious areas: Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Open space (lawns, parks, golf courses, cemeteries, etc)					
Poor condition (grass cover, 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover >75%)		39	61	74	80
Commercial and business (TND – TC) (7)	85	89	92	94	95
Industrial	72	81	88	91	93
Residential Districts by Average Lot Size (7):					
Multi-family (TND – NC) (9)	80	86	91	93	94
1/12 to 1/6 acre lots (TND – NG) (9)	75	83	89	92	94
1/8 acre (TND – NE)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
Undeveloped or agricultural lands (1)					
Cultivated Land: (8)					
Without conservation treatment		72	81	88	91
With conservation treatment		62	71	78	81
Pasture, grassland, or range – continuous forage for grazing. (2)	Hydrologic condition:				
	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow – continuous grass, protected from grazing and generally mowed for hay.	--	30	58	71	78
Brush – brush-weed-grass mixture with brush the major element. (3)	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 (4)	48	65	73
Woods. (5)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 (4)	55	70	77
Farmsteads – buildings, lanes, driveways, and surrounding lots.	--	59	74	82	86

Notes:

(1) Average runoff conditions, and I_a=0.2s.

(2) Poor: <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

(3) Poor: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

(4) Actual curve number is less than 30; use CN=30 for runoff computations.

(5) Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

(6) The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.

(7) Acronyms for zoning of residential districts are as follows:
TND – TC: Traditional Neighborhood Development – Town Center
TND – NC: Traditional Neighborhood Development – Neighborhood Center
TND – NG: Traditional Neighborhood Development – Neighborhood General
TND – NE: Traditional Neighborhood Development – Neighborhood Edge

(8) Source: SCS National Engineering Handbook, Section 4, Hydrology, Chapter 9, August 1972.

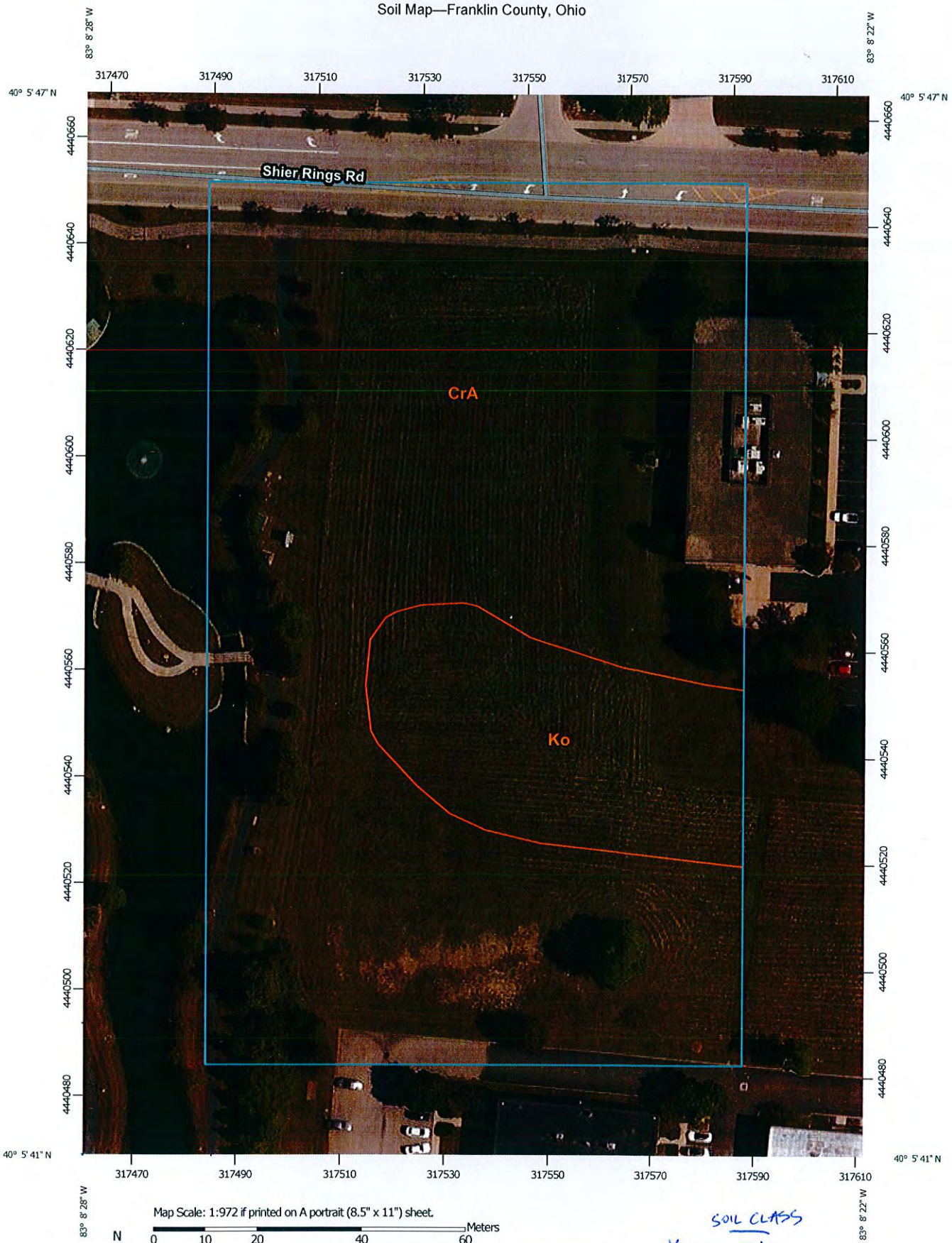
(9) Source: Curve numbers were calculated based upon percent of impervious area.

Table 2-5
Runoff Coefficients "C" for Typical Land Uses in Columbus

Cover Type and Hydrologic Condition	Average percent impervious area (5)	Runoff Coefficient for Hydrologic Soil Group (7)			
		A	B	C	D
Fully developed urban areas (vegetation established) (1)					
Impervious areas: Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		0.94	0.94	0.94	0.94
Open space (lawns, parks, golf courses, cemeteries, etc)					
Poor condition (grass cover, 50%)		0.29	0.48	0.63	0.70
Fair condition (grass cover 50% to 75%)		0.07	0.30	0.48	0.58
Good condition (grass cover >75%)		NA	0.19	0.39	0.50
Commercial and business (TND – TC) (6)	85	0.70	0.77	0.83	0.85
Industrial	72	0.52	0.67	0.75	0.80
Residential Districts by Average Lot Size (6):					
Multi-family (TND – NC)	80	0.63	0.75	0.80	0.83
1/12 to 1/6 acre lots (TND – NG)	75	0.56	0.70	0.77	0.83
1/8 acre (TND – NE)	65	0.44	0.60	0.72	0.77
1/4 acre	38	0.19	0.40	0.56	0.65
1/2 acre	25	0.11	0.32	0.50	0.60
1 acre	20	0.08	0.29	0.48	0.58
Undeveloped or agricultural lands(1)					
Cultivated Land:					
Without conservation treatment		0.35	0.52	0.67	0.75
With conservation treatment		0.21	0.34	0.46	0.52
Pasture, grassland, or range – continuous forage for grazing. (2)	Hydrologic condition:				
	Poor	0.29	0.48	0.63	0.70
	Fair	0.07	0.30	0.48	0.58
	Good	NA	0.19	0.39	0.50
Meadow – continuous grass, protected from grazing and generally mowed for hay.	--	NA	0.16	0.34	0.46
Brush – brush-weed-grass mixture with brush the major element. (3)	Poor	0.06	0.27	0.44	0.56
	Fair	NA	0.13	0.32	0.44
	Good	NA	0.06	0.25	0.37
Woods. (4)	Poor	0.04	0.26	0.44	0.56
	Fair	NA	0.18	0.37	0.48
	Good	NA	0.12	0.32	0.44
Farmsteads – buildings, lanes, driveways, and surrounding lots.	--	0.17	0.39	0.54	0.63

Notes:
NA – Method to derive value is not applicable for curve number values less than 40.
(1) Average runoff condition, and Ia=0.2s.
(2) Poor: <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.
(3) Poor: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
(4) Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.
(5) The average percent impervious area shown was used to develop the composite CN's which were then used to derive runoff coefficient values. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a runoff coefficient of 0.94 (or CN of 98), and pervious areas are considered equivalent to open space in good hydrologic condition.
(6) Acronyms for zoning of residential districts are as follows:
TND – TC: Traditional Neighborhood Development – Town Center
TND – NC: Traditional Neighborhood Development – Neighborhood Center
TND – NG: Traditional Neighborhood Development – Neighborhood General
TND – NE: Traditional Neighborhood Development – Neighborhood Edge
(7) These runoff coefficients were calculated from CN's drawn from the NRCS (SCS) Peak Discharge Method from TR-55 assuming a 10-year, 24-hour storm. For larger design storms, the runoff coefficients should be increased using the following C value correction factors:
1.0 for the 10-year design storm and less
1.1 for the 25-year design storm
1.2 for the 50-year design storm
1.3 for the 100-year design storm

Soil Map—Franklin County, Ohio



Map Scale: 1:972 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 45 90 180 270

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

SOIL CLASS

Ko = B/D

CrA = C

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Franklin County, Ohio
Survey Area Data: Version 13, Sep 26, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 4, 2014—Aug 27, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Franklin County, Ohio (OH049)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
CrA	Crosby silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	3.6	85.1%
Ko	Kokomo silty clay loam, 0 to 2 percent slopes	0.6	14.9%
Totals for Area of Interest		**4.3**	**100.0%**

TABLE 2-5 CRITICAL STORM DETERMINATION

If the Percent of Increase in Runoff Volume is		The Critical Storm Runoff Rate Will Be Limited to:
Equal to or Greater than	And less than	
--	10	1 year
10	20	2 year
20	50	5 year
50	100	10 year
100	250	25 year
250	500	50 year
500	--	100 year

iii. *Peak rate of runoff.* The peak rate of runoff from the critical storm occurring over the developed site shall not exceed the allowable peak rate of runoff from a 1 year, 24 hour storm occurring over the same area prior to development, as defined in the Stormwater Master Plan. Storms of less frequent occurrence (longer return period) than the critical storm shall have the allowable peak rate of runoff not greater than the allowable peak rate of runoff for the same storm as documented in the Stormwater Master Plan.

b) *Unstudied areas.* Stormwater control measures designed for parcels located outside drainage sub-basins established with the Stormwater Master Plan, or any subsequent update thereto shall comply to the following minimum design criteria:

i. Development of sites other than single-family residences and other development sites of less than or equal to 2.0 acres shall not release stormwater runoff greater than 0.2 cubic feet per second per acre of development. On-site storage shall be provided to achieve these peak flow rates.

ii. Development sites greater than 2.0 acres (including single-family lots) shall provide runoff controls as defined by the MORPC Stormwater Design Manual.

c) *Dam safety laws apply.* Stormwater detention and retention ponds which are considered by Ohio Department of Natural Resources (ODNR) to be dam structures regulated under the dam safety laws of the State of Ohio shall be designed to safely pass the design flood events as defined by ODNR. Where fill berms are proposed, calculations supporting the stability of the fill berms are to be submitted by a licensed professional engineer with demonstrated experience in geotechnical engineering. The applicant shall design all raised bermed stormwater ponds according to current ODNR dam safety criteria.

d) *Multiple drainage basins.* If the site has multiple drainage basins, the drainage basin divides that exist prior to development shall be used to determine predevelopment rates of discharge for each drainage area of the site.

e) *Fences.* Fenced stormwater facilities are strongly discouraged within the City and shall only be permitted if approved by the City. The City will consider fencing stormwater facilities only where steep slopes that potentially endanger human life are unavoidable. If fencing is required, the design shall conform to the City's fence code (Chapter 153 of the Zoning Code) along the right-of-way boundary around the entire perimeter, including maintenance berms with access for maintenance vehicles. Other designs may be permitted subject to the review and approval of the City Engineer.

f) *Grading requirements.* Areas adjacent to stormwater control measures shall be graded to restrict the entrance of stormwater except at planned locations. Where stormwater control measures,

Summary for Subcatchment 3S: SITE - PREDEVELOPED

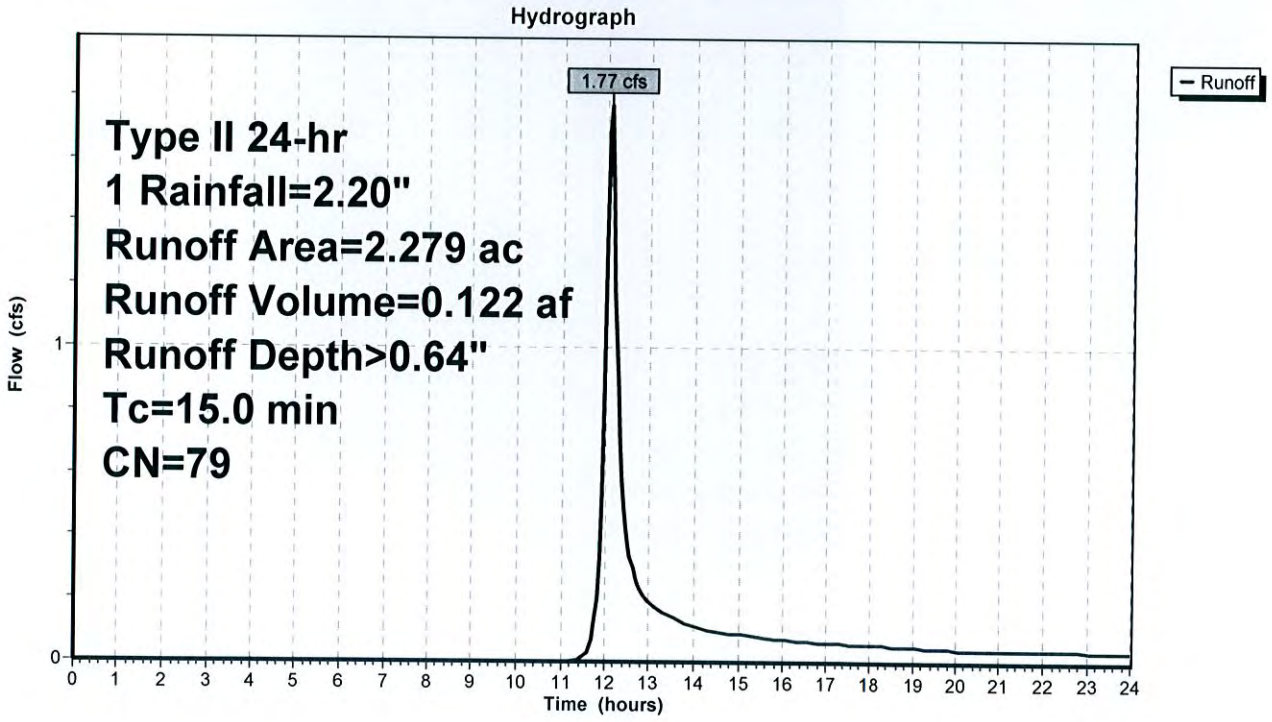
Runoff = 1.77 cfs @ 12.09 hrs, Volume= 0.122 af, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 Rainfall=2.20"

	Area (ac)	CN	Description
*	2.279	79	predeveloped - fair pasture/grass "c"
	2.279		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment 3S: SITE - PREDEVELOPED



Summary for Subcatchment 3S: SITE - POST DEVELOPED

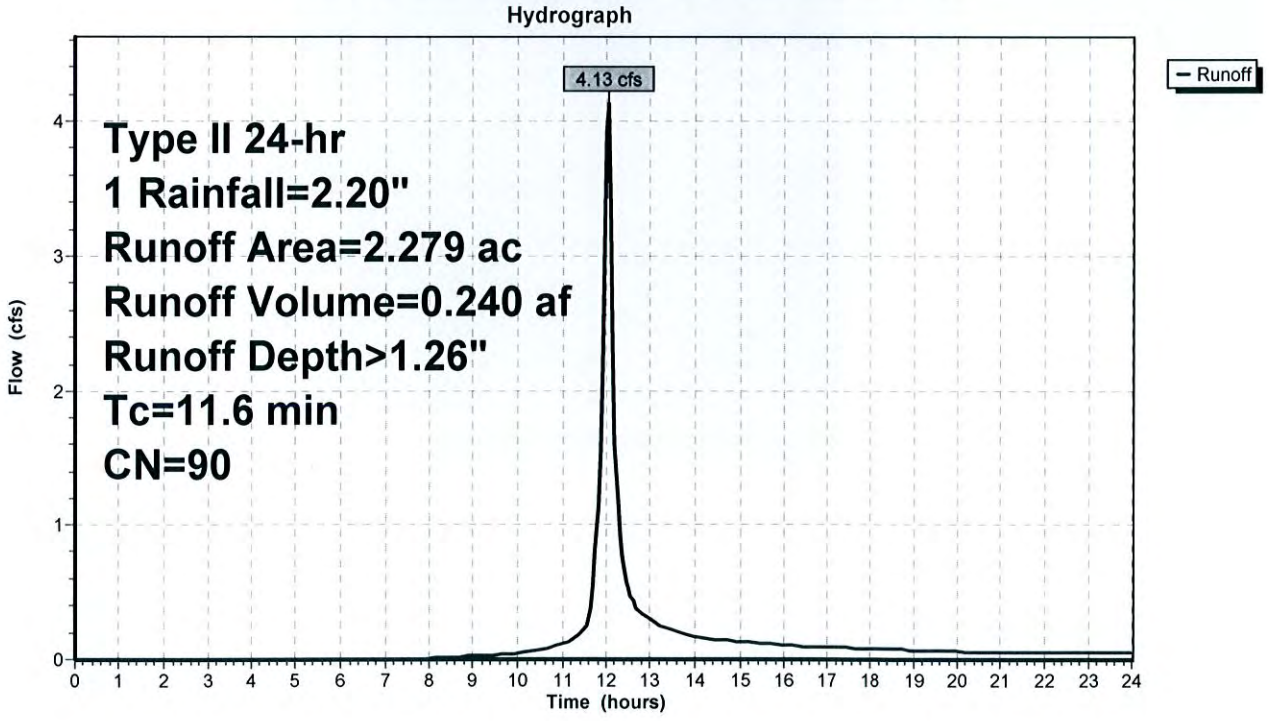
Runoff = 4.13 cfs @ 12.03 hrs, Volume= 0.240 af, Depth> 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 Rainfall=2.20"

	Area (ac)	CN	Description
*	1.527	98	impervious
*	0.752	74	pervious - good condition grass
	2.279	90	Weighted Average
	0.752		33.00% Pervious Area
	1.527		67.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6					**Direct Entry,**

Subcatchment 3S: SITE - POST DEVELOPED



Hydrograph for Subcatchment 3S: SITE - POST DEVELOPED

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.01	0.00	0.00
0.50	0.01	0.00	0.00
0.75	0.02	0.00	0.00
1.00	0.02	0.00	0.00
1.25	0.03	0.00	0.00
1.50	0.04	0.00	0.00
1.75	0.04	0.00	0.00
2.00	0.05	0.00	0.00
2.25	0.06	0.00	0.00
2.50	0.06	0.00	0.00
2.75	0.07	0.00	0.00
3.00	0.08	0.00	0.00
3.25	0.08	0.00	0.00
3.50	0.09	0.00	0.00
3.75	0.10	0.00	0.00
4.00	0.11	0.00	0.00
4.25	0.11	0.00	0.00
4.50	0.12	0.00	0.00
4.75	0.13	0.00	0.00
5.00	0.14	0.00	0.00
5.25	0.15	0.00	0.00
5.50	0.16	0.00	0.00
5.75	0.17	0.00	0.00
6.00	0.18	0.00	0.00
6.25	0.19	0.00	0.00
6.50	0.20	0.00	0.00
6.75	0.21	0.00	0.00
7.00	0.22	0.00	0.00
7.25	0.23	0.00	0.00
7.50	0.24	0.00	0.00
7.75	0.25	0.00	0.00
8.00	0.26	0.00	0.01
8.25	0.28	0.00	0.01
8.50	0.29	0.00	0.01
8.75	0.31	0.01	0.02
9.00	0.32	0.01	0.02
9.25	0.34	0.01	0.03
9.50	0.36	0.01	0.03
9.75	0.38	0.02	0.04
10.00	0.40	0.02	0.04
10.25	0.42	0.03	0.06
10.50	0.45	0.04	0.07
10.75	0.48	0.05	0.09
11.00	0.52	0.06	0.12
11.25	0.56	0.08	0.16
11.50	0.62	0.11	0.22
11.75	0.85	0.23	0.81
12.00	1.46	0.65	**3.93**
12.25	1.55	0.73	**1.17**
12.50	1.62	0.78	0.53
12.75	1.66	0.81	0.35
13.00	1.70	0.84	0.29
13.25	1.73	0.87	0.25
13.50	1.76	0.89	0.22
13.75	1.78	0.91	0.19
14.00	1.80	0.93	0.17
14.25	1.82	0.95	0.15
14.50	1.84	0.96	0.15
14.75	1.86	0.98	0.14
15.00	1.88	0.99	0.13
15.25	1.89	1.00	0.13
15.50	1.91	1.02	0.12
15.75	1.92	1.03	0.11
16.00	1.94	1.04	0.10
16.25	1.95	1.05	0.10
16.50	1.96	1.06	0.10
16.75	1.97	1.07	0.09
17.00	1.98	1.08	0.09
17.25	1.99	1.09	0.09
17.50	2.01	1.10	0.08
17.75	2.02	1.11	0.08
18.00	2.03	1.12	0.08
18.25	2.04	1.12	0.08
18.50	2.05	1.13	0.07
18.75	2.05	1.14	0.07
19.00	2.06	1.15	0.07
19.25	2.07	1.16	0.07
19.50	2.08	1.16	0.06
19.75	2.09	1.17	0.06
20.00	2.09	1.17	0.06
20.25	2.10	1.18	0.06
20.50	2.11	1.19	0.06
20.75	2.12	1.19	0.06
21.00	2.12	1.20	0.05
21.25	2.13	1.21	0.05
21.50	2.14	1.21	0.05
21.75	2.14	1.22	0.05
22.00	2.15	1.22	0.05
22.25	2.16	1.23	0.05
22.50	2.16	1.23	0.05
22.75	2.17	1.24	0.05
23.00	2.18	1.24	0.05
23.25	2.18	1.25	0.05
23.50	2.19	1.26	0.05
23.75	2.19	1.26	0.05
24.00	**2.20**	**1.27**	0.05

Summary for Pond 4P: detention

Inflow Area = 2.279 ac, 67.00% Impervious, Inflow Depth > 1.26" for 1 event
Inflow = 4.13 cfs @ 12.03 hrs, Volume= 0.240 af
Outflow = 1.52 cfs @ 12.21 hrs, Volume= 0.240 af, Atten= 63%, Lag= 10.8 min
Primary = 1.52 cfs @ 12.21 hrs, Volume= 0.240 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 899.12' @ 12.21 hrs Surf.Area= 2,291 sf Storage= 2,357 cf

Plug-Flow detention time= 9.5 min calculated for 0.240 af (100% of inflow)
Center-of-Mass det. time= 9.4 min (832.1 - 822.7)

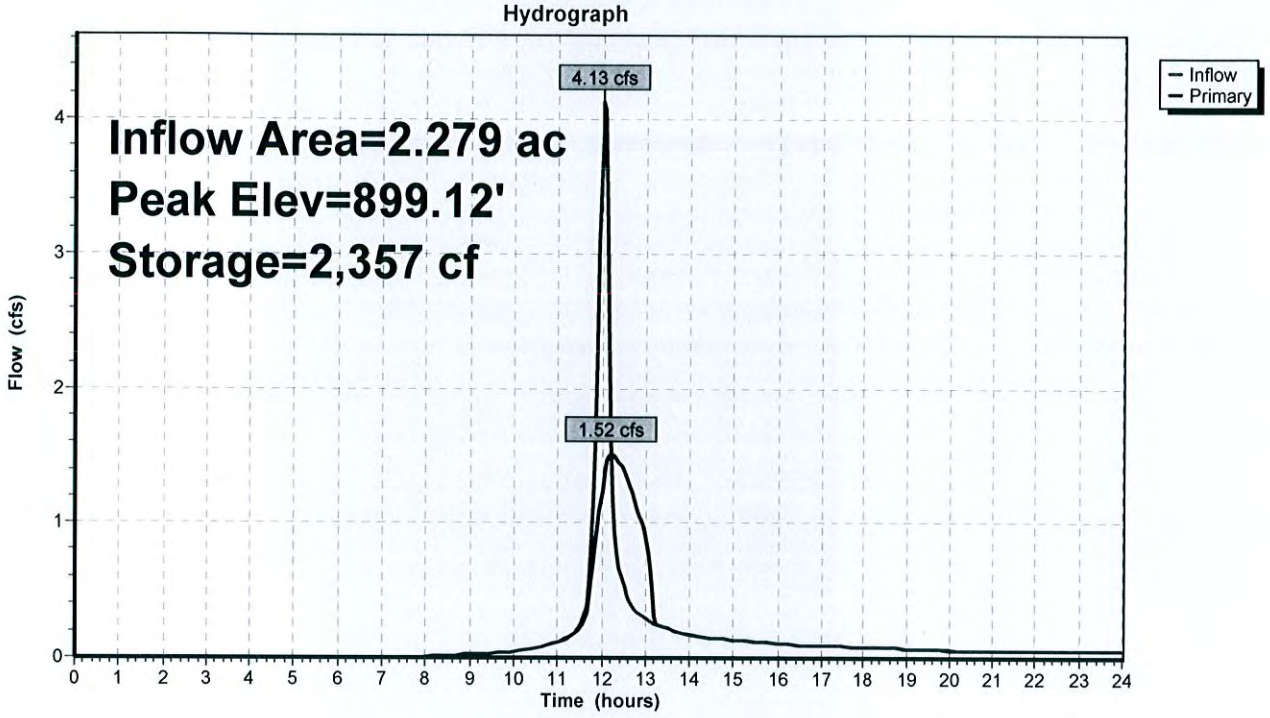
Volume	Invert	Avail.Storage	Storage Description
#1	896.98'	17,991 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
896.98	0	0	0	0
898.00	1,235	420	420	1,237
899.00	2,144	1,669	2,089	2,157
900.00	3,499	2,794	4,883	3,525
901.00	4,922	4,190	9,073	4,966
902.00	6,176	5,537	14,610	6,248
902.50	7,365	3,381	17,991	7,446

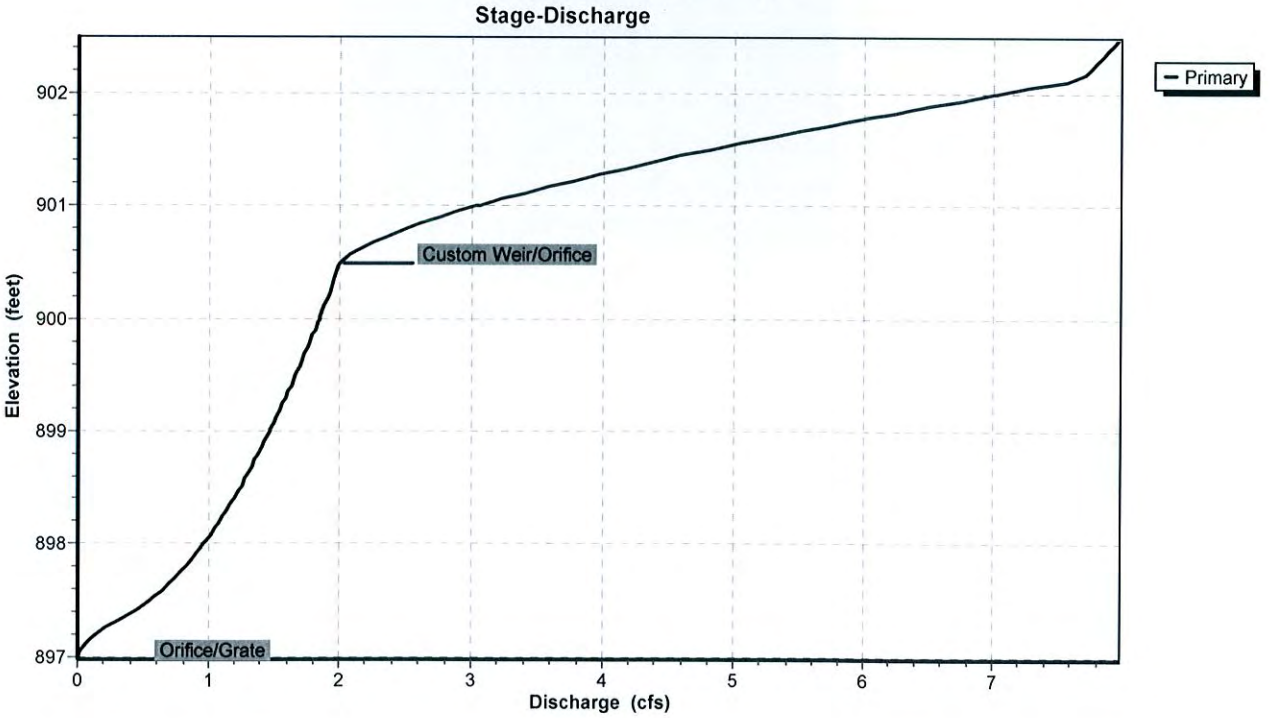
Device	Routing	Invert	Outlet Devices
#1	Primary	896.78'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 896.78' / 896.58' S= 0.0040 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	896.98'	**6.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	900.50'	**Custom Weir/Orifice, Cv= 1.00 (C= 1.25)** Head (feet) 0.00 2.00 Width (feet) 2.00 2.00

Primary OutFlow Max=1.52 cfs @ 12.21 hrs HW=899.12' (Free Discharge)
↑**1=Culvert** (Passes 1.52 cfs of 4.46 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 1.52 cfs @ 6.58 fps)
3=Custom Weir/Orifice (Controls 0.00 cfs)

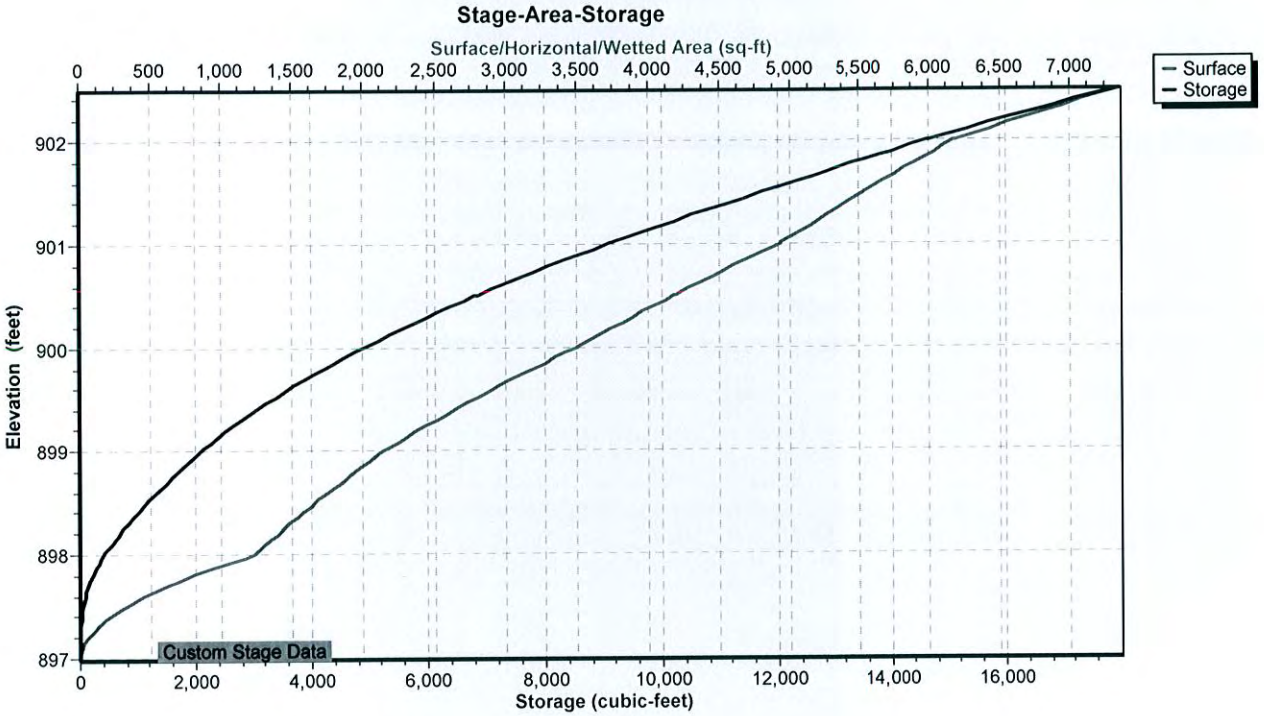
Pond 4P: detention



Pond 4P: detention



Pond 4P: detention



Hydrograph for Pond 4P: detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	896.98	0.00
0.50	0.00	0	896.98	0.00
1.00	0.00	0	896.98	0.00
1.50	0.00	0	896.98	0.00
2.00	0.00	0	896.98	0.00
2.50	0.00	0	896.98	0.00
3.00	0.00	0	896.98	0.00
3.50	0.00	0	896.98	0.00
4.00	0.00	0	896.98	0.00
4.50	0.00	0	896.98	0.00
5.00	0.00	0	896.98	0.00
5.50	0.00	0	896.98	0.00
6.00	0.00	0	896.98	0.00
6.50	0.00	0	896.98	0.00
7.00	0.00	0	896.98	0.00
7.50	0.00	0	896.99	0.00
8.00	0.01	0	897.01	0.01
8.50	0.01	0	897.04	0.01
9.00	0.02	0	897.06	0.02
9.50	0.03	0	897.08	0.03
10.00	0.04	1	897.10	0.04
10.50	0.07	1	897.13	0.07
11.00	0.12	3	897.18	0.11
11.50	0.22	9	897.26	0.22
12.00	**3.93**	**1,117**	**898.49**	**1.23**
12.50	**0.53**	**1,702**	**898.81**	**1.39**
13.00	0.29	281	897.87	0.87
13.50	0.22	9	897.26	0.22
14.00	0.17	6	897.22	0.17
14.50	0.15	5	897.21	0.15
15.00	0.13	4	897.19	0.13
15.50	0.12	3	897.18	0.12
16.00	0.10	3	897.17	0.10
16.50	0.10	2	897.16	0.10
17.00	0.09	2	897.15	0.09
17.50	0.08	2	897.15	0.08
18.00	0.08	2	897.14	0.08
18.50	0.07	2	897.14	0.07
19.00	0.07	1	897.13	0.07
19.50	0.06	1	897.12	0.06
20.00	0.06	1	897.12	0.06
20.50	0.06	1	897.11	0.06
21.00	0.05	1	897.11	0.05
21.50	0.05	1	897.11	0.05
22.00	0.05	1	897.11	0.05
22.50	0.05	1	897.11	0.05
23.00	0.05	1	897.11	0.05
23.50	0.05	1	897.10	0.05
24.00	0.05	1	897.10	0.05

Stage-Discharge for Pond 4P: detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
896.98	0.00	899.06	1.49	901.14	3.47
897.02	0.01	899.10	1.51	901.18	3.60
897.06	0.02	899.14	1.53	901.22	3.74
897.10	0.04	899.18	1.54	901.26	3.88
897.14	0.08	899.22	1.56	901.30	4.02
897.18	0.12	899.26	1.57	901.34	4.17
897.22	0.16	899.30	1.59	901.38	4.32
897.26	0.22	899.34	1.60	901.42	4.47
897.30	0.27	899.38	1.62	901.46	4.63
897.34	0.33	899.42	1.63	901.50	4.79
897.38	0.39	899.46	1.65	901.54	4.95
897.42	0.45	899.50	1.66	901.58	5.11
897.46	0.51	899.54	1.68	901.62	5.28
897.50	0.56	899.58	1.69	901.66	5.45
897.54	0.60	899.62	1.71	901.70	5.63
897.58	0.64	899.66	1.72	901.74	5.80
897.62	0.67	899.70	1.74	901.78	5.98
897.66	0.71	899.74	1.75	901.82	6.16
897.70	0.74	899.78	1.76	901.86	6.35
897.74	0.78	899.82	1.78	901.90	6.53
897.78	0.81	899.86	1.79	901.94	6.72
897.82	0.84	899.90	1.81	901.98	6.91
897.86	0.87	899.94	1.82	902.02	7.11
897.90	0.89	899.98	1.83	902.06	7.30
897.94	0.92	900.02	1.85	902.10	7.50
897.98	0.95	900.06	1.86	902.14	7.68
898.02	0.97	900.10	1.87	902.18	7.72
898.06	1.00	900.14	1.89	902.22	7.75
898.10	1.02	900.18	1.90	902.26	7.78
898.14	1.05	900.22	1.91	902.30	7.82
898.18	1.07	900.26	1.92	902.34	7.85
898.22	1.09	900.30	1.94	902.38	7.88
898.26	1.11	900.34	1.95	902.42	7.91
898.30	1.14	900.38	1.96	902.46	7.95
898.34	1.16	900.42	1.98	902.50	**7.98**
898.38	1.18	900.46	1.99		
898.42	1.20	900.50	2.00		
898.46	1.22	900.54	2.03		
898.50	1.24	900.58	2.08		
898.54	1.26	900.62	2.14		
898.58	1.28	900.66	2.21		
898.62	1.30	900.70	2.28		
898.66	1.32	900.74	2.37		
898.70	1.34	900.78	2.45		
898.74	1.35	900.82	2.55		
898.78	1.37	900.86	2.65		
898.82	1.39	900.90	2.75		
898.86	1.41	900.94	2.86		
898.90	1.42	900.98	2.97		
898.94	1.44	901.02	3.09		
898.98	1.46	901.06	3.21		
899.02	1.48	901.10	3.34		

Stage-Area-Storage for Pond 4P: detention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
896.98	0	0
897.08	12	0
897.18	47	3
897.28	107	11
897.38	190	25
897.48	297	49
897.58	427	85
897.68	582	136
897.78	760	203
897.88	962	288
897.98	1,187	396
898.08	1,299	521
898.18	1,380	655
898.28	1,464	797
898.38	1,551	948
898.48	1,640	1,108
898.58	1,732	1,276
898.68	1,826	1,454
898.78	1,923	1,642
898.88	2,022	1,839
898.98	2,123	2,046
899.08	2,240	2,264
899.18	2,364	2,494
899.28	2,490	2,737
899.38	2,620	2,992
899.48	2,753	3,261
899.58	2,890	3,543
899.68	3,029	3,839
899.78	3,173	4,149
899.88	3,319	4,474
899.98	3,469	4,813
900.08	3,604	5,167
900.18	3,737	5,534
900.28	3,873	5,914
900.38	4,011	6,308
900.48	4,152	6,717
900.58	4,295	7,139
900.68	4,440	7,576
900.78	4,588	8,027
900.88	4,738	8,493
900.98	4,891	8,975
901.08	5,017	9,470
901.18	5,137	9,978
901.28	5,259	10,498
901.38	5,382	11,030
901.48	5,506	11,574
901.58	5,632	12,131
901.68	5,759	12,701
901.78	5,888	13,283
901.88	6,018	13,878
901.98	6,150	14,487
902.08	6,359	15,111
902.18	6,592	15,759
902.28	6,829	16,430
902.38	7,070	17,125
902.48	**7,315**	**17,844**

Summary for Subcatchment 3S: SITE - POST DEVELOPED

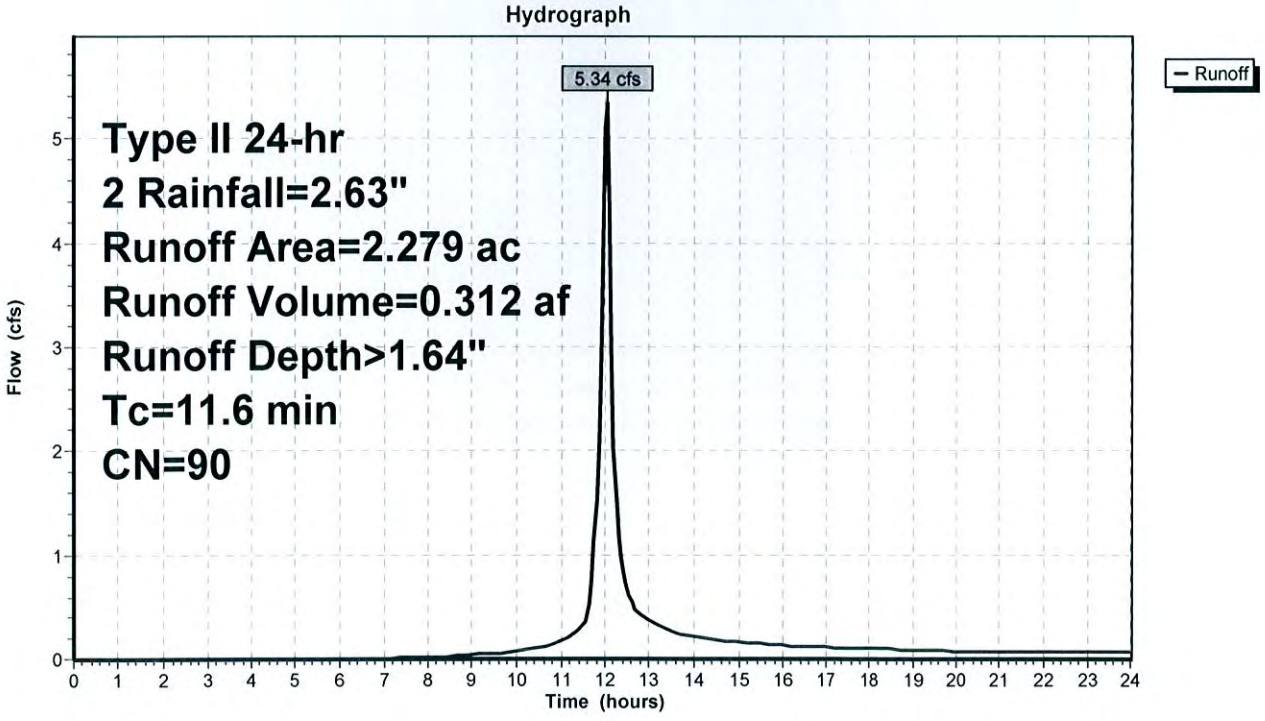
Runoff = 5.34 cfs @ 12.03 hrs, Volume= 0.312 af, Depth> 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=2.63"

	Area (ac)	CN	Description
*	1.527	98	impervious
*	0.752	74	pervious - good condition grass
	2.279	90	Weighted Average
	0.752		33.00% Pervious Area
	1.527		67.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6					**Direct Entry,**

Subcatchment 3S: SITE - POST DEVELOPED



Hydrograph for Subcatchment 3S: SITE - POST DEVELOPED

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.01	0.00	0.00
0.50	0.01	0.00	0.00
0.75	0.02	0.00	0.00
1.00	0.03	0.00	0.00
1.25	0.03	0.00	0.00
1.50	0.04	0.00	0.00
1.75	0.05	0.00	0.00
2.00	0.06	0.00	0.00
2.25	0.07	0.00	0.00
2.50	0.07	0.00	0.00
2.75	0.08	0.00	0.00
3.00	0.09	0.00	0.00
3.25	0.10	0.00	0.00
3.50	0.11	0.00	0.00
3.75	0.12	0.00	0.00
4.00	0.13	0.00	0.00
4.25	0.14	0.00	0.00
4.50	0.15	0.00	0.00
4.75	0.16	0.00	0.00
5.00	0.17	0.00	0.00
5.25	0.18	0.00	0.00
5.50	0.19	0.00	0.00
5.75	0.20	0.00	0.00
6.00	0.21	0.00	0.00
6.25	0.22	0.00	0.00
6.50	0.23	0.00	0.00
6.75	0.25	0.00	0.00
7.00	0.26	0.00	0.01
7.25	0.27	0.00	0.01
7.50	0.29	0.00	0.01
7.75	0.30	0.01	0.01
8.00	0.32	0.01	0.02
8.25	0.33	0.01	0.02
8.50	0.35	0.01	0.03
8.75	0.37	0.02	0.03
9.00	0.39	0.02	0.04
9.25	0.41	0.03	0.05
9.50	0.43	0.03	0.05
9.75	0.45	0.04	0.06
10.00	0.48	0.05	0.07
10.25	0.50	0.06	0.09
10.50	0.54	0.07	0.11
10.75	0.57	0.08	0.13
11.00	0.62	0.10	0.17
11.25	0.67	0.13	0.22
11.50	0.74	0.17	0.32
11.75	1.02	0.33	1.11
12.00	1.74	0.88	**5.10**
12.25	1.86	0.97	**1.49**
12.50	1.93	1.04	0.67
12.75	1.99	1.08	0.44
13.00	2.03	1.12	0.36
13.25	2.07	1.15	0.31
13.50	2.10	1.18	0.27
13.75	2.13	1.21	0.24
14.00	2.16	1.23	0.21
14.25	2.18	1.25	0.19
14.50	2.20	1.27	0.18
14.75	2.22	1.29	0.17
15.00	2.24	1.31	0.16
15.25	2.26	1.32	0.16
15.50	2.28	1.34	0.15
15.75	2.30	1.35	0.14
16.00	2.31	1.37	0.13
16.25	2.33	1.38	0.12
16.50	2.34	1.39	0.12
16.75	2.36	1.40	0.12
17.00	2.37	1.42	0.11
17.25	2.38	1.43	0.11
17.50	2.40	1.44	0.11
17.75	2.41	1.45	0.10
18.00	2.42	1.46	0.10
18.25	2.43	1.47	0.10
18.50	2.45	1.48	0.09
18.75	2.46	1.49	0.09
19.00	2.47	1.50	0.09
19.25	2.48	1.51	0.08
19.50	2.49	1.52	0.08
19.75	2.50	1.53	0.08
20.00	2.50	1.53	0.07
20.25	2.51	1.54	0.07
20.50	2.52	1.55	0.07
20.75	2.53	1.56	0.07
21.00	2.54	1.56	0.07
21.25	2.55	1.57	0.07
21.50	2.55	1.58	0.07
21.75	2.56	1.59	0.07
22.00	2.57	1.59	0.07
22.25	2.58	1.60	0.06
22.50	2.59	1.61	0.06
22.75	2.59	1.61	0.06
23.00	2.60	1.62	0.06
23.25	2.61	1.63	0.06
23.50	2.62	1.63	0.06
23.75	2.62	1.64	0.06
24.00	**2.63**	**1.65**	0.06

Summary for Pond 4P: detention

Inflow Area = 2.279 ac, 67.00% Impervious, Inflow Depth > 1.64" for 2 event
Inflow = 5.34 cfs @ 12.03 hrs, Volume= 0.312 af
Outflow = 1.68 cfs @ 12.23 hrs, Volume= 0.312 af, Atten= 68%, Lag= 12.1 min
Primary = 1.68 cfs @ 12.23 hrs, Volume= 0.312 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 899.55' @ 12.23 hrs Surf.Area= 2,848 sf Storage= 3,456 cf

Plug-Flow detention time= 13.0 min calculated for 0.312 af (100% of inflow)
Center-of-Mass det. time= 12.9 min (828.2 - 815.3)

Volume	Invert	Avail.Storage	Storage Description
#1	896.98'	17,991 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

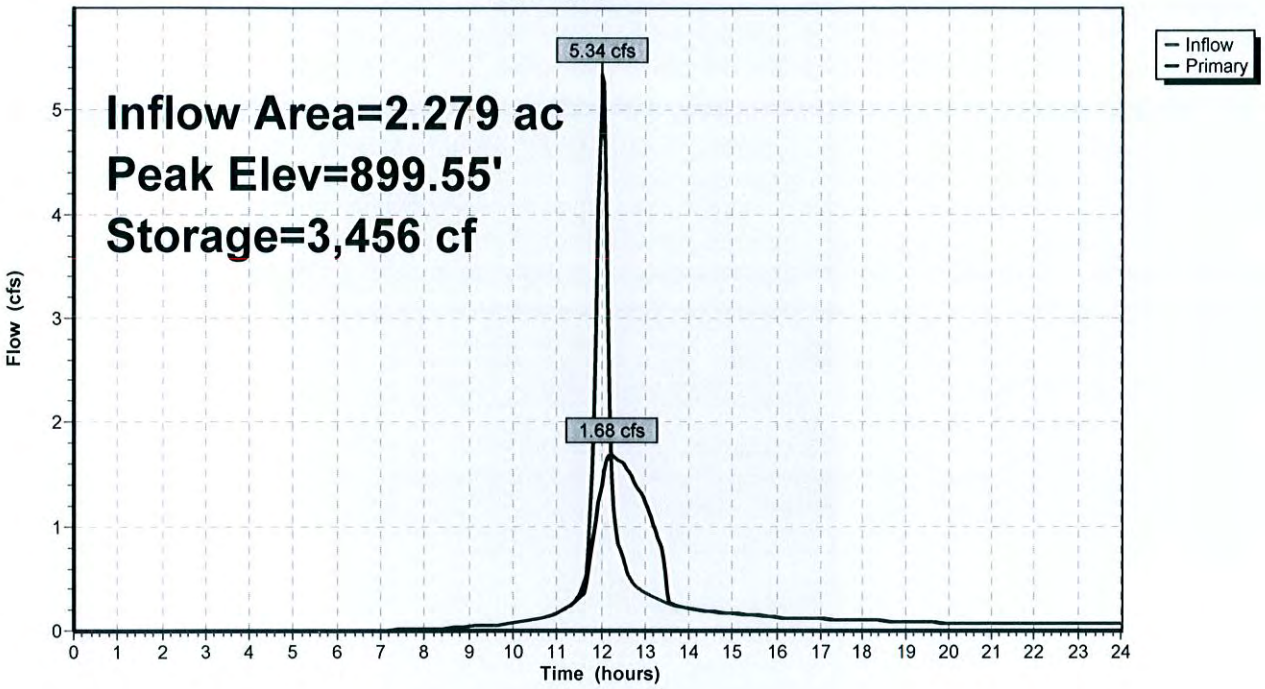
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
896.98	0	0	0	0
898.00	1,235	420	420	1,237
899.00	2,144	1,669	2,089	2,157
900.00	3,499	2,794	4,883	3,525
901.00	4,922	4,190	9,073	4,966
902.00	6,176	5,537	14,610	6,248
902.50	7,365	3,381	17,991	7,446

Device	Routing	Invert	Outlet Devices
#1	Primary	896.78'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 896.78' / 896.58' S= 0.0040 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	896.98'	**6.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	900.50'	**Custom Weir/Orifice, Cv= 1.00 (C= 1.25)** Head (feet) 0.00 2.00 Width (feet) 2.00 2.00

Primary OutFlow Max=1.68 cfs @ 12.23 hrs HW=899.55' (Free Discharge)
└**1=Culvert** (Passes 1.68 cfs of 5.04 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 7.30 fps)
  └**3=Custom Weir/Orifice** (Controls 0.00 cfs)

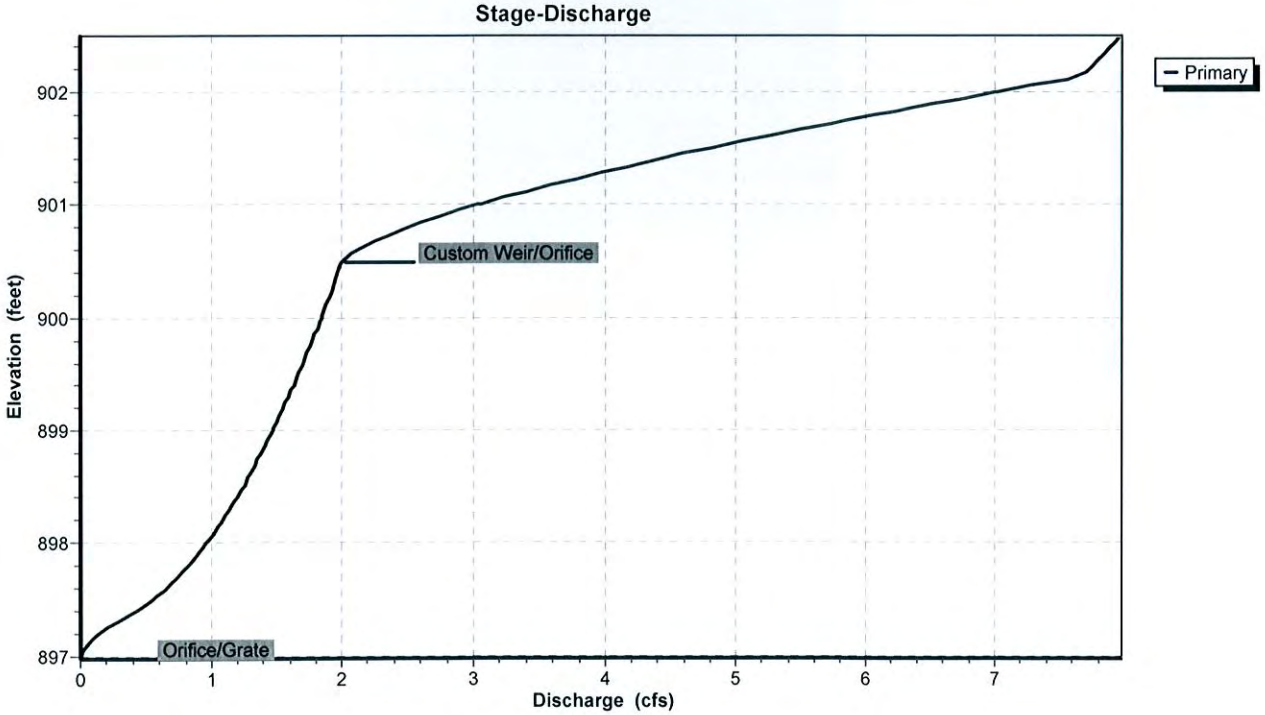
Pond 4P: detention

Hydrograph

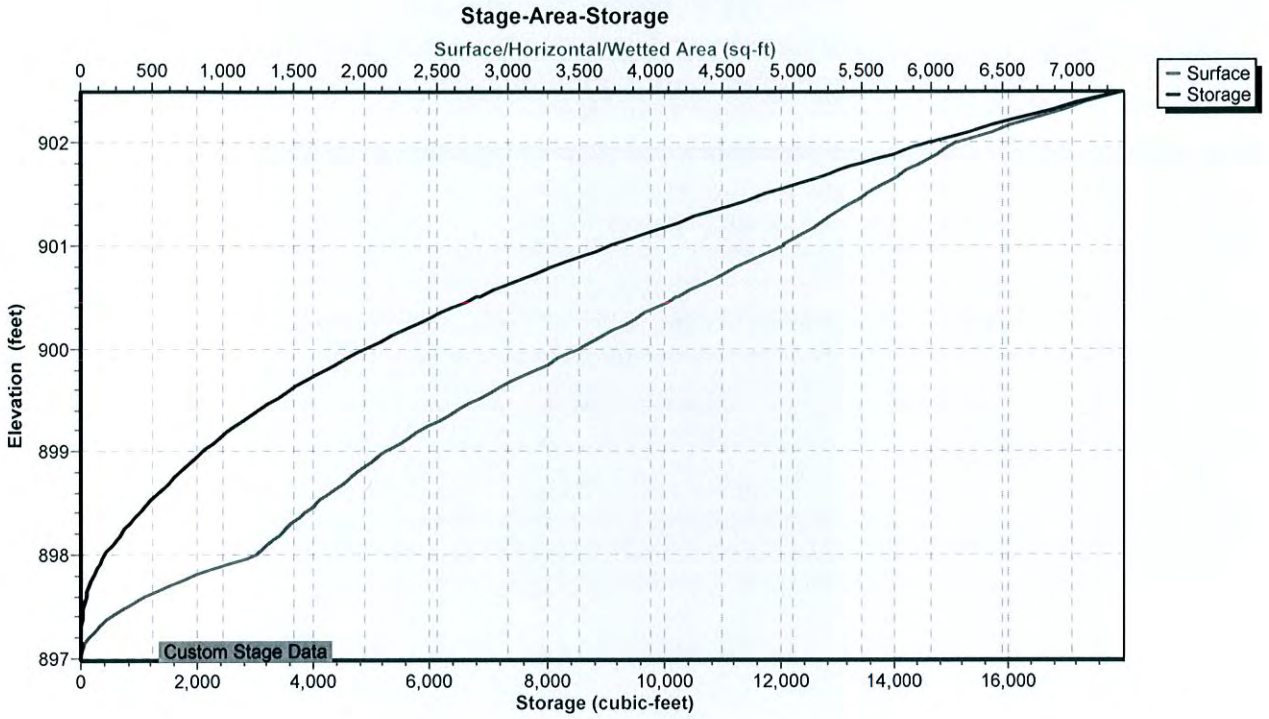


Pond 4P: detention

Stage-Discharge



Pond 4P: detention



Hydrograph for Pond 4P: detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	896.98	0.00
0.50	0.00	0	896.98	0.00
1.00	0.00	0	896.98	0.00
1.50	0.00	0	896.98	0.00
2.00	0.00	0	896.98	0.00
2.50	0.00	0	896.98	0.00
3.00	0.00	0	896.98	0.00
3.50	0.00	0	896.98	0.00
4.00	0.00	0	896.98	0.00
4.50	0.00	0	896.98	0.00
5.00	0.00	0	896.98	0.00
5.50	0.00	0	896.98	0.00
6.00	0.00	0	896.98	0.00
6.50	0.00	0	896.98	0.00
7.00	0.01	0	897.01	0.01
7.50	0.01	0	897.04	0.01
8.00	0.02	0	897.05	0.02
8.50	0.03	0	897.07	0.03
9.00	0.04	1	897.09	0.04
9.50	0.05	1	897.11	0.05
10.00	0.07	1	897.13	0.07
10.50	0.11	3	897.17	0.11
11.00	0.17	6	897.22	0.17
11.50	0.32	16	897.32	0.30
12.00	**5.10**	**1,664**	**898.79**	**1.38**
12.50	**0.67**	**2,837**	**899.32**	**1.60**
13.00	0.36	1,098	898.47	1.23
13.50	0.27	22	897.36	0.36
14.00	0.21	9	897.26	0.21
14.50	0.18	7	897.23	0.18
15.00	0.16	6	897.22	0.17
15.50	0.15	5	897.21	0.15
16.00	0.13	4	897.19	0.13
16.50	0.12	3	897.18	0.12
17.00	0.11	3	897.17	0.11
17.50	0.11	3	897.17	0.11
18.00	0.10	2	897.16	0.10
18.50	0.09	2	897.15	0.09
19.00	0.09	2	897.15	0.09
19.50	0.08	2	897.14	0.08
20.00	0.07	2	897.13	0.07
20.50	0.07	1	897.13	0.07
21.00	0.07	1	897.13	0.07
21.50	0.07	1	897.13	0.07
22.00	0.07	1	897.12	0.07
22.50	0.06	1	897.12	0.06
23.00	0.06	1	897.12	0.06
23.50	0.06	1	897.12	0.06
24.00	0.06	1	897.12	0.06

Stage-Discharge for Pond 4P: detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
896.98	0.00	899.06	1.49	901.14	3.47
897.02	0.01	899.10	1.51	901.18	3.60
897.06	0.02	899.14	1.53	901.22	3.74
897.10	0.04	899.18	1.54	901.26	3.88
897.14	0.08	899.22	1.56	901.30	4.02
897.18	0.12	899.26	1.57	901.34	4.17
897.22	0.16	899.30	1.59	901.38	4.32
897.26	0.22	899.34	1.60	901.42	4.47
897.30	0.27	899.38	1.62	901.46	4.63
897.34	0.33	899.42	1.63	901.50	4.79
897.38	0.39	899.46	1.65	901.54	4.95
897.42	0.45	899.50	1.66	901.58	5.11
897.46	0.51	899.54	1.68	901.62	5.28
897.50	0.56	899.58	1.69	901.66	5.45
897.54	0.60	899.62	1.71	901.70	5.63
897.58	0.64	899.66	1.72	901.74	5.80
897.62	0.67	899.70	1.74	901.78	5.98
897.66	0.71	899.74	1.75	901.82	6.16
897.70	0.74	899.78	1.76	901.86	6.35
897.74	0.78	899.82	1.78	901.90	6.53
897.78	0.81	899.86	1.79	901.94	6.72
897.82	0.84	899.90	1.81	901.98	6.91
897.86	0.87	899.94	1.82	902.02	7.11
897.90	0.89	899.98	1.83	902.06	7.30
897.94	0.92	900.02	1.85	902.10	7.50
897.98	0.95	900.06	1.86	902.14	7.68
898.02	0.97	900.10	1.87	902.18	7.72
898.06	1.00	900.14	1.89	902.22	7.75
898.10	1.02	900.18	1.90	902.26	7.78
898.14	1.05	900.22	1.91	902.30	7.82
898.18	1.07	900.26	1.92	902.34	7.85
898.22	1.09	900.30	1.94	902.38	7.88
898.26	1.11	900.34	1.95	902.42	7.91
898.30	1.14	900.38	1.96	902.46	7.95
898.34	1.16	900.42	1.98	902.50	**7.98**
898.38	1.18	900.46	1.99		
898.42	1.20	900.50	2.00		
898.46	1.22	900.54	2.03		
898.50	1.24	900.58	2.08		
898.54	1.26	900.62	2.14		
898.58	1.28	900.66	2.21		
898.62	1.30	900.70	2.28		
898.66	1.32	900.74	2.37		
898.70	1.34	900.78	2.45		
898.74	1.35	900.82	2.55		
898.78	1.37	900.86	2.65		
898.82	1.39	900.90	2.75		
898.86	1.41	900.94	2.86		
898.90	1.42	900.98	2.97		
898.94	1.44	901.02	3.09		
898.98	1.46	901.06	3.21		
899.02	1.48	901.10	3.34		

Stage-Area-Storage for Pond 4P: detention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
896.98	0	0
897.08	12	0
897.18	47	3
897.28	107	11
897.38	190	25
897.48	297	49
897.58	427	85
897.68	582	136
897.78	760	203
897.88	962	288
897.98	1,187	396
898.08	1,299	521
898.18	1,380	655
898.28	1,464	797
898.38	1,551	948
898.48	1,640	1,108
898.58	1,732	1,276
898.68	1,826	1,454
898.78	1,923	1,642
898.88	2,022	1,839
898.98	2,123	2,046
899.08	2,240	2,264
899.18	2,364	2,494
899.28	2,490	2,737
899.38	2,620	2,992
899.48	2,753	3,261
899.58	2,890	3,543
899.68	3,029	3,839
899.78	3,173	4,149
899.88	3,319	4,474
899.98	3,469	4,813
900.08	3,604	5,167
900.18	3,737	5,534
900.28	3,873	5,914
900.38	4,011	6,308
900.48	4,152	6,717
900.58	4,295	7,139
900.68	4,440	7,576
900.78	4,588	8,027
900.88	4,738	8,493
900.98	4,891	8,975
901.08	5,017	9,470
901.18	5,137	9,978
901.28	5,259	10,498
901.38	5,382	11,030
901.48	5,506	11,574
901.58	5,632	12,131
901.68	5,759	12,701
901.78	5,888	13,283
901.88	6,018	13,878
901.98	6,150	14,487
902.08	6,359	15,111
902.18	6,592	15,759
902.28	6,829	16,430
902.38	7,070	17,125
902.48	**7,315**	**17,844**

Summary for Subcatchment 3S: SITE - POST DEVELOPED

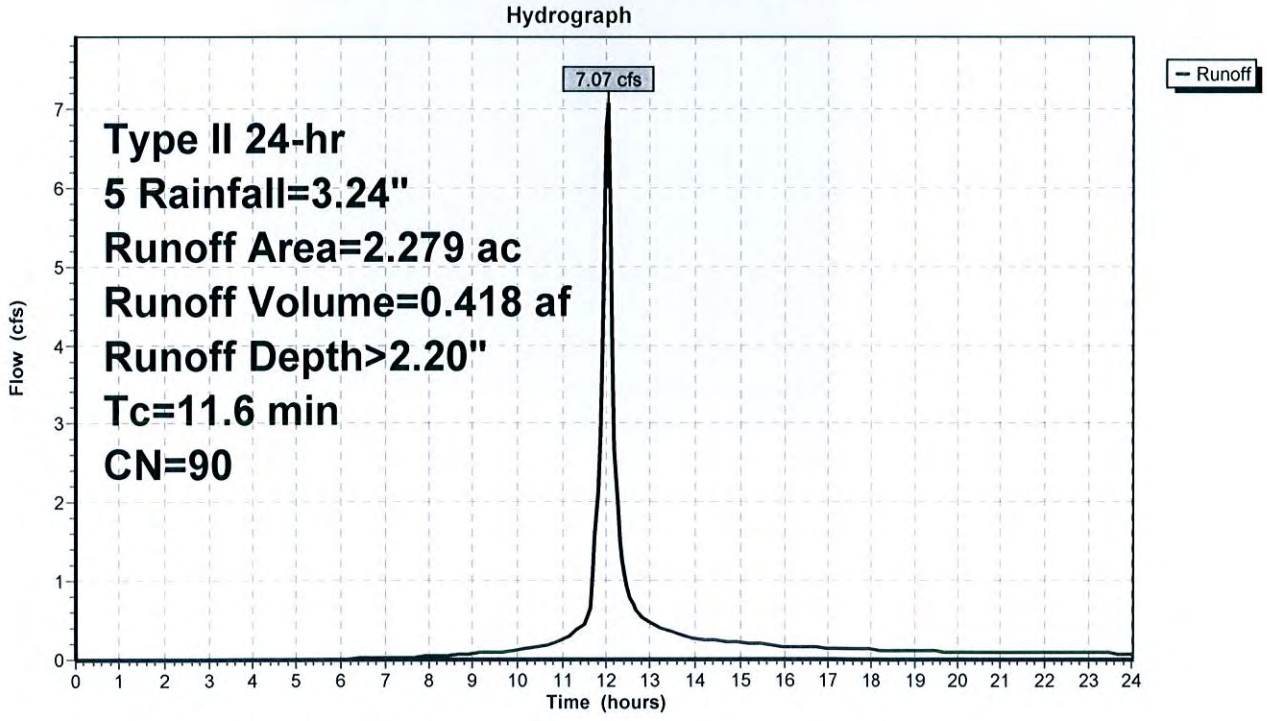
Runoff = 7.07 cfs @ 12.03 hrs, Volume= 0.418 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 5 Rainfall=3.24"

	Area (ac)	CN	Description
*	1.527	98	impervious
*	0.752	74	pervious - good condition grass
	2.279	90	Weighted Average
	0.752		33.00% Pervious Area
	1.527		67.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6					**Direct Entry,**

Subcatchment 3S: SITE - POST DEVELOPED



Hydrograph for Subcatchment 3S: SITE - POST DEVELOPED

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.01	0.00	0.00
0.50	0.02	0.00	0.00
0.75	0.03	0.00	0.00
1.00	0.03	0.00	0.00
1.25	0.04	0.00	0.00
1.50	0.05	0.00	0.00
1.75	0.06	0.00	0.00
2.00	0.07	0.00	0.00
2.25	0.08	0.00	0.00
2.50	0.09	0.00	0.00
2.75	0.10	0.00	0.00
3.00	0.11	0.00	0.00
3.25	0.12	0.00	0.00
3.50	0.13	0.00	0.00
3.75	0.14	0.00	0.00
4.00	0.16	0.00	0.00
4.25	0.17	0.00	0.00
4.50	0.18	0.00	0.00
4.75	0.19	0.00	0.00
5.00	0.20	0.00	0.00
5.25	0.22	0.00	0.00
5.50	0.23	0.00	0.00
5.75	0.24	0.00	0.00
6.00	0.26	0.00	0.01
6.25	0.27	0.00	0.01
6.50	0.29	0.00	0.01
6.75	0.30	0.01	0.02
7.00	0.32	0.01	0.02
7.25	0.34	0.01	0.02
7.50	0.35	0.01	0.03
7.75	0.37	0.02	0.03
8.00	0.39	0.02	0.04
8.25	0.41	0.03	0.04
8.50	0.43	0.03	0.05
8.75	0.45	0.04	0.06
9.00	0.48	0.05	0.07
9.25	0.50	0.06	0.08
9.50	0.53	0.07	0.09
9.75	0.56	0.08	0.10
10.00	0.59	0.09	0.11
10.25	0.62	0.11	0.14
10.50	0.66	0.12	0.17
10.75	0.71	0.15	0.20
11.00	0.76	0.18	0.25
11.25	0.83	0.21	0.33
11.50	0.92	0.27	0.45
11.75	1.25	0.50	1.56
12.00	2.15	1.22	**6.79**
12.25	2.29	1.34	**1.94**
12.50	2.38	1.43	0.86
12.75	2.45	1.48	0.56
13.00	2.50	1.53	0.47
13.25	2.55	1.57	0.39
13.50	2.59	1.61	0.35
13.75	2.62	1.64	0.31
14.00	2.66	1.67	0.27
14.25	2.69	1.70	0.25
14.50	2.71	1.72	0.23
14.75	2.74	1.75	0.22
15.00	2.77	1.77	0.21
15.25	2.79	1.79	0.20
15.50	2.81	1.81	0.19
15.75	2.83	1.83	0.18
16.00	2.85	1.85	0.16
16.25	2.87	1.86	0.16
16.50	2.89	1.88	0.15
16.75	2.90	1.90	0.15
17.00	2.92	1.91	0.14
17.25	2.94	1.93	0.14
17.50	2.95	1.94	0.13
17.75	2.97	1.96	0.13
18.00	2.98	1.97	0.13
18.25	3.00	1.98	0.12
18.50	3.01	2.00	0.12
18.75	3.03	2.01	0.11
19.00	3.04	2.02	0.11
19.25	3.05	2.03	0.10
19.50	3.06	2.04	0.10
19.75	3.07	2.05	0.10
20.00	3.08	2.06	0.09
20.25	3.09	2.07	0.09
20.50	3.11	2.08	0.09
20.75	3.12	2.09	0.09
21.00	3.13	2.10	0.09
21.25	3.14	2.11	0.09
21.50	3.15	2.12	0.08
21.75	3.16	2.13	0.08
22.00	3.17	2.14	0.08
22.25	3.18	2.15	0.08
22.50	3.18	2.15	0.08
22.75	3.19	2.16	0.08
23.00	3.20	2.17	0.08
23.25	3.21	2.18	0.08
23.50	3.22	2.19	0.08
23.75	3.23	2.20	0.08
24.00	**3.24**	**2.21**	0.08

Summary for Pond 4P: detention

Inflow Area = 2.279 ac, 67.00% Impervious, Inflow Depth > 2.20" for 5 event
Inflow = 7.07 cfs @ 12.03 hrs, Volume= 0.418 af
Outflow = 1.87 cfs @ 12.26 hrs, Volume= 0.418 af, Atten= 74%, Lag= 14.0 min
Primary = 1.87 cfs @ 12.26 hrs, Volume= 0.418 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 900.08' @ 12.26 hrs Surf.Area= 3,608 sf Storage= 5,178 cf

Plug-Flow detention time= 18.2 min calculated for 0.418 af (100% of inflow)
Center-of-Mass det. time= 18.1 min (825.1 - 807.0)

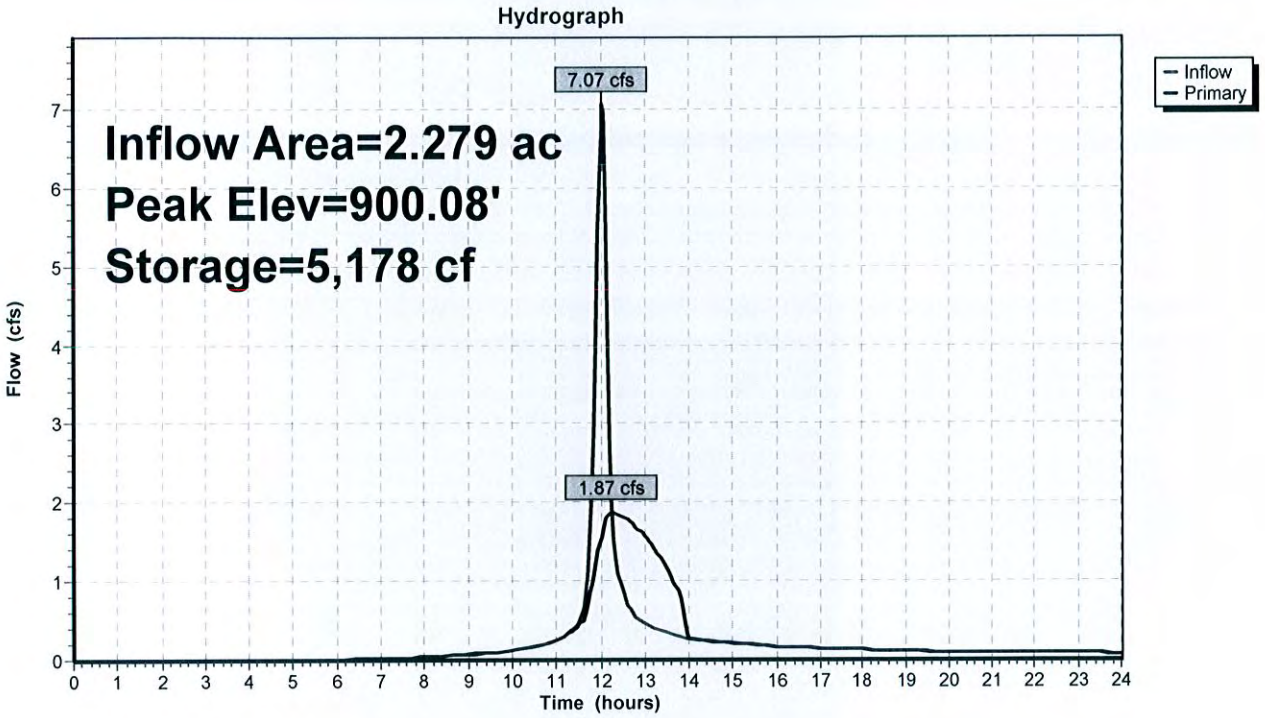
Volume	Invert	Avail.Storage	Storage Description
#1	896.98'	17,991 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
896.98	0	0	0	0
898.00	1,235	420	420	1,237
899.00	2,144	1,669	2,089	2,157
900.00	3,499	2,794	4,883	3,525
901.00	4,922	4,190	9,073	4,966
902.00	6,176	5,537	14,610	6,248
902.50	7,365	3,381	17,991	7,446

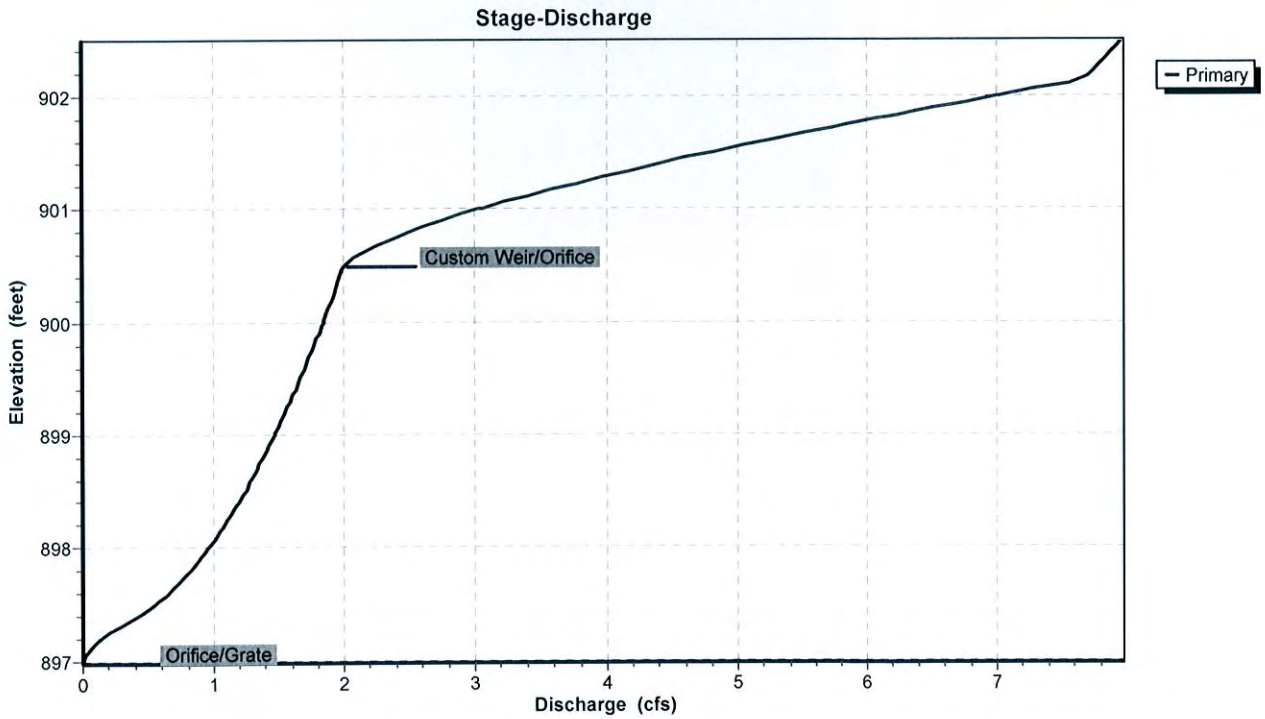
Device	Routing	Invert	Outlet Devices
#1	Primary	896.78'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 896.78' / 896.58' S= 0.0040 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	896.98'	**6.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	900.50'	**Custom Weir/Orifice, Cv= 1.00 (C= 1.25)** Head (feet) 0.00 2.00 Width (feet) 2.00 2.00

Primary OutFlow Max=1.87 cfs @ 12.26 hrs HW=900.08' (Free Discharge)
└**1=Culvert** (Passes 1.87 cfs of 5.69 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 1.87 cfs @ 8.10 fps)
  └**3=Custom Weir/Orifice** (Controls 0.00 cfs)

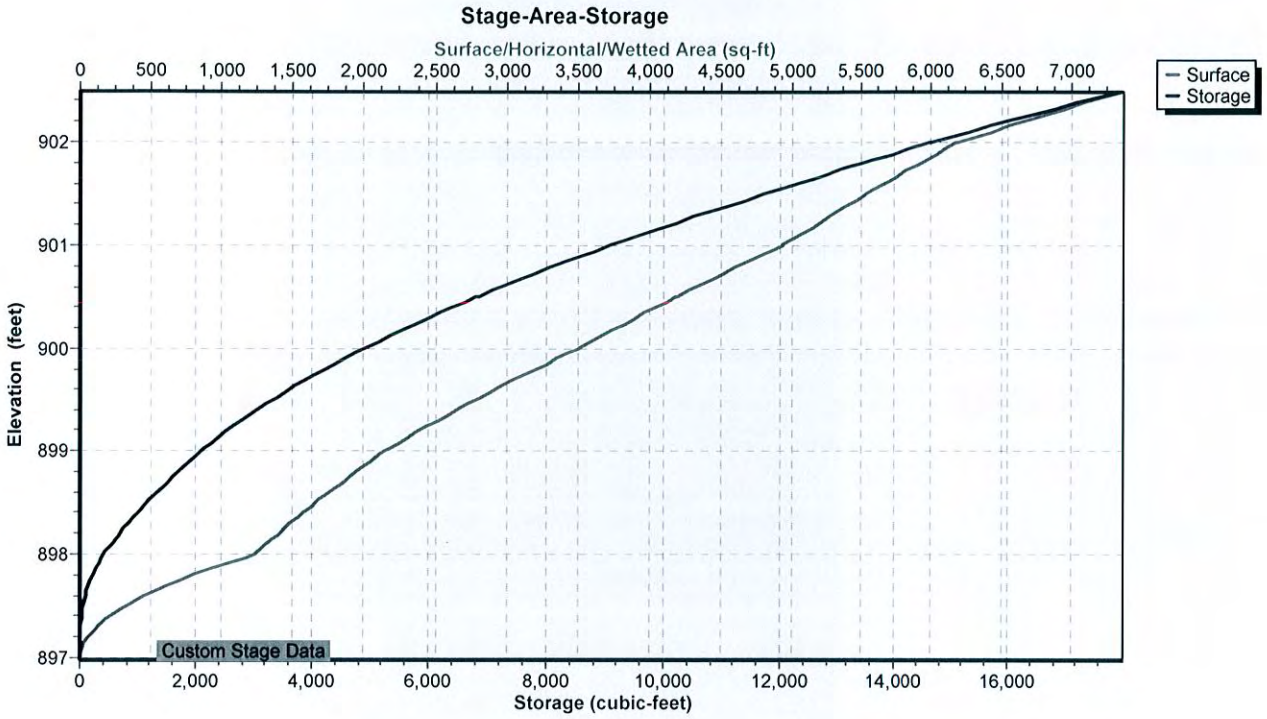
Pond 4P: detention



Pond 4P: detention



Pond 4P: detention



Hydrograph for Pond 4P: detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	896.98	0.00
0.50	0.00	0	896.98	0.00
1.00	0.00	0	896.98	0.00
1.50	0.00	0	896.98	0.00
2.00	0.00	0	896.98	0.00
2.50	0.00	0	896.98	0.00
3.00	0.00	0	896.98	0.00
3.50	0.00	0	896.98	0.00
4.00	0.00	0	896.98	0.00
4.50	0.00	0	896.98	0.00
5.00	0.00	0	896.98	0.00
5.50	0.00	0	896.98	0.00
6.00	0.01	0	897.01	0.01
6.50	0.01	0	897.04	0.01
7.00	0.02	0	897.06	0.02
7.50	0.03	0	897.07	0.03
8.00	0.04	1	897.09	0.04
8.50	0.05	1	897.11	0.05
9.00	0.07	1	897.13	0.07
9.50	0.09	2	897.15	0.09
10.00	0.11	3	897.18	0.11
10.50	0.17	6	897.22	0.16
11.00	0.25	11	897.28	0.25
11.50	0.45	31	897.41	0.43
12.00	**6.79**	**2,519**	**899.19**	**1.55**
12.50	**0.86**	**4,636**	**899.93**	**1.82**
13.00	0.47	2,647	899.24	1.57
13.50	0.35	886	898.34	1.16
14.00	0.27	13	897.30	0.28
14.50	0.23	10	897.27	0.23
15.00	0.21	8	897.26	0.21
15.50	0.19	7	897.24	0.19
16.00	0.16	6	897.22	0.17
16.50	0.15	5	897.21	0.15
17.00	0.14	4	897.20	0.14
17.50	0.13	4	897.19	0.13
18.00	0.13	4	897.19	0.13
18.50	0.12	3	897.18	0.12
19.00	0.11	3	897.17	0.11
19.50	0.10	3	897.16	0.10
20.00	0.09	2	897.15	0.09
20.50	0.09	2	897.15	0.09
21.00	0.09	2	897.15	0.09
21.50	0.08	2	897.15	0.08
22.00	0.08	2	897.15	0.08
22.50	0.08	2	897.14	0.08
23.00	0.08	2	897.14	0.08
23.50	0.08	2	897.14	0.08
24.00	0.08	2	897.14	0.08

Stage-Discharge for Pond 4P: detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
896.98	0.00	899.06	1.49	901.14	3.47
897.02	0.01	899.10	1.51	901.18	3.60
897.06	0.02	899.14	1.53	901.22	3.74
897.10	0.04	899.18	1.54	901.26	3.88
897.14	0.08	899.22	1.56	901.30	4.02
897.18	0.12	899.26	1.57	901.34	4.17
897.22	0.16	899.30	1.59	901.38	4.32
897.26	0.22	899.34	1.60	901.42	4.47
897.30	0.27	899.38	1.62	901.46	4.63
897.34	0.33	899.42	1.63	901.50	4.79
897.38	0.39	899.46	1.65	901.54	4.95
897.42	0.45	899.50	1.66	901.58	5.11
897.46	0.51	899.54	1.68	901.62	5.28
897.50	0.56	899.58	1.69	901.66	5.45
897.54	0.60	899.62	1.71	901.70	5.63
897.58	0.64	899.66	1.72	901.74	5.80
897.62	0.67	899.70	1.74	901.78	5.98
897.66	0.71	899.74	1.75	901.82	6.16
897.70	0.74	899.78	1.76	901.86	6.35
897.74	0.78	899.82	1.78	901.90	6.53
897.78	0.81	899.86	1.79	901.94	6.72
897.82	0.84	899.90	1.81	901.98	6.91
897.86	0.87	899.94	1.82	902.02	7.11
897.90	0.89	899.98	1.83	902.06	7.30
897.94	0.92	900.02	1.85	902.10	7.50
897.98	0.95	900.06	1.86	902.14	7.68
898.02	0.97	900.10	1.87	902.18	7.72
898.06	1.00	900.14	1.89	902.22	7.75
898.10	1.02	900.18	1.90	902.26	7.78
898.14	1.05	900.22	1.91	902.30	7.82
898.18	1.07	900.26	1.92	902.34	7.85
898.22	1.09	900.30	1.94	902.38	7.88
898.26	1.11	900.34	1.95	902.42	7.91
898.30	1.14	900.38	1.96	902.46	7.95
898.34	1.16	900.42	1.98	902.50	**7.98**
898.38	1.18	900.46	1.99		
898.42	1.20	900.50	2.00		
898.46	1.22	900.54	2.03		
898.50	1.24	900.58	2.08		
898.54	1.26	900.62	2.14		
898.58	1.28	900.66	2.21		
898.62	1.30	900.70	2.28		
898.66	1.32	900.74	2.37		
898.70	1.34	900.78	2.45		
898.74	1.35	900.82	2.55		
898.78	1.37	900.86	2.65		
898.82	1.39	900.90	2.75		
898.86	1.41	900.94	2.86		
898.90	1.42	900.98	2.97		
898.94	1.44	901.02	3.09		
898.98	1.46	901.06	3.21		
899.02	1.48	901.10	3.34		

Stage-Area-Storage for Pond 4P: detention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
896.98	0	0
897.08	12	0
897.18	47	3
897.28	107	11
897.38	190	25
897.48	297	49
897.58	427	85
897.68	582	136
897.78	760	203
897.88	962	288
897.98	1,187	396
898.08	1,299	521
898.18	1,380	655
898.28	1,464	797
898.38	1,551	948
898.48	1,640	1,108
898.58	1,732	1,276
898.68	1,826	1,454
898.78	1,923	1,642
898.88	2,022	1,839
898.98	2,123	2,046
899.08	2,240	2,264
899.18	2,364	2,494
899.28	2,490	2,737
899.38	2,620	2,992
899.48	2,753	3,261
899.58	2,890	3,543
899.68	3,029	3,839
899.78	3,173	4,149
899.88	3,319	4,474
899.98	3,469	4,813
900.08	3,604	5,167
900.18	3,737	5,534
900.28	3,873	5,914
900.38	4,011	6,308
900.48	4,152	6,717
900.58	4,295	7,139
900.68	4,440	7,576
900.78	4,588	8,027
900.88	4,738	8,493
900.98	4,891	8,975
901.08	5,017	9,470
901.18	5,137	9,978
901.28	5,259	10,498
901.38	5,382	11,030
901.48	5,506	11,574
901.58	5,632	12,131
901.68	5,759	12,701
901.78	5,888	13,283
901.88	6,018	13,878
901.98	6,150	14,487
902.08	6,359	15,111
902.18	6,592	15,759
902.28	6,829	16,430
902.38	7,070	17,125
902.48	**7,315**	**17,844**

Summary for Subcatchment 3S: SITE - POST DEVELOPED

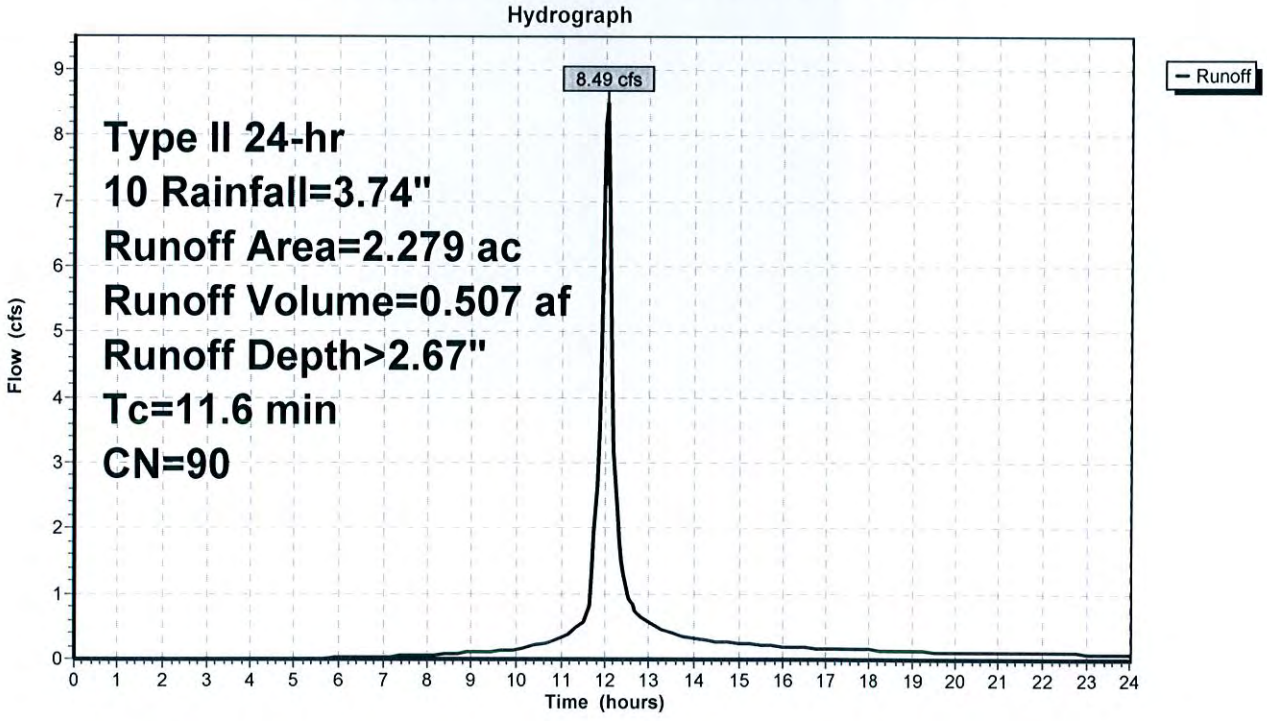
Runoff = 8.49 cfs @ 12.03 hrs, Volume= 0.507 af, Depth> 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=3.74"

	Area (ac)	CN	Description
*	1.527	98	impervious
*	0.752	74	pervious - good condition grass
	2.279	90	Weighted Average
	0.752		33.00% Pervious Area
	1.527		67.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6					**Direct Entry,**

Subcatchment 3S: SITE - POST DEVELOPED



Hydrograph for Subcatchment 3S: SITE - POST DEVELOPED

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.01	0.00	0.00
0.50	0.02	0.00	0.00
0.75	0.03	0.00	0.00
1.00	0.04	0.00	0.00
1.25	0.05	0.00	0.00
1.50	0.06	0.00	0.00
1.75	0.07	0.00	0.00
2.00	0.08	0.00	0.00
2.25	0.09	0.00	0.00
2.50	0.11	0.00	0.00
2.75	0.12	0.00	0.00
3.00	0.13	0.00	0.00
3.25	0.14	0.00	0.00
3.50	0.15	0.00	0.00
3.75	0.17	0.00	0.00
4.00	0.18	0.00	0.00
4.25	0.19	0.00	0.00
4.50	0.21	0.00	0.00
4.75	0.22	0.00	0.00
5.00	0.24	0.00	0.00
5.25	0.25	0.00	0.00
5.50	0.27	0.00	0.01
5.75	0.28	0.00	0.01
6.00	0.30	0.00	0.02
6.25	0.32	0.01	0.02
6.50	0.33	0.01	0.03
6.75	0.35	0.01	0.03
7.00	0.37	0.02	0.03
7.25	0.39	0.02	0.04
7.50	0.41	0.03	0.04
7.75	0.43	0.03	0.05
8.00	0.45	0.04	0.05
8.25	0.47	0.05	0.06
8.50	0.49	0.05	0.07
8.75	0.52	0.06	0.09
9.00	0.55	0.07	0.10
9.25	0.58	0.09	0.11
9.50	0.61	0.10	0.12
9.75	0.64	0.11	0.13
10.00	0.68	0.13	0.15
10.25	0.72	0.15	0.18
10.50	0.76	0.18	0.22
10.75	0.82	0.21	0.26
11.00	0.88	0.24	0.33
11.25	0.96	0.29	0.42
11.50	1.06	0.36	0.57
11.75	1.45	0.64	1.93
12.00	2.48	1.51	**8.18**
12.25	2.64	1.66	**2.31**
12.50	2.75	1.75	1.02
12.75	2.82	1.82	0.67
13.00	2.89	1.88	0.55
13.25	2.94	1.93	0.47
13.50	2.99	1.97	0.41
13.75	3.03	2.01	0.36
14.00	3.07	2.05	0.32
14.25	3.10	2.08	0.29
14.50	3.13	2.11	0.28
14.75	3.16	2.13	0.26
15.00	3.19	2.16	0.25
15.25	3.22	2.19	0.23
15.50	3.24	2.21	0.22
15.75	3.27	2.23	0.21
16.00	3.29	2.25	0.19
16.25	3.31	2.27	0.18
16.50	3.33	2.29	0.18
16.75	3.35	2.31	0.17
17.00	3.37	2.33	0.17
17.25	3.39	2.35	0.16
17.50	3.41	2.36	0.16
17.75	3.43	2.38	0.15
18.00	3.44	2.40	0.15
18.25	3.46	2.41	0.14
18.50	3.48	2.43	0.14
18.75	3.49	2.44	0.13
19.00	3.51	2.45	0.13
19.25	3.52	2.47	0.12
19.50	3.54	2.48	0.12
19.75	3.55	2.49	0.11
20.00	3.56	2.50	0.11
20.25	3.57	2.52	0.10
20.50	3.58	2.53	0.10
20.75	3.60	2.54	0.10
21.00	3.61	2.55	0.10
21.25	3.62	2.56	0.10
21.50	3.63	2.57	0.10
21.75	3.64	2.58	0.10
22.00	3.65	2.59	0.10
22.25	3.67	2.60	0.10
22.50	3.68	2.61	0.10
22.75	3.69	2.62	0.09
23.00	3.70	2.63	0.09
23.25	3.71	2.64	0.09
23.50	3.72	2.65	0.09
23.75	3.73	2.66	0.09
24.00	**3.74**	**2.67**	0.09

Summary for Pond 4P: detention

Inflow Area = 2.279 ac, 67.00% Impervious, Inflow Depth > 2.67" for 10 event
Inflow = 8.49 cfs @ 12.03 hrs, Volume= 0.507 af
Outflow = 1.99 cfs @ 12.28 hrs, Volume= 0.507 af, Atten= 77%, Lag= 15.2 min
Primary = 1.99 cfs @ 12.28 hrs, Volume= 0.507 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 900.47' @ 12.28 hrs Surf.Area= 4,138 sf Storage= 6,676 cf

Plug-Flow detention time= 22.5 min calculated for 0.507 af (100% of inflow)
Center-of-Mass det. time= 22.4 min (824.0 - 801.6)

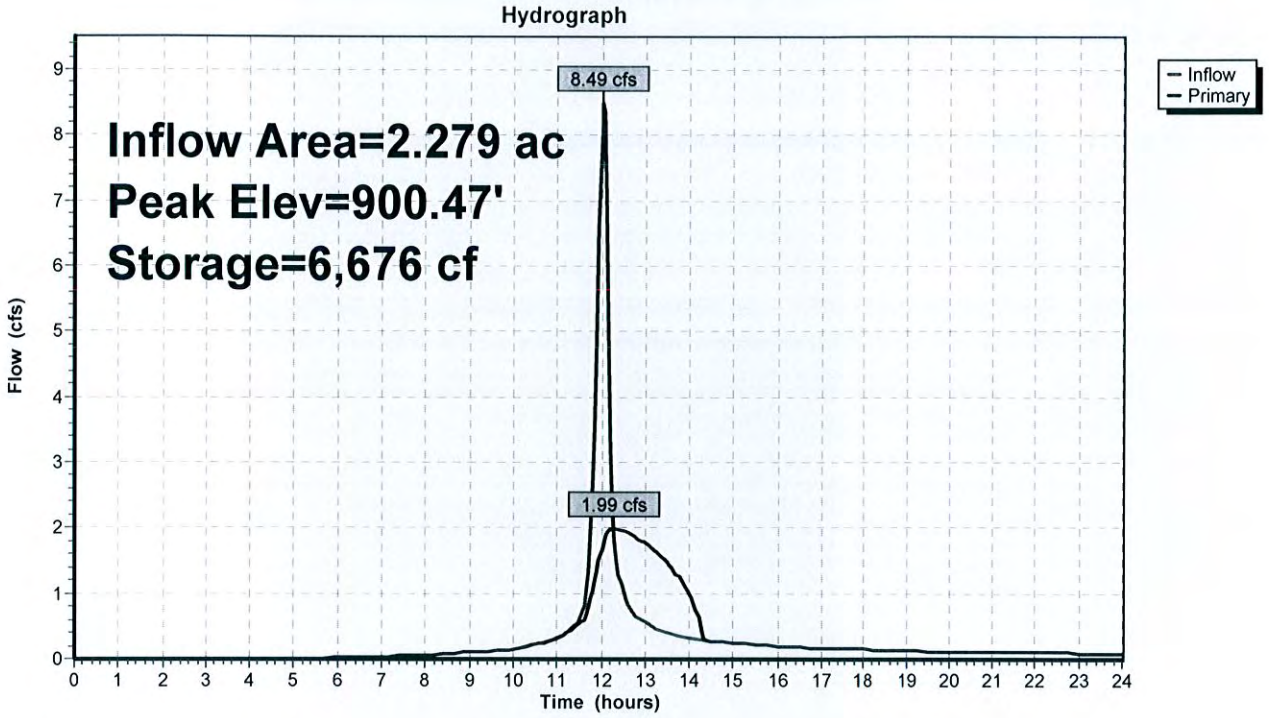
Volume	Invert	Avail.Storage	Storage Description
#1	896.98'	17,991 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
896.98	0	0	0	0
898.00	1,235	420	420	1,237
899.00	2,144	1,669	2,089	2,157
900.00	3,499	2,794	4,883	3,525
901.00	4,922	4,190	9,073	4,966
902.00	6,176	5,537	14,610	6,248
902.50	7,365	3,381	17,991	7,446

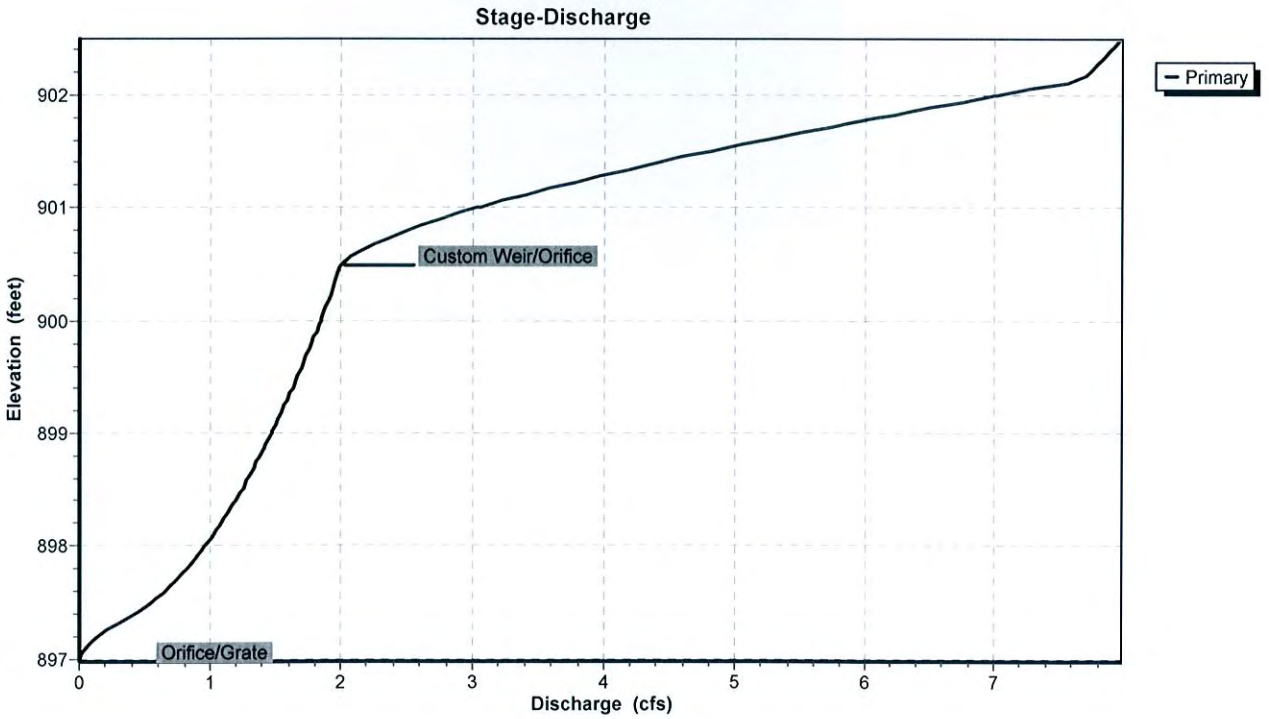
Device	Routing	Invert	Outlet Devices
#1	Primary	896.78'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 896.78' / 896.58' S= 0.0040 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	896.98'	**6.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	900.50'	**Custom Weir/Orifice, Cv= 1.00 (C= 1.25)** Head (feet) 0.00 2.00 Width (feet) 2.00 2.00

Primary OutFlow Max=1.99 cfs @ 12.28 hrs HW=900.47' (Free Discharge)
└**1=Culvert** (Passes 1.99 cfs of 6.11 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 1.99 cfs @ 8.64 fps)
└**3=Custom Weir/Orifice** (Controls 0.00 cfs)

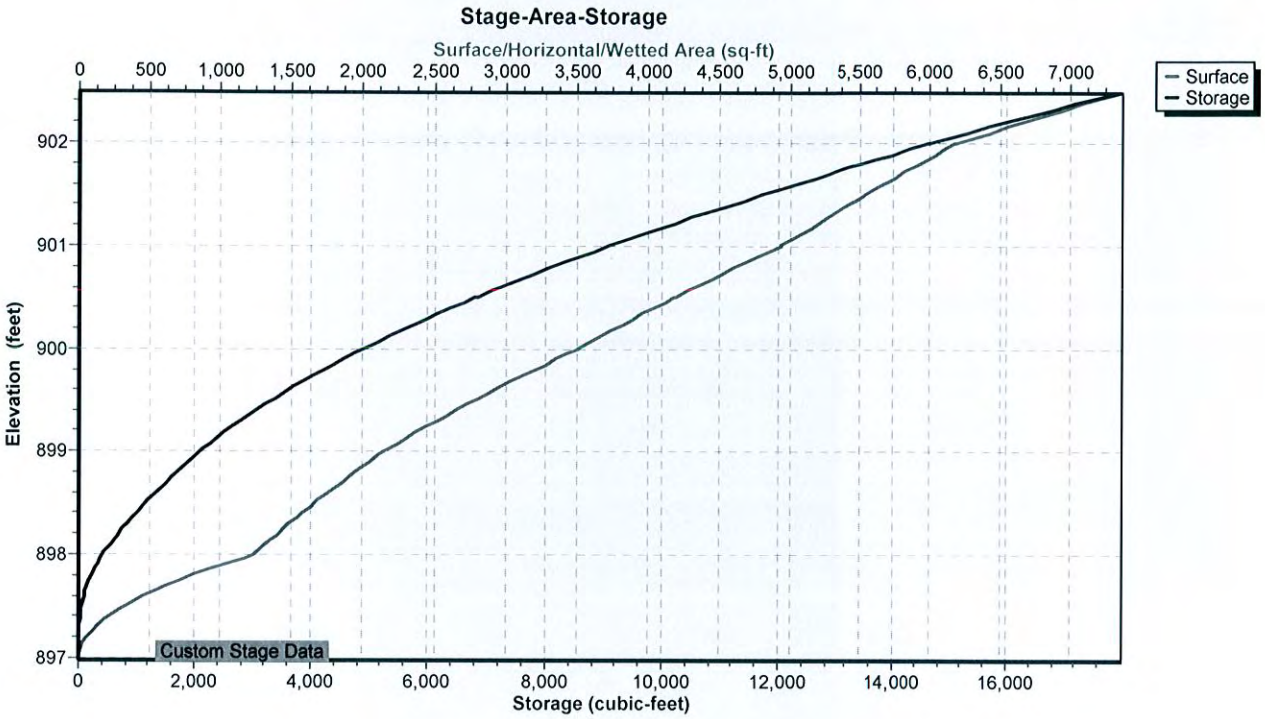
Pond 4P: detention



Pond 4P: detention



Pond 4P: detention



Hydrograph for Pond 4P: detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	896.98	0.00
0.50	0.00	0	896.98	0.00
1.00	0.00	0	896.98	0.00
1.50	0.00	0	896.98	0.00
2.00	0.00	0	896.98	0.00
2.50	0.00	0	896.98	0.00
3.00	0.00	0	896.98	0.00
3.50	0.00	0	896.98	0.00
4.00	0.00	0	896.98	0.00
4.50	0.00	0	896.98	0.00
5.00	0.00	0	896.99	0.00
5.50	0.01	0	897.03	0.01
6.00	0.02	0	897.05	0.02
6.50	0.03	0	897.06	0.03
7.00	0.03	0	897.08	0.03
7.50	0.04	1	897.10	0.04
8.00	0.05	1	897.11	0.05
8.50	0.07	2	897.13	0.07
9.00	0.10	3	897.16	0.10
9.50	0.12	3	897.18	0.12
10.00	0.15	5	897.21	0.15
10.50	0.22	9	897.26	0.21
11.00	0.33	17	897.33	0.32
11.50	0.57	50	897.48	0.54
12.00	**8.18**	**3,268**	**899.48**	**1.66**
12.50	**1.02**	**6,215**	**900.36**	**1.96**
13.00	0.55	4,127	899.77	1.76
13.50	0.41	2,055	898.98	1.46
14.00	0.32	472	898.04	0.99
14.50	0.28	13	897.30	0.28
15.00	0.25	11	897.28	0.25
15.50	0.22	9	897.26	0.22
16.00	0.19	7	897.24	0.19
16.50	0.18	6	897.23	0.18
17.00	0.17	6	897.22	0.17
17.50	0.16	5	897.21	0.16
18.00	0.15	5	897.21	0.15
18.50	0.14	4	897.20	0.14
19.00	0.13	4	897.19	0.13
19.50	0.12	3	897.18	0.12
20.00	0.11	3	897.17	0.11
20.50	0.10	3	897.17	0.10
21.00	0.10	3	897.16	0.10
21.50	0.10	3	897.16	0.10
22.00	0.10	2	897.16	0.10
22.50	0.10	2	897.16	0.10
23.00	0.09	2	897.16	0.09
23.50	0.09	2	897.15	0.09
24.00	0.09	2	897.15	0.09

Stage-Discharge for Pond 4P: detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
896.98	0.00	899.06	1.49	901.14	3.47
897.02	0.01	899.10	1.51	901.18	3.60
897.06	0.02	899.14	1.53	901.22	3.74
897.10	0.04	899.18	1.54	901.26	3.88
897.14	0.08	899.22	1.56	901.30	4.02
897.18	0.12	899.26	1.57	901.34	4.17
897.22	0.16	899.30	1.59	901.38	4.32
897.26	0.22	899.34	1.60	901.42	4.47
897.30	0.27	899.38	1.62	901.46	4.63
897.34	0.33	899.42	1.63	901.50	4.79
897.38	0.39	899.46	1.65	901.54	4.95
897.42	0.45	899.50	1.66	901.58	5.11
897.46	0.51	899.54	1.68	901.62	5.28
897.50	0.56	899.58	1.69	901.66	5.45
897.54	0.60	899.62	1.71	901.70	5.63
897.58	0.64	899.66	1.72	901.74	5.80
897.62	0.67	899.70	1.74	901.78	5.98
897.66	0.71	899.74	1.75	901.82	6.16
897.70	0.74	899.78	1.76	901.86	6.35
897.74	0.78	899.82	1.78	901.90	6.53
897.78	0.81	899.86	1.79	901.94	6.72
897.82	0.84	899.90	1.81	901.98	6.91
897.86	0.87	899.94	1.82	902.02	7.11
897.90	0.89	899.98	1.83	902.06	7.30
897.94	0.92	900.02	1.85	902.10	7.50
897.98	0.95	900.06	1.86	902.14	7.68
898.02	0.97	900.10	1.87	902.18	7.72
898.06	1.00	900.14	1.89	902.22	7.75
898.10	1.02	900.18	1.90	902.26	7.78
898.14	1.05	900.22	1.91	902.30	7.82
898.18	1.07	900.26	1.92	902.34	7.85
898.22	1.09	900.30	1.94	902.38	7.88
898.26	1.11	900.34	1.95	902.42	7.91
898.30	1.14	900.38	1.96	902.46	7.95
898.34	1.16	900.42	1.98	902.50	**7.98**
898.38	1.18	900.46	1.99		
898.42	1.20	900.50	2.00		
898.46	1.22	900.54	2.03		
898.50	1.24	900.58	2.08		
898.54	1.26	900.62	2.14		
898.58	1.28	900.66	2.21		
898.62	1.30	900.70	2.28		
898.66	1.32	900.74	2.37		
898.70	1.34	900.78	2.45		
898.74	1.35	900.82	2.55		
898.78	1.37	900.86	2.65		
898.82	1.39	900.90	2.75		
898.86	1.41	900.94	2.86		
898.90	1.42	900.98	2.97		
898.94	1.44	901.02	3.09		
898.98	1.46	901.06	3.21		
899.02	1.48	901.10	3.34		

Stage-Area-Storage for Pond 4P: detention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
896.98	0	0
897.08	12	0
897.18	47	3
897.28	107	11
897.38	190	25
897.48	297	49
897.58	427	85
897.68	582	136
897.78	760	203
897.88	962	288
897.98	1,187	396
898.08	1,299	521
898.18	1,380	655
898.28	1,464	797
898.38	1,551	948
898.48	1,640	1,108
898.58	1,732	1,276
898.68	1,826	1,454
898.78	1,923	1,642
898.88	2,022	1,839
898.98	2,123	2,046
899.08	2,240	2,264
899.18	2,364	2,494
899.28	2,490	2,737
899.38	2,620	2,992
899.48	2,753	3,261
899.58	2,890	3,543
899.68	3,029	3,839
899.78	3,173	4,149
899.88	3,319	4,474
899.98	3,469	4,813
900.08	3,604	5,167
900.18	3,737	5,534
900.28	3,873	5,914
900.38	4,011	6,308
900.48	4,152	6,717
900.58	4,295	7,139
900.68	4,440	7,576
900.78	4,588	8,027
900.88	4,738	8,493
900.98	4,891	8,975
901.08	5,017	9,470
901.18	5,137	9,978
901.28	5,259	10,498
901.38	5,382	11,030
901.48	5,506	11,574
901.58	5,632	12,131
901.68	5,759	12,701
901.78	5,888	13,283
901.88	6,018	13,878
901.98	6,150	14,487
902.08	6,359	15,111
902.18	6,592	15,759
902.28	6,829	16,430
902.38	7,070	17,125
902.48	**7,315**	**17,844**

Summary for Subcatchment 3S: SITE - POST DEVELOPED

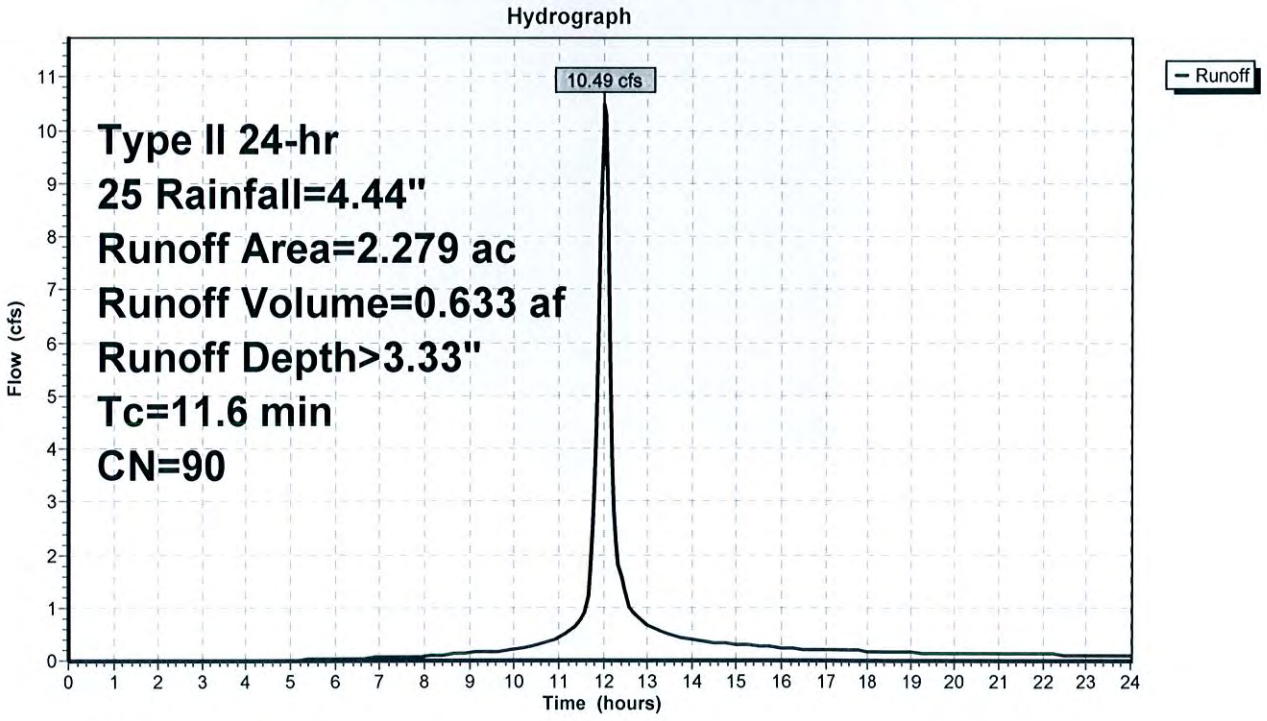
Runoff = 10.49 cfs @ 12.03 hrs, Volume= 0.633 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Rainfall=4.44"

	Area (ac)	CN	Description
*	1.527	98	impervious
*	0.752	74	pervious - good condition grass
	2.279	90	Weighted Average
	0.752		33.00% Pervious Area
	1.527		67.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6					**Direct Entry,**

Subcatchment 3S: SITE - POST DEVELOPED



Hydrograph for Subcatchment 3S: SITE - POST DEVELOPED

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.01	0.00	0.00
0.50	0.02	0.00	0.00
0.75	0.03	0.00	0.00
1.00	0.05	0.00	0.00
1.25	0.06	0.00	0.00
1.50	0.07	0.00	0.00
1.75	0.08	0.00	0.00
2.00	0.10	0.00	0.00
2.25	0.11	0.00	0.00
2.50	0.12	0.00	0.00
2.75	0.14	0.00	0.00
3.00	0.15	0.00	0.00
3.25	0.17	0.00	0.00
3.50	0.18	0.00	0.00
3.75	0.20	0.00	0.00
4.00	0.21	0.00	0.00
4.25	0.23	0.00	0.00
4.50	0.25	0.00	0.00
4.75	0.26	0.00	0.01
5.00	0.28	0.00	0.01
5.25	0.30	0.00	0.02
5.50	0.32	0.01	0.02
5.75	0.34	0.01	0.03
6.00	0.36	0.01	0.03
6.25	0.38	0.02	0.04
6.50	0.40	0.02	0.04
6.75	0.42	0.03	0.05
7.00	0.44	0.04	0.06
7.25	0.46	0.04	0.06
7.50	0.49	0.05	0.07
7.75	0.51	0.06	0.08
8.00	0.53	0.07	0.08
8.25	0.56	0.08	0.09
8.50	0.59	0.09	0.11
8.75	0.62	0.10	0.12
9.00	0.65	0.12	0.14
9.25	0.69	0.14	0.16
9.50	0.72	0.16	0.17
9.75	0.76	0.18	0.18
10.00	0.80	0.20	0.21
10.25	0.85	0.23	0.25
10.50	0.91	0.26	0.29
10.75	0.97	0.30	0.35
11.00	1.04	0.35	0.43
11.25	1.14	0.41	0.55
11.50	1.26	0.50	0.74
11.75	1.72	0.86	2.47
12.00	2.94	1.93	**10.13**
12.25	3.14	2.11	**2.83**
12.50	3.26	2.23	1.25
12.75	3.35	2.31	0.81
13.00	3.43	2.38	0.67
13.25	3.49	2.44	0.57
13.50	3.55	2.49	0.50
13.75	3.60	2.54	0.44
14.00	3.64	2.58	0.39
14.25	3.68	2.62	0.35
14.50	3.72	2.65	0.33
14.75	3.76	2.69	0.32
15.00	3.79	2.72	0.30
15.25	3.82	2.75	0.28
15.50	3.85	2.78	0.27
15.75	3.88	2.81	0.25
16.00	3.91	2.83	0.23
16.25	3.93	2.86	0.22
16.50	3.96	2.88	0.21
16.75	3.98	2.90	0.21
17.00	4.00	2.92	0.20
17.25	4.03	2.94	0.20
17.50	4.05	2.96	0.19
17.75	4.07	2.98	0.18
18.00	4.09	3.00	0.18
18.25	4.11	3.02	0.17
18.50	4.13	3.04	0.17
18.75	4.15	3.06	0.16
19.00	4.16	3.07	0.15
19.25	4.18	3.09	0.15
19.50	4.20	3.11	0.14
19.75	4.21	3.12	0.14
20.00	4.23	3.13	0.13
20.25	4.24	3.15	0.13
20.50	4.26	3.16	0.12
20.75	4.27	3.18	0.12
21.00	4.28	3.19	0.12
21.25	4.30	3.20	0.12
21.50	4.31	3.22	0.12
21.75	4.32	3.23	0.12
22.00	4.34	3.24	0.12
22.25	4.35	3.25	0.12
22.50	4.36	3.27	0.12
22.75	4.38	3.28	0.11
23.00	4.39	3.29	0.11
23.25	4.40	3.30	0.11
23.50	4.42	3.31	0.11
23.75	4.43	3.33	0.11
24.00	**4.44**	**3.34**	0.11

Summary for Pond 4P: detention

Inflow Area = 2.279 ac, 67.00% Impervious, Inflow Depth > 3.33" for 25 event
Inflow = 10.49 cfs @ 12.03 hrs, Volume= 0.633 af
Outflow = 2.75 cfs @ 12.26 hrs, Volume= 0.633 af, Atten= 74%, Lag= 14.0 min
Primary = 2.75 cfs @ 12.26 hrs, Volume= 0.633 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 900.90' @ 12.26 hrs Surf.Area= 4,768 sf Storage= 8,585 cf

Plug-Flow detention time= 25.8 min calculated for 0.633 af (100% of inflow)
Center-of-Mass det. time= 25.8 min (821.2 - 795.4)

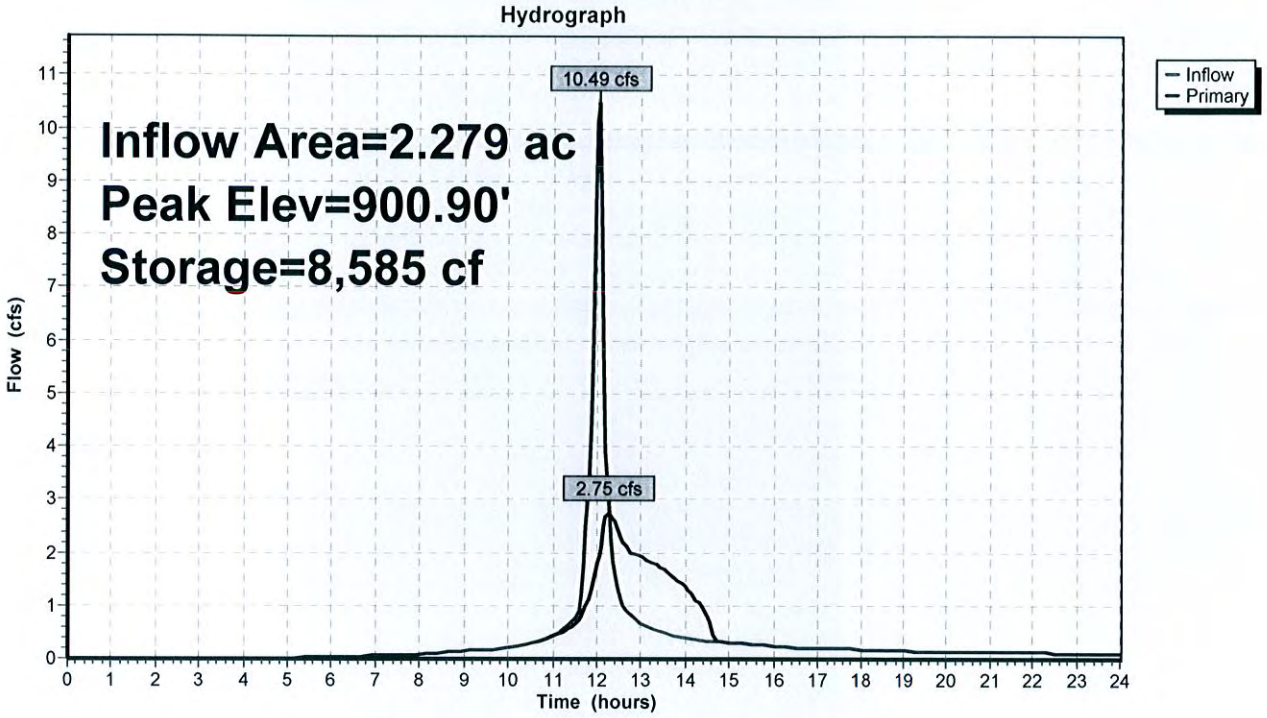
Volume	Invert	Avail.Storage	Storage Description
#1	896.98'	17,991 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
896.98	0	0	0	0
898.00	1,235	420	420	1,237
899.00	2,144	1,669	2,089	2,157
900.00	3,499	2,794	4,883	3,525
901.00	4,922	4,190	9,073	4,966
902.00	6,176	5,537	14,610	6,248
902.50	7,365	3,381	17,991	7,446

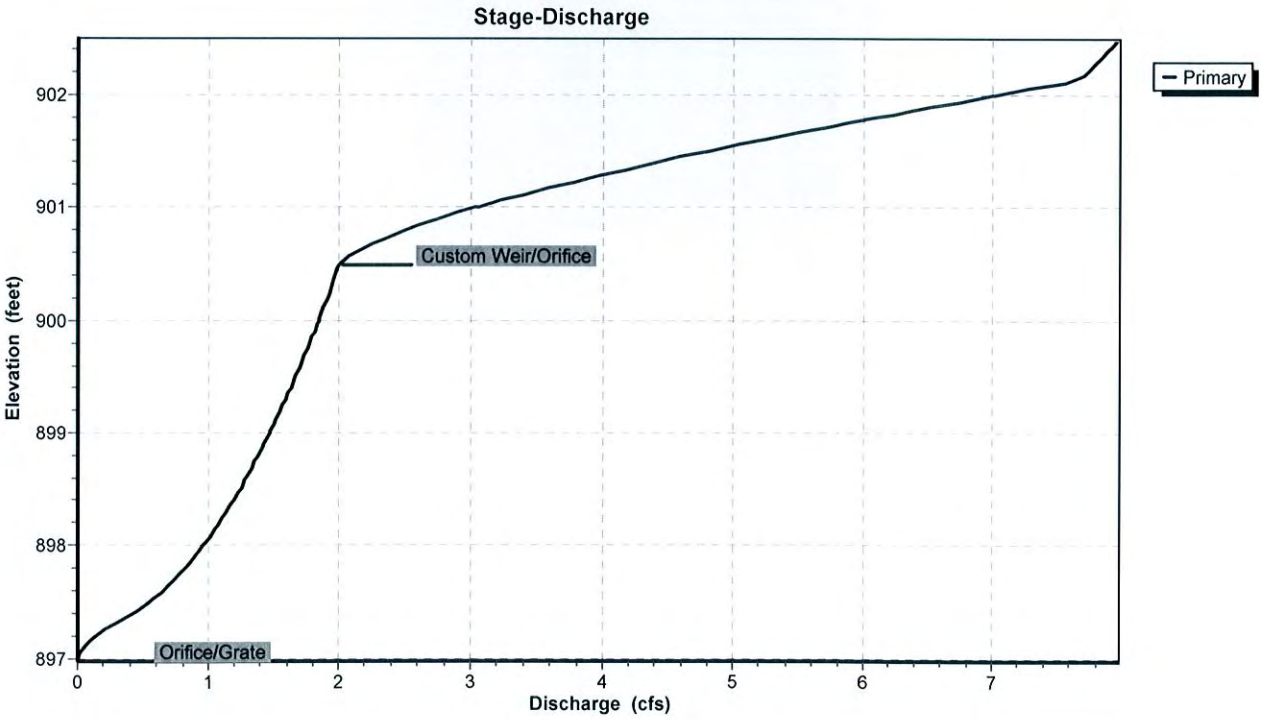
Device	Routing	Invert	Outlet Devices
#1	Primary	896.78'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 896.78' / 896.58' S= 0.0040 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	896.98'	**6.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	900.50'	**Custom Weir/Orifice, Cv= 1.00 (C= 1.25)** Head (feet) 0.00 2.00 Width (feet) 2.00 2.00

Primary OutFlow Max=2.74 cfs @ 12.26 hrs HW=900.90' (Free Discharge)
└**1=Culvert** (Passes 2.74 cfs of 6.55 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 2.12 cfs @ 9.19 fps)
  └**3=Custom Weir/Orifice** (Weir Controls 0.62 cfs @ 0.79 fps)

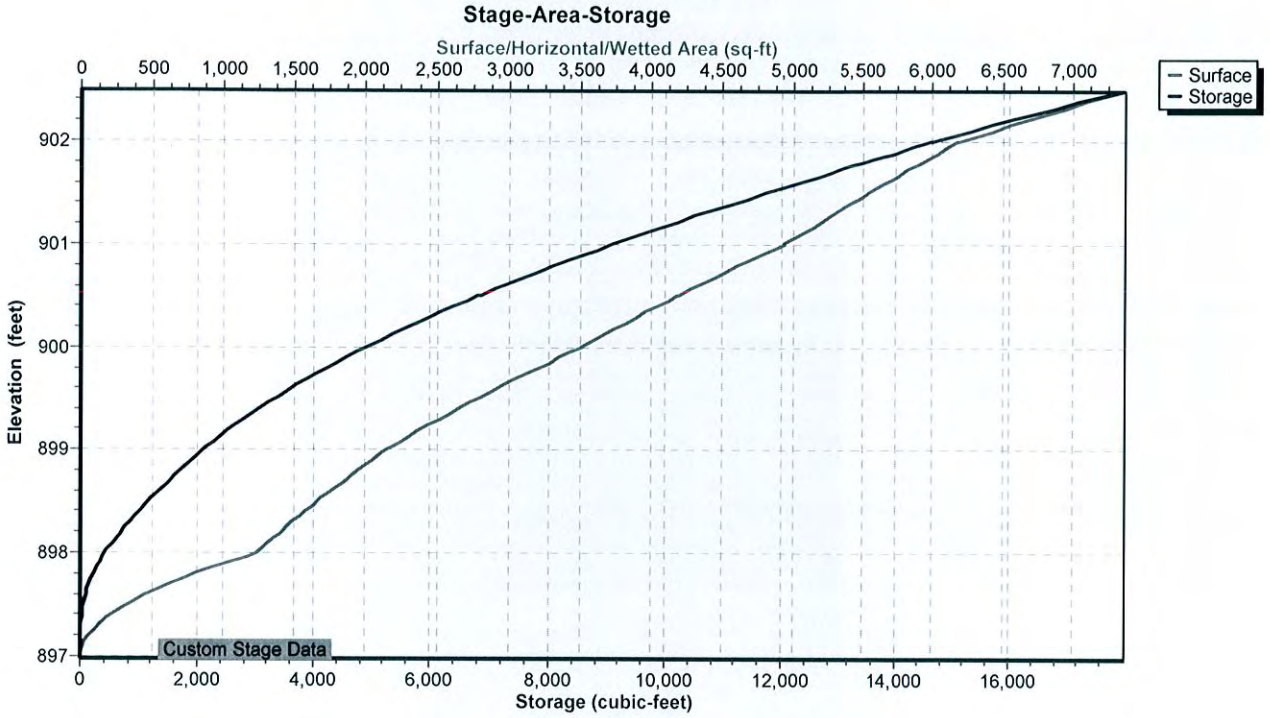
Pond 4P: detention



Pond 4P: detention



Pond 4P: detention



Hydrograph for Pond 4P: detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	896.98	0.00
0.50	0.00	0	896.98	0.00
1.00	0.00	0	896.98	0.00
1.50	0.00	0	896.98	0.00
2.00	0.00	0	896.98	0.00
2.50	0.00	0	896.98	0.00
3.00	0.00	0	896.98	0.00
3.50	0.00	0	896.98	0.00
4.00	0.00	0	896.98	0.00
4.50	0.00	0	897.00	0.00
5.00	0.01	0	897.04	0.01
5.50	0.02	0	897.06	0.02
6.00	0.03	0	897.08	0.03
6.50	0.04	1	897.10	0.04
7.00	0.06	1	897.11	0.06
7.50	0.07	1	897.13	0.07
8.00	0.08	2	897.15	0.08
8.50	0.11	3	897.17	0.11
9.00	0.14	4	897.20	0.14
9.50	0.17	6	897.22	0.17
10.00	0.21	8	897.25	0.21
10.50	0.29	14	897.31	0.29
11.00	0.43	29	897.40	0.42
11.50	0.74	98	897.61	0.66
12.00	**10.13**	**4,374**	**899.85**	**1.79**
12.50	**1.25**	**7,871**	**900.75**	**2.38**
13.00	0.67	5,706	900.23	1.91
13.50	0.50	3,483	899.56	1.69
14.00	0.39	1,524	898.72	1.34
14.50	0.33	190	897.76	0.79
15.00	0.30	16	897.32	0.30
15.50	0.27	13	897.30	0.27
16.00	0.23	10	897.27	0.24
16.50	0.21	9	897.26	0.22
17.00	0.20	8	897.25	0.20
17.50	0.19	7	897.24	0.19
18.00	0.18	6	897.23	0.18
18.50	0.17	6	897.22	0.17
19.00	0.15	5	897.21	0.16
19.50	0.14	4	897.20	0.14
20.00	0.13	4	897.19	0.13
20.50	0.12	4	897.19	0.12
21.00	0.12	3	897.18	0.12
21.50	0.12	3	897.18	0.12
22.00	0.12	3	897.18	0.12
22.50	0.12	3	897.18	0.12
23.00	0.11	3	897.17	0.11
23.50	0.11	3	897.17	0.11
24.00	0.11	3	897.17	0.11

Stage-Discharge for Pond 4P: detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
896.98	0.00	899.06	1.49	901.14	3.47
897.02	0.01	899.10	1.51	901.18	3.60
897.06	0.02	899.14	1.53	901.22	3.74
897.10	0.04	899.18	1.54	901.26	3.88
897.14	0.08	899.22	1.56	901.30	4.02
897.18	0.12	899.26	1.57	901.34	4.17
897.22	0.16	899.30	1.59	901.38	4.32
897.26	0.22	899.34	1.60	901.42	4.47
897.30	0.27	899.38	1.62	901.46	4.63
897.34	0.33	899.42	1.63	901.50	4.79
897.38	0.39	899.46	1.65	901.54	4.95
897.42	0.45	899.50	1.66	901.58	5.11
897.46	0.51	899.54	1.68	901.62	5.28
897.50	0.56	899.58	1.69	901.66	5.45
897.54	0.60	899.62	1.71	901.70	5.63
897.58	0.64	899.66	1.72	901.74	5.80
897.62	0.67	899.70	1.74	901.78	5.98
897.66	0.71	899.74	1.75	901.82	6.16
897.70	0.74	899.78	1.76	901.86	6.35
897.74	0.78	899.82	1.78	901.90	6.53
897.78	0.81	899.86	1.79	901.94	6.72
897.82	0.84	899.90	1.81	901.98	6.91
897.86	0.87	899.94	1.82	902.02	7.11
897.90	0.89	899.98	1.83	902.06	7.30
897.94	0.92	900.02	1.85	902.10	7.50
897.98	0.95	900.06	1.86	902.14	7.68
898.02	0.97	900.10	1.87	902.18	7.72
898.06	1.00	900.14	1.89	902.22	7.75
898.10	1.02	900.18	1.90	902.26	7.78
898.14	1.05	900.22	1.91	902.30	7.82
898.18	1.07	900.26	1.92	902.34	7.85
898.22	1.09	900.30	1.94	902.38	7.88
898.26	1.11	900.34	1.95	902.42	7.91
898.30	1.14	900.38	1.96	902.46	7.95
898.34	1.16	900.42	1.98	902.50	**7.98**
898.38	1.18	900.46	1.99		
898.42	1.20	900.50	2.00		
898.46	1.22	900.54	2.03		
898.50	1.24	900.58	2.08		
898.54	1.26	900.62	2.14		
898.58	1.28	900.66	2.21		
898.62	1.30	900.70	2.28		
898.66	1.32	900.74	2.37		
898.70	1.34	900.78	2.45		
898.74	1.35	900.82	2.55		
898.78	1.37	900.86	2.65		
898.82	1.39	900.90	2.75		
898.86	1.41	900.94	2.86		
898.90	1.42	900.98	2.97		
898.94	1.44	901.02	3.09		
898.98	1.46	901.06	3.21		
899.02	1.48	901.10	3.34		

Stage-Area-Storage for Pond 4P: detention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
896.98	0	0
897.08	12	0
897.18	47	3
897.28	107	11
897.38	190	25
897.48	297	49
897.58	427	85
897.68	582	136
897.78	760	203
897.88	962	288
897.98	1,187	396
898.08	1,299	521
898.18	1,380	655
898.28	1,464	797
898.38	1,551	948
898.48	1,640	1,108
898.58	1,732	1,276
898.68	1,826	1,454
898.78	1,923	1,642
898.88	2,022	1,839
898.98	2,123	2,046
899.08	2,240	2,264
899.18	2,364	2,494
899.28	2,490	2,737
899.38	2,620	2,992
899.48	2,753	3,261
899.58	2,890	3,543
899.68	3,029	3,839
899.78	3,173	4,149
899.88	3,319	4,474
899.98	3,469	4,813
900.08	3,604	5,167
900.18	3,737	5,534
900.28	3,873	5,914
900.38	4,011	6,308
900.48	4,152	6,717
900.58	4,295	7,139
900.68	4,440	7,576
900.78	4,588	8,027
900.88	4,738	8,493
900.98	4,891	8,975
901.08	5,017	9,470
901.18	5,137	9,978
901.28	5,259	10,498
901.38	5,382	11,030
901.48	5,506	11,574
901.58	5,632	12,131
901.68	5,759	12,701
901.78	5,888	13,283
901.88	6,018	13,878
901.98	6,150	14,487
902.08	6,359	15,111
902.18	6,592	15,759
902.28	6,829	16,430
902.38	7,070	17,125
902.48	**7,315**	**17,844**

Summary for Subcatchment 3S: SITE - POST DEVELOPED

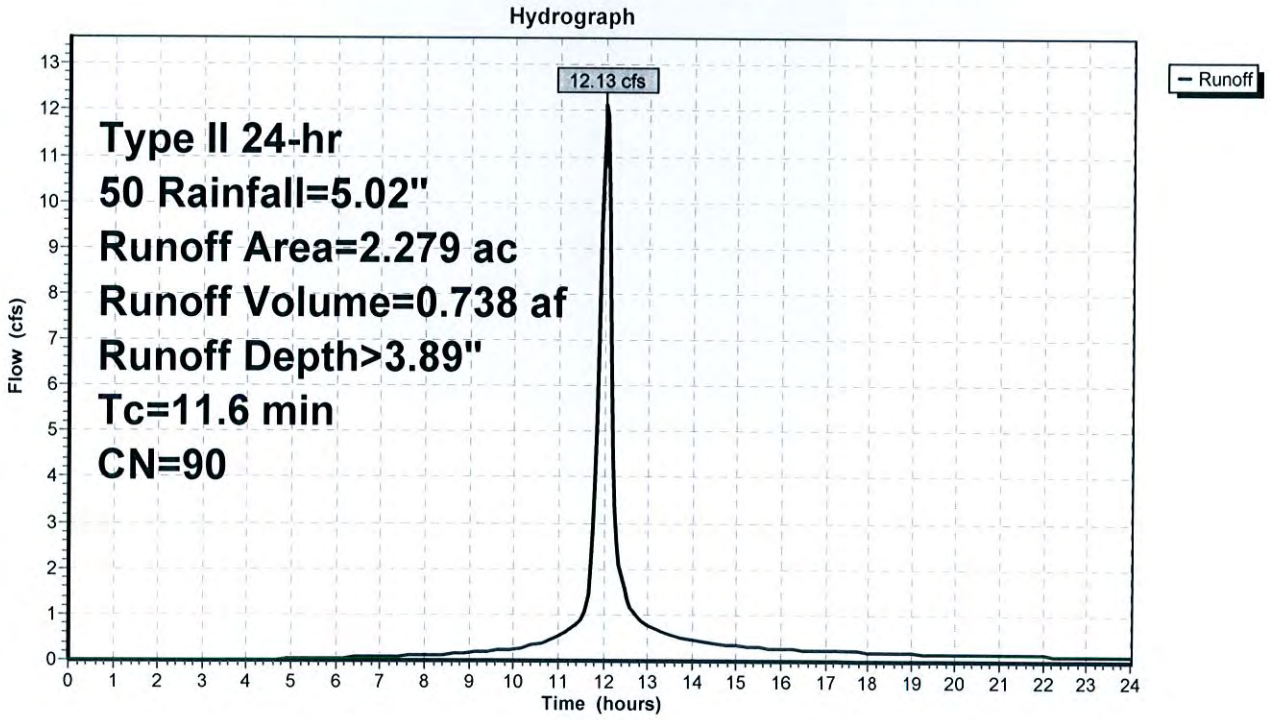
Runoff = 12.13 cfs @ 12.03 hrs, Volume= 0.738 af, Depth> 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 50 Rainfall=5.02"

	Area (ac)	CN	Description
*	1.527	98	impervious
*	0.752	74	pervious - good condition grass
	2.279	90	Weighted Average
	0.752		33.00% Pervious Area
	1.527		67.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6					**Direct Entry,**

Subcatchment 3S: SITE - POST DEVELOPED



Hydrograph for Subcatchment 3S: SITE - POST DEVELOPED

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.01	0.00	0.00
0.50	0.03	0.00	0.00
0.75	0.04	0.00	0.00
1.00	0.05	0.00	0.00
1.25	0.07	0.00	0.00
1.50	0.08	0.00	0.00
1.75	0.10	0.00	0.00
2.00	0.11	0.00	0.00
2.25	0.13	0.00	0.00
2.50	0.14	0.00	0.00
2.75	0.16	0.00	0.00
3.00	0.17	0.00	0.00
3.25	0.19	0.00	0.00
3.50	0.21	0.00	0.00
3.75	0.22	0.00	0.00
4.00	0.24	0.00	0.00
4.25	0.26	0.00	0.01
4.50	0.28	0.00	0.01
4.75	0.30	0.00	0.02
5.00	0.32	0.01	0.02
5.25	0.34	0.01	0.03
5.50	0.36	0.01	0.04
5.75	0.38	0.02	0.04
6.00	0.40	0.02	0.05
6.25	0.42	0.03	0.06
6.50	0.45	0.04	0.06
6.75	0.47	0.05	0.07
7.00	0.50	0.05	0.08
7.25	0.52	0.06	0.08
7.50	0.55	0.07	0.09
7.75	0.58	0.09	0.10
8.00	0.60	0.10	0.11
8.25	0.63	0.11	0.12
8.50	0.66	0.13	0.14
8.75	0.70	0.14	0.16
9.00	0.74	0.16	0.18
9.25	0.78	0.19	0.20
9.50	0.82	0.21	0.21
9.75	0.86	0.23	0.22
10.00	0.91	0.26	0.26
10.25	0.96	0.30	0.30
10.50	1.02	0.34	0.36
10.75	1.10	0.38	0.43
11.00	1.18	0.44	0.52
11.25	1.29	0.52	0.66
11.50	1.42	0.62	0.89
11.75	1.94	1.05	2.91
12.00	3.33	2.29	**11.74**
12.25	3.54	2.49	**3.26**
12.50	3.69	2.63	1.43
12.75	3.79	2.72	0.93
13.00	3.88	2.80	0.77
13.25	3.95	2.87	0.65
13.50	4.01	2.93	0.57
13.75	4.07	2.98	0.50
14.00	4.12	3.03	0.44
14.25	4.16	3.07	0.40
14.50	4.20	3.11	0.38
14.75	4.25	3.15	0.36
15.00	4.28	3.19	0.34
15.25	4.32	3.22	0.32
15.50	4.36	3.26	0.31
15.75	4.39	3.29	0.29
16.00	4.42	3.32	0.27
16.25	4.45	3.34	0.25
16.50	4.47	3.37	0.25
16.75	4.50	3.40	0.24
17.00	4.53	3.42	0.23
17.25	4.55	3.45	0.22
17.50	4.58	3.47	0.22
17.75	4.60	3.49	0.21
18.00	4.62	3.51	0.20
18.25	4.65	3.54	0.20
18.50	4.67	3.56	0.19
18.75	4.69	3.58	0.18
19.00	4.71	3.59	0.18
19.25	4.73	3.61	0.17
19.50	4.74	3.63	0.16
19.75	4.76	3.65	0.16
20.00	4.78	3.66	0.15
20.25	4.80	3.68	0.14
20.50	4.81	3.69	0.14
20.75	4.83	3.71	0.14
21.00	4.84	3.73	0.14
21.25	4.86	3.74	0.14
21.50	4.87	3.75	0.14
21.75	4.89	3.77	0.14
22.00	4.90	3.78	0.13
22.25	4.92	3.80	0.13
22.50	4.93	3.81	0.13
22.75	4.95	3.83	0.13
23.00	4.96	3.84	0.13
23.25	4.98	3.85	0.13
23.50	4.99	3.87	0.13
23.75	5.01	3.88	0.12
24.00	**5.02**	**3.90**	0.12

Summary for Pond 4P: detention

Inflow Area = 2.279 ac, 67.00% Impervious, Inflow Depth > 3.89" for 50 event
Inflow = 12.13 cfs @ 12.03 hrs, Volume= 0.738 af
Outflow = 3.60 cfs @ 12.24 hrs, Volume= 0.738 af, Atten= 70%, Lag= 12.7 min
Primary = 3.60 cfs @ 12.24 hrs, Volume= 0.738 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 901.18' @ 12.24 hrs Surf.Area= 5,136 sf Storage= 9,973 cf

Plug-Flow detention time= 26.6 min calculated for 0.738 af (100% of inflow)
Center-of-Mass det. time= 26.5 min (817.7 - 791.2)

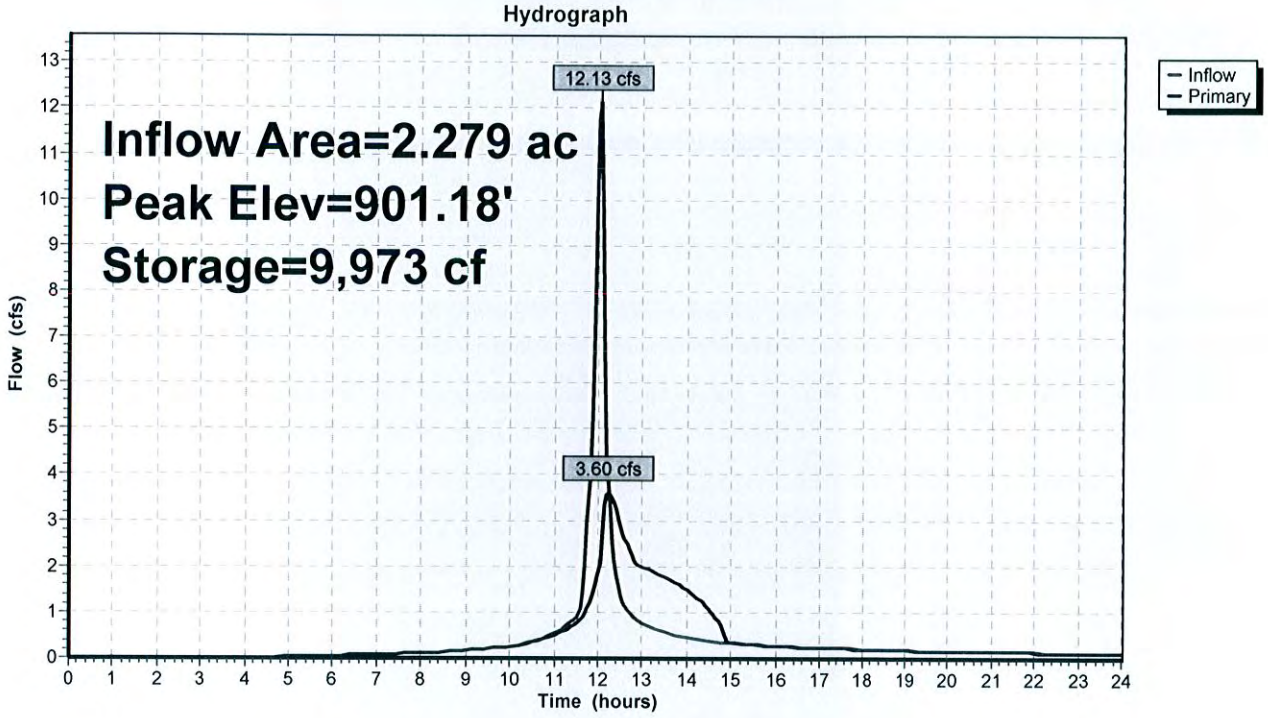
Volume	Invert	Avail.Storage	Storage Description
#1	896.98'	17,991 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
896.98	0	0	0	0
898.00	1,235	420	420	1,237
899.00	2,144	1,669	2,089	2,157
900.00	3,499	2,794	4,883	3,525
901.00	4,922	4,190	9,073	4,966
902.00	6,176	5,537	14,610	6,248
902.50	7,365	3,381	17,991	7,446

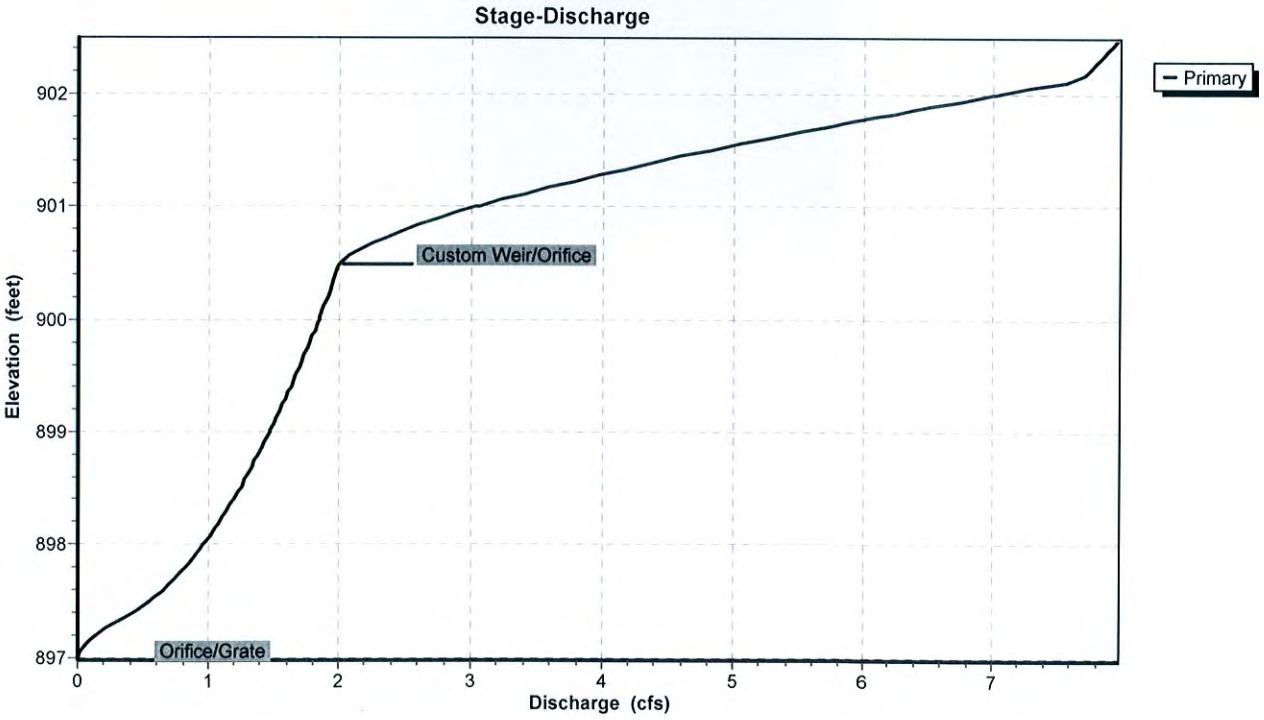
Device	Routing	Invert	Outlet Devices
#1	Primary	896.78'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 896.78' / 896.58' S= 0.0040 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	896.98'	**6.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	900.50'	**Custom Weir/Orifice, Cv= 1.00 (C= 1.25)** Head (feet) 0.00 2.00 Width (feet) 2.00 2.00

Primary OutFlow Max=3.59 cfs @ 12.24 hrs HW=901.18' (Free Discharge)
└**1=Culvert** (Passes 3.59 cfs of 6.82 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 2.20 cfs @ 9.54 fps)
  └**3=Custom Weir/Orifice** (Weir Controls 1.39 cfs @ 1.03 fps)

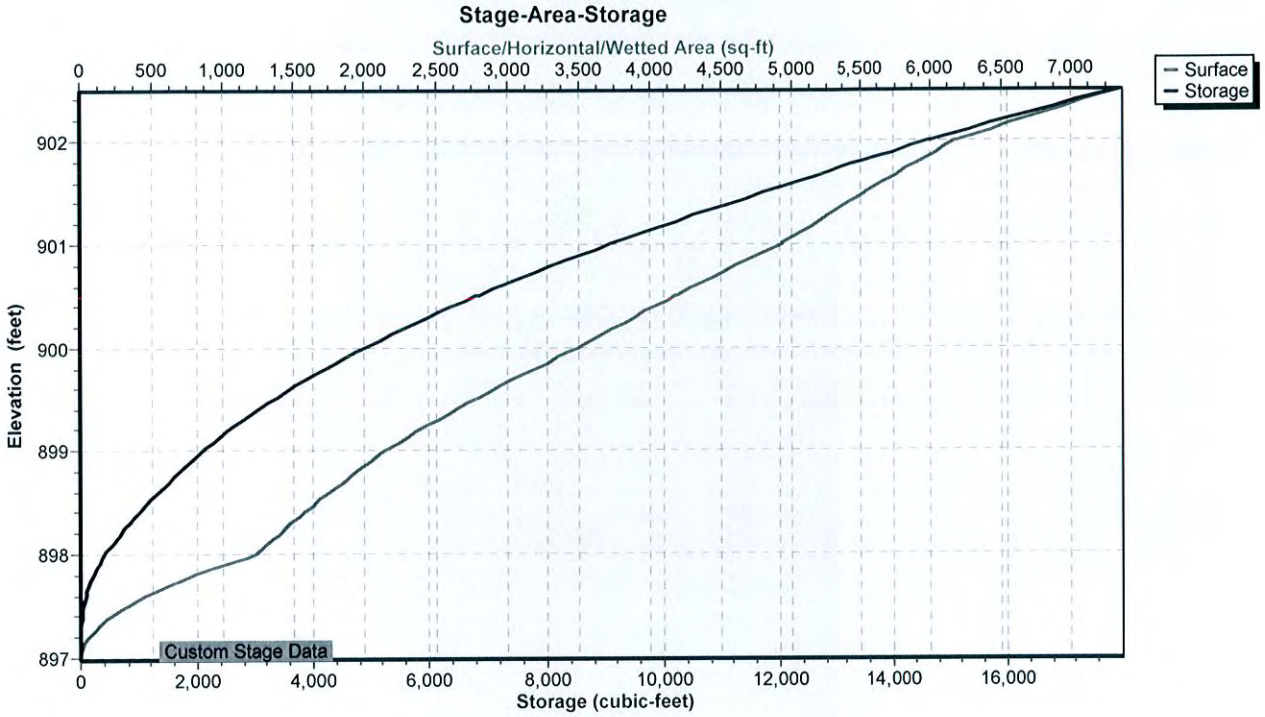
Pond 4P: detention



Pond 4P: detention



Pond 4P: detention



Hydrograph for Pond 4P: detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	896.98	0.00
0.50	0.00	0	896.98	0.00
1.00	0.00	0	896.98	0.00
1.50	0.00	0	896.98	0.00
2.00	0.00	0	896.98	0.00
2.50	0.00	0	896.98	0.00
3.00	0.00	0	896.98	0.00
3.50	0.00	0	896.98	0.00
4.00	0.00	0	896.99	0.00
4.50	0.01	0	897.04	0.01
5.00	0.02	0	897.06	0.02
5.50	0.04	0	897.09	0.04
6.00	0.05	1	897.10	0.05
6.50	0.06	1	897.12	0.06
7.00	0.08	2	897.14	0.08
7.50	0.09	2	897.15	0.09
8.00	0.11	3	897.17	0.11
8.50	0.14	4	897.20	0.14
9.00	0.18	6	897.23	0.18
9.50	0.21	8	897.25	0.21
10.00	0.26	12	897.29	0.26
10.50	0.36	21	897.35	0.35
11.00	0.52	42	897.45	0.50
11.50	0.89	156	897.71	0.75
12.00	**11.74**	**5,334**	**900.13**	**1.88**
12.50	**1.43**	**8,878**	**900.96**	**2.92**
13.00	0.77	6,480	900.42	1.98
13.50	0.57	4,270	899.82	1.78
14.00	0.44	2,215	899.06	1.49
14.50	0.38	627	898.16	1.06
15.00	0.34	20	897.35	0.35
15.50	0.31	16	897.32	0.31
16.00	0.27	13	897.30	0.27
16.50	0.25	11	897.28	0.25
17.00	0.23	10	897.27	0.23
17.50	0.22	9	897.26	0.22
18.00	0.20	8	897.25	0.20
18.50	0.19	7	897.24	0.19
19.00	0.18	6	897.23	0.18
19.50	0.16	6	897.22	0.16
20.00	0.15	5	897.21	0.15
20.50	0.14	4	897.20	0.14
21.00	0.14	4	897.20	0.14
21.50	0.14	4	897.20	0.14
22.00	0.13	4	897.19	0.13
22.50	0.13	4	897.19	0.13
23.00	0.13	4	897.19	0.13
23.50	0.13	4	897.19	0.13
24.00	0.12	4	897.18	0.12

Stage-Discharge for Pond 4P: detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
896.98	0.00	899.06	1.49	901.14	3.47
897.02	0.01	899.10	1.51	901.18	3.60
897.06	0.02	899.14	1.53	901.22	3.74
897.10	0.04	899.18	1.54	901.26	3.88
897.14	0.08	899.22	1.56	901.30	4.02
897.18	0.12	899.26	1.57	901.34	4.17
897.22	0.16	899.30	1.59	901.38	4.32
897.26	0.22	899.34	1.60	901.42	4.47
897.30	0.27	899.38	1.62	901.46	4.63
897.34	0.33	899.42	1.63	901.50	4.79
897.38	0.39	899.46	1.65	901.54	4.95
897.42	0.45	899.50	1.66	901.58	5.11
897.46	0.51	899.54	1.68	901.62	5.28
897.50	0.56	899.58	1.69	901.66	5.45
897.54	0.60	899.62	1.71	901.70	5.63
897.58	0.64	899.66	1.72	901.74	5.80
897.62	0.67	899.70	1.74	901.78	5.98
897.66	0.71	899.74	1.75	901.82	6.16
897.70	0.74	899.78	1.76	901.86	6.35
897.74	0.78	899.82	1.78	901.90	6.53
897.78	0.81	899.86	1.79	901.94	6.72
897.82	0.84	899.90	1.81	901.98	6.91
897.86	0.87	899.94	1.82	902.02	7.11
897.90	0.89	899.98	1.83	902.06	7.30
897.94	0.92	900.02	1.85	902.10	7.50
897.98	0.95	900.06	1.86	902.14	7.68
898.02	0.97	900.10	1.87	902.18	7.72
898.06	1.00	900.14	1.89	902.22	7.75
898.10	1.02	900.18	1.90	902.26	7.78
898.14	1.05	900.22	1.91	902.30	7.82
898.18	1.07	900.26	1.92	902.34	7.85
898.22	1.09	900.30	1.94	902.38	7.88
898.26	1.11	900.34	1.95	902.42	7.91
898.30	1.14	900.38	1.96	902.46	7.95
898.34	1.16	900.42	1.98	902.50	**7.98**
898.38	1.18	900.46	1.99		
898.42	1.20	900.50	2.00		
898.46	1.22	900.54	2.03		
898.50	1.24	900.58	2.08		
898.54	1.26	900.62	2.14		
898.58	1.28	900.66	2.21		
898.62	1.30	900.70	2.28		
898.66	1.32	900.74	2.37		
898.70	1.34	900.78	2.45		
898.74	1.35	900.82	2.55		
898.78	1.37	900.86	2.65		
898.82	1.39	900.90	2.75		
898.86	1.41	900.94	2.86		
898.90	1.42	900.98	2.97		
898.94	1.44	901.02	3.09		
898.98	1.46	901.06	3.21		
899.02	1.48	901.10	3.34		

Stage-Area-Storage for Pond 4P: detention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
896.98	0	0
897.08	12	0
897.18	47	3
897.28	107	11
897.38	190	25
897.48	297	49
897.58	427	85
897.68	582	136
897.78	760	203
897.88	962	288
897.98	1,187	396
898.08	1,299	521
898.18	1,380	655
898.28	1,464	797
898.38	1,551	948
898.48	1,640	1,108
898.58	1,732	1,276
898.68	1,826	1,454
898.78	1,923	1,642
898.88	2,022	1,839
898.98	2,123	2,046
899.08	2,240	2,264
899.18	2,364	2,494
899.28	2,490	2,737
899.38	2,620	2,992
899.48	2,753	3,261
899.58	2,890	3,543
899.68	3,029	3,839
899.78	3,173	4,149
899.88	3,319	4,474
899.98	3,469	4,813
900.08	3,604	5,167
900.18	3,737	5,534
900.28	3,873	5,914
900.38	4,011	6,308
900.48	4,152	6,717
900.58	4,295	7,139
900.68	4,440	7,576
900.78	4,588	8,027
900.88	4,738	8,493
900.98	4,891	8,975
901.08	5,017	9,470
901.18	5,137	9,978
901.28	5,259	10,498
901.38	5,382	11,030
901.48	5,506	11,574
901.58	5,632	12,131
901.68	5,759	12,701
901.78	5,888	13,283
901.88	6,018	13,878
901.98	6,150	14,487
902.08	6,359	15,111
902.18	6,592	15,759
902.28	6,829	16,430
902.38	7,070	17,125
902.48	**7,315**	**17,844**

Summary for Subcatchment 3S: SITE - POST DEVELOPED

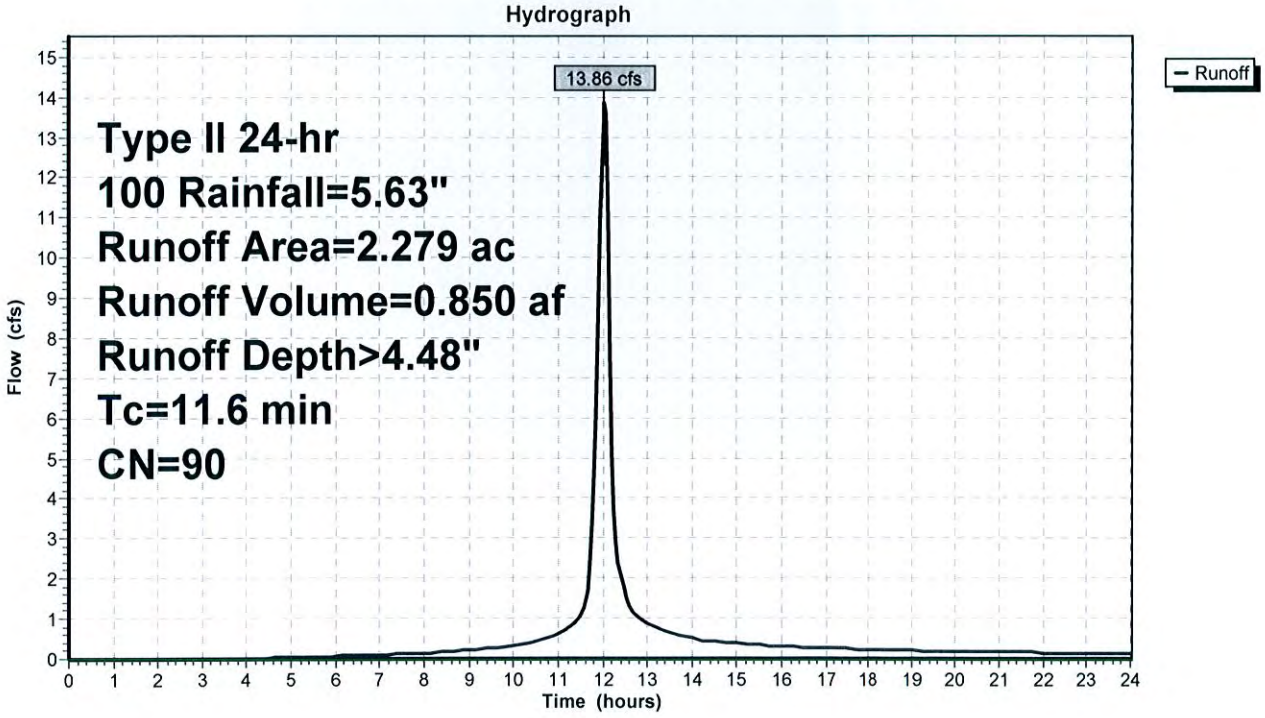
Runoff = 13.86 cfs @ 12.03 hrs, Volume= 0.850 af, Depth> 4.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=5.63"

	Area (ac)	CN	Description
*	1.527	98	impervious
*	0.752	74	pervious - good condition grass
	2.279	90	Weighted Average
	0.752		33.00% Pervious Area
	1.527		67.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6					**Direct Entry,**

Subcatchment 3S: SITE - POST DEVELOPED



Hydrograph for Subcatchment 3S: SITE - POST DEVELOPED

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.01	0.00	0.00
0.50	0.03	0.00	0.00
0.75	0.04	0.00	0.00
1.00	0.06	0.00	0.00
1.25	0.07	0.00	0.00
1.50	0.09	0.00	0.00
1.75	0.11	0.00	0.00
2.00	0.12	0.00	0.00
2.25	0.14	0.00	0.00
2.50	0.16	0.00	0.00
2.75	0.18	0.00	0.00
3.00	0.19	0.00	0.00
3.25	0.21	0.00	0.00
3.50	0.23	0.00	0.00
3.75	0.25	0.00	0.00
4.00	0.27	0.00	0.01
4.25	0.29	0.00	0.02
4.50	0.31	0.01	0.02
4.75	0.33	0.01	0.03
5.00	0.35	0.01	0.04
5.25	0.38	0.02	0.04
5.50	0.40	0.02	0.05
5.75	0.43	0.03	0.06
6.00	0.45	0.04	0.07
6.25	0.48	0.05	0.07
6.50	0.50	0.06	0.08
6.75	0.53	0.07	0.09
7.00	0.56	0.08	0.10
7.25	0.59	0.09	0.11
7.50	0.62	0.10	0.12
7.75	0.64	0.12	0.13
8.00	0.68	0.13	0.13
8.25	0.71	0.15	0.15
8.50	0.74	0.17	0.17
8.75	0.78	0.19	0.19
9.00	0.83	0.21	0.22
9.25	0.87	0.24	0.24
9.50	0.92	0.27	0.25
9.75	0.97	0.30	0.27
10.00	1.02	0.33	0.31
10.25	1.08	0.37	0.36
10.50	1.15	0.42	0.42
10.75	1.23	0.48	0.51
11.00	1.32	0.55	0.61
11.25	1.44	0.64	0.78
11.50	1.59	0.76	1.04
11.75	2.18	1.25	3.38
12.00	3.73	2.67	**13.42**
12.25	3.98	2.90	**3.70**
12.50	4.14	3.05	1.62
12.75	4.25	3.16	1.05
13.00	4.35	3.25	0.87
13.25	4.43	3.33	0.73
13.50	4.50	3.39	0.64
13.75	4.56	3.45	0.57
14.00	4.62	3.51	0.50
14.25	4.67	3.56	0.46
14.50	4.72	3.60	0.43
14.75	4.76	3.65	0.41
15.00	4.81	3.69	0.39
15.25	4.85	3.73	0.37
15.50	4.88	3.77	0.35
15.75	4.92	3.80	0.32
16.00	4.95	3.83	0.30
16.25	4.99	3.86	0.29
16.50	5.02	3.89	0.28
16.75	5.05	3.92	0.27
17.00	5.08	3.95	0.26
17.25	5.11	3.98	0.25
17.50	5.13	4.00	0.25
17.75	5.16	4.03	0.24
18.00	5.19	4.06	0.23
18.25	5.21	4.08	0.22
18.50	5.23	4.10	0.22
18.75	5.26	4.12	0.21
19.00	5.28	4.15	0.20
19.25	5.30	4.17	0.19
19.50	5.32	4.19	0.18
19.75	5.34	4.21	0.18
20.00	5.36	4.22	0.17
20.25	5.38	4.24	0.16
20.50	5.40	4.26	0.16
20.75	5.41	4.28	0.16
21.00	5.43	4.29	0.16
21.25	5.45	4.31	0.16
21.50	5.47	4.33	0.15
21.75	5.48	4.34	0.15
22.00	5.50	4.36	0.15
22.25	5.52	4.38	0.15
22.50	5.53	4.39	0.15
22.75	5.55	4.41	0.15
23.00	5.57	4.42	0.15
23.25	5.58	4.44	0.14
23.50	5.60	4.46	0.14
23.75	5.61	4.47	0.14
24.00	**5.63**	**4.49**	0.14

Summary for Pond 4P: detention

Inflow Area = 2.279 ac, 67.00% Impervious, Inflow Depth > 4.48" for 100 event
Inflow = 13.86 cfs @ 12.03 hrs, Volume= 0.850 af
Outflow = 4.57 cfs @ 12.22 hrs, Volume= 0.850 af, Atten= 67%, Lag= 11.6 min
Primary = 4.57 cfs @ 12.22 hrs, Volume= 0.850 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 901.45' @ 12.22 hrs Surf.Area= 5,463 sf Storage= 11,383 cf

Plug-Flow detention time= 26.7 min calculated for 0.850 af (100% of inflow)
Center-of-Mass det. time= 26.6 min (814.0 - 787.3)

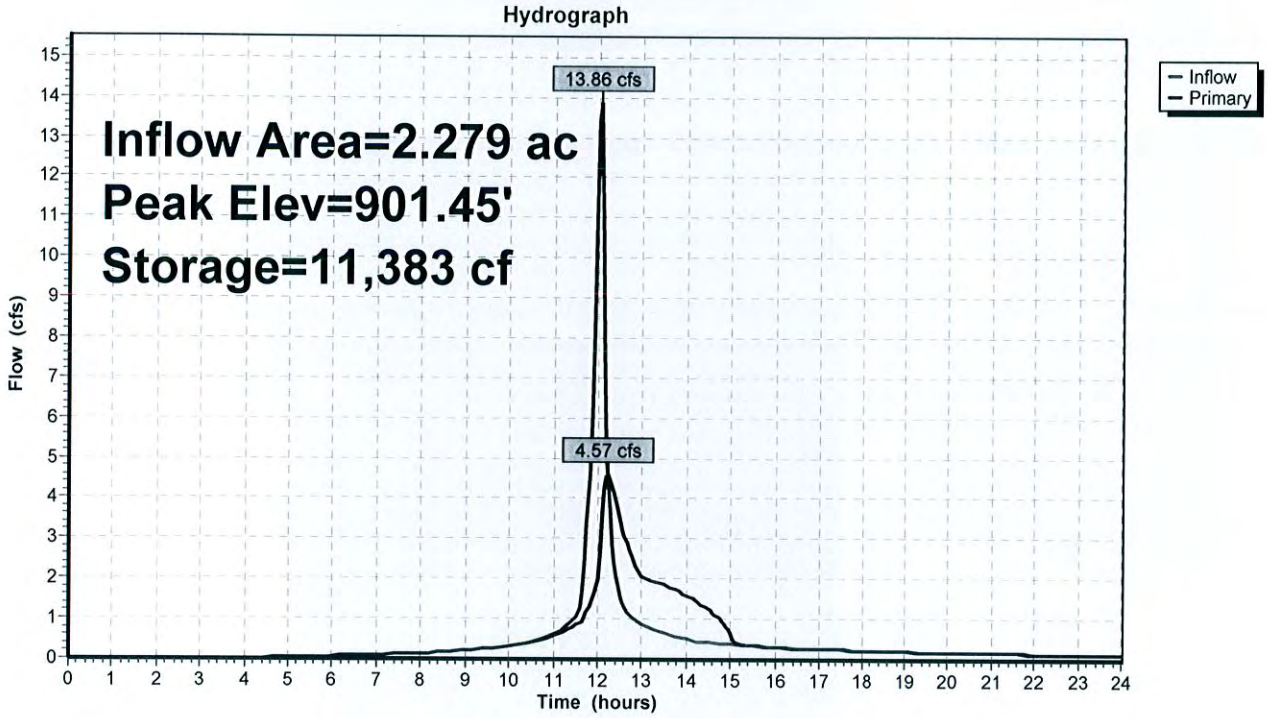
Volume	Invert	Avail.Storage	Storage Description
#1	896.98'	17,991 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
896.98	0	0	0	0
898.00	1,235	420	420	1,237
899.00	2,144	1,669	2,089	2,157
900.00	3,499	2,794	4,883	3,525
901.00	4,922	4,190	9,073	4,966
902.00	6,176	5,537	14,610	6,248
902.50	7,365	3,381	17,991	7,446

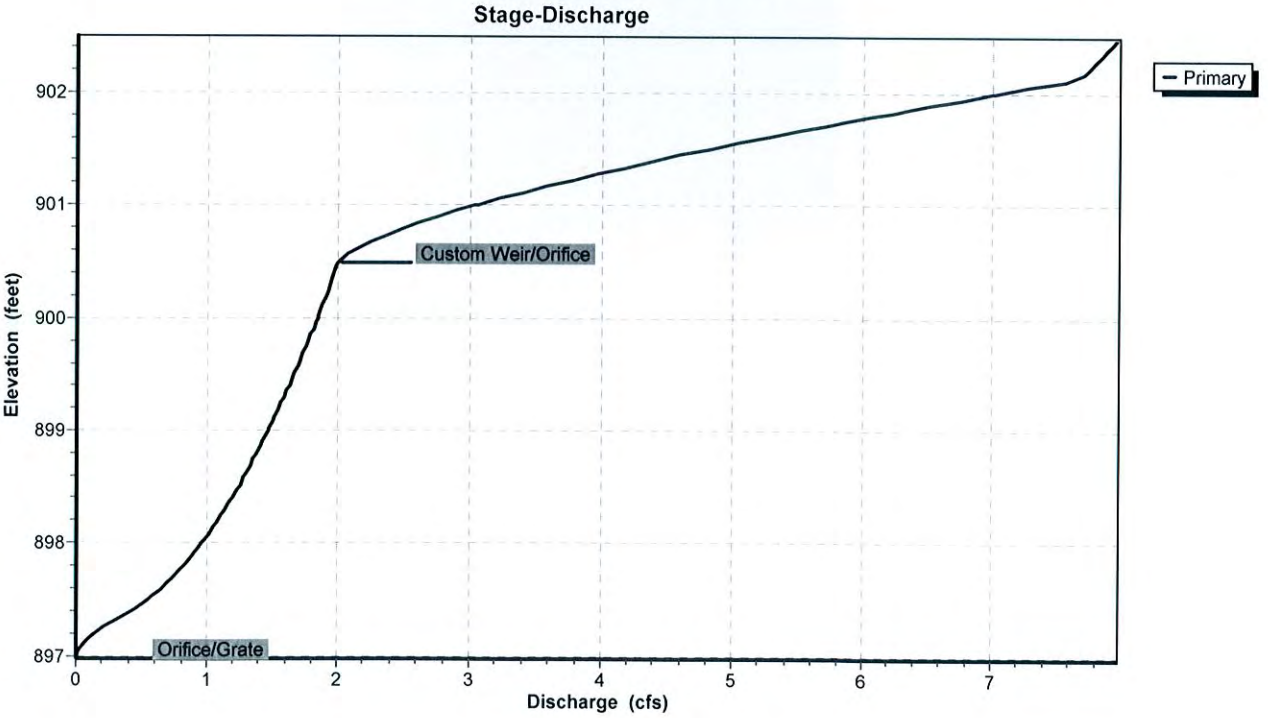
Device	Routing	Invert	Outlet Devices
#1	Primary	896.78'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 896.78' / 896.58' S= 0.0040 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	896.98'	**6.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	900.50'	**Custom Weir/Orifice, Cv= 1.00 (C= 1.25)** Head (feet) 0.00 2.00 Width (feet) 2.00 2.00

Primary OutFlow Max=4.54 cfs @ 12.22 hrs HW=901.44' (Free Discharge)
↑**1=Culvert** (Passes 4.54 cfs of 7.06 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 2.27 cfs @ 9.85 fps)
3=Custom Weir/Orifice (Weir Controls 2.27 cfs @ 1.21 fps)

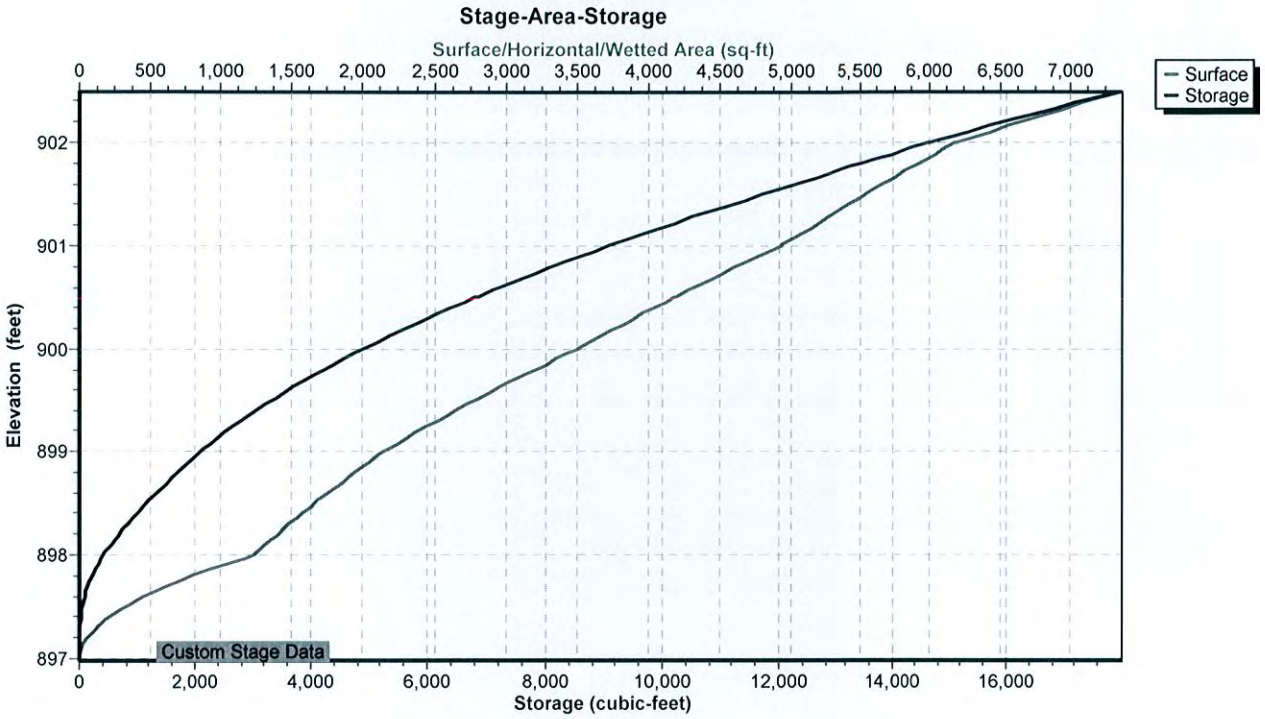
Pond 4P: detention



Pond 4P: detention



Pond 4P: detention



Hydrograph for Pond 4P: detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	896.98	0.00
0.50	0.00	0	896.98	0.00
1.00	0.00	0	896.98	0.00
1.50	0.00	0	896.98	0.00
2.00	0.00	0	896.98	0.00
2.50	0.00	0	896.98	0.00
3.00	0.00	0	896.98	0.00
3.50	0.00	0	896.98	0.00
4.00	0.01	0	897.04	0.01
4.50	0.02	0	897.06	0.02
5.00	0.04	1	897.09	0.04
5.50	0.05	1	897.11	0.05
6.00	0.07	1	897.13	0.07
6.50	0.08	2	897.15	0.08
7.00	0.10	3	897.16	0.10
7.50	0.12	3	897.18	0.12
8.00	0.13	4	897.19	0.13
8.50	0.17	6	897.22	0.17
9.00	0.22	9	897.26	0.22
9.50	0.25	11	897.28	0.25
10.00	0.31	16	897.32	0.31
10.50	0.42	29	897.39	0.41
11.00	0.61	63	897.52	0.58
11.50	1.04	239	897.83	0.84
12.00	**13.42**	**6,381**	**900.40**	**1.97**
12.50	**1.62**	**9,812**	**901.15**	**3.49**
13.00	0.87	7,063	900.56	2.06
13.50	0.64	4,909	900.01	1.84
14.00	0.50	2,827	899.32	1.59
14.50	0.43	1,095	898.47	1.23
15.00	0.39	85	897.58	0.64
15.50	0.35	20	897.35	0.35
16.00	0.30	16	897.32	0.30
16.50	0.28	13	897.30	0.28
17.00	0.26	12	897.29	0.26
17.50	0.25	11	897.28	0.25
18.00	0.23	10	897.27	0.23
18.50	0.22	9	897.26	0.22
19.00	0.20	8	897.25	0.20
19.50	0.18	7	897.24	0.18
20.00	0.17	6	897.22	0.17
20.50	0.16	5	897.22	0.16
21.00	0.16	5	897.21	0.16
21.50	0.15	5	897.21	0.15
22.00	0.15	5	897.21	0.15
22.50	0.15	5	897.21	0.15
23.00	0.15	5	897.20	0.15
23.50	0.14	4	897.20	0.14
24.00	0.14	4	897.20	0.14

Stage-Discharge for Pond 4P: detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
896.98	0.00	899.06	1.49	901.14	3.47
897.02	0.01	899.10	1.51	901.18	3.60
897.06	0.02	899.14	1.53	901.22	3.74
897.10	0.04	899.18	1.54	901.26	3.88
897.14	0.08	899.22	1.56	901.30	4.02
897.18	0.12	899.26	1.57	901.34	4.17
897.22	0.16	899.30	1.59	901.38	4.32
897.26	0.22	899.34	1.60	901.42	4.47
897.30	0.27	899.38	1.62	901.46	4.63
897.34	0.33	899.42	1.63	901.50	4.79
897.38	0.39	899.46	1.65	901.54	4.95
897.42	0.45	899.50	1.66	901.58	5.11
897.46	0.51	899.54	1.68	901.62	5.28
897.50	0.56	899.58	1.69	901.66	5.45
897.54	0.60	899.62	1.71	901.70	5.63
897.58	0.64	899.66	1.72	901.74	5.80
897.62	0.67	899.70	1.74	901.78	5.98
897.66	0.71	899.74	1.75	901.82	6.16
897.70	0.74	899.78	1.76	901.86	6.35
897.74	0.78	899.82	1.78	901.90	6.53
897.78	0.81	899.86	1.79	901.94	6.72
897.82	0.84	899.90	1.81	901.98	6.91
897.86	0.87	899.94	1.82	902.02	7.11
897.90	0.89	899.98	1.83	902.06	7.30
897.94	0.92	900.02	1.85	902.10	7.50
897.98	0.95	900.06	1.86	902.14	7.68
898.02	0.97	900.10	1.87	902.18	7.72
898.06	1.00	900.14	1.89	902.22	7.75
898.10	1.02	900.18	1.90	902.26	7.78
898.14	1.05	900.22	1.91	902.30	7.82
898.18	1.07	900.26	1.92	902.34	7.85
898.22	1.09	900.30	1.94	902.38	7.88
898.26	1.11	900.34	1.95	902.42	7.91
898.30	1.14	900.38	1.96	902.46	7.95
898.34	1.16	900.42	1.98	902.50	**7.98**
898.38	1.18	900.46	1.99		
898.42	1.20	900.50	2.00		
898.46	1.22	900.54	2.03		
898.50	1.24	900.58	2.08		
898.54	1.26	900.62	2.14		
898.58	1.28	900.66	2.21		
898.62	1.30	900.70	2.28		
898.66	1.32	900.74	2.37		
898.70	1.34	900.78	2.45		
898.74	1.35	900.82	2.55		
898.78	1.37	900.86	2.65		
898.82	1.39	900.90	2.75		
898.86	1.41	900.94	2.86		
898.90	1.42	900.98	2.97		
898.94	1.44	901.02	3.09		
898.98	1.46	901.06	3.21		
899.02	1.48	901.10	3.34		

Stage-Area-Storage for Pond 4P: detention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
896.98	0	0
897.08	12	0
897.18	47	3
897.28	107	11
897.38	190	25
897.48	297	49
897.58	427	85
897.68	582	136
897.78	760	203
897.88	962	288
897.98	1,187	396
898.08	1,299	521
898.18	1,380	655
898.28	1,464	797
898.38	1,551	948
898.48	1,640	1,108
898.58	1,732	1,276
898.68	1,826	1,454
898.78	1,923	1,642
898.88	2,022	1,839
898.98	2,123	2,046
899.08	2,240	2,264
899.18	2,364	2,494
899.28	2,490	2,737
899.38	2,620	2,992
899.48	2,753	3,261
899.58	2,890	3,543
899.68	3,029	3,839
899.78	3,173	4,149
899.88	3,319	4,474
899.98	3,469	4,813
900.08	3,604	5,167
900.18	3,737	5,534
900.28	3,873	5,914
900.38	4,011	6,308
900.48	4,152	6,717
900.58	4,295	7,139
900.68	4,440	7,576
900.78	4,588	8,027
900.88	4,738	8,493
900.98	4,891	8,975
901.08	5,017	9,470
901.18	5,137	9,978
901.28	5,259	10,498
901.38	5,382	11,030
901.48	5,506	11,574
901.58	5,632	12,131
901.68	5,759	12,701
901.78	5,888	13,283
901.88	6,018	13,878
901.98	6,150	14,487
902.08	6,359	15,111
902.18	6,592	15,759
902.28	6,829	16,430
902.38	7,070	17,125
902.48	**7,315**	**17,844**

PRELIMINARY
STORMWATER MANAGEMENT PLAN
FOR
ROCKIN' JUMP
(Case 16-010CU)

PROPOSED BY:

MS. ARZANA DARUWALLA
5993 MAXTOWN ROAD
WESTERVILLE, OHIO 43082
(614) 353-901
zaana_ehy@yahoo.com

PREPARED BY:

MARK R. SCHROEDER, P.E.

DATE:

FEBRUARY 12, 2016

HOCKADEN AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND SURVEYORS
883 N. Cassady Avenue, Columbus, Ohio 43219
Telephone: (614) 252-0993 Fax: (614) 252-0444 E-mail: mschroeder@hockaden.com

Mark Schroeder

From: Joseph O'Brien [josephobrienpg@gmail.com]
Sent: Friday, February 12, 2016 9:40 AM
To: MHendershot@dublin.oh.us
Cc: Mark Schroeder
Subject: AquaSwirl Volumetric Treatment
Attachments: Rockin Jump.docx

Mike:

I have attached sizing results for an AquaSwirl on the Rockin Jump project in Dublin based on updated parameters provided by Mark Schroeder of Hockaden & Associates, Inc. These results show that the AquaSwirl (an AS-3) is calculated to achieve 87.22% net annual TSS reduction. The results also show that the system treats 99.23% of the net annual runoff volume from the site. This is shown in the column labeled "Total Rainfall %."

AquaShield sizes their systems based on the techniques recommended by the Center of Watershed Protection. This means they have a minimum standard of achieving 80% TSS reduction. But they must also treat 90% or more of the net annual runoff volume. For example, if the sizing program were to determine that an AS-2 was sufficient to achieve 80% TSS reduction, but it wasn't treating at least 90% of the net annual runoff volume, the sizing program would keep adding rain events to the calculation until the AquaSwirl treated 90% or more of the net annual runoff volume. This might result in a larger AquaSwirl for the project than would be necessary to achieve 80% net annual TSS reduction.

Note that the "Operating Rate" shown in the table was calculated using the rational method based on the rainfall intensity (shown in the first column), the acreage of the site, and the C factor.

Please let us know if this meets your requirements for treating the WQv on a project. If additional information is needed, please provide an example for us.

Thank you for your time and attention in reviewing this, and best regards,

--

AquaShield StormTech

Joseph O'Brien PG
Sales Agent
ENTEL, Inc
734-657-3839
josephobrienpg@gmail.com

AquaShield™ STORMWATER TREATMENT SOLUTIONS

Sizing Report

2705 Kanasita Drive • Chattanooga, TN 37343 • Phone: (423) 870-8888 • Fax: (423) 826-2112 • www.aquashieldinc.com

Site Information

Project Name: **Rockin Jump**

Site Area (acres): **2.1**

Unit Label:

Runoff Coeff. : **.76**

Unit Location: **Dublin, OH**

Target Removal Efficiency(%): **80 %**

Product Recommendation

Aqua-Swirl™ Model	Net Annual TSS Removal Efficiency	Chamber Diameter	Maximum Stub-Out Pipe Outer Diameter		Oil/Debris Storage Capacity	Sediment Storage Capacity
AS-3	**87.22 %**	3.25 ft.	10 in.	16 in.	110 gal	20 ft³

Rainfall Information

NCDC Station[1]: **COLUMBUS WSO AIRPORT, OH**

Data Range: **8152 days (~22.33 yrs within 55 yr span)[4]**

Rainfall Event Range (in./hr)	Rainfall Interval Point (in./hr)	Operating Rate (gpm/ft^2)	Total Rainfall (%)	Removal Efficiency (%)[2]	Relative Efficiency(%)
0.08 - 0.10	0.090	7.78	34.34	94.64	32.50
0.10 - 0.12	0.110	9.51	13.14	93.64	12.30
0.12 - 0.14	0.130	11.24	9.65	92.57	8.93
0.14 - 0.16	0.150	12.96	7.32	91.42	6.69
0.16 - 0.18	0.170	14.69	5.91	90.18	5.33
0.18 - 0.20	0.190	16.42	4.59	88.86	4.08
0.20 - 0.25	0.225	19.45	7.39	86.34	6.38
0.25 - 0.35	0.300	25.93	7.89	80.12	6.32
0.35 - 0.45	0.400	34.57	3.85	70.01	2.70
0.45 - 0.55	0.500	43.22	2.06	57.83	1.19
0.55 - 0.65	0.600	51.86	1.26	43.60	0.55
0.65 - 0.75	0.700	60.50	0.76	27.31	0.21
0.75 - 1.00	0.825	71.30	1.07	4.06	0.04
		Total Cumulative Rainfall %:	**99.23[3]**	**Net Annual %:**	**87.22**

Sales Agent Information

Agent Name: **Joe OBrien**

Phone: **(734) 657-3839**

Company Name: **Entel Service & Technology**

Fax: **(734) 944-7754**

Address: **5782 Katz Farm Court**

E-mail: **josephobrienpg@gmail.com**

City, State Zip: **Saline, MI 48176**

Footnotes

1. Recorded as hourly precipitation rainfall data (inches), National Climatic Data Center (NCDC)
2. Based on Tennessee Tech University laboratory testing of the AquaSwirl™ Model AS-3 for OK-110 silica particles 50-125 microns(Neary, 2002)
3. 90% Rainfall Event, calculated as a cumulative percentile of individual events, www.stormwatercenter.net, sizing criteria (Center for Watershed Protection)
4. NCDC data may not be consecutive, skipping days, months and/or years in the range of dates.
5. The Aqua-Swirl™ Conveyance Flow Diversion (CFD) provides full treatment of the "first flush," while the peak design storm is diverted and channeled through the main conveyance pipe. Please refer to your local representative for more information.

LABORATORY EVALUATION of TSS REMOVAL EFFICIENCY for the AQUA-SWIRL® CONCENTRATOR STORMWATER TREATMENT SYSTEM

October 22, 2009

Vincent S. Neary, Ph.D., P.E.
President, Springburn LLC
Formerly Associate Professor, Department of Civil and Environmental Engineering,
Tennessee Technological University, PO 5015, Cookeville, TN 38505-0001

PURPOSE

The purpose of this technical report is to document the results of independent laboratory performance testing of an Aqua-Swirl® Concentrator Stormwater Treatment System (Aqua-Swirl®) at Tennessee Technological University in Cookeville, TN during 2002. The purpose of testing the Aqua-Swirl® in a laboratory-controlled environment is to provide accurate, repeatable documentation of performance in order to predict performance for a range of field conditions. These parameters include flow rate, influent concentration, specific gravity and grain size distribution of pollutants.

The primary purpose of this study was to evaluate the hydraulic and sediment separation performance of a 5/8-scale (0.65) Aqua-Swirl® Model AS-5 with successive loading rates from 0.2 to 1.2 cfs (10.8 to 64.9 gpm/ft^2). Study objectives included the following criteria:

1. *Hydraulic Performance: Stage-Discharge Rating.* Develop a stage-discharge rating curve for flow rates (Q) ranging from 0.2 to 1.2 cfs.
2. *Hydraulic Performance: Detention Time-Discharge Rating.* Develop a detention time-discharge rating curve; where the detention (residence) time, under steady flow conditions, is the volume of water in the concentrator V divided by the flow rate Q (i.e., $t_D = V/Q$).
3. *Hydraulic Performance:* Head-loss-Velocity Head Rating. Develop a head loss-velocity head-rating curve and determine the minor loss coefficient for the Aqua-Swirl® unit.

4. *Treatment Performance: Removal Efficiency-Discharge Rating.* Develop a removal efficiency-loading rate rating curve; where the sediment removal efficiency of the concentrator is the difference between the influent and effluent sediment concentrations; and, where the loading rate is calculated as the ratio of the flow rate in gallons per minute (gpm) to the bottom area of the concentrator.

AQUA-SWIRL® CONCENTRATOR

The method of stormwater treatment provided by the Aqua-Swirl® focuses on vortex or circular flow initiated by the fixed tangential inlet on the body of the hydrodynamic separator. Through this induced hydraulically controlled swirling action, the pre-engineered system removes suspended solids and attached pollutants. The Aqua-Swirl® is constructed of high density polyethylene (HDPE) materials providing consistency in design and application in the field. The Aqua-Swirl® can also be constructed of a fiber reinforced polymer (FRP) material.

LABORATORY METHODS

Experimental Set-up

A schematic of the experimental set-up is shown in Figure 1. The main components of the set-up include a headwater tank, an Aqua-Swirl® having a 39-in. diameter and height of 46.1-in. (as measured from the inside base to the invert of the influent/effluent pipes), and a 42-in. diameter tailwater tank with a 43-in. high baffle connected with 8-in. PVC piping. The tailwater tank discharges to a 234-in. x 30-in. trench (lined with black plastic) 165-in. upstream of the sump. Water in the sump is re-circulated to the headwater tank. The flow rate (Q) is adjusted between 0.2 and 1.2 cfs using one or two variable speed pumps. The tailwater tank and trench allowed settling of most of the sediment prior to entering the sump. For high flows, $Q = 0.8$ to 1.2 cfs, some sediment was deposited in the sump; however, none of the sediment was withdrawn by the pump intakes and re-circulated. The length of the inlet pipe between the control valve and the Aqua-Swirl® concentrator is 171-in., which is much

greater than 8-diameters (64-in.) to establish a fully developed flow condition prior to entering the concentrator.

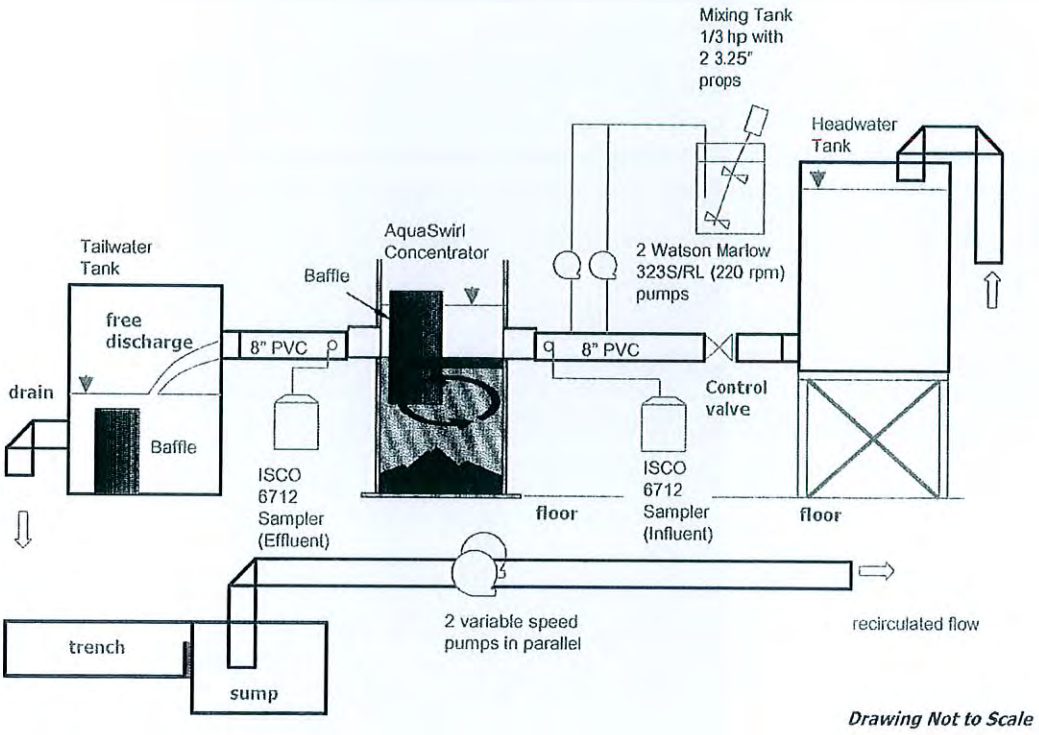


Figure 1. Experimental set-up.

Sediment Feeding

Unground silica sand OK-110, provided by U.S. Silica, was used as a surrogate for solids transported by runoff. The OK-110 material has a reported median grain size (d_{50}) of 110 microns (μm) with particles ranging in size from approximately 50 to 150 μm, and a specific gravity of 2.65. The OK-110 material was introduced as a slurry with a concentration of 179,671 mg/L (1.5 lbs/gal). The mass loading rate was set based on a target inlet concentration of 200 mg/L for the range of flow rates tested, Q = 0.2 to 1.2 cfs. The required loading rate to maintain this concentration was calculated by mass balance. The peristaltic pump was calibrated to establish the relationship between loading rate (mg/s) and pump

speed (rpm). The location of the sediment feeding was set to the crown of the inlet pipe 82-in. (10 diameters) upstream of the inlet.

Stage-Discharge Measurement and Detention Time

The stage-discharge rating curve was established by measuring the stage in the Aqua-Swirl® with respect to the inlet pipe invert for a range of flows. Stage was measured using an ultrasonic stage recorder positioned directly over the center of the concentrator. The flow was measured using a magnetic flow meter. The detention time was then calculated as the ratio of the volume in the concentrator V divided by the flow rate Q, i.e., $t_D = V/Q$, where $V=h\pi d^2/4$, h = stage with respect to concentrator bottom, and d = concentrator diameter.

Headloss Measurement

Head loss was measured for a range of flows, $Q = 0.2$ to 1.2 cfs, with a manometer as the difference in the piezometric head ($z + p/\gamma$) between the inlet and outlet of the concentrator, where z = elevation head and p/γ = hydrostatic pressure head. Piezometers were located at the pipe invert 6-in. inches upstream and downstream of the inlet and outlet, respectively. The sampling strainer was installed 2-in. upstream of the piezometer in the outlet pipe, prior to measuring head loss. It is recognized that the strainer could create a low pressure region in the vicinity of the piezometer and potentially exaggerate the head loss measurement. It is considered that the degree of interference is not significant for this test.

Removal Efficiency

One of the key objectives of this study was to evaluate solids removal efficiency. Either direct or indirect methods are typically used for determining removal efficiencies. The direct method requires the collection and measurement of all the material that entered and was collected in the device. In contrast, the indirect method requires that influent and effluent sediment concentrations be measured. Stormwater BMP testing protocols have traditionally required the application of the indirect method due to the difficulty in applying the direct

method under field conditions. The American Public Works Association (APWA, November 1999) and many other regulatory authorities specify that removal efficiencies be calculated using the indirect method. Hence, the indirect method was used for this investigation.

For a steady flow condition, i.e. the influent and effluent flows are equal; the removal efficiency is calculated as,

$$\text{Removal Efficiency}\,\% = \frac{C\,avg_{\text{influent}} - C\,avg_{\text{effluent}}}{C\,avg_{\text{influent}}} x\,100 \qquad (1)$$

Indirect Method

Influent and effluent samples were collected using ISCO 6712 discrete portable autosamplers. The samplers were programmed in delayed start mode to provide five, 1-liter samples at time intervals corresponding to the detention time for the flow rate evaluated. Sample blanks were also collected prior to sediment feeding for quality assurance and control. Sample ports were initially located at the bottom of the pipes, 9-in. upstream and 4-in. downstream of the inlet and outlet pipes, respectively. ISCO strainers were installed vertically in order to allow for the collection of a sample from the entire water column.

The average, median and standard deviation for the influent and effluent sample concentrations were calculated based on the five samples collected for each pipe. The samples were equally spaced over the duration of the experimental run. Removal efficiencies were calculated using equation (1) for each of the corresponding influent/effluent sample concentrations.

The analytical protocol recommended by APWA (November 1999) for measuring solids concentration was used in this study. This protocol is actually the method for obtaining the suspended solids concentration (SSC), which analyzes the whole sample. Although evaluation of total suspended solids (TSS) is standard practice in the wastewater industry due to the predominance of organic solids, it is not feasible for very fine sand particles

such as OK-110 sand and larger particles. A TSS sample entails withdrawal of an aliquot of the original sample for subsequent analysis. Gray et al. (2000) state, "... if a sample contains a substantial percentage of sand size material, then stirring, shaking, or otherwise agitating the sample before obtaining a sub-sample, it will rarely produce an aliquot representative of the SSC and particle-size distribution of the original sample. This a by-product of the rapid settling properties of the sand size material, compared to those for silt and clay size materials, given virtually uniform densities and shapes."

RESULTS

Stage-Discharge Measurement and Detention Time

Table 1 shows the measured stage above the invert corresponding to the flow rate considered, and the detention time. The stage from the bottom h is calculated by adding 3.833 ft to the stage with respect to the invert. The stage-discharge rating curve is shown in Figure 2.

Headloss Measurement

Table 2 shows the measured head loss between the Aqua-Swirl® inlet and outlet for flows ranging from 0.2 to 1.2 cfs; where y = flow depth in the inlet pipe, y/d = the ratio of flow depth to pipe diameter, A = the cross-sectional flow area, and V = the average velocity. Plotting the head loss against the velocity head $V^2/2g$ (Figure 3), the slope of the straight-line curve fit (with the y-intercept at zero) gives the loss coefficient $K = 3.77$ in the well-known minor loss equation $h_m = K\frac{V^2}{2g}$. The loss coefficient K is slightly greater than that associated with an open gate valve ($K = 3.0$).

Table 1. Stage-Discharge Rating and Detention Time.

Discharge (cfs)	Stage (ft)	Volume (ft^3)	Detention Time (min)
0.2	0.300	39.77	3.3
0.3	0.362	40.36	2.2
0.4	0.460	41.31	1.7
0.5	0.570	42.37	1.4
0.6	0.620	42.85	1.2
0.8	0.734	43.94	0.92
0.9	0.810	44.67	0.83
1.0	0.860	45.16	0.75
1.1	0.930	45.83	0.69
1.2	0.950	46.02	0.64

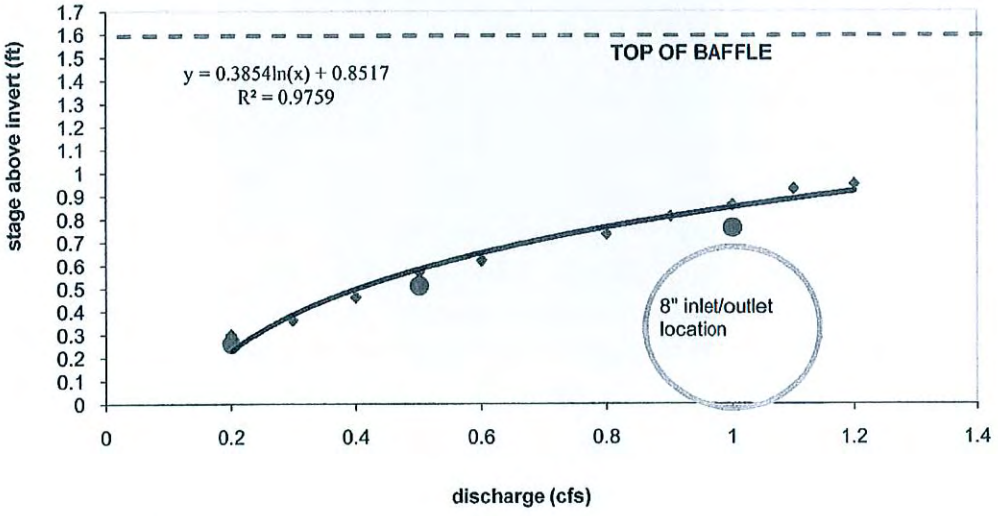


Figure 2. Stage-Discharge Rating Curve.

Table 2. Head Loss Measurements.

flow cfs	Y ft	y/d	A ft^2	V fps	$V^2/2g$ ft	head loss ft
0.20	0.300	0.450	0.1524	1.30	0.026	0.117
0.27	0.354	0.530	0.1880	1.46	0.033	0.083
0.40	0.460	0.690	0.2568	1.55	0.037	0.158
0.51	0.570	0.855	0.3177	1.60	0.040	0.158
0.60	0.620	0.930	0.3381	1.78	0.049	0.200
0.80	0.734	1.101	0.3491	2.30	0.082	0.325
0.84	0.783	1.175	0.3491	2.40	0.089	0.292
1.05	0.870	1.305	0.3491	3.01	0.140	0.467
1.20	0.950	1.425	0.3491	3.44	0.184	0.692
1.45	0.995	1.493	0.3491	4.16	0.268	1.050

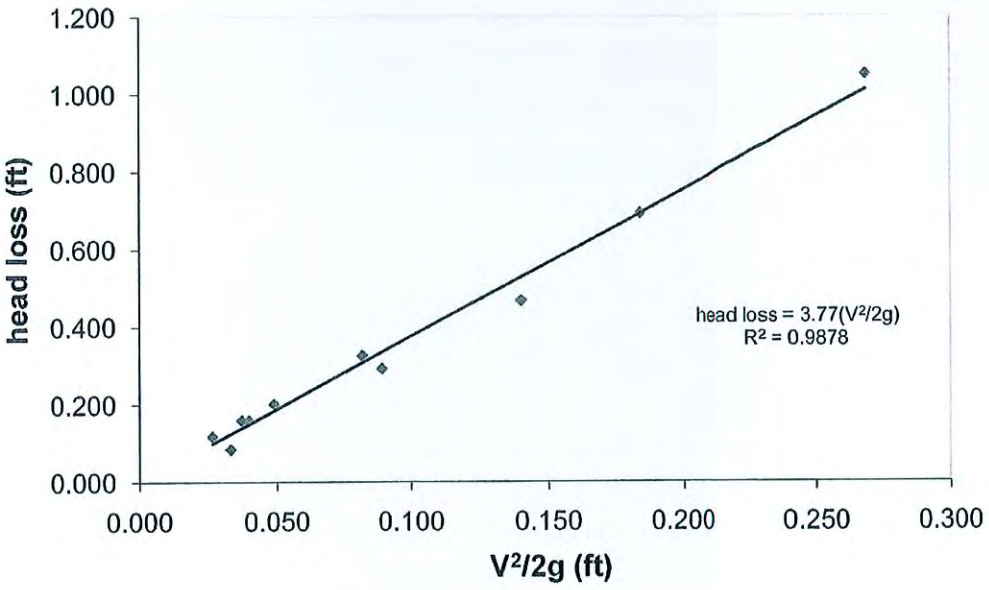


Figure 3. Head Loss vs. Velocity Head.

Tested Flow Rates and Removal Efficiencies

A summary of the tested flow rates and removal efficiencies for the Aqua-Swirl® are provided in Table 3. Measured SSC concentrations and removal efficiencies, calculated using equation (1), are summarized in Tables 4-7 for four flow rates spanning Q = 0.2 to 1.2 cfs, or 17 to 100% of the tested loading rate.

Table 3. Summary of Tested Flow Rates and Removal Efficiencies.

Flow Rate (cfs)	Loading Rate (gpm/ft^2)	% Tested Loading Rate	Average Influent SSC Concentration (mg/L)	Average Effluent SSC Concentration (mg/L)	Removal Efficiency (%)
0.2	10.8	17	435	49	89
0.5	27.0	42	462	83	82
0.8	43.3	67	261	113	57
1.2	64.9	100	119	98	18

Table 4. Q = 0.2 cfs, 17% of Tested Loading Rate.

SSC Concentration (mg/L)				Removal Efficiency
Influent		Effluent		%
IB	29	EB	13	
I1	142	E1	57	60
I2	544	E2	38	93
I3	425	E3	101	76
I4	544	E4	38	93
I5	518	E5	12	98
I AVG	435	E AVG	49	**89**
I MED	518	E MED	38	93
I STDV	171	E STDV	33	

Table 5. Q = 0.5 cfs, 42% of Tested Loading Rate.

SSC Concentration (mg/L)				Removal Efficiency
Influent		Effluent		%
IB	29.0	EB	11.8	
I1	342	E1	12.3	96
I2	590	E2	42.6	93
I3	396	E3	139	65
I4	508	E4	105	79
I5	476	E5	118	75
I AVG	462	E AVG	83	**82**
I MED	476	E MED	105	78
I STDV	97	E STDV	54	

Table 6. Q = 0.8 cfs, 67% of Tested Loading Rate.

SSC Concentration (mg/L)				Removal Efficiency
Influent		Effluent		%
IB	22.0	EB	52.7	
I1	140.3	E1	204.8	-46
I2	252.5	E2	91.4	64
I3	399.1	E3	172.7	57
I4	266.3	E4	53.7	80
I5	246.9	E5	42.0	83
I AVG	261	E AVG	113	**57**
I MED	253	E MED	91	64
I STDV	92	E STDV	72	

Table 7. Q = 1.2 cfs, 100% of Tested Loading Rate.

SSC Concentration (mg/L)				Removal Efficiency
Influent		Effluent		%
IB	11.1	EB	16.0	
I1	26.7	E1	37.0	-39
I2	96.4	E2	87.8	9
I3	122	E3	137	-12
I4	128	E4	86.9	32
I5	223	E5	140	37
I AVG	119	E AVG	98	**18**
I MED	122	E MED	88	28
I STDV	71	E STDV	43	

Aqua-Swirl® Performance Curve

Positive removal efficiencies were observed throughout the full tested range of the hydraulic loading/operating capacity of the system (Table 3). The average removal efficiency was calculated for each loading rate by determining the average concentration of five influent and five effluent samples. Removal efficiency was calculated using equation 1. Based on the average removal rates for the four tested flow rates, Q = 0.2 to 1.2 cfs (10.8 to 64.9 gpm/ft^2) a performance curve for an Aqua-Swirl® can be derived showing the variation of removal efficiency with loading rate (Figure 4). For purposes of this curve, 100% removal efficiency is taken to occur at zero loading rate.

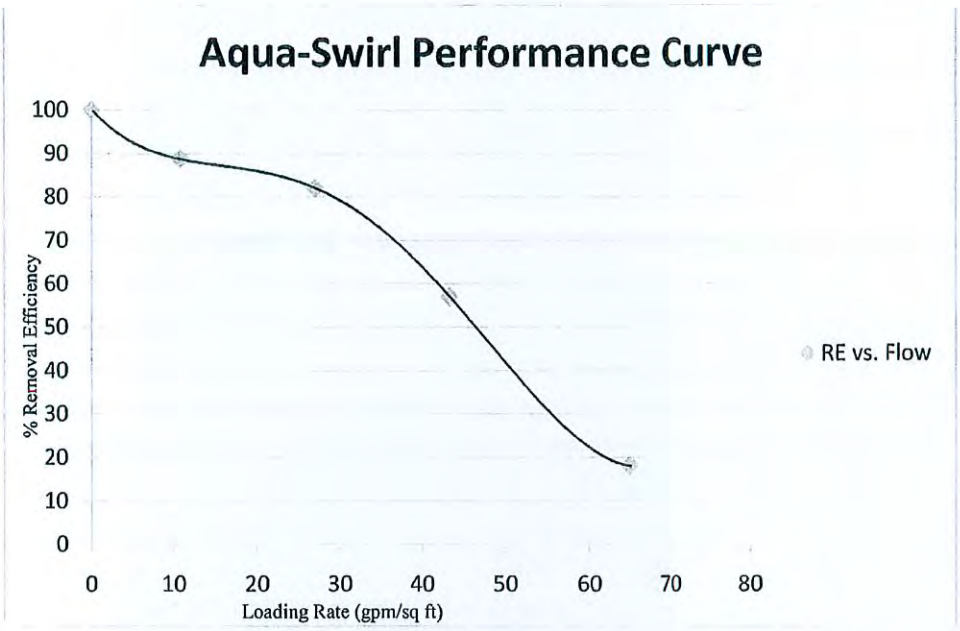


Figure **4. Performance curve for Aqua-Swirl® Stormwater Treatment System.**

Aqua-Swirl® Net Annual TSS Removal Efficiency

An annual TSS removal efficiency of the Aqua-Swirl® was calculated using five years of hydrologic data from the Portland, Maine area (Table 8). The expected annual removal calculation method shown below estimates the percent runoff volume for a range of storm intensities in that area as presented by Vortechnics, Technical Bulletin No. 4, 2001. The product of percent runoff volume and removal efficiency for a given loading rate gives the relative, or annual, removal efficiency at this loading rate. The sum of the relative removal efficiencies over the range of intensities and loading rates is the net annual TSS removal efficiency. The calculations summarized in Table 8 used a 1-acre site and a runoff coefficient of 0.9.

The estimated annual TSS removal efficiency calculated by this method for the Aqua-Swirl® is 91%. When considering an instantaneous removal efficiency on a per storm event basis, an 80% TSS removal rate can be achieved up to a loading rate of 28.3 gpm/ft^2.

Table 8. Net Annual TSS Removal for Aqua-Swirl® Stormwater Treatment System.

Rainfall Intensity (in/hr)	Loading Rate (gpm/ft^2)	Total Rainfall Volume (%)	Removal Efficiency (%)	Relative Removal Efficiency (%)
0.08	3.6	36.92	98.9	36.5
0.16	7.1	21.91	97.3	21.3
0.24	10.6	11.90	95.4	11.4
0.32	14.1	7.64	93.1	7.1
0.40	17.7	4.97	90.4	4.5
0.48	21.3	2.92	87.3	2.6
0.56	24.7	3.01	83.9	2.5
0.64	28.3	2.04	80.0	1.6
0.72	31.8	1.78	75.8	1.3
0.80	35.4	1.43	71.2	1.0
0.88	38.9	1.16	66.2	0.8
0.96	42.4	0.83	60.8	0.5
Net Annual TSS Removal %				**91.1**

CONCLUSIONS

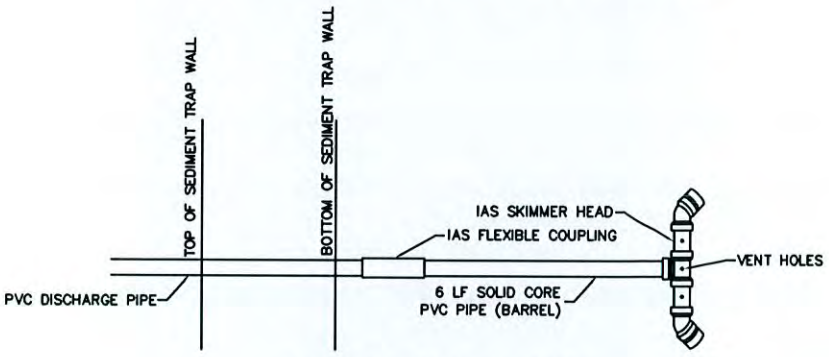
Removal efficiencies for the Aqua-Swirl® range from an assumed 100% at a zero operating rate, 82% at 50% of the tested operating rate, and 18% at 100% of the tested operating rate. The estimated annual TSS removal efficiency for the Aqua-Swirl® is calculated to be 91%. At a loading rate up to 28.3 gpm/ft^2, the Aqua-Swirl® can achieve 80% TSS removal on a per storm event basis.

The hydraulics performance evaluation indicates that the concentrator exhibits minimal head loss over its full operating range. A stage-discharge rating curve and detention time discharge rating curve are now available for standard design data. A negligible head of less than 3.5-inches above the crown of the inlet piping was observed at the tested flow rate.

Vincent S. Neary, Ph.D., P.E.

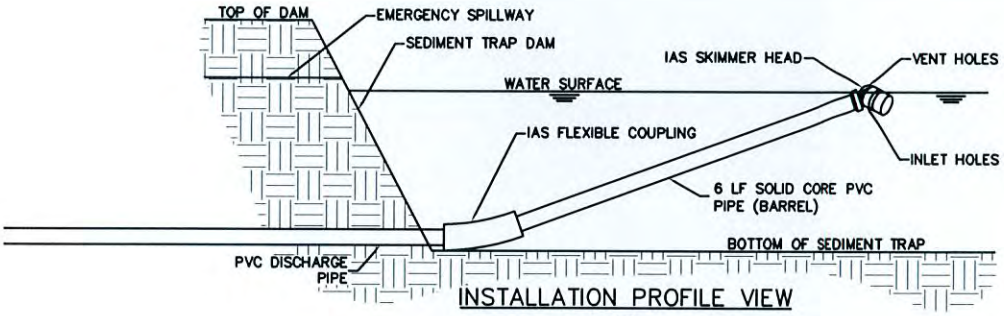
11/1/09
Date

IAS WATER QUALITY SKIMMER



INSTALLATION PLAN VIEW

NTS



INSTALLATION PROFILE VIEW

NTS

SKIMMER SIZE (IN)	COLOR CODE	BARREL SIZE (IN)	DISCHARGE PIPE SIZE (IN)	24 HOUR FLOW (CF)	2 DAY FLOW (CF)	3 DAY FLOW (CF)	4 DAY FLOW (CF)	5 DAY FLOW (CF)	6 DAY FLOW (CF)	7 DAY FLOW (CF)
1.5	RED	2	2	1,804	3,608	5,412	7,216	9,020	10,824	12,628
1.75	BLACK	2	2	2,405	4,810	7,216	9,621	12,027	14,432	16,837
2	YELLOW	3	3	3,928	7,856	11,784	15,712	19,640	23,568	27,496
2.5	GREEN	3	3	6,137	12,275	18,412	24,550	30,687	36,825	42,962
3	BLUE	4	4	10,205	20,410	30,616	40,812	51,026	61,232	71,437
4	ORANGE	4	4	22,220	44,440	66,661	88,881	111,101	133,322	155,542
5	SILVER	6	6	34,719	69,438	104,157	138,877	173,596	208,315	243,034
6	WHITE	6	6	49,995	99,991	149,987	199,983	249,978	299,974	349,970
8	NONE	8	8	102,631	205,262	307,894	410,525	513,156	615,788	718,419

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