McKIM & CREED

LETTER OF TRANSMITTAL

TO:	Chatham County Environmental Quality 80-A East Street Pittsboro, NC 27312
ATTENTION:	Mr. Brian Burkhart

DATE:	March 21, 2018	
PROJECT NO:	2735-0206	TASK NO: EXP
RE:	Briar Chapel – Phase 16N	
TRANSMITTAL NO:	1	PAGE 1 OF 1

WE ARE SENDING: ☐ Originals ☒ Prints ☐ Shop Drawings ☐ Samples
☐ Specifications ☒ Calculations ☐ Other -

Quantity	Dwg No.	Rev.	Description	Status
3			Stormwater Design Plans	G
3			Supporting Calculations	

Issue Status Code: A. Preliminary B. Fabrication Only C. For Information D. Bid
E. Construction F. For Review & Comments G. For Approval H. See Remarks

REMARKS:

Brian, please find attached plans and calculations for Phase 16N at Briar chapel. Please let us know if you have any questions.

Thank you!

1730 Varsity Drive, Suite 500 Raleigh, NC 27606 919/233-8091 Fax 919/233-8031

Cc:

McKIM & CREED, INC.

Signed _____

Chris Seamster, RLA
Project Manager

McKIM&CREED

ENGINEERS

SURVEYORS

PLANNERS

March 21, 2018

Mr. Brian Burkhart
Environmental Quality Director
964 East Street
P.O. Box 910
Pittsboro, NC 27312

RE: Briar Chapel – Phase 16 North

Mr. Burkhart,

Please find enclosed the plans, calculations, supplement forms and operation and maintenance agreements for Phase 16 North at Briar Chapel for your information. These items have all been submitted to NCDEQ for their review.

BMP #36 receives some drainage from the US Steel Conservation subdivision and has been designed using the same methodology discussed during the permitting of the pond in Phase 16 South, which received some drainage from the US Steel Amenity area. BMP #35 does not receive any drainage for the US Steel subdivision.

Please let me know if you have any questions on this. Thank you for your assistance.

Sincerely,
McKIM & CREED, INC.

Gareth Avant

Gareth Avant, PE
Project Engineer

Venture IV Building
Suite 500
1730 Varsity Drive
Raleigh, NC 27606

919.233.8091
Fax 919.233.8031
www.mckimcreed.com

Operation & Maintenance Agreement

Project Name:	**Briar Chapel - Phase 16 North**
Project Location:	**End of Middleton Place at Briar Chpael Ph. 16S, Pittsboro, NC**

Cover Page

Maintenance records shall be kept on the following BMP(s). This maintenance record shall be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired, or replaced **immediately.** These deficiencies can affect the integrity of structures, safety of the public, and the pollutant removal efficiency of the BMP(s).

The BMP(s) on this project include (check all that apply & corresponding O&M tables will be added automatically):

Bioretention Cell	Quantity:		Location(s):	
Dry Detention Basin	Quantity:		Location(s):	
Grassed Swale	Quantity:		Location(s):	
Green Roof	Quantity:		Location(s):	
Infiltration Basin	Quantity:		Location(s):	
Infiltration Trench	Quantity:		Location(s):	
Level Spreader/VFS	Quantity:		Location(s):	
Permeable Pavement	Quantity:		Location(s):	
Proprietary System	Quantity:		Location(s):	
Rainwater Harvesting	Quantity:		Location(s):	
Sand Filter	Quantity:		Location(s):	
Stormwater Wetland	Quantity:		Location(s):	
Wet Detention Basin	Quantity:	2	Location(s):	
Disconnected Impervious Area	Present:	No	Location(s):	
User Defined BMP	Present:	No	Location(s):	

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed for each BMP above, and attached O&M tables. I agree to notify NCDENR of any problems with the system or prior to any changes to the system or responsible party.

* Responsible Party:	**Lee Bowman**
Title & Organization:	**Senior Project Manager, NNP-Briar Chapel, LLC**
Street address:	**1342 Briar Chapel Parkway**
City, state, zip:	**Chapel Hill, NC 27516**
Phone number(s):	**(919) 951-0700**
Email:	**lbowman@newlandco.com**

Signature: _____ Date: 3/23/18

I, Amy L. Kingrea, a Notary Public for the State of North Carolina

County of Durham, do hearby certify that G. Lee Bowman

personally appeared before me this 23 day of March 2018 and

acknowledge the due execution of the Operations and Maintenance Agreement.

Witness my hand and official seal, _____

Amy L. Kingrea Notary Public Durham County, NC

Seal

My commission expires 6/23/2020

Wet Detention Pond Maintenance Requirements

The wet detention basin system is defined as the wet detention basin, pretreatment including forebays and the vegetated filter if one is provided.

Important maintenance procedures:

- Immediately after the wet detention basin is established, the plants on the vegetated shelf and perimeter of the basin should be watered twice weekly if needed, until the plants become established (commonly six weeks).
- No portion of the wet detention pond should be fertilized after the first initial fertilization that is required to establish the plants on the vegetated shelf.
- Stable groundcover should be maintained in the drainage area to reduce the sediment load to the wet detention basin.
- If the basin must be drained for an emergency or to perform maintenance, the flushing of sediment through the emergency drain should be minimized to the maximum extent practical.
- Once a year, a dam safety expert should inspect the embankment.

After the wet detention pond is established, it should be inspected **once a month and within 24 hours after every storm event greater than 1.0 inches (or 1.5 inches if in a Coastal County)**. Records of operation and maintenance should be kept in a known set location and must be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
The entire BMP	Trash/debris is present.	Remove the trash/debris.
The perimeter of the BMP	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Vegetation is too short or too long.	Maintain vegetation at a height of approximately six inches.
The inlet device	The pipe is clogged.	Unclog the pipe. Dispose of the sediment off-site.
	The pipe is cracked or otherwise damaged.	Replace the pipe.
	Erosion is occurring in the swale.	Regrade the swale if necessary to smooth it over and provide erosion control devices such as reinforced turf matting or riprap to avoid future problems with erosion.
	Stone verge is clogged or covered in sediment (if applicable).	Remove sediment and replace with clean stone.
The forebay	Sediment has accumulated to a depth greater than the original design depth for sediment storage.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
The vegetated shelf	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.

Wet Detention Pond Maintenance Requirements (Continued)

The main treatment area	Sediment has accumulated to a depth greater than the original design sediment storage depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Algal growth covers over 50% of the area.	Consult a professional to remove and control the algal growth.
	Cattails, phragmites or other invasive plants cover 50% of the basin surface.	Remove the plants by wiping them with pesticide (do not spray).
The embankment	Shrubs have started to grow on the embankment.	Remove shrubs immediately.
	Evidence of muskrat or beaver activity is present.	Use traps to remove muskrats and consult a professional to remove beavers.
	A tree has started to grow on the embankment.	Consult a dam safety specialist to remove the tree.
	An annual inspection by an appropriate professional shows that the embankment needs repair. (if applicable)	Make all needed repairs.
The outlet device	Clogging has occurred.	Clean out the outlet device. Dispose of the sediment off-site.
	The outlet device is damaged	Repair or replace the outlet device.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the local NC Department of Environment and Natural Resources Regional Office.

The measuring device used to determine the sediment elevation shall be such that it will give an accurate depth reading and not readily penetrate into accumulated sediments.

Wet Detention Pond Design Summary

Wet Pond Diagram

WET POND ID		FOREBAY		MAIN POND	
1 - BMP #35		Permanent Pool El.	490.5	Permanent Pool El.	490.5
		Temporary Pool El:	492	Temporary Pool El:	492
Pretreatment other than forebay?	No	Clean Out Depth:	2.5	Clean Out Depth:	4.5
		Sediment Removal El:	488	Sediment Removal El:	486
Has Veg. Filter?	No	Bottom Elevation:	486.5	Bottom Elevation:	484.5

WET POND ID		FOREBAY		MAIN POND	
2 - BMP #36		Permanent Pool El.	507.5	Permanent Pool El.	507.5
		Temporary Pool El:	509	Temporary Pool El:	509
Pretreatment other than forebay?	No	Clean Out Depth:	2.5	Clean Out Depth:	4
		Sediment Removal El:	505	Sediment Removal El:	503.5
Has Veg. Filter?	No	Bottom Elevation:	503.5	Bottom Elevation:	502

SUPPLEMENT-EZ FORM COVER PAGE

Please indicate the types, quantities and locations of SCMs that will be used on this project:

	Quantity	Location(s)
Infiltration System		
Bioretention Cell		
Wet Pond	2	
Stormwater Wetland		
Permeable Pavement		
Sand Filter		
Rainwater Harvesting		
Green Roof		
Level Spreader-Filter Strip		
Disconnected Impervious Surface		
Treatment Swale		
Dry Pond		

Project Name:

Briar Chapel Phase 16 North

Address

N/A

City / Town

Pittsboro, NC

Designer information for this project:

Name and Title:	Gareth C. Avant
Organization:	McKim and Creed, Inc.
Street address:	1730 Varsity Drive, Suite 500
City, State, Zip:	Raleigh, NC 27606
Phone number(s):	(919)233-8091
Email:	gavant@mkcimcreed.com

Applicant:

Company:	NNP-Briar Chapel, LLC
Contact:	Lee Bowman, Senior Project Manager
Mailing Address:	1342 Briar Chapel Parkway
City, State, Zip:	Chapel Hill, NC 27516
Phone number(s):	(919) 951-0700
Email:	lbowman@newlandco.com

Designer

NORTH CAROLINA PROFESSIONAL SEAL 036348 ENGINEER GARETH C. AVANT

Seal

Signature of Designer

3-21-2018

Date

Certification Statement:

I certify, under penalty of law: that this Supplement-EZ form and all supporting information were prepared under my direction or supervision;

- that the information provided in the form is, to the best of my knowledge and belief, true, accurate, and complete; and

- that the engineering plans, specifications, operation and maintenance agreements and other supporting information are consistent with the information provided here.

I am aware that there are significant penalties for submitting false information including the possibility of fines and imprisonment for knowing violations as well as a report being made to my professional board.

WET POND

Briar Chapel Phase 16 North

THE DRAINAGE AREA			1
Drainage area number	1 (BMP #35)	**Break down of BUA in the drainage area (both new and existing):**	
Total coastal wetlands area (sq ft)	sf	- Parking / driveway (sq ft)	
Total surface water area (sq ft)	sf	- Sidewalk (sq ft)	13364 sf
Total drainage area (sq ft)	728269 sf	- Roof (sq ft)	152700 sf
BUA associated with existing development (sq ft)	sf	- Roadway (sq ft)	54404 sf
Proposed new BUA (sq ft)	264562 sf	- Other, please specify in the comment box below (sq ft)	44094 sf
Percent BUA of drainage area	36%	**Total BUA (sq ft)**	264562 sf
COMPLIANCE WITH THE APPLICABLE STORMWATER PROGRAM			
Stormwater program(s) that apply (please specify):		Design rainfall depth (in)	1.0 in
		Minimum volume required (cu ft)	22876 cf
		Design volume of SCM (cu ft)	24101 cf
GENERAL MDC FROM 02H .1050			
#1 Is the SCM sized to treat the SW from all surfaces at build-out?	Yes	#7 If applicable, with the SCM be cleaned out after construction?	
#2 Is the SCM located on or near contaminated soils?	No	#8 Does the mainetenance access comply with General MDC (8)?	Yes
#3 What are the side slopes of the SCM (H:V)?	3:1	#9 Does the drainage easement comply with General MDC (9)?	Yes
#3 Does the SCM have retaining walls, gabion walls or other engineered side slopes?	No	#10 If the SCM is on a single family lot, does the plat comply with General MDC (10)?	
#4 Are the inlets, outlets, and receiving stream protected from erosion (10-year storm)?	Yes	#11 Is there an O&M Agreement that complies with General MDC (11)?	Yes
#5 Is there a a bypass for flows in excess of the design flow?	Yes	#12 Is there an O&M Plan that complies with General MDC (12)?	Yes
#6 What is the method for dewatering the SCM for maintenance?	Pump (preferred)	#13 Was the SCM designed by an NC licensed professional?	Yes
WET POND MDC FROM 02H .1053			
#1 Method used	SA/DA	#6 Width of the vegetated shelf (feet)	6 ft
#1 Surface area of the main permanent pool (square feet)	10201 sf	#6 Location of vegetated shelf	@ Normal Pool
#1 Volume of the main permanent pool (cubic feet)	31684 cf	#6 Elevation of top of shelf (fmsl)	491 ft
#2 Average depth of the main pool (feet)	3.1 ft	#6 Elevation of bottom of shelf (fmsl)	490 ft
#2 Was the vegetated shelf included in the calculation of average depth?	No	#6 Slope of vegetated shelf (H:V)	6:1
#2 Elevation of the bottom of the permanent pool (fmsl)	485 ft	#7 Diameter of drawdown orifice (inches)	2.5 in
#2 Elevation of the top of the permanent pool (fmsl)	490.5	#7 Drawdown time for the temporary pool (hours)	55 hrs
#2 Elevation of the top of the temporary pool (fmsl)	498 ft	#7 Does the orifice drawdown from below the top surface of the permanent pool?	Yes
#3 Depth provided for sediment storage (inches)	18 in	#8 Does the pond minimize impacts to the receiving channel from the 1-yr, 24-hr storm?	Yes
#4 Are the inlet(s) and outlet located in a manner that avoids short-circuiting?	Yes	#9 Are fountains proposed?	No
#4 Describe any measures, such as berms or baffles, that will be taken to improve the flow path:		#9 If yes, is documentation provided per Wet Pond MDC (9)?	
Berm has been provided between forebay and permanent pool to promote a longer flow path than without		#10 Is a trash rack or other device provided to protect the outlet system?	Yes
#5 Volume of the forebay (cubic feet)	5563	#11 Are the dam and embankment planted in non-clumping turf grass?	Yes
#5 Is this 15-20% of the volume in the main pool?	Yes	#11 Species of turf that will be used on the dam and embankment	
#5 Depth of forebay at entrance (inches)	42 in	#11 Describe the planting plan for the vegetated shelf:	
#5 Depth of forebay at exit (inches)	18 in	Vegetated shelf is planted around the main pool with shallow water (sweetflag, pickerelweed, blue frag iris, soft rush, and three square bulrush) and shallow land (swap milkweed, cardinal flower, scarlet rose mallow, dwarf joe pye weed, spooted trumpetweed) plantings. Hybrid bermuda sod is planted on the berm between the forebay and main pond.	
#5 Does water flow out of the forebay in a non-erosive manner?	Yes		
#5 Clean-out depth for forebay (inches)	18 in		
#5 Will the forebay be cleaned out when the depth is reduced to less than the above?	Yes		
ADDITIONAL INFORMATION			
Please use this space to provide any additional information about this wet pond that you think is relevant to the review:			
Other BUA - 44,094 sq ft provided as additional contingency			

THE DRAINAGE AREA			2
Drainage area number	2 (BMP #36)	**Break down of BUA in the drainage area (both new and existing):**	
Total coastal wetlands area (sq ft)	sf	- Parking / driveway (sq ft)	
Total surface water area (sq ft)	sf	- Sidewalk (sq ft)	7404 sf
Total drainage area (sq ft)	450123 sf	- Roof (sq ft)	71400 sf
BUA associated with existing development (sq ft)	sf	- Roadway (sq ft)	24992 sf
Proposed new BUA (sq ft)	148556 sf	- Other, please specify in the comment box below (sq ft)	44760 sf
Percent BUA of drainage area	33%	**Total BUA (sq ft)**	148556 sf
COMPLIANCE WITH THE APPLICABLE STORMWATER PROGRAM			
Stormwater program(s) that apply (please specify):		Design rainfall depth (in)	1 and 1.43
		Minimum volume required (cu ft)	14301 cf
		Design volume of SCM (cu ft)	15523 cf
GENERAL MDC FROM 02H .1050			
#1 Is the SCM sized to treat the SW from all surfaces at build-out?	Yes	#7 If applicable, with the SCM be cleaned out after construction?	
#2 Is the SCM located on or near contaminated soils?	No	#8 Does the mainetenance access comply with General MDC (8)?	Yes
#3 What are the side slopes of the SCM (H:V)?	3:1	#9 Does the drainage easement comply with General MDC (9)?	Yes
#3 Does the SCM have retaining walls, gabion walls or other engineered side slopes?	No	#10 If the SCM is on a single family lot, does the plat comply with General MDC (10)?	
#4 Are the inlets, outlets, and receiving stream protected from erosion (10-year storm)?	Yes	#11 Is there an O&M Agreement that complies with General MDC (11)?	Yes
#5 Is there a a bypass for flows in excess of the design flow?	Yes	#12 Is there an O&M Plan that complies with General MDC (12)?	Yes
#6 What is the method for dewatering the SCM for maintenance?	Pump (preferred)	#13 Was the SCM designed by an NC licensed professional?	Yes
WET POND MDC FROM 02H .1053			
#1 Method used	SA/DA	#6 Width of the vegetated shelf (feet)	6 ft
#1 Surface area of the main permanent pool (square feet)	6783 sf	#6 Location of vegetated shelf	@ Normal Pool
#1 Volume of the main permanent pool (cubic feet)	20373 cf	#6 Elevation of top of shelf (fmsl)	508 ft
#2 Average depth of the main pool (feet)	3 ft	#6 Elevation of bottom of shelf (fmsl)	507 ft
#2 Was the vegetated shelf included in the calculation of average depth?	No	#6 Slope of vegetated shelf (H:V)	6:1
#2 Elevation of the bottom of the permanent pool (fmsl)	502.5 ft	#7 Diameter of drawdown orifice (inches)	2.0 in
#2 Elevation of the top of the permanent pool (fmsl)	507.5 ft	#7 Drawdown time for the temporary pool (hours)	58 hrs
#2 Elevation of the top of the temporary pool (fmsl)	514.50 ft	#7 Does the orifice drawdown from below the top surface of the permanent pool?	Yes
#3 Depth provided for sediment storage (inches)	18 in	#8 Does the pond minimize impacts to the receiving channel from the 1-yr, 24-hr storm?	Yes
#4 Are the inlet(s) and outlet located in a manner that avoids short-circuiting?	Yes	#9 Are fountains proposed?	No
#4 Describe any measures, such as berms or baffles, that will be taken to improve the flow path:		#9 If yes, is documentation provided per Wet Pond MDC (9)?	
Berms between the forebay and main pool outlet to promote a longer flow path		#10 Is a trash rack or other device provided to protect the outlet system?	Yes
#5 Volume of the forebay (cubic feet)	3638	#11 Are the dam and embankment planted in non-clumping turf grass?	Yes
#5 Is this 15-20% of the volume in the main pool?	Yes	#11 Species of turf that will be used on the dam and embankment	
#5 Depth of forebay at entrance (inches)	42 in	#11 Describe the planting plan for the vegetated shelf:	
#5 Depth of forebay at exit (inches)	18 in	Vegetated shelf is planted around the main pool with shallow water (sweetflag, pickerelweed, blue frag iris, soft rush, and three square bulrush) and shallow land (swap milkweed, cardinal flower, scarlet rose mallow, dwarf joe pye weed, spooted trumpetweed) plantings. Hybrid bermuda sod is planted on the berm between the forebay and main pond.	
#5 Does water flow out of the forebay in a non-erosive manner?	Yes		
#5 Clean-out depth for forebay (inches)	18 in		
#5 Will the forebay be cleaned out when the depth is reduced to less than the above?	Yes		
ADDITIONAL INFORMATION			
Please use this space to provide any additional information about this wet pond that you think is relevant to the review:			
Other BUA - 44,760 = 20,000 for future open space and 24,760 sq ft provided as additional contingency			

401 NARRATIVE & SUPPORTING CALCULATIONS

Briar Chapel Development
Phase 16 North

Chatham County, North Carolina
March 21, 2018

Prepared for:

BRIAR CHAPEL™
by
Newland COMMUNITIES

NNP Briar Chapel, LLC
1342 Briar Chapel Parkway
Chapel Hill, North Carolina 27516

Prepared By:

McKIM&CREED
1730 Varsity Drive, Suite 500
Raleigh, North Carolina 27606
Phone: (919) 233.8091
Fax: (919) 233.8031

M&C Project No. 02735-0206

PROJECT DESCRIPITON

The purpose of the project is to construct water, sewer and roadway infrastructure to support 62 residential lots in the Phase 16 North section of the overall Briar Chapel Development.

Based on the conditions of the approved 401 Water Quality Certification, NCDENR-DWR will require runoff from the roads to be captured and treated for 85% TSS removal before being discharged into existing stream buffers. To meet this requirement, the runoff from the general area of Phase 16 North construction will be directed to one of two stormwater wet detention devices designed per the latest version of NC DEQ's Minimum Design Criteria. Calculations for these new facilities are included in this package.

Upon completion of the project's construction, the proposed public roads will be turned over to and maintained by NCDOT.

SITE DESCRIPTION

The project area is approximately 24 acres of disturbed area located north of Phase 16S (DWR# 05-0732 v33) within the BC West development area, which is west of the intersection of Boulder Point Drive and Briar Chapel Parkway.

The site generally slopes away from a ridge north of or right at the northern limits of disturbance and drains to the southeast and southwest. The slopes in the site range from 5-20% in localized areas.

SOILS

According to the Chatham County Generalized Soil Survey, the soils located on the site are classified as Vance Sandy Loam, 2 to 6 percent slopes (VaB); Wedowee sandy loam, 2 to 15 percent slopes (We(X)); and Wedowee sandy loam, 15 to 35 percent slopes, bouldery (WdC, WdE)

The following soil descriptions are associated with the soils found on the site:

VaB – Vance Sandy Loam, 2 to 6 percent slopes – often found in piedmont uplands on ridges and side slopes. Permeability is slow and the soils are well drained. Soils have a moderate shrink/swell potential. The seasonal high water table is generally more than 6.0 feet below the surface.

We(X) – Wedowee sandy loam soils are often found in piedmont uplands, along ridges and side slopes. Permeability is moderate and the soils are well drained. Soils have a low shrink/swell potential. The seasonal high water is generally more than 6.0 feet below the surface.

WdC – Wedowee sandy loam, boulder soils carry the same characteristics of Wedowee We(X) soils, listed above, with the exception that large boulders are more commonly found.

WdE – Wedowee sandy loam, boulder soils carry the same characteristics of Wedowee We(X) soils, listed above, with the exception that large boulders are more commonly found.

WET DETENTION DESIGN

The wet detention ponds for this project have been designed to remove 85% of the total suspended solids entering from the surrounding drainage areas before discharging into the adjacent stream buffers. The calculations provided with this package include all projected future drainage areas that might be captured by the ponds. Treated runoff will be dissipated by a riprap outlet protection device before entering any stream buffers.

Design parameters were taken from the BMP manual, DEQ's design supplement forms, and the latest version of NC DEQ's Minimum Design Criteria for stormwater Control Measures. BMP #36 receives stormwater from a portion of the US Steel Conservation subdivision, which is zoned differently than the Briar Chapel Community, and is designed with Chatham County Stormwater guidelines in mind. This includes the 1.43-inch storm in addition to the 2-year and 5-year design storms.

BMP SUMMARY OF RESULTS

In order to meet the requirements of the development, three wet detention basins have been designed based on an assumption of the full buildout condition of the site. A summary table is provided below and the supporting calculations have been included with this submittal.

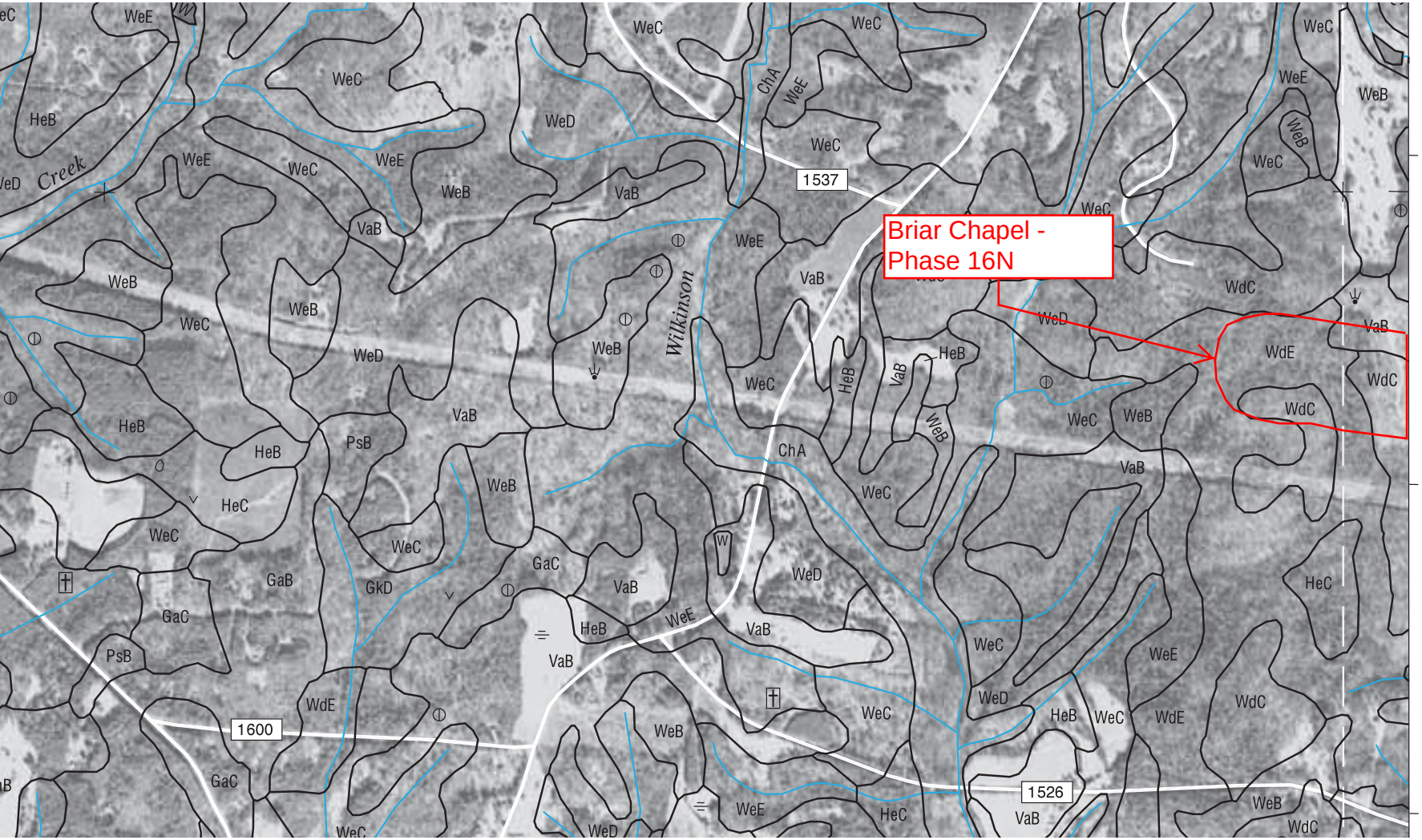
	BMP #35			***BMP #36***					
	1-yr	***10-yr***	***100-yr***	***1-yr***	***2-yr***	***5-yr***	***10-yr***	***25-yr***	***100-yr***
Pre-Development Discharge (cfs)	6.93	25.31	49.75	5.20	8.56	14.17	18.91	25.64	37.03
Post-Development Controlled Discharge (cfs)	5.02	23.71	80.65	4.67	7.66	10.69	18.86	22.22	56.62
Peak Water Surface Elevation (ft)	492.89'	495.40'	496.74'	509.54'	510.17'	511.13'	511.75'	512.56'	513.24'

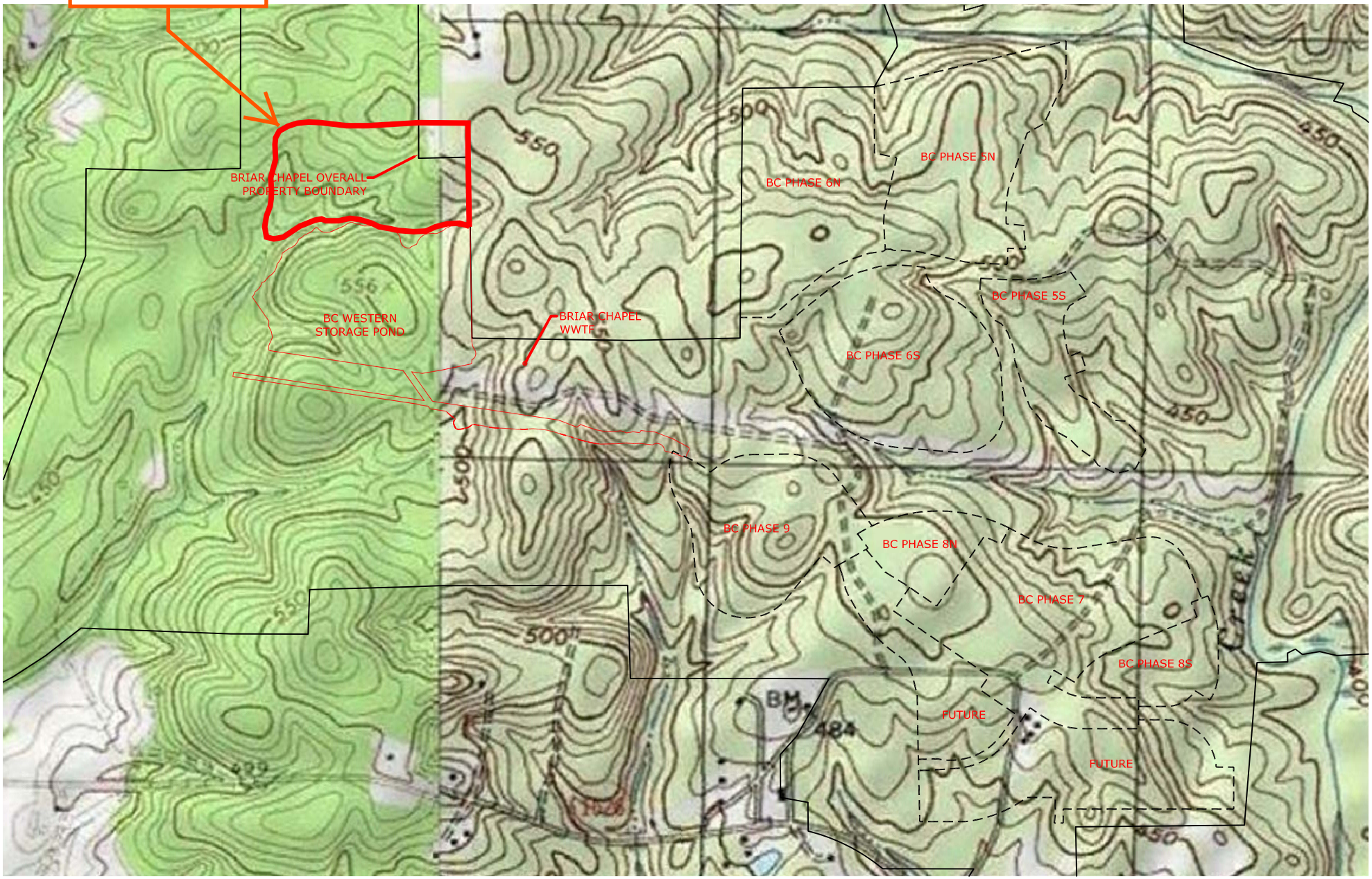
MAINTENANCE CONSIDERATIONS

The property owner shall be responsible for periodic inspection and maintenance of all permanent stormwater management devices and shall adhere to conditions agreed upon by the executed Operation and Maintenance agreements included with this submittal. Any measure that fails to function as intended shall be repaired immediately.

Maps


Briar Chapel - Phase 16N
35°50′00″
39 68 000m N
39 67
39 66
39 65
39 64
1532
1530
1721
1526
1528
1717
Bennett Mountain
Pokeberry Creek
Jones Branch
Herndon
s sheet 4 Bynum


Briar Chapel -
Phase 16N
Wilkinson
Creek
1537
1600
1526
39 67
35° 50′ 00″
39 66
39 65


Briar Chapel -
Phase 16N
BRIAR CHAPEL OVERALL
PROPERTY BOUNDARY
BC WESTERN
STORAGE POND
BRIAR CHAPEL
WWTF
BC PHASE 5N
BC PHASE 6N
BC PHASE 5S
BC PHASE 6S
BC PHASE 9
BC PHASE 8N
BC PHASE 7
BC PHASE 8S
FUTURE
FUTURE
550
500
450
556
484
BM

Wet Detention Pond #35 Design

WATER QUALITY POND CALCULATIONS

Project Name

Briar Chapel - Phase 16N (BMP #35)

Project Number

02735-0206

Date
March 15, 2018

3rd revision _____
2nd revision _____
1st revision _____

Water Quality Pond Drainage Area Data

Project: Briar Chapel - Phase 16N (BMP #35)
Project No.: 02735-0206

Date: March 15, 2018

Total site area: 728,269 square feet = 16.72 acres

Impervious areas	Drainage area to pond			Other Drainage Area	
	Existing [sf]	Proposed [sf]	Change [sf]	Existing [sf]	Proposed [sf]
On-site buildings (BUA)	0	152,700	152,700	0	0
On-site streets	0	54,404	54,404	0	0
On-site alleys	0	0	0	0	0
On-site sidewalks	0	13,364	13,364	0	0
On-site future (open space)	0	0	0	0	0
Off-site future development	0	0	0	0	0
20% Contingency	0	44,094	44,094	0	0
Total Impervious	***0***	***264,562***	***264,562***	***0***	***0***

Non-impervious areas	Drainage area to pond			Other Drainage Area	
	Existing [sf]	Proposed [sf]	Change [sf]	Existing [sf]	Proposed [sf]
On-site grass/landscape	0	463,707	463,707	0	0
On-site woods	728,269	0	-728,269	0	0
Other undeveloped	0	0	0	0	0
Total off-site non-impervious	0	0	0	0	0
Total non-impervious	728,269	463,707	-264,562	0	0

Total Drainage Area	728,269	728,269	0	0	0
Percent Impervious	0.0	36.3	36.3	n/a	n/a

Water Quality Pond Surface Area Calculations

Project: Briar Chapel - Phase 16N (BMP #35)
Project No.: 02735-0206

Date: March 15, 2018

Total on-site drainage area to pond: 728,269 square feet
Total impervious area in drainage area: 264,562 square feet

Average water depth of basin at normal pool: 3.1 feet

Location of site: Chatham County
Site region: Piedmont

% Impervious cover: 36.3 percent

If the site is in a coastal area, will a vegetative filter be used? n/a

Surface Area/Drainage Area Ratios:

For a site in the Piedmont: 1.4 percent
For a site in a Coastal County: 1.6 percent

Required surface area of pond:

For a site in the Piedmont: 9,860.0 square feet
For a site in a Coastal County: 11,350.0 square feet

Notes:

Water Quality Pond Stormwater Runoff Volume Calculations

Project	Briar Chapel - Phase 16N (BMP #35)	
Project No.	02735-0206	
Date	March 15, 2018	
Drainage area	728,269	square feet
Impervious area	264,562	square feet
Rainfall depth	1.00	inches
Percent Impervious	36.3	percent

R(v)=0.05+0.009*(Percent impervious)

Runoff coefficient - R(v)	0.38	in/in

Runoff volume=(Design rainfall)*(R(v))*(Drainage area)

Runoff volume	22,876.6	cubic feet

Notes:

Water Quality Pond Volume Calculations
Stage-Storage Data for Pond - Temporary Pool

Project: Briar Chapel - Phase 16N (BMP #35)
Project No.: 02735-0206

Date: March 15, 2018

Contour ID	Stage	Area [sq. ft.]	Area [acres]	Incremental Area [sq. ft.]	Incremental Area [acres]	Incremental volume [cu. ft]	Incremental volume [acre-ft]	Cumulative volume [cu. ft]	Cumulative volume [acre-ft]
490.5	0	13,593.0	0.312	13,593.0	0.31	0.0	0.0	0.0	0.0
491	0.5	15,825.0	0.363	15,825.0	0.05	7,354.5	0.17	7,354.5	0.17
492	1.5	17,669.0	0.406	17,669.0	0.04	16,747.0	0.38	24,101.5	0.55
493	2.5	19,558.0	0.449	19,558.0	0.04	18,613.5	0.43	42,715.0	0.98
494	3.5	21,506.0	0.494	21,506.0	0.04	20,532.0	0.47	63,247.0	1.45
495	4.5	23,521.0	0.540	23,521.0	0.05	22,513.5	0.52	85,760.5	1.97
496	5.5	25,604.0	0.588	25,604.0	0.05	24,562.5	0.56	110,323.0	2.53
497	6.5	27,777.0	0.638	27,777.0	0.05	26,690.5	0.61	137,013.5	3.15
498	7.5	29,577.0	0.679	29,577.0	0.04	28,677.0	0.66	165,690.5	3.80

Water Quality Pond Volume Calculations
Stage-Storage Data for Pond - Main Pool

Project: Briar Chapel - Phase 16N (BMP #35)
Project No.: 02735-0206

Date: March 15, 2018

Contour ID	Stage	Area [sq. ft.]	Area [acres]	Incremental Area [sq. ft.]	Incremental Area [acres]	Incremental volume [cu. ft]	Incremental volume [acre-ft]	Cumulative volume [cu. ft]	Cumulative volume [acre-ft]
485	0	2,469.0	0.057	2,469.0	0.1	0.0	0.0	0.0	0.0
486	1	3,499.0	0.080	1,030.0	0.0	2,984.0	0.1	2,984.0	0.1
487	2	4,661.0	0.107	1,162.0	0.0	4,080.0	0.1	7,064.0	0.2
488	3	5,921.0	0.136	1,260.0	0.0	5,291.0	0.1	12,355.0	0.2
489	4	7,282.0	0.167	1,361.0	0.0	6,601.5	0.2	18,956.5	0.3
490	5	8,716.0	0.200	1,434.0	0.0	7,999.0	0.2	26,955.5	0.3
490.5	5.5	10,201.0	0.234	1,485.0	0.0	4,729.3	0.1	31,684.8	0.3

Water Quality Pond Volume Calculations
Stage-Storage Data for Pond - Forebays

Project: Briar Chapel - Phase 16N (BMP #35)
Project No.: 02735-0206

Date: March 15, 2018

Contour ID	Stage	Area [sq. ft.]	Area [acres]	Incremental Area [sq. ft.]	Incremental Area [acres]	Incremental volume [cu. ft]	Incremental volume [acre-ft]	Cumulative volume [cu. ft]	Cumulative volume [acre-ft]
487	0	351.0	0.008	351.0	0.0	0.0	0.0	0.0	0.0
488	1	986.0	0.023	635.0	0.0	668.5	0.0	668.5	0.0
489	2	1,709.0	0.039	723.0	0.0	1,347.5	0.0	2,016.0	0.0
490	3	2,508.0	0.058	799.0	0.0	2,108.5	0.0	4,124.5	0.1
490.5	3.5	3,249.0	0.075	741.0	0.0	1,439.3	0.0	5,563.8	0.1

Water Quality Basin Dewatering Time Calculations

Project Briar Chapel - Phase 16N (BMP #35)
Project No. 02735-0206

Date March 15, 2018

Water quality treatment volume	22,877	cubic feet
Total treatment volume	24,101	cubic feet
Maximum head of water above dewatering hole	1.50	feet
Driving head	0.50	feet
Orifice coefficient	0.60	
Diameter of each hole	2.50	inches
Number of holes	1	
Cross sectional area of each hole =	0.034	square feet
Cross sectional area of each hole =	4.9	square inches
Cross sectional area of dewatering hole(s) =	0.034	square feet
Cross sectional area of dewatering hole(s) =	4.9	square inches
Dewatering time for water quality volume =	2.3	days
	55.0	hours
Dewatering time for total volume =	2.4	days
	58.0	hours

Notes:
Dewatering time formula: t (days) = V / (Cd*A*Sqrt (2*32.2*H)*86,400)

t = drawdown time
V = treatment volume
Cd = orifice coefficient
A = cross sectional area of orifice
H = driving head (1/3 max. head)

Water Quality Pond Summary Information

Project: Briar Chapel - Phase 16N (BMP #35)
Project No.: 02735-0206

Date: March 15, 2018

Drainage area to pond	728,269	square feet =	16.72	acres
Impervious area in drainage area	264,562	square feet =	6.07	acres

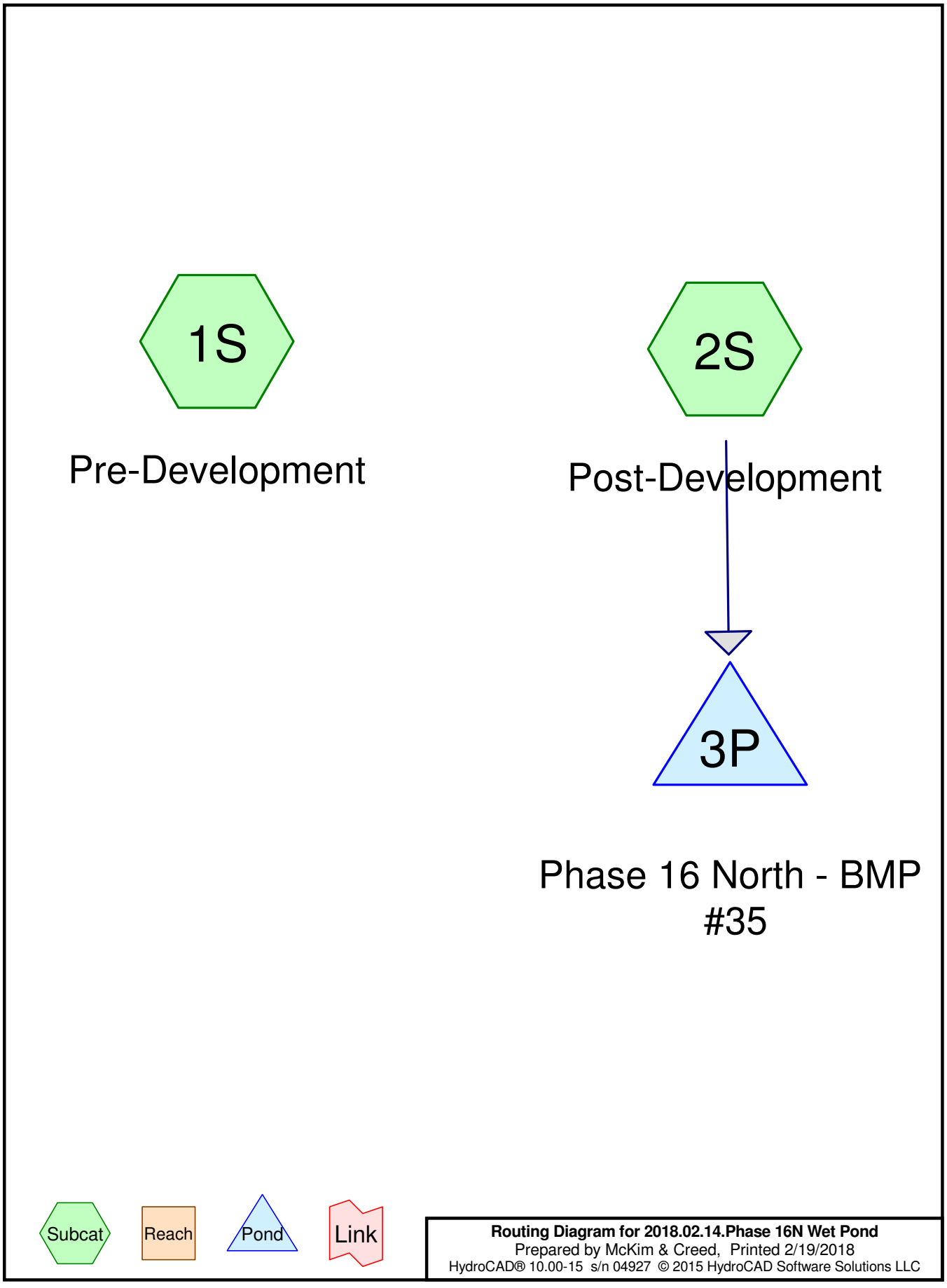
Bottom of pond elevation	485.00	feet
Normal pool elevation	490.50	feet
Main pond volume at normal pool	31,684	cubic feet
Forebay volume at normal pool	5,563	cubic feet
Forbay % of total volume	17.6%	

Required volume for design rainfall	22,877	cubic feet
Required surface area for main pool	9,860	square feet

Volume provided for storage of design rainfall = 24,101 cubic feet at elevation 492

Surface area provided at normal pool of main pond = 10,201 square feet

Average Depth 3.09 feet


1S
Pre-Development
2S
Post-Development
3P
Phase 16 North - BMP #35
Subcat
Reach
Pond
Link
Routing Diagram for 2018.02.14.Phase 16N Wet Pond
Prepared by McKim & Creed, Printed 2/19/2018
HydroCAD® 10.00-15 s/n 04927 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
10.640	74	>75% Grass cover, Good, HSG C (2S)
6.080	98	Paved parking, HSG C (2S)
16.720	70	Woods, Good, HSG C (1S)
33.440	**76**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
33.440	HSG C	1S, 2S
0.000	HSG D	
0.000	Other	
33.440		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	10.640	0.000	0.000	10.640	>75% Grass cover, Good	2S
0.000	0.000	6.080	0.000	0.000	6.080	Paved parking	2S
0.000	0.000	16.720	0.000	0.000	16.720	Woods, Good	1S
0.000	**0.000**	**33.440**	**0.000**	**0.000**	**33.440**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3P	486.00	485.00	64.2	0.0156	0.013	24.0	0.0	0.0

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=16.720 ac 0.00% Impervious Runoff Depth=0.69"
Flow Length=1,271' Tc=39.4 min CN=70 Runoff=6.93 cfs 0.964 af

Subcatchment 2S: Post-Development Runoff Area=16.720 ac 36.36% Impervious Runoff Depth=1.41"
Flow Length=696' Tc=10.0 min CN=83 Runoff=35.83 cfs 1.971 af

Pond 3P: Phase 16 North - BMP #35 Peak Elev=492.89' Storage=39,692 cf Inflow=35.83 cfs 1.971 af
Primary=5.02 cfs 1.500 af Secondary=0.00 cfs 0.000 af Outflow=5.02 cfs 1.500 af

Total Runoff Area = 33.440 ac Runoff Volume = 2.935 af Average Runoff Depth = 1.05"
81.82% Pervious = 27.360 ac 18.18% Impervious = 6.080 ac

Summary for Subcatchment 1S: Pre-Development

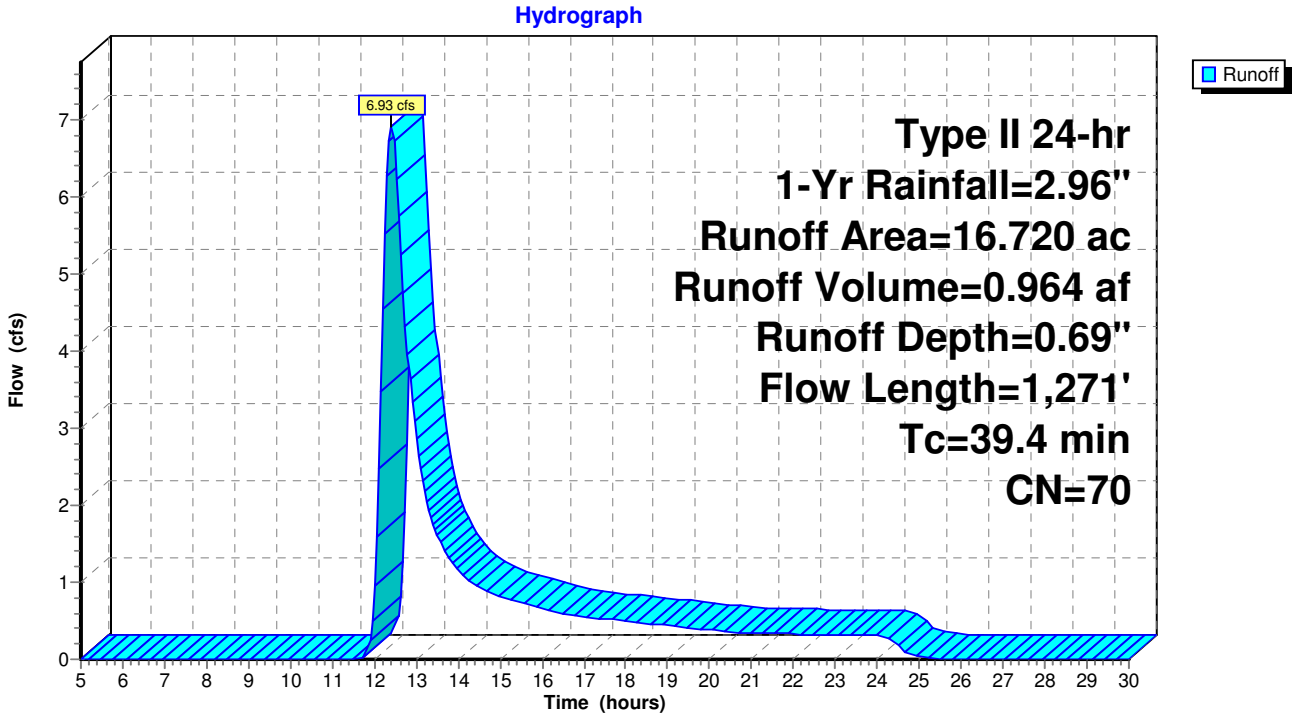
Runoff = 6.93 cfs @ 12.41 hrs, Volume= 0.964 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.96"

Area (ac)	CN	Description
16.720	70	Woods, Good, HSG C
16.720		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.1	124	0.0201	0.09		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
15.3	1,147	0.0627	1.25		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
39.4	1,271	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

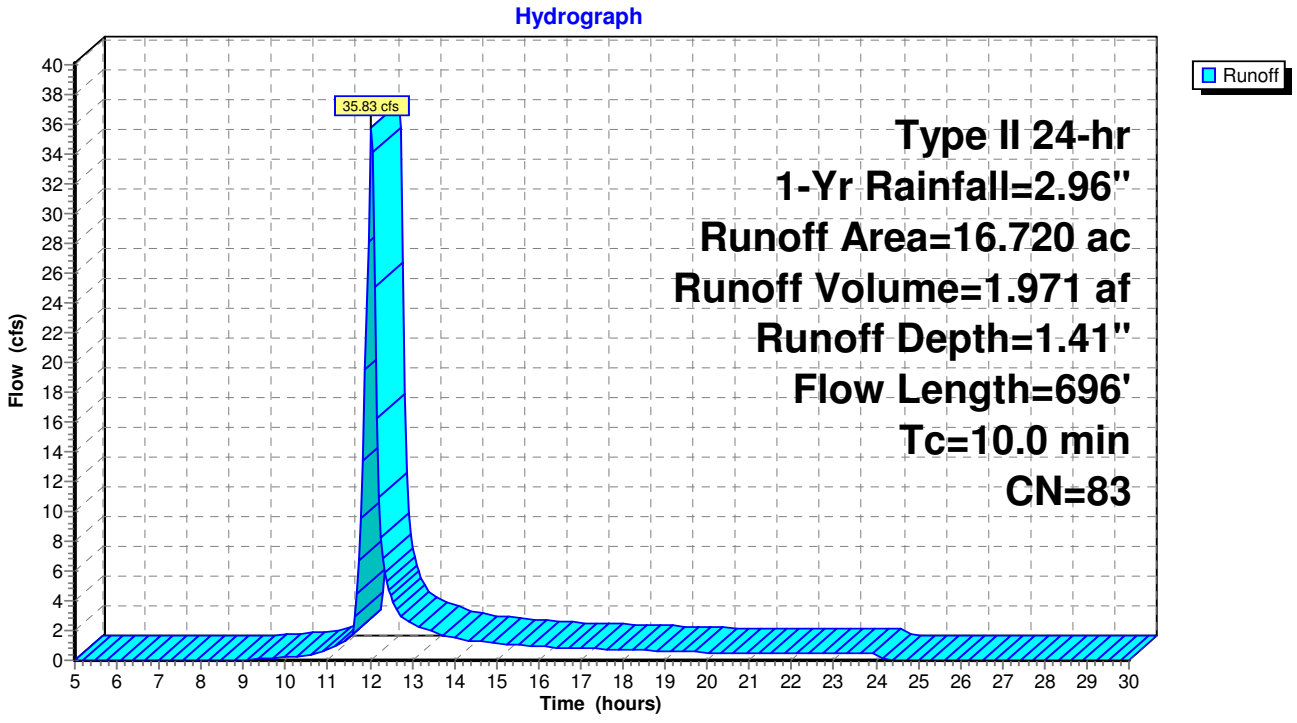
Runoff = 35.83 cfs @ 12.02 hrs, Volume= 1.971 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.96"

Area (ac)	CN	Description
10.640	74	>75% Grass cover, Good, HSG C
6.080	98	Paved parking, HSG C
16.720	83	Weighted Average
10.640		63.64% Pervious Area
6.080		36.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	37	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.56"
4.2	659	0.0303	2.61		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.6					**Direct Entry,**
10.0	696	Total			

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #35

Inflow Area = 16.720 ac, 36.36% Impervious, Inflow Depth = 1.41" for 1-Yr event
Inflow = 35.83 cfs @ 12.02 hrs, Volume= 1.971 af
Outflow = 5.02 cfs @ 12.42 hrs, Volume= 1.500 af, Atten= 86%, Lag= 24.4 min
Primary = 5.02 cfs @ 12.42 hrs, Volume= 1.500 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 492.89' @ 12.42 hrs Surf.Area= 18,870 sf Storage= 39,692 cf

Plug-Flow detention time= 225.0 min calculated for 1.497 af (76% of inflow)
Center-of-Mass det. time= 132.3 min (969.5 - 837.2)

Volume	Invert	Avail.Storage	Storage Description
#1	490.50'	148,256 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

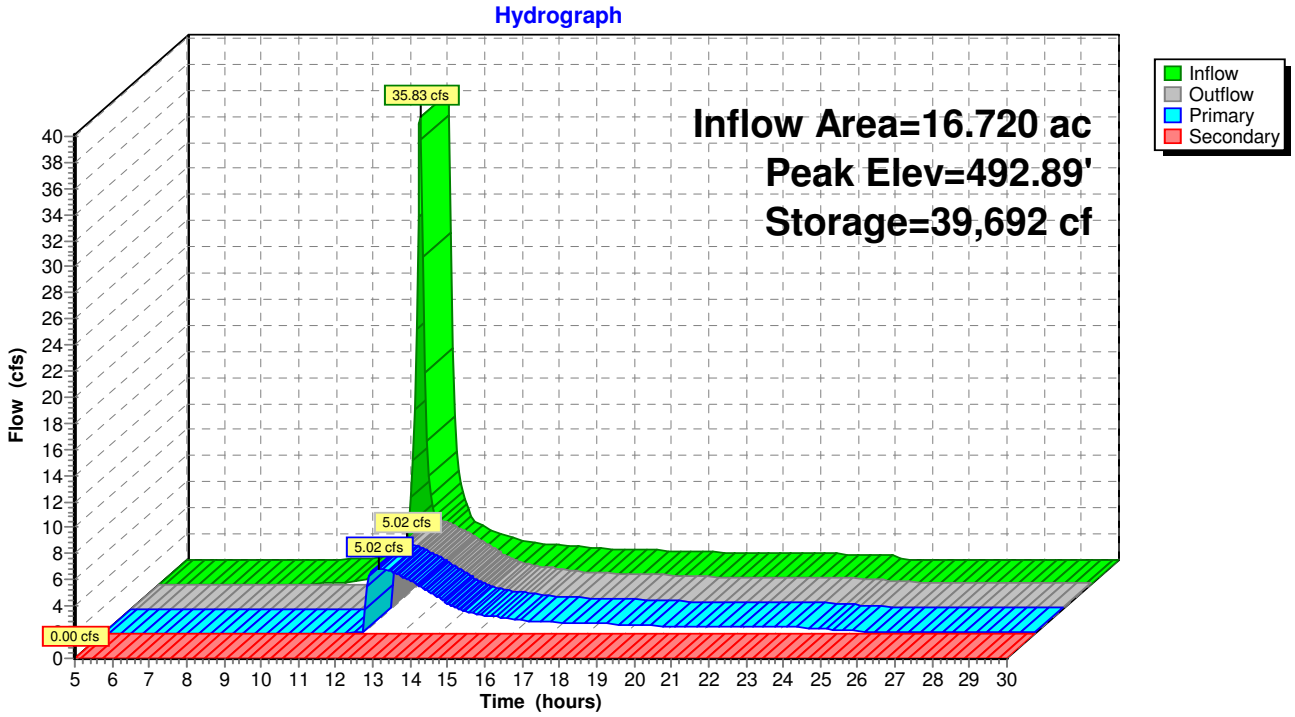
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
490.50	13,593	0	0
491.00	15,433	7,257	7,257
492.00	17,212	16,323	23,579
493.00	19,068	18,140	41,719
494.00	21,002	20,035	61,754
495.00	23,017	22,010	83,764
496.00	25,117	24,067	107,831
497.00	27,297	26,207	134,038
497.50	29,577	14,219	148,256

Device	Routing	Invert	Outlet Devices
#1	Primary	486.00'	**24.0" Round Culvert** L= 64.2' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 486.00' / 485.00' S= 0.0156 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	490.50'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	492.00'	**42.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	495.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	496.00'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=5.02 cfs @ 12.42 hrs HW=492.89' (Free Discharge)
└**1=Culvert** (Passes 5.02 cfs of 36.72 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.25 cfs @ 7.28 fps)
  ├**3=Orifice/Grate** (Orifice Controls 4.77 cfs @ 4.09 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=490.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Phase 16 North - BMP #35



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=16.720 ac 0.00% Impervious Runoff Depth=2.16"
Flow Length=1,271' Tc=39.4 min CN=70 Runoff=25.31 cfs 3.014 af

Subcatchment 2S: Post-Development Runoff Area=16.720 ac 36.36% Impervious Runoff Depth=3.33"
Flow Length=696' Tc=10.0 min CN=83 Runoff=83.03 cfs 4.637 af

Pond 3P: Phase 16 North - BMP #35 Peak Elev=495.40' Storage=93,145 cf Inflow=83.03 cfs 4.637 af
Primary=23.71 cfs 4.158 af Secondary=0.00 cfs 0.000 af Outflow=23.71 cfs 4.158 af

Total Runoff Area = 33.440 ac Runoff Volume = 7.652 af Average Runoff Depth = 2.75"
81.82% Pervious = 27.360 ac 18.18% Impervious = 6.080 ac

Summary for Subcatchment 1S: Pre-Development

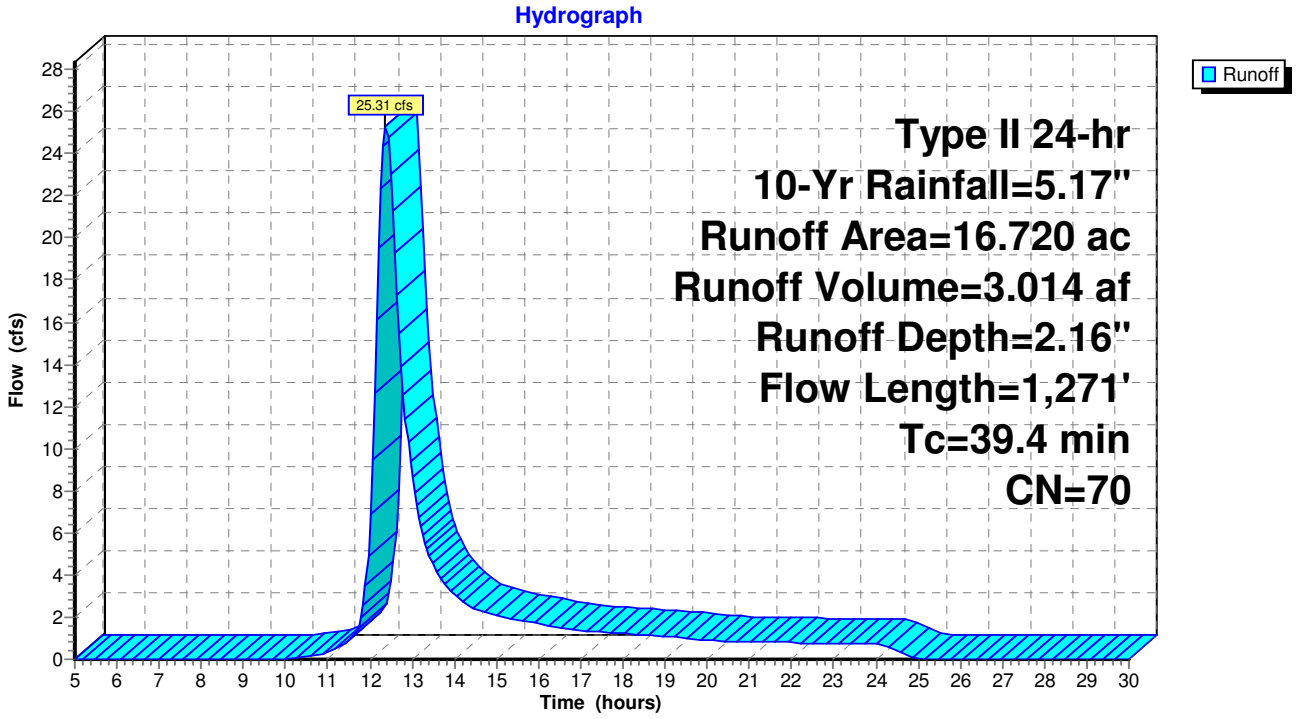
Runoff = 25.31 cfs @ 12.38 hrs, Volume= 3.014 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=5.17"

Area (ac)	CN	Description
16.720	70	Woods, Good, HSG C
16.720		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.1	124	0.0201	0.09		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
15.3	1,147	0.0627	1.25		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
39.4	1,271	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

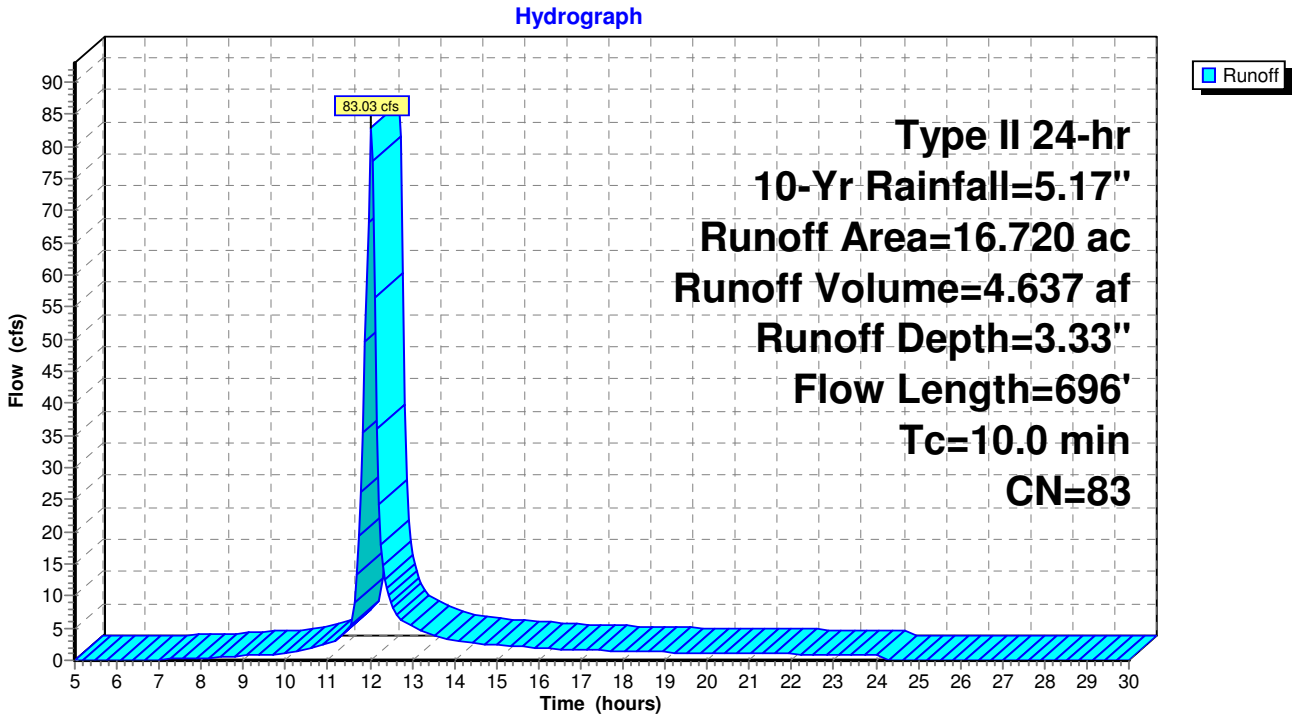
Runoff = 83.03 cfs @ 12.01 hrs, Volume= 4.637 af, Depth= 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=5.17"

Area (ac)	CN	Description
10.640	74	>75% Grass cover, Good, HSG C
6.080	98	Paved parking, HSG C
16.720	83	Weighted Average
10.640		63.64% Pervious Area
6.080		36.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	37	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.56"
4.2	659	0.0303	2.61		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.6					**Direct Entry,**
10.0	696	Total			

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #35

Inflow Area = 16.720 ac, 36.36% Impervious, Inflow Depth = 3.33" for 10-Yr event
Inflow = 83.03 cfs @ 12.01 hrs, Volume= 4.637 af
Outflow = 23.71 cfs @ 12.21 hrs, Volume= 4.158 af, Atten= 71%, Lag= 12.1 min
Primary = 23.71 cfs @ 12.21 hrs, Volume= 4.158 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 495.40' @ 12.21 hrs Surf.Area= 23,858 sf Storage= 93,145 cf

Plug-Flow detention time= 152.9 min calculated for 4.150 af (89% of inflow)
Center-of-Mass det. time= 101.7 min (914.4 - 812.7)

Volume	Invert	Avail.Storage	Storage Description
#1	490.50'	148,256 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

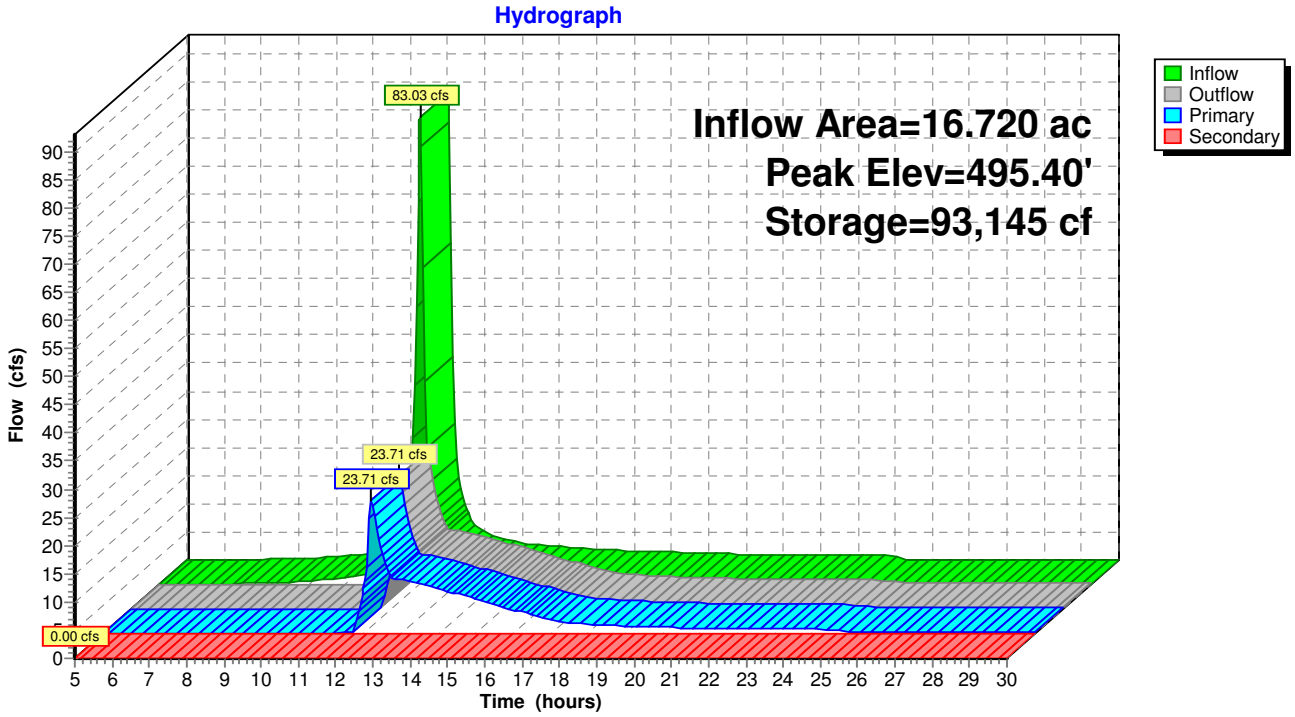
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
490.50	13,593	0	0
491.00	15,433	7,257	7,257
492.00	17,212	16,323	23,579
493.00	19,068	18,140	41,719
494.00	21,002	20,035	61,754
495.00	23,017	22,010	83,764
496.00	25,117	24,067	107,831
497.00	27,297	26,207	134,038
497.50	29,577	14,219	148,256

Device	Routing	Invert	Outlet Devices
#1	Primary	486.00'	**24.0" Round Culvert** L= 64.2' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 486.00' / 485.00' S= 0.0156 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	490.50'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	492.00'	**42.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	495.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	496.00'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=23.30 cfs @ 12.21 hrs HW=495.39' (Free Discharge)
└**1=Culvert** (Passes 23.30 cfs of 43.82 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.36 cfs @ 10.54 fps)
  ├**3=Orifice/Grate** (Orifice Controls 10.09 cfs @ 8.65 fps)
  └**4=Orifice/Grate** (Weir Controls 12.86 cfs @ 2.05 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=490.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Phase 16 North - BMP #35



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=16.720 ac 0.00% Impervious Runoff Depth=4.14"
Flow Length=1,271' Tc=39.4 min CN=70 Runoff=49.75 cfs 5.768 af

Subcatchment 2S: Post-Development Runoff Area=16.720 ac 36.36% Impervious Runoff Depth>5.61"
Flow Length=696' Tc=10.0 min CN=83 Runoff=136.80 cfs 7.822 af

Pond 3P: Phase 16 North - BMP #35 Peak Elev=496.74' Storage=126,897 cf Inflow=136.80 cfs 7.822 af
Primary=47.20 cfs 6.873 af Secondary=33.45 cfs 0.466 af Outflow=80.65 cfs 7.339 af

Total Runoff Area = 33.440 ac Runoff Volume = 13.590 af Average Runoff Depth = 4.88"
81.82% Pervious = 27.360 ac 18.18% Impervious = 6.080 ac

Summary for Subcatchment 1S: Pre-Development

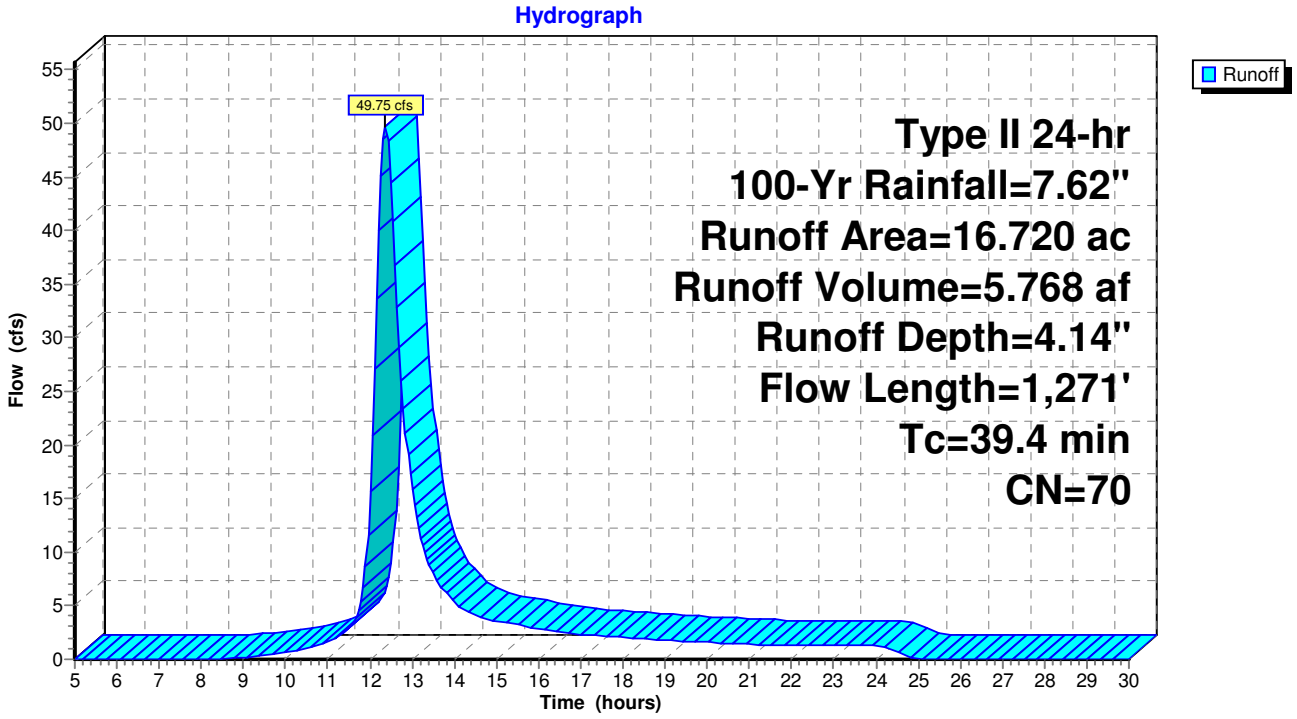
Runoff = 49.75 cfs @ 12.36 hrs, Volume= 5.768 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=7.62"

Area (ac)	CN	Description
16.720	70	Woods, Good, HSG C
16.720		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.1	124	0.0201	0.09		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
15.3	1,147	0.0627	1.25		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
39.4	1,271	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

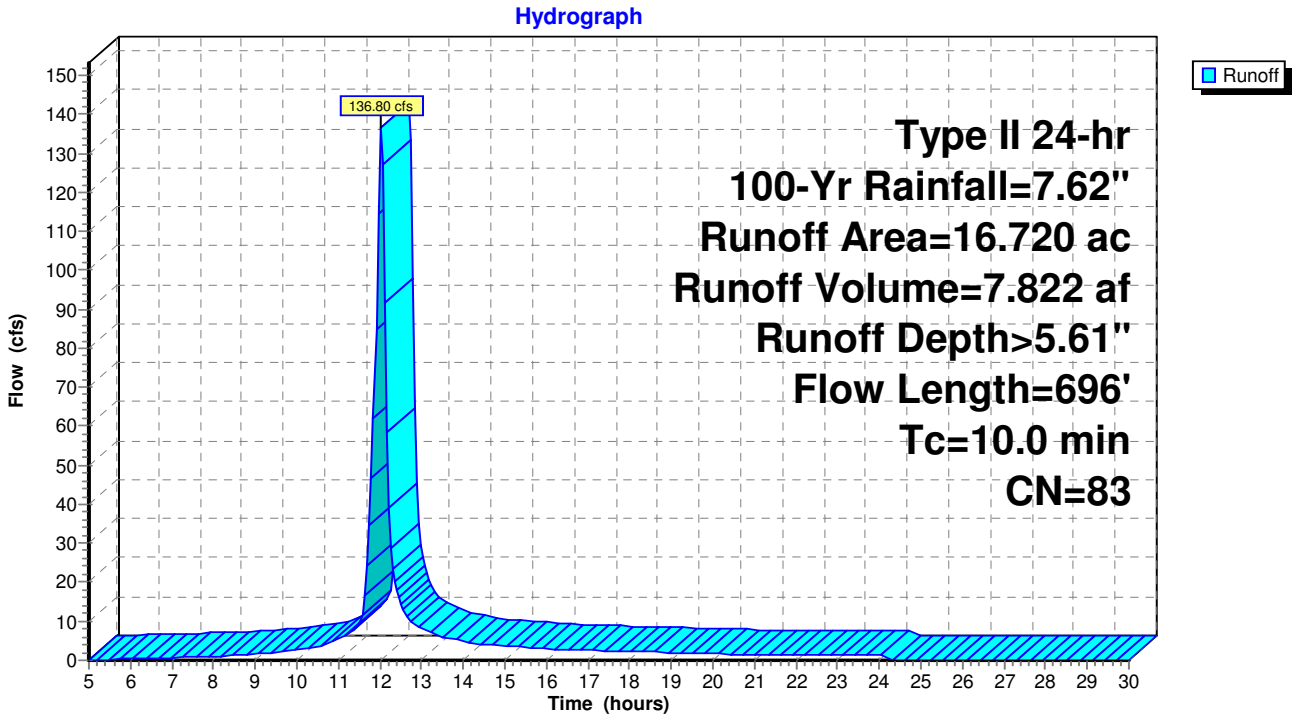
Runoff = 136.80 cfs @ 12.01 hrs, Volume= 7.822 af, Depth> 5.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=7.62"

Area (ac)	CN	Description
10.640	74	>75% Grass cover, Good, HSG C
6.080	98	Paved parking, HSG C
16.720	83	Weighted Average
10.640		63.64% Pervious Area
6.080		36.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	37	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.56"
4.2	659	0.0303	2.61		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.6					**Direct Entry,**
10.0	696	Total			

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #35

Inflow Area = 16.720 ac, 36.36% Impervious, Inflow Depth > 5.61" for 100-Yr event
Inflow = 136.80 cfs @ 12.01 hrs, Volume= 7.822 af
Outflow = 80.65 cfs @ 12.12 hrs, Volume= 7.339 af, Atten= 41%, Lag= 6.6 min
Primary = 47.20 cfs @ 12.12 hrs, Volume= 6.873 af
Secondary = 33.45 cfs @ 12.12 hrs, Volume= 0.466 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 496.74' @ 12.12 hrs Surf.Area= 26,721 sf Storage= 126,897 cf

Plug-Flow detention time= 112.9 min calculated for 7.324 af (94% of inflow)
Center-of-Mass det. time= 79.1 min (877.1 - 798.0)

Volume	Invert	Avail.Storage	Storage Description
#1	490.50'	148,256 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

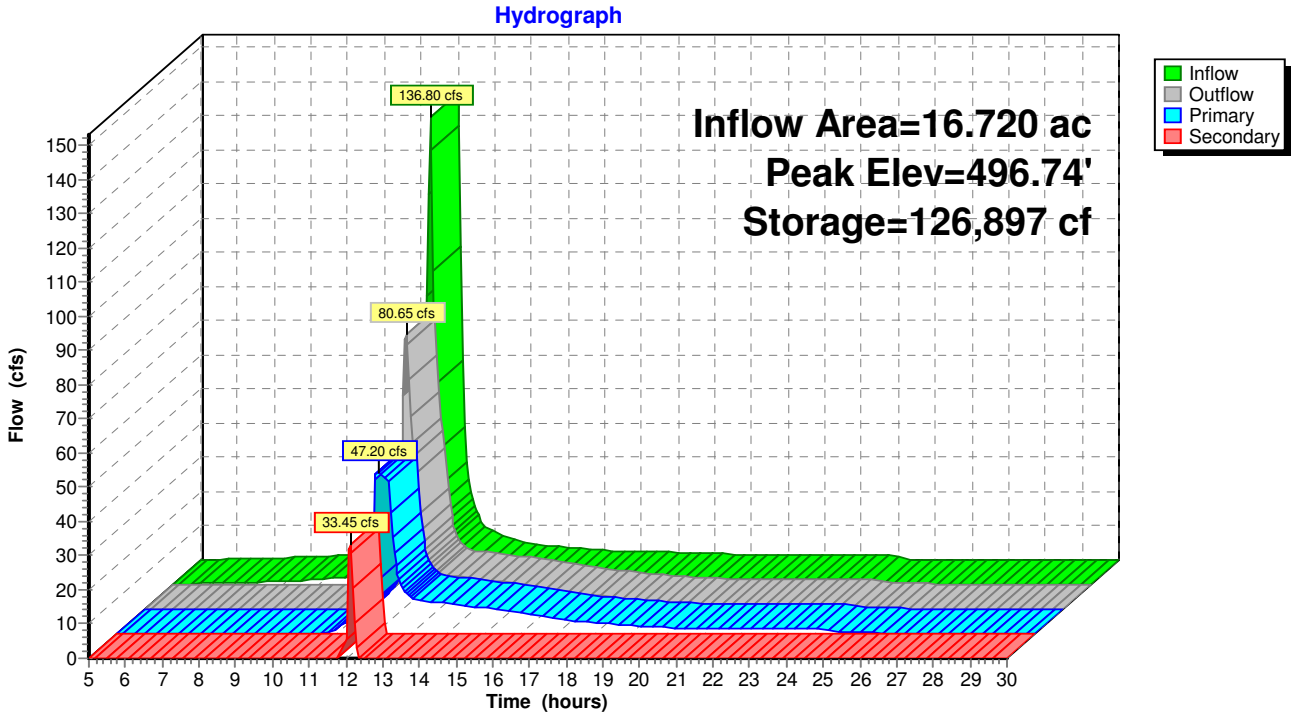
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
490.50	13,593	0	0
491.00	15,433	7,257	7,257
492.00	17,212	16,323	23,579
493.00	19,068	18,140	41,719
494.00	21,002	20,035	61,754
495.00	23,017	22,010	83,764
496.00	25,117	24,067	107,831
497.00	27,297	26,207	134,038
497.50	29,577	14,219	148,256

Device	Routing	Invert	Outlet Devices
#1	Primary	486.00'	**24.0" Round Culvert** L= 64.2' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 486.00' / 485.00' S= 0.0156 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	490.50'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	492.00'	**42.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	495.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	496.00'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=47.11 cfs @ 12.12 hrs HW=496.70' (Free Discharge)
└**1=Culvert** (Inlet Controls 47.11 cfs @ 15.00 fps)
  ├**2=Orifice/Grate** (Passes < 0.41 cfs potential flow)
  ├**3=Orifice/Grate** (Passes < 11.96 cfs potential flow)
  └**4=Orifice/Grate** (Passes < 100.48 cfs potential flow)

Secondary OutFlow Max=31.34 cfs @ 12.12 hrs HW=496.70' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Weir Controls 31.34 cfs @ 2.24 fps)

Pond 3P: Phase 16 North - BMP #35



ANTI-FLOATATION DESIGN	DATE: 3/15/2018	DESIGNED BY: BSS
PROJECT NAME: Briar Chapel - Phase 16 North PROJECT LOCATION: Chatham County, NC	PROJECT NO: 2735-0206	CHECKED BY: GCA

Pond Name=	BMP #35				
Riser Outer Width =	5	ft	Riser Resisting Force =	12,825	lb
Riser Outer Length =	5	ft	Base Resisting Force =	14,400	lb
Riser Inner Width =	4	ft	Total Resisting Force =	27,225	lb
Riser Inner Length =	4	ft			
Riser Height =	9.5	ft	Riser Buoyant Force =	14,820	lb
			Base Buoyant Force =	5,990	lb
Concrete Base Length =	8	ft	Total Buoyant Force =	20,810	lb
Concrete Base Width =	8	ft			
Concrete Base Depth =	18	in	Factor of Safety	1.31	**Design Acceptable**

OUTLET PROTECTION DESIGN	DATE: 03/15/2018	DESIGNED BY: BSS
PROJECT NAME: Briar Chapel Phase 16 North PROJECT LOCATION: Chatham County, NC	PROJECT NO: 2735-0206	CHECKED BY GCA

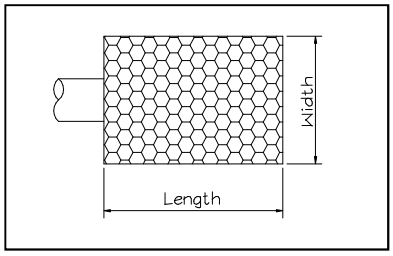
Storm Outlet Structure

Structure=	BMP #35 Out		Q_{10}/Q_{full} =	0.87	
Size=	24	in	V/Vfull =	1.12	
Q_{10} =	23.71	cfs	V =	9.7	fps
Qfull =	27.10	cfs			
Vfull =	8.63	fps			

From Fig. 8.06.b.1:

Zone = 3

From Fig. 8.06.b.2:



D_{50}	=	10	in
D_{MAX}	=	15	in
Riprap Class	=	1	
Apron Thickness	=	24	in
Apron Length	=	16.0	ft
Apron Width = 3 x Dia	=	6.0	ft

Wet Detention Pond #36
Design

WATER QUALITY POND CALCULATIONS

Project Name

Briar Chapel - Phase 16 North (BMP #36)

Project Number

02735-0206

Date

March 15, 2018

3rd revision _____

2nd revision _____

1st revision _____

Water Quality Pond Drainage Area Data

Project: Briar Chapel - Phase 16 North (BMP #36)
Project No.: 02735-0206

Date: March 15, 2018

Total site area: 450,123 square feet = 10.33 acres

	Drainage area to pond			Other Drainage Area	
Impervious areas	Existing [sf]	Proposed [sf]	Change [sf]	Existing [sf]	Proposed [sf]
On-site buildings (BUA)	0	71,400	71,400	0	0
On-site streets	0	24,992	24,992	0	0
On-site alleys	0	0	0	0	0
On-site sidewalks	0	7,404	7,404	0	0
On-site future (open space)	0	20,000	20,000	0	0
Off-site future development	0	0	0	0	0
20% Contingency	0	24,760	24,760	0	0
Total Impervious	***0***	***148,556***	***148,556***	***0***	***0***

	Drainage area to pond			Other Drainage Area	
Non-impervious areas	Existing [sf]	Proposed [sf]	Change [sf]	Existing [sf]	Proposed [sf]
On-site grass/landscape	0	60,313	60,313	0	0
On-site woods	450,123	241,254	-208,869	0	0
Other undeveloped	0	0	0	0	0
Total off-site non-impervious	0	0	0	0	0
Total non-impervious	450,123	301,567	-148,556	0	0

Total Drainage Area	450,123	450,123	0	0	0
Percent Impervious	0.0	33.0	33.0	n/a	n/a

Water Quality Pond Surface Area Calculations

Project: Briar Chapel - Phase 16 North (BMP #36)
Project No.: 02735-0206

Date: March 15, 2018

Total on-site drainage area to pond: 450,123 square feet
Total impervious area in drainage area: 148,556 square feet

Average water depth of basin at normal pool: 3.0 feet

Location of site: Chatham County
Site region: Piedmont

% Impervious cover: 33.0 percent

If the site is in a coastal area, will a vegetative filter be used? n/a

Surface Area/Drainage Area Ratios:

For a site in the Piedmont: 1.3 percent
For a site in a Coastal County: 1.5 percent

Required surface area of pond:

For a site in the Piedmont: 5,730.0 square feet
For a site in a Coastal County: 6,560.0 square feet

Notes:

Water Quality Pond Stormwater Runoff Volume Calculations

Project	Briar Chapel - Phase 16 North (BMP #36)
Project No.	02735-0206
Date	March 5, 2018

ONSITE (Phase 16 North)

Drainage area	261,382	square feet
Impervious area	119,210	square feet
Rainfall depth	1.00	inches
Percent Impervious	45.6	percent

R(v)=0.05+0.009*(Percent impervious)

Runoff coefficient - R(v)	0.46	in/in

Runoff volume=(Design rainfall)*(R(v))*(Drainage area)

Runoff volume	10,029.8	cubic feet

OFFSITE (US Steel Section 2)

Drainage area	188,741	square feet
Impervious area	29,346	square feet
Rainfall depth	1.43	inches
Percent Impervious	15.5	percent

R(v)=0.05+0.009*(Percent impervious)

Runoff coefficient - R(v)	0.19	in/in

Runoff volume=(Design rainfall)*(R(v))*(Drainage area)

Runoff volume	4,271.9	cubic feet

TOTAL STORAGE VOLUME REQUIRED

	14,301.8	cubic feet

Water Quality Pond Volume Calculations
Stage-Storage Data for Pond - Temporary Pool

Project: Briar Chapel - Phase 16 North (BMP #36)
Project No.: 02735-0206

Date: March 15, 2018

Contour ID	Stage	Area [sq. ft.]	Area [acres]	Incremental Area [sq. ft.]	Incremental Area [acres]	Incremental volume [cu. ft]	Incremental volume [acre-ft]	Cumulative volume [cu. ft]	Cumulative volume [acre-ft]
507.5	0	8,921.0	0.205	8,921.0	0.20	0.0	0.0	0.0	0.0
508	0.5	10,157.0	0.233	10,157.0	0.03	4,769.5	0.11	4,769.5	0.11
509	1.5	11,350.0	0.261	11,350.0	0.03	10,753.5	0.25	15,523.0	0.36
510	2.5	12,600.0	0.289	12,600.0	0.03	11,975.0	0.27	27,498.0	0.63
511	3.5	13,906.0	0.319	13,906.0	0.03	13,253.0	0.30	40,751.0	0.94
512	4.5	15,269.0	0.351	15,269.0	0.03	14,587.5	0.33	55,338.5	1.27
513	5.5	16,689.0	0.383	16,689.0	0.03	15,979.0	0.37	71,317.5	1.64
514	6.5	18,165.0	0.417	18,165.0	0.03	17,427.0	0.40	88,744.5	2.04
514.5	7	18,924.0	0.434	18,924.0	0.02	9,272.3	0.21	98,016.8	2.25

Water Quality Pond Volume Calculations
Stage-Storage Data for Pond - Main Pool

Project: Briar Chapel - Phase 16 North (BMP #36)
Project No.: 02735-0206

Date: March 15, 2018

Contour ID	Stage	Area [sq. ft.]	Area [acres]	Incremental Area [sq. ft.]	Incremental Area [acres]	Incremental volume [cu. ft]	Incremental volume [acre-ft]	Cumulative volume [cu. ft]	Cumulative volume [acre-ft]
502.5	0	2,009.0	0.046	2,009.0	0.0	0.0	0.0	0.0	0.0
503	0.5	2,441.0	0.056	432.0	0.0	1,112.5	0.0	1,112.5	0.0
504	1.5	3,168.0	0.073	727.0	0.0	2,804.5	0.1	3,917.0	0.1
505	2.5	3,982.0	0.091	814.0	0.0	3,575.0	0.1	7,492.0	0.1
506	3.5	4,854.0	0.111	872.0	0.0	4,418.0	0.1	11,910.0	0.2
507	4.5	5,787.0	0.133	933.0	0.0	5,320.5	0.1	17,230.5	0.2
507.5	5	6,783.0	0.156	996.0	0.0	3,142.5	0.1	20,373.0	0.2

Water Quality Pond Volume Calculations
Stage-Storage Data for Pond - Forebays

Project: Briar Chapel - Phase 16 North (BMP #36)
Project No.: 02735-0206

Date: March 15, 2018

Contour ID	Stage	Area [sq. ft.]	Area [acres]	Incremental Area [sq. ft.]	Incremental Area [acres]	Incremental volume [cu. ft]	Incremental volume [acre-ft]	Cumulative volume [cu. ft]	Cumulative volume [acre-ft]
504	0	390.0	0.009	390.0	0.0	0.0	0.0	0.0	0.0
505	1	505.0	0.012	115.0	0.0	447.5	0.0	447.5	0.0
506	2	1,184.0	0.027	679.0	0.0	844.5	0.0	1,292.0	0.0
507	3	1,680.0	0.039	496.0	0.0	1,432.0	0.0	2,724.0	0.1
507.5	3.5	1,979.0	0.045	299.0	0.0	914.8	0.0	3,638.8	0.1

Water Quality Basin Dewatering Time Calculations

Project Briar Chapel - Phase 16 North (BMP #36)
Project No. 02735-0206

Date March 15, 2018

Water quality treatment volume	14,302	cubic feet
Total treatment volume	15,523	cubic feet
Maximum head of water above dewatering hole	1.50	feet
Driving head	0.50	feet
Orifice coefficient	0.60	
Diameter of each hole	2.00	inches
Number of holes	1	
Cross sectional area of each hole =	0.022	square feet
Cross sectional area of each hole =	3.1	square inches
Cross sectional area of dewatering hole(s) =	0.022	square feet
Cross sectional area of dewatering hole(s) =	3.1	square inches
Dewatering time for water quality volume =	2.2	days
	53.8	hours
Dewatering time for total volume =	2.4	days
	58.3	hours

Notes:
Dewatering time formula: t (days) = V / (Cd*A*Sqrt (2*32.2*H)*86,400)

t = drawdown time
V = treatment volume
Cd = orifice coefficient
A = cross sectional area of orifice
H = driving head (1/3 max. head)

Water Quality Pond Summary Information

Project Briar Chapel - Phase 16 North (BMP #36)
Project No. 02735-0206

Date March 15, 2018

Drainage area to pond	450,123	square feet =	10.33	acres
Impervious area in drainage area	148,556	square feet =	3.41	acres

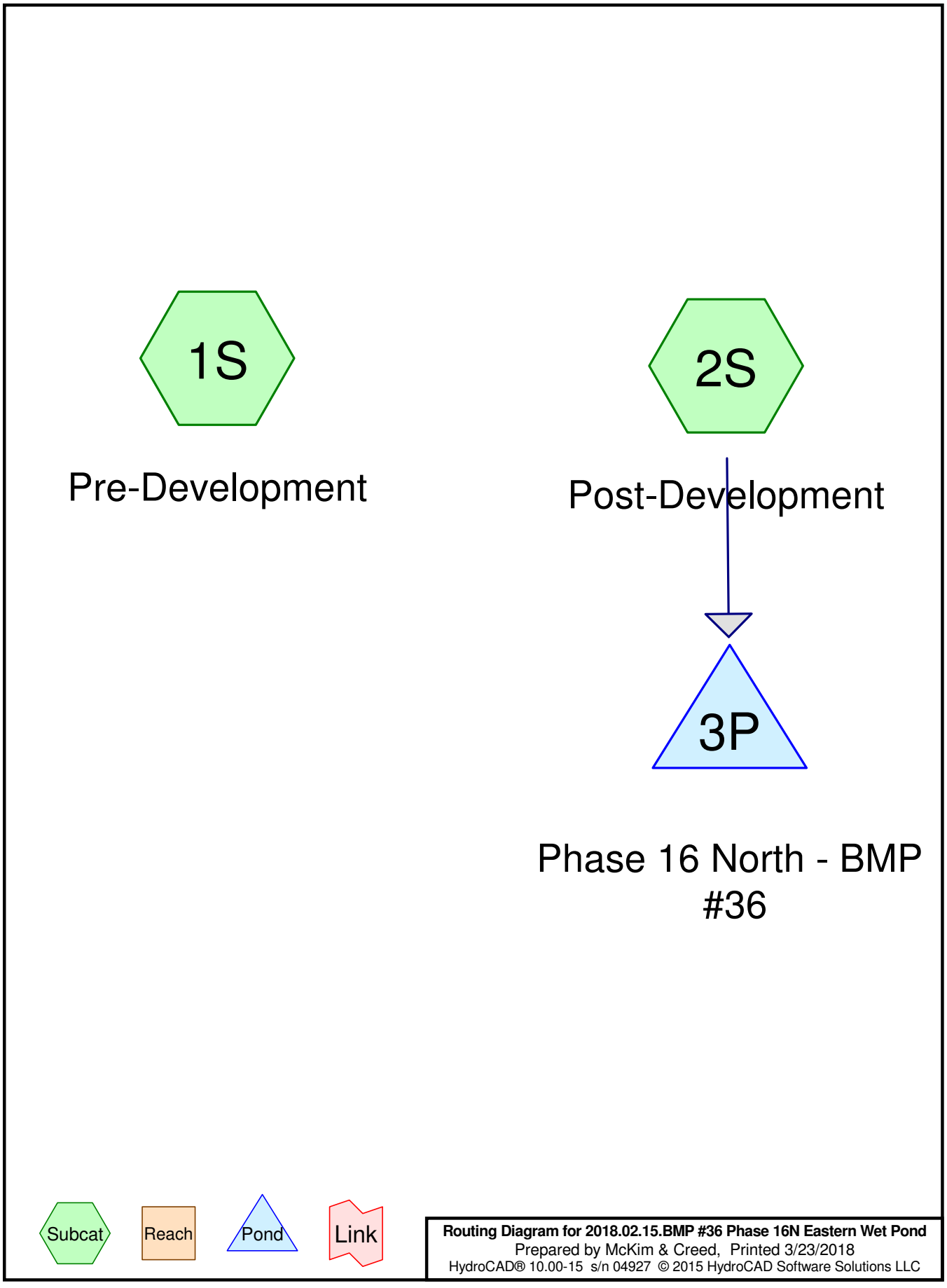
Bottom of pond elevation	502.50	feet
Normal pool elevation	507.50	feet
Main pond volume at normal pool	20,373	cubic feet
Forebay volume at normal pool	3,638	cubic feet
Forbay % of total volume	17.9%	

Required volume for design rainfall	14,302	cubic feet
Required surface area for main pool	5,730	square feet

Volume provided for storage of design rainfall = 15,523 cubic feet at elevation 509

Surface area provided at normal pool of main pond = 6,782 square feet

Average Depth 2.98 feet


1S
Pre-Development
2S
Post-Development
3P
Phase 16 North - BMP #36
Subcat
Reach
Pond
Link
Routing Diagram for 2018.02.15.BMP #36 Phase 16N Eastern Wet Pond
Prepared by McKim & Creed, Printed 3/23/2018
HydroCAD® 10.00-15 s/n 04927 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.920	74	>75% Grass cover, Good, HSG C (2S)
3.410	98	Paved parking, HSG C (2S)
10.330	70	Woods, Good, HSG C (1S)
20.660	**76**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
20.660	HSG C	1S, 2S
0.000	HSG D	
0.000	Other	
20.660		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	6.920	0.000	0.000	6.920	>75% Grass cover, Good	2S
0.000	0.000	3.410	0.000	0.000	3.410	Paved parking	2S
0.000	0.000	10.330	0.000	0.000	10.330	Woods, Good	1S
0.000	**0.000**	**20.660**	**0.000**	**0.000**	**20.660**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3P	505.50	505.00	48.9	0.0102	0.013	18.0	0.0	0.0

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=10.330 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,065' Tc=29.9 min CN=70 Runoff=0.01 cfs 0.004 af

Subcatchment 2S: Post-Development Runoff Area=10.330 ac 33.01% Impervious Runoff Depth=0.11"
Tc=5.0 min CN=82 Runoff=1.51 cfs 0.098 af

Pond 3P: Phase 16 North - BMP #36 Peak Elev=507.77' Storage=2,511 cf Inflow=1.51 cfs 0.098 af
Primary=0.05 cfs 0.060 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.060 af

Total Runoff Area = 20.660 ac Runoff Volume = 0.102 af Average Runoff Depth = 0.06"
83.49% Pervious = 17.250 ac 16.51% Impervious = 3.410 ac

Summary for Subcatchment 1S: Pre-Development

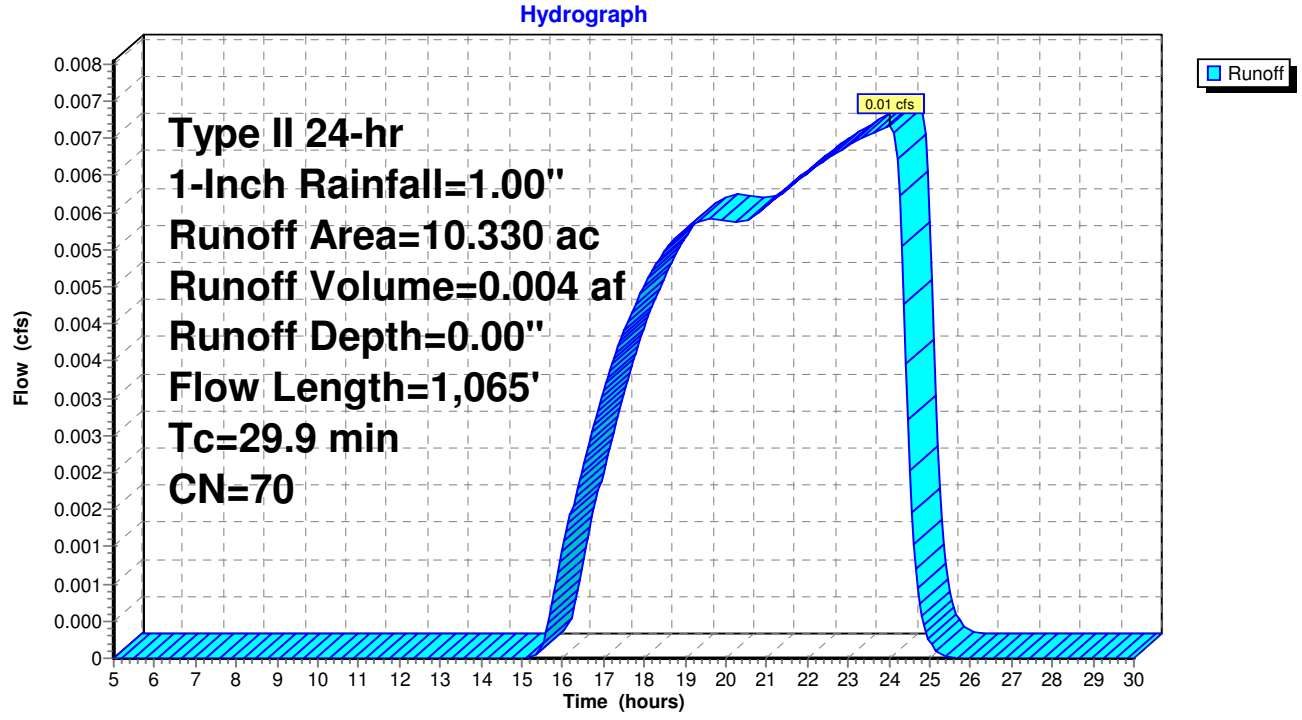
Runoff = 0.01 cfs @ 24.03 hrs, Volume= 0.004 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Inch Rainfall=1.00"

Area (ac)	CN	Description
10.330	70	Woods, Good, HSG C
10.330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	95	0.0330	0.10		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
7.7	610	0.0704	1.33		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
6.2	360	0.0380	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	1,065	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

[49] Hint: Tc<2dt may require smaller dt

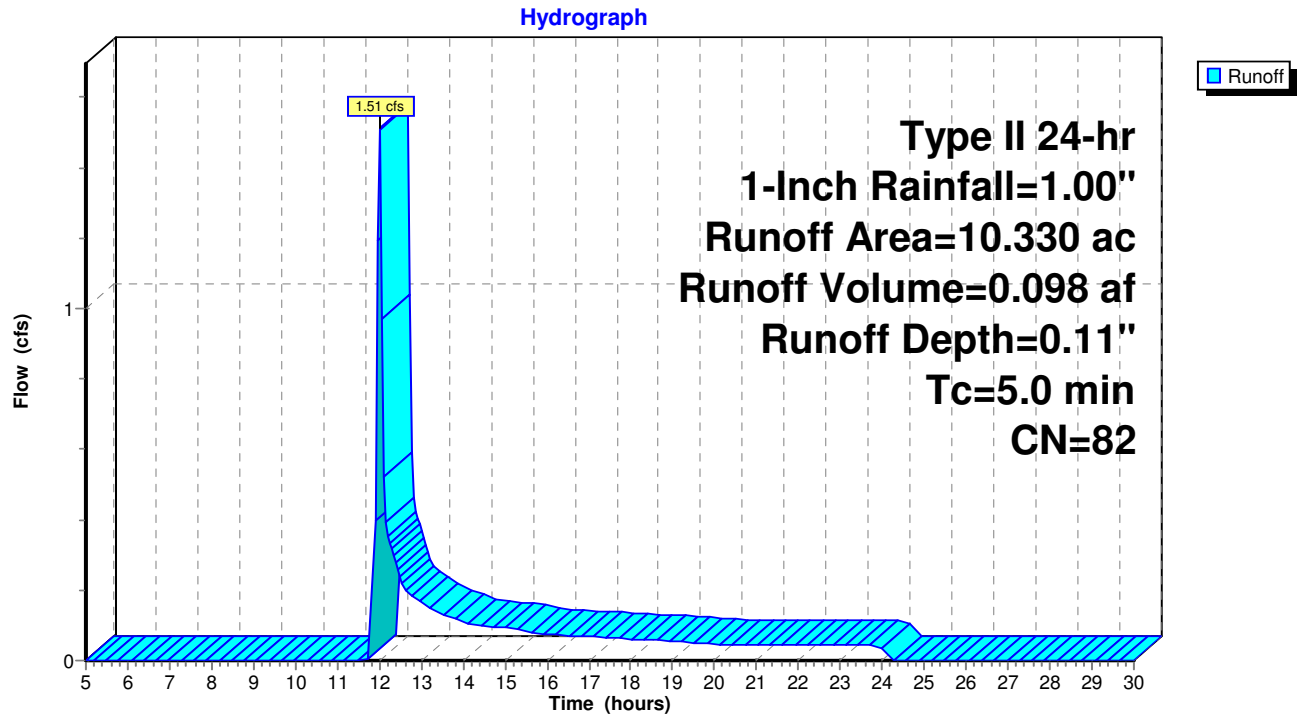
Runoff = 1.51 cfs @ 11.99 hrs, Volume= 0.098 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Inch Rainfall=1.00"

Area (ac)	CN	Description
6.920	74	>75% Grass cover, Good, HSG C
3.410	98	Paved parking, HSG C
10.330	82	Weighted Average
6.920		66.99% Pervious Area
3.410		33.01% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #36

Inflow Area = 10.330 ac, 33.01% Impervious, Inflow Depth = 0.11" for 1-Inch event
Inflow = 1.51 cfs @ 11.99 hrs, Volume= 0.098 af
Outflow = 0.05 cfs @ 21.09 hrs, Volume= 0.060 af, Atten= 97%, Lag= 546.1 min
Primary = 0.05 cfs @ 21.09 hrs, Volume= 0.060 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 507.77' @ 21.09 hrs Surf.Area= 9,592 sf Storage= 2,511 cf

Plug-Flow detention time= 491.1 min calculated for 0.060 af (61% of inflow)
Center-of-Mass det. time= 343.4 min (1,269.8 - 926.4)

Volume	Invert	Avail.Storage	Storage Description
#1	507.50'	98,017 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

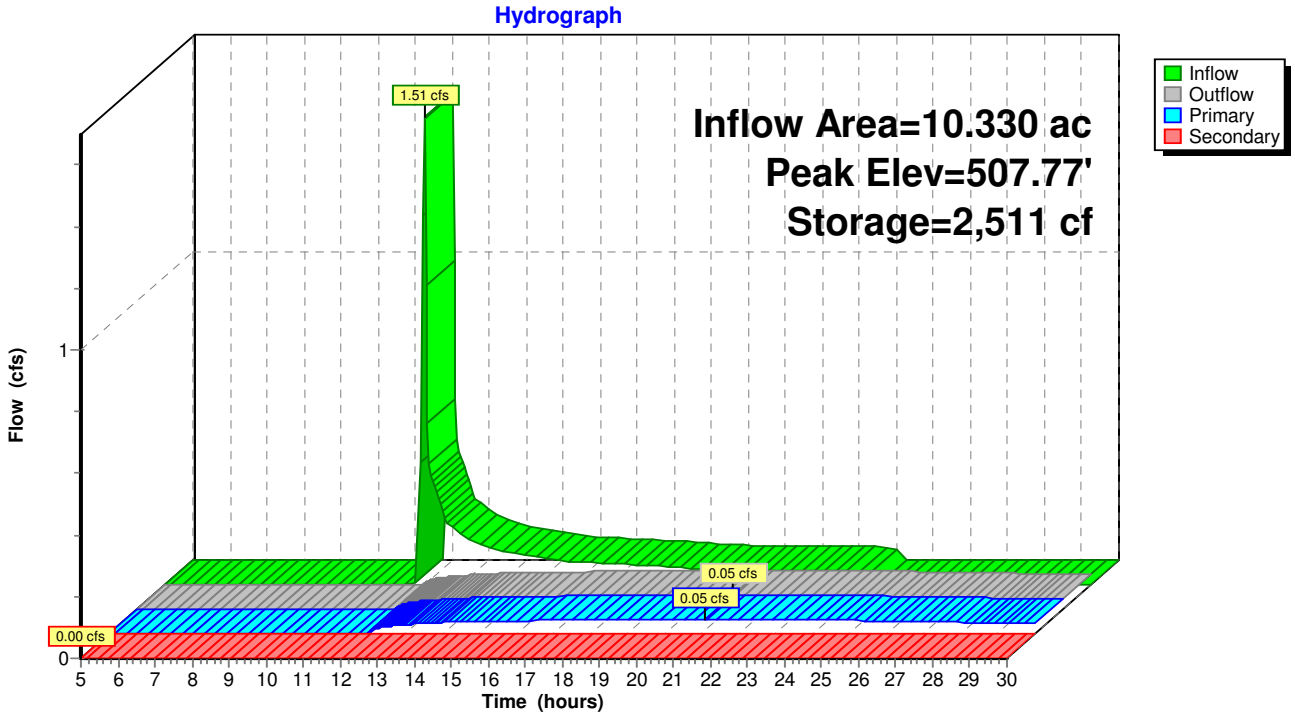
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
507.50	8,921	0	0
508.00	10,157	4,770	4,770
509.00	11,350	10,754	15,523
510.00	12,600	11,975	27,498
511.00	13,906	13,253	40,751
512.00	15,269	14,588	55,339
513.00	16,689	15,979	71,318
514.00	18,165	17,427	88,745
514.50	18,924	9,272	98,017

Device	Routing	Invert	Outlet Devices
#1	Primary	505.50'	**18.0" Round Culvert** L= 48.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 505.50' / 505.00' S= 0.0102 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	507.50'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	509.00'	**28.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	511.45'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	512.50'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.05 cfs @ 21.09 hrs HW=507.77' (Free Discharge)
└**1=Culvert** (Passes 0.05 cfs of 10.33 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.05 cfs @ 2.09 fps)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=507.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Phase 16 North - BMP #36



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=10.330 ac 0.00% Impervious Runoff Depth=0.69"
Flow Length=1,065' Tc=29.9 min CN=70 Runoff=5.20 cfs 0.596 af

Subcatchment 2S: Post-Development Runoff Area=10.330 ac 33.01% Impervious Runoff Depth=1.35"
Tc=5.0 min CN=82 Runoff=25.09 cfs 1.160 af

Pond 3P: Phase 16 North - BMP #36 Peak Elev=509.54' Storage=21,817 cf Inflow=25.09 cfs 1.160 af
Primary=4.67 cfs 0.855 af Secondary=0.00 cfs 0.000 af Outflow=4.67 cfs 0.855 af

Total Runoff Area = 20.660 ac Runoff Volume = 1.756 af Average Runoff Depth = 1.02"
83.49% Pervious = 17.250 ac 16.51% Impervious = 3.410 ac

Summary for Subcatchment 1S: Pre-Development

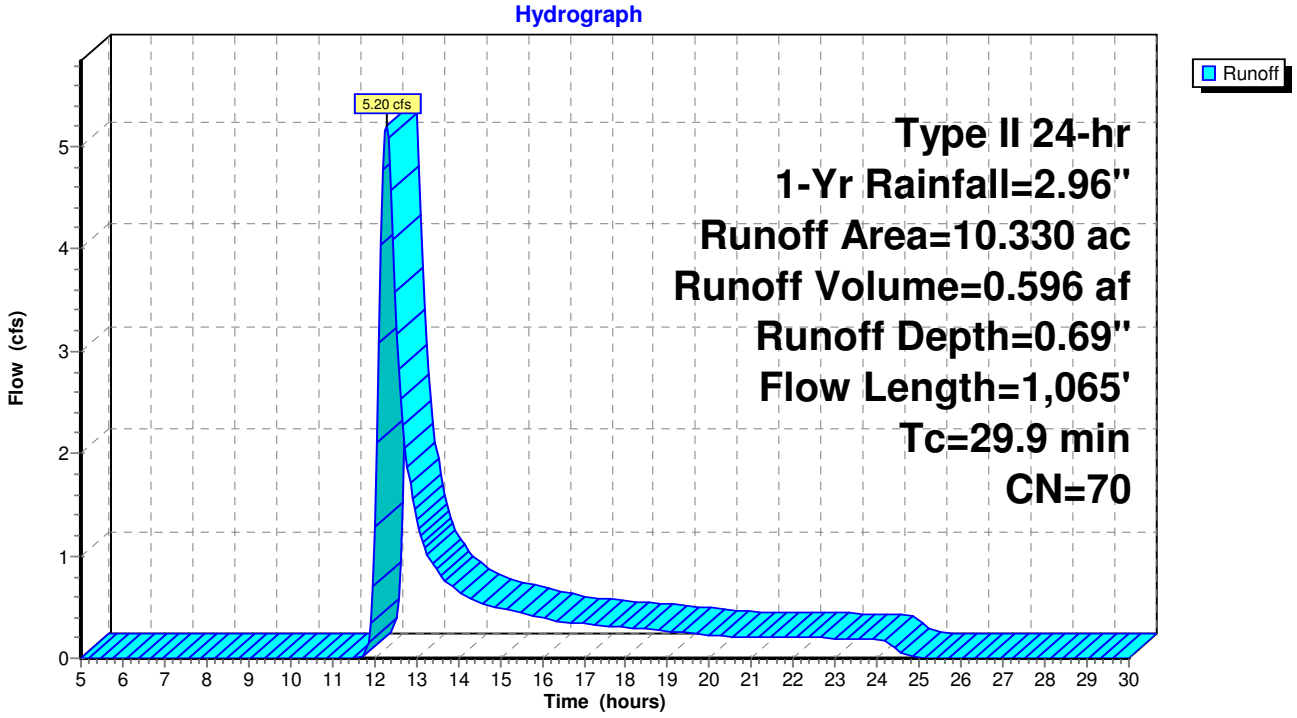
Runoff = 5.20 cfs @ 12.28 hrs, Volume= 0.596 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.96"

Area (ac)	CN	Description
10.330	70	Woods, Good, HSG C
10.330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	95	0.0330	0.10		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
7.7	610	0.0704	1.33		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
6.2	360	0.0380	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	1,065	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

[49] Hint: Tc<2dt may require smaller dt

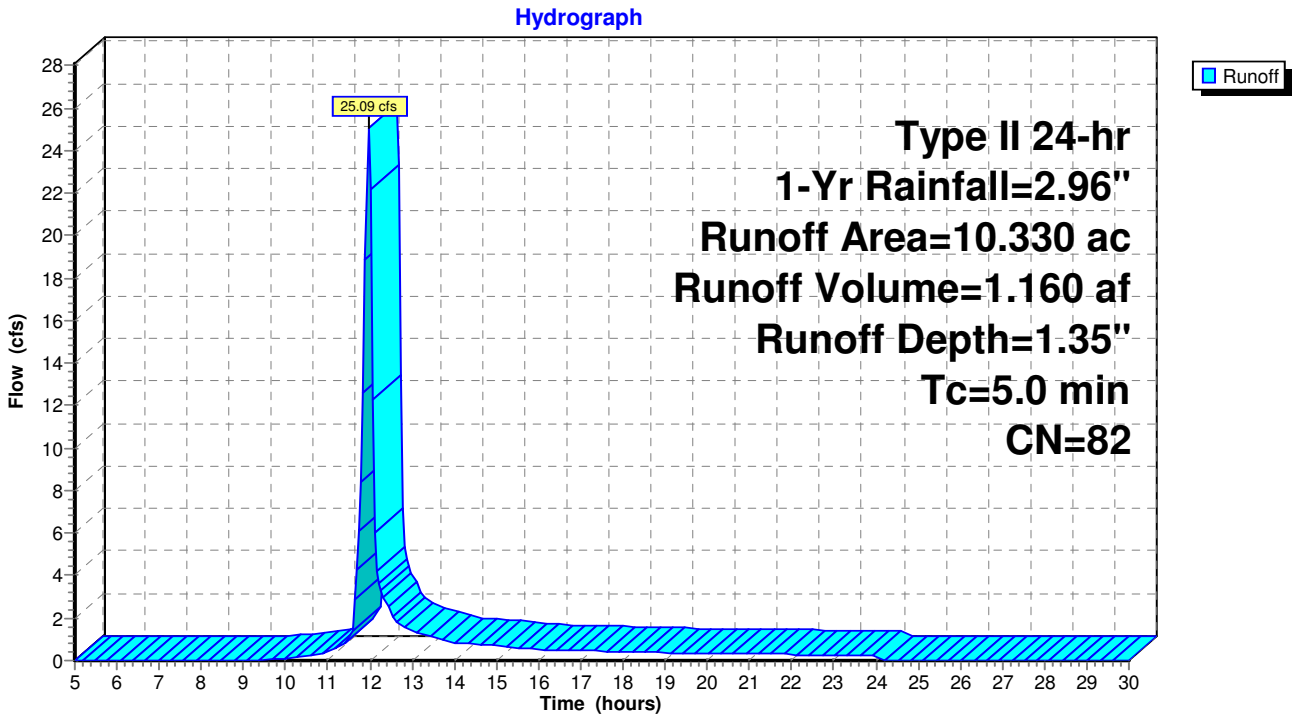
Runoff = 25.09 cfs @ 11.96 hrs, Volume= 1.160 af, Depth= 1.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.96"

Area (ac)	CN	Description
6.920	74	>75% Grass cover, Good, HSG C
3.410	98	Paved parking, HSG C
10.330	82	Weighted Average
6.920		66.99% Pervious Area
3.410		33.01% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #36

Inflow Area = 10.330 ac, 33.01% Impervious, Inflow Depth = 1.35" for 1-Yr event
Inflow = 25.09 cfs @ 11.96 hrs, Volume= 1.160 af
Outflow = 4.67 cfs @ 12.14 hrs, Volume= 0.855 af, Atten= 81%, Lag= 11.1 min
Primary = 4.67 cfs @ 12.14 hrs, Volume= 0.855 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 509.54' @ 12.14 hrs Surf.Area= 12,023 sf Storage= 21,817 cf

Plug-Flow detention time= 228.4 min calculated for 0.855 af (74% of inflow)
Center-of-Mass det. time= 128.7 min (964.6 - 835.9)

Volume	Invert	Avail.Storage	Storage Description
#1	507.50'	98,017 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

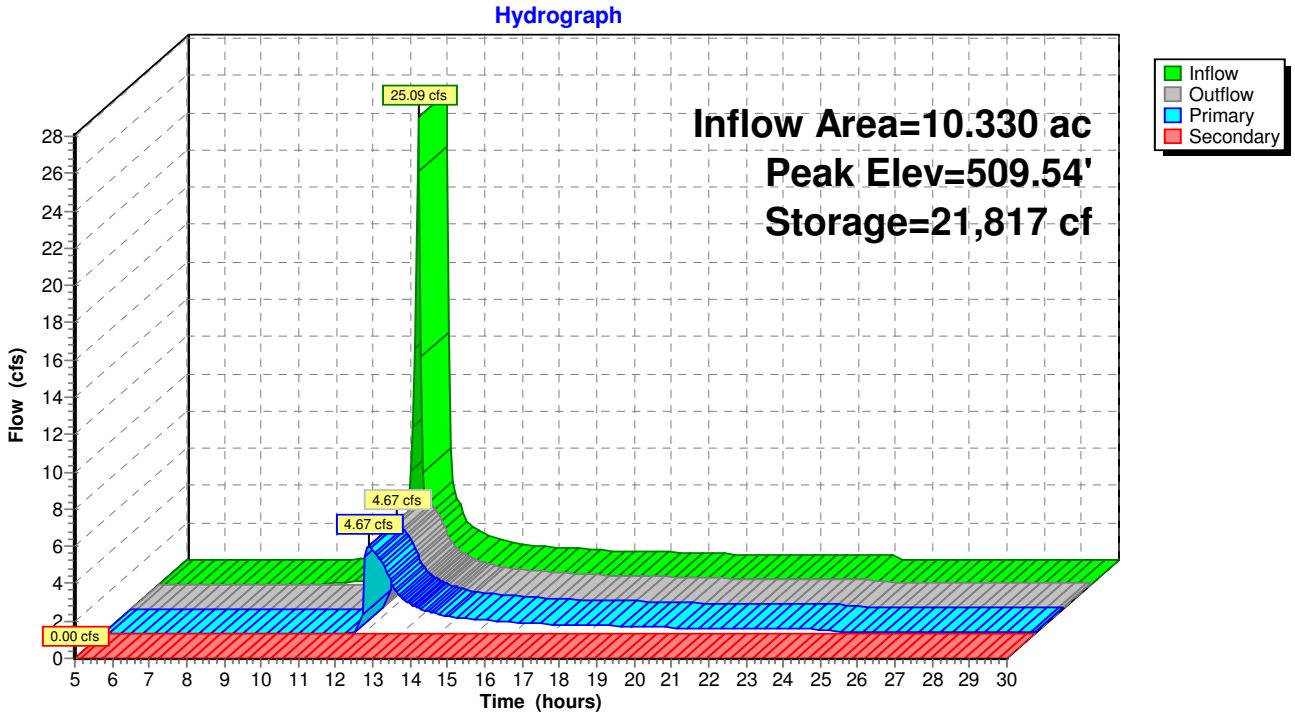
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
507.50	8,921	0	0
508.00	10,157	4,770	4,770
509.00	11,350	10,754	15,523
510.00	12,600	11,975	27,498
511.00	13,906	13,253	40,751
512.00	15,269	14,588	55,339
513.00	16,689	15,979	71,318
514.00	18,165	17,427	88,745
514.50	18,924	9,272	98,017

Device	Routing	Invert	Outlet Devices
#1	Primary	505.50'	**18.0" Round Culvert** L= 48.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 505.50' / 505.00' S= 0.0102 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	507.50'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	509.00'	**28.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	511.45'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	512.50'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=4.67 cfs @ 12.14 hrs HW=509.54' (Free Discharge)
└**1=Culvert** (Passes 4.67 cfs of 15.43 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.15 cfs @ 6.73 fps)
  ├**3=Orifice/Grate** (Orifice Controls 4.52 cfs @ 2.91 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=507.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Phase 16 North - BMP #36



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=10.330 ac 0.00% Impervious Runoff Depth=0.07"
Flow Length=1,065' Tc=29.9 min CN=70 Runoff=0.13 cfs 0.058 af

Subcatchment 2S: Post-Development Runoff Area=10.330 ac 33.01% Impervious Runoff Depth=0.31"
Tc=5.0 min CN=82 Runoff=5.30 cfs 0.265 af

Pond 3P: Phase 16 North - BMP #36 Peak Elev=508.30' Storage=7,884 cf Inflow=5.30 cfs 0.265 af
Primary=0.09 cfs 0.125 af Secondary=0.00 cfs 0.000 af Outflow=0.09 cfs 0.125 af

Total Runoff Area = 20.660 ac Runoff Volume = 0.323 af Average Runoff Depth = 0.19"
83.49% Pervious = 17.250 ac 16.51% Impervious = 3.410 ac

Summary for Subcatchment 1S: Pre-Development

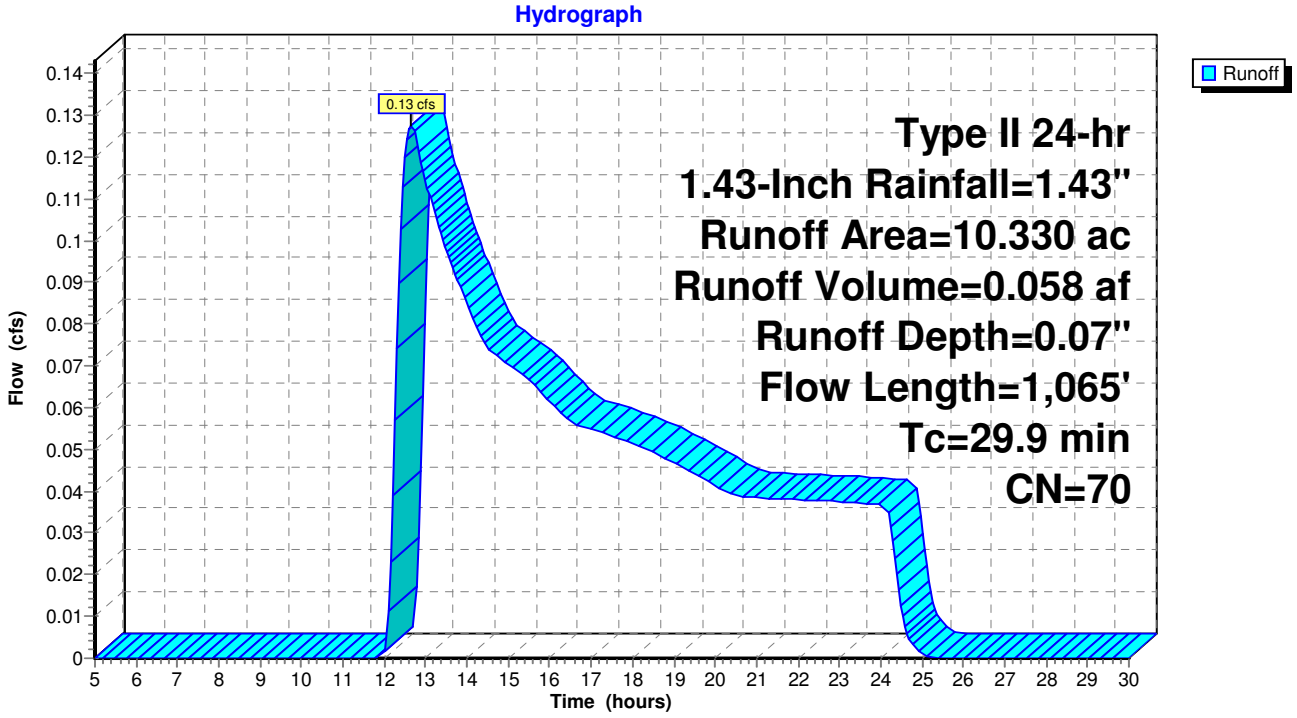
Runoff = 0.13 cfs @ 12.66 hrs, Volume= 0.058 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1.43-Inch Rainfall=1.43"

Area (ac)	CN	Description
10.330	70	Woods, Good, HSG C
10.330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	95	0.0330	0.10		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
7.7	610	0.0704	1.33		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
6.2	360	0.0380	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	1,065	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

[49] Hint: Tc<2dt may require smaller dt

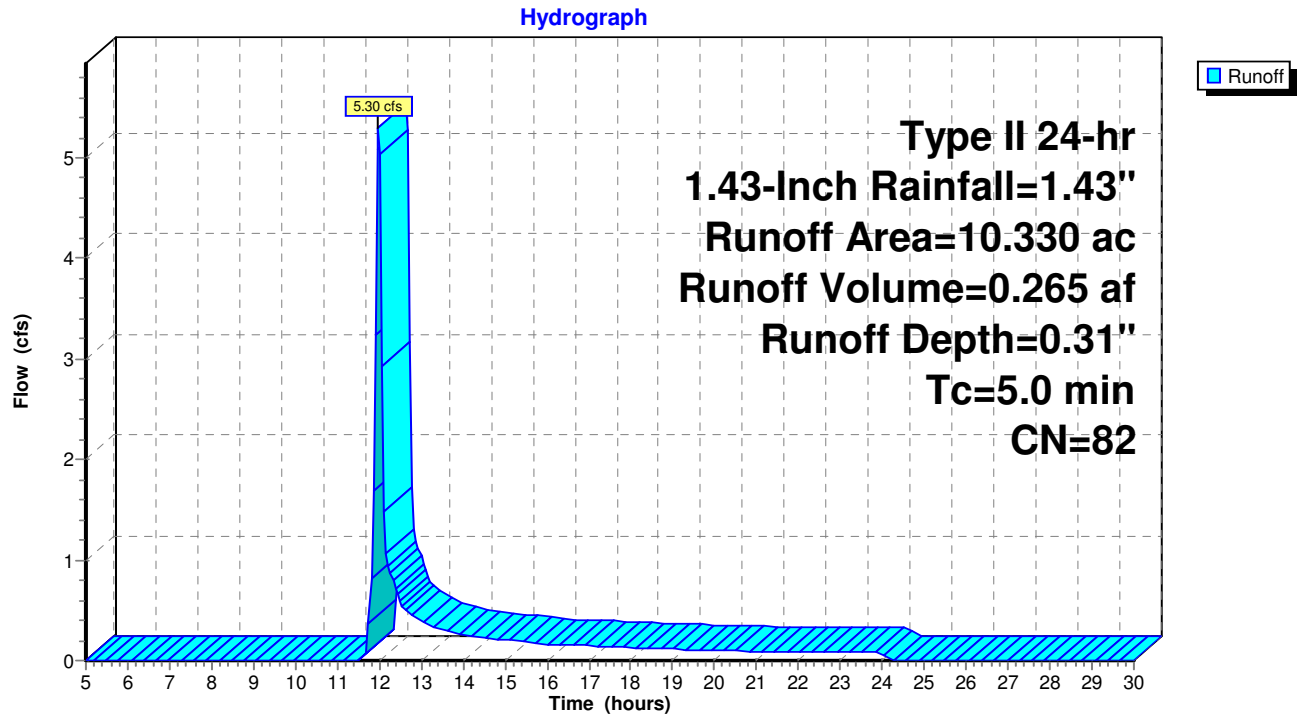
Runoff = 5.30 cfs @ 11.97 hrs, Volume= 0.265 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1.43-Inch Rainfall=1.43"

Area (ac)	CN	Description
6.920	74	>75% Grass cover, Good, HSG C
3.410	98	Paved parking, HSG C
10.330	82	Weighted Average
6.920		66.99% Pervious Area
3.410		33.01% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #36

Inflow Area = 10.330 ac, 33.01% Impervious, Inflow Depth = 0.31" for 1.43-Inch event
Inflow = 5.30 cfs @ 11.97 hrs, Volume= 0.265 af
Outflow = 0.09 cfs @ 23.13 hrs, Volume= 0.125 af, Atten= 98%, Lag= 669.6 min
Primary = 0.09 cfs @ 23.13 hrs, Volume= 0.125 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 508.30' @ 23.13 hrs Surf.Area= 10,516 sf Storage= 7,884 cf

Plug-Flow detention time= 538.6 min calculated for 0.125 af (47% of inflow)
Center-of-Mass det. time= 382.9 min (1,266.1 - 883.1)

Volume	Invert	Avail.Storage	Storage Description
#1	507.50'	98,017 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

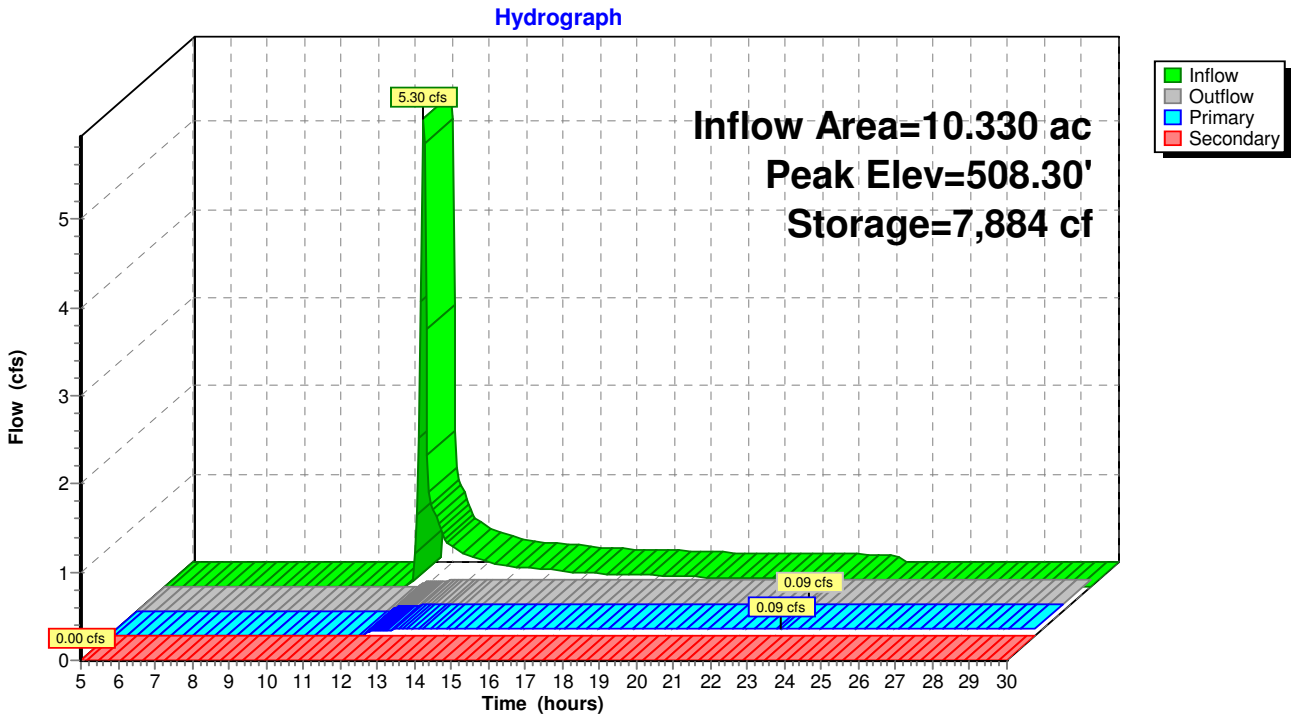
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
507.50	8,921	0	0
508.00	10,157	4,770	4,770
509.00	11,350	10,754	15,523
510.00	12,600	11,975	27,498
511.00	13,906	13,253	40,751
512.00	15,269	14,588	55,339
513.00	16,689	15,979	71,318
514.00	18,165	17,427	88,745
514.50	18,924	9,272	98,017

Device	Routing	Invert	Outlet Devices
#1	Primary	505.50'	**18.0" Round Culvert** L= 48.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 505.50' / 505.00' S= 0.0102 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	507.50'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	509.00'	**28.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	511.45'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	512.50'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.09 cfs @ 23.13 hrs HW=508.30' (Free Discharge)
└**1=Culvert** (Passes 0.09 cfs of 12.19 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.09 cfs @ 4.08 fps)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=507.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Phase 16 North - BMP #36



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=10.330 ac 0.00% Impervious Runoff Depth=1.05"
Flow Length=1,065' Tc=29.9 min CN=70 Runoff=8.56 cfs 0.905 af

Subcatchment 2S: Post-Development Runoff Area=10.330 ac 33.01% Impervious Runoff Depth=1.84"
Tc=5.0 min CN=82 Runoff=34.14 cfs 1.584 af

Pond 3P: Phase 16 North - BMP #36 Peak Elev=510.17' Storage=29,634 cf Inflow=34.14 cfs 1.584 af
Primary=7.66 cfs 1.279 af Secondary=0.00 cfs 0.000 af Outflow=7.66 cfs 1.279 af

Total Runoff Area = 20.660 ac Runoff Volume = 2.490 af Average Runoff Depth = 1.45"
83.49% Pervious = 17.250 ac 16.51% Impervious = 3.410 ac

Summary for Subcatchment 1S: Pre-Development

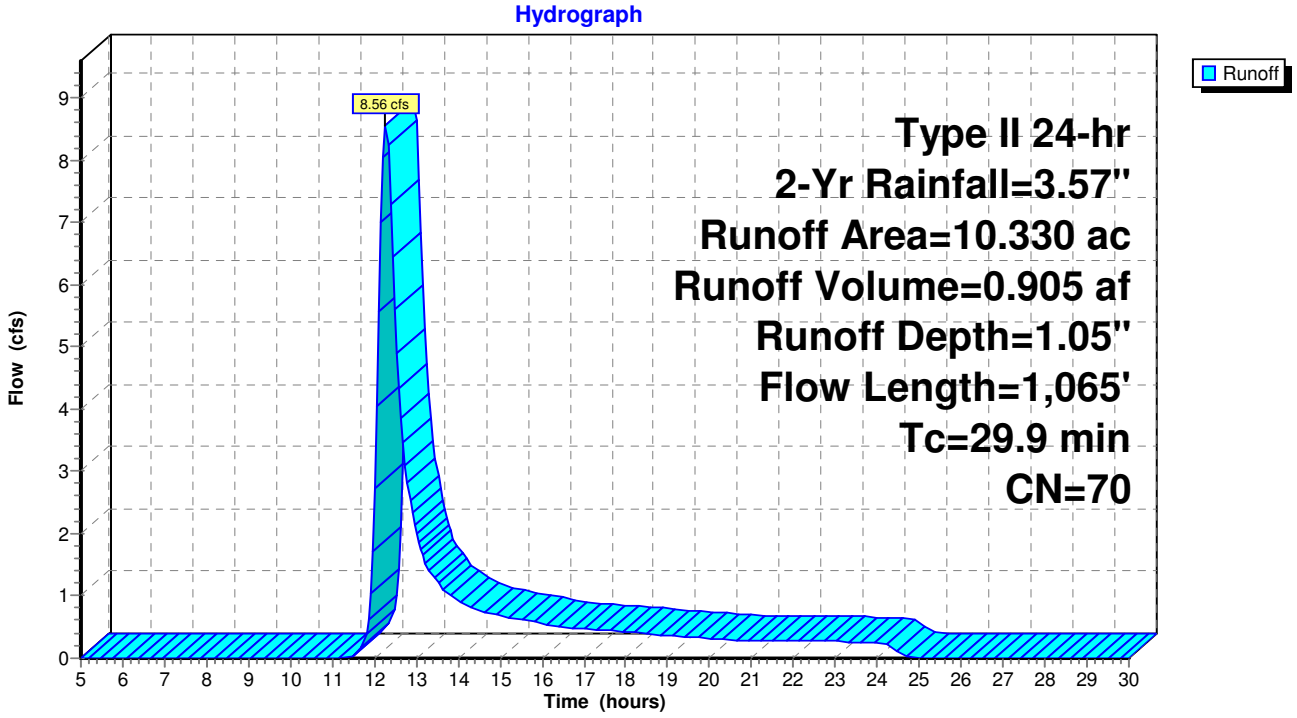
Runoff = 8.56 cfs @ 12.27 hrs, Volume= 0.905 af, Depth= 1.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Yr Rainfall=3.57"

Area (ac)	CN	Description
10.330	70	Woods, Good, HSG C
10.330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	95	0.0330	0.10		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
7.7	610	0.0704	1.33		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
6.2	360	0.0380	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	1,065	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

[49] Hint: Tc<2dt may require smaller dt

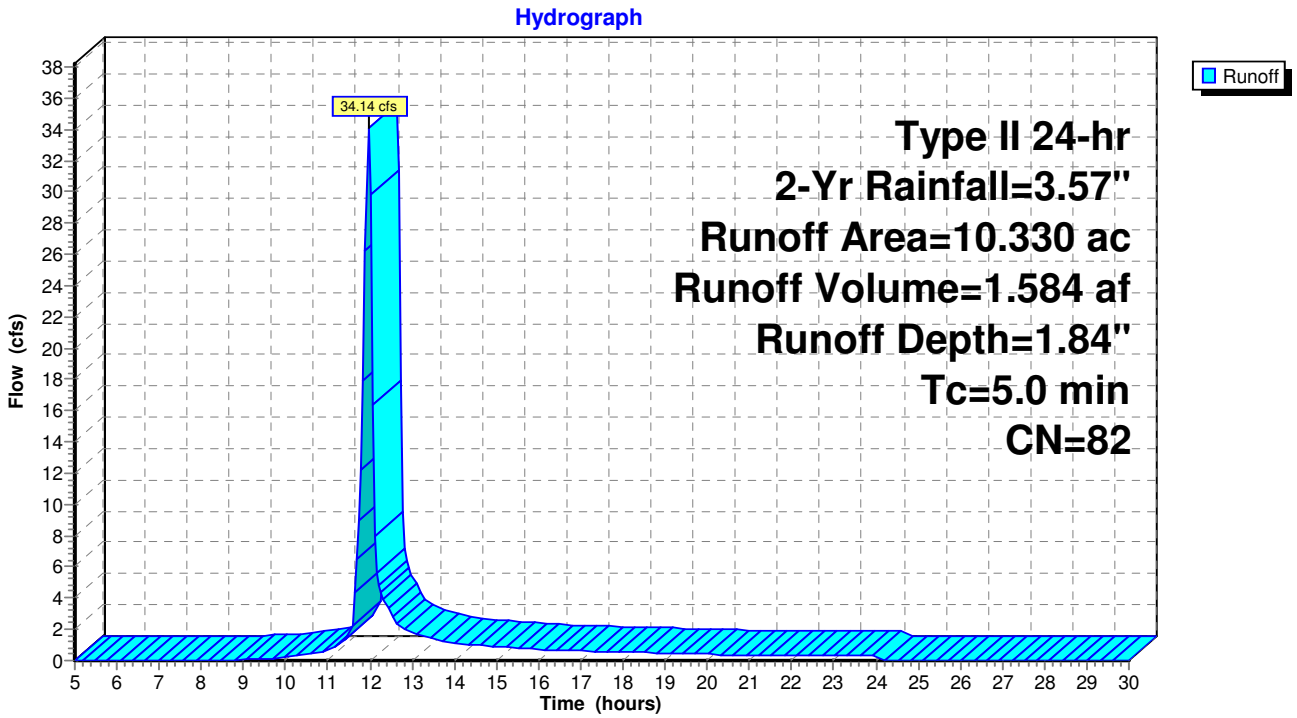
Runoff = 34.14 cfs @ 11.96 hrs, Volume= 1.584 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Yr Rainfall=3.57"

Area (ac)	CN	Description
6.920	74	>75% Grass cover, Good, HSG C
3.410	98	Paved parking, HSG C
10.330	82	Weighted Average
6.920		66.99% Pervious Area
3.410		33.01% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #36

Inflow Area = 10.330 ac, 33.01% Impervious, Inflow Depth = 1.84" for 2-Yr event
Inflow = 34.14 cfs @ 11.96 hrs, Volume= 1.584 af
Outflow = 7.66 cfs @ 12.12 hrs, Volume= 1.279 af, Atten= 78%, Lag= 9.6 min
Primary = 7.66 cfs @ 12.12 hrs, Volume= 1.279 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 510.17' @ 12.12 hrs Surf.Area= 12,820 sf Storage= 29,634 cf

Plug-Flow detention time= 178.4 min calculated for 1.279 af (81% of inflow)
Center-of-Mass det. time= 96.3 min (923.3 - 827.0)

Volume	Invert	Avail.Storage	Storage Description
#1	507.50'	98,017 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

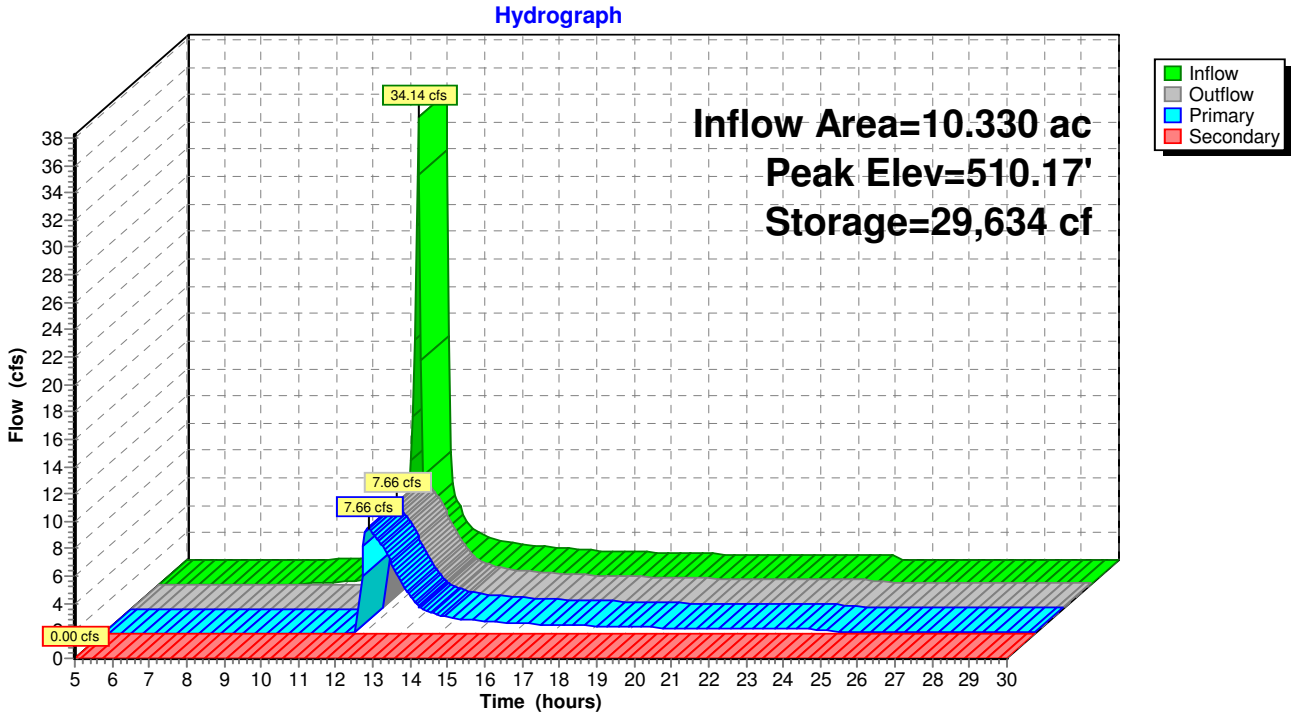
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
507.50	8,921	0	0
508.00	10,157	4,770	4,770
509.00	11,350	10,754	15,523
510.00	12,600	11,975	27,498
511.00	13,906	13,253	40,751
512.00	15,269	14,588	55,339
513.00	16,689	15,979	71,318
514.00	18,165	17,427	88,745
514.50	18,924	9,272	98,017

Device	Routing	Invert	Outlet Devices
#1	Primary	505.50'	**18.0" Round Culvert** L= 48.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 505.50' / 505.00' S= 0.0102 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	507.50'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	509.00'	**28.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	511.45'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	512.50'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=7.62 cfs @ 12.12 hrs HW=510.16' (Free Discharge)
└**1=Culvert** (Passes 7.62 cfs of 16.82 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 7.73 fps)
  ├**3=Orifice/Grate** (Orifice Controls 7.45 cfs @ 4.79 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=507.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Phase 16 North - BMP #36



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=10.330 ac 0.00% Impervious Runoff Depth=1.65"
Flow Length=1,065' Tc=29.9 min CN=70 Runoff=14.17 cfs 1.423 af

Subcatchment 2S: Post-Development Runoff Area=10.330 ac 33.01% Impervious Runoff Depth=2.61"
Tc=5.0 min CN=82 Runoff=47.95 cfs 2.247 af

Pond 3P: Phase 16 North - BMP #36 Peak Elev=511.13' Storage=42,550 cf Inflow=47.95 cfs 2.247 af
Primary=10.69 cfs 1.939 af Secondary=0.00 cfs 0.000 af Outflow=10.69 cfs 1.939 af

Total Runoff Area = 20.660 ac Runoff Volume = 3.669 af Average Runoff Depth = 2.13"
83.49% Pervious = 17.250 ac 16.51% Impervious = 3.410 ac

Summary for Subcatchment 1S: Pre-Development

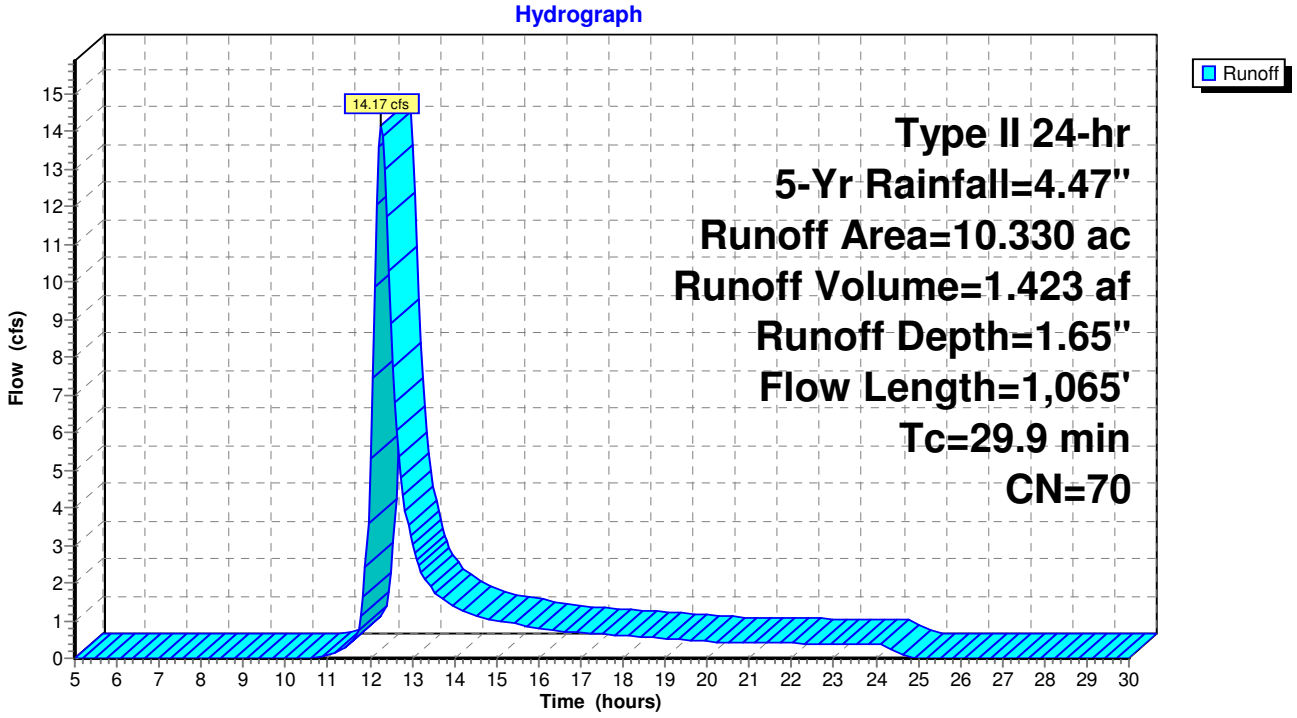
Runoff = 14.17 cfs @ 12.26 hrs, Volume= 1.423 af, Depth= 1.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 5-Yr Rainfall=4.47"

Area (ac)	CN	Description
10.330	70	Woods, Good, HSG C
10.330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	95	0.0330	0.10		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
7.7	610	0.0704	1.33		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
6.2	360	0.0380	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	1,065	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

[49] Hint: Tc<2dt may require smaller dt

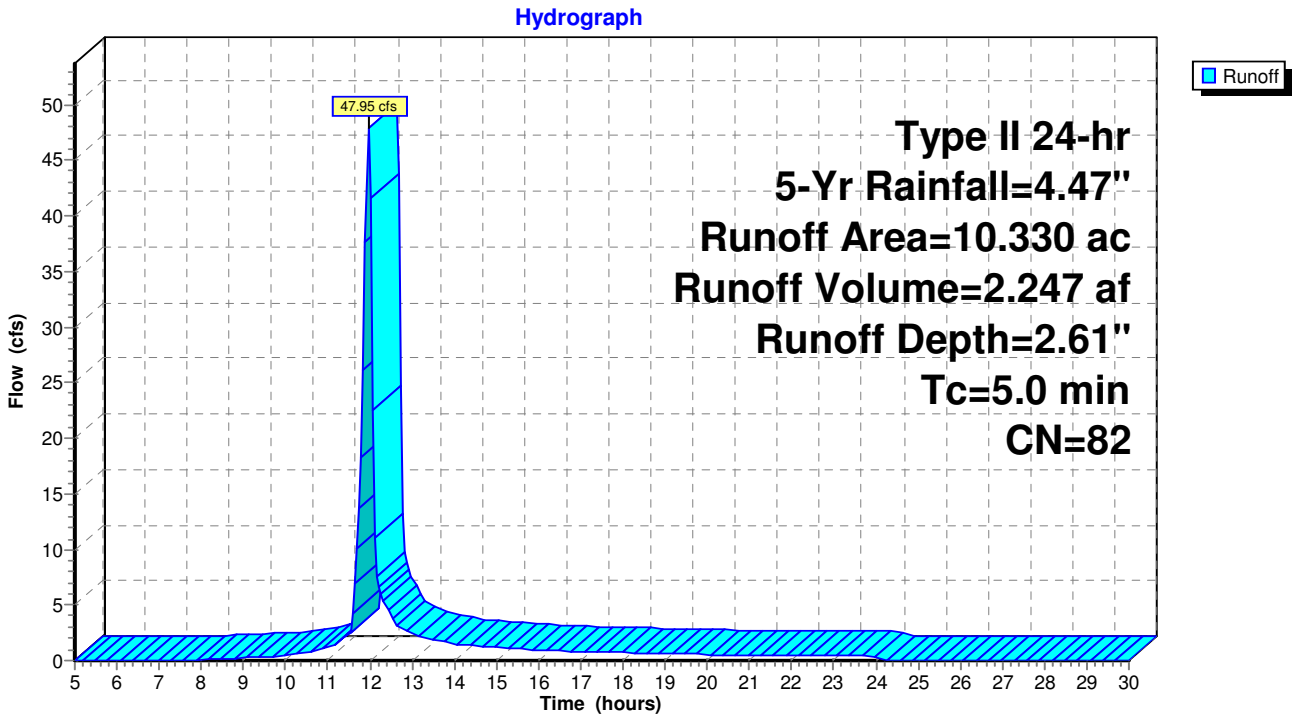
Runoff = 47.95 cfs @ 11.96 hrs, Volume= 2.247 af, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 5-Yr Rainfall=4.47"

Area (ac)	CN	Description
6.920	74	>75% Grass cover, Good, HSG C
3.410	98	Paved parking, HSG C
10.330	82	Weighted Average
6.920		66.99% Pervious Area
3.410		33.01% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #36

Inflow Area = 10.330 ac, 33.01% Impervious, Inflow Depth = 2.61" for 5-Yr event
Inflow = 47.95 cfs @ 11.96 hrs, Volume= 2.247 af
Outflow = 10.69 cfs @ 12.12 hrs, Volume= 1.939 af, Atten= 78%, Lag= 9.6 min
Primary = 10.69 cfs @ 12.12 hrs, Volume= 1.939 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 511.13' @ 12.12 hrs Surf.Area= 14,081 sf Storage= 42,550 cf

Plug-Flow detention time= 143.1 min calculated for 1.939 af (86% of inflow)
Center-of-Mass det. time= 78.6 min (895.6 - 817.0)

Volume	Invert	Avail.Storage	Storage Description
#1	507.50'	98,017 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

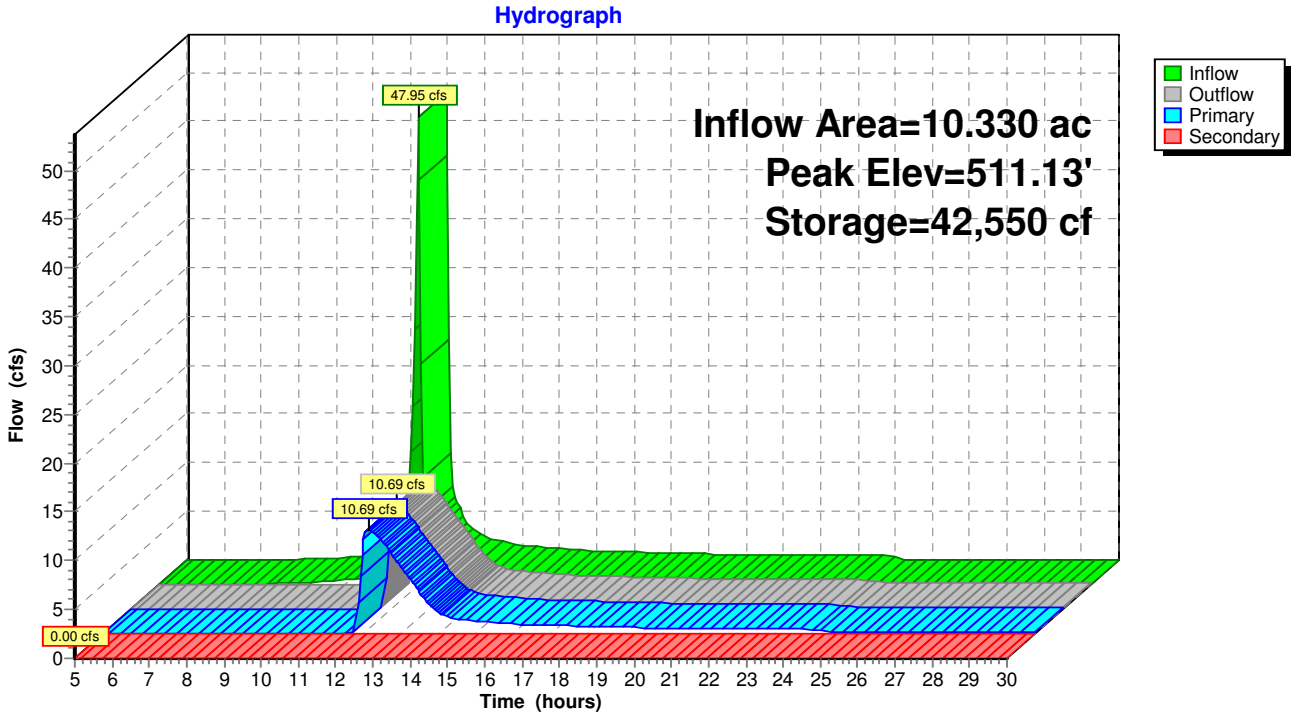
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
507.50	8,921	0	0
508.00	10,157	4,770	4,770
509.00	11,350	10,754	15,523
510.00	12,600	11,975	27,498
511.00	13,906	13,253	40,751
512.00	15,269	14,588	55,339
513.00	16,689	15,979	71,318
514.00	18,165	17,427	88,745
514.50	18,924	9,272	98,017

Device	Routing	Invert	Outlet Devices
#1	Primary	505.50'	**18.0" Round Culvert** L= 48.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 505.50' / 505.00' S= 0.0102 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	507.50'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	509.00'	**28.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	511.45'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	512.50'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=10.66 cfs @ 12.12 hrs HW=511.12' (Free Discharge)
└**1=Culvert** (Passes 10.66 cfs of 18.77 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 9.05 fps)
  ├**3=Orifice/Grate** (Orifice Controls 10.46 cfs @ 6.72 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=507.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Phase 16 North - BMP #36



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=10.330 ac 0.00% Impervious Runoff Depth=2.16"
Flow Length=1,065' Tc=29.9 min CN=70 Runoff=18.91 cfs 1.862 af

Subcatchment 2S: Post-Development Runoff Area=10.330 ac 33.01% Impervious Runoff Depth=3.23"
Tc=5.0 min CN=82 Runoff=58.88 cfs 2.782 af

Pond 3P: Phase 16 North - BMP #36 Peak Elev=511.75' Storage=51,628 cf Inflow=58.88 cfs 2.782 af
Primary=18.86 cfs 2.474 af Secondary=0.00 cfs 0.000 af Outflow=18.86 cfs 2.474 af

Total Runoff Area = 20.660 ac Runoff Volume = 4.644 af Average Runoff Depth = 2.70"
83.49% Pervious = 17.250 ac 16.51% Impervious = 3.410 ac

Summary for Subcatchment 1S: Pre-Development

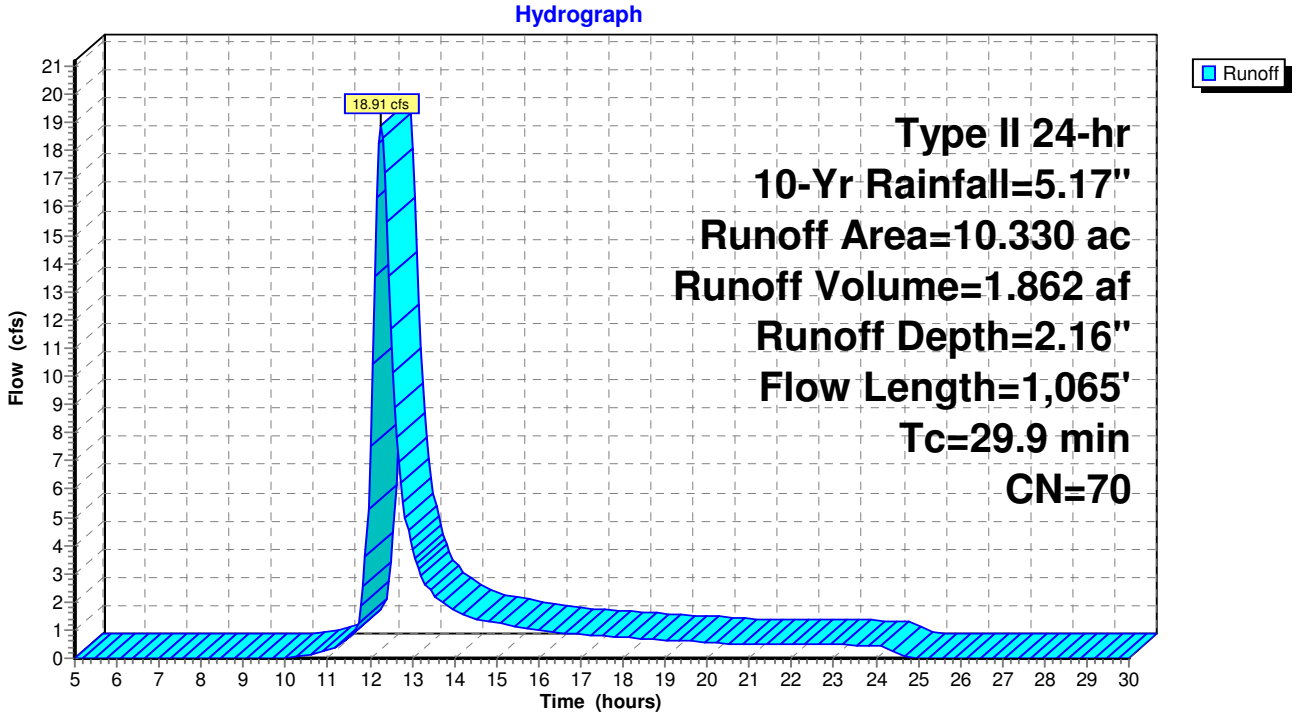
Runoff = 18.91 cfs @ 12.25 hrs, Volume= 1.862 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=5.17"

Area (ac)	CN	Description
10.330	70	Woods, Good, HSG C
10.330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	95	0.0330	0.10		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
7.7	610	0.0704	1.33		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
6.2	360	0.0380	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	1,065	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

[49] Hint: Tc<2dt may require smaller dt

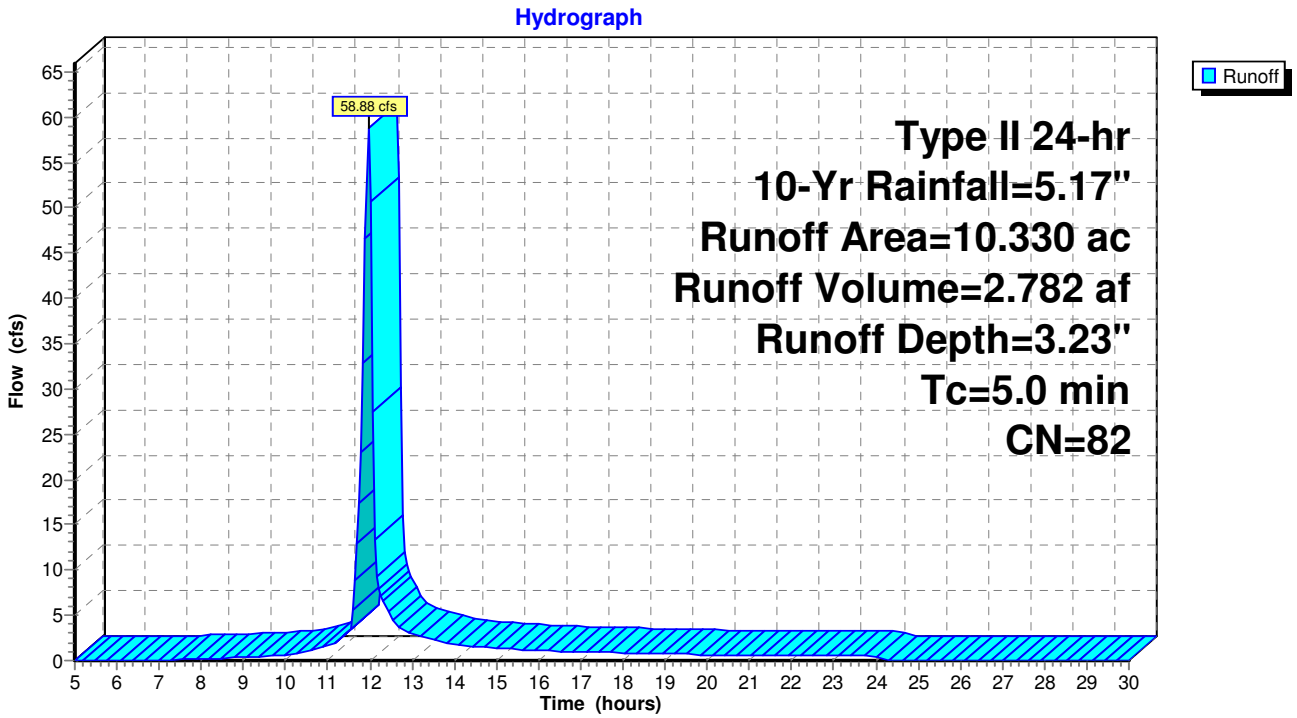
Runoff = 58.88 cfs @ 11.95 hrs, Volume= 2.782 af, Depth= 3.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=5.17"

Area (ac)	CN	Description
6.920	74	>75% Grass cover, Good, HSG C
3.410	98	Paved parking, HSG C
10.330	82	Weighted Average
6.920		66.99% Pervious Area
3.410		33.01% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #36

Inflow Area = 10.330 ac, 33.01% Impervious, Inflow Depth = 3.23" for 10-Yr event
Inflow = 58.88 cfs @ 11.95 hrs, Volume= 2.782 af
Outflow = 18.86 cfs @ 12.09 hrs, Volume= 2.474 af, Atten= 68%, Lag= 8.0 min
Primary = 18.86 cfs @ 12.09 hrs, Volume= 2.474 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 511.75' @ 12.09 hrs Surf.Area= 14,934 sf Storage= 51,628 cf

Plug-Flow detention time= 127.0 min calculated for 2.474 af (89% of inflow)
Center-of-Mass det. time= 71.8 min (882.7 - 810.9)

Volume	Invert	Avail.Storage	Storage Description
#1	507.50'	98,017 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

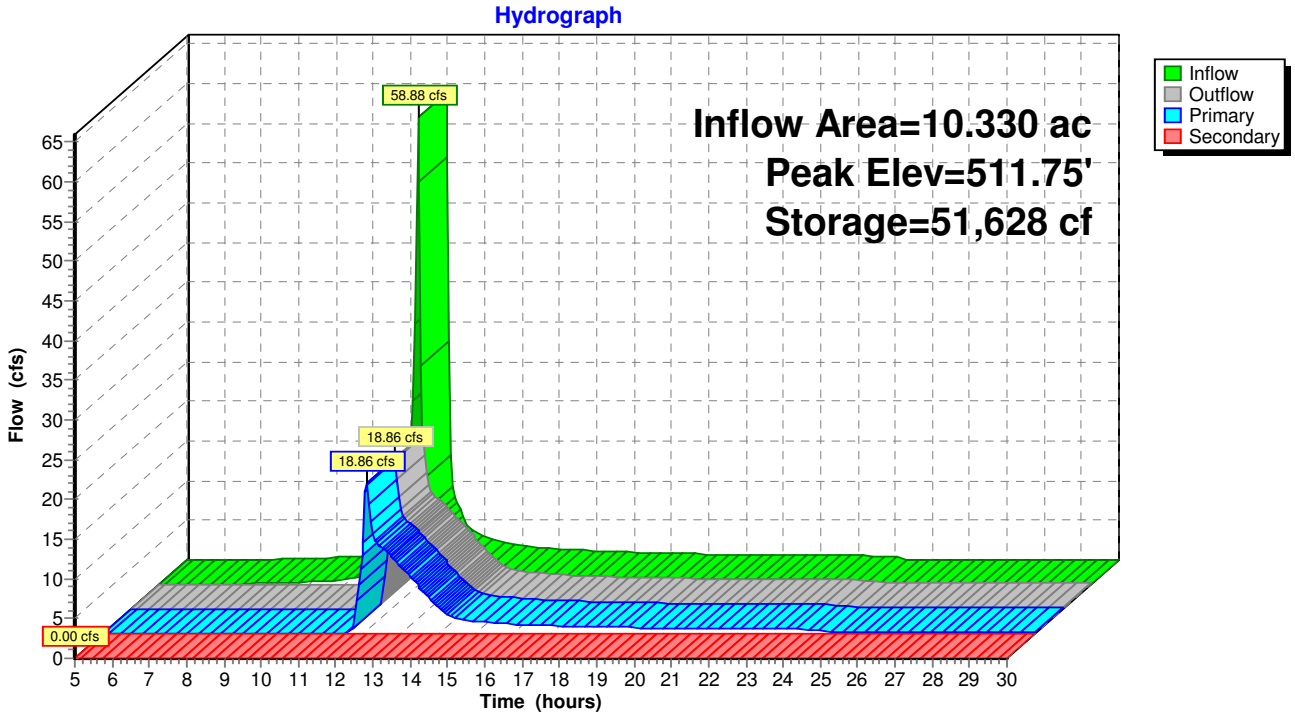
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
507.50	8,921	0	0
508.00	10,157	4,770	4,770
509.00	11,350	10,754	15,523
510.00	12,600	11,975	27,498
511.00	13,906	13,253	40,751
512.00	15,269	14,588	55,339
513.00	16,689	15,979	71,318
514.00	18,165	17,427	88,745
514.50	18,924	9,272	98,017

Device	Routing	Invert	Outlet Devices
#1	Primary	505.50'	**18.0" Round Culvert** L= 48.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 505.50' / 505.00' S= 0.0102 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	507.50'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	509.00'	**28.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	511.45'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	512.50'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=18.52 cfs @ 12.09 hrs HW=511.74' (Free Discharge)
└**1=Culvert** (Passes 18.52 cfs of 19.95 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.21 cfs @ 9.82 fps)
  ├**3=Orifice/Grate** (Orifice Controls 12.02 cfs @ 7.73 fps)
  └**4=Orifice/Grate** (Weir Controls 6.28 cfs @ 1.78 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=507.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Phase 16 North - BMP #36



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=10.330 ac 0.00% Impervious Runoff Depth=2.89"
Flow Length=1,065' Tc=29.9 min CN=70 Runoff=25.64 cfs 2.490 af

Subcatchment 2S: Post-Development Runoff Area=10.330 ac 33.01% Impervious Runoff Depth=4.09"
Tc=5.0 min CN=82 Runoff=73.67 cfs 3.519 af

Pond 3P: Phase 16 North - BMP #36 Peak Elev=512.56' Storage=64,131 cf Inflow=73.67 cfs 3.519 af
Primary=21.38 cfs 3.206 af Secondary=0.84 cfs 0.004 af Outflow=22.22 cfs 3.210 af

Total Runoff Area = 20.660 ac Runoff Volume = 6.010 af Average Runoff Depth = 3.49"
83.49% Pervious = 17.250 ac 16.51% Impervious = 3.410 ac

Summary for Subcatchment 1S: Pre-Development

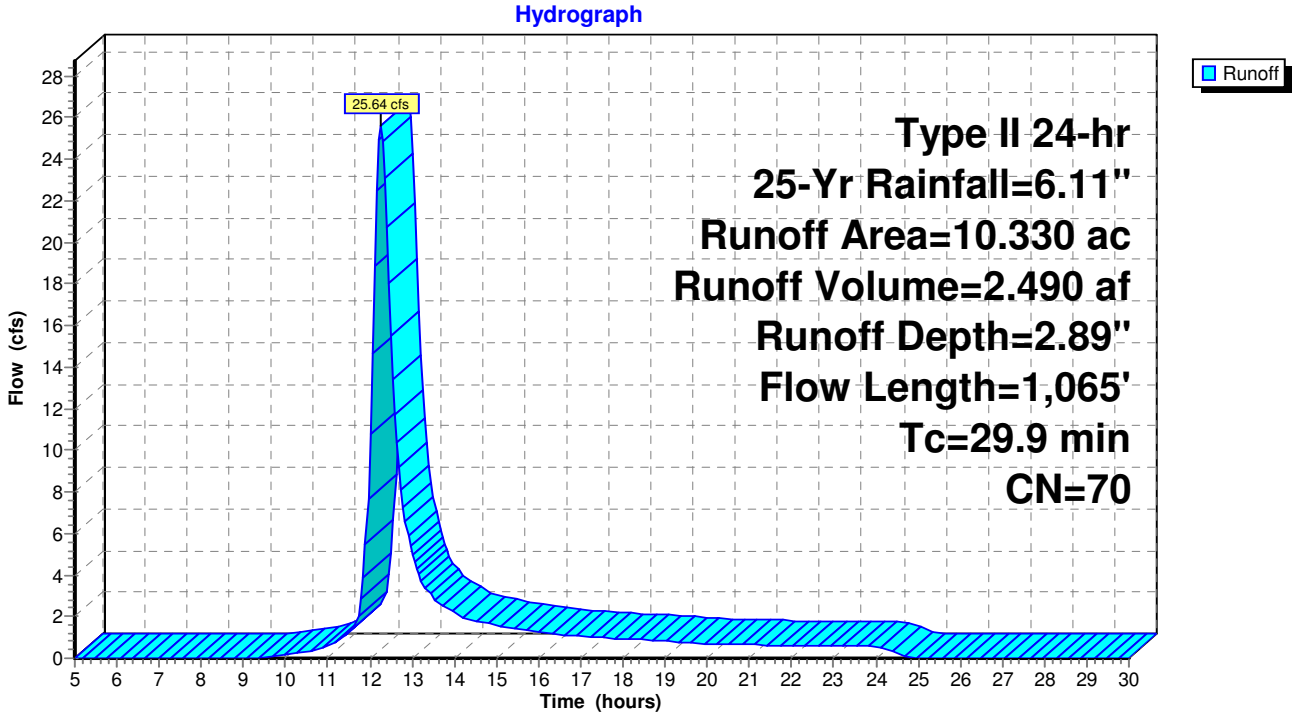
Runoff = 25.64 cfs @ 12.25 hrs, Volume= 2.490 af, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-Yr Rainfall=6.11"

Area (ac)	CN	Description
10.330	70	Woods, Good, HSG C
10.330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	95	0.0330	0.10		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
7.7	610	0.0704	1.33		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
6.2	360	0.0380	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	1,065	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

[49] Hint: Tc<2dt may require smaller dt

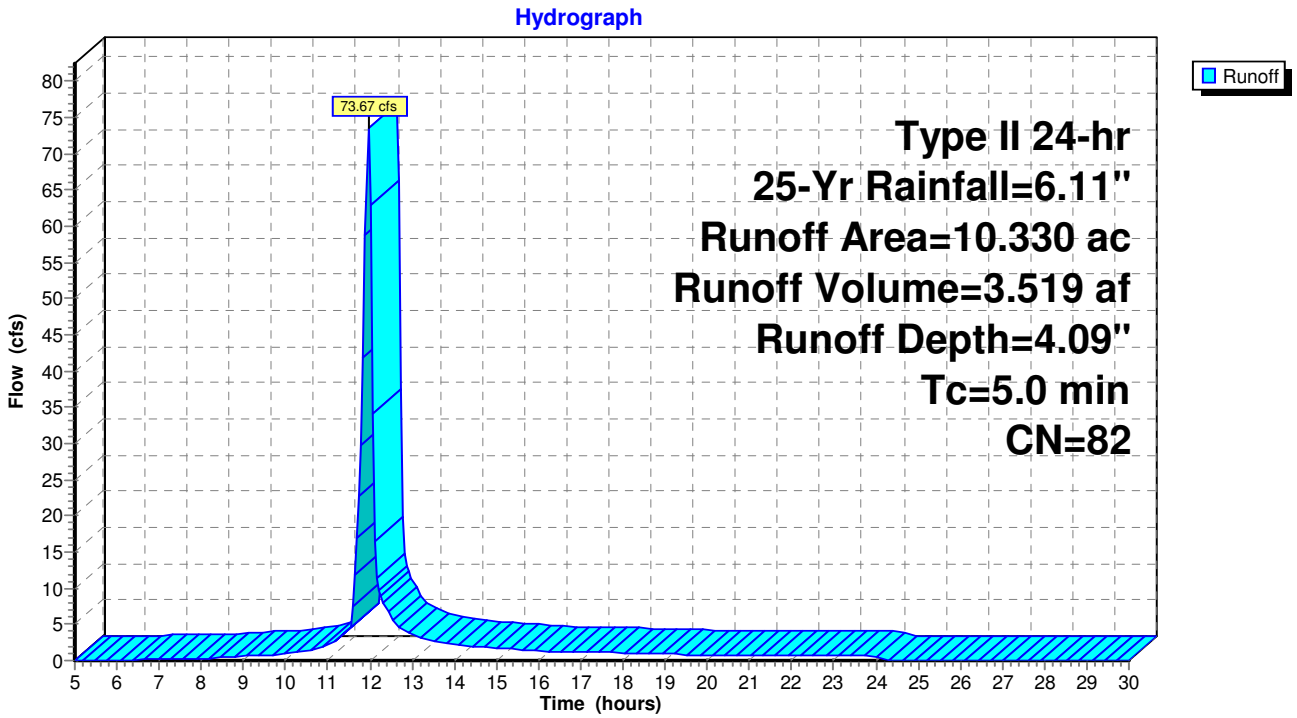
Runoff = 73.67 cfs @ 11.95 hrs, Volume= 3.519 af, Depth= 4.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-Yr Rainfall=6.11"

Area (ac)	CN	Description
6.920	74	>75% Grass cover, Good, HSG C
3.410	98	Paved parking, HSG C
10.330	82	Weighted Average
6.920		66.99% Pervious Area
3.410		33.01% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #36

Inflow Area = 10.330 ac, 33.01% Impervious, Inflow Depth = 4.09" for 25-Yr event
Inflow = 73.67 cfs @ 11.95 hrs, Volume= 3.519 af
Outflow = 22.22 cfs @ 12.10 hrs, Volume= 3.210 af, Atten= 70%, Lag= 8.5 min
Primary = 21.38 cfs @ 12.09 hrs, Volume= 3.206 af
Secondary = 0.84 cfs @ 12.10 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 512.56' @ 12.09 hrs Surf.Area= 16,066 sf Storage= 64,131 cf

Plug-Flow detention time= 111.6 min calculated for 3.210 af (91% of inflow)
Center-of-Mass det. time= 65.5 min (869.8 - 804.2)

Volume	Invert	Avail.Storage	Storage Description
#1	507.50'	98,017 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

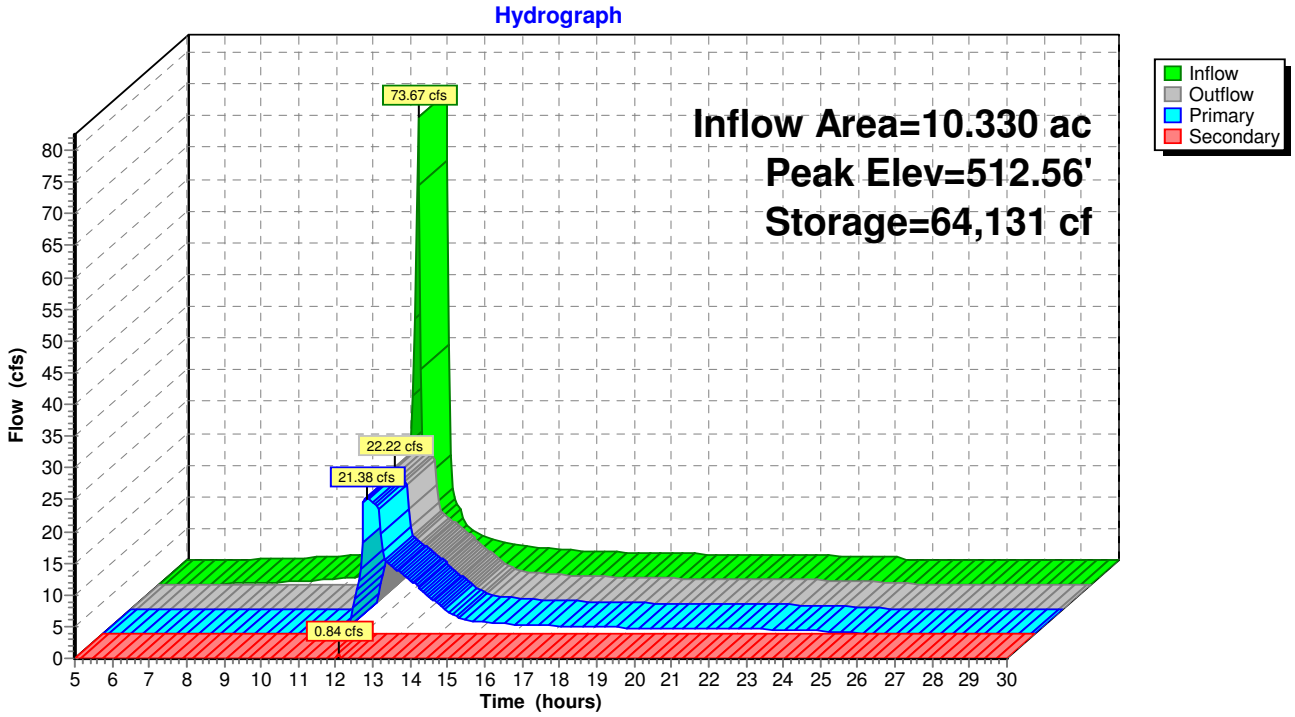
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
507.50	8,921	0	0
508.00	10,157	4,770	4,770
509.00	11,350	10,754	15,523
510.00	12,600	11,975	27,498
511.00	13,906	13,253	40,751
512.00	15,269	14,588	55,339
513.00	16,689	15,979	71,318
514.00	18,165	17,427	88,745
514.50	18,924	9,272	98,017

Device	Routing	Invert	Outlet Devices
#1	Primary	505.50'	**18.0" Round Culvert** L= 48.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 505.50' / 505.00' S= 0.0102 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	507.50'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	509.00'	**28.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	511.45'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	512.50'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=21.36 cfs @ 12.09 hrs HW=512.55' (Free Discharge)
└**1=Culvert** (Inlet Controls 21.36 cfs @ 12.09 fps)
  ├**2=Orifice/Grate** (Passes < 0.23 cfs potential flow)
  ├**3=Orifice/Grate** (Passes < 13.78 cfs potential flow)
  └**4=Orifice/Grate** (Passes < 45.35 cfs potential flow)

Secondary OutFlow Max=0.71 cfs @ 12.10 hrs HW=512.56' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Weir Controls 0.71 cfs @ 0.63 fps)

Pond 3P: Phase 16 North - BMP #36



Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Development Runoff Area=10.330 ac 0.00% Impervious Runoff Depth=4.14"
Flow Length=1,065' Tc=29.9 min CN=70 Runoff=37.03 cfs 3.563 af

Subcatchment 2S: Post-Development Runoff Area=10.330 ac 33.01% Impervious Runoff Depth>5.50"
Tc=5.0 min CN=82 Runoff=97.49 cfs 4.734 af

Pond 3P: Phase 16 North - BMP #36 Peak Elev=513.24' Storage=75,441 cf Inflow=97.49 cfs 4.734 af
Primary=22.50 cfs 4.019 af Secondary=34.12 cfs 0.405 af Outflow=56.62 cfs 4.424 af

Total Runoff Area = 20.660 ac Runoff Volume = 8.298 af Average Runoff Depth = 4.82"
83.49% Pervious = 17.250 ac 16.51% Impervious = 3.410 ac

Summary for Subcatchment 1S: Pre-Development

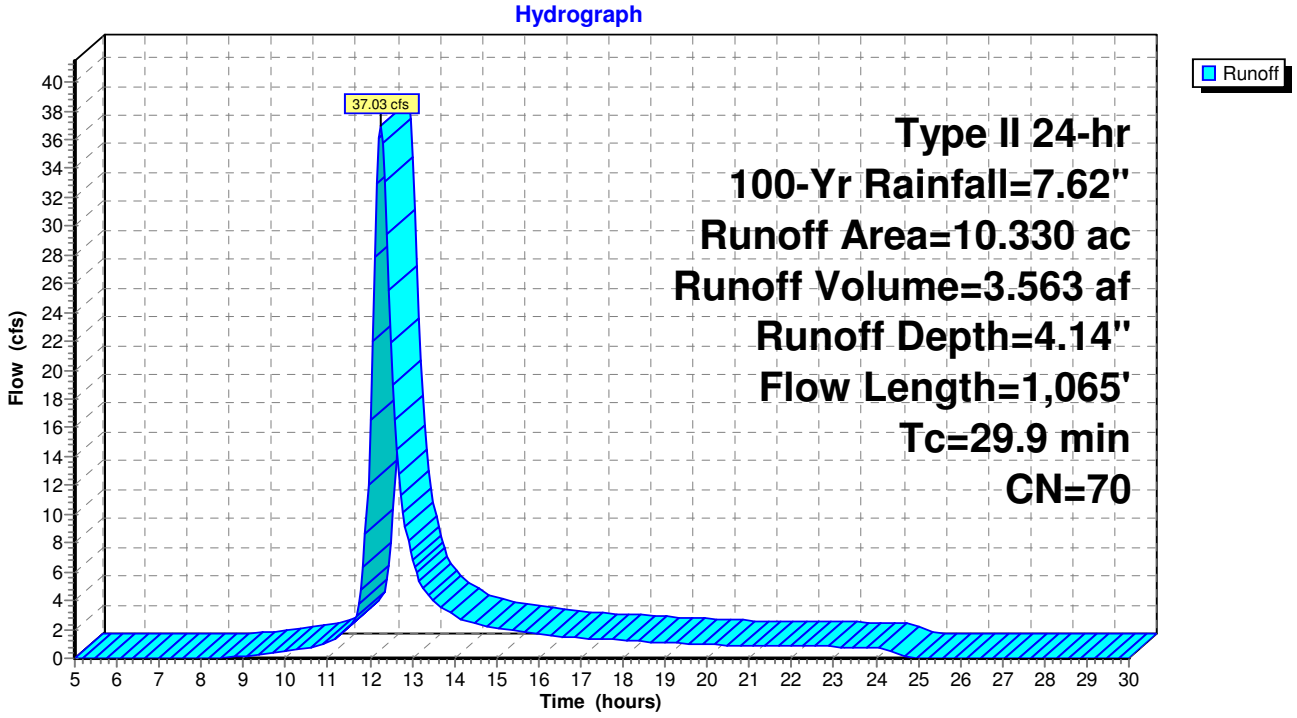
Runoff = 37.03 cfs @ 12.24 hrs, Volume= 3.563 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=7.62"

Area (ac)	CN	Description
10.330	70	Woods, Good, HSG C
10.330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	95	0.0330	0.10		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.56"
7.7	610	0.0704	1.33		**Shallow Concentrated Flow, Concentrated Flow** Woodland Kv= 5.0 fps
6.2	360	0.0380	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	1,065	Total			

Subcatchment 1S: Pre-Development



Summary for Subcatchment 2S: Post-Development

[49] Hint: Tc<2dt may require smaller dt

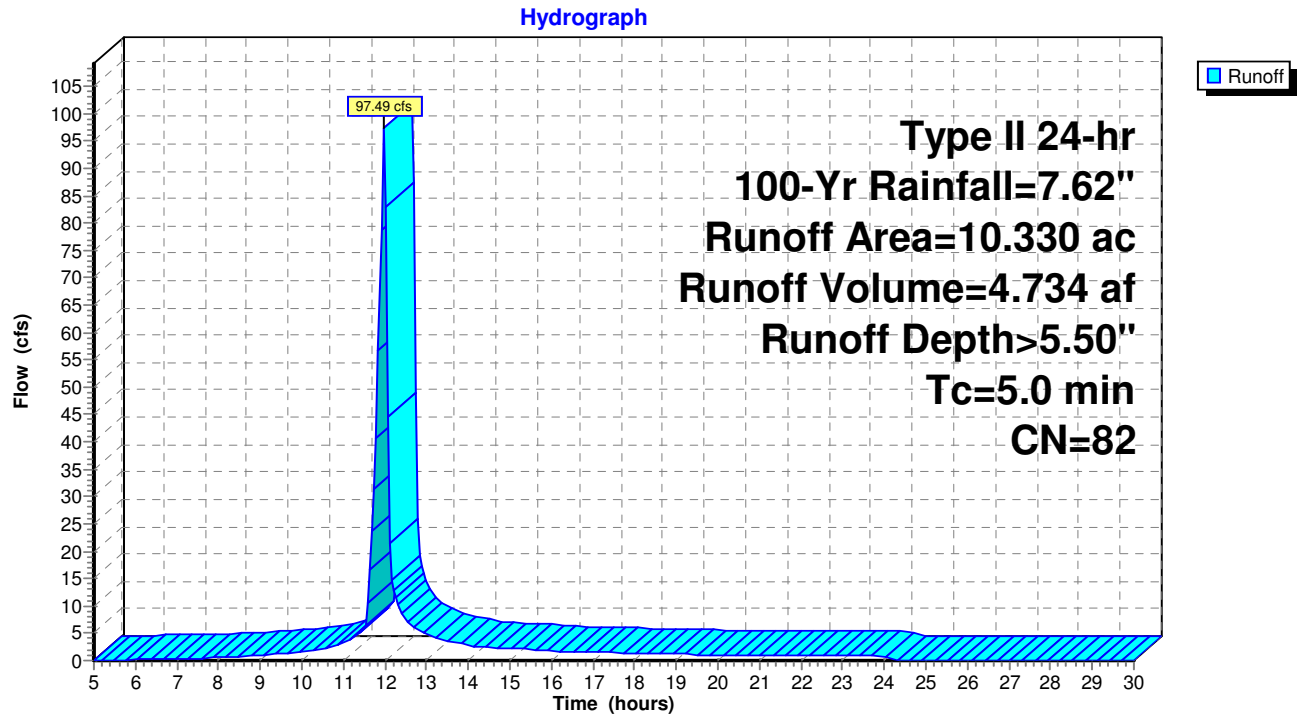
Runoff = 97.49 cfs @ 11.95 hrs, Volume= 4.734 af, Depth> 5.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=7.62"

Area (ac)	CN	Description
6.920	74	>75% Grass cover, Good, HSG C
3.410	98	Paved parking, HSG C
10.330	82	Weighted Average
6.920		66.99% Pervious Area
3.410		33.01% Impervious Area

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

Subcatchment 2S: Post-Development



Summary for Pond 3P: Phase 16 North - BMP #36

Inflow Area = 10.330 ac, 33.01% Impervious, Inflow Depth > 5.50" for 100-Yr event
Inflow = 97.49 cfs @ 11.95 hrs, Volume= 4.734 af
Outflow = 56.62 cfs @ 12.04 hrs, Volume= 4.424 af, Atten= 42%, Lag= 5.5 min
Primary = 22.50 cfs @ 12.04 hrs, Volume= 4.019 af
Secondary = 34.12 cfs @ 12.04 hrs, Volume= 0.405 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 513.24' @ 12.04 hrs Surf.Area= 17,050 sf Storage= 75,441 cf

Plug-Flow detention time= 93.8 min calculated for 4.424 af (93% of inflow)
Center-of-Mass det. time= 57.3 min (853.2 - 795.9)

Volume	Invert	Avail.Storage	Storage Description
#1	507.50'	98,017 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

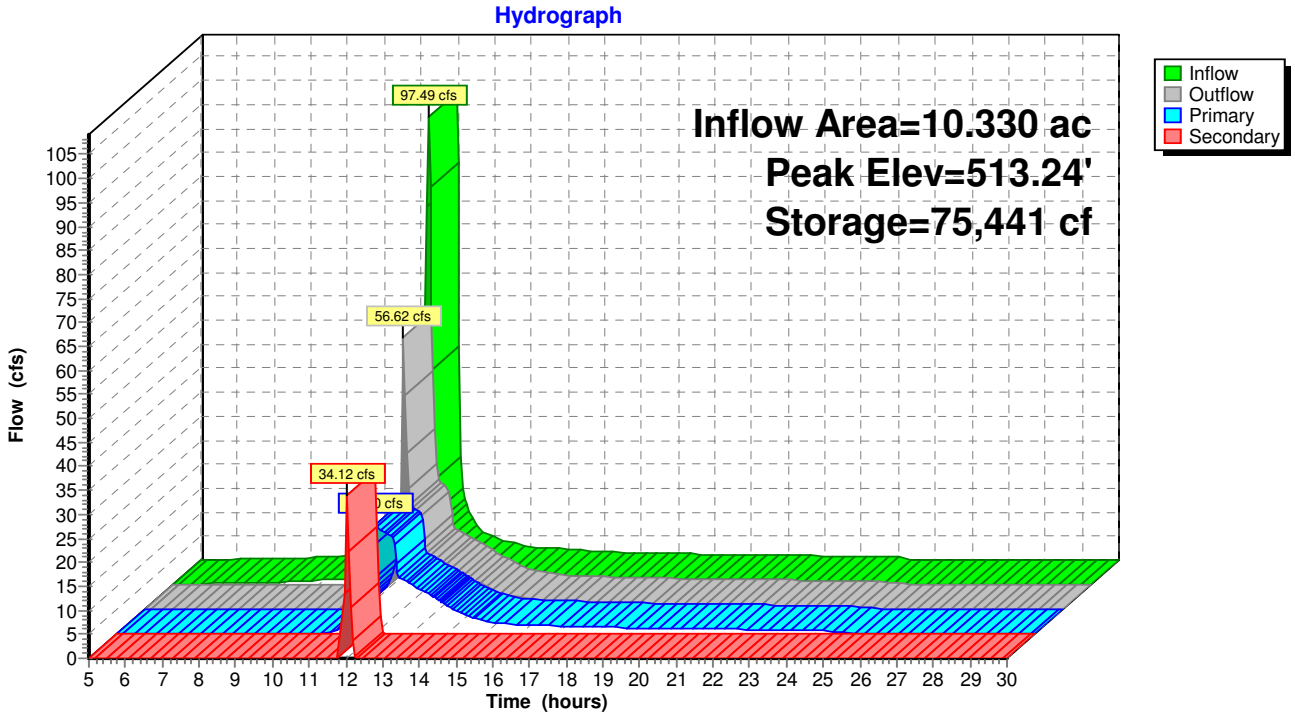
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
507.50	8,921	0	0
508.00	10,157	4,770	4,770
509.00	11,350	10,754	15,523
510.00	12,600	11,975	27,498
511.00	13,906	13,253	40,751
512.00	15,269	14,588	55,339
513.00	16,689	15,979	71,318
514.00	18,165	17,427	88,745
514.50	18,924	9,272	98,017

Device	Routing	Invert	Outlet Devices
#1	Primary	505.50'	**18.0" Round Culvert** L= 48.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 505.50' / 505.00' S= 0.0102 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	507.50'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	509.00'	**28.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	511.45'	**36.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	512.50'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=22.48 cfs @ 12.04 hrs HW=513.23' (Free Discharge)
└**1=Culvert** (Inlet Controls 22.48 cfs @ 12.72 fps)
  ├**2=Orifice/Grate** (Passes < 0.25 cfs potential flow)
  ├**3=Orifice/Grate** (Passes < 15.09 cfs potential flow)
  └**4=Orifice/Grate** (Passes < 57.80 cfs potential flow)

Secondary OutFlow Max=33.14 cfs @ 12.04 hrs HW=513.23' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Weir Controls 33.14 cfs @ 2.27 fps)

Pond 3P: Phase 16 North - BMP #36



ANTI-FLOATATION DESIGN	DATE: 3/15/2018	DESIGNED BY: BSS
PROJECT NAME: Briar Chapel - Phase 16 North PROJECT LOCATION: Chatham County, NC	PROJECT NO: 2735-0206	CHECKED BY: GCA

Pond Name=	BMP #36				
Riser Outer Width =	4	ft	Riser Resisting Force =	6,773	lb
Riser Outer Length =	4	ft	Base Resisting Force =	3,600	lb
Riser Inner Width =	3	ft	Total Resisting Force =	10,373	lb
Riser Inner Length =	3	ft			
Riser Height =	6.45	ft	Riser Buoyant Force =	6,440	lb
			Base Buoyant Force =	1,498	lb
Concrete Base Length =	6	ft	Total Buoyant Force =	7,937	lb
Concrete Base Width =	6	ft			
Concrete Base Depth =	8	in	Factor of Safety	1.31	**Design Acceptable**

OUTLET PROTECTION DESIGN	DATE: 03/15/2018	DESIGNED BY: BSS
PROJECT NAME: Briar Chapel Phase 16 North PROJECT LOCATION: Chatham County, NC	PROJECT NO: 2735-0206	CHECKED BY GCA

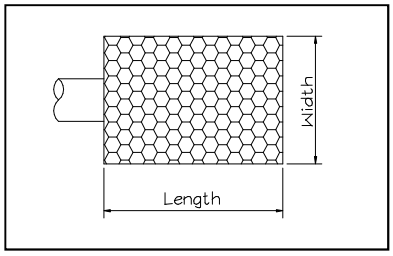
Storm Outlet Structure

Structure=	BMP #36 Out		Q_{10}/Q_{full} =	1.04	
Size=	18	in	V/Vfull =	1.14	
Q_{10} =	18.86	cfs	V =	11.7	fps
Qfull =	18.16	cfs			
Vfull =	10.28	fps			

From Fig. 8.06.b.1:

Zone = 3

From Fig. 8.06.b.2:



D_{50}	=	10	in
D_{MAX}	=	15	in
Riprap Class	=	1	
Apron Thickness	=	24	in
Apron Length	=	12.0	ft
Apron Width = 3 x Dia	=	5.0	ft

STORM DRAINAGE
SUMMARY TABLES

Catch Basin FlexTable: Spread Report

Label	Inlet	Inlet Drainage Area (acres)	Inlet C	Total Rational Flow to Inlet (ft³/s)	Intercepted Rational Flow (ft³/s)	Capture Efficiency (Calculated) (%)	Bypassed Rational Flow (ft³/s)	Inlet Location	Spread / Top Width (ft)	Bypass Target	Longitudinal Slope (Inlet) (ft/ft)
CI-16-121	NCDOT 840.03	0.020	0.800	0.06	0.06	100.0	0.00	On Grade	2.0	CI-16-122	0.029
CI-16-109	NCDOT 840.03	0.020	0.800	0.12	0.12	99.3	0.00	On Grade	2.4	CI-16-108	0.029
DBL CI-16-120	DBL NCDOT 840.03	0.160	0.800	0.69	0.69	100.0	0.00	In Sag	3.0	<None>	
CI-16-107	NCDOT 840.03	0.060	0.800	0.20	0.20	96.1	0.01	On Grade	3.0	CI-16-106	0.029
DBL CI-16-212	DBL NCDOT 840.03	0.200	0.850	0.72	0.72	100.0	0.00	In Sag	3.1	<None>	
CI-16-108	NCDOT 840.03	0.070	0.800	0.23	0.22	95.2	0.01	On Grade	3.1	CI-16-107	0.029
CI-16-106	NCDOT 840.03	0.090	0.800	0.30	0.28	92.4	0.02	On Grade	3.5	CI-16-105	0.029
CI-16-114	NCDOT 840.03	0.110	0.800	0.35	0.33	91.7	0.03	On Grade	3.5	CI-16-116	0.040
CI-16-204	NCDOT 840.03	0.090	0.800	0.37	0.34	91.4	0.03	On Grade	3.5	DBL CI-16-212	0.042
CI-16-105	NCDOT 840.03	0.090	0.800	0.31	0.29	91.8	0.03	On Grade	3.5	DBL CI-16-104	0.029
CI-16-113	NCDOT 840.03	0.120	0.800	0.39	0.35	90.7	0.04	On Grade	3.6	CI-16-112	0.040
CI-16-122	NCDOT 840.03	0.110	0.800	0.35	0.32	90.3	0.03	On Grade	3.7	CI-16-123	0.029
CI-16-111	NCDOT 840.03	0.120	0.800	0.44	0.39	89.0	0.05	On Grade	3.8	CI-16-110	0.040
CI-16-112	NCDOT 840.03	0.130	0.800	0.46	0.40	88.5	0.05	On Grade	3.8	CI-16-111	0.040
DBL CI-16-213	DBL NCDOT 840.03	0.230	0.850	0.97	0.97	100.0	0.00	In Sag	4.1	<None>	
CI-16-205	NCDOT 840.03	0.120	0.800	0.57	0.49	85.7	0.08	On Grade	4.1	CI-16-204	0.042
CI-16-110	NCDOT 840.03	0.110	0.800	0.40	0.35	87.2	0.05	On Grade	4.2	CI-16-109	0.020
CI-16-123	NCDOT 840.03	0.200	0.800	0.68	0.55	81.2	0.13	On Grade	4.7	DBL CI-16-104	0.029
CI-16-211	NCDOT 840.03	0.220	0.800	0.88	0.70	79.0	0.19	On Grade	4.9	DBL CI-16-213	0.042
CI-16-116	NCDOT 840.03	0.270	0.800	0.90	0.71	78.4	0.19	On Grade	4.9	DBL CI-16-117	0.040
CI-16-210	NCDOT 840.03	0.200	0.800	0.81	0.63	78.7	0.17	On Grade	5.0	CI-16-211	0.030
CI-16-206	NCDOT 840.03	0.220	0.800	0.84	0.65	78.1	0.18	On Grade	5.1	CI-16-205	0.030
CI-16-208	NCDOT 840.03	0.190	0.800	0.61	0.49	79.5	0.13	On Grade	5.5	CI-16-206	0.010
DBL CI-16-104	DBL NCDOT 840.03	0.430	0.800	1.54	1.54	100.0	0.00	In Sag	5.8	<None>	
CI-16-209	NCDOT 840.03	0.220	0.800	0.71	0.55	77.4	0.16	On Grade	5.9	CI-16-210	0.010
CI-16-119	NCDOT 840.03	0.230	0.800	0.74	0.57	76.7	0.17	On Grade	6.0	DBL CI-16-120	0.010
CI-16-118	NCDOT 840.03	0.250	0.800	0.81	0.61	75.5	0.20	On Grade	6.2	DBL CI-16-117	0.010
DBL CI-16-117	DBL NCDOT 840.03	0.410	0.800	1.72	1.72	100.0	0.00	In Sag	6.2	<None>	

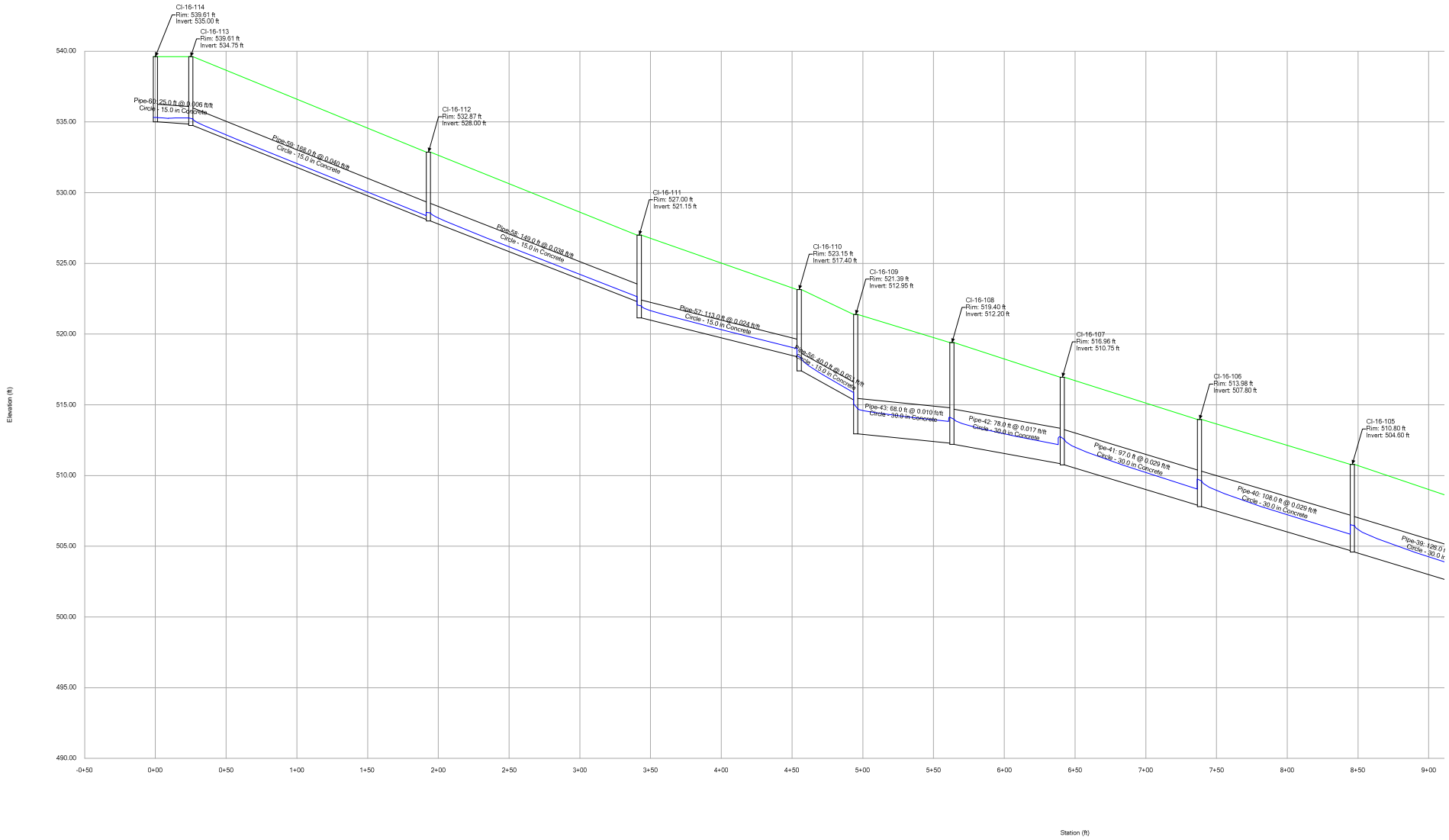
BRIAR CHAPEL - PHASE 16N

STORM DRAINAGE DESIGN SUMMARY TABLE - 10 YEAR DESIGN STORM

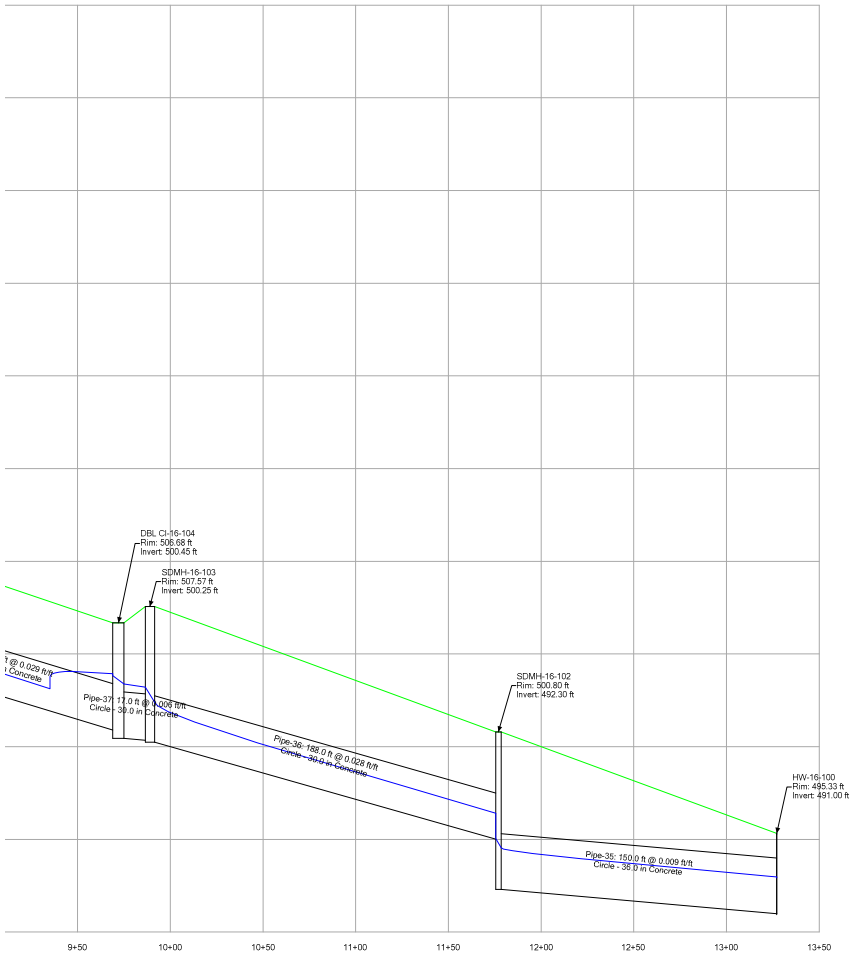
Upstream Node	Upstream Rim Elevation (ft)	Upstream Invert (ft)	HGL In (ft)	Downstream Node	Downstream Rim Elevation (ft)	Downstream Invert (ft)	HGL Out (ft)	Upstream Cover (ft.)	Downstream Cover (ft.)	Length (ft)	Slope (%)	Upstream Inlet Area (acres)	System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Pipe Dia. (in)	Pipe Full Flow Capacity (cfs)	Average Velocity (ft/s)	Material	Manning's n
DI-16-126B	533.95	530.20	531.07	DI-16-126	524.83	521.15	521.63	2.50	2.43	177.2	5.10%	1.03	0.62	7.38	4.60	15	14.60	10.53	RCP	0.013
DI-16-126	524.83	519.05	520.83	DI-16-125	519.50	515.75	518.06	4.53	2.50	179	1.80%	0.79	1.09	7.30	8.03	15	8.77	6.55	RCP	0.013
DI-16-125	519.50	515.20	517.64	SDMH-16-124	522.85	514.30	516.85	2.30	6.55	124	0.70%	3.25	3.04	5.90	18.09	24	19.27	5.76	RCP	0.013
SDMH-16-124	522.85	514.20	516.79	DBL CI-16-117	522.19	514.10	516.71	6.65	6.09	12	0.80%	(N/A)	3.04	5.86	17.97	24	20.65	5.72	RCP	0.013
DBL CI-16-117	522.19	514.00	516.64	DBL CI-16-120	522.18	513.80	516.45	6.19	6.38	24	0.80%	0.41	3.37	5.86	19.89	24	20.65	6.33	RCP	0.013
CI-16-118	523.76	519.25	519.82	CI-16-119	523.76	519.10	519.83	3.26	3.41	24	0.60%	0.25	0.20	7.38	1.49	15	5.11	3.61	RCP	0.013
CI-16-119	523.76	519.00	519.68	DBL CI-16-120	522.18	517.25	517.83	3.51	3.68	175	1.00%	0.23	0.38	7.35	2.84	15	6.46	5.10	RCP	0.013
DBL CI-16-120	522.18	513.70	515.87	CI-16-121	521.41	513.30	515.40	6.48	6.11	46	0.90%	0.16	3.88	5.85	22.88	24	21.09	7.28	RCP	0.013
CI-16-121	521.41	513.20	515.23	CI-16-109	521.39	513.05	515.20	5.70	5.84	24	0.60%	0.02	3.90	5.84	22.93	30	32.43	7.16	RCP	0.013
CI-16-114	539.61	535.00	535.32	CI-16-113	539.61	534.85	535.28	3.36	3.51	25	0.60%	0.11	0.09	7.38	0.65	15	5.00	2.82	RCP	0.013
CI-16-113	539.61	534.75	535.21	CI-16-112	532.87	528.10	528.61	3.61	3.52	168	4.00%	0.12	0.18	7.34	1.36	15	12.85	6.81	RCP	0.013
CI-16-116	527.01	522.30	522.80	CI-16-111	527.00	521.15	522.22	3.46	4.60	24	4.80%	0.27	0.22	7.38	1.61	15	14.14	7.65	RCP	0.013
CI-16-112	532.87	528.00	528.58	CI-16-111	527.00	522.30	522.64	3.62	3.45	149	3.80%	0.13	0.29	7.22	2.09	15	12.63	7.62	RCP	0.013
CI-16-111	527.00	521.15	521.99	CI-16-110	523.15	518.40	518.97	4.60	3.50	113	2.40%	0.12	0.60	7.12	4.31	15	10.08	7.88	RCP	0.013
CI-16-110	523.15	517.40	518.30	CI-16-109	521.39	515.35	515.87	4.50	4.79	40	5.10%	0.11	0.69	7.05	4.89	15	14.62	10.73	RCP	0.013
CI-16-109	521.39	512.95	514.72	CI-16-108	519.40	512.30	514.13	5.94	4.60	68	1.00%	0.02	4.60	5.83	27.04	30	40.10	8.77	RCP	0.013
CI-16-108	519.40	512.20	513.98	CI-16-107	516.96	510.85	512.76	4.70	3.61	78	1.70%	0.07	4.66	5.81	27.30	30	53.96	11.02	RCP	0.013
CI-16-107	516.96	510.75	512.56	CI-16-106	513.98	507.90	509.76	3.71	3.58	97	2.90%	0.06	4.79	5.80	28.03	30	70.30	13.51	RCP	0.013
CI-16-106	513.98	507.80	509.62	CI-16-105	510.80	504.70	506.53	3.68	3.60	108	2.90%	0.09	4.87	5.79	28.39	30	69.49	13.44	RCP	0.013
CI-16-105	510.80	504.60	506.46	DBL CI-16-104	506.68	500.90	503.94	3.70	3.28	126	2.90%	0.09	5.10	5.77	29.66	30	70.28	13.71	RCP	0.013
DBL CI-16-104	506.68	500.45	503.38	SDMH-16-103	507.57	500.35	503.21	3.73	4.72	17	0.60%	0.43	7.08	5.75	41.07	30	31.46	8.37	RCP	0.013
SDMH-16-103	507.57	500.25	502.40	SDMH-16-102	500.80	495.01	496.41	4.82	3.29	188	2.80%	(N/A)	7.08	5.75	41.04	30	68.50	14.58	RCP	0.013
SDMH-16-102	500.80	492.30	494.55	HW-16-100	495.33	491.00	492.97	5.50	1.33	150	0.90%	(N/A)	8.27	5.73	47.74	36	62.09	9.69	RCP	0.013
SDMH-16-127	508.95	501.45	504.05	DBL CI-16-104	506.68	501.00	503.84	5.50	3.68	76	0.60%	(N/A)	1.64	7.14	11.80	24	17.41	3.76	RCP	0.013
DI-16-128	506.25	502.35	504.42	SDMH-16-127	508.95	501.55	504.15	1.90	5.40	96	0.80%	0.82	1.64	7.27	12.01	24	20.65	3.82	RCP	0.013
DI-16-131	511.59	508.00	508.71	DI-16-128	506.25	502.95	504.55	2.59	2.30	130	3.90%	0.52	0.36	7.38	2.71	12	9.13	10.13	PVC	0.010
DI-16-129	528.25	512.07	513.01	DI-16-128	506.25	502.95	504.47	15.18	2.30	122	7.50%	0.48	0.74	7.31	5.47	12	12.66	15.54	PVC	0.010
DI-16-130	534.84	530.90	531.65	DI-16-129	528.25	525.00	525.40	2.94	2.25	154	3.80%	0.58	0.41	7.38	3.02	12	9.07	10.38	PVC	0.010
DI-16-132	507.50	499.50	500.65	SDMH-16-102	500.80	496.00	496.70	6.75	3.55	63	5.60%	0.47	1.19	7.27	8.73	15	15.23	12.83	RCP	0.013
DI-16-133	513.50	509.85	510.87	DI-16-132	507.50	503.65	504.32	2.40	2.60	203	3.10%	1.23	0.86	7.38	6.41	15	11.29	9.49	RCP	0.013
CI-16-122	516.96	512.25	513.04	CI-16-107	516.96	512.10	513.04	3.46	3.61	25	0.60%	0.11	0.09	7.38	0.65	15	5.00	2.82	RCP	0.013
CI-16-123	510.79	506.20	506.99	CI-16-105	510.80	506.05	506.99	3.34	3.50	25	0.60%	0.2	0.16	7.38	1.19	15	5.00	3.34	RCP	0.013
DBL CI-16-213	525.42	518.40	519.28	DBL CI-16-212	525.42	518.25	519.27	5.77	5.92	25	0.60%	0.23	0.20	7.38	1.45	15	5.00	3.53	RCP	0.013
DBL CI-16-212	525.42	518.15	519.20	CI-16-204	527.78	517.45	519.05	6.02	9.08	102	0.70%	0.2	0.37	7.35	2.71	15	5.35	4.37	RCP	0.013
CI-16-205	532.45	527.70	528.64	CI-16-204	527.78	523.20	523.76	3.50	3.33	110	4.10%	0.12	0.76	7.08	5.42	15	13.06	10.15	RCP	0.013
CI-16-206	537.44	532.70	533.59	CI-16-205	532.45	527.80	528.71	3.49	3.40	132	3.70%	0.22	0.66	7.15	4.78	15	12.45	9.48	RCP	0.013
CI-16-209	540.48	535.95	536.44	CI-16-208	540.48	535.80	536.45	3.28	3.43	25	0.60%	0.22	0.18	7.38	1.31	15	5.00	3.43	RCP	0.013
CI-16-211	527.78	517.50	519.26	CI-16-204	527.78	517.35	519.07	8.28	8.43	25	0.60%	0.22	3.37	5.70	19.37	24	17.52	6.17	RCP	0.013
SDMH-16-214	528.45	518.10	519.64	CI-16-211	527.78	518.00	519.49	8.35	7.78	12	0.80%	(N/A)	3.20	5.71	18.37	24	20.65	7.43	RCP	0.013
DI-16-215	523.25	518.70	520.50	SDMH-16-214	528.45	518.20	519.75	2.55	8.25	92	0.50%	0.13	3.20	5.74	18.47	24	16.68	5.88	RCP	0.013
DI-16-216	526.37	521.00	522.53	DI-16-215	523.25	518.80	520.76	3.37	2.45	40	5.50%	1.09	3.10	5.74	17.96	24	53.05	15.25	RCP	0.013
DI-16-217	533.50	528.75	530.13	DI-16-216	526.37	521.10	522.90	3.25	3.77	182	4.20%	1.17	2.40	5.77	13.92	18	21.53	12.96	RCP	0.013
DI-16-218	537.50	532.50	533.70	DI-16-217	533.50	528.85	530.35	3.50	3.15	211	1.70%	0.57	1.64	5.81	9.58	18	13.81	8.44	RCP	0.013
DI-16-219	538.41	534.60	535.65	DI-16-218	537.50	533.10	533.99	2.31	2.90	135	1.10%	0.37	1.24	5.85	7.29	18	11.07	6.69	RCP	0.013
DI-16-220	539.50	535.30	536.32	DI-16-219	538.41	534.70	535.75	2.70	2.21	117	0.50%	1.69	1.01	5.90	6.03	18	7.52	4.73	RCP	0.013
CI-16-204	527.78	517.25	519.00	SDMH-16-203	528.44	517.15	518.76	8.03	8.79	11	0.90%	0.09	4.57	5.69	26.22	30	39.11	8.54	RCP	0.013
SDMH-16-203	528.44	517.05	518.80	SDMH-16-202	521.80	515.75	517.20	8.89	3.55	130	1.00%	(N/A)	4.57	5.69	26.21	30	41.01	8.86	RCP	0.013
SDMH-16-202	521.80	511.00	512.91	HW-16-200	512.33	508.00	509.21	8.30	1.83	97	3.10%	(N/A)	5.50	5.66	31.40	30	72.13	14.18	RCP	0.013
DI-16-221	528.26	520.00	520.97	SDMH-16-202	521.80	518.50	519.22	7.26	2.30	39	3.80%	0.48	0.93	7.31	6.85	12	9.08	12.70	PVC	0.010
DI-16-222	537.25	534.00	534.88	DI-16-221	528.26	525.00	525.46	2.25	2.26	190	4.70%	0.85	0.60	7.38	4.43	12	10.08	12.42	PVC	0.010
CI-16-210	537.43	532.95	533.64	CI-16-206	537.44	532.80	533.64	3.22	3.39	25	0.60%	0.2	0.16	7.38	1.19	15	5.00	3.34	RCP	0.013
CI-16-208	540.48	535.70	536.32	CI-16-206	537.44	532.90	533.70	3.53	3.29	214	1.30%	0.19	0.33	7.34	2.43	15	7.39	5.39	RCP	0.013

Profile Report

Engineering Profile - CI-16-114 to HW-16-100 (2018.02.28.



Phase 16S.stsw)



Profile Report

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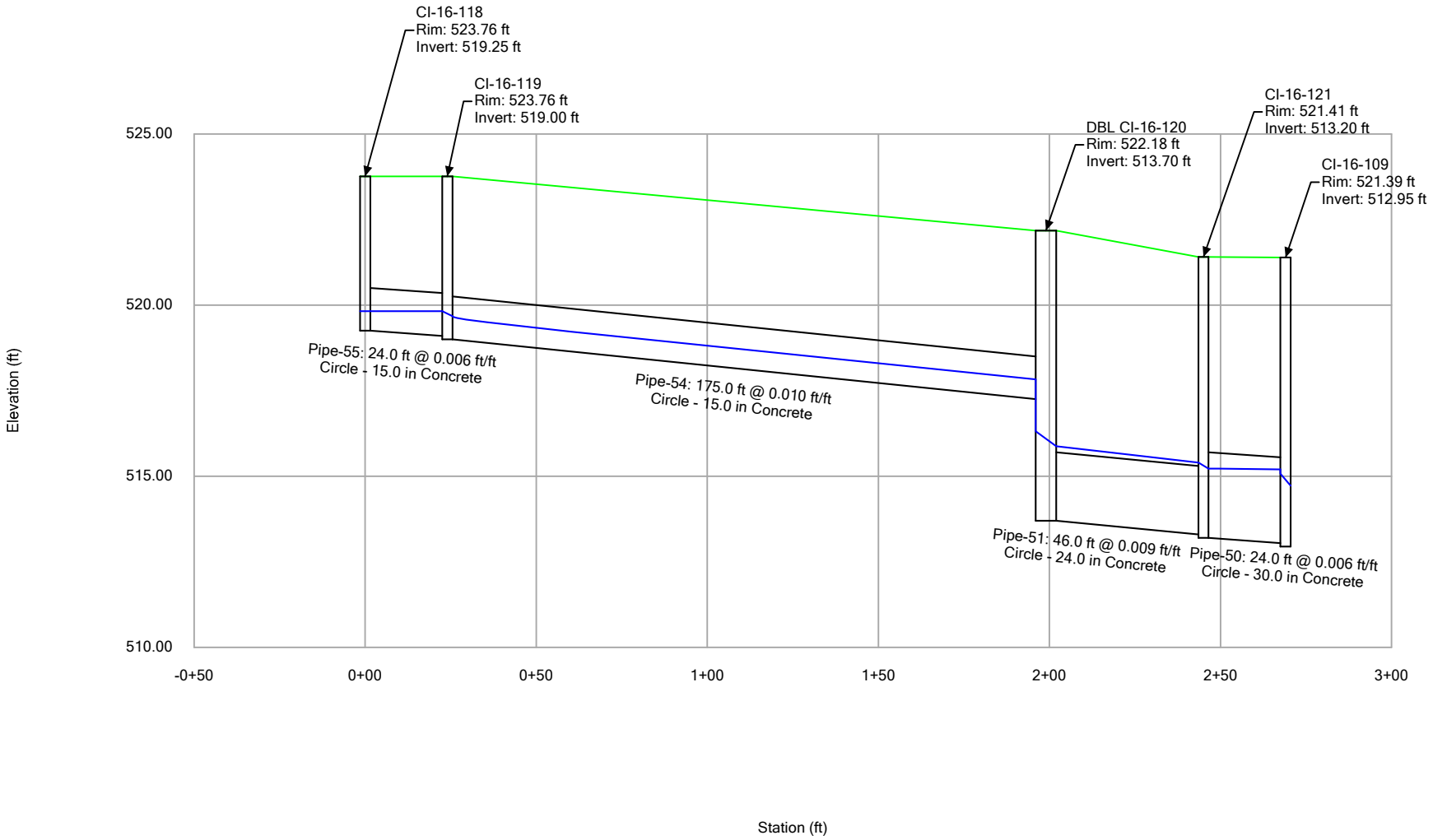

Profile Report
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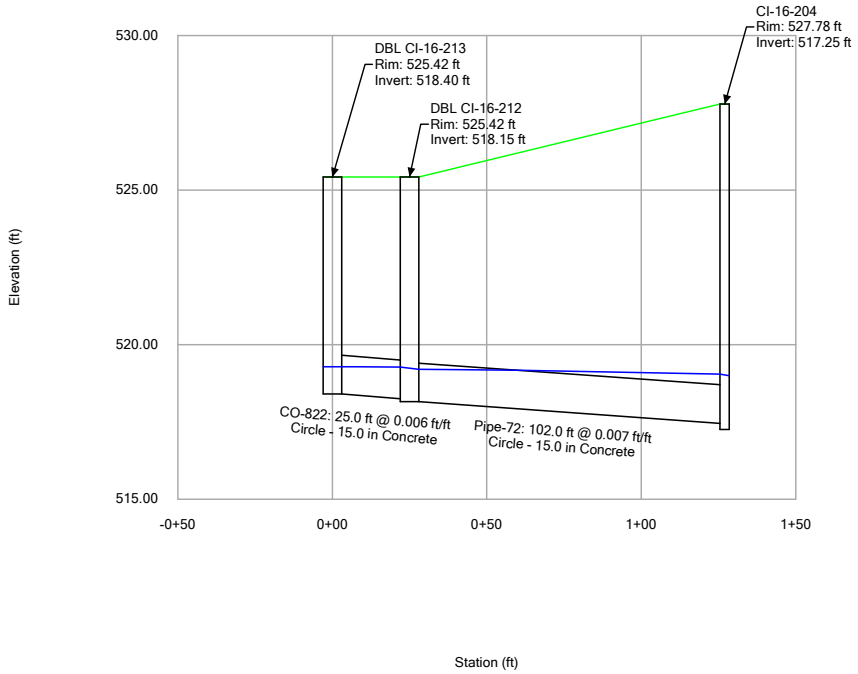

Profile Report

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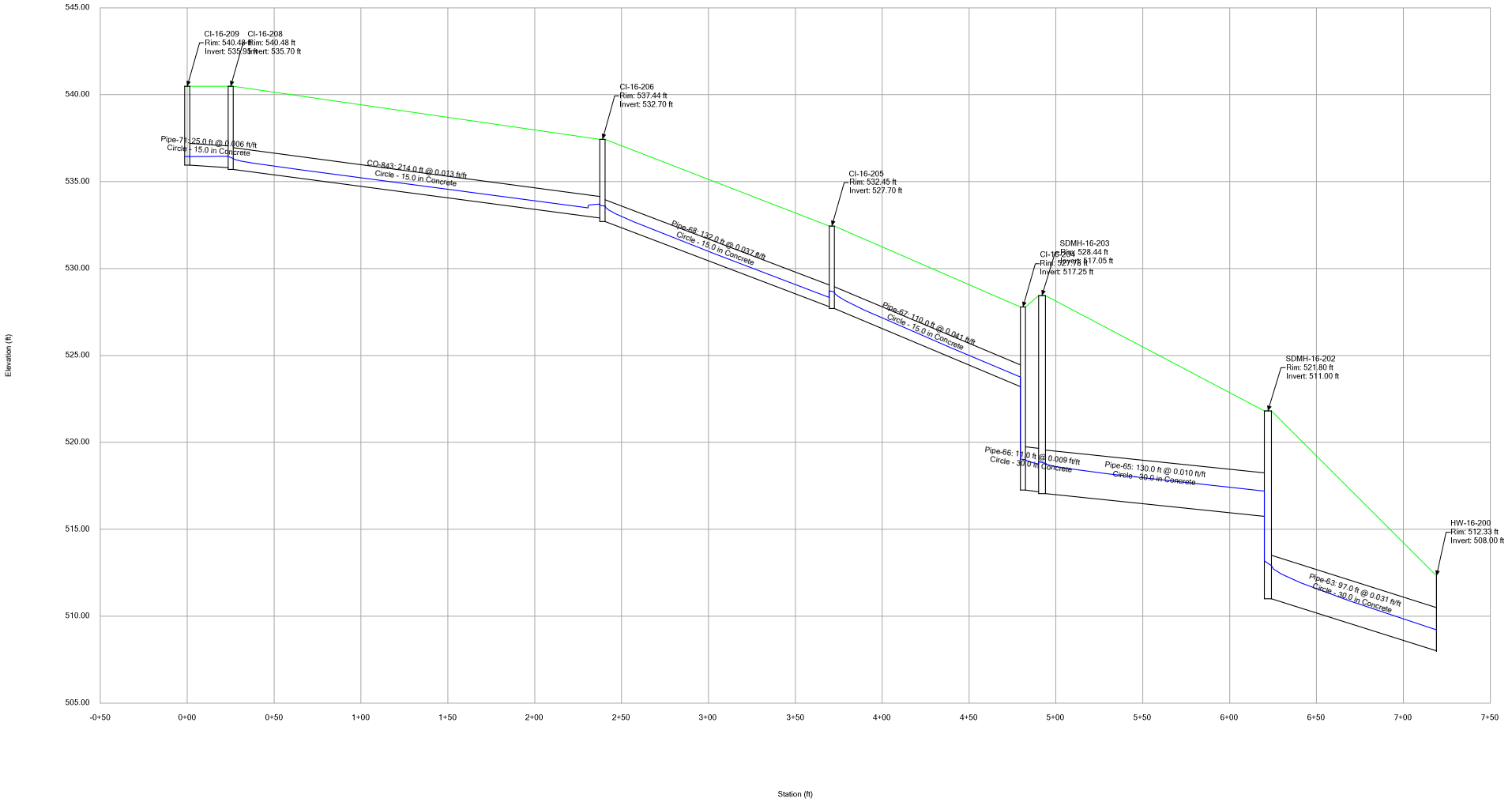
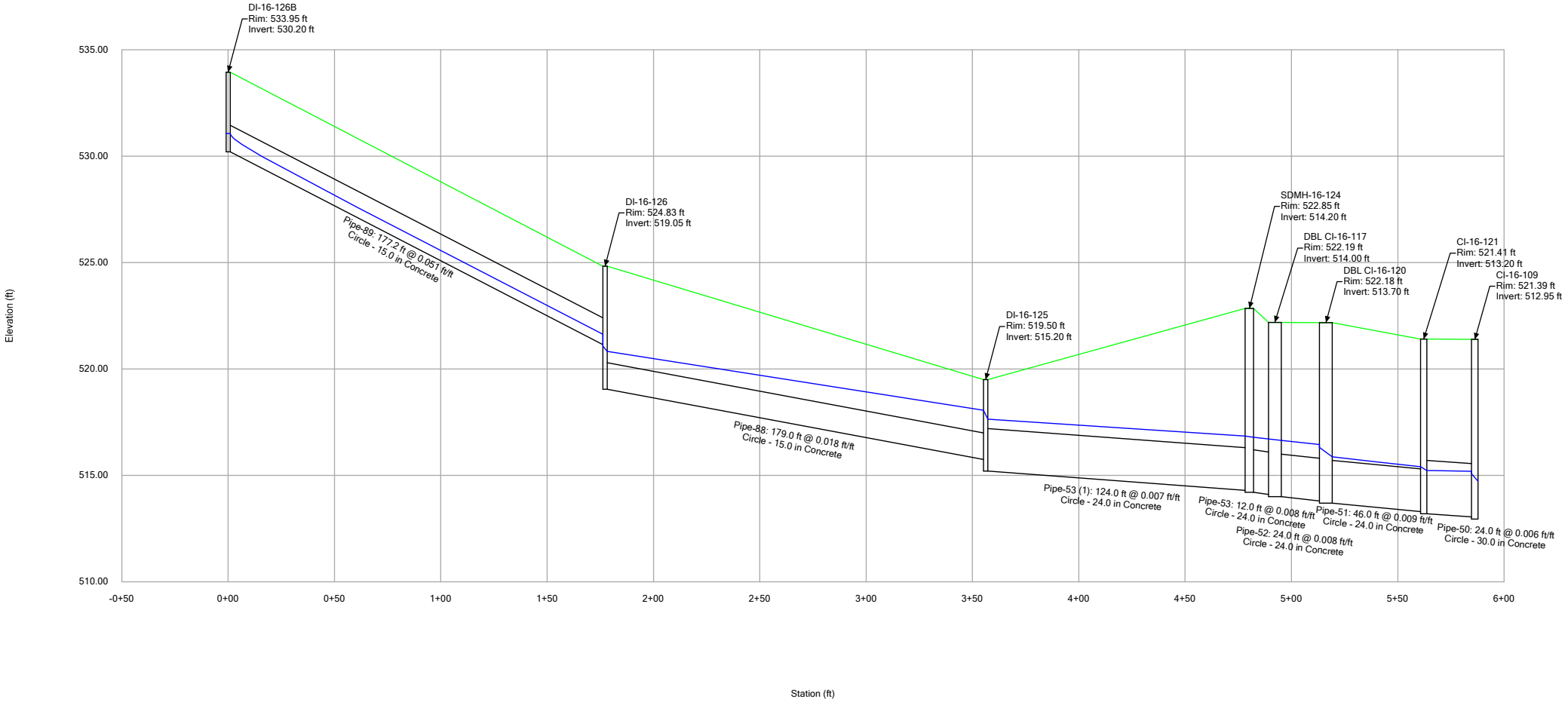


Profile Report

Engineering Profile - DI-16-126B TO CI-16-109 (2018.02.28. Phase 16S.stsw)



Profile Report

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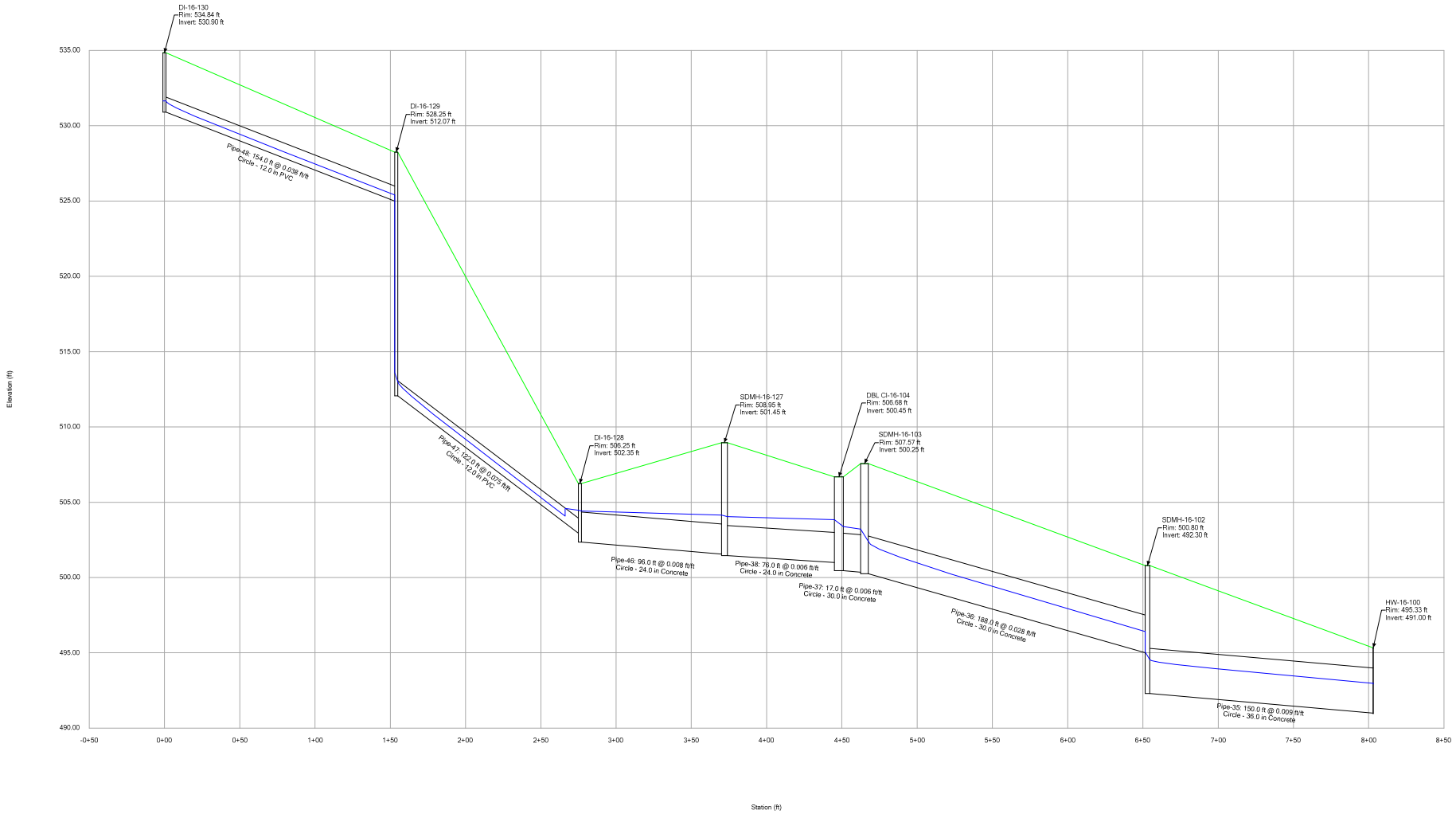

Profile Report

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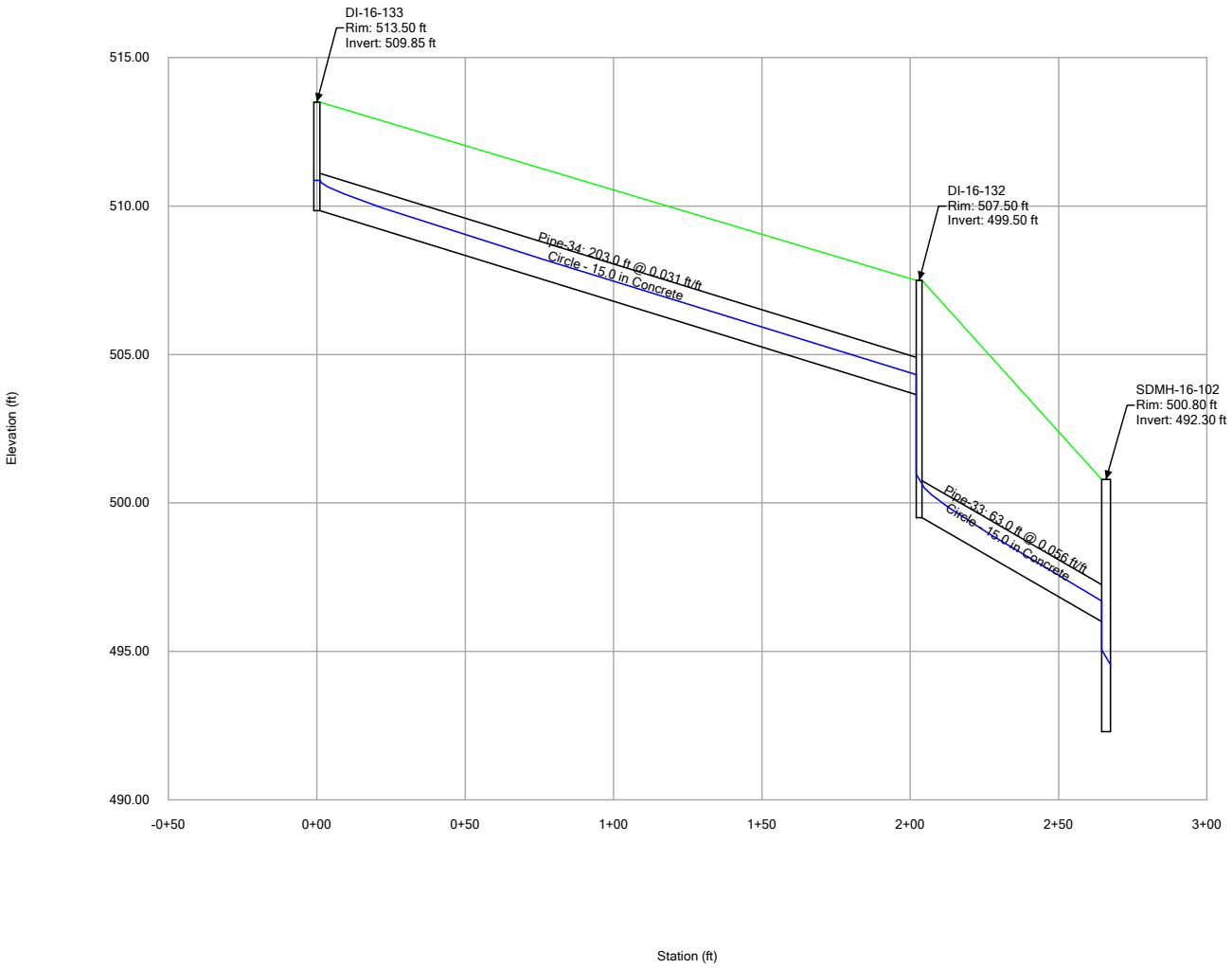

Profile Report
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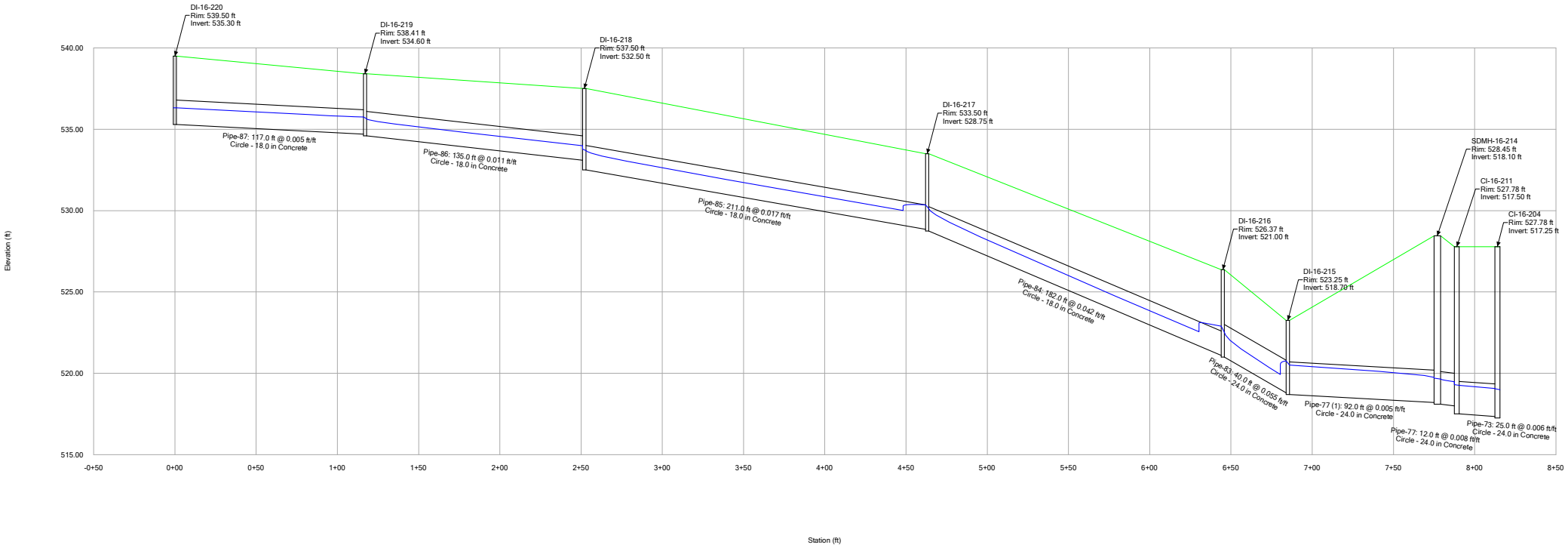

Profile Report

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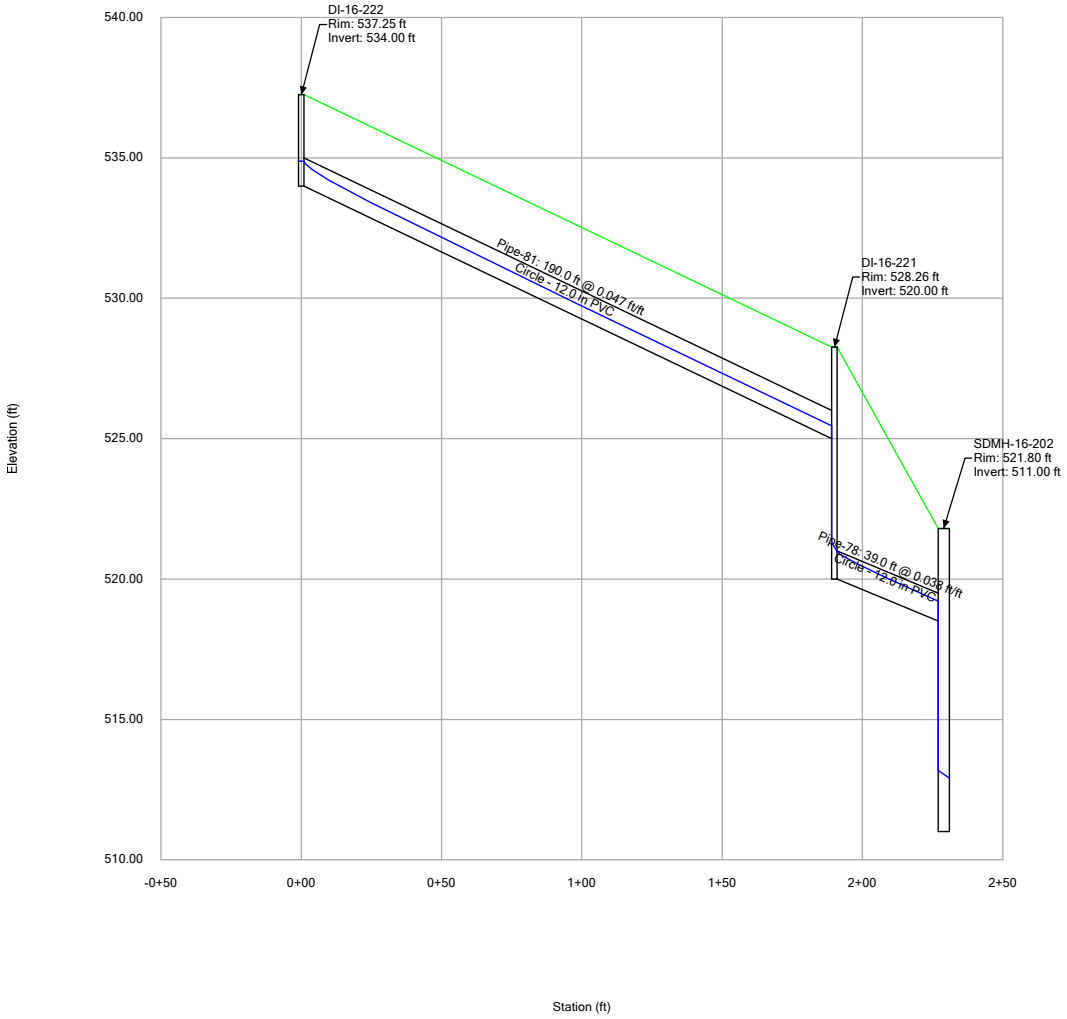
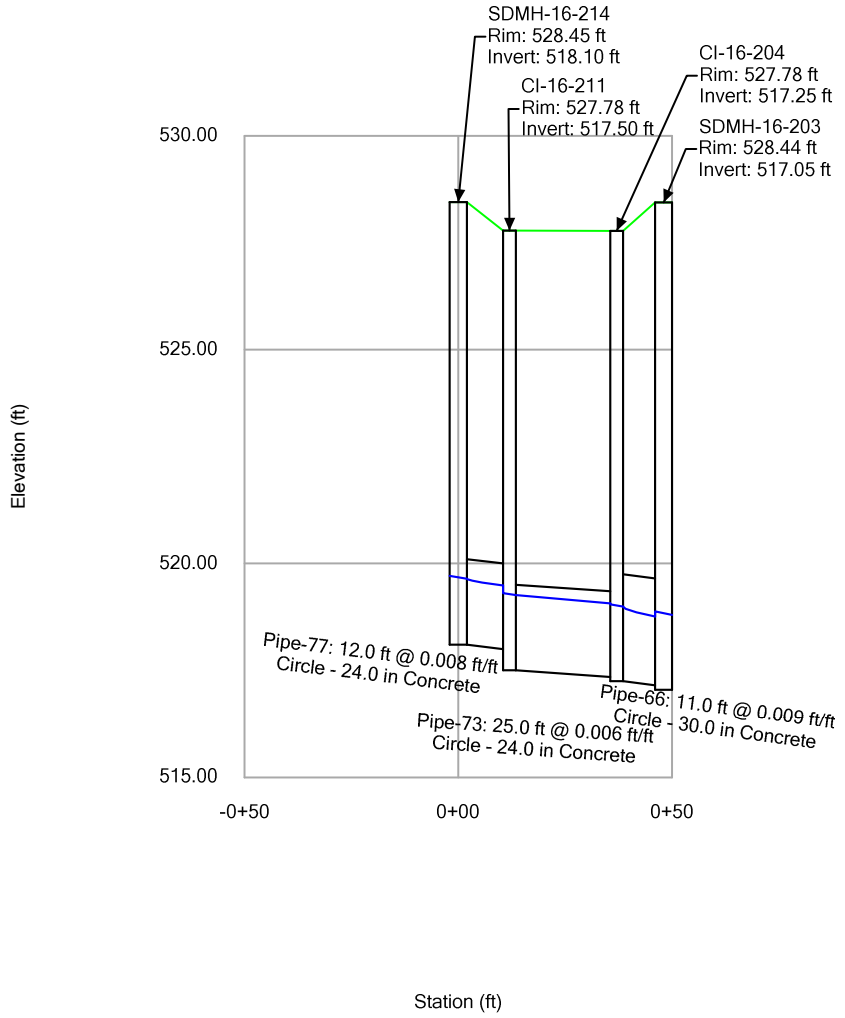


Profile Report

Engineering Profile - Profile - 1 (2018.02.28. Phase 16S.stsw)



CHATHAM COUNTY
NORTH CAROLINA

WATERSHED PROTECTION DIVISION
Environmental Quality Department
P.O. Box 548
Pittsboro, NC 27312
PHONE: (919) 545-8343

Fax: (919) 542-8268 ● E-mail: morgan.dewit@chathamnc.org ● Website: www.chathamnc.org

STORMWATER LETTER OF APPROVAL

April 30, 2018

Mr. Gareth Avant, PE
McKim & Creed
1730 Varsity Drive
Raleigh, NC 27606

VIA EMAIL: gavant@mckimcreed.com

Project Name: Briar Chapel – Phase 16 North

The Chatham County Stormwater Administrator has reviewed the stormwater plans and calculations dated March 21, 2018 for the Briar Chapel – Phase 16 North project pursuant to the Chatham County Compact Communities Ordinance and finds the plans acceptable.

If the approved plans are changed or modified in any way, a revised plan set and associated calculations shall be submitted to Chatham County for approval of the changes prior to constructing the modifications.

The Chatham County Environmental Quality Department shall be notified once the stormwater system and Stormwater Control Measures have been installed per the approved plan.

If you have any questions, please do not hesitate to contact me directly.

Sincerely,

Morgan H DeWit

Morgan DeWit, PE
Senior Watershed Specialist

C: Rachael Thorn, CPESC, Watershed Protection Supervisor

Water Resources
Environmental Quality

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
LINDA CULPEPPER
Interim Director

May 1, 2018

DWR # 05-0732 v43
Chatham County

Mr. Lee Bowman, Senior Project Manager
NNP Briar Chapel LLC
1342 Briar Chapel Parkway
Chapel Hill, North Carolina 27516

Subject: **APPROVAL OF STORMWATER MANAGEMENT PLAN**
Briar Chapel –Phase 16 North

Dear Mr. Bowman:

The Division of Water Resources (Division) recently reviewed the proposed stormwater management plan (SMP) for the subject project as required by Individual 401 Water Quality Certification #3567 issued by the Division on February 3, 2017. Submittal of the SMP satisfies Condition No. 3 of the 401 Certification for this Phase of the project and is subject to the requirements below.

The Division approves the SMP consisting of two (2) wet detention basins (ponds) and all associated stormwater conveyances, inlet and outlet structures, and grading and drainage patterns depicted on plan sheets dated March 21, 2018, which are incorporated by reference and are enforceable by the Division. The following conditions also apply [15A NCAC 02H .0506(b)(5)]:

a. The maximum allowable drainage area for the approved Wet Detention Basin #35 shall be 728,269 square feet and the maximum allowable built-upon area within that drainage area shall be 264,562 square feet. Any changes to these maximum areas shall require the applicant to submit and receive approval for a revised stormwater management plan by the Division. [15A NCAC 02H .0506(b)(5)]

b. The maximum allowable drainage area for the approved Wet Detention Basin #36 shall be 450,123 square feet and the maximum allowable built-upon area within that drainage area shall be 148,556 square feet. Any changes to these maximum areas shall require the applicant to submit and receive approval for a revised stormwater management plan by the Division. [15A NCAC 02H .0506(b)(5)]

c. The approved SCMs shall be constructed and operational before any permanent building or other structure is occupied at the site. [15A NCAC 02H .0506(b)(5)]

d. The SMP may not be modified without prior written authorization from the Division. [15A NCAC 02H .0506(b)(5)]

e. Maintenance activities for the two (2) wet detention basins shall be performed in accordance with the notarized O&M agreements signed by Mr. Lee Bowman of NNP Briar Chapel LLC on March 23, 2018. The O&M agreement shall transfer with the sale of the land or transfer of ownership/responsibility for the Stormwater Control Measures (SCMs). The Division shall be notified promptly of every transfer. [15A NCAC 02H .0506(b)(5)]

f. The applicant and/or authorized agent shall provide a completed Certificate of Completion form to the Division within thirty (30) days of project completion (available at https://edocs.deq.nc.gov/Forms/Certificate-of-Completion). [15A NCAC 02H .0506(b)(5)]

Please contact Chonticha McDaniel at (919) 807-6379 or chonticha.mcdaniel@ncdenr.gov if you have any questions or concerns regarding this matter.

Sincerely,

Karen Higgins

Karen Higgins, Supervisor
401 & Buffer Permitting Branch

cc: Gareth Avant, PE – McKim & Creed, Inc. (via email)
DWR, Raleigh Regional Office
DWR 401 & Buffer Permitting Branch File