McKIM&CREED

ENGINEERS

SURVEYORS

PLANNERS

May 8, 2019

Ms. Karen Higgins
512 N. Salisbury St.
Archdale Building - 9th floor
Raleigh, NC 27604

RE: Briar Chapel – Phase 14

Ms. Higgins,

Please find enclosed the plans, caclulations, supplement forms and operation and maintenance agreements for Phase 14 at Briar Chapel.

This letter is to formally request approval of the stormwater management plan for the enclosed plans in accordance with Water Quality Certification as issued by the Division of Water Resources on February 3, 2017.

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 14**
Project Location:	**Southwest of Briar Chapel Parkway/Catullo Run**

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:	**4020 Westchase Blvd. Suite 150**
City, state, zip:	**Raleigh, NC 27607**
Phone number(s):	**(919) 951-0712**
Email:	**lbowman@newlandco.com**

Signature: _____ Date: 4/26/19

I, Brenda L Paquin, a Notary Public for the State of North Carolina

County of Wake, do hearby certify that D. Lee Bowman

personally appeared before me this 26th day of April and

acknowledge the due execution of the Operations and Maintenance Agreement.

Witness my hand and official seal, Brenda L Paquin.

BRENDA L. PAQUIN NOTARY PUBLIC WAKE COUNTY, NC

Seal

My commission expires

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 #45		Permanent Pool El.	408.5	Permanent Pool El.	408.5
		Temporary Pool El:	410	Temporary Pool El:	410
Pretreatment other than forebay?	No	Clean Out Depth:	3.5	Clean Out Depth:	3.5
		Sediment Removal El:	405	Sediment Removal El:	405
Has Veg. Filter?	No	Bottom Elevation:	403.5	Bottom Elevation:	403.5

WET POND ID		FOREBAY		MAIN POND	
2 - BMP #46		Permanent Pool El.	443.5	Permanent Pool El.	443.5
		Temporary Pool El:	444.7	Temporary Pool El:	444.7
Pretreatment other than forebay?	No	Clean Out Depth:	1.5	Clean Out Depth:	4.5
		Sediment Removal El:	442	Sediment Removal El:	439
Has Veg. Filter?	No	Bottom Elevation:	439.5	Bottom Elevation:	437.5

401 NARRATIVE & SUPPORTING CALCULATIONS

Briar Chapel Development
Phase 14

Chatham County, North Carolina
May 8, 2019

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. 02735-0248

PROJECT DESCRIPITON

The purpose of the project is to construct water, sewer and roadway infrastructure to support 89 residential lots in the Phase 14 within 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 14 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 31.8 acres of disturbed area located to the southwest of the intersection of Briar Chapel Parkway and Catullo Run.

The site generally slopes away from a ridge along the center of the site and drains to the east and west. The slopes in the site range from 5-30% 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 (WeC); 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:

ChA – Chewacla and Wehadkee soils, 0 to 2 percent slopes – frequently flooded. Permeability is moderate and the soils are poorly drained. Soils have a moderate shrink/swell potential. The seasonal high water table is generally 0 to 2.0 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.

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 SUMMARY OF RESULTS

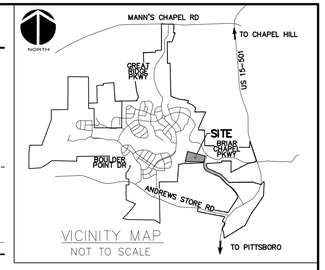
In order to meet the requirements of the development, one stormwater wetland and one wet detention basin have been designed based on an assumption of the full buildout condition of the site. A summary table is provided below and the supporting calculations have been included with this submittal.

	BMP #45			***BMP #46***		
	1-yr	***10-yr***	***100-yr***	***1-yr***	***10-yr***	***100-yr***
Pre-Development Discharge (cfs)	5.58	19.76	38.67	4.69	17.53	35.99
Post-Development Controlled Discharge (cfs)	5.43	16.49	37.86	4.00	14.52	35.39
Peak Water Surface Elevation (ft)	410.43'	412.06'	413.46'	445.04'	446.34'	447.65'

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



BMP #45
(WET DETENTION POND)

BMP 46
(WET DETENTION POND)

CALL N.C. ONE CALL CENTER BEFORE YOU DIG
STOP
1-800-632-4949
AVOID UTILITY DAMAGE

NORTH

60' 0 60' 120'

SCALE: 1"=60' (Horiz.)

REV.NO.	DESCRIPTIONS	DATE
1	INITIAL SUBMITTAL	2019.05.08

REVISIONS

SEAL

SEAL

McKIM&CREED
1730 Varsity Drive, Suite 500
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Phone: (919)233-8091, Fax: (919)233-8031
F-1222

www.mckimcreed.com

BRIAR CHAPEL™
by Newland COMMUNITIES

BRIAR CHAPEL
PHASE 14
CHATHAM COUNTY, NORTH CAROLINA

STORWATER BMP
DRAINAGE AREA MAP

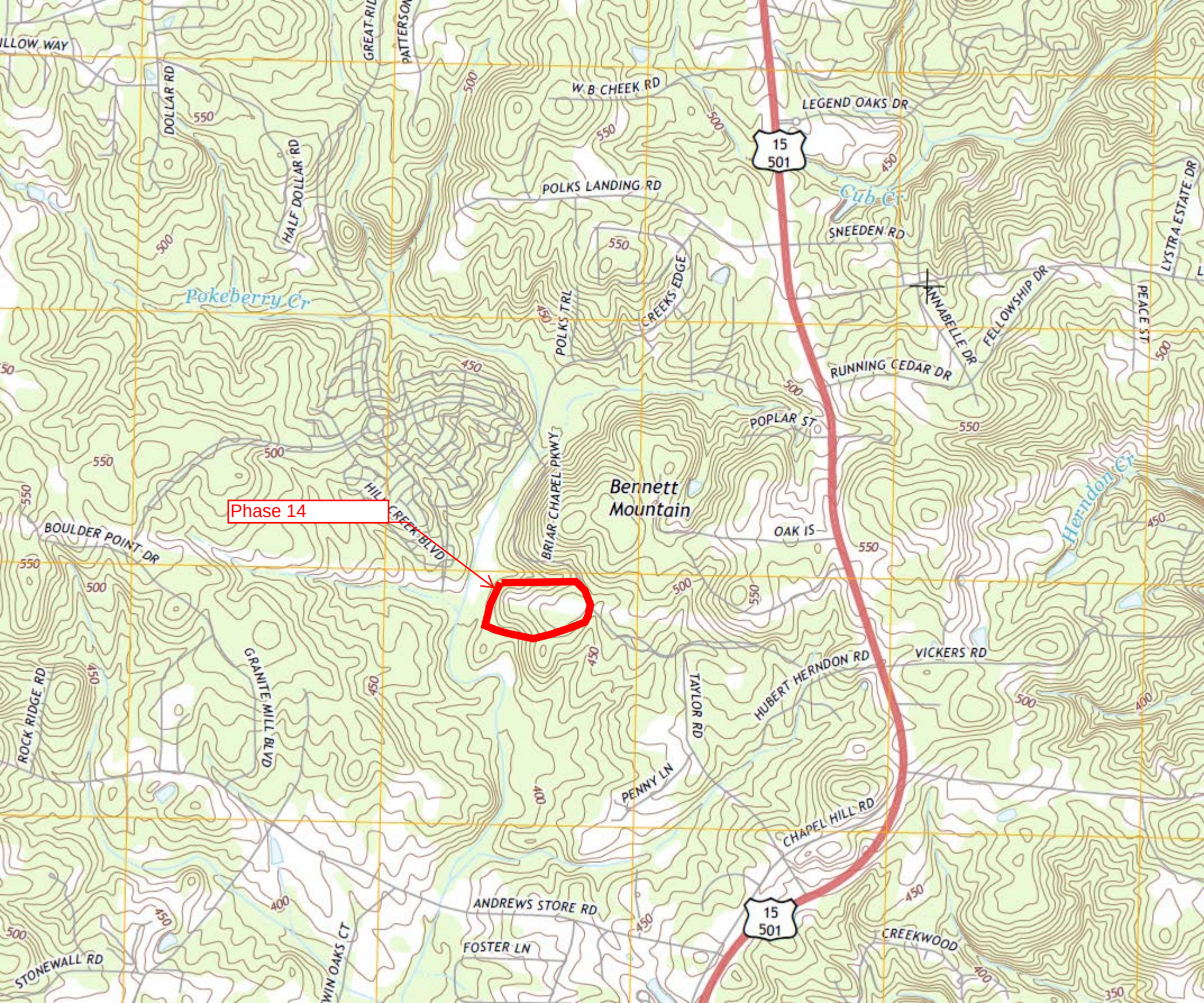
DATE:	MAY 8, 2019
MCE PROJ. #	02735-0239
DRAWN	DCR
DESIGNED	DCR
CHECKED	GCA
PROJ. MGR.	CHS

SCALE
HORIZONTAL: AS NOTED
VERTICAL: N/A

M&C FILE NUMBER
DA MAP
DRAWING NUMBER
DA

STATUS: FINAL DRAWINGS FOR REVIEW PURPOSES ONLY

REVISION 1


Phase 14
Bennett Mountain
W B CHEEK RD
LEGEND OAKS DR
POLKS LANDING RD
SNEEDEN RD
DOLLAR RD
HALF DOLLAR RD
Pokeberry Cr
Cub Cr
Herndon Cr
POLKS TRL
CREEKS EDGE
ANNABELLE DR
FELLOWSHIP DR
PEACE ST
LYSTRA ESTATE DR
RUNNING CEDAR DR
POPLAR ST
OAK IS
BRIAR CHAPEL PKWY
BOULDER POINT DR
GRANITE MILL BLVD
ROCK RIDGE RD
TAYLOR RD
HUBERT HERNDON RD
VICKERS RD
PENNY LN
CHAPEL HILL RD
ANDREWS STORE RD
FOSTER LN
CREEKWOOD
STONEWALL RD
15
501

Map Scale: 1:3,710 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Chatham County, North Carolina
Survey Area Data: Version 21, Sep 10, 2018

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

Date(s) aerial images were photographed: Jun 15, 2015—Dec 9, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ChA	Chewacla and Wehadkee soils, 0 to 2 percent slopes, frequently flooded	13.7	22.0%
WdE	Wedowee sandy loam, 15 to 35 percent slopes, bouldery	21.4	34.5%
WeB	Wedowee sandy loam, 2 to 6 percent slopes	11.8	19.0%
WeC	Wedowee sandy loam, 6 to 10 percent slopes	14.9	24.0%
WeD	Wedowee sandy loam, 10 to 15 percent slopes	0.3	0.5%
Totals for Area of Interest		**62.1**	**100.0%**

NORTH CAROLINA Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://FRIS.NC.GOV/FRIS

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A,V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee See Notes *Zone X*
OTHER AREAS	Areas Determined to be Outside the 0.2% Annual Chance Floodplain *Zone X*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Accredited or Provisionally Accredited Levee, Dike, or Floodwall
	Non-accredited Levee, Dike, or Floodwall
OTHER FEATURES	BM5510 North Carolina Geodetic Survey bench mark
	BM5510 National Geodetic Survey bench mark
	BM5510 Contractor Est. NCFMP Survey bench mark
	012 —18.2— Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	8 Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) revising portions of this panel, and digital versions of this FIRM may be available. Visit the North Carolina Floodplain Mapping Program website at http://www.ncfloodmaps.com, or contact the FEMA Map Service Center.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Flood Insurance Study (FIS) means an examination, evaluation, and determination of flood hazards, corresponding water surface elevations, flood hazard risk zones, and other flood data in a community issued by the North Carolina Floodplain Mapping Program (NCFMP). The Flood Insurance Study (FIS) is comprised of the following products used together: the Digital Flood Hazard Database, the Water Surface Elevation Rasters, the digitally derived, autogenerated Flood Insurance Rate Map and the Flood Insurance Survey Report. A Flood Insurance Survey is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. This report contains detailed flood elevation data, data tables and FIRM indices. When a flood study is completed for the NFIP, the digital information, reports and maps are assembled into an FIS. Information shown on this FIRM is provided in digital format by the NCFMP. Base map information shown on this FIRM was provided in digital format by the NCFMP. The source of this information can be determined from the metadata available in the digital FLOOD database and in the Technical Support Data Notebook (TSDN).

ACCREDITED LEVEE NOTES TO USERS: If an accredited levee note appears on this panel check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

PROVISIONALLY ACCREDITED LEVEE NOTES TO USERS: If a Provisionally Accredited Levee (PAL) note appears on this panel, check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicates the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

LIMIT OF MODERATE WAVE ACTION NOTES TO USERS: For some coastal flooding zones the AE Zone category has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

COASTAL BARRIER RESOURCES SYSTEM (CBRS) NOTE

This map may include approximate boundaries of the CBRS for informational purposes only. Flood insurance is not available within CBRS areas for structures that are newly built or substantially improved on or after the date(s) indicated on the map. For more information see http://www.fws.gov/cbra, the FIS Report, or call the U.S. Fish and Wildlife Service Customer Service Center at 1-800-344-WILD.

CBRS Area   Otherwise Protected Area

SCALE

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet   1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

PANEL LOCATOR

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9765

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
CHATHAM COUNTY	370299	9765	K

VERSION NUMBER
2.3.3.2

MAP NUMBER
3710976500K

MAP REVISED
November 17, 2017

Cooperating Technical State

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

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SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes *Zone X*

OTHER AREAS

- Areas Determined to be Outside the 0.2% Annual Chance Floodplain *Zone X*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall
- BM5510 North Carolina Geodetic Survey bench mark
- BM5510 National Geodetic Survey bench mark
- BM5510 Contractor Est. NCFMP Survey bench mark
- 012 18.2 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)

NOTES TO USERS

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For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Flood Insurance Study (FIS) means an examination, evaluation, and determination of flood hazards, corresponding water surface elevations, flood hazard risk zones, and other flood data in a community issued by the North Carolina Floodplain Mapping Program (NCFMP). The Flood Insurance Study (FIS) is comprised of the following products used together: the Digital Flood Hazard Database, the Water Surface Elevation Rasters, the digitally derived, autogenerated Flood Insurance Rate Map and the Flood Insurance Survey Report. A Flood Insurance Survey is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. This report contains detailed flood elevation data, data tables and FIRM indices. When a flood study is completed for the NFIP, the digital information, reports and maps are assembled into an FIS. Information shown on this FIRM is provided in digital format by the NCFMP. Base map information shown on this FIRM was provided in digital format by the NCFMP. The source of this information can be determined from the metadata available in the digital FLOOD database and in the Technical Support Data Notebook (TSDN).

ACCREDITED LEVEE NOTES TO USERS: If an accredited levee note appears on this panel check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

PROVISIONALLY ACCREDITED LEVEE NOTES TO USERS: If a Provisionally Accredited Levee (PAL) note appears on this panel, check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicates the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

LIMIT OF MODERATE WAVE ACTION NOTES TO USERS: For some coastal flooding zones the AE Zone category has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

SCALE

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

PANEL LOCATOR

FEMA National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

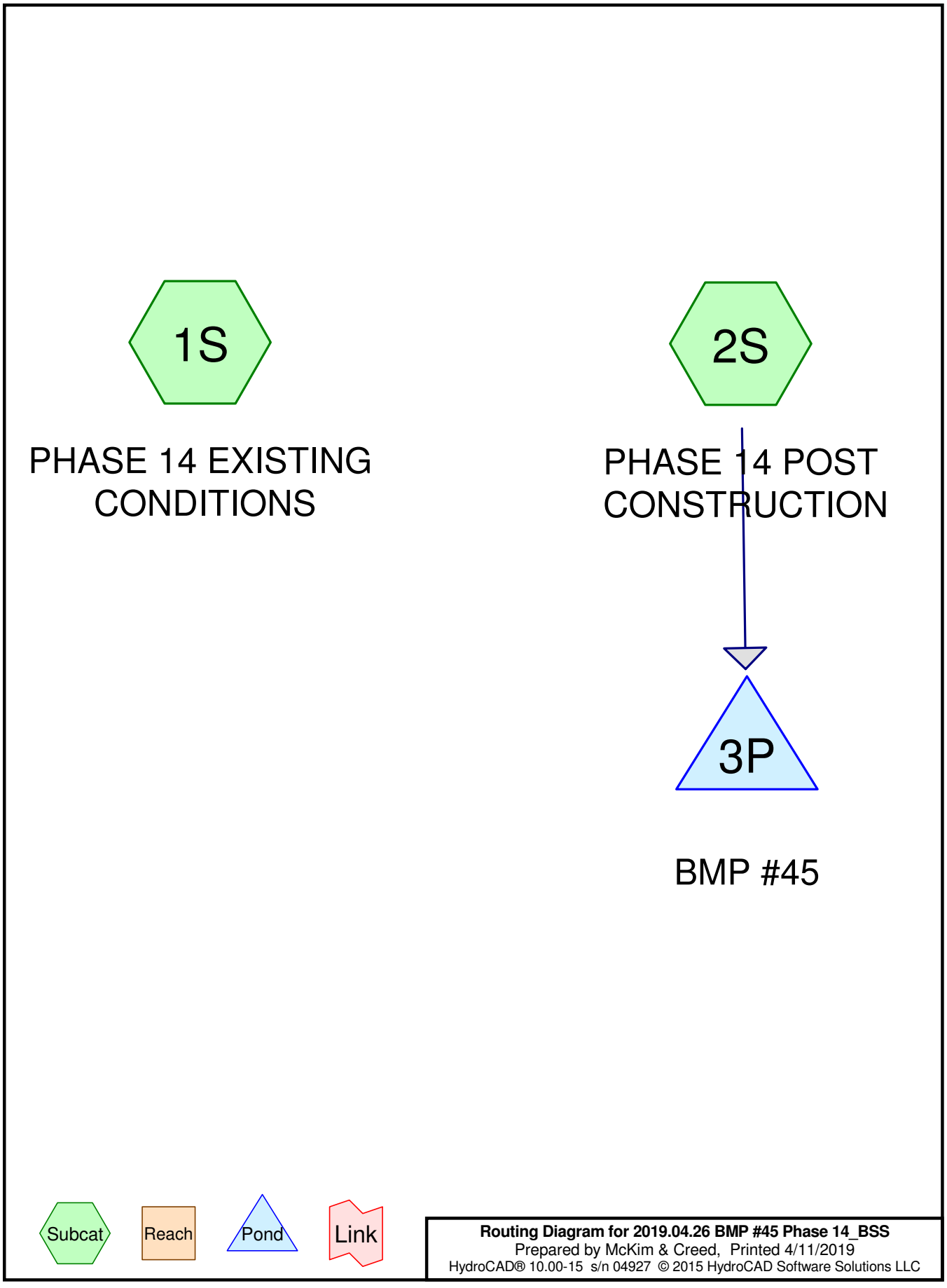
PANEL 9775

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
CHATHAM COUNTY	370299	9775	K

BMP #45 ROUTING



Routing Diagram for 2019.04.26 BMP #45 Phase 14_BSS
Prepared by McKim & Creed, Printed 4/11/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.201	74	>75% Grass cover, Good, HSG C (2S)
4.110	98	Paved roads w/curbs & sewers, HSG D (2S)
8.312	70	Woods, Good, HSG C (1S)
16.623	**78**	**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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: PHASE 14 EXISTING Runoff Area=362,057 sf 0.00% Impervious Runoff Depth>0.00"
Flow Length=705' Tc=19.4 min CN=70 Runoff=0.00 cfs 0.001 af

Subcatchment 2S: PHASE 14 POST Runoff Area=362,057 sf 49.45% Impervious Runoff Depth>0.17"
Tc=5.0 min CN=86 Runoff=2.69 cfs 0.120 af

Pond 3P: BMP #45 Peak Elev=408.90' Storage=4,099 cf Inflow=2.69 cfs 0.120 af
Primary=0.04 cfs 0.026 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.026 af

Total Runoff Area = 16.623 ac Runoff Volume = 0.122 af Average Runoff Depth = 0.09"
75.27% Pervious = 12.513 ac 24.73% Impervious = 4.110 ac

Summary for Subcatchment 1S: PHASE 14 EXISTING CONDITIONS

[73] Warning: Peak may fall outside time span

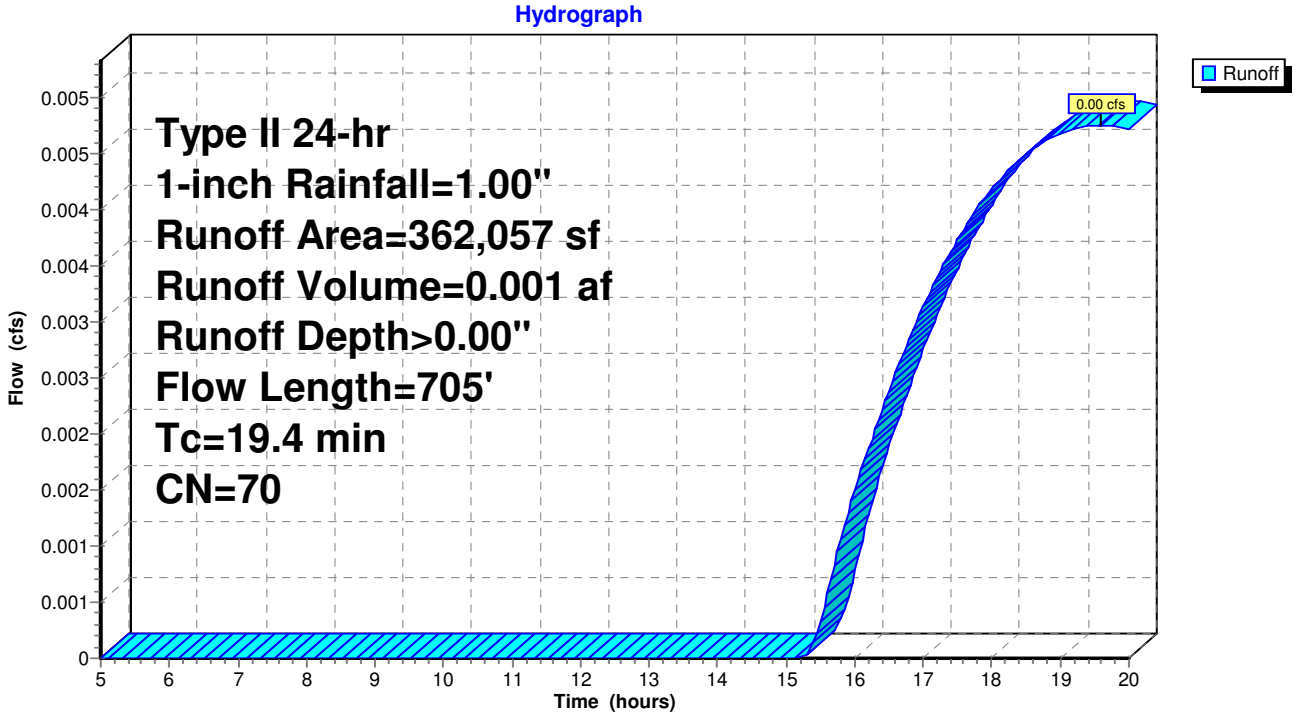
Runoff = 0.00 cfs @ 19.60 hrs, Volume= 0.001 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-inch Rainfall=1.00"

Area (sf)	CN	Description
362,057	70	Woods, Good, HSG C
362,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	100	0.0550	0.12		**Sheet Flow, Overland Flow** Woods: Light underbrush n= 0.400 P2= 3.48"
5.7	605	0.1256	1.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
19.4	705	Total			

Subcatchment 1S: PHASE 14 EXISTING CONDITIONS



Summary for Subcatchment 2S: PHASE 14 POST CONSTRUCTION

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

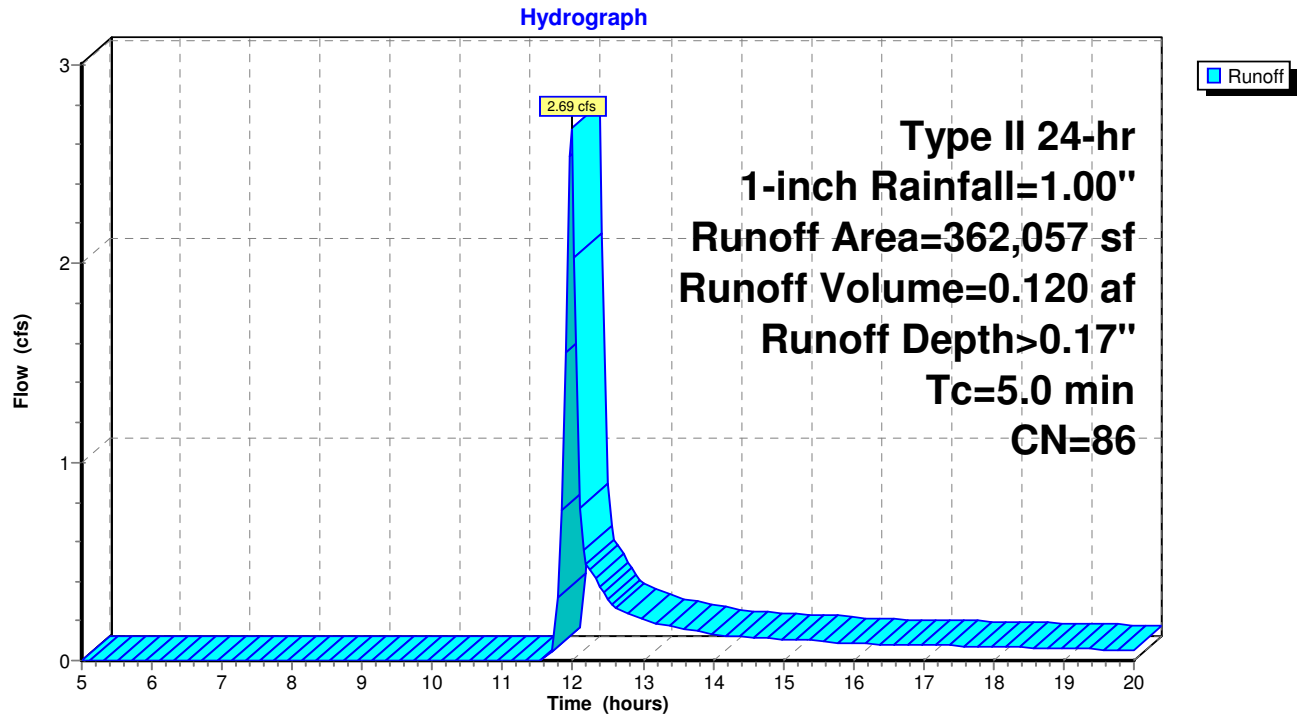
Runoff = 2.69 cfs @ 11.98 hrs, Volume= 0.120 af, Depth> 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-inch Rainfall=1.00"

Area (sf)	CN	Description
179,051	98	Paved roads w/curbs & sewers, HSG D
183,006	74	>75% Grass cover, Good, HSG C
362,057	86	Weighted Average
183,006		50.55% Pervious Area
179,051		49.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assume 5 min**

Subcatchment 2S: PHASE 14 POST CONSTRUCTION



Summary for Pond 3P: BMP #45

Inflow Area = 8.312 ac, 49.45% Impervious, Inflow Depth > 0.17" for 1-inch event
Inflow = 2.69 cfs @ 11.98 hrs, Volume= 0.120 af
Outflow = 0.04 cfs @ 20.00 hrs, Volume= 0.026 af, Atten= 98%, Lag= 481.5 min
Primary = 0.04 cfs @ 20.00 hrs, Volume= 0.026 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 408.90' @ 20.00 hrs Surf.Area= 10,999 sf Storage= 4,099 cf

Plug-Flow detention time= 258.7 min calculated for 0.026 af (22% of inflow)
Center-of-Mass det. time= 144.4 min (973.9 - 829.5)

Volume	Invert	Avail.Storage	Storage Description
#1	408.50'	120,142 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

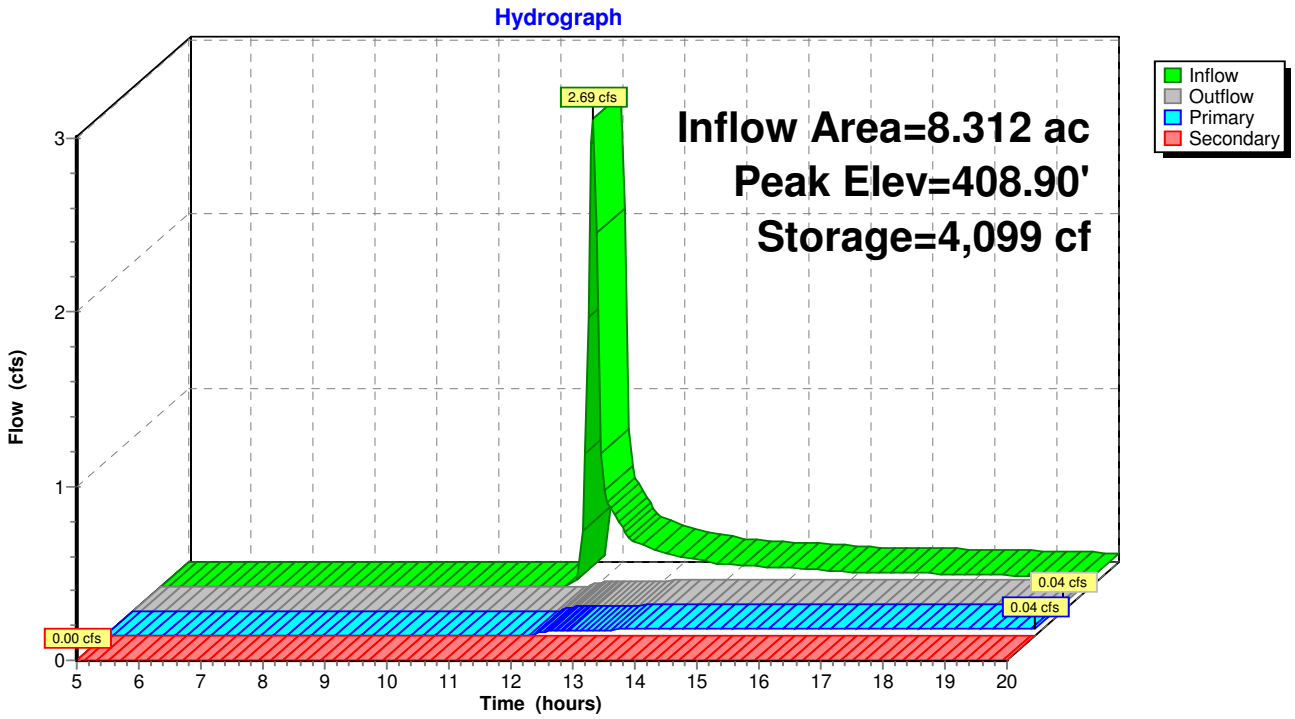
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
408.50	9,524	0	0
409.00	11,370	5,224	5,224
410.00	12,707	12,039	17,262
411.00	14,100	13,404	30,666
412.00	15,555	14,828	45,493
413.00	17,056	16,306	61,799
414.00	18,619	17,838	79,636
415.00	20,239	19,429	99,065
416.00	21,915	21,077	120,142

Device	Routing	Invert	Outlet Devices
#1	Primary	405.00'	**24.0" Round Culvert** L= 60.8' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 405.00' / 404.00' S= 0.0164 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	408.50'	**1.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	410.00'	**24.0" W x 5.0" H Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 1	413.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**10.0' 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=0.04 cfs @ 20.00 hrs HW=408.90' (Free Discharge)
└**1=Culvert** (Passes 0.04 cfs of 25.76 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.04 cfs @ 2.76 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=408.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: BMP #45



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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: PHASE 14 EXISTING Runoff Area=362,057 sf 0.00% Impervious Runoff Depth>0.60"
Flow Length=705' Tc=19.4 min CN=70 Runoff=5.58 cfs 0.419 af

Subcatchment 2S: PHASE 14 POST Runoff Area=362,057 sf 49.45% Impervious Runoff Depth>1.50"
Tc=5.0 min CN=86 Runoff=24.08 cfs 1.037 af

Pond 3P: BMP #45 Peak Elev=410.43' Storage=22,830 cf Inflow=24.08 cfs 1.037 af
Primary=5.43 cfs 0.629 af Secondary=0.00 cfs 0.000 af Outflow=5.43 cfs 0.629 af

Total Runoff Area = 16.623 ac Runoff Volume = 1.456 af Average Runoff Depth = 1.05"
75.27% Pervious = 12.513 ac 24.73% Impervious = 4.110 ac

Summary for Subcatchment 1S: PHASE 14 EXISTING CONDITIONS

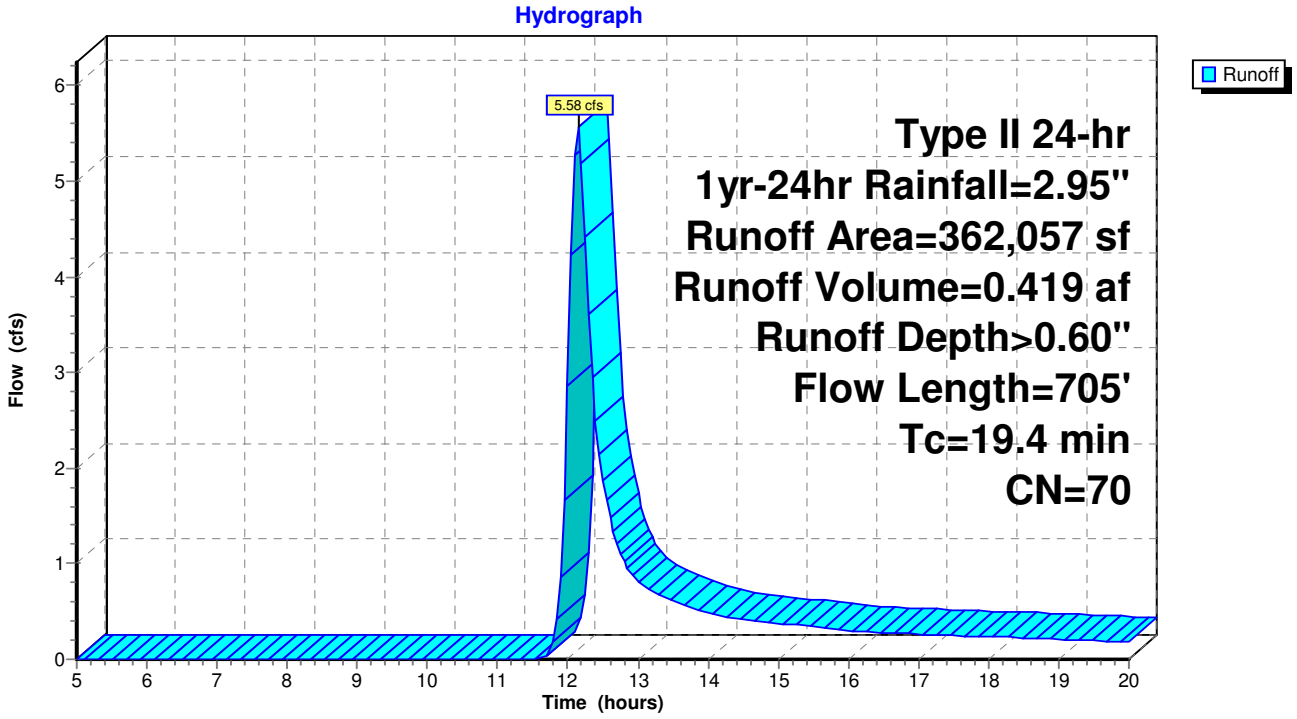
Runoff = 5.58 cfs @ 12.15 hrs, Volume= 0.419 af, Depth> 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr-24hr Rainfall=2.95"

Area (sf)	CN	Description
362,057	70	Woods, Good, HSG C
362,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	100	0.0550	0.12		**Sheet Flow, Overland Flow** Woods: Light underbrush n= 0.400 P2= 3.48"
5.7	605	0.1256	1.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
19.4	705	Total			

Subcatchment 1S: PHASE 14 EXISTING CONDITIONS



Summary for Subcatchment 2S: PHASE 14 POST CONSTRUCTION

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

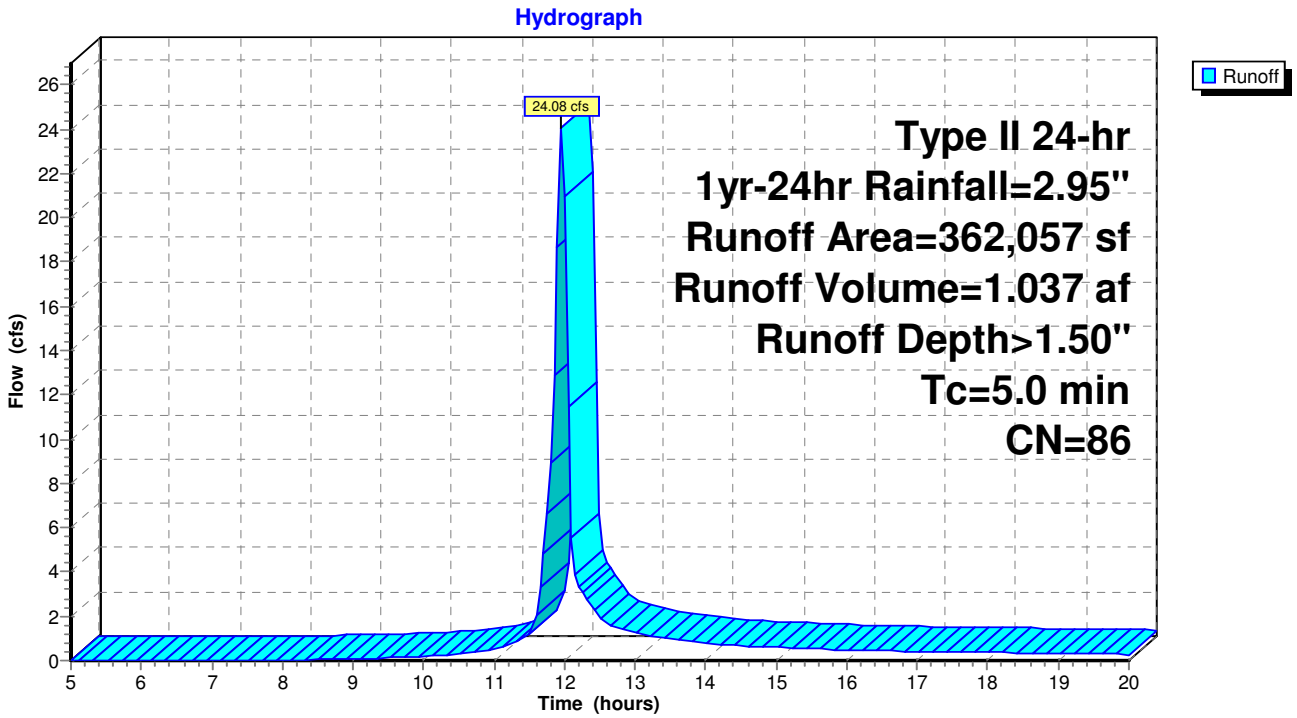
Runoff = 24.08 cfs @ 11.96 hrs, Volume= 1.037 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr-24hr Rainfall=2.95"

Area (sf)	CN	Description
179,051	98	Paved roads w/curbs & sewers, HSG D
183,006	74	>75% Grass cover, Good, HSG C
362,057	86	Weighted Average
183,006		50.55% Pervious Area
179,051		49.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assume 5 min**

Subcatchment 2S: PHASE 14 POST CONSTRUCTION



Summary for Pond 3P: BMP #45

Inflow Area = 8.312 ac, 49.45% Impervious, Inflow Depth > 1.50" for 1yr-24hr event
Inflow = 24.08 cfs @ 11.96 hrs, Volume= 1.037 af
Outflow = 5.43 cfs @ 12.12 hrs, Volume= 0.629 af, Atten= 77%, Lag= 9.7 min
Primary = 5.43 cfs @ 12.12 hrs, Volume= 0.629 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 410.43' @ 12.12 hrs Surf.Area= 13,303 sf Storage= 22,830 cf

Plug-Flow detention time= 144.9 min calculated for 0.629 af (61% of inflow)
Center-of-Mass det. time= 70.1 min (851.7 - 781.6)

Volume	Invert	Avail.Storage	Storage Description
#1	408.50'	120,142 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

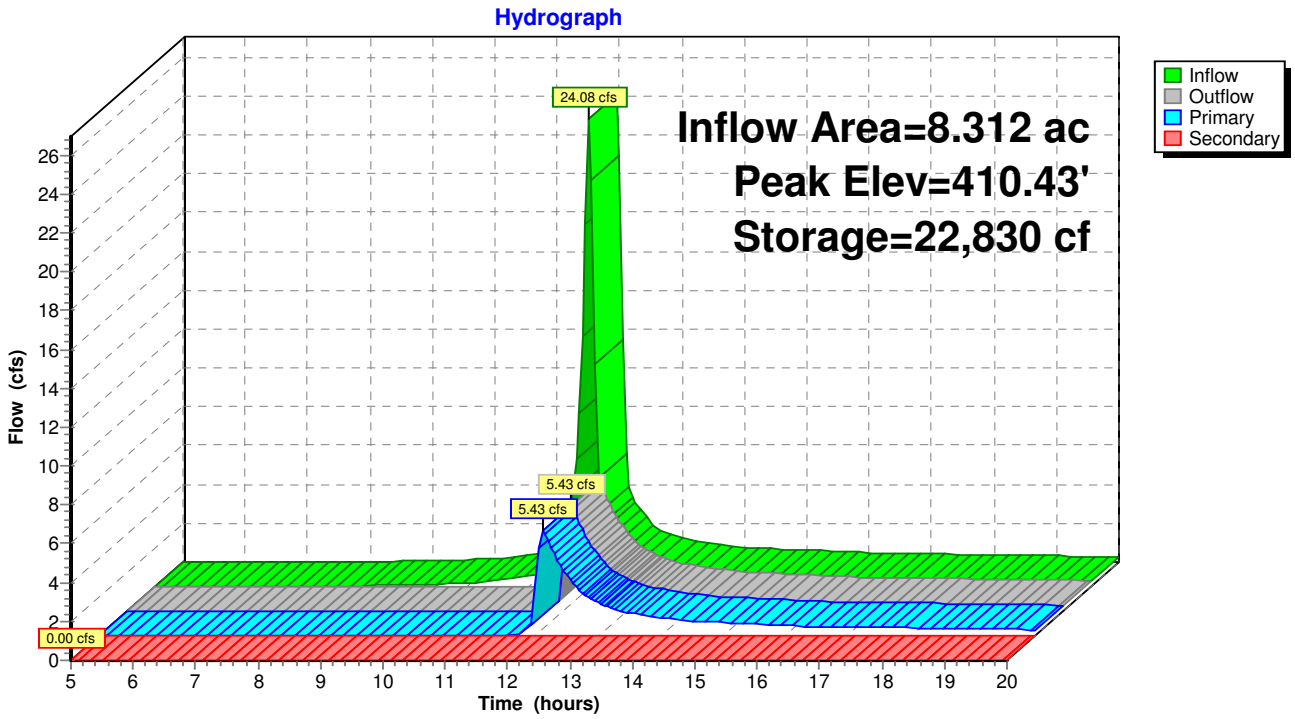
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
408.50	9,524	0	0
409.00	11,370	5,224	5,224
410.00	12,707	12,039	17,262
411.00	14,100	13,404	30,666
412.00	15,555	14,828	45,493
413.00	17,056	16,306	61,799
414.00	18,619	17,838	79,636
415.00	20,239	19,429	99,065
416.00	21,915	21,077	120,142

Device	Routing	Invert	Outlet Devices
#1	Primary	405.00'	**24.0" Round Culvert** L= 60.8' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 405.00' / 404.00' S= 0.0164 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	408.50'	**1.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	410.00'	**24.0" W x 5.0" H Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 1	413.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**10.0' 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=5.37 cfs @ 12.12 hrs HW=410.42' (Free Discharge)
└**1=Culvert** (Passes 5.37 cfs of 31.81 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.10 cfs @ 6.55 fps)
  └**3=Orifice/Grate** (Orifice Controls 5.27 cfs @ 2.11 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=408.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: BMP #45



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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: PHASE 14 EXISTING Runoff Area=362,057 sf 0.00% Impervious Runoff Depth>1.95"
Flow Length=705' Tc=19.4 min CN=70 Runoff=19.76 cfs 1.351 af

Subcatchment 2S: PHASE 14 POST Runoff Area=362,057 sf 49.45% Impervious Runoff Depth>3.37"
Tc=5.0 min CN=86 Runoff=51.81 cfs 2.336 af

Pond 3P: BMP #45 Peak Elev=412.06' Storage=46,363 cf Inflow=51.81 cfs 2.336 af
Primary=16.49 cfs 1.916 af Secondary=0.00 cfs 0.000 af Outflow=16.49 cfs 1.916 af

Total Runoff Area = 16.623 ac Runoff Volume = 3.687 af Average Runoff Depth = 2.66"
75.27% Pervious = 12.513 ac 24.73% Impervious = 4.110 ac

Summary for Subcatchment 1S: PHASE 14 EXISTING CONDITIONS

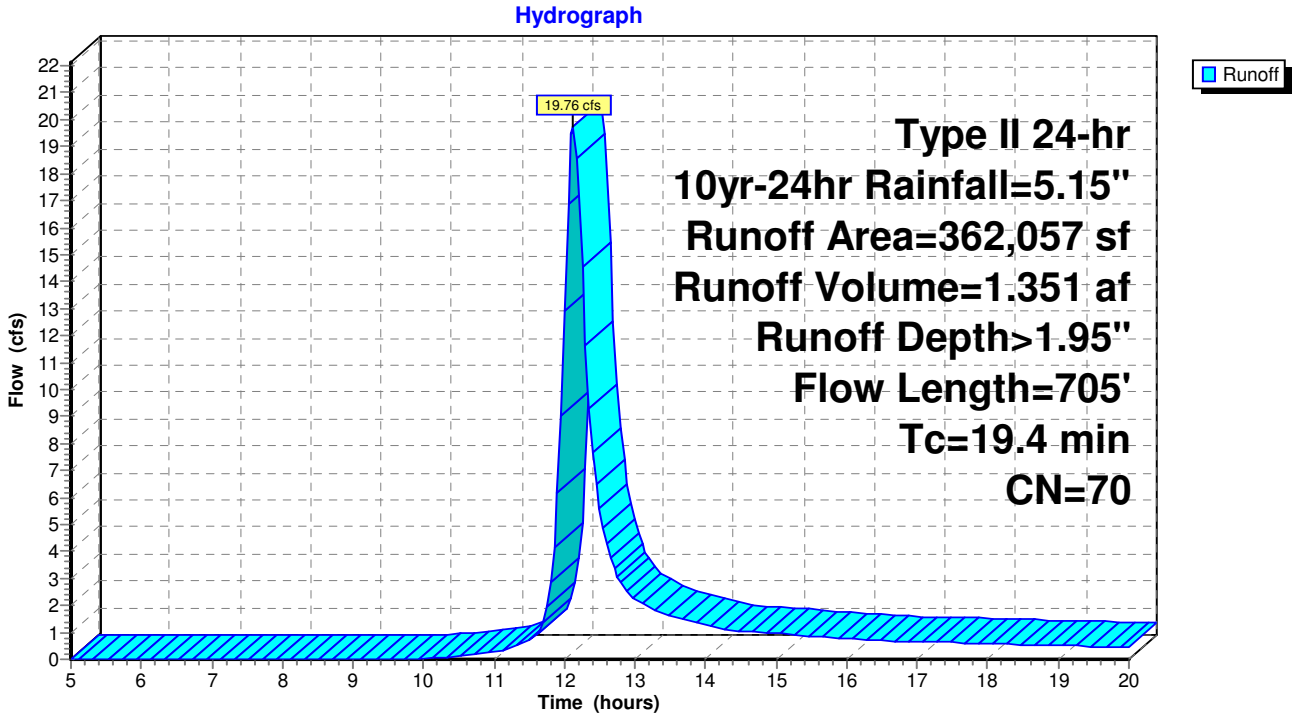
Runoff = 19.76 cfs @ 12.13 hrs, Volume= 1.351 af, Depth> 1.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr-24hr Rainfall=5.15"

Area (sf)	CN	Description
362,057	70	Woods, Good, HSG C
362,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	100	0.0550	0.12		**Sheet Flow, Overland Flow** Woods: Light underbrush n= 0.400 P2= 3.48"
5.7	605	0.1256	1.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
19.4	705	Total			

Subcatchment 1S: PHASE 14 EXISTING CONDITIONS



Summary for Subcatchment 2S: PHASE 14 POST CONSTRUCTION

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

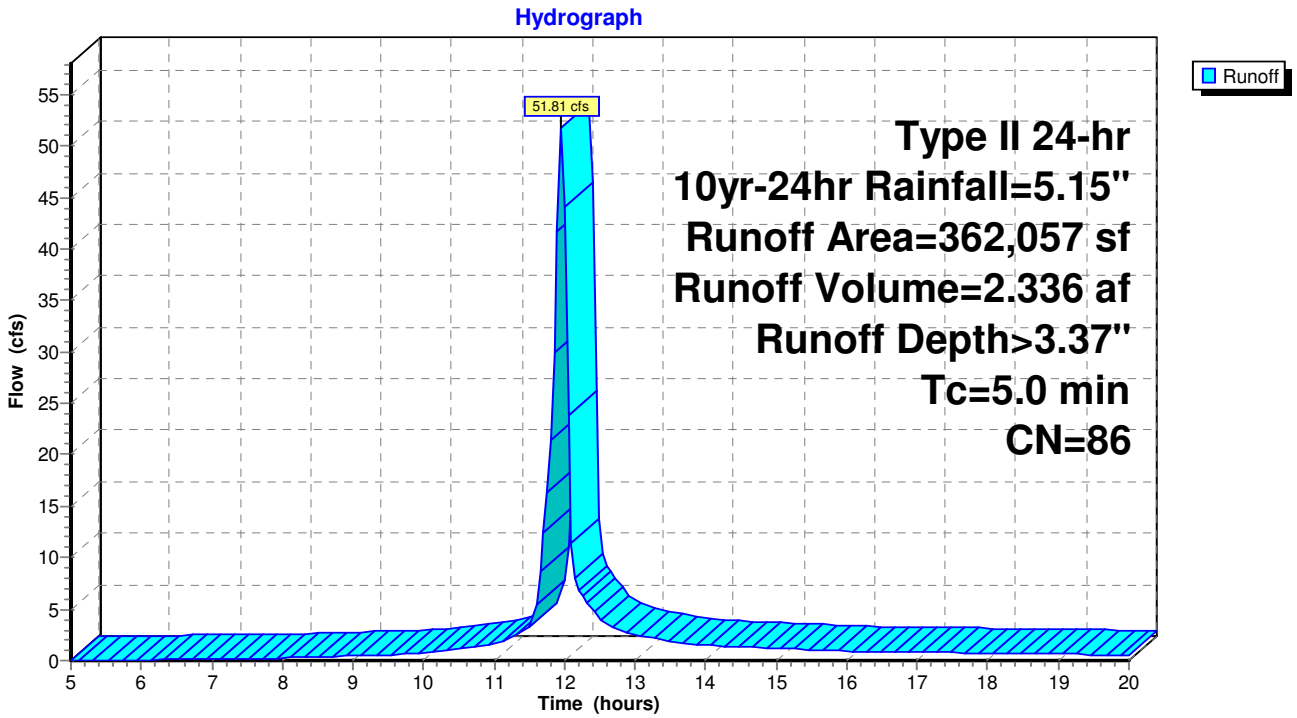
Runoff = 51.81 cfs @ 11.95 hrs, Volume= 2.336 af, Depth> 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr-24hr Rainfall=5.15"

Area (sf)	CN	Description
179,051	98	Paved roads w/curbs & sewers, HSG D
183,006	74	>75% Grass cover, Good, HSG C
362,057	86	Weighted Average
183,006		50.55% Pervious Area
179,051		49.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assume 5 min**

Subcatchment 2S: PHASE 14 POST CONSTRUCTION



Summary for Pond 3P: BMP #45

Inflow Area = 8.312 ac, 49.45% Impervious, Inflow Depth > 3.37" for 10yr-24hr event
Inflow = 51.81 cfs @ 11.95 hrs, Volume= 2.336 af
Outflow = 16.49 cfs @ 12.08 hrs, Volume= 1.916 af, Atten= 68%, Lag= 7.7 min
Primary = 16.49 cfs @ 12.08 hrs, Volume= 1.916 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 412.06' @ 12.08 hrs Surf.Area= 15,639 sf Storage= 46,363 cf

Plug-Flow detention time= 97.2 min calculated for 1.916 af (82% of inflow)
Center-of-Mass det. time= 45.8 min (809.0 - 763.2)

Volume	Invert	Avail.Storage	Storage Description
#1	408.50'	120,142 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

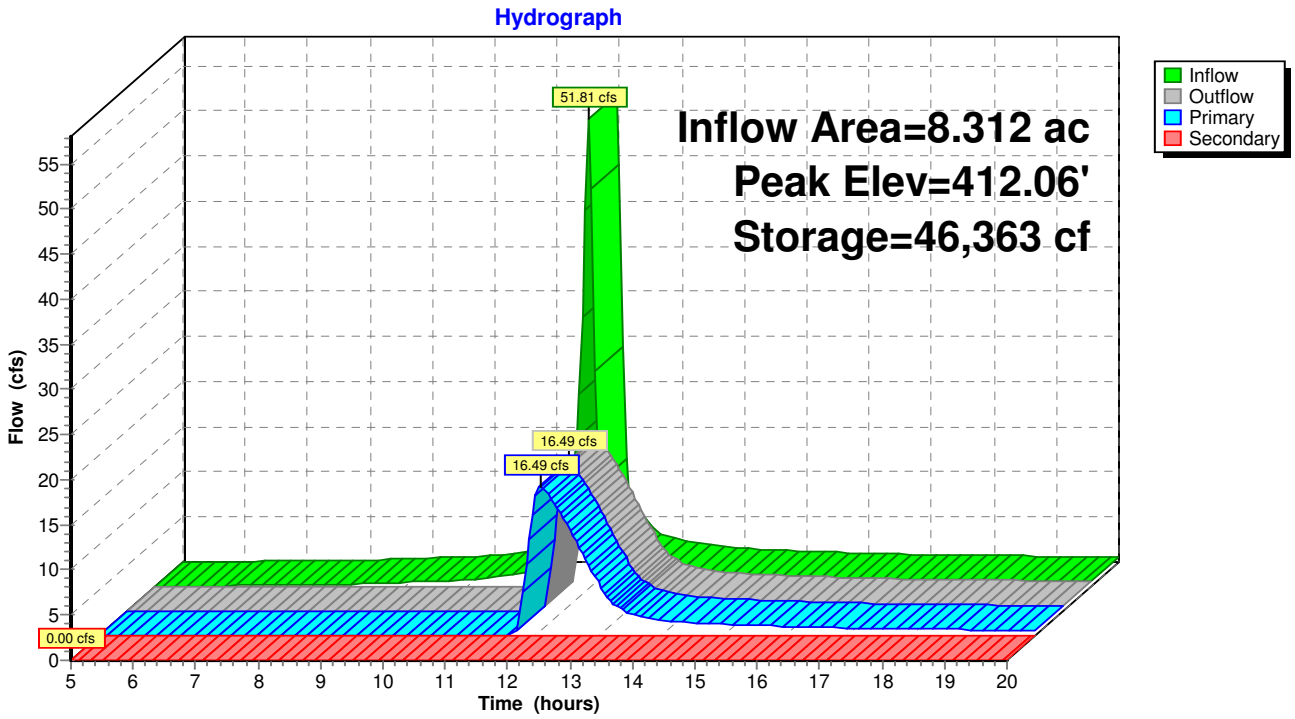
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
408.50	9,524	0	0
409.00	11,370	5,224	5,224
410.00	12,707	12,039	17,262
411.00	14,100	13,404	30,666
412.00	15,555	14,828	45,493
413.00	17,056	16,306	61,799
414.00	18,619	17,838	79,636
415.00	20,239	19,429	99,065
416.00	21,915	21,077	120,142

Device	Routing	Invert	Outlet Devices
#1	Primary	405.00'	**24.0" Round Culvert** L= 60.8' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 405.00' / 404.00' S= 0.0164 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	408.50'	**1.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	410.00'	**24.0" W x 5.0" H Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 1	413.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**10.0' 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=16.45 cfs @ 12.08 hrs HW=412.05' (Free Discharge)
└**1=Culvert** (Passes 16.45 cfs of 37.19 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.14 cfs @ 8.98 fps)
  ├**3=Orifice/Grate** (Orifice Controls 16.31 cfs @ 6.52 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=408.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: BMP #45



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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: PHASE 14 EXISTING Runoff Area=362,057 sf 0.00% Impervious Runoff Depth>3.80"
Flow Length=705' Tc=19.4 min CN=70 Runoff=38.67 cfs 2.631 af

Subcatchment 2S: PHASE 14 POST Runoff Area=362,057 sf 49.45% Impervious Runoff Depth>5.58"
Tc=5.0 min CN=86 Runoff=82.93 cfs 3.868 af

Pond 3P: BMP #45 Peak Elev=413.46' Storage=69,739 cf Inflow=82.93 cfs 3.868 af
Primary=37.86 cfs 3.439 af Secondary=0.00 cfs 0.000 af Outflow=37.86 cfs 3.439 af

Total Runoff Area = 16.623 ac Runoff Volume = 6.500 af Average Runoff Depth = 4.69"
75.27% Pervious = 12.513 ac 24.73% Impervious = 4.110 ac

Summary for Subcatchment 1S: PHASE 14 EXISTING CONDITIONS

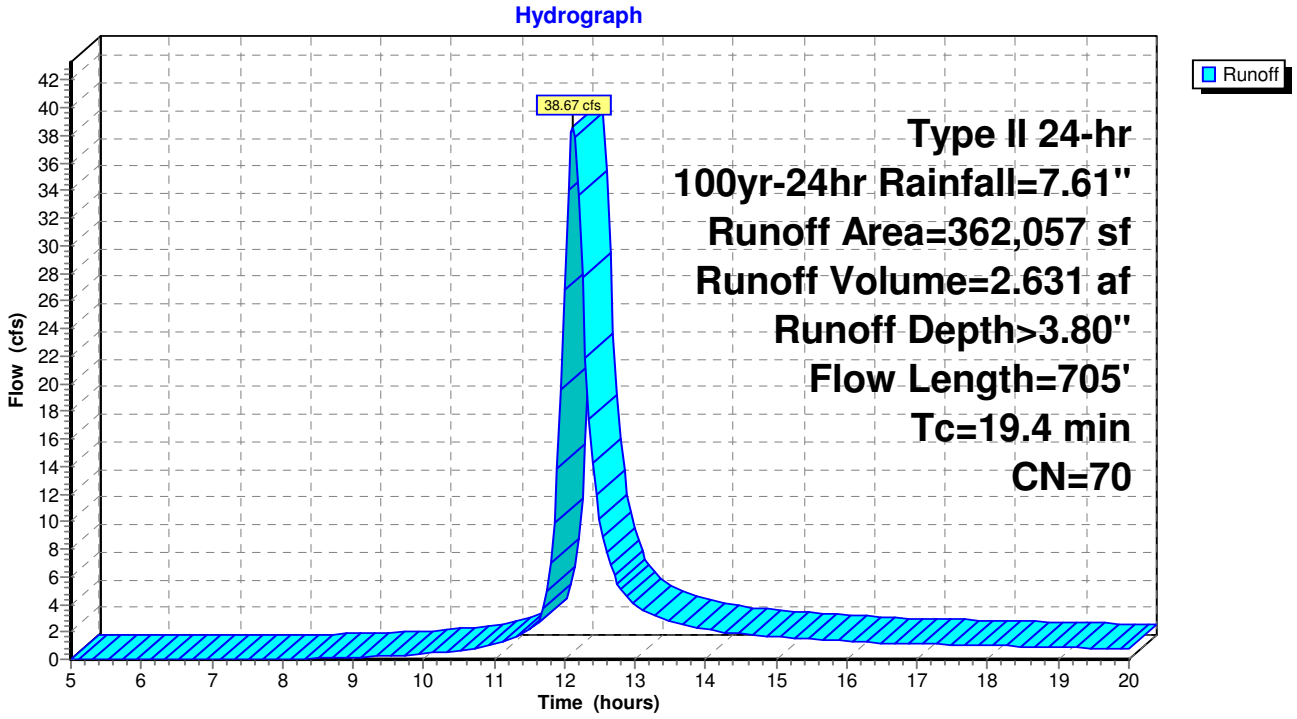
Runoff = 38.67 cfs @ 12.12 hrs, Volume= 2.631 af, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr-24hr Rainfall=7.61"

Area (sf)	CN	Description
362,057	70	Woods, Good, HSG C
362,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	100	0.0550	0.12		**Sheet Flow, Overland Flow** Woods: Light underbrush n= 0.400 P2= 3.48"
5.7	605	0.1256	1.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
19.4	705	Total			

Subcatchment 1S: PHASE 14 EXISTING CONDITIONS



Summary for Subcatchment 2S: PHASE 14 POST CONSTRUCTION

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

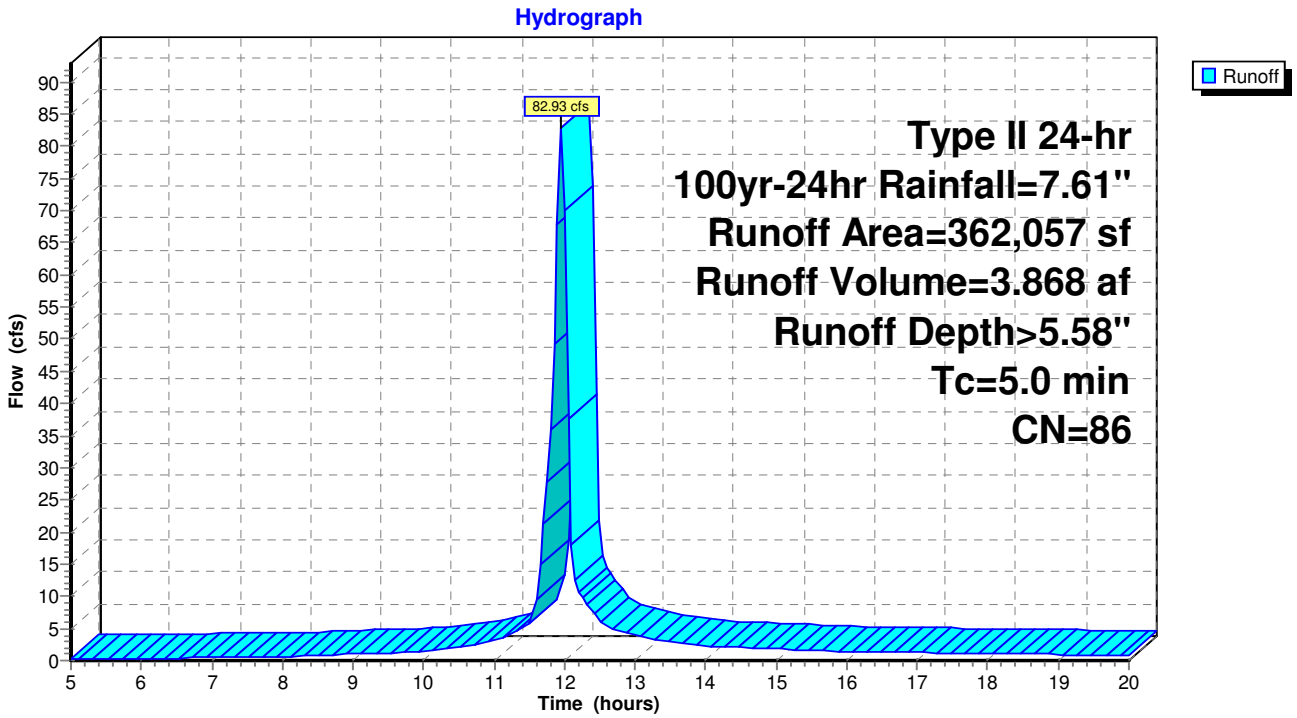
Runoff = 82.93 cfs @ 11.95 hrs, Volume= 3.868 af, Depth> 5.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr-24hr Rainfall=7.61"

Area (sf)	CN	Description
179,051	98	Paved roads w/curbs & sewers, HSG D
183,006	74	>75% Grass cover, Good, HSG C
362,057	86	Weighted Average
183,006		50.55% Pervious Area
179,051		49.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assume 5 min**

Subcatchment 2S: PHASE 14 POST CONSTRUCTION



Summary for Pond 3P: BMP #45

[82] Warning: Early inflow requires earlier time span

Inflow Area = 8.312 ac, 49.45% Impervious, Inflow Depth > 5.58" for 100yr-24hr event
Inflow = 82.93 cfs @ 11.95 hrs, Volume= 3.868 af
Outflow = 37.86 cfs @ 12.06 hrs, Volume= 3.439 af, Atten= 54%, Lag= 6.5 min
Primary = 37.86 cfs @ 12.06 hrs, Volume= 3.439 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 413.46' @ 12.06 hrs Surf.Area= 17,769 sf Storage= 69,739 cf

Plug-Flow detention time= 82.2 min calculated for 3.427 af (89% of inflow)
Center-of-Mass det. time= 45.3 min (797.4 - 752.1)

Volume	Invert	Avail.Storage	Storage Description
#1	408.50'	120,142 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

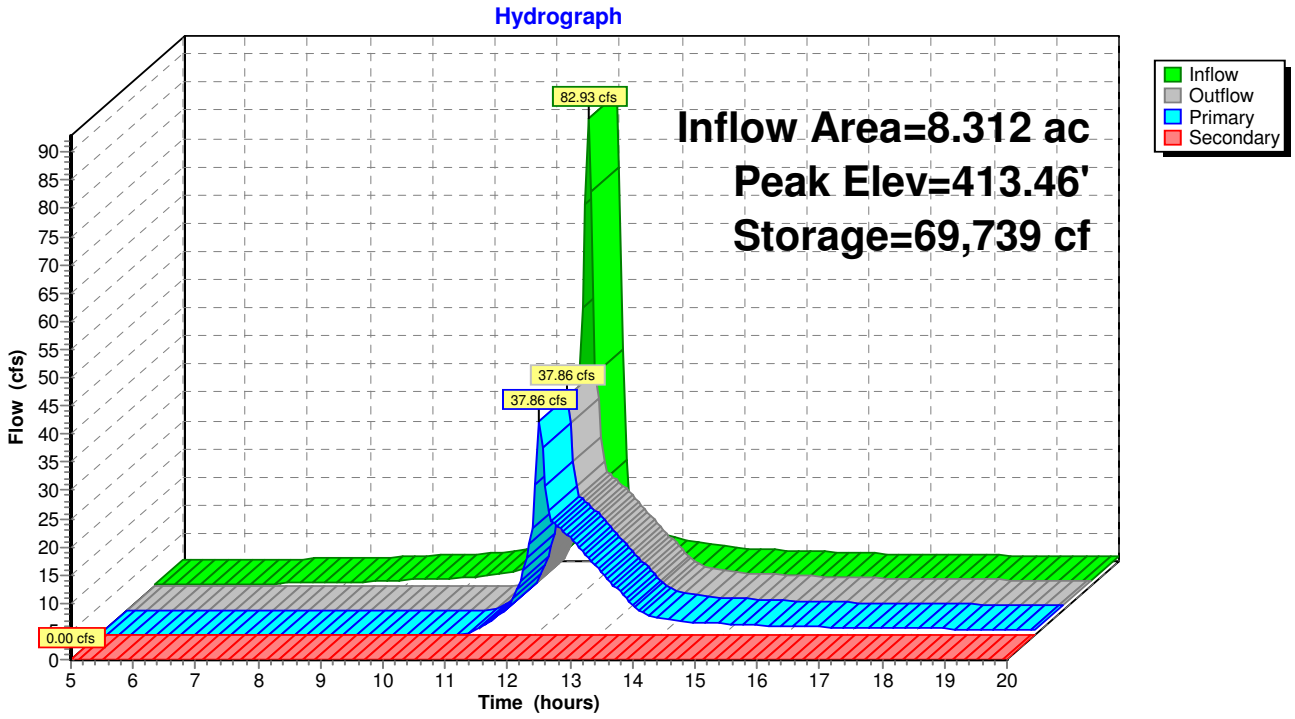
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
408.50	9,524	0	0
409.00	11,370	5,224	5,224
410.00	12,707	12,039	17,262
411.00	14,100	13,404	30,666
412.00	15,555	14,828	45,493
413.00	17,056	16,306	61,799
414.00	18,619	17,838	79,636
415.00	20,239	19,429	99,065
416.00	21,915	21,077	120,142

Device	Routing	Invert	Outlet Devices
#1	Primary	405.00'	**24.0" Round Culvert** L= 60.8' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 405.00' / 404.00' S= 0.0164 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	408.50'	**1.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	410.00'	**24.0" W x 5.0" H Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 1	413.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**10.0' 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=36.52 cfs @ 12.06 hrs HW=413.43' (Free Discharge)
└─**1=Culvert** (Passes 36.52 cfs of 41.23 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 10.61 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 21.60 cfs @ 8.64 fps)
  └─**4=Orifice/Grate** (Weir Controls 14.76 cfs @ 2.14 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=408.50' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: BMP #45



WATER QUALITY POND CALCULATIONS - BMP #45

Project Name

Briar Chapel - Phase 14 - BMP #45

Project Number

02735-0249

Date
April 19, 2019

3rd revision
2nd revision
1st revision

Water Quality Pond Drainage Area Data

Project: Briar Chapel - Phase 14 - BMP #45
Project No.: 02735-0249
Date: April 19, 2019

1543094
2080688
2365515

Total site area: 362,057 square feet = 8.31 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	123,200	123,200	0	0
On-site streets	0	31,620	31,620	0	0
On-site alleys	0	0	0	0	0
On-site sidewalks	0	7,953	7,953	0	0
On-site future (open space)	0	0	0	0	0
Off-site future development	0	0	0	0	0
Contingency (10%)	0	16,277	16,277	0	0
Total Impervious	***0***	***179,051***	***179,051***	***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	183,006	183,006	0	0
On-site woods	362,057	0	-362,057	0	0
Other undeveloped	0	0	0	0	0
Total off-site non-impervious	0	0	0	0	0
Total non-impervious	362,057	183,006	-179,051	0	0

Total Drainage Area	362,057	362,057	0	0	0
Percent Impervious	0.0	49.5	49.5	n/a	n/a

Water Quality Pond Surface Area Calculations

Project: Briar Chapel - Phase 14 - BMP #45
Project No.: 02735-0249

Date: April 19, 2019

Total on-site drainage area to pond: 362,057 square feet
Total impervious area in drainage area: 179,051 square feet

Average water depth of basin at normal pool: 3.0 feet

Location of site: Wake County
Site region: Piedmont

% Impervious cover: 49.5 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: 1.8 percent
For a site in a Coastal County: 2.0 percent

Required surface area of pond:

For a site in the Piedmont: 6,430.0 square feet for main pool
For a site in a Coastal County: 7,400.0 square feet

Notes:

Water Quality Pond Stormwater Runoff Volume Calculations

Project	Briar Chapel - Phase 14 - BMP #45	
Project No.	02735-0249	
Date	April 19, 2019	
Drainage area	362,057	square feet
Impervious area	179,051	square feet
Rainfall depth	1.00	inches
Percent Impervious	49.5	percent

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

Runoff coefficient - R(v)	0.50	in/in

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

Runoff volume	14,937.4	cubic feet

Notes:

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

Project: Briar Chapel - Phase 14 - BMP #45
Project No.: 02735-0249

Date: April 19, 2019

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]
408.5	0	9,524.0	0.219	9,524.0	0.22	0.0	0.0	0.0	0.0
409	0.5	11,370.0	0.261	11,370.0	0.04	5,223.5	0.12	5,223.5	0.12
410	1.5	12,707.0	0.292	12,707.0	0.03	12,038.5	0.28	17,262.0	0.40
411	2.5	14,100.0	0.324	14,100.0	0.03	13,403.5	0.31	30,665.5	0.70
412	3.5	15,550.0	0.357	15,550.0	0.03	14,825.0	0.34	45,490.5	1.04
413	4.5	17,056.0	0.392	17,056.0	0.03	16,303.0	0.37	61,793.5	1.42
414	5.5	18,619.0	0.427	18,619.0	0.04	17,837.5	0.41	79,631.0	1.83
415	6.5	20,239.3	0.465	20,239.3	0.04	19,429.2	0.45	99,060.2	2.27
416	7.5	21,915.0	0.503	21,915.0	0.04	21,077.2	0.48	120,137.3	2.76

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

Project: Briar Chapel - Phase 14 - BMP #45
Project No.: 02735-0249

Date: April 19, 2019

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]
404	0	3,461.0	0.079	3,461.0	0.1	0.0	0.0	0.0	0.0
405	1	4,227.0	0.097	766.0	0.0	3,844.0	0.1	3,844.0	0.1
406	2	5,048.0	0.116	821.0	0.0	4,637.5	0.1	8,481.5	0.2
407	3	5,927.0	0.136	879.0	0.0	5,487.5	0.1	13,969.0	0.2
408	4	6,861.0	0.158	934.0	0.0	6,394.0	0.1	20,363.0	0.3
408.5	4.5	7,853.0	0.180	992.0	0.0	3,678.5	0.1	24,041.5	0.2

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

Project: Briar Chapel - Phase 14 - BMP #45
Project No.: 02735-0249

Date: April 19, 2019

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]
404	0	249.0	0.006	249.0	0.0	0.0	0.0	0.0	0.0
405	1	459.0	0.011	210.0	0.0	354.0	0.0	354.0	0.0
406	2	730.0	0.017	271.0	0.0	594.5	0.0	948.5	0.0
407	3	1,061.0	0.024	331.0	0.0	895.5	0.0	1,844.0	0.0
408	4	1,453.0	0.033	392.0	0.0	1,257.0	0.0	3,101.0	0.0
408.5	4.5	1,671.0	0.038	218.0	0.0	781.0	0.0	3,882.0	0.0

Water Quality Basin Dewatering Time Calculations

Project Briar Chapel - Phase 14 - BMP #45
Project No. 02735-0249

Date April 19, 2019

Water quality treatment volume	14,937	cubic feet
Total treatment volume	17,262	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	1.75	inches
Number of holes	1	
Cross sectional area of each hole =	0.017	square feet
Cross sectional area of each hole =	2.4	square inches
Cross sectional area of dewatering hole(s) =	0.017	square feet
Cross sectional area of dewatering hole(s) =	2.4	square inches
Dewatering time for water quality volume =	3.1	days
	73.3	hours
Dewatering time for total volume =	3.5	days
	84.7	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 14 - BMP #45
Project No.	02735-0249
Date	April 19, 2019

Drainage area to pond	362,057	square feet =	8.31	acres
Impervious area in drainage area	179,051	square feet =	4.11	acres

Bottom of pond elevation	404.00	feet
Normal pool elevation	408.50	feet
Main pond volume at normal pool	24,041	cubic feet
Forebay volume at normal pool	3,822	cubic feet
Forebay % of total volume	15.9%	

Required volume for design rainfall	14,937	cubic feet
Required surface area for main pool	6,430	square feet

Volume provided for storage of design rainfall = 17,262 cubic feet at elevation 410

Surface area provided at normal pool of main pond = 7,853 square feet

Average Depth 3.06 feet

ANTI-FLOATATION DESIGN	DATE: 4/12/2019	DESIGNED BY: BSS
PROJECT NAME: Briar Chapel Phase 14 PROJECT LOCATION: Chatham County, NC	PROJECT NO: 02735-0248	CHECKED BY: GCA

Pond Name=	BMP #46				
Riser Outer Width =	5	ft	Riser Resisting Force =	10,800	lb
Riser Outer Length =	5	ft	Base Resisting Force =	12,000	lb
Riser Inner Width =	4	ft	Total Resisting Force =	22,800	lb
Riser Inner Length =	4	ft			
Riser Height =	8	ft	Riser Buoyant Force =	12,480	lb
			Base Buoyant Force =	4,992	lb
Concrete Base Length =	8	ft	Total Buoyant Force =	17,472	lb
Concrete Base Width =	8	ft			
Concrete Base Depth =	15	in	Factor of Safety	1.30	**Design Acceptable**

OUTLET PROTECTION DESIGN	DATE: 04/12/2019	DESIGNED BY: BSS
PROJECT NAME: Briar Chapel - Phase 14 PROJECT LOCATION: Chatham County, NC	PROJECT NO: 02735-0248	CHECKED BY GCA

Storm Outlet Structure

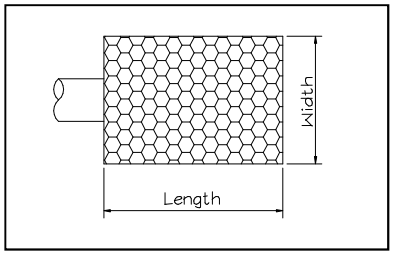
Structure=	BMP #45	
Size=	24	in
Q10 =	16.49	cfs
Qfull =	29.19	cfs
Vfull =	9.29	fps

Q_{10}/Q_{full} =	0.57	
V/Vfull =	1.02	
V =	9.5	fps

From Fig. 8.06.b.1:

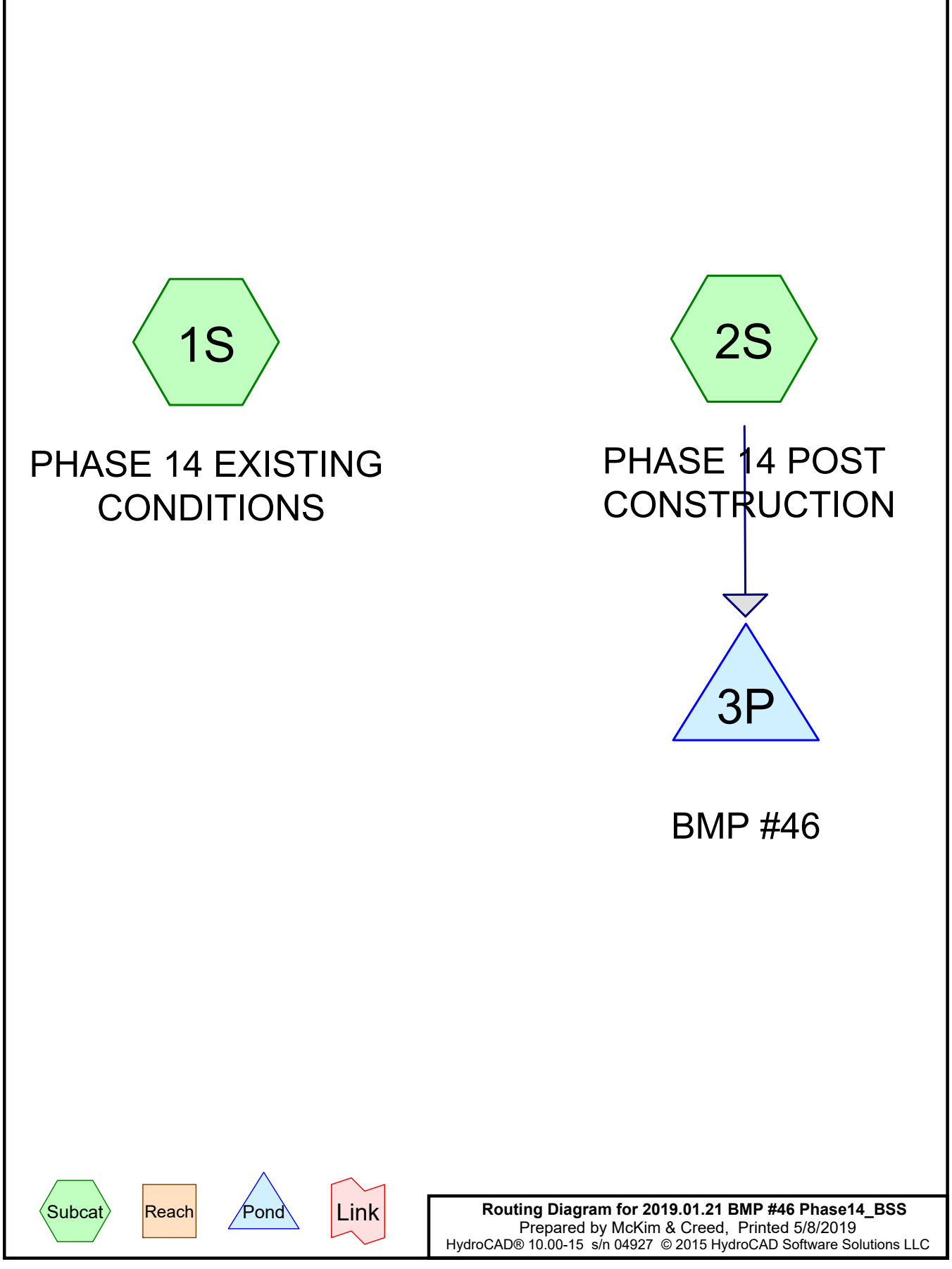
Zone = 3 (4)

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

BMP #46 ROUTING



Routing Diagram for 2019.01.21 BMP #46 Phase14_BSS
Prepared by McKim & Creed, Printed 5/8/2019

Summary for Subcatchment 1S: PHASE 14 EXISTING CONDITIONS

[73] Warning: Peak may fall outside time span

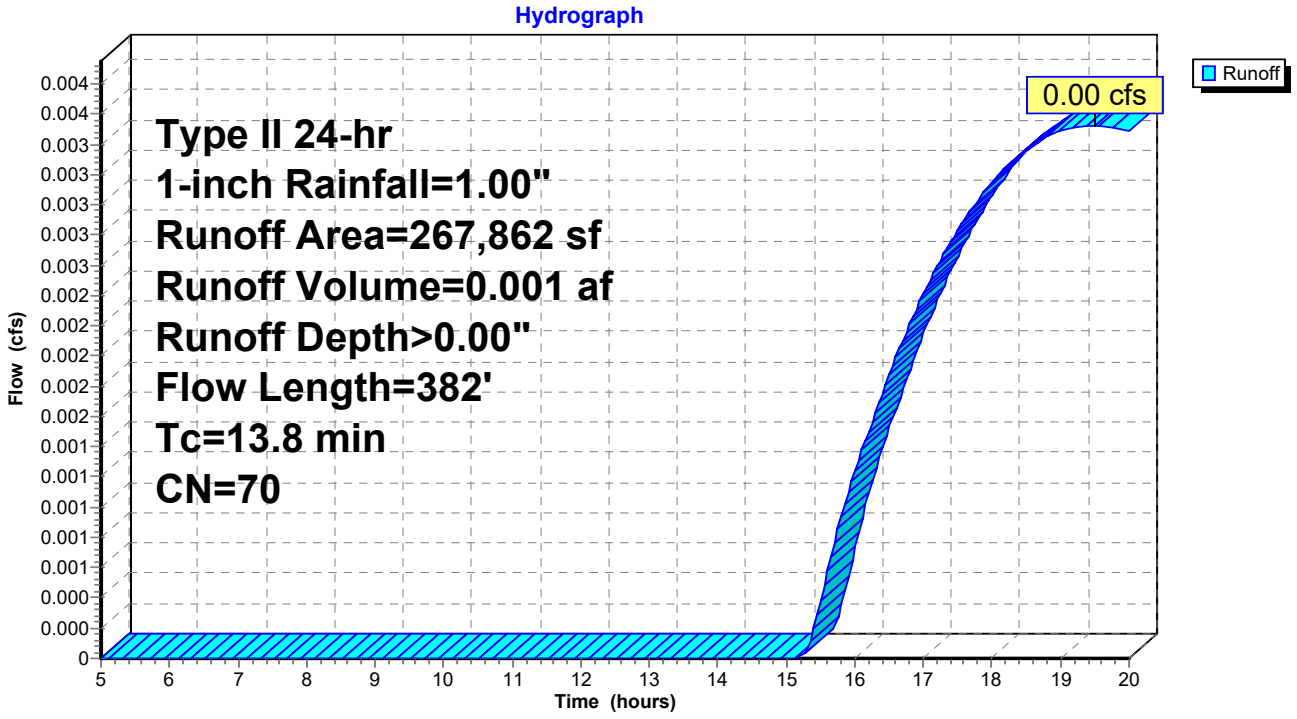
Runoff = 0.00 cfs @ 19.49 hrs, Volume= 0.001 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-inch Rainfall=1.00"

Area (sf)	CN	Description
267,862	70	Woods, Good, HSG C
267,862		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	100	0.1000	0.15		**Sheet Flow, Overland Flow** Woods: Light underbrush n= 0.400 P2= 3.48"
3.0	282	0.0975	1.56		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.8	382	Total			

Subcatchment 1S: PHASE 14 EXISTING CONDITIONS



Summary for Subcatchment 2S: PHASE 14 POST CONSTRUCTION

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

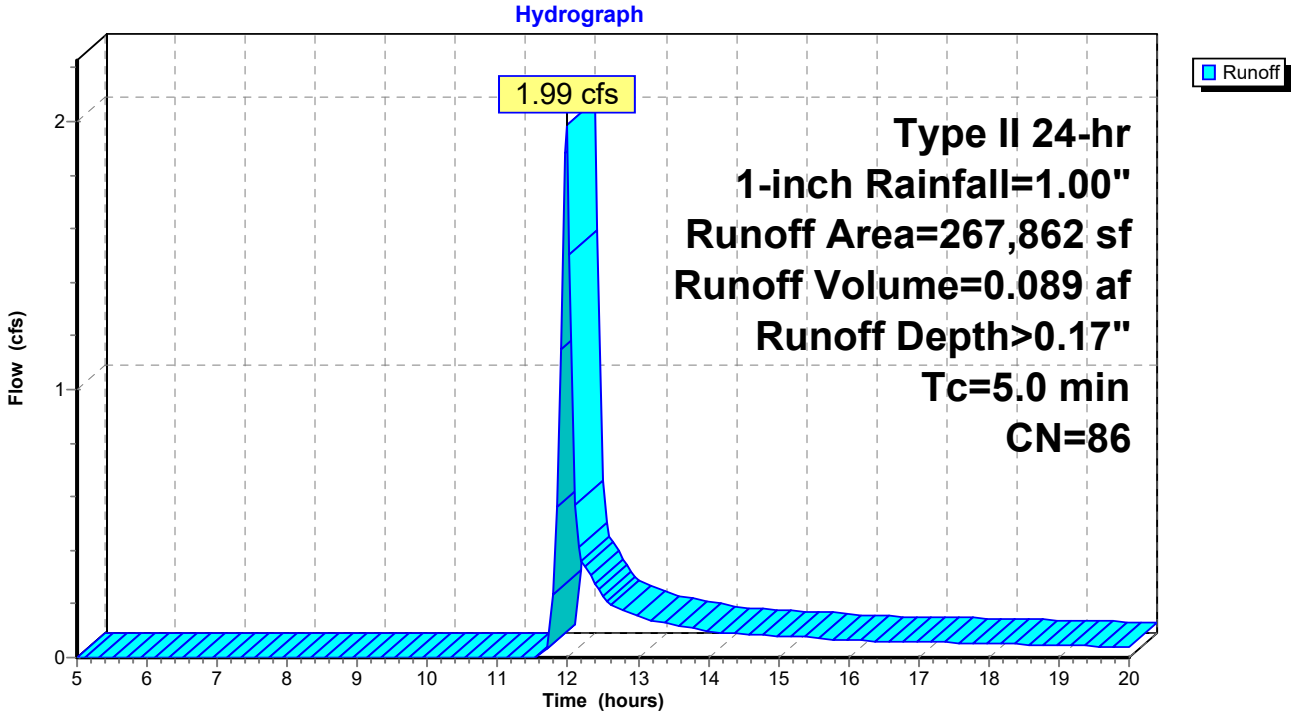
Runoff = 1.99 cfs @ 11.98 hrs, Volume= 0.089 af, Depth> 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-inch Rainfall=1.00"

Area (sf)	CN	Description
134,723	98	Paved roads w/curbs & sewers, HSG D
133,139	74	>75% Grass cover, Good, HSG C
267,862	86	Weighted Average
133,139		49.70% Pervious Area
134,723		50.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assume 5 min**

Subcatchment 2S: PHASE 14 POST CONSTRUCTION



Summary for Pond 3P: BMP #46

Inflow Area = 6.149 ac, 50.30% Impervious, Inflow Depth > 0.17" for 1-inch event
Inflow = 1.99 cfs @ 11.98 hrs, Volume= 0.089 af
Outflow = 0.04 cfs @ 20.00 hrs, Volume= 0.023 af, Atten= 98%, Lag= 481.5 min
Primary = 0.04 cfs @ 20.00 hrs, Volume= 0.023 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 443.82' @ 20.00 hrs Surf.Area= 9,555 sf Storage= 2,874 cf

Plug-Flow detention time= 257.6 min calculated for 0.023 af (26% of inflow)
Center-of-Mass det. time= 144.1 min (973.6 - 829.5)

Volume	Invert	Avail.Storage	Storage Description
#1	443.50'	92,624 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

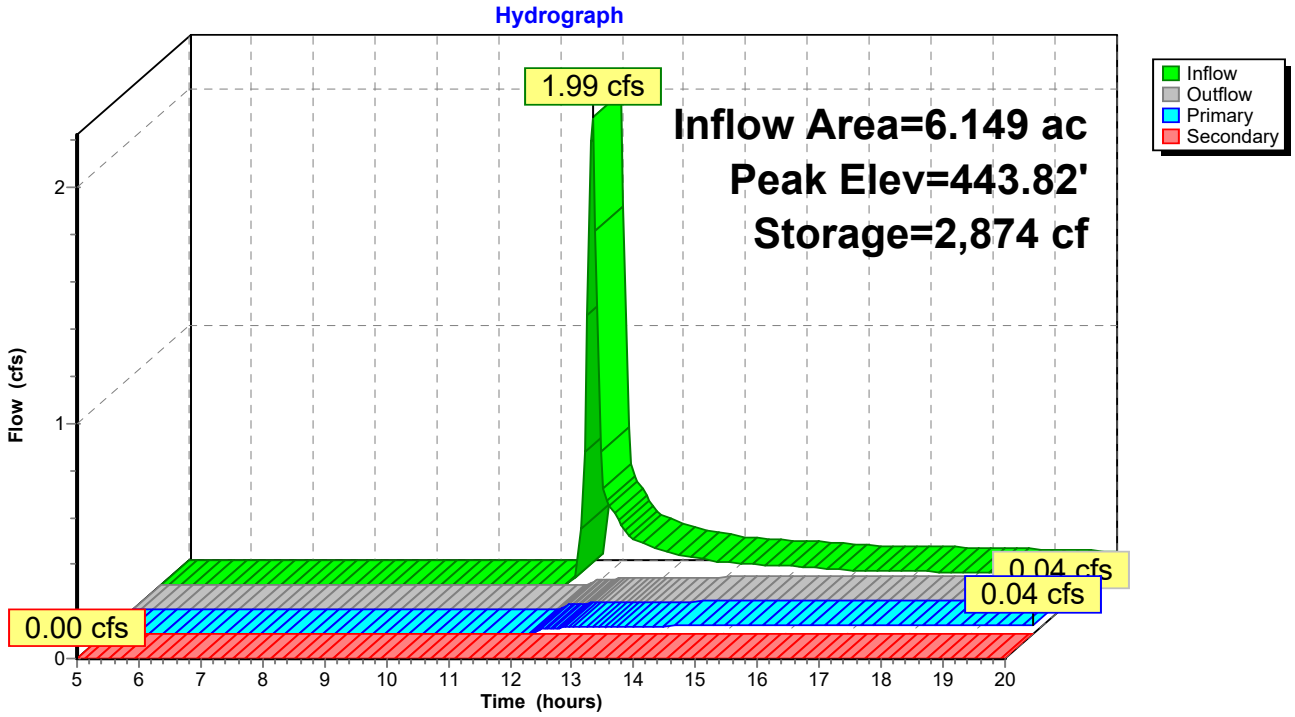
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
443.50	8,321	0	0
444.00	10,241	4,641	4,641
445.00	11,629	10,935	15,576
446.00	13,074	12,352	27,927
447.00	14,574	13,824	41,751
448.00	16,132	15,353	57,104
449.00	17,746	16,939	74,043
450.00	19,416	18,581	92,624

Device	Routing	Invert	Outlet Devices
#1	Primary	440.50'	**24.0" Round Culvert** L= 51.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 440.50' / 440.00' S= 0.0098 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	443.50'	**1.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	444.70'	**24.0" W x 5.0" H Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 1	447.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	448.00'	**10.0' 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=0.04 cfs @ 20.00 hrs HW=443.82' (Free Discharge)
└**1=Culvert** (Passes 0.04 cfs of 23.05 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.04 cfs @ 2.41 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=443.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: BMP #46



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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: PHASE 14 EXISTING Runoff Area=267,862 sf 0.00% Impervious Runoff Depth>0.57"
Flow Length=382' Tc=13.8 min CN=70 Runoff=4.69 cfs 0.293 af

Subcatchment 2S: PHASE 14 POST Runoff Area=267,862 sf 50.30% Impervious Runoff Depth>1.44"
Tc=5.0 min CN=86 Runoff=17.18 cfs 0.739 af

Pond 3P: BMP #46 Peak Elev=445.04' Storage=16,099 cf Inflow=17.18 cfs 0.739 af
Primary=4.00 cfs 0.451 af Secondary=0.00 cfs 0.000 af Outflow=4.00 cfs 0.451 af

Total Runoff Area = 12.299 ac Runoff Volume = 1.032 af Average Runoff Depth = 1.01"
74.85% Pervious = 9.206 ac 25.15% Impervious = 3.093 ac

Summary for Subcatchment 1S: PHASE 14 EXISTING CONDITIONS

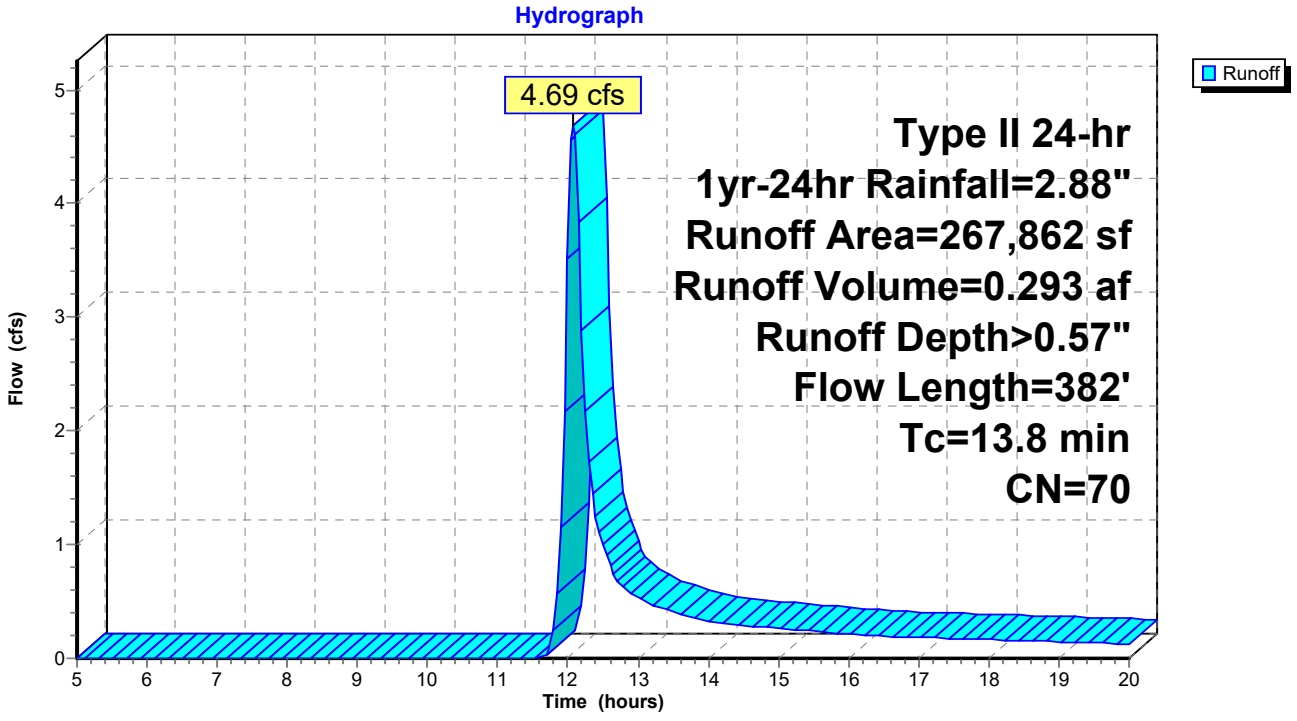
Runoff = 4.69 cfs @ 12.08 hrs, Volume= 0.293 af, Depth> 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr-24hr Rainfall=2.88"

Area (sf)	CN	Description
267,862	70	Woods, Good, HSG C
267,862		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	100	0.1000	0.15		**Sheet Flow, Overland Flow** Woods: Light underbrush n= 0.400 P2= 3.48"
3.0	282	0.0975	1.56		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.8	382	Total			

Subcatchment 1S: PHASE 14 EXISTING CONDITIONS



Summary for Subcatchment 2S: PHASE 14 POST CONSTRUCTION

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

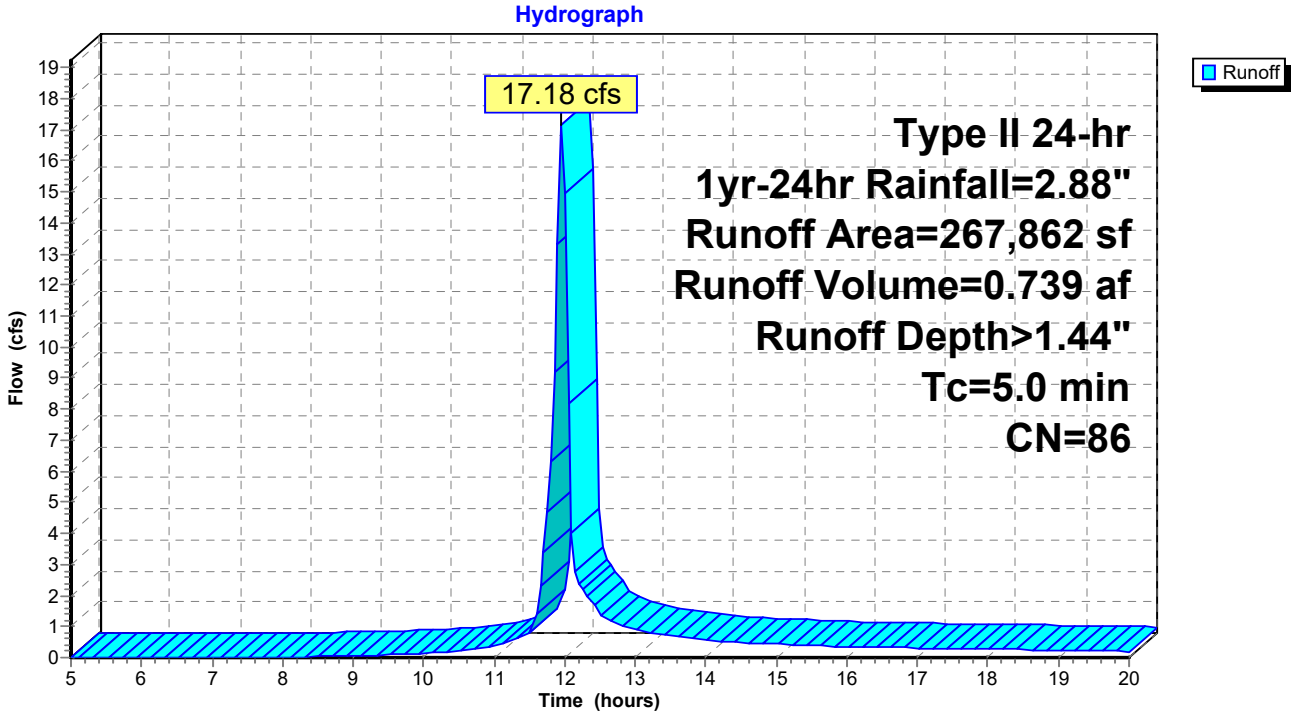
Runoff = 17.18 cfs @ 11.96 hrs, Volume= 0.739 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1yr-24hr Rainfall=2.88"

Area (sf)	CN	Description
134,723	98	Paved roads w/curbs & sewers, HSG D
133,139	74	>75% Grass cover, Good, HSG C
267,862	86	Weighted Average
133,139		49.70% Pervious Area
134,723		50.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assume 5 min**

Subcatchment 2S: PHASE 14 POST CONSTRUCTION



Summary for Pond 3P: BMP #46

Inflow Area = 6.149 ac, 50.30% Impervious, Inflow Depth > 1.44" for 1yr-24hr event
Inflow = 17.18 cfs @ 11.96 hrs, Volume= 0.739 af
Outflow = 4.00 cfs @ 12.12 hrs, Volume= 0.451 af, Atten= 77%, Lag= 9.6 min
Primary = 4.00 cfs @ 12.12 hrs, Volume= 0.451 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 445.04' @ 12.12 hrs Surf.Area= 11,694 sf Storage= 16,099 cf

Plug-Flow detention time= 142.7 min calculated for 0.451 af (61% of inflow)
Center-of-Mass det. time= 67.8 min (850.2 - 782.4)

Volume	Invert	Avail.Storage	Storage Description
#1	443.50'	92,624 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

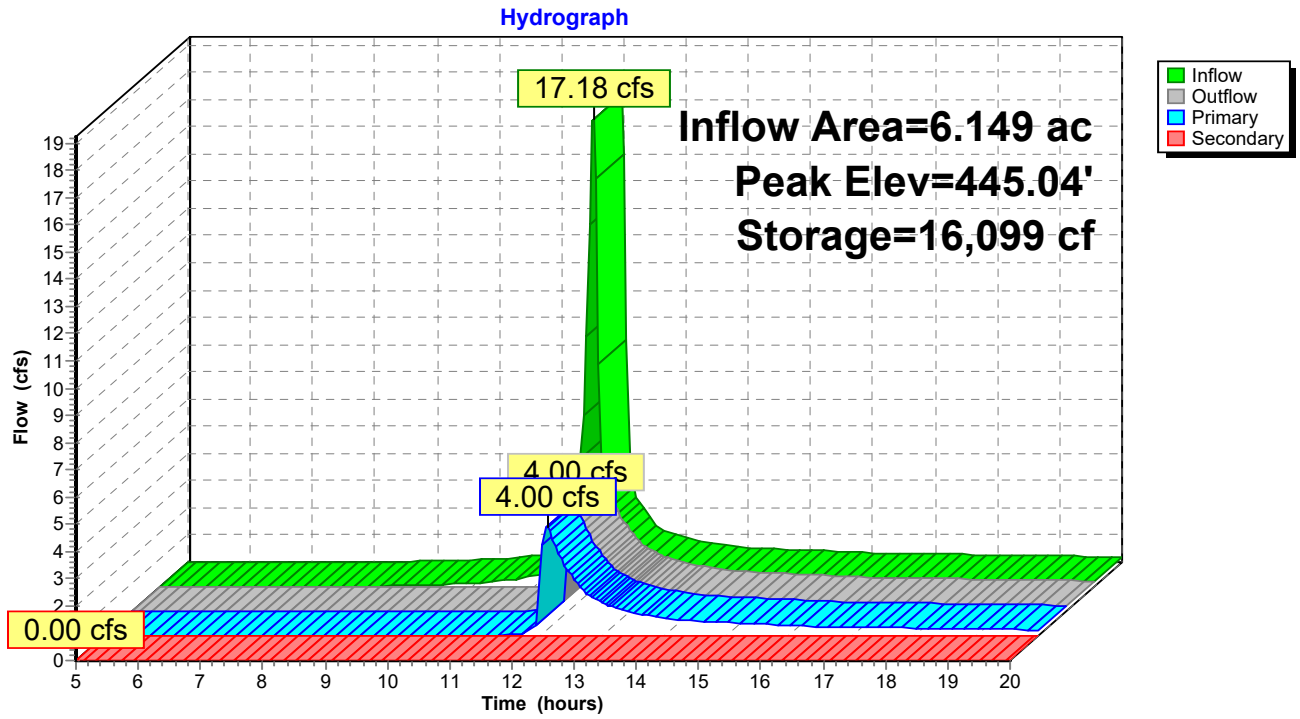
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
443.50	8,321	0	0
444.00	10,241	4,641	4,641
445.00	11,629	10,935	15,576
446.00	13,074	12,352	27,927
447.00	14,574	13,824	41,751
448.00	16,132	15,353	57,104
449.00	17,746	16,939	74,043
450.00	19,416	18,581	92,624

Device	Routing	Invert	Outlet Devices
#1	Primary	440.50'	**24.0" Round Culvert** L= 51.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 440.50' / 440.00' S= 0.0098 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	443.50'	**1.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	444.70'	**24.0" W x 5.0" H Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 1	447.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	448.00'	**10.0' 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=3.91 cfs @ 12.12 hrs HW=445.04' (Free Discharge)
└**1=Culvert** (Passes 3.91 cfs of 28.46 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.09 cfs @ 5.84 fps)
  ├**3=Orifice/Grate** (Orifice Controls 3.82 cfs @ 1.87 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=443.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: BMP #46



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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: PHASE 14 EXISTING Runoff Area=267,862 sf 0.00% Impervious Runoff Depth>1.96"
Flow Length=382' Tc=13.8 min CN=70 Runoff=17.53 cfs 1.002 af

Subcatchment 2S: PHASE 14 POST Runoff Area=267,862 sf 50.30% Impervious Runoff Depth>3.37"
Tc=5.0 min CN=86 Runoff=38.33 cfs 1.729 af

Pond 3P: BMP #46 Peak Elev=446.34' Storage=32,452 cf Inflow=38.33 cfs 1.729 af
Primary=14.52 cfs 1.433 af Secondary=0.00 cfs 0.000 af Outflow=14.52 cfs 1.433 af

Total Runoff Area = 12.299 ac Runoff Volume = 2.730 af Average Runoff Depth = 2.66"
74.85% Pervious = 9.206 ac 25.15% Impervious = 3.093 ac

Summary for Subcatchment 1S: PHASE 14 EXISTING CONDITIONS

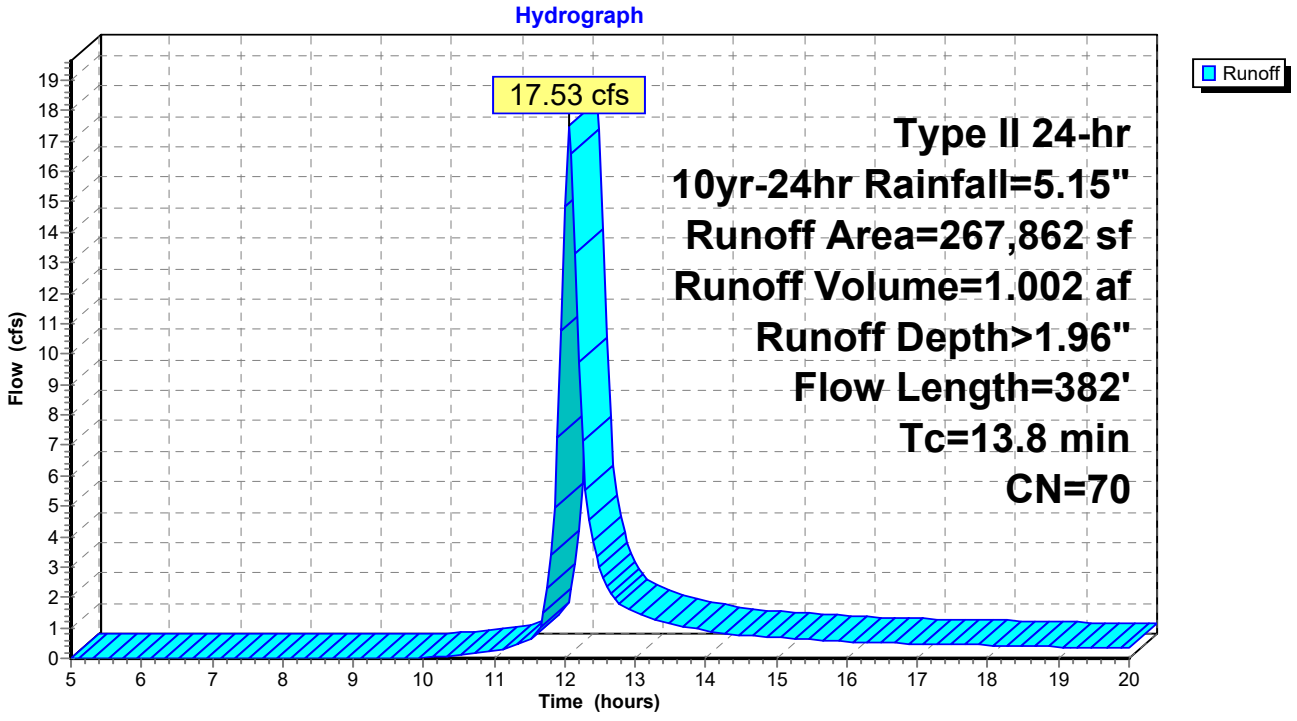
Runoff = 17.53 cfs @ 12.06 hrs, Volume= 1.002 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr-24hr Rainfall=5.15"

Area (sf)	CN	Description
267,862	70	Woods, Good, HSG C
267,862		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	100	0.1000	0.15		**Sheet Flow, Overland Flow** Woods: Light underbrush n= 0.400 P2= 3.48"
3.0	282	0.0975	1.56		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.8	382	Total			

Subcatchment 1S: PHASE 14 EXISTING CONDITIONS



Summary for Subcatchment 2S: PHASE 14 POST CONSTRUCTION

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

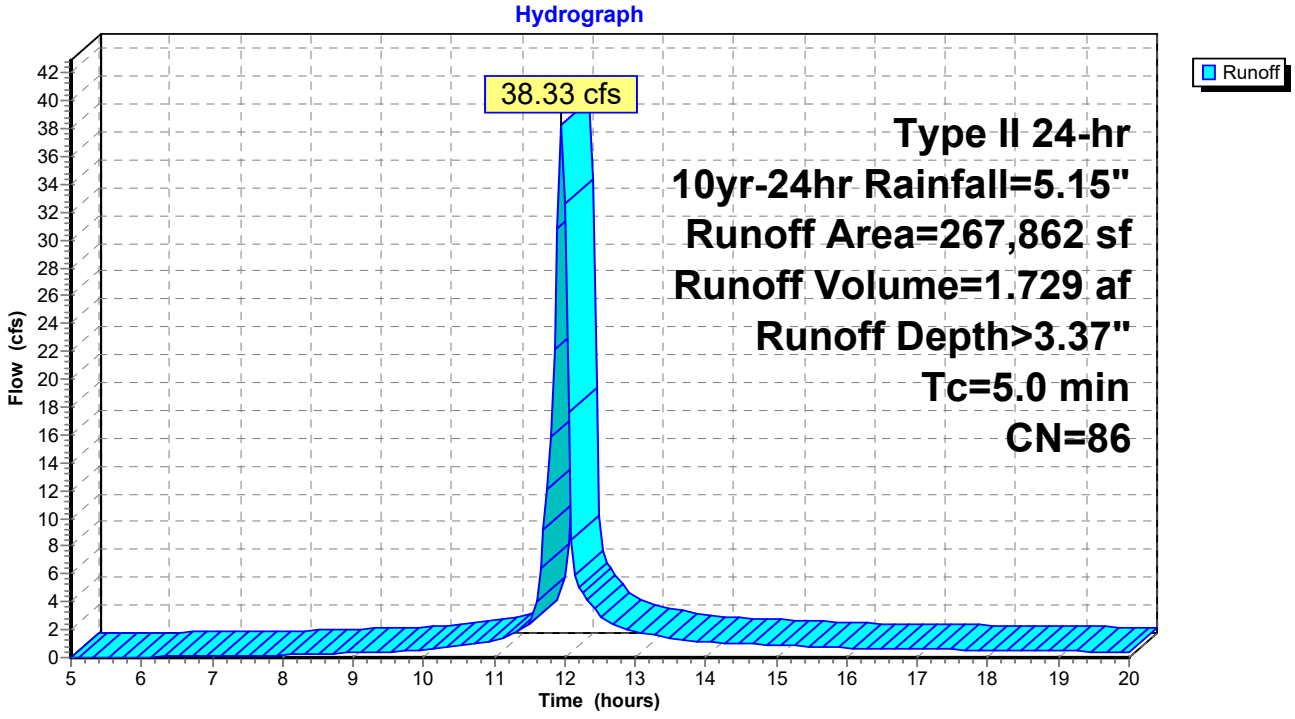
Runoff = 38.33 cfs @ 11.95 hrs, Volume= 1.729 af, Depth> 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr-24hr Rainfall=5.15"

Area (sf)	CN	Description
134,723	98	Paved roads w/curbs & sewers, HSG D
133,139	74	>75% Grass cover, Good, HSG C
267,862	86	Weighted Average
133,139		49.70% Pervious Area
134,723		50.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assume 5 min**

Subcatchment 2S: PHASE 14 POST CONSTRUCTION



Summary for Pond 3P: BMP #46

Inflow Area = 6.149 ac, 50.30% Impervious, Inflow Depth > 3.37" for 10yr-24hr event
Inflow = 38.33 cfs @ 11.95 hrs, Volume= 1.729 af
Outflow = 14.52 cfs @ 12.07 hrs, Volume= 1.433 af, Atten= 62%, Lag= 7.0 min
Primary = 14.52 cfs @ 12.07 hrs, Volume= 1.433 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 446.34' @ 12.07 hrs Surf.Area= 13,583 sf Storage= 32,452 cf

Plug-Flow detention time= 91.1 min calculated for 1.428 af (83% of inflow)
Center-of-Mass det. time= 42.1 min (805.3 - 763.2)

Volume	Invert	Avail.Storage	Storage Description
#1	443.50'	92,624 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

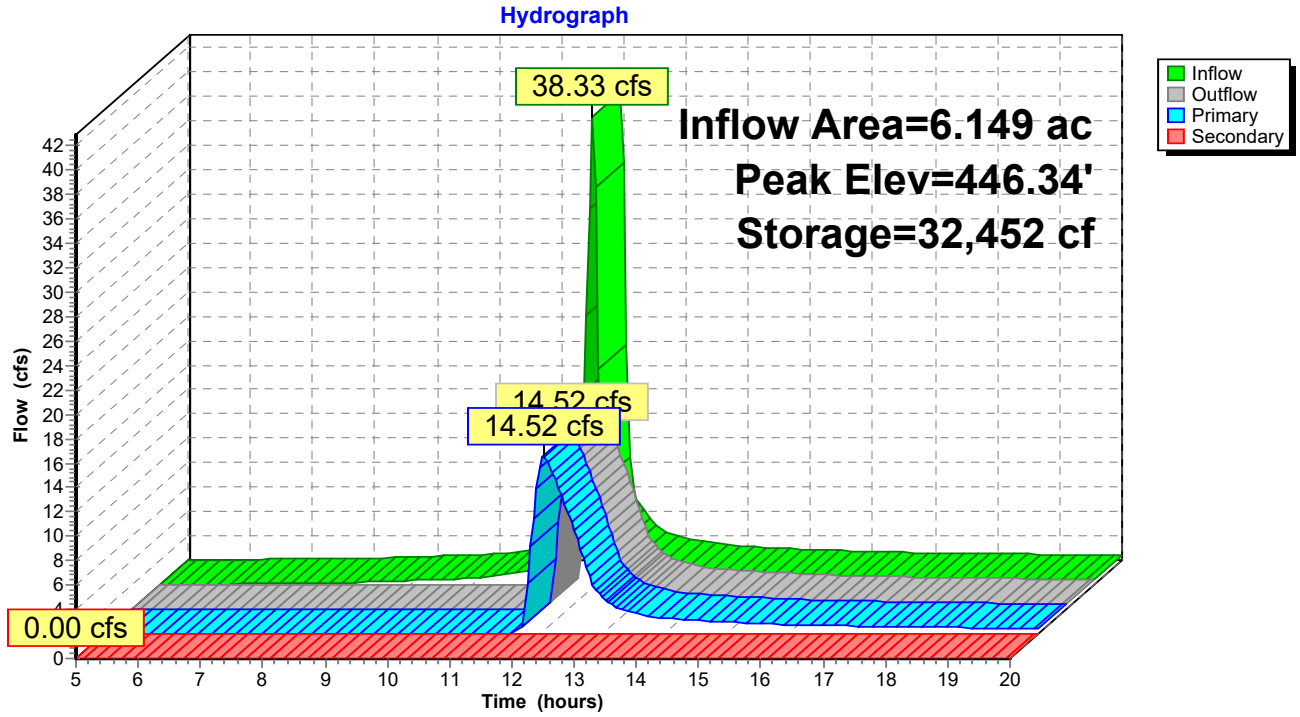
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
443.50	8,321	0	0
444.00	10,241	4,641	4,641
445.00	11,629	10,935	15,576
446.00	13,074	12,352	27,927
447.00	14,574	13,824	41,751
448.00	16,132	15,353	57,104
449.00	17,746	16,939	74,043
450.00	19,416	18,581	92,624

Device	Routing	Invert	Outlet Devices
#1	Primary	440.50'	**24.0" Round Culvert** L= 51.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 440.50' / 440.00' S= 0.0098 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	443.50'	**1.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	444.70'	**24.0" W x 5.0" H Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 1	447.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	448.00'	**10.0' 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=14.41 cfs @ 12.07 hrs HW=446.32' (Free Discharge)
└**1=Culvert** (Passes 14.41 cfs of 33.21 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 7.98 fps)
  ├**3=Orifice/Grate** (Orifice Controls 14.29 cfs @ 5.71 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=443.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: BMP #46



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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: PHASE 14 EXISTING Runoff Area=267,862 sf 0.00% Impervious Runoff Depth>4.04"
Flow Length=382' Tc=13.8 min CN=70 Runoff=35.99 cfs 2.070 af

Subcatchment 2S: PHASE 14 POST Runoff Area=267,862 sf 50.30% Impervious Runoff Depth>5.85"
Tc=5.0 min CN=86 Runoff=64.05 cfs 2.997 af

Pond 3P: BMP #46 Peak Elev=447.45' Storage=48,534 cf Inflow=64.05 cfs 2.997 af
Primary=35.39 cfs 2.693 af Secondary=0.00 cfs 0.000 af Outflow=35.39 cfs 2.693 af

Total Runoff Area = 12.299 ac Runoff Volume = 5.066 af Average Runoff Depth = 4.94"
74.85% Pervious = 9.206 ac 25.15% Impervious = 3.093 ac

Summary for Subcatchment 1S: PHASE 14 EXISTING CONDITIONS

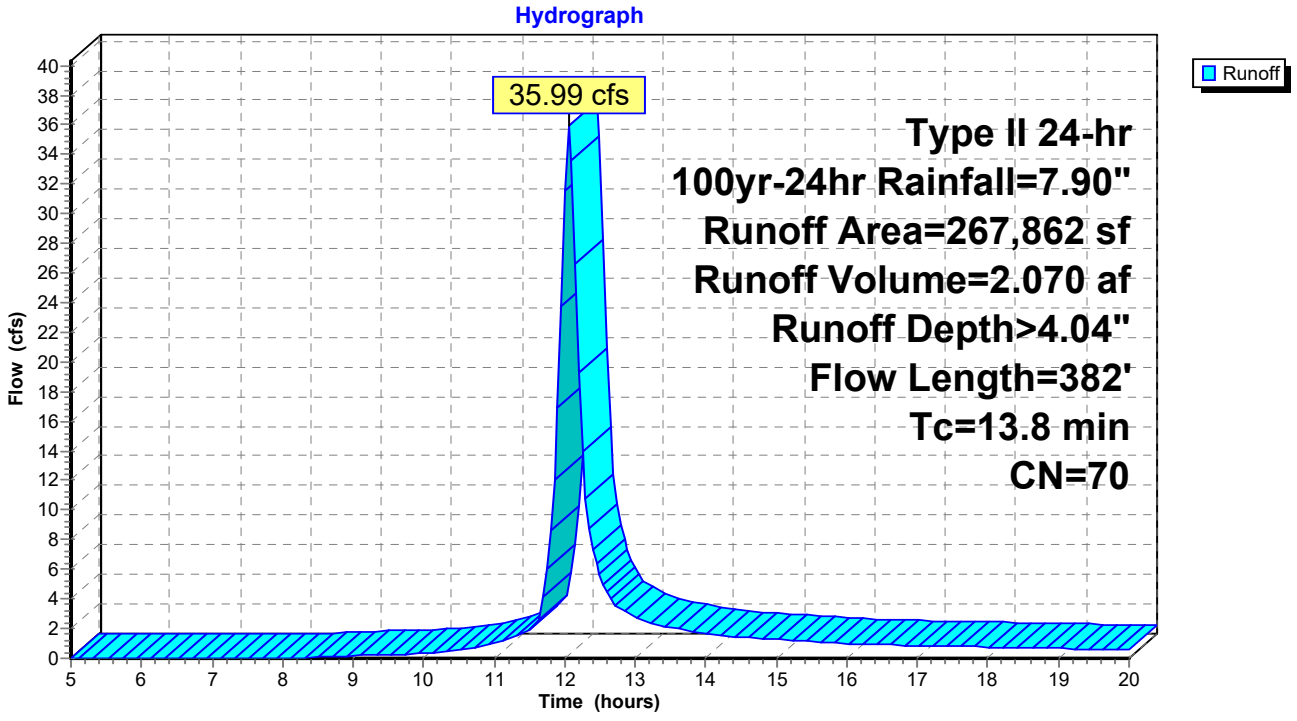
Runoff = 35.99 cfs @ 12.06 hrs, Volume= 2.070 af, Depth> 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr-24hr Rainfall=7.90"

Area (sf)	CN	Description
267,862	70	Woods, Good, HSG C
267,862		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	100	0.1000	0.15		**Sheet Flow, Overland Flow** Woods: Light underbrush n= 0.400 P2= 3.48"
3.0	282	0.0975	1.56		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.8	382	Total			

Subcatchment 1S: PHASE 14 EXISTING CONDITIONS



Summary for Subcatchment 2S: PHASE 14 POST CONSTRUCTION

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

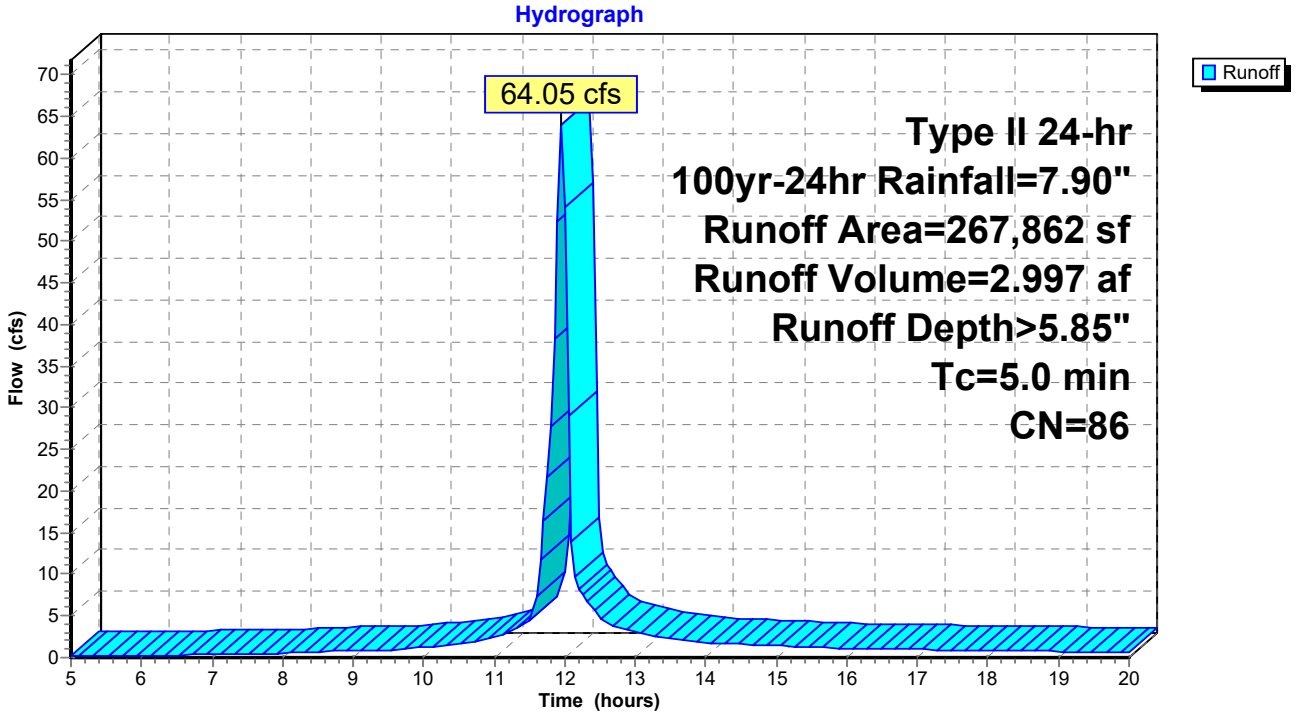
Runoff = 64.05 cfs @ 11.95 hrs, Volume= 2.997 af, Depth> 5.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr-24hr Rainfall=7.90"

Area (sf)	CN	Description
134,723	98	Paved roads w/curbs & sewers, HSG D
133,139	74	>75% Grass cover, Good, HSG C
267,862	86	Weighted Average
133,139		49.70% Pervious Area
134,723		50.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assume 5 min**

Subcatchment 2S: PHASE 14 POST CONSTRUCTION



Summary for Pond 3P: BMP #46

[82] Warning: Early inflow requires earlier time span

Inflow Area = 6.149 ac, 50.30% Impervious, Inflow Depth > 5.85" for 100yr-24hr event
Inflow = 64.05 cfs @ 11.95 hrs, Volume= 2.997 af
Outflow = 35.39 cfs @ 12.05 hrs, Volume= 2.693 af, Atten= 45%, Lag= 5.8 min
Primary = 35.39 cfs @ 12.05 hrs, Volume= 2.693 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 447.45' @ 12.05 hrs Surf.Area= 15,282 sf Storage= 48,534 cf

Plug-Flow detention time= 74.2 min calculated for 2.684 af (90% of inflow)
Center-of-Mass det. time= 39.7 min (790.9 - 751.2)

Volume	Invert	Avail.Storage	Storage Description
#1	443.50'	92,624 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

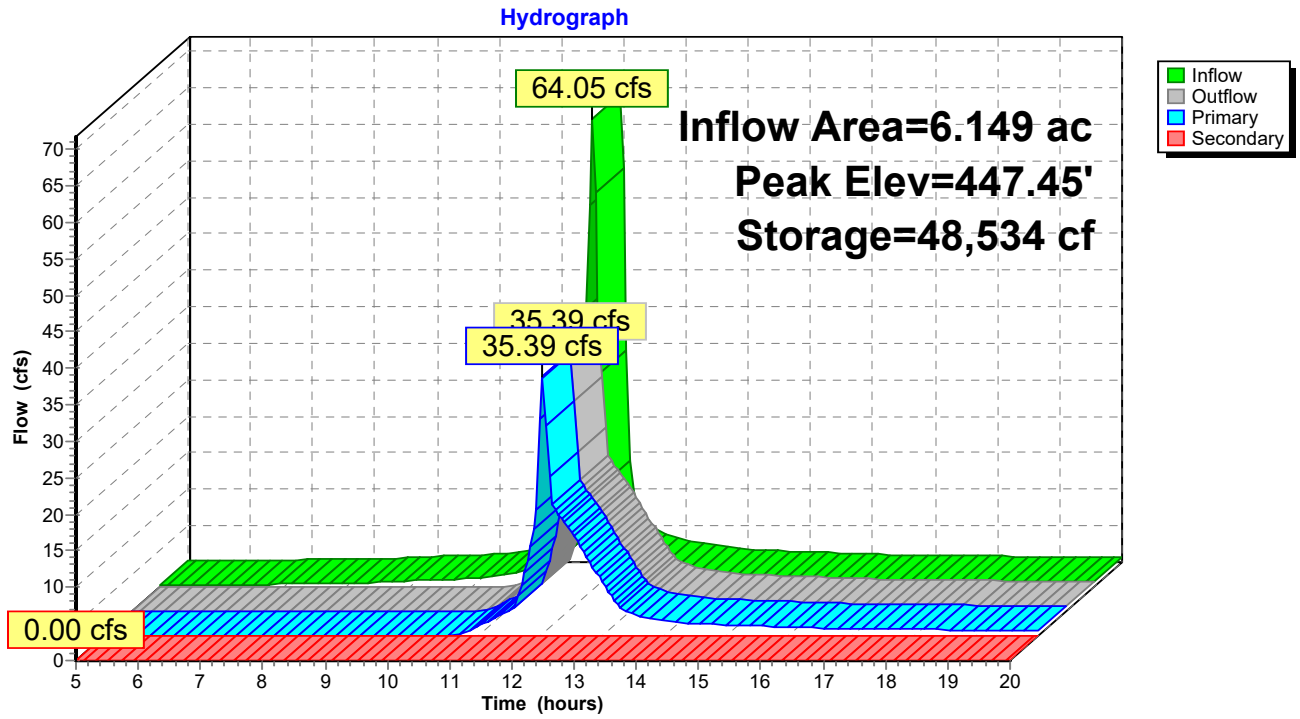
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
443.50	8,321	0	0
444.00	10,241	4,641	4,641
445.00	11,629	10,935	15,576
446.00	13,074	12,352	27,927
447.00	14,574	13,824	41,751
448.00	16,132	15,353	57,104
449.00	17,746	16,939	74,043
450.00	19,416	18,581	92,624

Device	Routing	Invert	Outlet Devices
#1	Primary	440.50'	**24.0" Round Culvert** L= 51.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 440.50' / 440.00' S= 0.0098 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	443.50'	**1.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	444.70'	**24.0" W x 5.0" H Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 1	447.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	448.00'	**10.0' 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=35.12 cfs @ 12.05 hrs HW=447.45' (Free Discharge)
└**1=Culvert** (Passes 35.12 cfs of 36.90 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.15 cfs @ 9.48 fps)
  ├**3=Orifice/Grate** (Orifice Controls 19.18 cfs @ 7.67 fps)
  └**4=Orifice/Grate** (Weir Controls 15.78 cfs @ 2.19 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=443.50' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: BMP #46



WATER QUALITY POND CALCULATIONS - BMP #46

Project Name

Briar Chapel - Phase 14 - BMP #46

Project Number

02735-0248

Date
April 19, 2019

3rd revision
2nd revision
1st revision

Water Quality Pond Drainage Area Data

Project: Briar Chapel - Phase 14 - BMP #46
Project No.: 02735-0248

Date: April 19, 2019

1543094
2080688
2365515

Total site area: 267,862 square feet = 6.15 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	72,600	72,600	0	0
On-site streets	0	40,455	40,455	0	0
On-site alleys	0	0	0	0	0
On-site sidewalks	0	9,420	9,420	0	0
On-site future (open space)	0	0	0	0	0
Off-site future development	0	0	0	0	0
Contingency (10%)	0	12,248	12,248	0	0
Total Impervious	***0***	***134,723***	***134,723***	***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	133,140	133,140	0	0
On-site woods	267,862	0	-267,862	0	0
Other undeveloped	0	0	0	0	0
Total off-site non-impervious	0	0	0	0	0
Total non-impervious	267,862	133,140	-134,723	0	0

Total Drainage Area	267,862	267,862	0	0	0
Percent Impervious	0.0	50.3	50.3	n/a	n/a

Water Quality Pond Surface Area Calculations

Project: Briar Chapel - Phase 14 - BMP #46
Project No.: 02735-0248

Date: April 19, 2019

Total on-site drainage area to pond: 267,862 square feet
Total impervious area in drainage area: 134,723 square feet

Average water depth of basin at normal pool: 3.15 feet

Location of site: Chatham County
Site region: Piedmont

% Impervious cover: 50.3 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: 1.8 percent
For a site in a Coastal County: 2.0 percent

Required surface area of pond:

For a site in the Piedmont: 4,690.0 square feet for main pool
For a site in a Coastal County: 5,420.0 square feet

Notes:

Water Quality Pond Stormwater Runoff Volume Calculations

Project	Briar Chapel - Phase 14 - BMP #46	
Project No.	02735-0248	
Date	April 19, 2019	
Drainage area	267,862	square feet
Impervious area	134,723	square feet
Rainfall depth	1.00	inches
Percent Impervious	50.3	percent

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

Runoff coefficient - R(v)	0.50	in/in

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

Runoff volume	11,220.3	cubic feet

Notes:

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

Project: Briar Chapel - Phase 14 - BMP #46
Project No.: 02735-0248

Date: April 19, 2019

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]
443.5	0	8,321.0	0.191	8,321.0	0.19	0.0	0.0	0.0	0.0
444	0.5	10,241.0	0.235	10,241.0	0.04	4,640.5	0.11	4,640.5	0.11
444.7	1.2	11,207.0	0.257	11,207.0	0.02	7,506.8	0.17	12,147.3	0.28
445	1.5	11,629.0	0.267	11,629.0	0.01	3,425.4	0.08	15,572.7	0.36
446	2.5	13,074.0	0.300	13,074.0	0.03	12,351.5	0.28	27,924.2	0.64
447	3.5	14,574.0	0.335	14,574.0	0.03	13,824.0	0.32	41,748.2	0.96
448	4.5	16,132.0	0.370	16,132.0	0.04	15,353.0	0.35	57,101.2	1.31
449	5.5	17,746.0	0.407	17,746.0	0.04	16,939.0	0.39	74,040.2	1.70
450	6.5	19,416.0	0.446	19,416.0	0.04	18,581.0	0.43	92,621.2	2.13

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

Project: Briar Chapel - Phase 14 - BMP #46
Project No.: 02735-0248

Date: April 19, 2019

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]
438	0	1,556.0	0.036	1,556.0	0.0	0.0	0.0	0.0	0.0
439	1	2,160.0	0.050	604.0	0.0	1,858.0	0.0	1,858.0	0.0
440	2	2,821.0	0.065	661.0	0.0	2,490.5	0.1	4,348.5	0.1
441	3	3,538.0	0.081	717.0	0.0	3,179.5	0.1	7,528.0	0.1
442	4	4,312.0	0.099	774.0	0.0	3,925.0	0.1	11,453.0	0.2
443	5	5,142.0	0.118	830.0	0.0	4,727.0	0.1	16,180.0	0.2
443.5	5.5	6,029.0	0.138	887.0	0.0	2,792.8	0.1	18,972.8	0.2

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

Project: Briar Chapel - Phase 14 - BMP #46
Project No.: 02735-0248

Date: April 19, 2019

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]
440	0	32.0	0.001	32.0	0.0	0.0	0.0	0.0	0.0
441	1	182.0	0.004	150.0	0.0	107.0	0.0	107.0	0.0
442	2	432.0	0.010	250.0	0.0	307.0	0.0	414.0	0.0
443	3	850.0	0.020	418.0	0.0	641.0	0.0	1,055.0	0.0
443.5	3.5	1,085.0	0.025	235.0	0.0	483.8	0.0	1,538.8	0.0

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]
440	0	53.0	0.001	53.0	0.0	0.0	0.0	0.0	0.0
441	1	257.0	0.006	204.0	0.0	155.0	0.0	155.0	0.0
442	2	572.0	0.013	315.0	0.0	414.5	0.0	569.5	0.0
443	3	1,022.0	0.023	450.0	0.0	797.0	0.0	1,366.5	0.0
443.5	3.5	1,207.0	0.028	185.0	0.0	557.3	0.0	1,923.8	0.0

Water Quality Basin Dewatering Time Calculations

Project Briar Chapel - Phase 14 - BMP #46
Project No. 02735-0248

Date April 19, 2019

Water quality treatment volume	11,220	cubic feet
Total treatment volume	12,147	cubic feet
Maximum head of water above dewatering hole	1.20	feet
Driving head	0.40	feet
Orifice coefficient	0.60	
Diameter of each hole	1.75	inches
Number of holes	1	
Cross sectional area of each hole =	0.017	square feet
Cross sectional area of each hole =	2.4	square inches
Cross sectional area of dewatering hole(s) =	0.017	square feet
Cross sectional area of dewatering hole(s) =	2.4	square inches
Dewatering time for water quality volume =	2.6	days
	61.6	hours
Dewatering time for total volume =	2.8	days
	66.7	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 14 - BMP #46
Project No.: 02735-0248

Date: April 19, 2019

Drainage area to pond	267,862	square feet =	6.15	acres
Impervious area in drainage area	134,723	square feet =	3.09	acres

Bottom of pond elevation	438.00	feet
Normal pool elevation	443.50	feet
Main pond volume at normal pool	18,973	cubic feet
Forebay volume at normal pool	3,463	cubic feet
Forebay % of total volume	18.2%	

Required volume for design rainfall	11,220	cubic feet
Required surface area for main pool	4,690	square feet

Volume provided for storage of design rainfall = 12,147 cubic feet at elevation 444.7

Surface area provided at normal pool of main pond = 6,029 square feet

Average Depth 3.15 feet

ANTI-FLOATATION DESIGN	DATE: 4/12/2019	DESIGNED BY: BSS
PROJECT NAME: Briar Chapel Phase 14 PROJECT LOCATION: Chatham County, NC	PROJECT NO: 02735-0248	CHECKED BY: GCA

Pond Name=	BMP #46				
Riser Outer Width =	5	ft	Riser Resisting Force =	8,775	lb
Riser Outer Length =	5	ft	Base Resisting Force =	9,188	lb
Riser Inner Width =	4	ft	Total Resisting Force =	17,963	lb
Riser Inner Length =	4	ft			
Riser Height =	6.5	ft	Riser Buoyant Force =	10,140	lb
			Base Buoyant Force =	3,822	lb
Concrete Base Length =	7	ft	Total Buoyant Force =	13,962	lb
Concrete Base Width =	7	ft			
Concrete Base Depth =	15	in	Factor of Safety	1.29	**Design Acceptable**

OUTLET PROTECTION DESIGN	DATE: 04/12/2019	DESIGNED BY: BSS
PROJECT NAME: Briar Chapel - Phase 14 PROJECT LOCATION: Chatham County, NC	PROJECT NO: 02735-0248	CHECKED BY GCA

Storm Outlet Structure

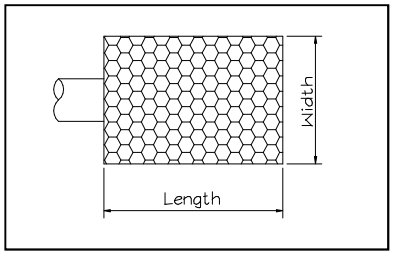
Structure=	BMP #46	
Size=	24	in
Q10 =	14.51	cfs
Qfull =	22.36	cfs
Vfull =	7.12	fps

Q_{10}/Q_{full} =	0.65	
V/Vfull =	1.07	
V =	7.6	fps

From Fig. 8.06.b.1:

Zone = 3 (4)

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