NEW HAMPSHIRE ALTERATION OF TERRAIN PERMIT APPLICATION FOR THE ANTRIM WIND PARK PROJECT IN ANTRIM, NEW HAMPSHIRE

Submitted to:

NEW HAMPSHIRE SITE EVALUATION COMMITTEE

Submitted by:

Antrim Wind Energy
155 Fleet St.
Portsmouth, NH 03801-0065

Prepared by:

TRC

14 Gabriel Drive

Augusta, Maine 04330

July 2015

Application Elements

(From Item #10 of the Application Form)

- **Copy of the signed application form including application checklist**

  Exhibit 1
- **Copy of the check**

  Exhibit 2
- **Copy of the USGS map with the property boundaries outlined (1" = 2000' scale)**

  Exhibit 3
- **Copy of the proof of delivery to the municipality**

  The Town of Antrim Board of Selectmen will be provided with a copy of the entire SEC application at the time it is filed. The Applicant will file a copy of the return receipt or other documentation of receipt by the Town with the SEC and has reserved Appendix 8 of the SEC application for this purpose.
- **Narrative of the project with a summary table of the peak discharge rate for the off-site discharge points**

  See Stormwater Management Narrative (Exhibit 4)
- **Web GIS printout – with the "Surface Water Impairments" layer turned on**

  Exhibit 3
- **Web GIS printouts – with the AoT screening layers turned on**

  Exhibit 3
- **NHB letter**

  Exhibit 5
- **The Web Soil Survey Map with the project's watershed outlined**

  See Stormwater Design Drawings (Exhibit 4) Sheet WS-3
- **Aerial Photograph (1" = 2000' scale with the site boundaries outlined)**

  Exhibit 3
- **Photographs representative of the site**

  Exhibit 6
- **Groundwater Recharge Volume calculations**

  See Stormwater Management Narrative (Exhibit 4) Section 4.1.2
- **BMP worksheets**

  See Stormwater Management Narrative (Exhibit 4) Appendix B

- **Drainage analysis**

  See Stormwater Management Narrative (Exhibit 4) Appendix A

- **Riprap apron or other energy dissipation or stability calculations**

  See Stormwater Management Narrative (Exhibit 4) Appendix C

- **Site Specific Soil Survey report**

  Not applicable—waiver requested. See Exhibit 7 for Waiver Request

- **Infiltration Feasibility Report**

  Not applicable— See Stormwater Management Narrative (Exhibit 4) Section 4.1.3

- **Registration and Notification Form for Storm Water Infiltration to Groundwater**

  Not applicable— See Stormwater Management Narrative (Exhibit 4) Section 4.1.3

- **Inspection and maintenance manual with long term maintenance agreements**

  See Post-Construction Stormwater Management, Inspection, & Maintenance Plan (Exhibit 8).

- **Source control plan**

  Not applicable, per NH DES Environmental Fact Sheet WDDWGB225: The project will use best management practices (BMPs) so that there will be no contact between regulated substances and precipitation/ runoff from any portion of the site.

- **One set of design plans on 24” x 36” white paper**

  See Civil Design Drawings (Exhibit 7A of the SEC Application)

- **Pre- & post-development color coded soil plans**

  See Stormwater Design Drawings (Exhibit 4) Sheet WS-3

- **Pre- & post-development drainage area plans on 24” x 36” white paper**

  See Stormwater Design Drawings (Exhibit 4) Sheets WS1 & WS2

- **100-year Floodplain Report**

  Not applicable. The project is not within a 100-year floodplain.

Exhibit 1

Application Form

NHDES-W-01-003

ALTERATION OF TERRAIN PERMIT APPLICATION

Water Division/ Alteration of Terrain Bureau/ Land Resources Management
Check the Status of your Application: http://des.nh.gov/onestop

RSA/ Rule: RSA 485-A:17, Env-Wq 1500

Administrative Use Only	Administrative Use Only	Administrative Use Only	File Number: Check No. Amount: Initials:

1. PROJECT LOCATION			
PROJECT NAME: Antrim Wind Park			
ADDRESS: 354 Keene Road			
TOWN/CITY: Antrim	COUNTY: Hillsborough	STATE: NH	ZIPCODE:
TAX MAP: 212; 235; 236; 239	BLOCK:	LOT NUMBER:	UNIT:
LOCATION COORDINATES:	☐ LATITUDE/LONGITUDE ☐ UTM ☐ STATE PLANE		
2. APPLICANT INFORMATION (DESIRED PERMIT HOLDER)			
APPLICANT NAME: Antrim Wind Energy, LLC	CONTACT NAME: John B. Kenworthy		
EMAIL: generate@eolian-energy.com	FAX:603-457-0065	PHONE: 603-570-4842	
ADDRESS: 155 Fleet Street			
TOWN/CITY: Portsmouth	STATE: NH	ZIPCODE: 03801-4050	
3. PROPERTY OWNER INFORMATION (IF DIFFERENT FROM APPLICANT)			
PROPERTY OWNER: See Exhibit 11	CONTACT NAME:		
EMAIL:	FAX:	PHONE:	
ADDRESS:			
TOWN/CITY:	STATE:	ZIPCODE:	
4. AGENT INFORMATION			
ENGINEERING FIRM: TRC	CONTACT NAME: Dana Valleau		
EMAIL: dvalleau@trcsolutions.com	FAX: 207-621-8226	PHONE: 207-620-3834	
ADDRESS: 14 Gabriel Drive			
TOWN/CITY: Augusta	STATE: ME	ZIPCODE: 04330	

5. PROJECT TYPE				
☐ EXCAVATION	☒ COMMERCIAL	☐ SCHOOL	☐ AGRICULTURAL	☐ LANDFILL
☐ RESIDENTIAL	☐ GOLF COURSE	☐ MUNICIPAL	☐ LAND CONVERSION	☐ OTHER

6. BRIEF PROJECT DESCRIPTION (PLEASE DO NOT REPLY "SEE ATTACHED")

Construct 9 wind turbines and associated infrastructure, including access roads, an electric collection system, an operations and maintenance buildling, and a substation in Antrim, NH.

7. IF APPLICABLE, DESCRIBE ANY WORK STARTED PRIOR TO RECEIVING PERMIT

Installation of meterological tower (2009).

8. REQUIRED QUESTIONS (PLEASE DO NOT LEAVE FIELDS BLANK. IF NOT APPLICABLE, STATE "N/A")

A. Date a copy of the *complete* application was sent to the municipality[1]: __/__/____. **(Attach proof of delivery)**

B. Total area of disturbance: 2,487,956 square feet

C. Additional impervious cover as a result of the project: 495,292 square feet (use the "-" symbol to indicate a net reduction in impervious coverage). Total impervious cover: 495,292 square feet.

D. Total undisturbed cover: _____ square feet

E. Number of lots proposed: 0

F. Total length of roadway: 19,008 linear feet

G. Select plan type submitted: ☐ Land Conversion ☒ Detailed Development ☐ Excavation, Grading & Reclamation ☐ Steep Slope

H. Name of receiving waters: NORTH BRANCH RIVER, GREGG LAKE, UNNAMED STREAM

Using NHDES's Web GIS OneStop program (www2.des.state.nh.us/gis/onestop/), with the Surface Water Impairment layer turned on, list the impairments identified: ________NA________ (enter "NA" if no pollutants are listed).
For more guidance see: http://des.nh.gov/organization/divisions/water/wmb/tmdl/documents/onestop_gis_wqc_ref_guide.pdf

I. ☐ This project is within ¼ mi of a designated river (**River name:** ________NA____________) AND I have notified the Local River Management Advisory Committee by providing them with a copy of the complete application[1], including all supporting materials, on **Month:** __ **Day:** __ **Year:** ____ **(Attach proof of delivery)**

☒ This project is **not** within ¼ mi of a designated river.

J. Name of species identified by the Natural Heritage Bureau as threatened or endangered or of concern: See attached NHNHB documentation in Exhibit 5..

K. Cut volume 0 cubic feet and fill volume NA cubic feet within the 100-year floodplain (enter "NA" if not within the floodplain)

L. Is the project within a Water Supply Intake Protection Area (WSIPA)? YES☐ NO☒

Is the project within a Groundwater Protection Area (GPA)? YES☐ NO☒

Are the well setbacks outlined in Env-Wq 1508.02 being met? YES☒ NO☐

Note: Guidance document titled "*Using DES's OneStop WebGIS to Locate Protection Areas*" is available online. For more details on the restrictions in these areas, read Chapter 3.1 in Volume 2 of the NH Stormwater Manual.

[1] In accordance with Env-Wq 1503.05 (c)(4), *provide proof* that a completed application form, checklist, plans and all other supporting materials have been sent or delivered to the governing body of each municipality in which the project is proposed. Env-Wq 1503.05 (c)(4) also requires the applicant to provide proof that a completed application form, checklist, plans and all other supporting materials have been sent or delivered to the Local River Advisory Committee, if the project is within 1/4 mi of a designated river.

8. REQUIRED QUESTIONS CONTINUED

M. Is the project a High Load area in accordance with Env-Wq 1502.26? YES☐ NO☒
If yes, specify type of high load land use or activity? _____

N. For each type of approval or permit, check "Yes" if the permit or approval type is required for your project and indicate the permit number / approval date. Indicate "Pending" if the application has been filed, but the permit has not yet been issued. Check "No" to indicate that the permit type is required, but not yet been filed with the Department. Check "N/A" if the permit or approval type is not required for your project.

1. Water Supply Approval	☐ Y	☒N	☐N/A	Permit number:	Pending ☐
2. Wetlands Permit	☒ Y	☐N	☐N/A	Permit number:	Pending ☒
3. Shoreland Permit	☐ Y	☒N	☐N/A	Permit number:	Pending ☐
4. UIC Registration	☐ Y	☒N	☐N/A	Registration date:	Pending ☐
5. Large/Small Community Well Approval	☐ Y	☒N	☐N/A	Approval letter date:	Pending ☐
6. Large Groundwater Withdrawal Permit	☐ Y	☒N	☐N/A	Permit number:	Pending ☐
7. Other: SEC	☒ Y	☐N	☐N/A	Permit number:	Pending ☒

9. ADDITIONAL INFORMATION

A. If you have had a pre-application meeting with AoT staff, state his or her name(s):CRAIG RENNIE
Attach a copy of the meeting minutes.

B. Will blasting of bedrock be required? YES☒ NO☐ If yes, estimated quantity of blast rock: _____ cubic yards.
If yes, standard blasting BMP notes must be placed on the plans, available at:
http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-10-12.pdf

If greater than 5,000 cubic yards of blast rock will be generated, a groundwater monitoring program must be developed and submitted to DES. Contact the AoT Bureau for additional detail.

C. Indicate if the project will withdraw from, or directly discharge to, any of the following water sources *post-development* and, if "Yes", indicate its purpose*:*

1. Stream or Wetland Purpose:	YES ☐ Withdrawal ☐ Discharge ☐ NO ☒
2. Man-made pond created by impounding a stream or wetland Purpose:	YES ☐ Withdrawal ☐ Discharge ☐ NO ☒
3. Unlined pond dug into the water table Purpose:	YES ☐ Withdrawal ☐ Discharge ☐ NO ☒

10. CHECK ALL APPLICATION ATTACHMENTS THAT APPLY (SUBMIT WITH APPLICATION IN ORDER LISTED)

LOOSE:

☒ Signed application form: des.nh.gov/organization/divisions/water/aot/index.htm (with attached proof(s) of delivery)
☒ Check for the application fee: des.nh.gov/organization/divisions/water/aot/fees.htm
☒ Color copy of a USGS map with the property boundaries outlined (1" = 2,000' scale)
☒ A copy of the pre-application meeting minutes, if you had a pre-application meeting with AoT staff.

BIND IN A REPORT IN THE FOLLOWING ORDER:

☒ Copy of the signed application form & application checklist (des.nh.gov/organization/divisions/water/aot/index.htm)
☒ Copy of the check
☒ Copy of the USGS map with the property boundaries outlined (1" = 2,000' scale)
☒ Narrative of the project with a summary table of the peak discharge rate for the off-site discharge points
☒ Web GIS printout with the "Surface Water Impairments" layer turned on - www2.des.state.nh.us/gis/onestop/
☒ Web GIS printouts with the AoT screening layers turned on - www2.des.state.nh.us/gis/onestop/
☒ NHB letter using DataCheck Tool – www.nhdfl.org/about-forests-and-lands/bureaus/natural-heritage-bureau/
☒ The Web Soil Survey Map with project's watershed outlined – websoilsurvey.nrcs.usda.gov
☒ Aerial photograph (1" = 2,000' scale with the site boundaries outlined)
☒ Photographs representative of the site
☐ Groundwater Recharge Volume calculations (one worksheet for each permit application):
des.nh.gov/organization/divisions/water/aot/documents/bmp_worksh.xls
☒ BMP worksheets (one worksheet for each treatment system):
des.nh.gov/organization/divisions/water/aot/documents/bmp_worksh.xls

10. CHECK ALL APPLICATION ATTACHMENTS THAT APPLY (SUBMIT WITH APPLICATION IN ORDER LISTED)

☒ Drainage analysis, stamped by a professional engineer (see Application Checklist for details)
☒ Riprap apron or other energy dissipation or stability calculations
☐ Site Specific Soil Survey report, stamped and with a certification note prepared by the soil scientist that the survey was done in accordance with the Site Specific Soil Mapping standards, *Site-Specific Soil Mapping Standards for NH & VT, SSSNNE Special Publication No. 3.*
☐ Infiltration Feasibility Report (example online)
☐ Registration and Notification Form for Storm Water Infiltration to Groundwater (UIC Registration-for underground systems only, including drywells and trenches): (http://des.nh.gov/organization/divisions/water/dwgb/dwspp/gw_discharge)
☒ Inspection and maintenance manual with, if applicable, long term maintenance agreements
☐ Source control plan

PLANS:

☒ One set of design plans on 34 - 36" by 22 - 24" white paper (see Application Checklist for details)
☒ Pre & post-development color coded soil plans on 11" x 17" (see Application Checklist for details)
☒ Pre & post-development drainage area plans on 34 - 36" by 22 - 24" white paper (see Application Checklist for details)

100-YEAR FLOODPLAIN REPORT:

☐ All information required in Env-Wq 1503.09, submitted as a separate report.

☒ **REVIEW APPLICATION FOR COMPLETENESS & CONFIRM INFORMATION LISTED ON THE APPLICATION IS INCLUDED WITH SUBMITTAL.**

11. REQUIRED SIGNATURES		
☒ APPLICANT OR ☐ AGENT: SIGNATURE	John B. Kenworthy PRINT NAME LEGIBLY	7 / 2 / 15 DATE
OWNER OR OWNER'S AGENT (IF DIFFERENT FROM APPLICANT): SIGNATURE	 PRINT NAME LEGIBLY	/ / DATE
By initialing here, I understand that in accordance with Env-Wq 1503.20(e), within one week after permit approval, the applicant shall submit a copy of all approved documents to the department in PDF format on a CD.		JBK

ATTACHMENT A:
ALTERATION OF TERRAIN PERMIT APPLICATION CHECKLIST

Check the box to indicate the item has been provided or provide an explanation why the item does not apply.

DESIGN PLANS

☒ Plans printed on 34 - 36” by 22 - 24” white paper

☒ PE stamp

☒ Wetland delineation

☒ Temporary erosion control measures

☒ Treatment for all stormwater runoff from impervious surfaces such as roadways (including gravel roadways), parking areas, and non-residential roof runoff. Guidance on treatment BMPs can be found in Volume 2, Chapter 4 of the NH Stormwater Management Manual.

☒ Pre-existing 2-foot contours

☒ Proposed 2-foot contours

☒ Drainage easements protecting the drainage/treatment structures

☒ Compliance with the Wetlands Bureau, RSA 482- A http://des.nh.gov/organization/divisions/water/wetlands/index.htm. Note that artificial detention in wetlands is not allowed.

☐ Compliance with the Comprehensive Shoreland Protection Act, RSA 483-B. http://des.nh.gov/organization/divisions/water/wetlands/cspa

☐ Benches. Benching is needed if you have more than 20 feet change in elevation on a 2:1 slope, 30 feet change in elevation on a 3:1 slope, 40 feet change in elevation on a 4:1 slope.

☐ Check to see if any proposed ponds need state Dam permits. http://des.nh.gov/organization/divisions/water/dam/documents/damdef.pdf

DETAILS

☒ Typical roadway x-section

☐ Detention basin with inverts noted on the outlet structure

☒ Stone berm level spreader

☒ Outlet protection – riprap aprons

☒ A general installation detail for an erosion control blanket

☒ Silt fences or mulch berm

☐ Storm drain inlet protection. Note that since hay bales must be embedded 4 inches into the ground, they are not to be used on hard surfaces such as pavement.

☒ Hay bale barriers

☒ Stone check dams

☒ Gravel construction exit

☒ The treatment BMP's proposed

☐ Any innovative BMP's proposed

CONSTRUCTION SEQUENCE/EROSION CONTROL

☒ Note that the project is to be managed in a manner that meets the requirements and intent of RSA 430:53 and Chapter Agr 3800 relative to invasive species.

☒ Note that perimeter controls shall be installed prior to earth moving operations

☒ Note that ponds and swales shall be installed early on in the construction sequence (before rough grading the site)

☒ Note that all ditches and swales shall be stabilized prior to directing runoff to them

☒ Note that all roadways and parking lots shall be stabilized within 72 hours of achieving finished grade

☒ Note that all cut and fill slopes shall be seeded/loamed within 72 hours of achieving finished grade

☒ Note that all erosion controls shall be inspected weekly AND after every half-inch of rainfall

☒ Note the limits on the open area allowed, see Env-Wq 1505.02 for detailed information

Example note: The smallest practical area shall be disturbed during construction, but in no case shall exceed 5 acres at any one time before disturbed areas are stabilized

☒ Note the definition of the word "stable"

Example note: An area shall be considered stable if one of the following has occurred:

- Base course gravels have been installed in areas to be paved
- A minimum of 85 percent vegetated growth has been established
- A minimum of 3 inches of non-erosive material such stone or riprap has been installed
- Or, erosion control blankets have been properly installed.

☒ Note the limit of time an area may be exposed
Example note: All areas shall be stabilized within 45 days of initial disturbance

☒ Provide temporary and permanent seeding specifications. (Reed canary grass is listed in the Green Book; however, this is a problematic species according to the Wetlands Bureau and therefore should not be specified)

☒ Provide winter construction notes that meet or exceed our standards.

Standard Winter Notes:

- All proposed vegetated areas that do not exhibit a minimum of 85 percent vegetative growth by October 15, or which are disturbed after October 15, shall be stabilized by seeding and installing erosion control blankets on slopes greater than 3:1, and seeding and placing 3 to 4 tons of mulch per acre, secured with anchored netting, elsewhere. The installation of erosion control blankets or mulch and netting shall not occur over accumulated snow or on frozen ground and shall be completed in advance of thaw or spring melt events.

- All ditches or swales which do not exhibit a minimum of 85 percent vegetative growth by October 15, or which are disturbed after October 15, shall be stabilized temporarily with stone or erosion control blankets appropriate for the design flow conditions.

- After November 15, incomplete road or parking surfaces, where work has stopped for the winter season, shall be protected with a minimum of 3 inches of crushed gravel per NHDOT item 304.3.

☐ Note at the end of the construction sequence that "Lot disturbance, other than that shown on the approved plans, shall not commence until after the roadway has the base course to design elevation and the associated drainage is complete and stable". – This note is applicable to single/duplex family subdivisions, when lot development is not part of the permit.

DRAINAGE ANALYSES

Please double-side 8 ½" x 11" sheets where possible but, **do not** reduce the text such that more than one page fits on one side.

☒ PE stamp

☒ Rainfall amount obtained from the Northeast Regional Climate Center- http://precip.eas.cornell.edu/. Include extreme precipitation table as obtained from the above referenced website.

☒ Drainage analyses, in the following order:

- Pre-development analysis: Drainage diagram
- Pre-development analysis: Area Listing and Soil Listing
- Pre-development analysis: Node listing 1-year (if applicable), 2-year, 10-year and 50-year
- Pre-development analysis: Full summary of the 10-year storm
- Post-development analysis: Drainage diagram
- Post-development analysis: Area Listing and Soil Listing
- Post-development analysis: Node listing for the 2-year, 10-year and 50-year
- Post-development analysis: Full summary of the 10-year storm

☒ Review the Area Listing and Soil Listing reports

- Hydrologic soil groups (HSG) match the HSGs on the soil maps provided
- There is the same or less HSG A soil area after development (check for each HSG)
- There is the same or less "woods" cover in the post-development
- Undeveloped land was assumed to be in "good" condition
- The amount of impervious cover in the analyses is correct

Note: A good check is to subtract the total impervious area used in the pre analysis from the total impervious area used in the post-analysis. For residential projects without demolition occurring, a good check is to take this change in impervious area, subtract out the roadway and divide the remaining by the number of houses/units proposed. Do these numbers make sense?

☒ Check the storage input used to model the ponds

☐ Check to see if the artificial berms pass the 50-year storm, i.e., make sure the constructed berms on ponds are not overtopped

☐ Check the outlet structure proposed and make sure it matches that modeled

☒ Check to see if the total areas in the pre and post analyses are same

☒ Confirm the correct NRCS storm type was modeled (Coos, Carroll & Grafton counties are Type II, all others Type III)

PRE AND POST-DEVELOPMENT DRAINAGE AREA PLANS

☒ Plans printed on 34 - 36” by 22 - 24” on white paper

☒ Submit these plans separate from the soil plans

☒ A north arrow

☒ A scale

☒ Labeled subcatchments, reaches and ponds

☒ Tc lines

☒ A clear delineation of the subcatchment boundaries

☒ Roadway station numbers

☒ Culverts and other conveyance structures

PRE AND POST-DEVELOPMENT COLOR-CODED SOIL PLANS

☒ 11” x 17”sheets suitable, as long as it is readable

☒ Submit these plans separate from the drainage area plans

☒ A north arrow

☒ A scale

☐ Name of the soil scientist who performed the survey and date the soil survey took place

☒ 2-foot contours (5-foot contours if application is for a gravel pit) as well as other surveyed features

☒ Delineation of the soil boundaries and wetland boundaries

☒ Delineation of the subcatchment boundaries

☒ Soil series symbols (e.g., 26)

☒ A key or legend which identifies each soil series symbol and its associated soil series name (e.g., 26 = Windsor)

☒ The hydrologic soil group color coding (A = Green, B = yellow, C= orange, D=red, Water=blue, & Impervious = gray)

Please note that excavation projects (e.g., gravel pits) have similar requirements to that above, however the following are common exceptions/additions:

☐ Drainage report is not needed if site does not have off-site flow.

☐ 5 foot contours allowed rather than 2 foot.

☐ No PE stamp needed on the plans

☐ Add a note to the plans that the applicant must submit to the Department of Environmental Services a written update of the project and revised plans documenting the project status every five years from the date of the Alteration of Terrain permit.

☐ Add reclamation notes.

See NRCS publication titled: *Vegetating New Hampshire Sand and Gravel Pits* for a good resource, it is posted online at: http://des.nh.gov/organization/divisions/water/aot/categories/publications .

Exhibit 2

Copy of the Application Check

Antrim Wind Energy LLC
155 Fleet Street
Portsmouth, NH 03801
603-570-4842

Centrix Bank & Trust
1 Atwood Lane, Bedford, New Hampshire 03110

001458
54-202/114

DATE 7/3/2015

PAY TO THE ORDER OF Treasurer State of New Hampshire $ **11,250.00

Eleven Thousand Two Hundred Fifty and 00/100** DOLLARS

State of New Hampshire Treasury
25 Capitol Street, Room 121
Concord, NH 03301

Memo Alteration of Terrain Permit Application Fee

AUTHORIZED SIGNATURE

⑈001458⑈ ⑆011402024⑆ 1010125354⑈

Antrim Wind Energy LLC

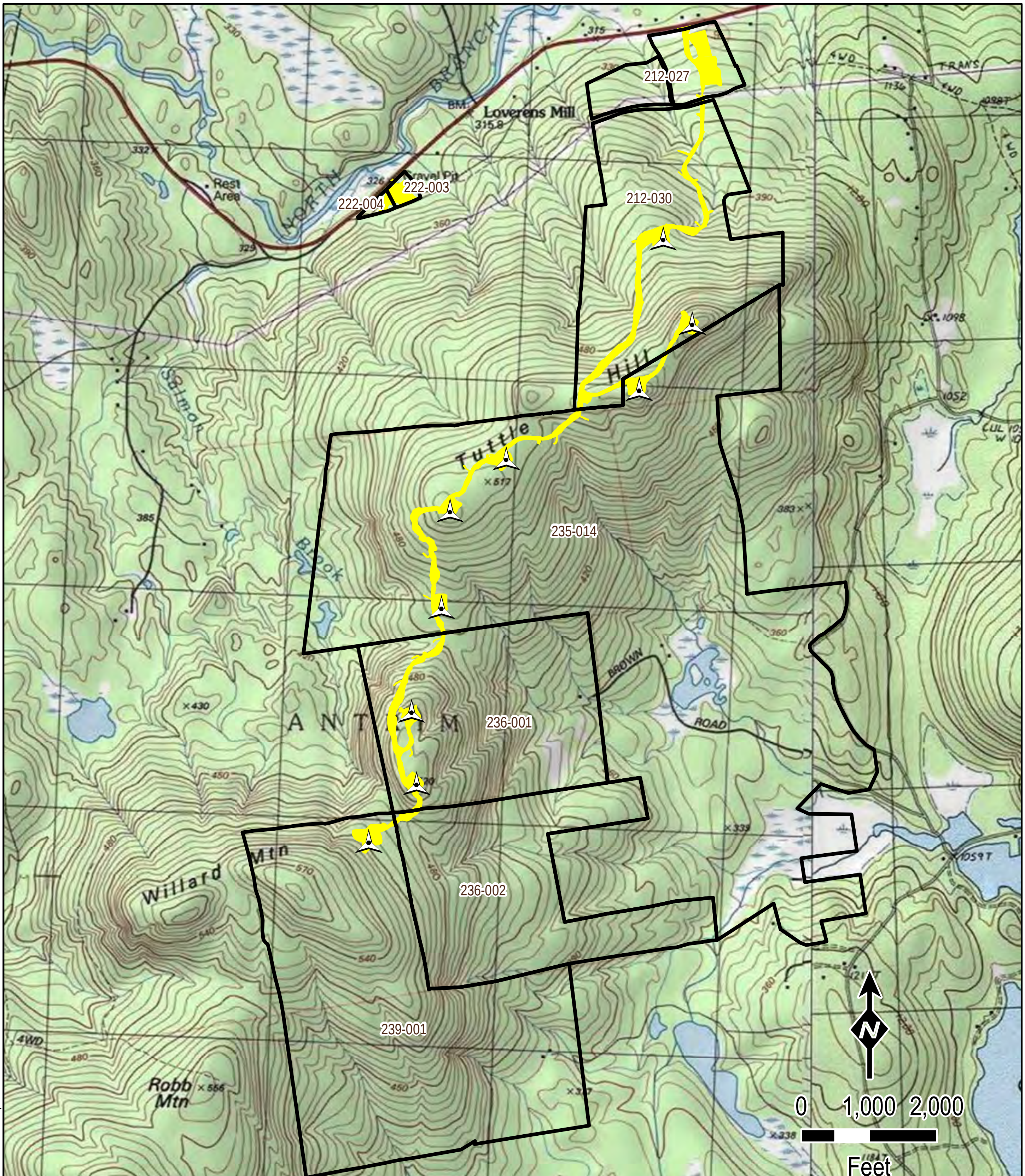
Treasurer State of New Hampshire		7/3/2015	001458
	AoT Permit App Fee		11,250.00
Eastern Checking	Alteration of Terrain Permit Application Fee		11,250.00

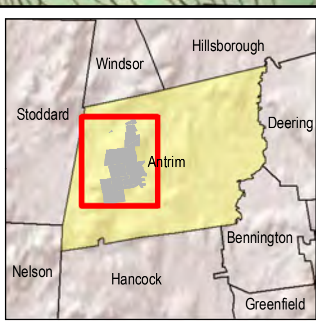
Antrim Wind Energy LLC

Treasurer State of New Hampshire		7/3/2015	001458
	AoT Permit App Fee		11,250.00
Eastern Checking	Alteration of Terrain Permit Application Fee		11,250.00

Exhibit 3

Project Mapping





Legend

Proposed WTG

Project Footprint

Project Parcels

Antrim Wind Energy

ANTRIM WIND ENERGY PROJECT

354 KEENE ROAD, ANTRIM, NH

Project Location Map

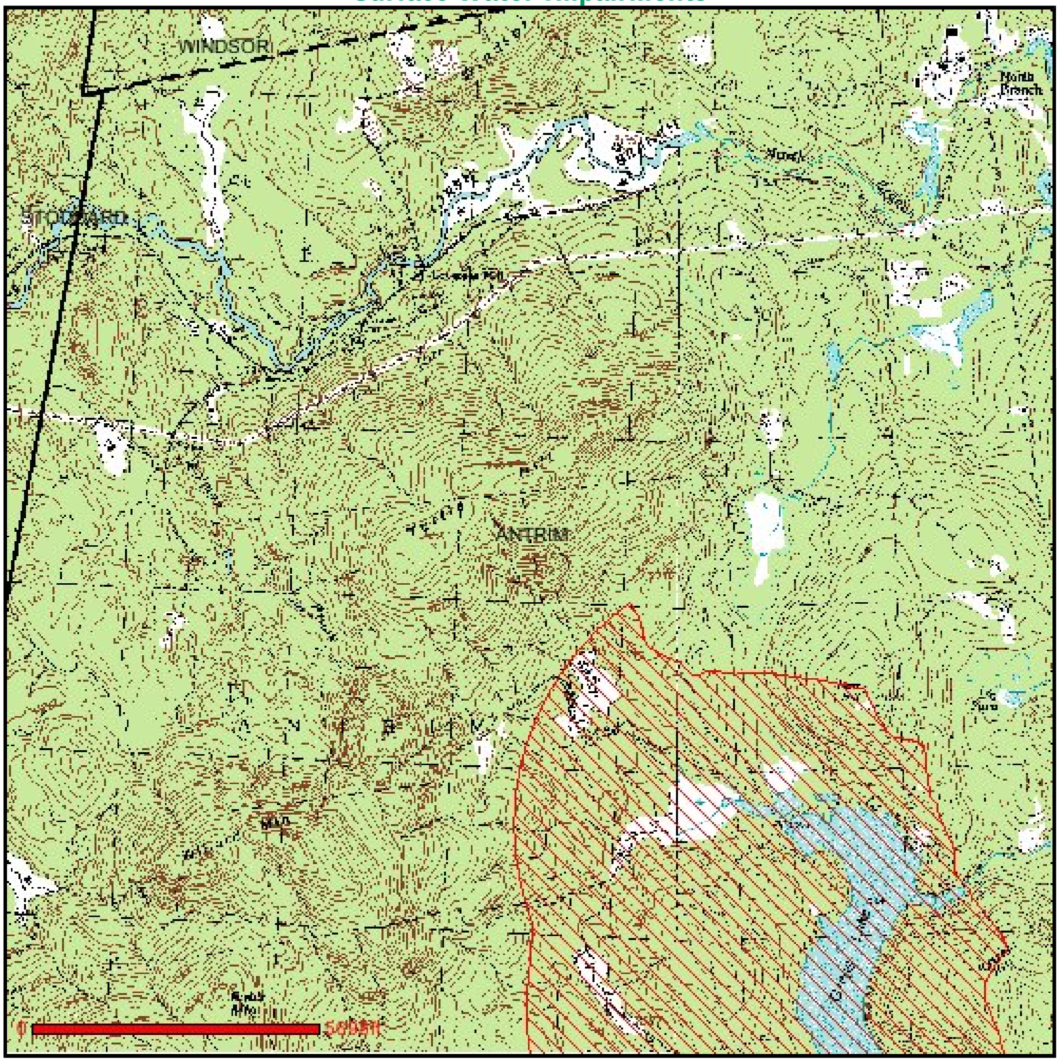
Produced by: TRC | 1/29/2015

V:\PROJECTS\AUGUSTA\Eolian\ANTRIM\Figure C1 Project Location Map.mxd

New Hampshire Department of Environmental Services

OneStop Program GIS

Surface Water Impairments



Legend

- 2010 Surface Water Impairments with 1-Mile Buffer For Development Projects
- Town Boundary
- County Boundary
- State Boundary

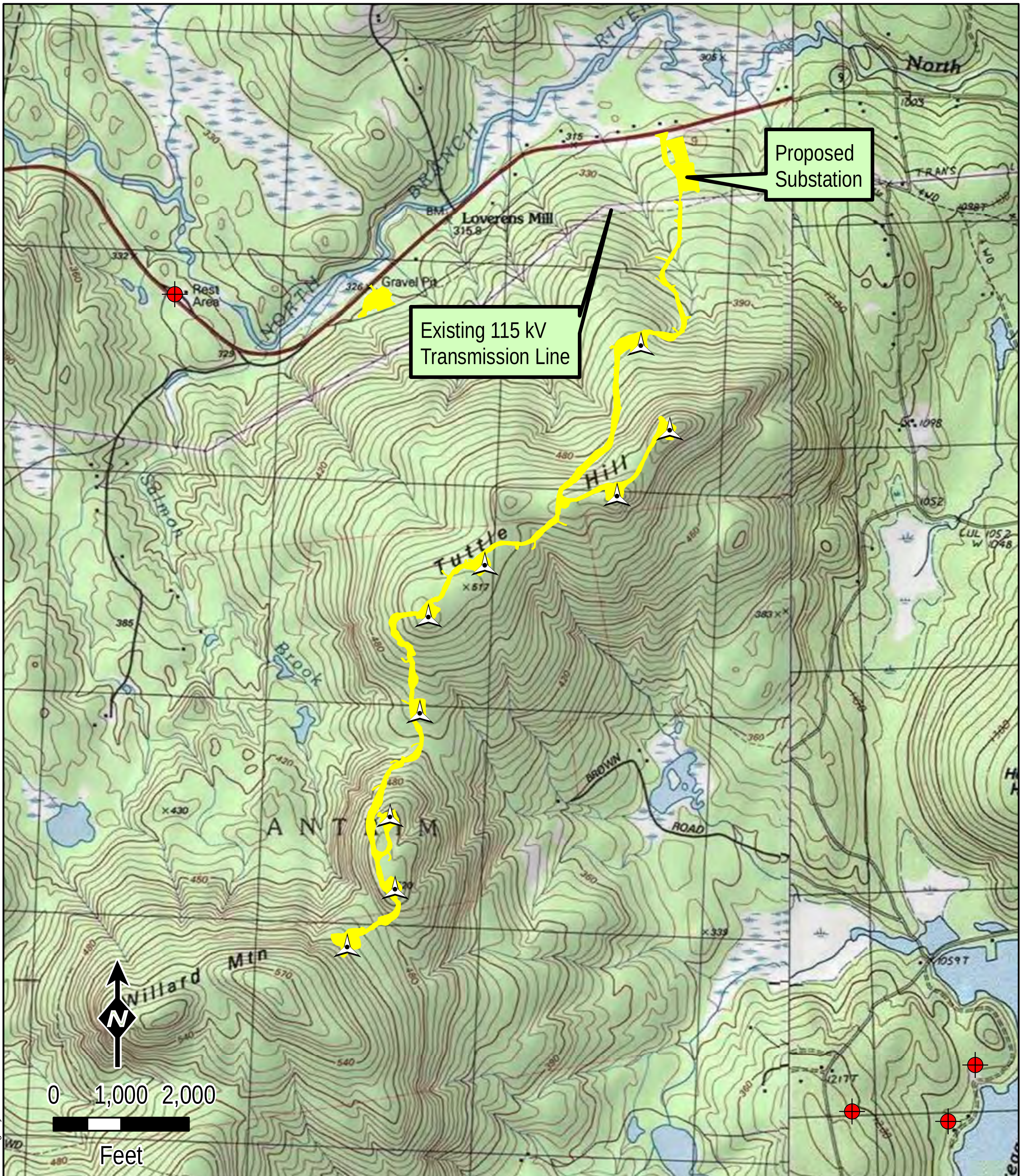
Map Scale = 1 : 69526 (1" = 1.1 miles or 5794 feet)

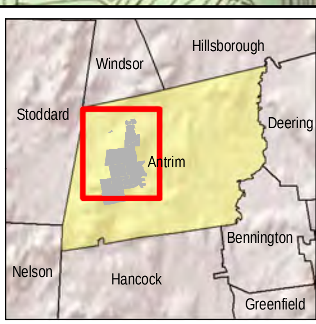
The information contained in the OneStop Program GIS is the best available according to the procedures and standards of each of the contributing programs and of the GIS. The different programs are regularly maintaining the information in their databases. As a result, the GIS may not always provide access to all existing information, and it may occasionally contain unintentional inaccuracies. The Department can not be responsible for the misuse or misinterpretation of the information presented by this system.

Map prepared 7/4/2015 10:51:12 AM

GRANIT Complex Systems Research Center

Developed in cooperation with NH GRANIT





Legend

- Proposed WTG
- Proposed Project Area
- Public Water Supply
- Wellhead Protection Area *
- Aquifer Saturated Thickness Contour *
- Aquifer Transmissity *

** no features within map extents*

*** There are no Groundwater Classification Areas GAA or GA1 or Water Supply Intakes in Antrim*

EOLIAN
RENEWABLE ENERGY

ANTRIM WIND ENERGY PROJECT

354 KEENE ROAD, ANTRIM, NH

Revised Project Area with NH DES Alteration of Terrain Screening Layers

Produced by: TRC | 7/7/2015

Source: NH Department of Environmental Services Drinking Water and Groundwater Bureau

V:\PROJECTS\AUGUSTA\Eolian\ANTRIM\Revised AoT Screening Layers.mxd

Exhibit 4

Stormwater Management Narrative

ANTRIM WINDPARK PROJECT

Alteration of Terrain Permit Application

Stormwater Management Narrative

Submitted to:

New Hampshire Department of Environmental Services

Submitted by:

Antrim Wind Energy, LLC
155 Fleet Street
Portsmouth, NH 03801

Prepared by:

TRC
249 Western Avenue
Augusta, ME 04330

May 2015

STATE OF NEW HAMPSHIRE
DANIEL T. BUTLER
No. 8105
LICENSED
PROFESSIONAL ENGINEER

5/1/15

TRC

TABLE OF CONTENTS

1.0 ANTRIM WINDPARK PROJECT 1
2.0 EXISTING CONDITIONS 1
2.1 LAND COVER 1
2.2 SOILS 1
2.3 SITE TOPOGRAPHY/HYDROLOGY 2
2.4 DOWNSTREAM WATERBODIES 2
3.0 PROPOSED DEVELOPMENT DESCRIPTION 3
3.1 ALTERATIONS TO LAND COVER 3
3.2 ALTERATIONS TO NATURAL DRAINAGE WAYS 4
4.0 REGULATORY REQUIREMENTS 5
4.1 RUNOFF QUANTITY CONTROL 5
4.1.1 Watershed Analysis: Pre- v. Post-development 5
4.1.2 Groundwater Recharge Volume 6
4.1.3 Infiltration Feasibility Report 7
4.1.4 Channel Protection 7
4.1.5 Peak Control 7
4.2 RUNOFF QUALITY CONTROL 7
4.2.1 Water Quality Volume 8
4.2.2 Water Quality Flow 8
4.2.3 Roadway Buffers 8
4.2.4 Ditch Turnout Buffers 9
4.2.5 Small Pervious Area Buffers 9
4.2.6 Treatment Swales 9
4.2.7 Bioretention Basins 10
4.3 CONVEYANCE AND STABILIZATION 10
4.3.1 Culvert Sizing 10
4.3.2 Permeable Road Base 10
4.3.3 Outlet Protection 11
4.3.4 Ditch protection 11
4.3.5 Slope Stabilization 11
5.0 RUNOFF ANALYSIS 12
5.1 METHODOLOGY 12
5.1.1 Rainfall Data 12
5.1.2 Curve Number Computations 13
5.1.3 Time of Concentration Calculations 13
5.1.4 Travel Time Calculations 14
5.1.5 Reservoir Routing Calculations 14
5.1.6 Peak Discharge Calculations 14
6.0 CONCLUSIONS 14

APPENDICES

Appendix A	Watershed Analysis Calculations
Appendix B	Water Quality Calculations
Appendix C	Conveyance and Stabilization Calculations
Appendix D	Post-construction Inspection and Maintenance Plan

1.0 ANTRIM WINDPARK PROJECT

The proposed Antrim Windpark Project is a wind energy generation facility to be located near Antrim, New Hampshire. The project will include construction of nine (9) wind turbine generators (WTGs), a substation, and associated access roads, crane pads, and stormwater management facilities. The proposed site is generally linear, running approximately north to south along the ridge top of Tuttle Hill and Willard Mountain and spanning several individually owned parcels. The site will be accessed from State Route 9 (Keene Road). Approximately 3.6 miles of gravel road will be constructed.

Within the project area, approximately 57.1 acres will be disturbed during construction. Following construction, approximately 45.8 acres will be restored and re-vegetated including roadway shoulders and side slopes, and much of the construction pad area at the tower locations. Approximately 11.3 acres will remain as permanently developed area including the access road, substation yards and buildings, crane pads, and tower foundations.

2.0 EXISTING CONDITIONS

2.1 Land Cover

The project site is predominantly unimproved and heavily wooded. The ridge can be accessed in several places by rough trails or 4WD roads. Evidence of past logging activities is clear in some areas. Public Service of New Hampshire (PSNH) maintains a right-of-way that crosses the northerly part of the site.

2.2 Soils

Soil information used in stormwater runoff analysis was obtained from the Natural Resources Conservation Service (NRCS) medium intensity soil survey of Hillsborough County, New Hampshire. The information was downloaded from the NRCS Web Soil Survey website. See Appendix A for copies of this information. The Hydrologic Soil Groups (HSG) of the soils are classified by Technical Release TR-55 of the Natural Resources Conservation Service (formerly the Soil Conservation Service). Table 1 below summarizes the soils identified on or adjacent to the site.

Table 1. Site Soils

Symbol	Soil Type	HSG
77C, 77D	Marlow stony loam	C
160B, 160C	Tunbridge-Lyman-Monadnock complex, stony	C
161C, 161D	Lyman-Tunbridge rock outcrop complex	C
399	Rock outcrop	D

2.3 Site Topography/Hydrology

The proposed project generally follows the ridge top from Tuttle Hill to Willard Mountain, with the land sloping primarily northwesterly and southeasterly. Slopes range from approximately 2 percent at the ridge top and saddles to approximately 50 percent along the steeper natural slopes. Elevations across the area that would be developed for the wind park range from approximately 1,050 to 1,700 feet above mean sea level. The project will run along the divide between three (3) watersheds. Currently runoff flows overland northwesterly to North Branch River, northeasterly to an unnamed watershed, and southeasterly to Gregg Lake.

The two-foot contour information shown on the plans is based on an aerial survey performed by James W. Sewell Co. in 2011.

2.4 Downstream Waterbodies

As shown on the Watershed Plan, the project site straddles three (3) watersheds. Runoff from Watershed 1W flows northwesterly, under Route 9, to the North Branch River. Runoff from Watershed 2W flows northeasterly to an unnamed stream, which continues to its confluence with North Branch River at Steels Pond, and then on to Franklin Pierce Lake. Runoff from Watershed 3W flows southeasterly to Gregg Lake. In addition, several wetlands, vernal pools, and intermittent streams were identified on site during a natural resources survey performed by TRC in 2011.

3.0 PROPOSED DEVELOPMENT DESCRIPTION

This project involves the construction of a 9-turbine wind energy generation facility, including a 1.64 acre crushed stone yard area (PSNH substation, collector substation, and Operation & Maintenance building parking area), a 3.6 mile gravel access road, 9 graveled wind turbine generator construction areas, a 34kV collector system, and an associated stormwater management system.

3.1 Alterations to Land Cover

The substation yards are located approximately at STA. 8+00. They are located adjacent to the existing PSNH transmission corridor to minimize the amount of clearing required for the new lines. Both yards will be constructed to PSNH standards, with an open-graded crushed stone surface, two (2) control houses, an Operations & Maintenance building, and associated parking area and stormwater management facilities. The entire yard will be enclosed within a security fence.

An access road, with two (2) spur roads, will be constructed from the project entrance at Route 9 to its termination at WTG-9. The total length will be approximately 3.6 miles. The road will be constructed of compacted crushed stone. From STA. 0+00 to STA. 37+12, the access road will be constructed with a width of 16 feet. The remainder of the road will have a construction width of 34 feet to accommodate the crane. The road will have a maximum slope of 12%, with the exception of one short length near WTG-8 where it reaches 13%. It will be graded with a mono-pitched cross slope of 2%. Side slopes will be constructed at a slope of 2H:1V to minimize the footprint. Upon completion of construction, the road width will be reduced to 16 feet along its entire length by re-vegetating a 9-foot shoulder on both sides. The side slopes will also be permanently stabilized and re-vegetated.

A gravel wind turbine construction area will be built at each WTG location. These areas will be approximately 0.9 acres, and will provide room for a 6000 square foot crane pad, a 20-foot diameter concrete tower foundation, and a turbine assembly area. These locations will also be used as staging and laydown areas during construction. After construction, a significant portion of each of these areas will be re-vegetated, leaving the 6,000 square foot crane pad as impervious area. See Sheet C-19 for a reclamation detail.

A 34.5 kV collector system will be constructed from the turbines to the collector sub-station. Beginning at WTG-9, the collector system will be constructed underground, under the roadway. It will remain underground to STA. 64+50. From STA. 64+50 to STA. 42+00 the collector system will run overhead, roughly parallel to the road. At STA. 42+00 it goes back underground to STA. 36+30, in the vicinity of WTG-1. It then returns to overhead to STA. 11+94. From STA. 11+94, it will run underground to the substation.

3.2 Alterations to Natural Drainage Ways

The stormwater management system has been designed to minimize impacts to the existing natural drainage ways. Because much of the road will be constructed on the crest of the ridge, overall drainage patterns and directions of flow will remain generally the same. A permeable road base (rock sandwich) will be provided at appropriate locations to maintain sheet flow conditions and provide hydraulic connectivity between wetlands. Where steep roadway/ditch slopes will impede the effectiveness of a permeable road base, culverts have been spaced every 100 feet in order to minimize channelization of runoff. In addition, oversized culverts will be installed in locations where animals are likely to want to cross under the roadway.

The roadway will cross two (2) identified streams. The first stream crossing is located near STA. 2+25. In this area, the road is in approximately 10 feet of cut. This is necessary in order to meet the maximum slope requirement of 12% for construction and delivery vehicles. As such, impacts to the stream cannot be avoided. The second crossing is located near STA. 18+75. For this crossing, culvert SD-4 will be a 3-sided concrete box culvert designed to comply with NHDES stream crossing guidelines. A culvert cross section detail is provided on Sheet C-23.

The project has been laid out to minimize wetland impacts to the greatest extent practicable. However, construction will result in approximately 0.22 acres of wetland impacts.

4.0 REGULATORY REQUIREMENTS

This Stormwater Management Narrative has been prepared as part of an NHDES Alteration of Terrain Permit application. As such, the project has been designed to meet the standards set forth in the "New Hampshire Code of Administrative Rules, Chapter Env-Wq 1500 Alteration of Terrain", as well as the "New Hampshire Stormwater Manual (Volumes 1, 2, and 3) –December 2008".

4.1 Runoff Quantity Control

Design requirements for runoff quantity control are included in Chapter 2 of the New Hampshire Stormwater Manual (SWM).

4.1.1 Watershed Analysis: Pre- v. Post-development

Because this project will result in a relatively small amount of new impervious area distributed between three (3) expansive, largely undeveloped watersheds, it is unlikely that the development will result in a significant increase in runoff compared to the pre-development condition. Pre- and post-development stormwater runoff models have been prepared for each of the three (3) watersheds affected by the project. These models demonstrate that, on a watershed scale, the project will not result in a significant increase in stormwater peak rates of runoff for the 2-year, 10-year, or 50-year design storms in any of the three watersheds. Table 2 below summarizes the results of this analysis. Note that the proposed road will result in minimal changes to the total watershed areas. See Appendix A for CN and Tc calculations and model results.

Table 2. Watershed Analysis Results

Stormwater Runoff – Summary Table					
Analysis Point	**Design Storm**	**Peak Rate of Runoff (cfs)**			
		Pre	**Post**	**Diff.**	**Percent**
SP-1	Area (ac)	1664.68	1663.54	-1.14	-0.07%
	2-year	279.18	278.99	-0.19	-0.07%
	10-year	877.70	877.10	-0.60	-0.07%
	50-year	1622.52	1621.41	-1.11	-0.07%
SP-2	Area (ac)	595.44	595.43	-0.01	0.00%
	2-year	139.11	139.10	-0.01	-0.01%
	10-year	416.29	416.28	-0.01	0.00%
	50-year	754.35	754.34	-0.01	0.00%
SP-3	Area (ac)	1997.73	1998.42	0.69	0.03%
	2-year	193.34	193.44	0.10	0.05%
	10-year	655.39	655.73	0.34	0.05%
	50-year	1263.86	1264.53	0.67	0.05%

4.1.2 Groundwater Recharge Volume

The Groundwater Recharge Volume (GRV) criterion is a standard implemented to protect groundwater resources. The volume is calculated by the equation:

$$GRV = A_i * R_d$$

Where A_i represents the Effective Impervious Area created by the development. Effective Impervious Area is defined as the total impervious cover that is directly tied to the storm drain network. Because this project will create no effective impervious area, the GRV is also zero, and no infiltration is required.

4.1.3 Infiltration Feasibility Report

No infiltration is proposed for this project. Therefore an Infiltration Feasibility report has not been prepared.

4.1.4 Channel Protection

The Channel Protection criterion is intended to prevent erosion and sedimentation of streams, downstream receiving waters, and wetlands. Based on the Watershed Analysis described in section 4.1.1 above, the 2-year, 24-hour post-development peak flow rates and runoff volumes will not increase significantly from the pre-development condition as a result of the project. Therefore, no runoff quantity controls are required.

4.1.5 Peak Control

The Peak Control criterion is intended to prevent off-site impacts due to an increase in the peak rate of runoff resulting from a development. Based on the Watershed Analysis described in section 4.1.1 above, the 10-year and 50-year, 24-hour post-development peak flow rates are not anticipated to increase significantly as a result of the project. Therefore, no runoff detention facilities are required.

4.2 Runoff Quality Control

Design requirements for runoff quality control are included in Chapters 2 and 4 of the New Hampshire Stormwater Manual (SWM). However, since the New Hampshire stormwater regulations do not address the atypical nature of a linear project such as this, the Maine Stormwater Management (Chapter 500) rules were used as a secondary reference. Under Maine Chapter 500 rules for a linear project, a stormwater management system is required to capture and treat the water quality volume of runoff from at least 75% of the impervious area and 50% of the total developed area. For this project, the impervious area and developed area are equal because all re-vegetated areas will return to a natural condition (no landscaping).

To address the applicable water quality treatment standards for this project, the stormwater management system incorporates a combination of roadway buffers, ditch turnout buffers, treatment swales, and bioretention basins. The proposed stormwater management system provides treatment for the water quality volume of runoff from 81% of the new impervious area.

4.2.1 Water Quality Volume

The Water Quality Volume (WQV) is the amount of runoff from a rainfall event that is required to be captured and treated by a pollutant removal device. The volume is based on the first one (1) inch of rainfall. For this project, WQV calculations are required for the water quality swales and bioretention basins. Refer to Appendix B for all WQV calculations.

4.2.2 Water Quality Flow

The Water Quality Flow (WQF) is the flow rate used for sizing flow-through water quality treatment devices. Calculation of the WQF is based on the WQV. For this project, WQF calculations are required for the water quality swales. Refer to Appendix B for all WQF calculations.

4.2.3 Roadway Buffers

Roadway buffers are the preferred method of water quality treatment for this project. Since the access roads are the predominant design feature, roadway buffers are well-suited to the site. They are especially suitable because of their low-impact, low maintenance characteristics. The design criteria for roadway buffers include; 1) a length of 50 feet for a single lane of traffic, and 2) a maximum slope of 20%. The buffers delineated on the design plans incorporate 9 feet of re-vegetated shoulder and 20 feet of embankment slope (roughly 60% of the total length). Due to the challenging topography and remoteness of the site, the criteria are not always strictly adhered to. For example, in some cases the crane pad area must drain across the road or the buffer slope somewhat exceeds 20%. In these situations the buffer length has been increased to 75 feet.

4.2.4 Ditch Turnout Buffers

Ditch turnout buffers are proposed for areas where the roadway is not approximately parallel to the contours, but the slopes are suitable for buffers. These are reasonably low impact and low maintenance devices. The design criteria for this method are unclear, so engineering judgment was used in the design. The buffer length is determined by the size of the contributing area, with a slope no greater than 15%. The level spreader length must be from 20 to 50 feet in length. Refer to Appendix B for ditch turnout buffer calculations.

4.2.5 Small Pervious Area Buffers

Small pervious area buffers are proposed for wind turbine locations where the re-vegetated construction area can be graded to act as a buffer for the permanent impervious areas. These locations include WTG-2, 5, and 9. The design criteria in the NHSWM were followed.

4.2.6 Treatment Swales

Treatment swales are proposed in areas that are too steep for buffers. Design of these swales is a multi-step procedure. First, the WQV and WQF were calculated using the appropriate NHDES design worksheets. Second, a worksheet was created using *FlowMaster V8i* software. For this analysis, swale parameters and discharge (WQF) were used as input. The software applies the Manning's formula to calculate the normal depth and velocity. Finally an appropriate length was used with the velocity such that the minimum residence time of 10 minutes was achieved. The swales were then checked for adequate capacity and stability. A HydroCAD model was created for this step using the design parameters determined in the first part of the process, and the 10-year, 24-hour storm. Because the contributing subcatchments (designated with an SW-_) are relatively small, a minimum Tc of 6 minutes was assumed. Refer to Appendix B for treatment swale calculations.

4.2.7 Bioretention Basins

Two (2) bioretention basins are proposed for the substation yard area. The WQV was calculated using the appropriate NHDES design worksheets, and an appropriately sized basins were designed. Both basins will be underdrained to avoid any potential infiltration difficulties. Refer to Appendix B for bioretention basin calculations.

4.3 Conveyance and Stabilization

Conveyance features utilized in this project include culverts, permeable road base, and open roadside ditches. All conveyance features were designed in accordance with the appropriate criteria described in the guidance documents. Subcatchments delineated for conveyance analysis are designated with a number such as 1.3, which indicates that it is the 3rd subcatchment delineated in watershed WS-1.

4.3.1 Culvert Sizing

HydroCAD software (see section 5.1 below) was used to determine appropriate culvert sizes. Contributing subcatchments were delineated on the Stormwater Management Plan and modeled with the analysis software. The 25-year, 24-hour storm event was used as the basis for culvert sizing. A minimum diameter of 15 inches was used in most cases, in order to minimize the blockage potential between inspection and maintenance visits. However, 12 inch culverts are proposed for the steeper areas where they are placed every 100 feet. See Appendix C for the *HydroCAD* reports.

4.3.2 Permeable Road Base

Permeable road base is a specialized road base constructed of coarse rock that allows runoff to pass freely under the road. The runoff is discharged as sheet flow, minimizing or eliminating the need for culverts. Permeable road base is proposed for: 1) reasonably flat lengths of roadway where bypass is less likely, 2) areas where the road is in a fill condition to minimize channelization of runoff, and 3) areas where the roadway crosses wetlands and maintaining hydrologic/hydraulic connectivity is desirable. Refer to Sheet C-23 for details.

4.3.3 Outlet Protection

Plunge pools are the predominant means of outlet protection proposed for this project. They have been designed based on the guidance in Section 4-6.6 of the NHSWM. While the level spreaders are intended as part of a water quality device, they also perform as outlet protection. In addition, permanent check dams are provided for certain channel outlets where anticipated design flows are low. Refer to Sheet C-23 for details.

4.3.4 Ditch protection

Armoring for the roadside channels is proposed where steep slopes will lead to erosive velocities under vegetated conditions. As a general rule, any channel steeper than 8% will not be capable of supporting vegetation. The 10-year, 24-hour storm event was used as the basis for stabilization design. After the steep slopes were identified, contributing subcatchments were modeled in *HydroCAD* to determine the design flow. Then, a worksheet was created using *FlowMaster V8i* software. The input parameters included the ditch cross-section, longitudinal slope, design flow, and a roughness coefficient. The roughness coefficient of the riprap was calculated using guidance found in the Maine DEP "Erosion and Sediment Control BMPs – March, 2003", Section E-6 – Riprap Waterways. The software then calculated the normal depth and velocity of the flow. The roughness coefficient (based on the D_{50}) was selected based on the flow depth, and the velocity was calculated as a check. Refer to Appendix C for the HydroCAD reports and riprap sizing calculations.

4.3.5 Slope Stabilization

An embankment slope of 2H:1V was used during site design in order to minimize the footprint and impacts of the project. These slopes will be stabilized with erosion control blankets, loam, and seed. See Sheet C-21 for details.

5.0 RUNOFF ANALYSIS

As described above, stormwater runoff analysis was performed in order to compare pre- and post-development runoff characteristics of the impacted watersheds. It was also performed to determine design flows for water quality swales and ditch/culvert sizing. A Stormwater Management Plan has been prepared in order to illustrate the design assumptions applied when developing the water quality treatment and conveyance features described above.

The Stormwater Management Plan for the proposed project includes 2-foot contours, land cover types, soil groups, watershed boundaries, time of concentration flow lines, existing features, and drainage ways as well as the locations of proposed buildings, roads, other above ground structures and the stormwater management system.

Stormwater analysis calculations are provided in Appendices A, B, and C. The analyses include computations for determining the times of concentration and travel times for the subcatchments, as well as the HydroCAD output which includes composite CN calculations, peak discharge calculations for the design storms, and routing calculations.

5.1 Methodology

Stormwater runoff was estimated using HydroCAD, Version 10.0. HydroCAD software is based on methodologies developed by the United States Department of Agriculture Soil Conservation Service (USDA-SCS), namely *Urban Hydrology for Small Watersheds*, Technical Release 55 and Technical Release 20 (TR-55 and TR-20), in conjunction with other hydrologic and hydraulic calculations. Based on site specific information, including land cover, slopes, soils, and rainfall data, the program estimates inflow and outflow hydrographs for a watershed.

5.1.1 Rainfall Data

Storm events modeled for the runoff analyses assumed precipitation events with a 24-hour duration having a Type III rainfall distribution, with return frequencies of 2, 10, 25, and 50 years. The corresponding precipitation depths for these storm events are 2.8, 4.2, 5.0, and 5.6 inches, respectively. The rainfall distribution type is based on Figure B-2 of the NRCS TR-55 manual (1986). Rainfall amounts are based on Appendix A of the NHSWM, Volume 2 (2008).

5.1.2 Curve Number Computations

Runoff curve numbers are based on the land cover and soils of the project site. Cover types for the site were determined from aerial photography and site visits, and are indicated on the Watershed and Stormwater Management Plans.

The soil classifications and hydrologic soil groups within the area to be developed were obtained from the Natural Resources Conservation Service (NRCS) medium intensity soil survey of Hillsborough County, New Hampshire. The information was downloaded from the NRCS Web Soil Survey website. See Appendix A for copies of this information. The Hydrologic Soil Groups (HSG) of the soils are classified by Technical Release TR-55 of the NRCS (formerly the Soil Conservation Service).

The runoff curve numbers are taken from a look-up table within the *HydroCAD* program. According to software documentation, this table is based on Table 2-2 of the SCS/NRCS TR-55 publication.

5.1.3 Time of Concentration Calculations

Times of concentration were calculated using USDA-SCS TR-55 methodologies for each sub-catchment considering the hydrologic flow lengths, slope, vegetative cover, surface roughness, and each stage-storage relationship. The type and length of each hydrologic flow line for determining time of concentration and travel times in the area to be developed are indicated on the Stormwater Management Plans. The maximum sheet flow length used for this analysis was 100 feet. Shallow concentrated flow lengths varied for each sub-watershed and were extended until they reached the end of the sub-watershed or until it reached a concentrated flow channel. A summary of the input data used to estimate the time of concentration for each subcatchment is provided in the runoff analysis calculations in each appendix.

5.1.4 Travel Time Calculations

The travel time for each subcatchment was calculated using a spreadsheet based on equations prepared by the USDA-NRCS. These times were then input directly into *HydroCAD*. The spreadsheets are included with the runoff analysis calculations.

5.1.5 Reservoir Routing Calculations

Reservoir routing calculations are included in the HydroCAD output. The "dynamic storage-indication" method was used in the peak runoff analysis to model the reaches and ponds more accurately.

5.1.6 Peak Discharge Calculations

Peak discharge calculations are included in the *HydroCAD* output. The Alteration of Terrain Permit application requires analysis of 2, 10, and 50-year storm events. The 25-year event is also included for culvert sizing.

6.0 CONCLUSIONS

The information in this report demonstrates that as proposed, the Antrim Windpark Project will meet the stormwater management requirements of Chapter Env-Wq 1500 Alteration of Terrain. It has been shown that groundwater recharge and quantity control of runoff from the project will not be required because no significant increase in runoff is anticipated. It has also been shown that the proposed water quality treatment measures provide adequate treatment of runoff from the site, and that nearby natural resources are protected.

APPENDIX A

Watershed Analysis Calculations

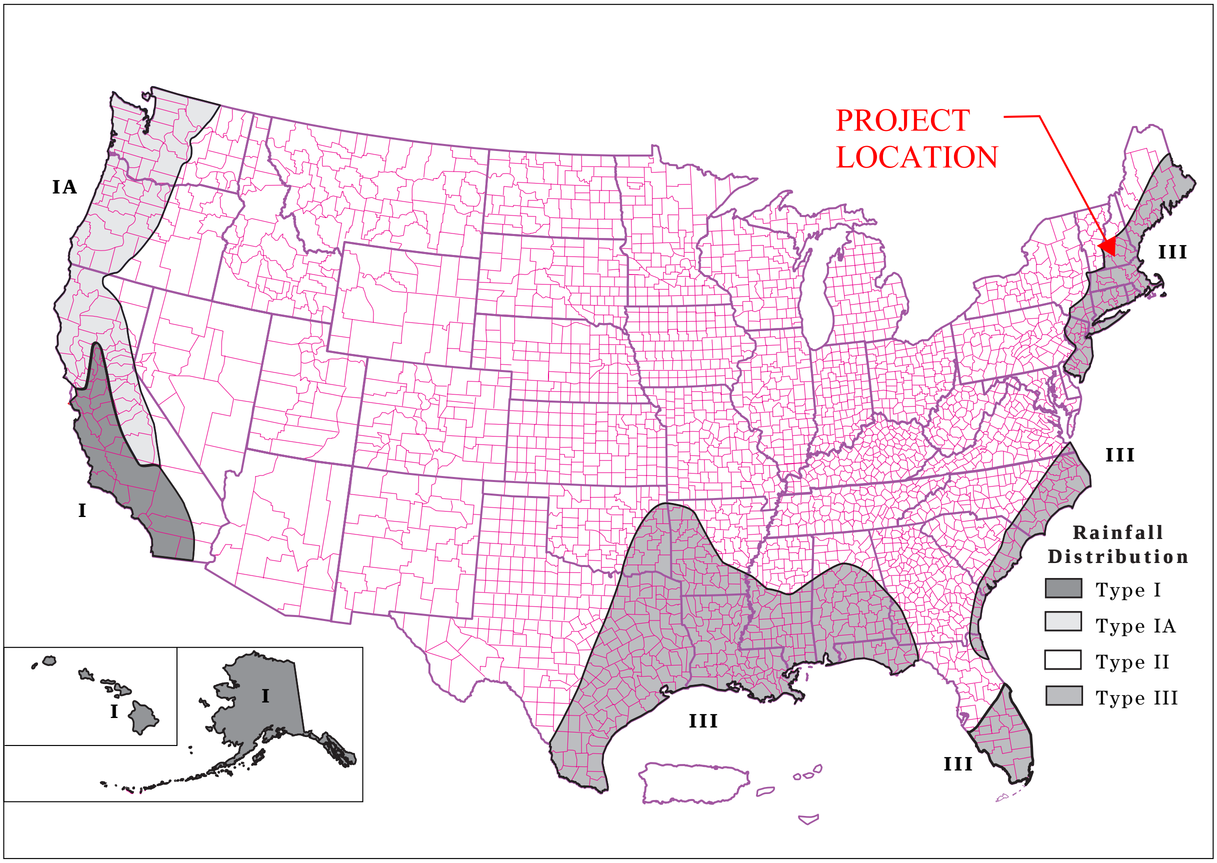
Rainfall and Soils Data (12 pages)

Watershed Tc and CN Calculations (7 pages)

Pre-development Runoff Model Results (28 pages)

Post-development Runoff Model Results (28 pages)

Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

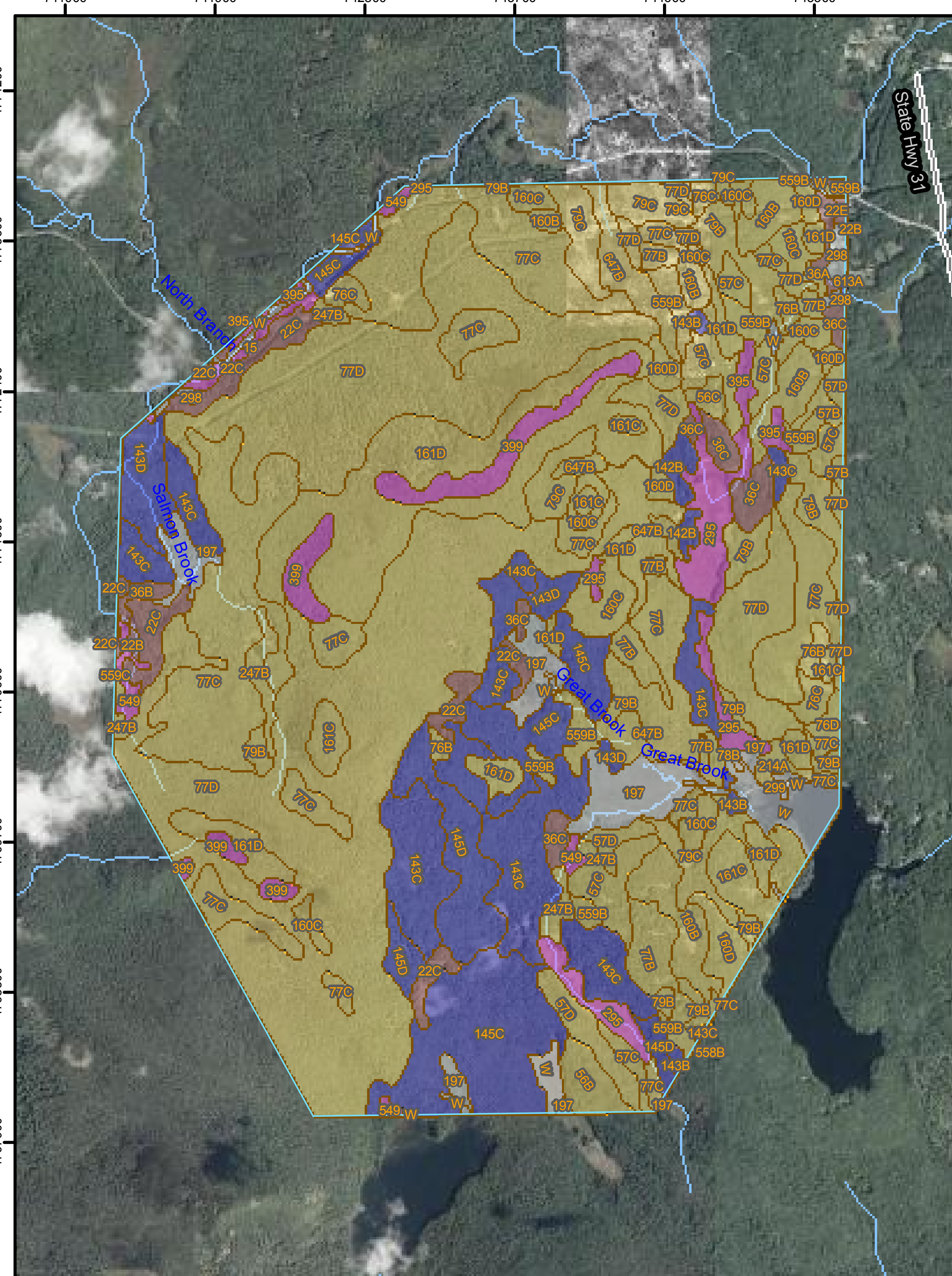
Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

* FROM: New Hampshire Stormwater Manual, Volume 2, Appendix A (2008)

TOWN	24-hour SCS Rainfall* 1 yr	2 yr	10 yr	25 yr	50 yr	100 yr
ACWORTH	2.3	2.7	4.1	4.8	5.4	6.1
ALBANY	2.7	3.2	4.8	5.5	6.1	6.4
ALEXANDRIA	2.4	2.7	4.1	4.9	5.3	6.0
ALLENSTOWN	2.5	2.9	4.3	5.1	5.6	6.3
ALSTEAD	2.3	2.7	4.1	4.9	5.4	6.1
ALTON	2.4	2.9	4.2	5.1	5.5	6.2
AMHERST	2.5	2.9	4.3	5.1	5.7	6.4
ANDOVER	2.3	2.8	4.1	4.9	5.4	6.0
ANTRIM	2.4	2.8	4.2	5.0	5.6	6.2
ASHLAND	2.4	2.8	4.2	5.0	5.4	6.0
ATKINSON	2.5	3.0	4.4	5.2	5.8	6.5
ATKINSON & GILMANTON ACADEMY GRANT	2.3	2.5	3.8	4.6	4.9	5.4
AUBURN	2.5	3.0	4.3	5.1	5.7	6.4
BARNSTEAD	2.4	2.9	4.2	5.1	5.6	6.2
BARRINGTON	2.5	3.0	4.3	5.1	5.7	6.3
BARTLETT	3.0	3.5	5.1	5.9	6.4	7.0
BATH	2.3	2.5	3.9	4.7	5.0	5.7
BEAN'S GRANT2.80	3.6	4.5	5.9	6.4	7.2	
BEAN'S PURCHASE	3.0	3.7	5.2	6.1	6.6	7.2
BEDFORD	2.5	2.9	4.3	5.1	5.7	6.4
BELMONT	2.4	2.8	4.2	5.0	5.5	6.1
BENNINGTON	2.4	2.8	4.2	5.0	5.6	6.3
BENTON	2.3	2.6	4.0	4.8	5.1	5.8
BERLIN	2.5	3.2	4.4	5.0	5.6	6.2
BETHLEHEM EAST	2.4	3.3	4.5	5.2	6.0	6.6
BETHLEHEM WEST	2.4	2.8	4.0	4.9	5.2	5.9
BOSCAWEN	2.4	2.8	4.2	5.0	5.5	6.1
BOW	2.4	2.9	4.2	5.0	5.6	6.3
BRADFORD	2.3	2.8	4.1	4.9	5.5	6.1
BRENTWOOD	2.6	3.0	4.3	5.2	5.7	6.4
BRIDGEWATER	2.4	2.7	4.1	4.9	5.4	6.0
BRISTOL	2.4	2.7	4.1	4.9	5.4	6.0
BROOKFIELD	2.4	2.9	4.2	5.2	5.5	6.2
BROOKLINE	2.5	2.9	4.3	5.1	5.7	6.4
CAMBRIDGE	2.5	2.8	4.0	4.9	5.2	6.0
CAMPTON	2.4	2.8	4.2	4.9	5.3	6.0
CANAAN	2.3	2.6	4.0	4.8	5.3	5.9
CANDIA	2.5	3.0	4.3	5.1	5.7	6.3
CANTERBURY	2.4	2.8	4.2	5.0	5.5	6.2
CARROLL	2.5	3.2	4.5	5.1	6.0	6.4
CENTER HARBOR	2.4	2.8	4.2	5.0	5.4	6.0
CHANDLER'S PURCHASE	2.8	3.6	5.0	5.8	6.4	7.1

*Rainfall data is interpolated from *Technical Paper No. 40 (TP40) Rainfall Frequency Atlas of the Eastern United States* . Other data may be used (e.g., *Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada* by Cornell University, Northeast Regional Climate Center, September, 1993.)



Map Scale: 1:36,300 if printed on A size (8.5" x 11") sheet.

N

Meters
0 300 600 1,200 1,800

Feet
0 1,000 2,000 4,000 6,000

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:36,300 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 18N NAD83

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

Soil Survey Area: Hillsborough County, New Hampshire, Western Part
Survey Area Data: Version 11, Oct 27, 2009

Date(s) aerial images were photographed: Data not available.

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Hillsborough County, New Hampshire, Western Part (NH602)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
15	Searsport muck	D	12.9	0.3%
22B	Colton loamy sand, 3 to 8 percent slopes	A	5.2	0.1%
22C	Colton loamy sand, 8 to 15 percent slopes	A	95.5	1.9%
22E	Colton loamy sand, 15 to 50 percent slopes	A	5.0	0.1%
27B	Groveton very fine sandy loam, 0 to 5 percent slopes	B	0.4	0.0%
36A	Adams loamy sand, 0 to 3 percent slopes	A	5.0	0.1%
36B	Adams loamy sand, 3 to 8 percent slopes	A	8.5	0.2%
36C	Adams loamy sand, 8 to 15 percent slopes	A	55.7	1.1%
36E	Adams loamy sand, 15 to 50 percent slopes	A	1.5	0.0%
56B	Becket fine sandy loam, 3 to 8 percent slopes	C	30.1	0.6%
56C	Becket fine sandy loam, 8 to 15 percent slopes	C	10.3	0.2%
57B	Becket stony fine sandy loam, 3 to 8 percent slopes	C	12.1	0.2%
57C	Becket stony fine sandy loam, 8 to 15 percent slopes	C	108.8	2.1%
57D	Becket stony fine sandy loam, 15 to 25 percent slopes	C	52.2	1.0%
76B	Marlow loam, 3 to 8 percent slopes	C	18.8	0.4%
76C	Marlow loam, 8 to 15 percent slopes	C	28.2	0.6%
76D	Marlow loam, 15 to 25 percent slopes	C	10.1	0.2%
77B	Marlow stony loam, 3 to 8 percent slopes	C	75.2	1.5%
77C	Marlow stony loam, 8 to 15 percent slopes	C	680.8	13.3%
77D	Marlow stony loam, 15 to 35 percent slopes	C	1,387.4	27.2%
78B	Peru loam, 3 to 8 percent slopes	C	6.8	0.1%
79B	Peru stony loam, 0 to 8 percent slopes	C	125.9	2.5%
79C	Peru stony loam, 8 to 15 percent slopes	C	123.3	2.4%
142B	Monadnock fine sandy loam, 3 to 8 percent slopes	B	21.8	0.4%
143B	Monadnock stony fine sandy loam, 3 to 8 percent slopes	B	11.5	0.2%
143C	Monadnock stony fine sandy loam, 8 to 15 percent slopes	B	337.5	6.6%

Hydrologic Soil Group— Summary by Map Unit — Hillsborough County, New Hampshire, Western Part (NH602)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
143D	Monadnock stony fine sandy loam, 15 to 35 percent slope s	B	82.1	1.6%
145C	Monadnock very bouldery fine sandy loam, 8 to 15 percen t slopes	B	282.0	5.5%
145D	Monadnock very bouldery fine sandy loam, 15 to 35 perce nt slopes	B	116.0	2.3%
160B	Tunbridge-Lyman-Monadnock complex, stony, 3 to 8 percen t slopes	C	121.7	2.4%
160C	Tunbridge-Lyman-Monadnock complex, stony, 8 to 15 perce nt slopes	C	104.4	2.0%
160D	Tunbridge-Lyman-Monadnock complex, stony, 15 to 25 perc ent slopes	C	54.2	1.1%
161C	Lyman-Tunbridge-Rock outcrop complex, 3 to 15 percent s lopes	C	83.4	1.6%
161D	Lyman-Tunbridge-Rock outcrop complex, 15 to 35 percent slopes	C	377.0	7.4%
197	Borohemists, ponded		119.0	2.3%
214A	Naumburg fine sandy loam, 0 to 3 percent slopes	C	10.9	0.2%
247B	Lyme stony loam, 0 to 5 percent slopes	C	41.9	0.8%
295	Greenwood mucky peat	D	109.1	2.1%
298	Pits, gravel		15.2	0.3%
299	Udorthents, smoothed		3.0	0.1%
395	Chocorua mucky peat	D	20.8	0.4%
399	Rock outcrop	D	93.1	1.8%
549	Peacham stony muck	D	23.0	0.4%
558B	Skerry fine sandy loam, 3 to 8 percent slopes	C	0.0	0.0%
559B	Skerry stony fine sandy loam, 0 to 8 percent slopes	C	69.6	1.4%
559C	Skerry stony fine sandy loam, 8 to 15 percent slopes	C	0.1	0.0%
613A	Croghan loamy fine sand, 0 to 3 percent slopes	B	1.3	0.0%
647B	Pillsbury stony loam, 0 to 5 percent slopes	C	69.3	1.4%
W	Water		79.5	1.6%
Totals for Area of Interest			**5,107.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

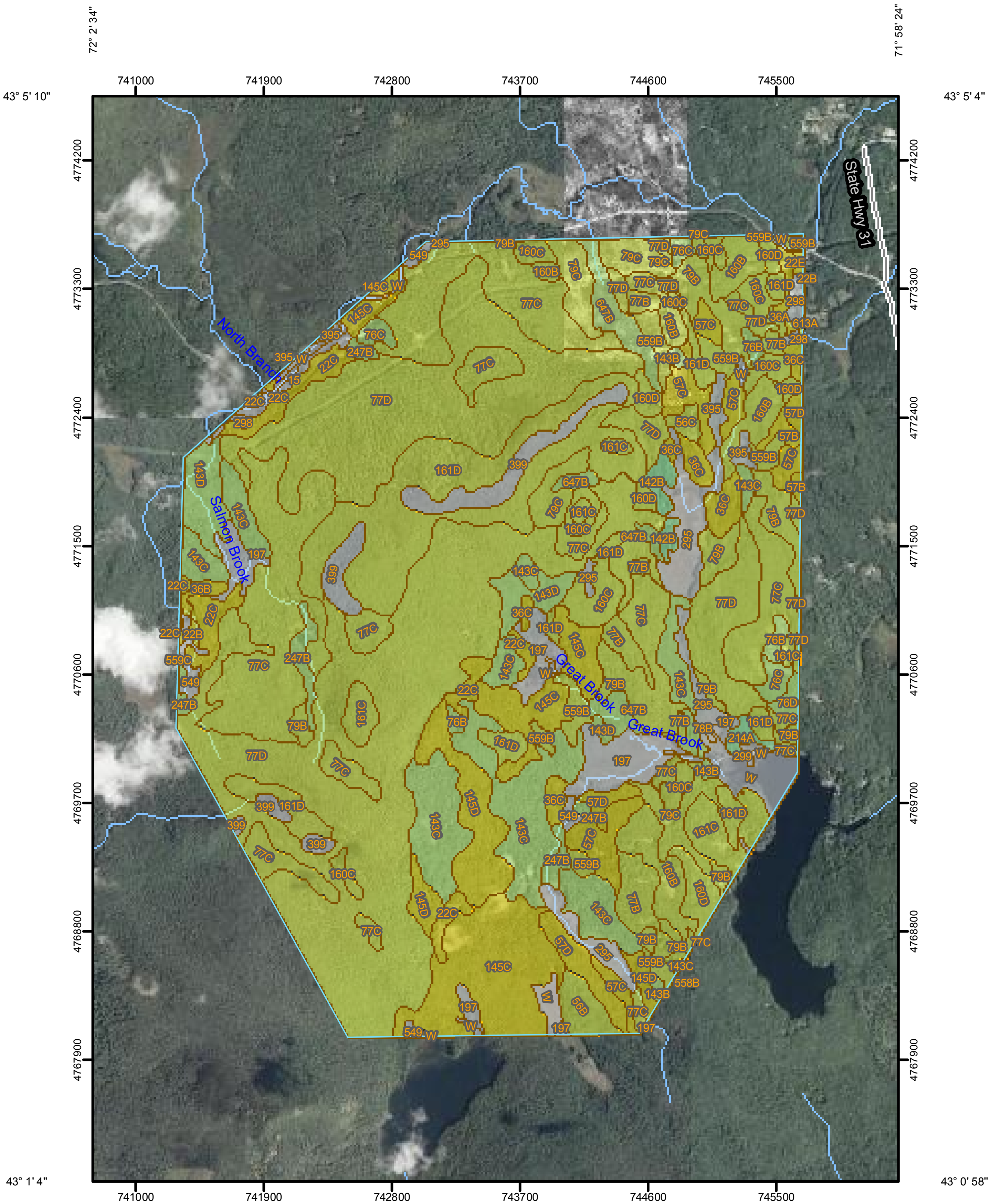
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

K Factor, Whole Soil—Hillsborough County, New Hampshire, Western Part
(Antrim Wind Project)



Map Scale: 1:36,300 if printed on A size (8.5" x 11") sheet.

N

Meters
0 300 600 1,200 1,800

Feet
0 1,000 2,000 4,000 6,000

MAP LEGEND

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

Soils
- Soil Map Units

Soil Ratings
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

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

MAP INFORMATION

Map Scale: 1:36,300 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 18N NAD83

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

Soil Survey Area: Hillsborough County, New Hampshire, Western Part
Survey Area Data: Version 11, Oct 27, 2009

Date(s) aerial images were photographed: Data not available.

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.

K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Hillsborough County, New Hampshire, Western Part (NH602)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
15	Searsport muck		12.9	0.3%
22B	Colton loamy sand, 3 to 8 percent slopes	.17	5.2	0.1%
22C	Colton loamy sand, 8 to 15 percent slopes	.17	95.5	1.9%
22E	Colton loamy sand, 15 to 50 percent slopes	.17	5.0	0.1%
27B	Groveton very fine sandy loam, 0 to 5 percent slopes	.32	0.4	0.0%
36A	Adams loamy sand, 0 to 3 percent slopes	.17	5.0	0.1%
36B	Adams loamy sand, 3 to 8 percent slopes	.17	8.5	0.2%
36C	Adams loamy sand, 8 to 15 percent slopes	.17	55.7	1.1%
36E	Adams loamy sand, 15 to 50 percent slopes	.17	1.5	0.0%
56B	Becket fine sandy loam, 3 to 8 percent slopes	.20	30.1	0.6%
56C	Becket fine sandy loam, 8 to 15 percent slopes	.20	10.3	0.2%
57B	Becket stony fine sandy loam, 3 to 8 percent slopes	.17	12.1	0.2%
57C	Becket stony fine sandy loam, 8 to 15 percent slopes	.17	108.8	2.1%
57D	Becket stony fine sandy loam, 15 to 25 percent slopes	.17	52.2	1.0%
76B	Marlow loam, 3 to 8 percent slopes	.24	18.8	0.4%
76C	Marlow loam, 8 to 15 percent slopes	.24	28.2	0.6%
76D	Marlow loam, 15 to 25 percent slopes	.24	10.1	0.2%
77B	Marlow stony loam, 3 to 8 percent slopes	.20	75.2	1.5%
77C	Marlow stony loam, 8 to 15 percent slopes	.20	680.8	13.3%
77D	Marlow stony loam, 15 to 35 percent slopes	.20	1,387.4	27.2%
78B	Peru loam, 3 to 8 percent slopes	.24	6.8	0.1%
79B	Peru stony loam, 0 to 8 percent slopes	.20	125.9	2.5%
79C	Peru stony loam, 8 to 15 percent slopes	.20	123.3	2.4%
142B	Monadnock fine sandy loam, 3 to 8 percent slopes	.28	21.8	0.4%
143B	Monadnock stony fine sandy loam, 3 to 8 percent slopes	.24	11.5	0.2%
143C	Monadnock stony fine sandy loam, 8 to 15 percent slopes	.24	337.5	6.6%

K Factor, Whole Soil— Summary by Map Unit — Hillsborough County, New Hampshire, Western Part (NH602)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
143D	Monadnock stony fine sandy loam, 15 to 35 percent slope s	.24	82.1	1.6%
145C	Monadnock very bouldery fine sandy loam, 8 to 15 percen t slopes	.17	282.0	5.5%
145D	Monadnock very bouldery fine sandy loam, 15 to 35 perce nt slopes	.17	116.0	2.3%
160B	Tunbridge-Lyman-Monadnock complex, stony, 3 to 8 percen t slopes	.20	121.7	2.4%
160C	Tunbridge-Lyman-Monadnock complex, stony, 8 to 15 perce nt slopes	.20	104.4	2.0%
160D	Tunbridge-Lyman-Monadnock complex, stony, 15 to 25 perc ent slopes	.20	54.2	1.1%
161C	Lyman-Tunbridge-Rock outcrop complex, 3 to 15 percent s lopes	.20	83.4	1.6%
161D	Lyman-Tunbridge-Rock outcrop complex, 15 to 35 percent slopes	.20	377.0	7.4%
197	Borohemists, ponded		119.0	2.3%
214A	Naumburg fine sandy loam, 0 to 3 percent slopes	.28	10.9	0.2%
247B	Lyme stony loam, 0 to 5 percent slopes	.24	41.9	0.8%
295	Greenwood mucky peat		109.1	2.1%
298	Pits, gravel		15.2	0.3%
299	Udorthents, smoothed		3.0	0.1%
395	Chocorua mucky peat		20.8	0.4%
399	Rock outcrop		93.1	1.8%
549	Peacham stony muck		23.0	0.4%
558B	Skerry fine sandy loam, 3 to 8 percent slopes	.24	0.0	0.0%
559B	Skerry stony fine sandy loam, 0 to 8 percent slopes	.20	69.6	1.4%
559C	Skerry stony fine sandy loam, 8 to 15 percent slopes	.20	0.1	0.0%
613A	Croghan loamy fine sand, 0 to 3 percent slopes	.17	1.3	0.0%
647B	Pillsbury stony loam, 0 to 5 percent slopes	.24	69.3	1.4%
W	Water		79.5	1.6%
Totals for Area of Interest			**5,107.0**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Layer Options: Surface Layer

PROJECT:	Eolian Renewable Energy LLC	Calculated By:	PMM
	Antrim Wind Project	Checked By:	
Proj. No.:	186317.0000.0000	Date:	March 25, 2015
	Time of Concentration Summary		

Time of Concentration Equations:

1. Where $T_t := \frac{0.007 \cdot (N \cdot L)^{0.8}}{P_2^{0.5} \cdot S^{0.4}}$ from SCS TR-55. — For Sheet Flow (300 feet or less)

2. Where $V := 20.3282 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* — For Shallow Concentrated Flow (Paved surfaces)

3. Where $T_t := \frac{L}{3600 \cdot V}$ from the SCS Upland Method *Channel Flow Chart* — Travel time equation

4. Where $V := 16.1345 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* — For Shallow Concentrated Flow (Unpaved surfaces)

5. Where: $v = 7 \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* — For Shallow Concentrated Flow (Short Grass Pasture)

6. Where: $v = 5 \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* — For Shallow Concentrated Flow (Woodland)

7. Where $V := 12 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* — For Channel Flow - Waterways and Swamps, No Channels

8. Where $V := 15 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* — For Channel Flow - Grassed Waterways and Roadside Ditches

9. Where $V := 21 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* — For Channel Flow - Small Tributary & Swamp w/Channels

10. Where $V := 35 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* — For Channel Flow - Large Tributary

11. Where $V := 60 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* — For Channel Flow - Main River

12. Where $V := \frac{1.49 \cdot R^{.667} \cdot \sqrt{S}}{N}$ — For Channel Flow - Culvert Flow

13. Where P_2 = 2-Year, 24 Hour Rainfall (in) (Antrim, NH: P2= 2.8 inches)

Mannings Roughness Coefficients Table

Surface Description	n - value
Smooth surfaces	0.011
Crush Stone/Substation Yards	0.025
Fallow	0.050
Cultivated: Residue<=20%	0.060
Cultivated: Residue>=20%	0.170
Grass: Short	0.150
Grass: Dense	0.240
Grass: Bermuda	0.410
Range	0.130
Woods: Light underbrush	0.400
Woods: Dense underbrush	0.800

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 25, 2015
Watershed:	**1W - Pre and Post**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.4								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.05								
T_t^1, hr	0.265								0.2652
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity^4, ft/sec									
T_t^3, hr									0.0000
Woodland									
Length, ft		60	1545						
Slope, ft/ft		0.083	0.291						
Velocity^5, ft/sec		1.4431	2.6972						
T_t^3, hr		0.012	0.159						0.1707
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity^6, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity^7, ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft				1930	1245				
Slope, ft/ft				0.036	0.072				
Velocity^8, ft/sec				3.984	5.635				
T_t, hr				0.135	0.061				0.1959
Large Tributary									
Length, ft						8425			
Slope, ft/ft						0.026			
Velocity^8, ft/sec						5.644			
T_t, hr						0.415			0.4147
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity^{11}, ft/sec									
Length, L, ft									
T_t, hr									0.0000
								HR	1.046
								Min	**62.79**

249 Western Avenue
Augusta, ME 04330
207.621.7000 PHONE
207.621.7001 FAX
www.TRCsolutions.com

PROJECT:	Antrim Wind Project
Project No:	186317.0000.0000
Subject:	Composite Curve Number
Calculated By:	PMM
Checked By:	
Date:	March 25, 2015
Revised Date:	

Assumptions:

Runoff curve numbers for cover types as referenced from Table 2-2c USDA, 1986, Urban Hydrology for Small Watersheds: TR55.
Land cover types as referenced from recent aerial photography and site visits.
Soil types and hydrologic soil groups are referenced from the NRCS Web Soil Survey for Hillsborough County, NH

Pre-development (1W - North Branch River Watershed)

Cover Description	Hydrologic Soil Group	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Buildings	A	0.016	0.00%	98	1.568
	B	0.374	0.02%	98	36.652
	C	0.278	0.02%	98	27.244
	D	0.010	0.00%	98	0.980
	Unclassified	0.110	0.01%	98	10.780
Other Impervious	A	1.837	0.11%	76	139.612
	B	2.685	0.16%	85	228.225
	C	1.753	0.11%	89	156.017
	D	0.655	0.04%	91	59.605
	Unclassified	0.920	0.06%	91	83.720
	Pavement	3.281	0.20%	98	321.538
Meadow, Good Condition	A	12.831	0.77%	30	384.930
	B	13.799	0.83%	58	800.342
	C	37.423	2.25%	71	2657.033
	D	5.959	0.36%	78	464.802
	Unclassified	0.577	0.03%	78	45.006
Woods, Good Condition	A	66.513	4.00%	30	1995.390
	B	152.463	9.16%	55	8385.465
	C	1282.411	77.04%	70	89768.770
	D	53.855	3.24%	77	4146.835
	Unclassified	26.934	1.62%	77	2073.918
Total Watershed =		1664.684	100.00%		111788.432
				Weighted CN =	**67**

Post-development (1W - North Branch River Watershed)

Cover Description	Hydrologic Soil Group	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Buildings	A	0.016	0.00%	98	1.568
	B	0.374	0.02%	98	36.652
	C	0.364	0.02%	98	35.672
	D	0.010	0.00%	98	0.980
	Unclassified	0.110	0.01%	98	10.780
Other Impervious	A	1.837	0.11%	76	139.612
	B	2.685	0.16%	85	228.225
	C	9.836	0.59%	89	875.404
	D	0.769	0.05%	91	69.979
	Unclassified	0.920	0.06%	91	83.720
	Pavement	3.281	0.20%	98	321.538
Meadow, Good Condition	A	12.831	0.77%	30	384.930
	B	13.799	0.83%	58	800.342
	C	64.295	3.86%	71	4564.945
	D	6.170	0.37%	78	481.260
	Unclassified	0.577	0.03%	78	45.006
Woods, Good Condition	A	66.513	4.00%	30	1995.390
	B	152.463	9.16%	55	8385.465
	C	1246.217	74.91%	70	87235.190
	D	53.540	3.22%	77	4122.580
	Unclassified	26.934	1.62%	77	2073.918
Total Watershed =		1663.541	100.00%		111893.156
				Weighted CN =	**67**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 25, 2015
Watershed:	**2W - Pre and Post**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.4								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.1								
T_t[1], hr	0.201								0.2010
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity[4], ft/sec									
T_t[3], hr									0.0000
Woodland									
Length, ft			2810						
Slope, ft/ft			0.093						
Velocity[5], ft/sec			1.5207						
T_t[3], hr			0.513						0.5133
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000
								HR	0.714
								Min	**42.86**

TRC
249 Western Avenue
Augusta, ME 04330
207.621.7000 PHONE
207.621.7001 FAX
www.TRCsolutions.com

PROJECT:	Antrim Wind Project
Project No:	186317.0000.0000
Subject:	Composite Curve Number
Calculated By:	PMM
Checked By:	
Date:	March 25, 2015
Revised Date:	

Assumptions:

Runoff curve numbers for cover types as referenced from Table 2-2c USDA, 1986, Urban Hydrology for Small Watersheds: TR55.
Land cover types as referenced from recent aerial photography and site visits.
Soil types and hydrologic soil groups are referenced from the NRCS Web Soil Survey for Hillsborough County, NH

Pre-development (2W - Unnamed Watershed)

Cover Description	Hydrologic Soil Group	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Buildings	A	0	0%	98	0.000
	B	0.038	0.01%	98	3.724
	C	0.204	0.03%	98	19.992
	D	0	0%	98	0.000
	Unclassified	0	0%	98	0.000
Other Impervious	A	0.894	0.15%	76	67.944
	B	0.614	0.10%	85	52.190
	C	2.068	0.35%	89	184.052
	D	0.318	0.05%	91	28.938
	Unclassified	0	0%	91	0.000
Meadow, Good Condition	A	1.770	0.30%	30	53.100
	B	6.372	1.07%	58	369.576
	C	7.926	1.33%	71	562.746
	D	44.214	7.43%	78	3448.692
	Unclassified	0	0%	78	0.000
Woods, Good Condition	A	28.548	4.79%	30	856.440
	B	27.101	4.55%	55	1490.555
	C	430.277	72.26%	70	30119.390
	D	45.093	7.57%	77	3472.161
	Unclassified	0	0%	77	0.000
Total Watershed =		595.437	100.00%		40729.500
				Weighted CN =	**68**

Post-development (2W - Unnamed Watershed)

Cover Description	Hydrologic Soil Group	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Buildings	A	0	0%	98	0.000
	B	0.038	0.01%	98	3.724
	C	0.204	0.03%	98	19.992
	D	0	0%	98	0.000
	Unclassified	0	0%	98	0.000
Other Impervious	A	0.894	0.15%	76	67.944
	B	0.614	0.10%	85	52.190
	C	2.281	0.38%	89	203.009
	D	0.318	0.05%	91	28.938
	Unclassified	0	0%	91	0.000
Meadow, Good Condition	A	1.770	0.30%	30	53.100
	B	6.372	1.07%	58	369.576
	C	8.692	1.46%	71	617.132
	D	44.996	7.56%	78	3509.688
	Unclassified	0	0%	78	0.000
Woods, Good Condition	A	28.548	4.79%	30	856.440
	B	27.101	4.55%	55	1490.555
	C	429.554	72.14%	70	30068.780
	D	44.046	7.40%	77	3391.542
	Unclassified	0	0%	77	0.000
Total Watershed =		595.428	100.00%		40732.610
				Weighted CN =	**68**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 25, 2015
Watershed:	**3W - Pre and Post**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.4								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.02								
T_t[1], hr	0.383								0.3826
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity[4], ft/sec									
T_t[3], hr									0.0000
Woodland									
Length, ft		865	630						
Slope, ft/ft		0.050	0.087						
Velocity[5], ft/sec		1.1180	1.4748						
T_t[3], hr		0.215	0.119						0.3336
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft				4925					
Slope, ft/ft				0.004					
Velocity[8], ft/sec				1.328					
T_t, hr				1.030					1.0300
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	1.746
Min	**104.77**

TRC
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PROJECT:	Antrim Wind Project
Project No:	186317.0000.0000
Subject:	Composite Curve Number
Calculated By:	PMM
Checked By:	
Date:	March 25, 2015
Revised Date:	

Assumptions:

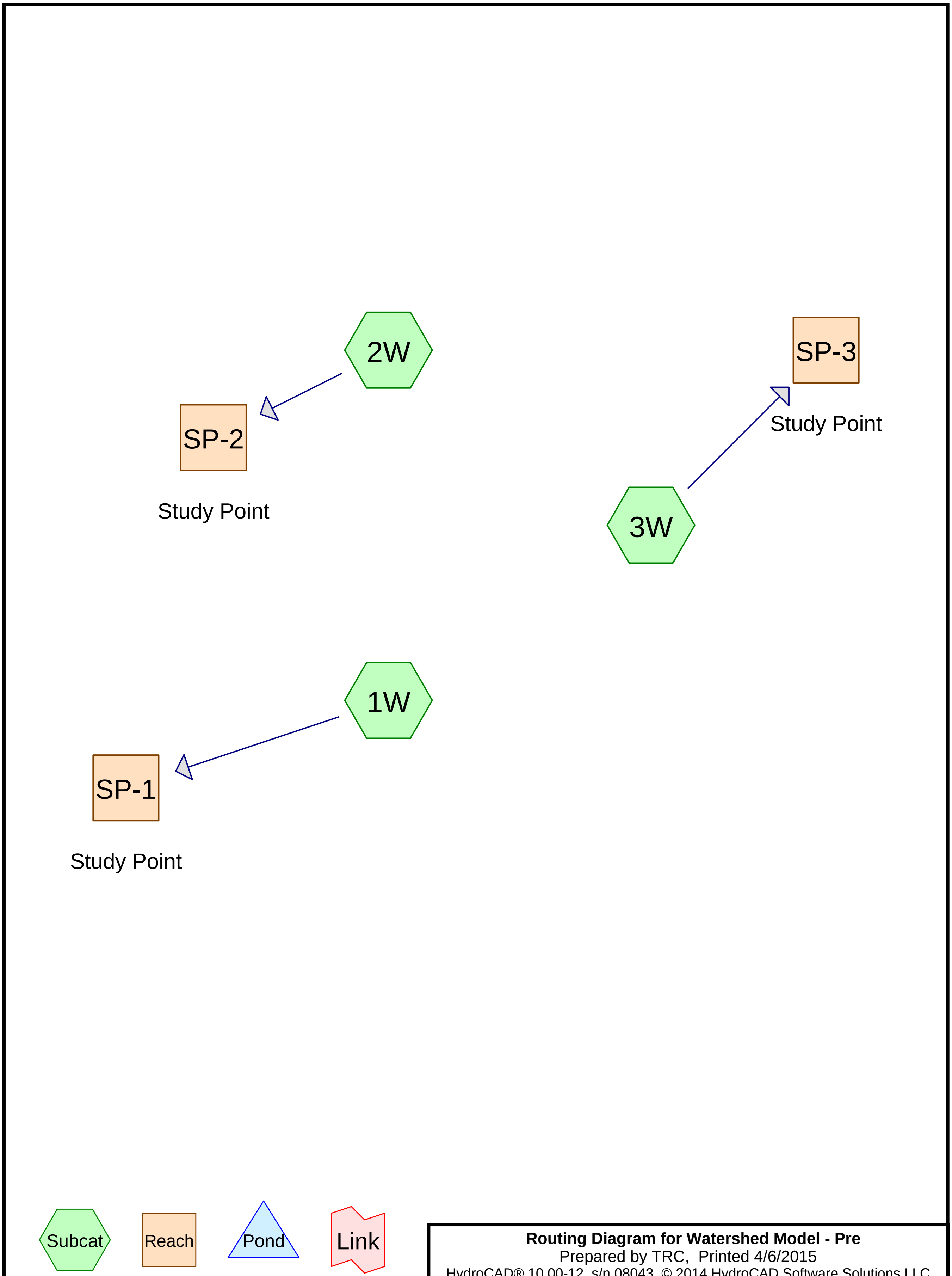
Runoff curve numbers for cover types as referenced from Table 2-2c USDA, 1986, Urban Hydrology for Small Watersheds: TR55.
Land cover types as referenced from recent aerial photography and site visits.
Soil types and hydrologic soil groups are referenced from the NRCS Web Soil Survey for Hillsborough County, NH

Pre-development (3W - Gregg Lake Watershed)

Cover Description	Hydrologic Soil Group	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Buildings	A	0	0%	98	0.000
	B	0.135	0.01%	98	13.230
	C	0.781	0.04%	98	76.538
	D	0	0%	98	0.000
	Unclassified	0	0%	98	0.000
Other Impervious	A	0.304	0.02%	76	23.104
	B	3.282	0.16%	85	278.970
	C	9.071	0.45%	89	807.319
	D	0.057	0.00%	91	5.187
	Unclassified	0	0%	91	0.000
Meadow, Good Condition	A	1.389	0.07%	30	41.670
	B	13.053	0.65%	58	757.074
	C	53.756	2.69%	71	3816.676
	D	28.798	1.44%	78	2246.244
	Unclassified	57.362	2.87%	78	4474.236
Woods, Good Condition	A	42.100	2.11%	30	1263.000
	B	606.658	30.37%	55	33366.190
	C	1103.235	55.22%	70	77226.450
	D	29.079	1.46%	77	2239.083
	Unclassified	48.668	2.44%	77	3747.436
Total Watershed =		1997.728	100.00%		130382.407
				Weighted CN =	**65**

Post-development (3W - Gregg Lake Watershed)

Cover Description	Hydrologic Soil Group	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Buildings	A	0	0.0%	98	0.000
	B	0.135	0.01%	98	13.230
	C	0.781	0.04%	98	76.538
	D	0	0%	98	0.000
	Unclassified	0	0%	98	0.000
Other Impervious	A	0.304	0.02%	76	23.104
	B	3.282	0.16%	85	278.970
	C	9.003	0.45%	89	801.267
	D	0.489	0.02%	91	44.499
	Unclassified	0	0%	91	0.000
Meadow, Good Condition	A	1.389	0.07%	30	41.670
	B	13.053	0.65%	58	757.074
	C	68.766	3.44%	71	4882.386
	D	30.862	1.54%	78	2407.236
	Unclassified	57.362	2.87%	78	4474.236
Woods, Good Condition	A	42.100	2.11%	30	1263.000
	B	606.658	30.35%	55	33366.190
	C	1089.085	54.49%	70	76235.950
	D	26.837	1.34%	77	2066.449
	Unclassified	48.668	2.43%	77	3747.436
Total Watershed =		1998.774	100.00%		130479.235
				Weighted CN =	**65**



Routing Diagram for Watershed Model - Pre
Prepared by TRC, Printed 4/6/2015

Summary for Subcatchment 1W:

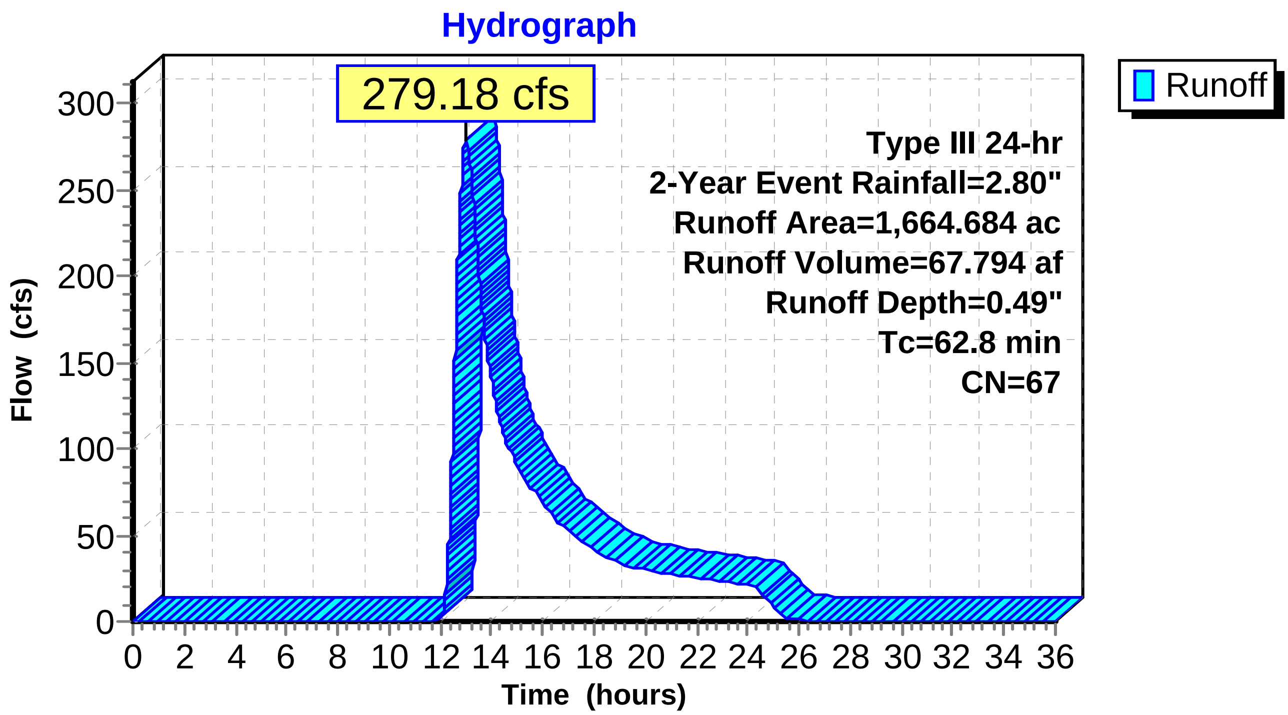
Runoff = 279.18 cfs @ 13.04 hrs, Volume= 67.794 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.788	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	1.753	89	Gravel roads, HSG C
	1.575	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	37.423	71	Meadow, non-grazed, HSG C
	6.536	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,282.411	70	Woods, Good, HSG C
	80.789	77	Woods, Good, HSG D
	1,664.684	67	Weighted Average
	1,660.615		99.76% Pervious Area
	4.069		0.24% Impervious Area

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

Subcatchment 1W:



Summary for Subcatchment 2W:

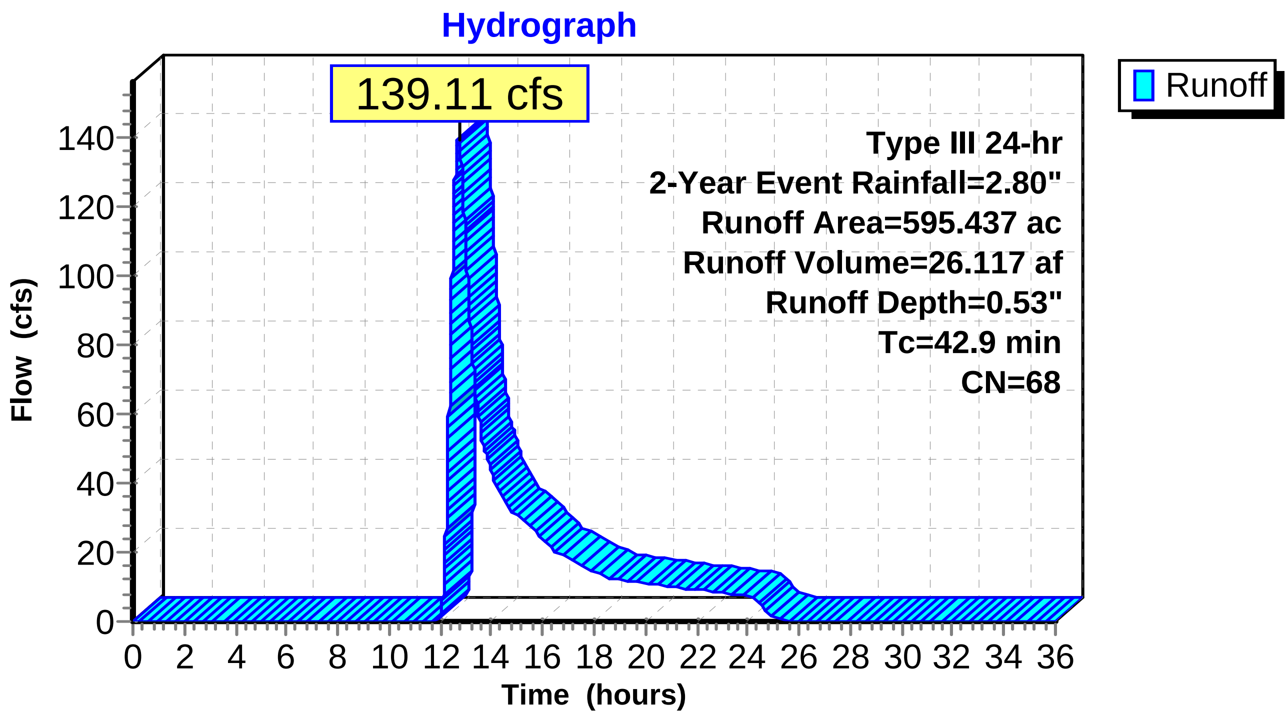
Runoff = 139.11 cfs @ 12.72 hrs, Volume= 26.117 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.068	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	7.926	71	Meadow, non-grazed, HSG C
	44.214	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	430.277	70	Woods, Good, HSG C
	45.093	77	Woods, Good, HSG D
	595.437	68	Weighted Average
	595.195		99.96% Pervious Area
	0.242		0.04% Impervious Area

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

Subcatchment 2W:



Summary for Subcatchment 3W:

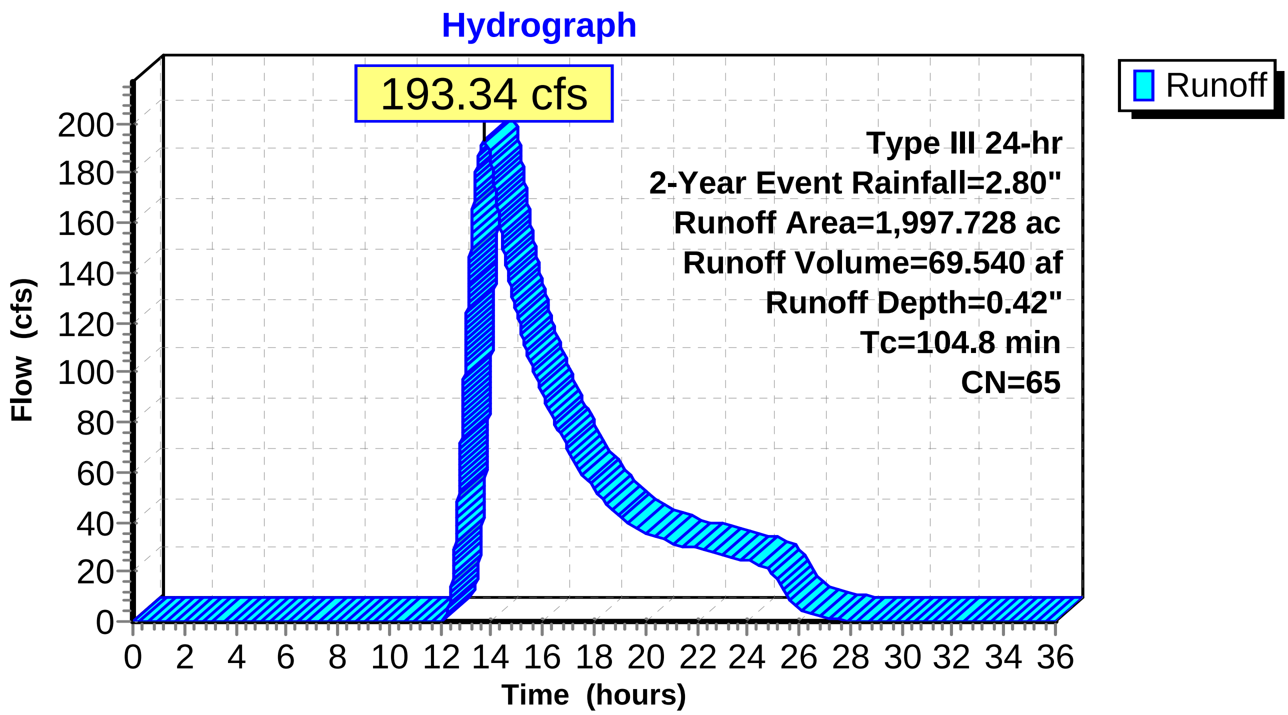
Runoff = 193.34 cfs @ 13.74 hrs, Volume= 69.540 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	9.071	89	Gravel roads, HSG C
	0.057	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	53.756	71	Meadow, non-grazed, HSG C
	86.160	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,103.235	70	Woods, Good, HSG C
	77.747	77	Woods, Good, HSG D
	1,997.728	65	Weighted Average
	1,996.812		99.95% Pervious Area
	0.916		0.05% Impervious Area

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

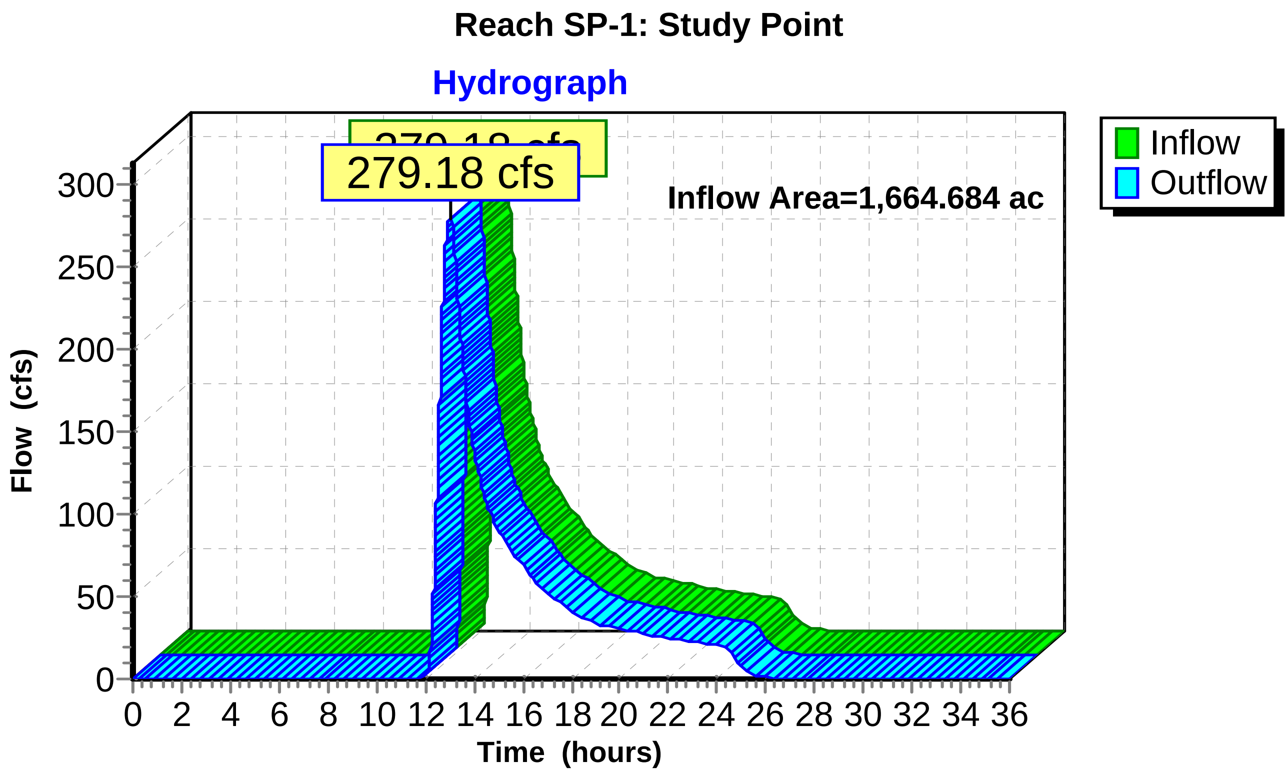
Subcatchment 3W:



Summary for Reach SP-1: Study Point

Inflow Area =	1,664.684 ac,	0.24% Impervious,	Inflow Depth = 0.49"	for 2-Year Event event	
Inflow =	279.18 cfs @	13.04 hrs,	Volume=	67.794 af	
Outflow =	279.18 cfs @	13.04 hrs,	Volume=	67.794 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

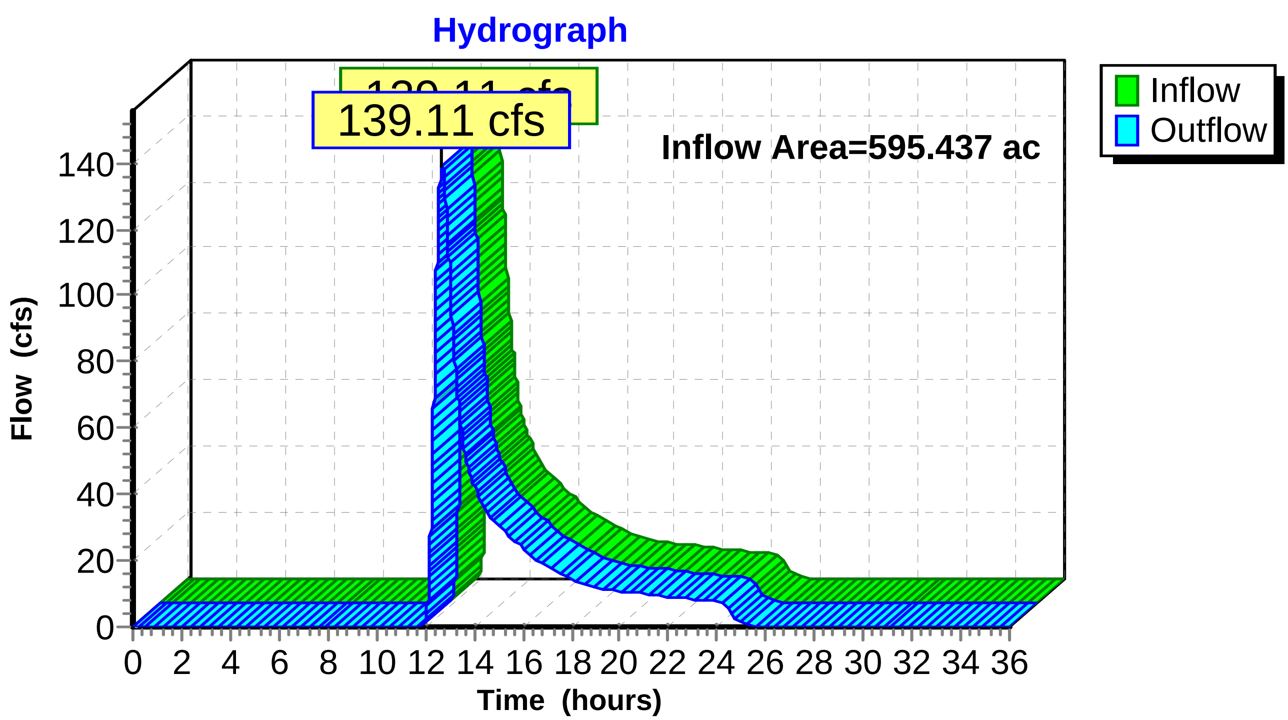


Summary for Reach SP-2: Study Point

Inflow Area =	595.437 ac,	0.04% Impervious, Inflow Depth = 0.53"	for 2-Year Event event	
Inflow =	139.11 cfs @	12.72 hrs, Volume=	26.117 af	
Outflow =	139.11 cfs @	12.72 hrs, Volume=	26.117 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

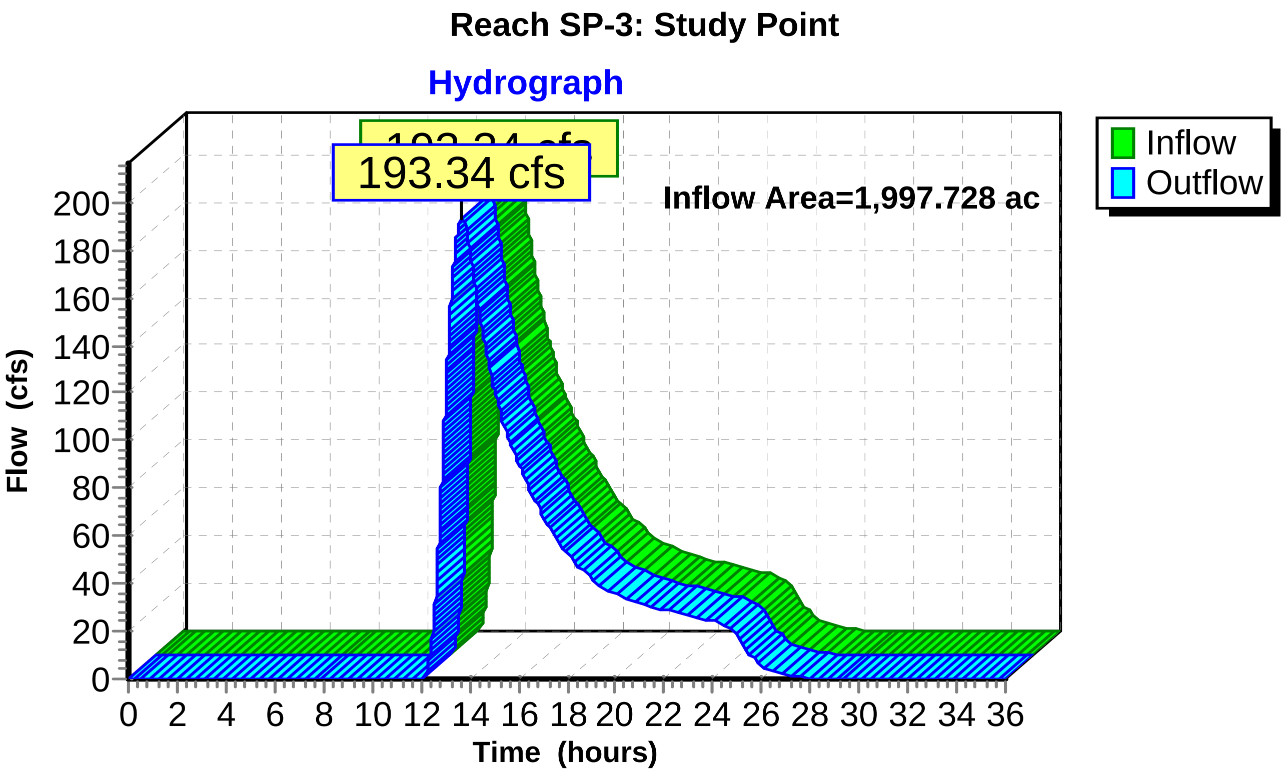
Reach SP-2: Study Point



Summary for Reach SP-3: Study Point

Inflow Area = 1,997.728 ac, 0.05% Impervious, Inflow Depth = 0.42" for 2-Year Event event
Inflow = 193.34 cfs @ 13.74 hrs, Volume= 69.540 af
Outflow = 193.34 cfs @ 13.74 hrs, Volume= 69.540 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3



Summary for Subcatchment 1W:

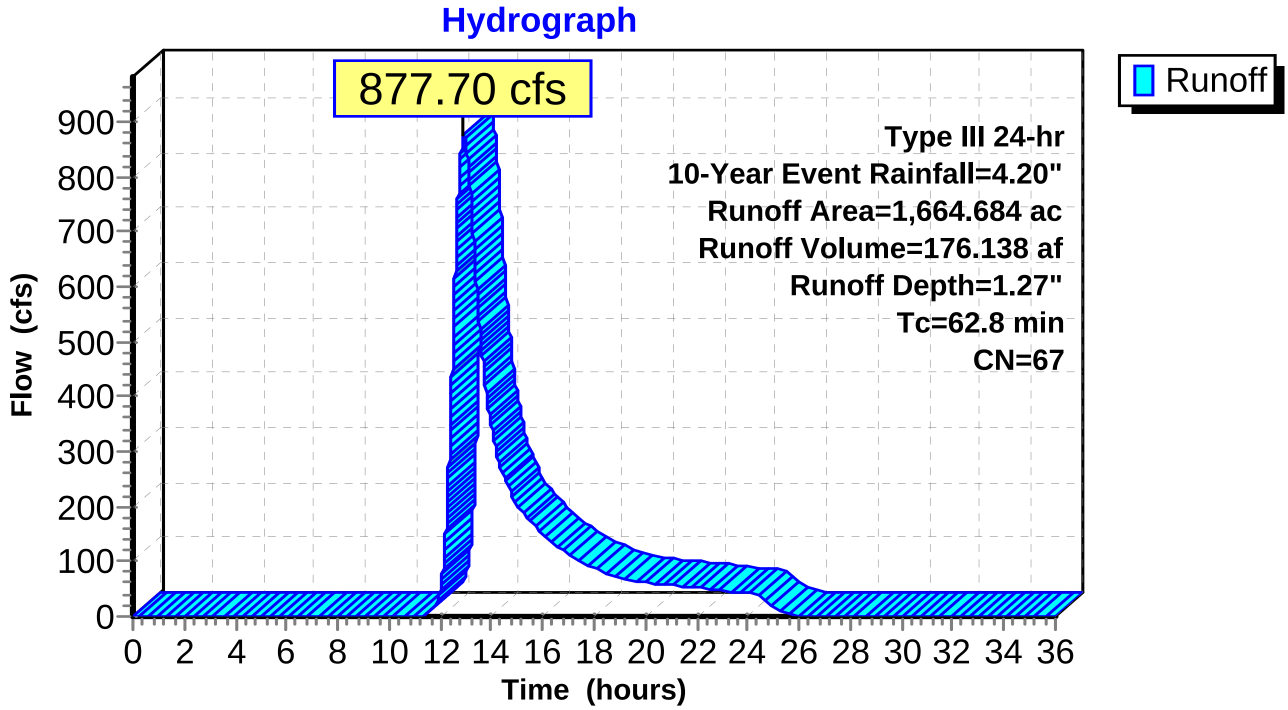
Runoff = 877.70 cfs @ 12.91 hrs, Volume= 176.138 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.788	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	1.753	89	Gravel roads, HSG C
	1.575	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	37.423	71	Meadow, non-grazed, HSG C
	6.536	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,282.411	70	Woods, Good, HSG C
	80.789	77	Woods, Good, HSG D
	1,664.684	67	Weighted Average
	1,660.615		99.76% Pervious Area
	4.069		0.24% Impervious Area

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

Subcatchment 1W:



Summary for Subcatchment 2W:

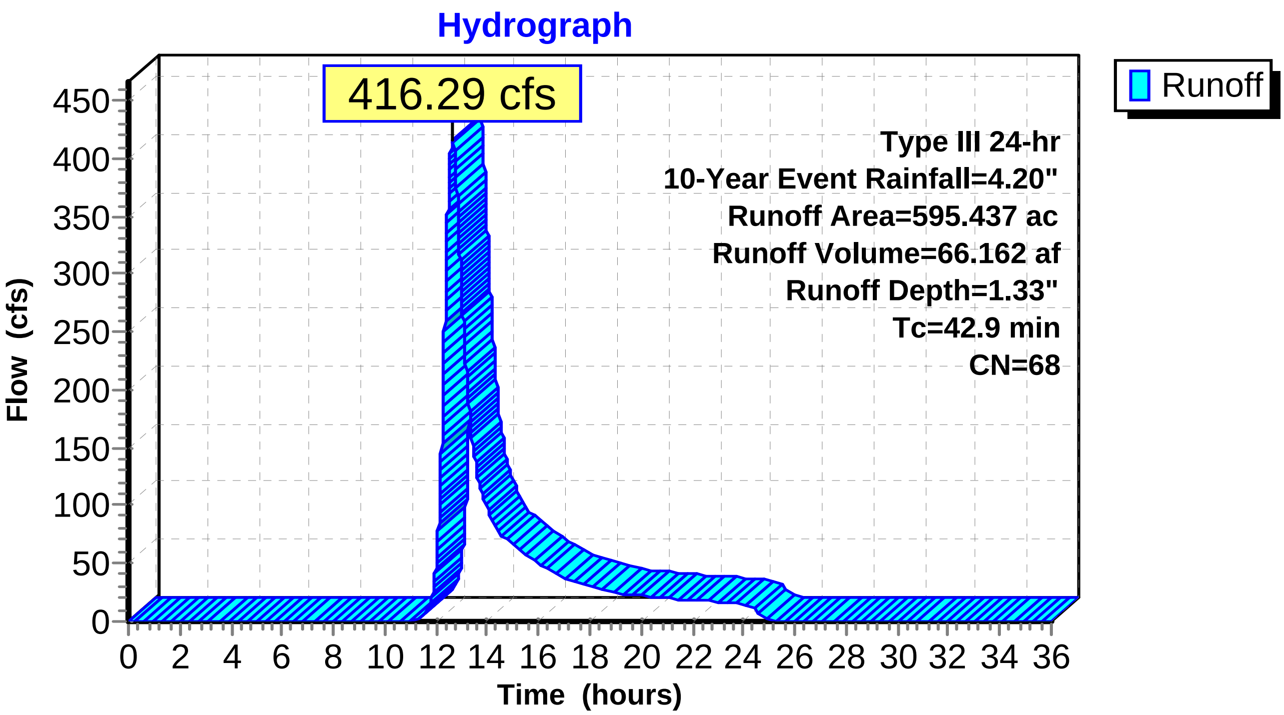
Runoff = 416.29 cfs @ 12.63 hrs, Volume= 66.162 af, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.068	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	7.926	71	Meadow, non-grazed, HSG C
	44.214	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	430.277	70	Woods, Good, HSG C
	45.093	77	Woods, Good, HSG D
	595.437	68	Weighted Average
	595.195		99.96% Pervious Area
	0.242		0.04% Impervious Area

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

Subcatchment 2W:



Summary for Subcatchment 3W:

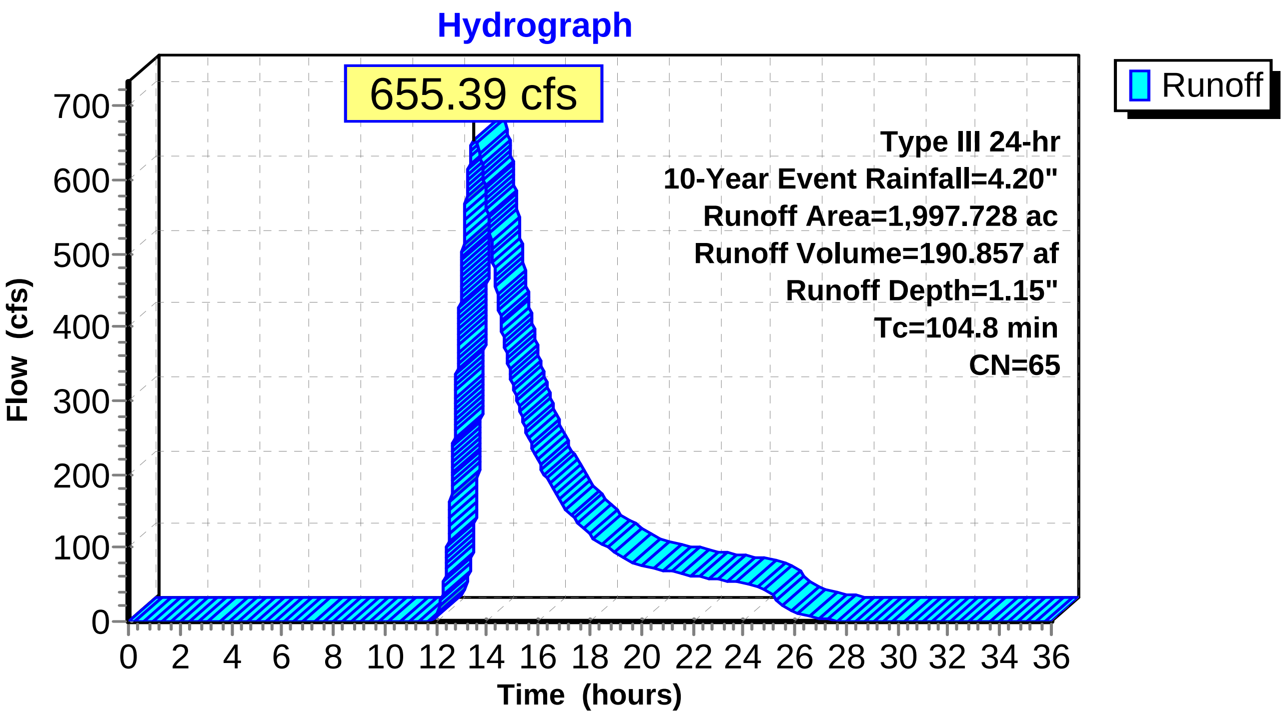
Runoff = 655.39 cfs @ 13.51 hrs, Volume= 190.857 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	9.071	89	Gravel roads, HSG C
	0.057	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	53.756	71	Meadow, non-grazed, HSG C
	86.160	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,103.235	70	Woods, Good, HSG C
	77.747	77	Woods, Good, HSG D
	1,997.728	65	Weighted Average
	1,996.812		99.95% Pervious Area
	0.916		0.05% Impervious Area

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

Subcatchment 3W:

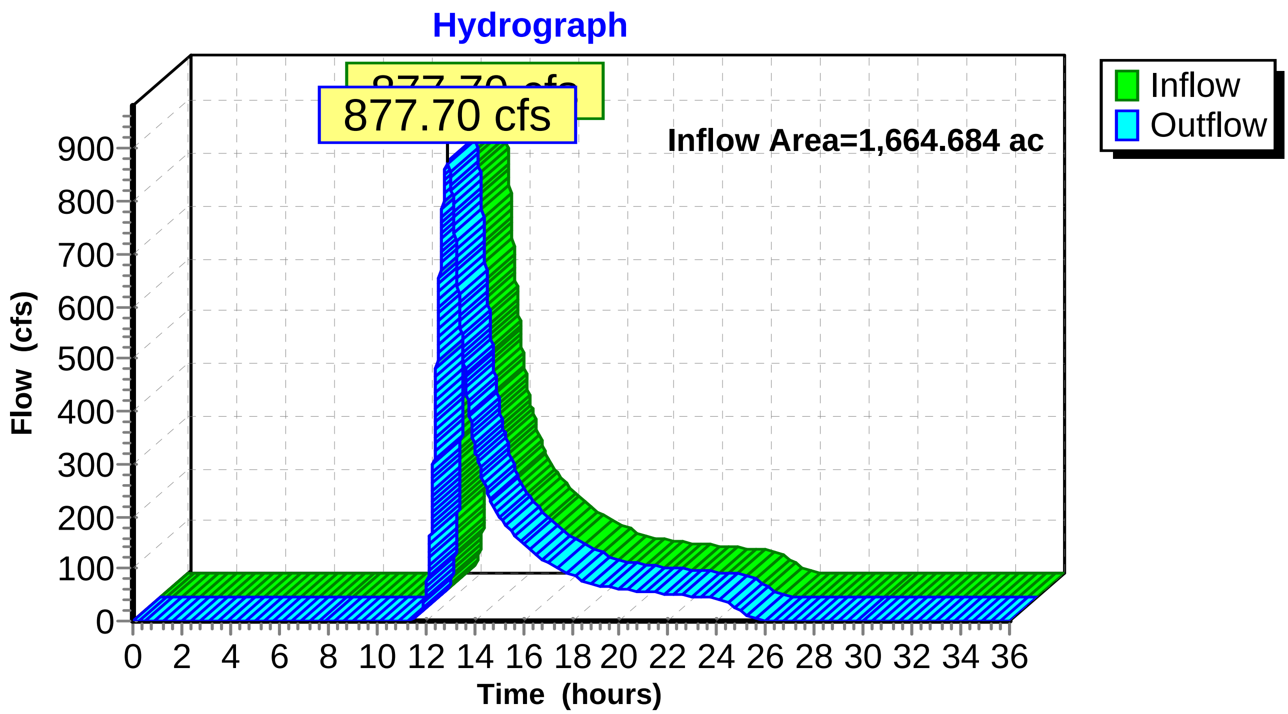


Summary for Reach SP-1: Study Point

Inflow Area = 1,664.684 ac, 0.24% Impervious, Inflow Depth = 1.27" for 10-Year Event event
Inflow = 877.70 cfs @ 12.91 hrs, Volume= 176.138 af
Outflow = 877.70 cfs @ 12.91 hrs, Volume= 176.138 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-1: Study Point

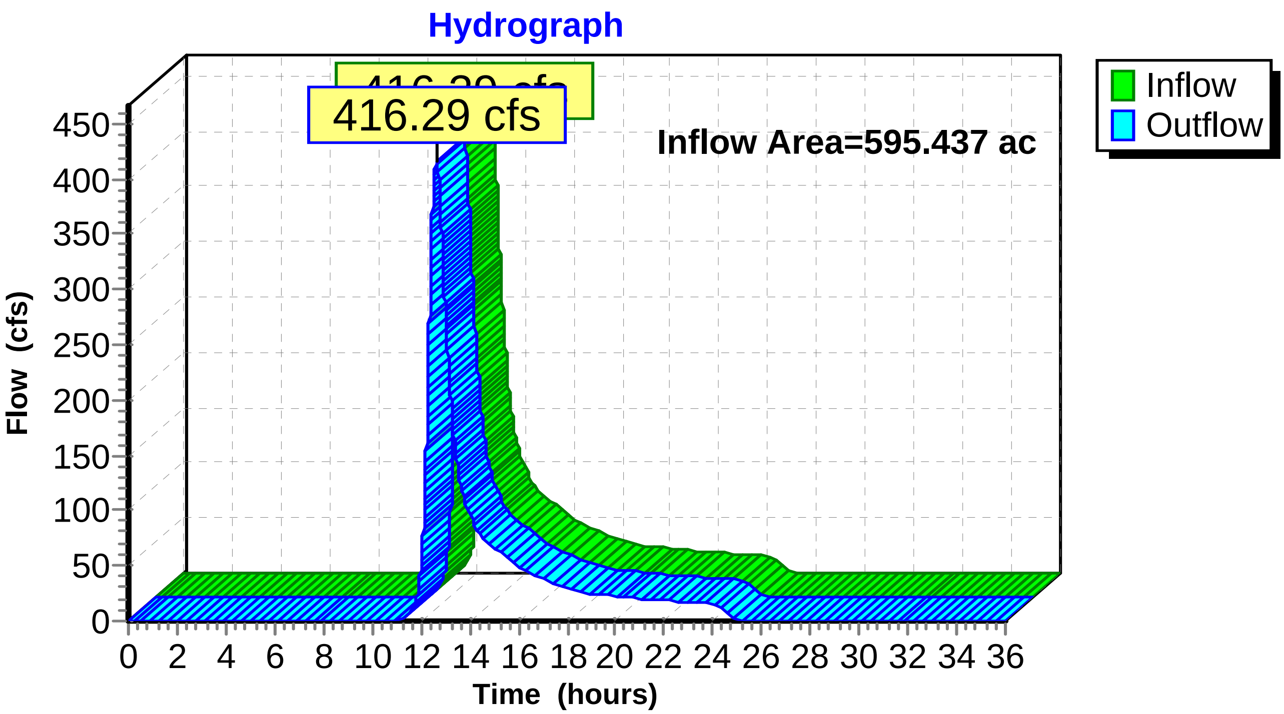


Summary for Reach SP-2: Study Point

Inflow Area = 595.437 ac, 0.04% Impervious, Inflow Depth = 1.33" for 10-Year Event event
Inflow = 416.29 cfs @ 12.63 hrs, Volume= 66.162 af
Outflow = 416.29 cfs @ 12.63 hrs, Volume= 66.162 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

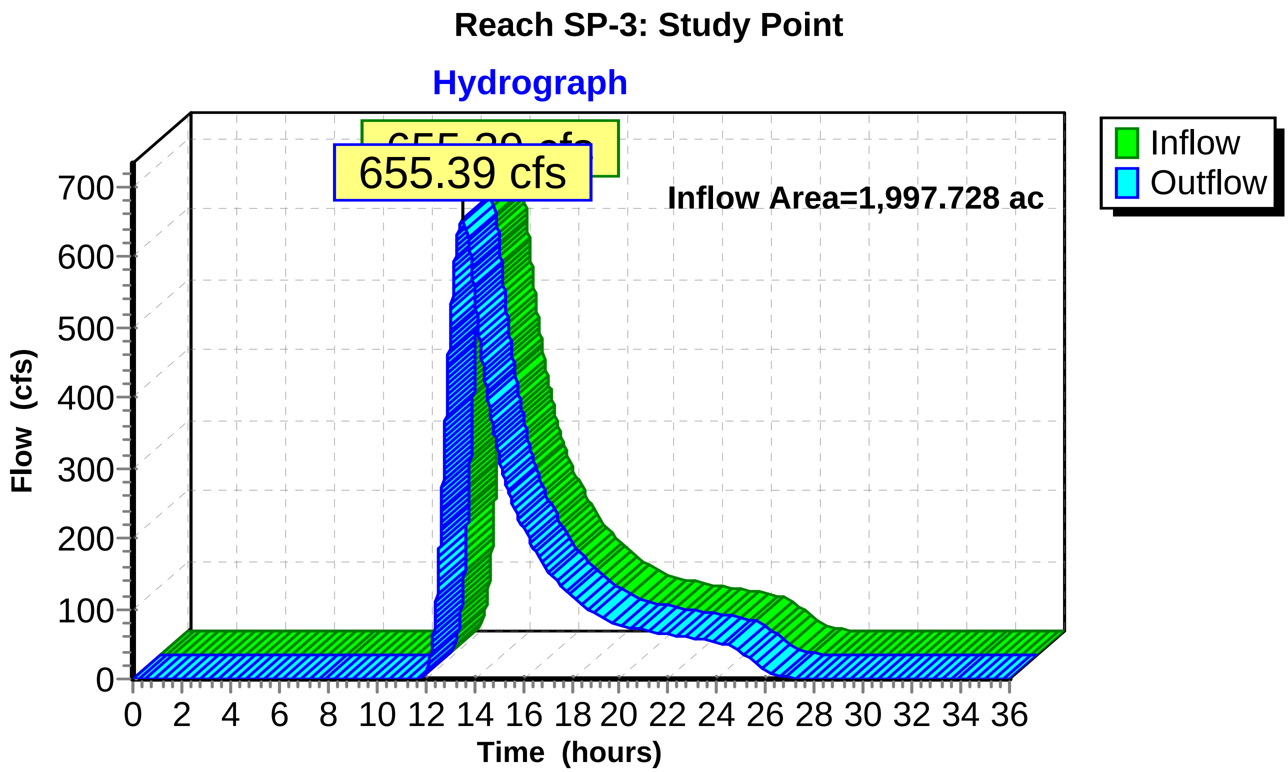
Reach SP-2: Study Point



Summary for Reach SP-3: Study Point

Inflow Area = 1,997.728 ac, 0.05% Impervious, Inflow Depth = 1.15" for 10-Year Event event
Inflow = 655.39 cfs @ 13.51 hrs, Volume= 190.857 af
Outflow = 655.39 cfs @ 13.51 hrs, Volume= 190.857 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3



Summary for Subcatchment 1W:

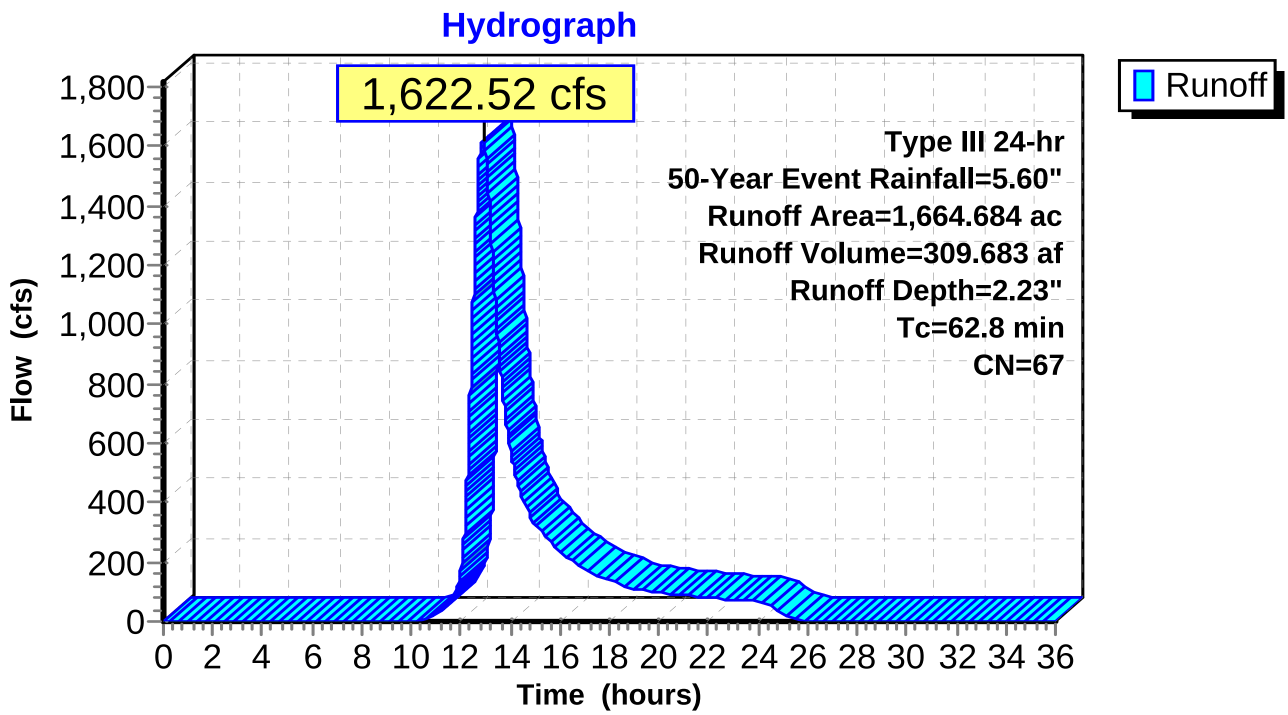
Runoff = 1,622.52 cfs @ 12.91 hrs, Volume= 309.683 af, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.788	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	1.753	89	Gravel roads, HSG C
	1.575	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	37.423	71	Meadow, non-grazed, HSG C
	6.536	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,282.411	70	Woods, Good, HSG C
	80.789	77	Woods, Good, HSG D
	1,664.684	67	Weighted Average
	1,660.615		99.76% Pervious Area
	4.069		0.24% Impervious Area

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

Subcatchment 1W:



Summary for Subcatchment 2W:

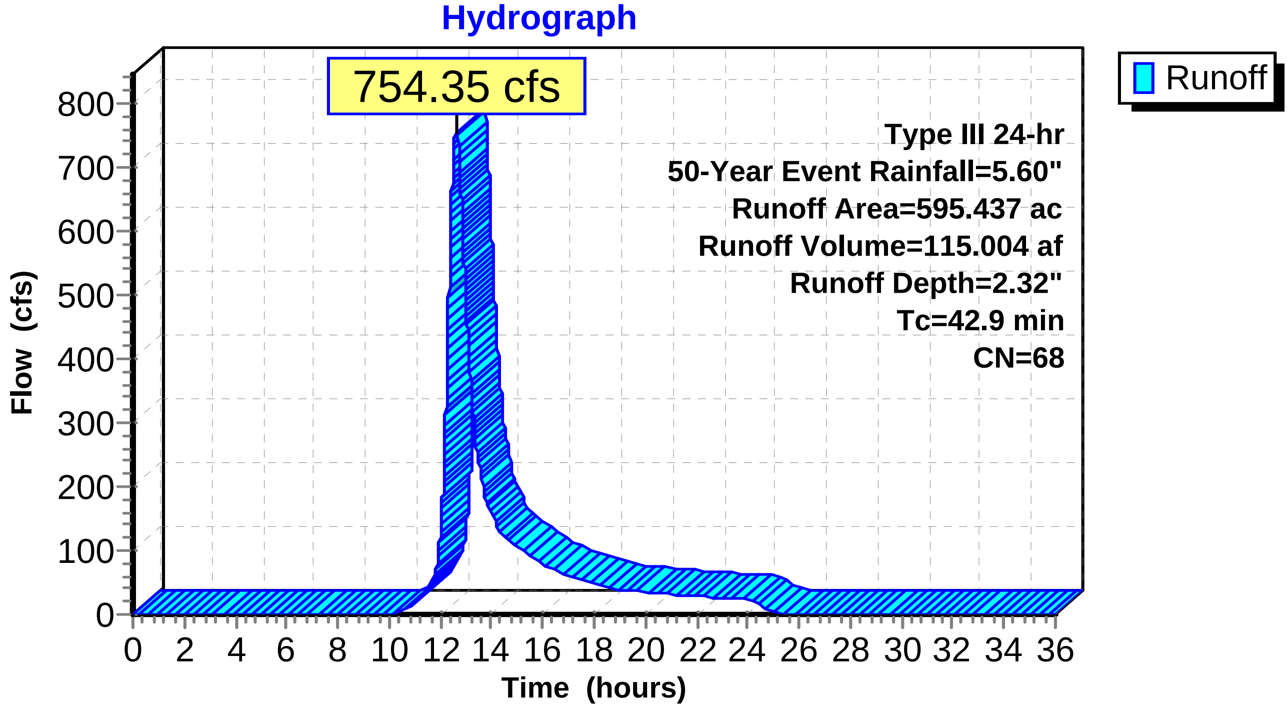
Runoff = 754.35 cfs @ 12.63 hrs, Volume= 115.004 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.068	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	7.926	71	Meadow, non-grazed, HSG C
	44.214	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	430.277	70	Woods, Good, HSG C
	45.093	77	Woods, Good, HSG D
	595.437	68	Weighted Average
	595.195		99.96% Pervious Area
	0.242		0.04% Impervious Area

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

Subcatchment 2W:



Summary for Subcatchment 3W:

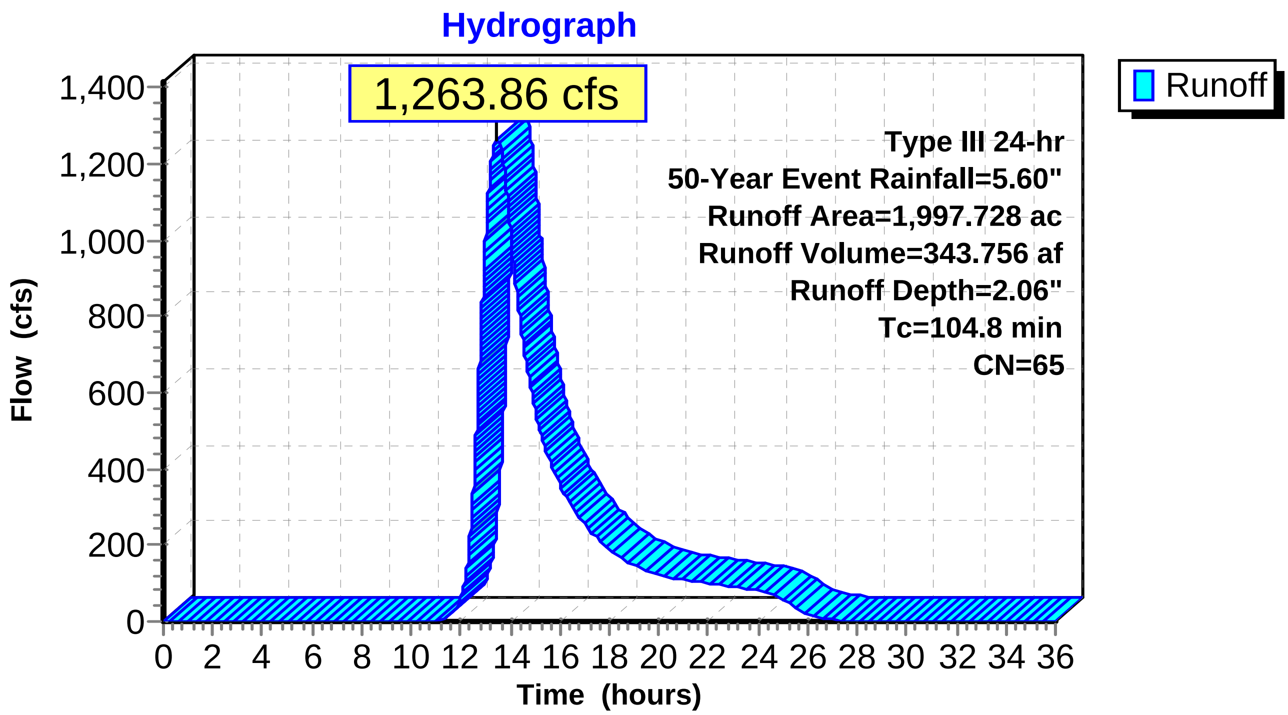
Runoff = 1,263.86 cfs @ 13.40 hrs, Volume= 343.756 af, Depth= 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	9.071	89	Gravel roads, HSG C
	0.057	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	53.756	71	Meadow, non-grazed, HSG C
	86.160	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,103.235	70	Woods, Good, HSG C
	77.747	77	Woods, Good, HSG D
	1,997.728	65	Weighted Average
	1,996.812		99.95% Pervious Area
	0.916		0.05% Impervious Area

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

Subcatchment 3W:

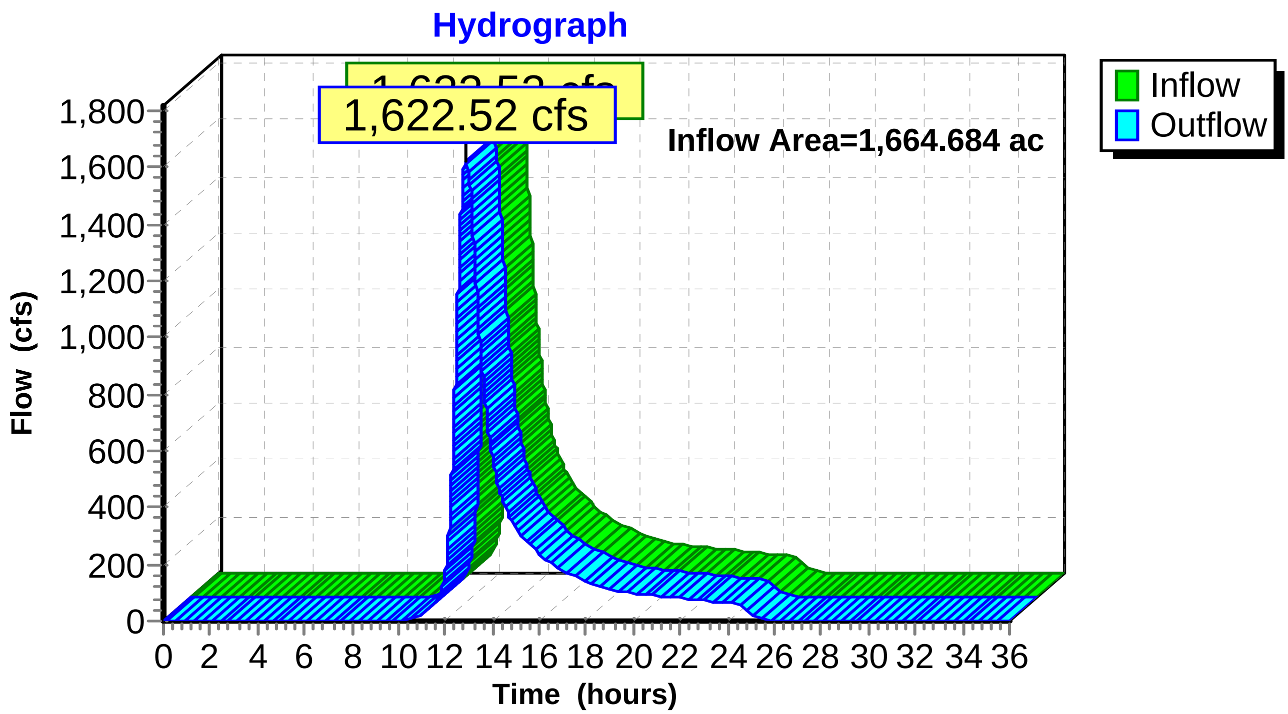


Summary for Reach SP-1: Study Point

Inflow Area =	1,664.684 ac,	0.24% Impervious, Inflow Depth = 2.23"	for 50-Year Event event
Inflow =	1,622.52 cfs @	12.91 hrs, Volume=	309.683 af
Outflow =	1,622.52 cfs @	12.91 hrs, Volume=	309.683 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

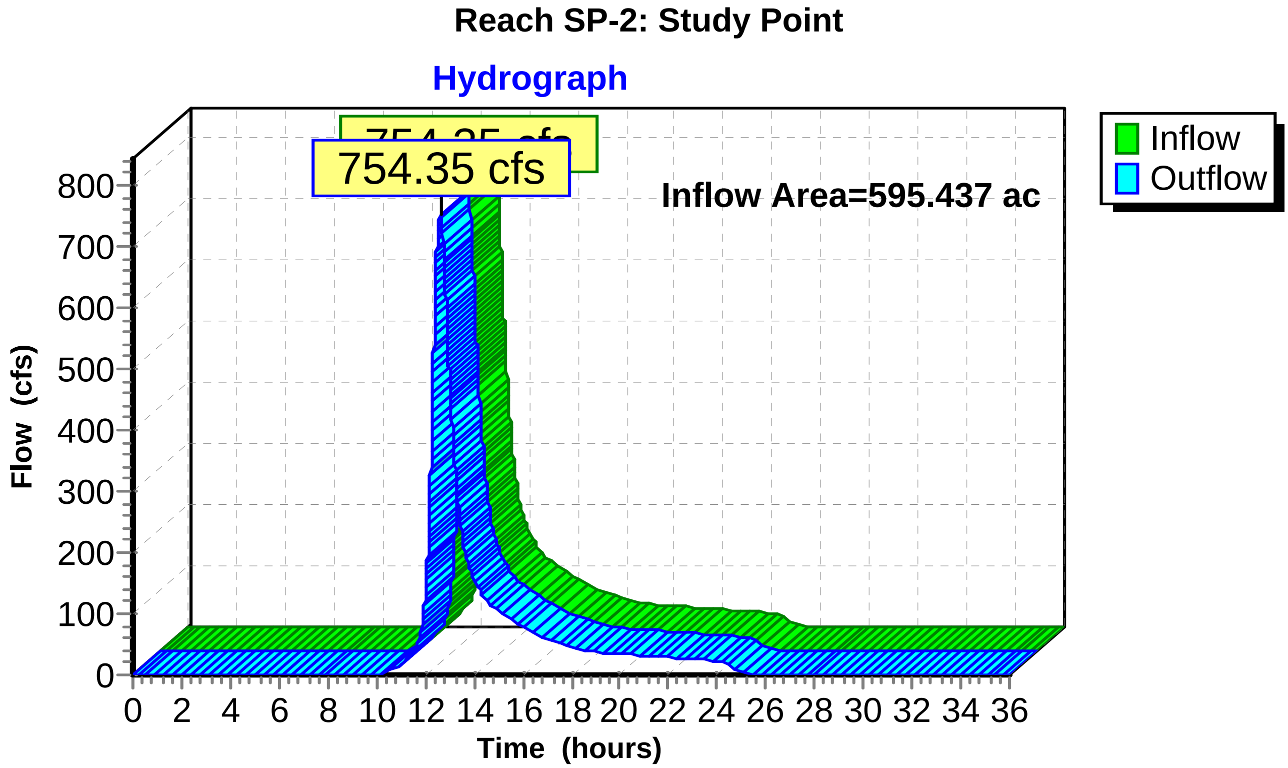
Reach SP-1: Study Point



Summary for Reach SP-2: Study Point

Inflow Area = 595.437 ac, 0.04% Impervious, Inflow Depth = 2.32" for 50-Year Event event
Inflow = 754.35 cfs @ 12.63 hrs, Volume= 115.004 af
Outflow = 754.35 cfs @ 12.63 hrs, Volume= 115.004 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

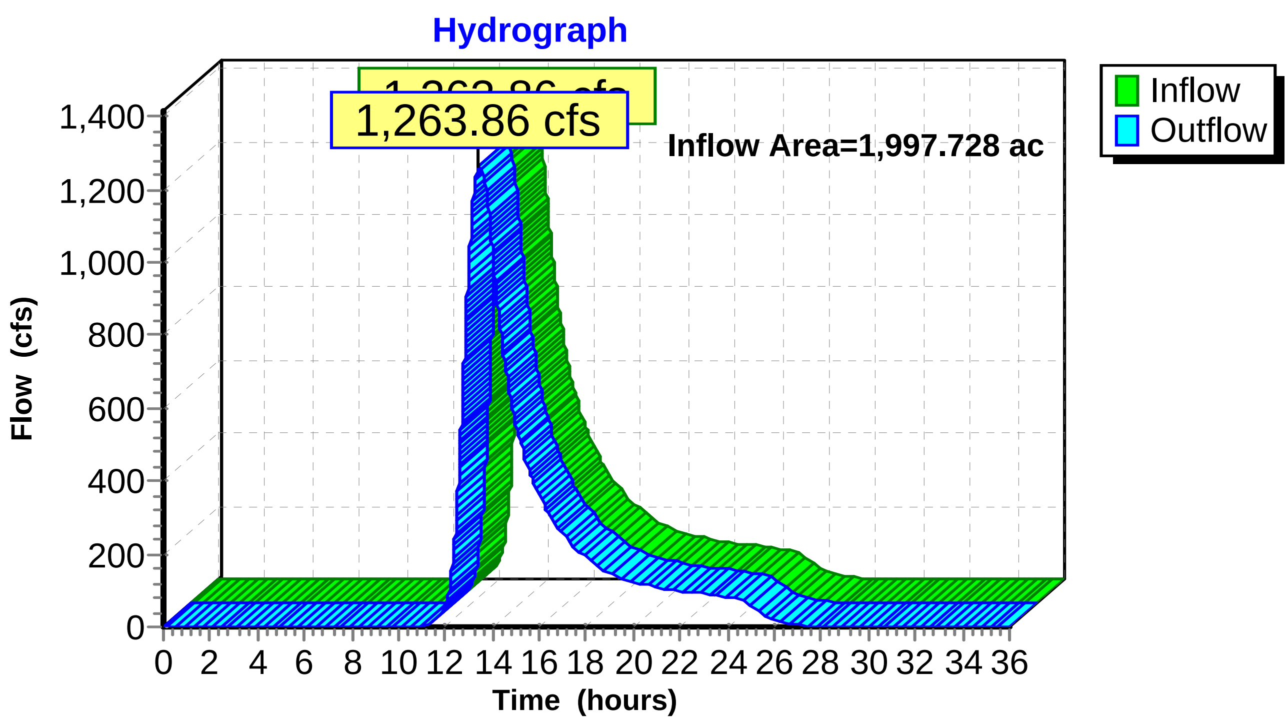


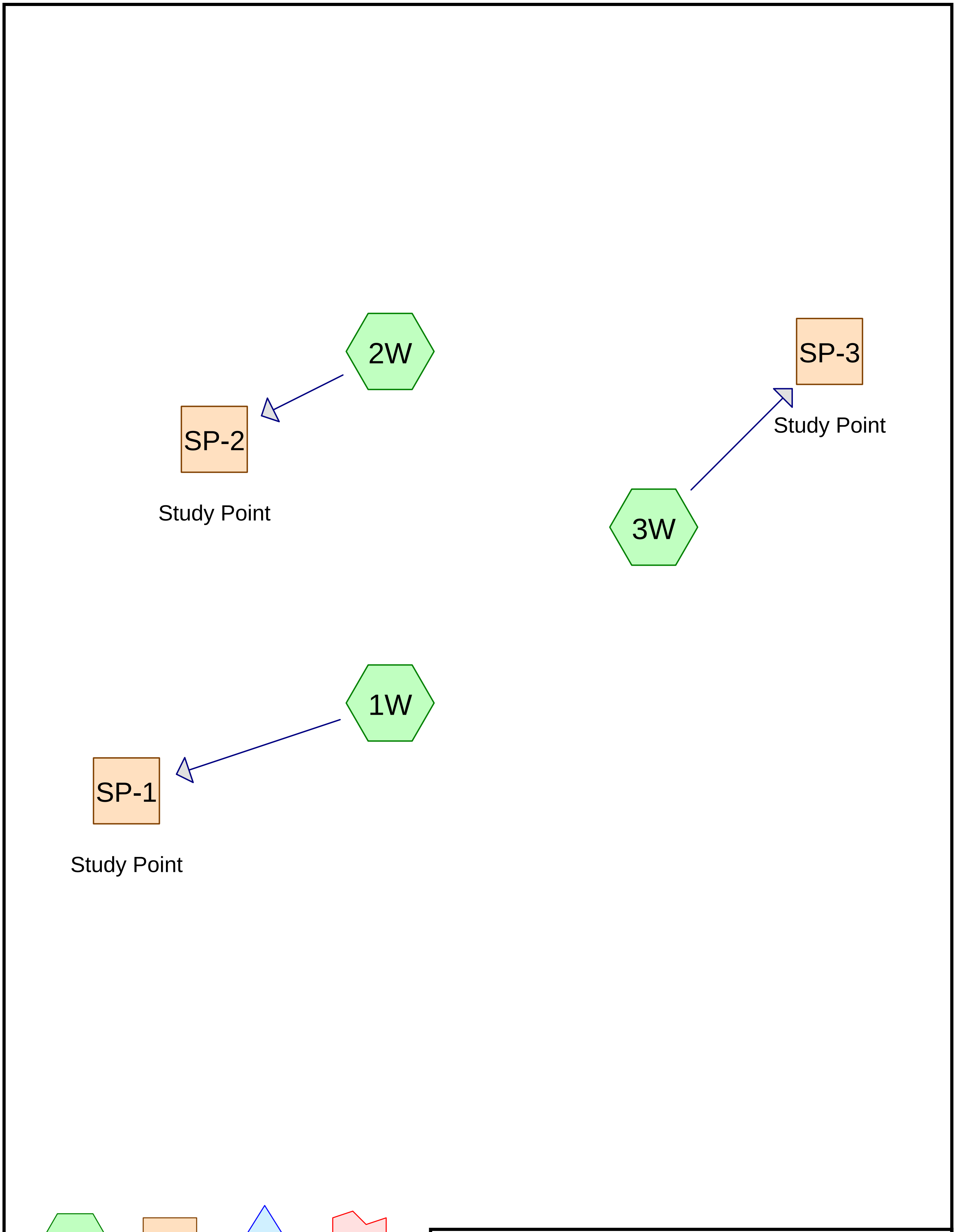
Summary for Reach SP-3: Study Point

Inflow Area = 1,997.728 ac, 0.05% Impervious, Inflow Depth = 2.06" for 50-Year Event event
Inflow = 1,263.86 cfs @ 13.40 hrs, Volume= 343.756 af
Outflow = 1,263.86 cfs @ 13.40 hrs, Volume= 343.756 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-3: Study Point





Routing Diagram for Watershed Model - Post
Prepared by TRC, Printed 4/6/2015
HydroCAD® 10.00-12 s/n 08043 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment 1W:

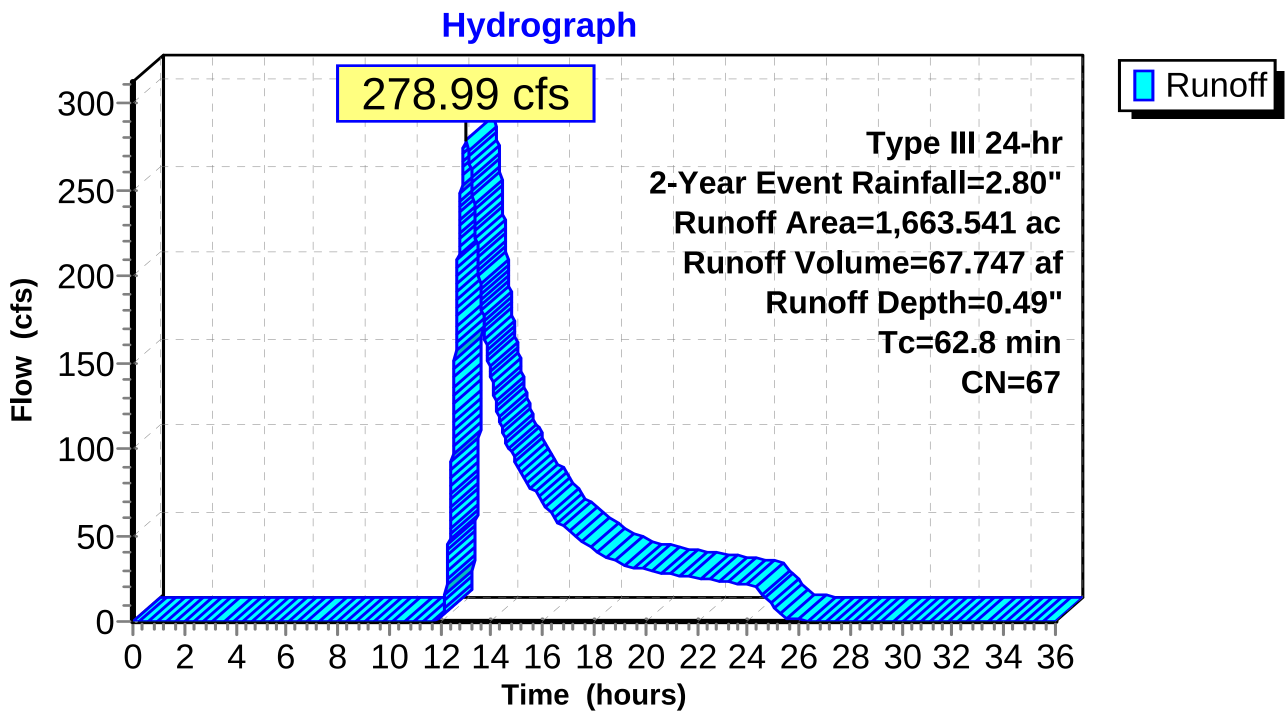
Runoff = 278.99 cfs @ 13.04 hrs, Volume= 67.747 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.874	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	9.836	89	Gravel roads, HSG C
	1.689	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	64.295	71	Meadow, non-grazed, HSG C
	6.747	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,246.217	70	Woods, Good, HSG C
	80.474	77	Woods, Good, HSG D
	1,663.541	67	Weighted Average
	1,659.386		99.75% Pervious Area
	4.155		0.25% Impervious Area

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

Subcatchment 1W:



Summary for Subcatchment 2W:

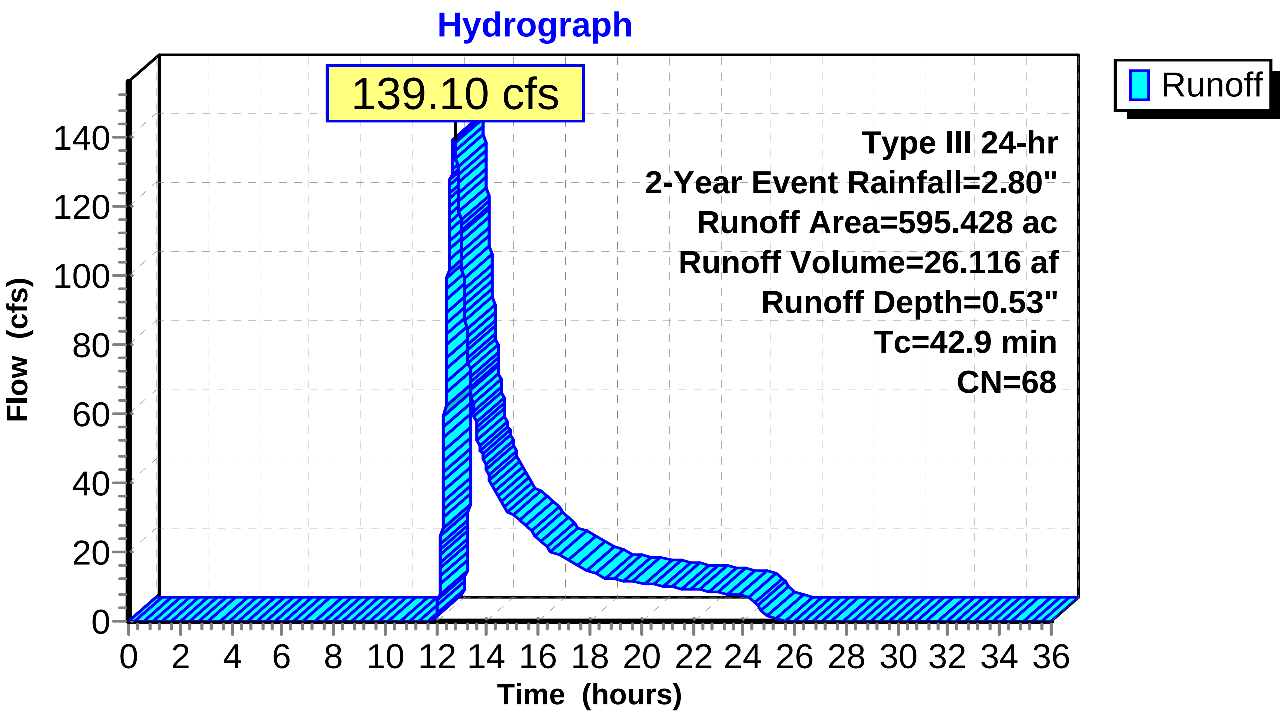
Runoff = 139.10 cfs @ 12.72 hrs, Volume= 26.116 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.281	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	8.692	71	Meadow, non-grazed, HSG C
	44.996	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	429.554	70	Woods, Good, HSG C
	44.046	77	Woods, Good, HSG D
	595.428	68	Weighted Average
	595.186		99.96% Pervious Area
	0.242		0.04% Impervious Area

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

Subcatchment 2W:



Summary for Subcatchment 3W:

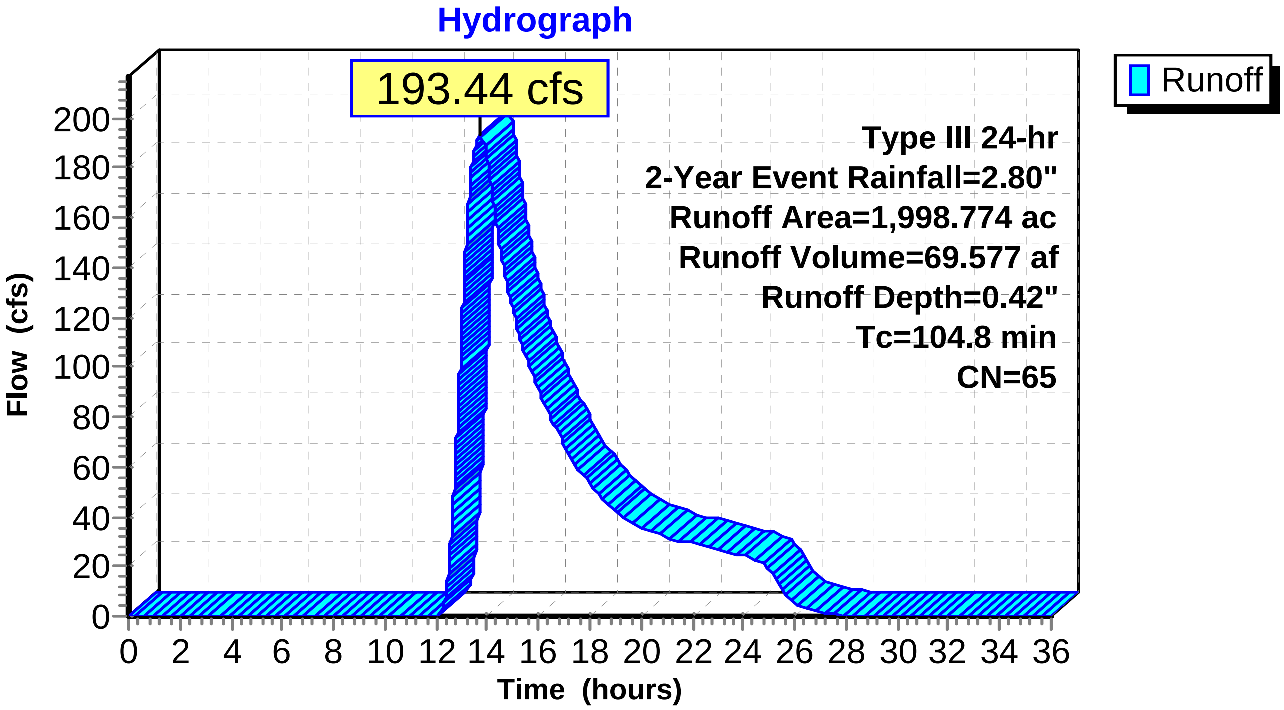
Runoff = 193.44 cfs @ 13.74 hrs, Volume= 69.577 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	9.003	89	Gravel roads, HSG C
	0.489	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	68.766	71	Meadow, non-grazed, HSG C
	88.224	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,089.085	70	Woods, Good, HSG C
	75.505	77	Woods, Good, HSG D
	1,998.774	65	Weighted Average
	1,997.858		99.95% Pervious Area
	0.916		0.05% Impervious Area

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

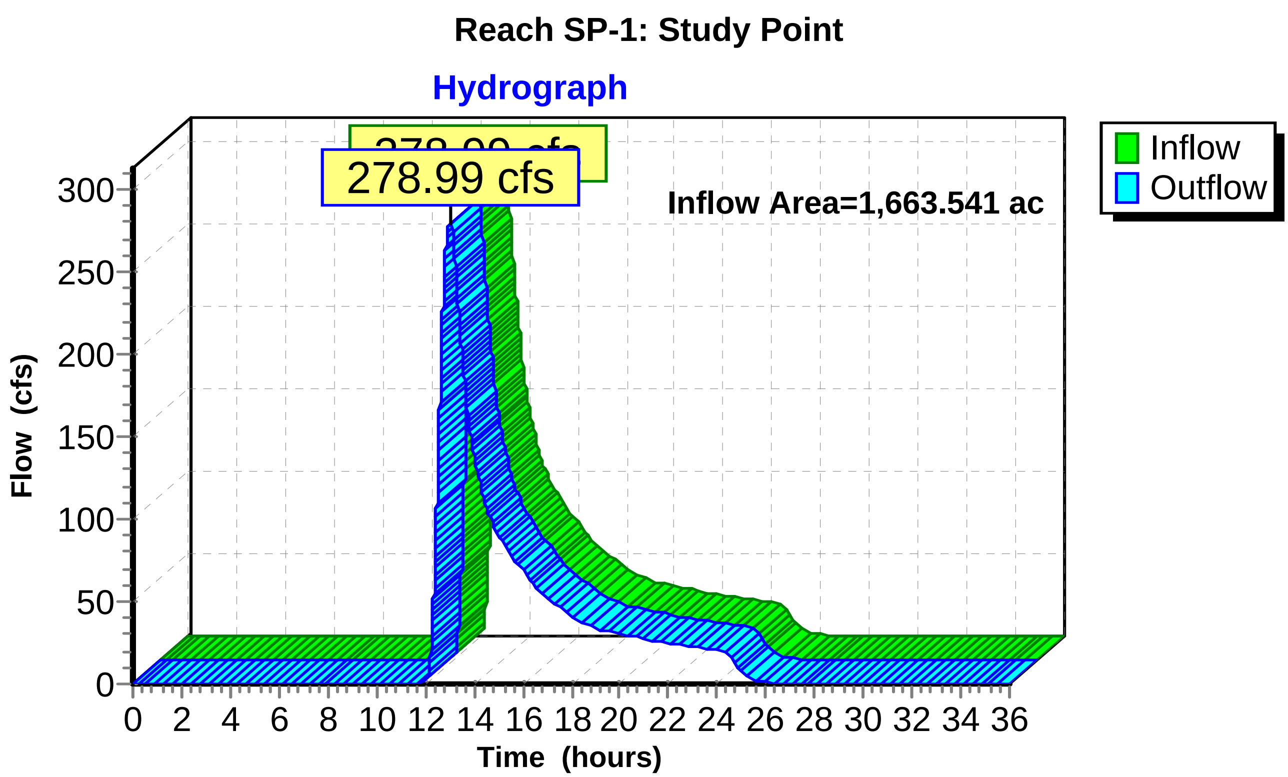
Subcatchment 3W:



Summary for Reach SP-1: Study Point

Inflow Area =	1,663.541 ac,	0.25% Impervious, Inflow Depth =	0.49"	for 2-Year Event event
Inflow =	278.99 cfs @	13.04 hrs, Volume=	67.747 af	
Outflow =	278.99 cfs @	13.04 hrs, Volume=	67.747 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

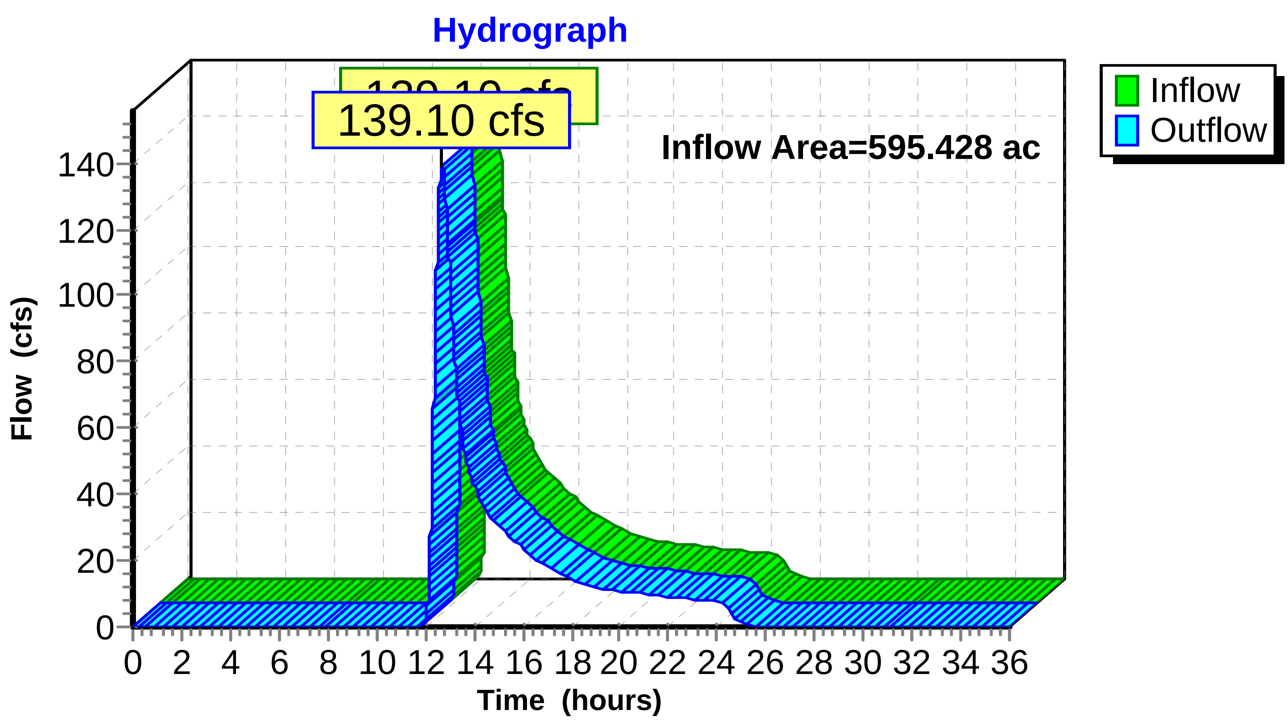


Summary for Reach SP-2: Study Point

Inflow Area = 595.428 ac, 0.04% Impervious, Inflow Depth = 0.53" for 2-Year Event event
Inflow = 139.10 cfs @ 12.72 hrs, Volume= 26.116 af
Outflow = 139.10 cfs @ 12.72 hrs, Volume= 26.116 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-2: Study Point

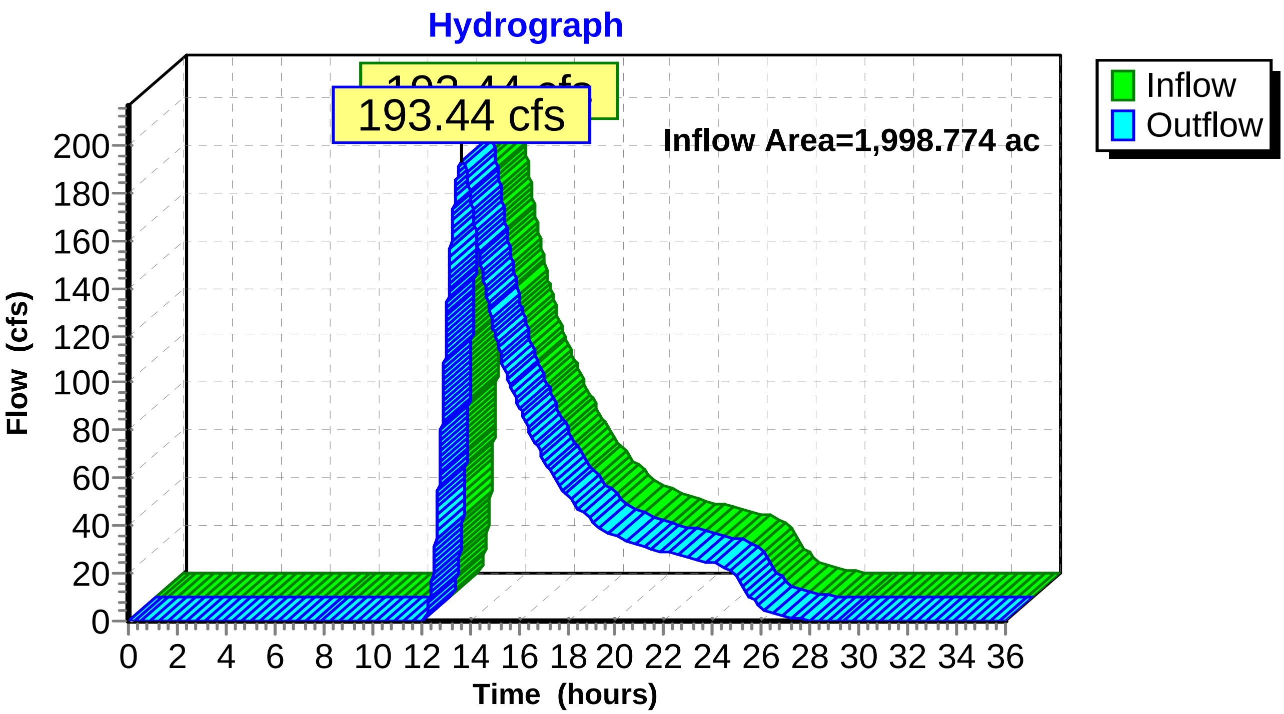


Summary for Reach SP-3: Study Point

Inflow Area = 1,998.774 ac, 0.05% Impervious, Inflow Depth = 0.42" for 2-Year Event event
Inflow = 193.44 cfs @ 13.74 hrs, Volume= 69.577 af
Outflow = 193.44 cfs @ 13.74 hrs, Volume= 69.577 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-3: Study Point



Summary for Subcatchment 1W:

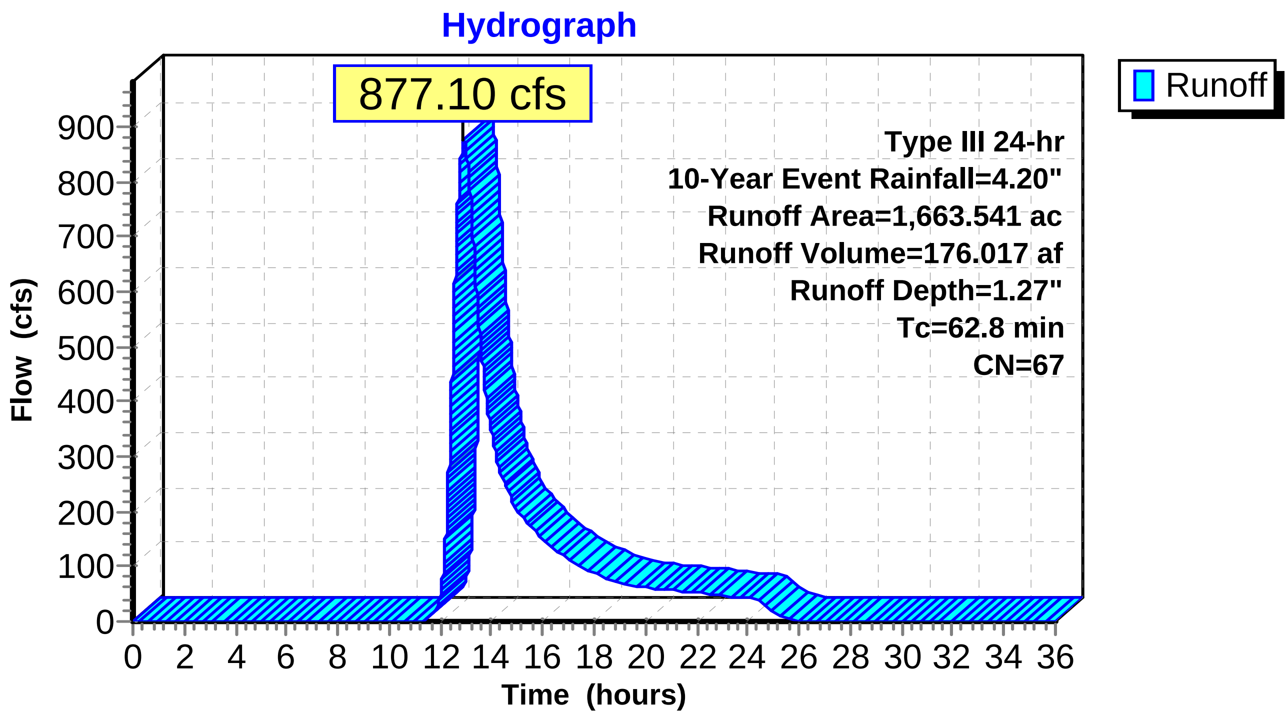
Runoff = 877.10 cfs @ 12.91 hrs, Volume= 176.017 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.874	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	9.836	89	Gravel roads, HSG C
	1.689	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	64.295	71	Meadow, non-grazed, HSG C
	6.747	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,246.217	70	Woods, Good, HSG C
	80.474	77	Woods, Good, HSG D
	1,663.541	67	Weighted Average
	1,659.386		99.75% Pervious Area
	4.155		0.25% Impervious Area

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

Subcatchment 1W:



Summary for Subcatchment 2W:

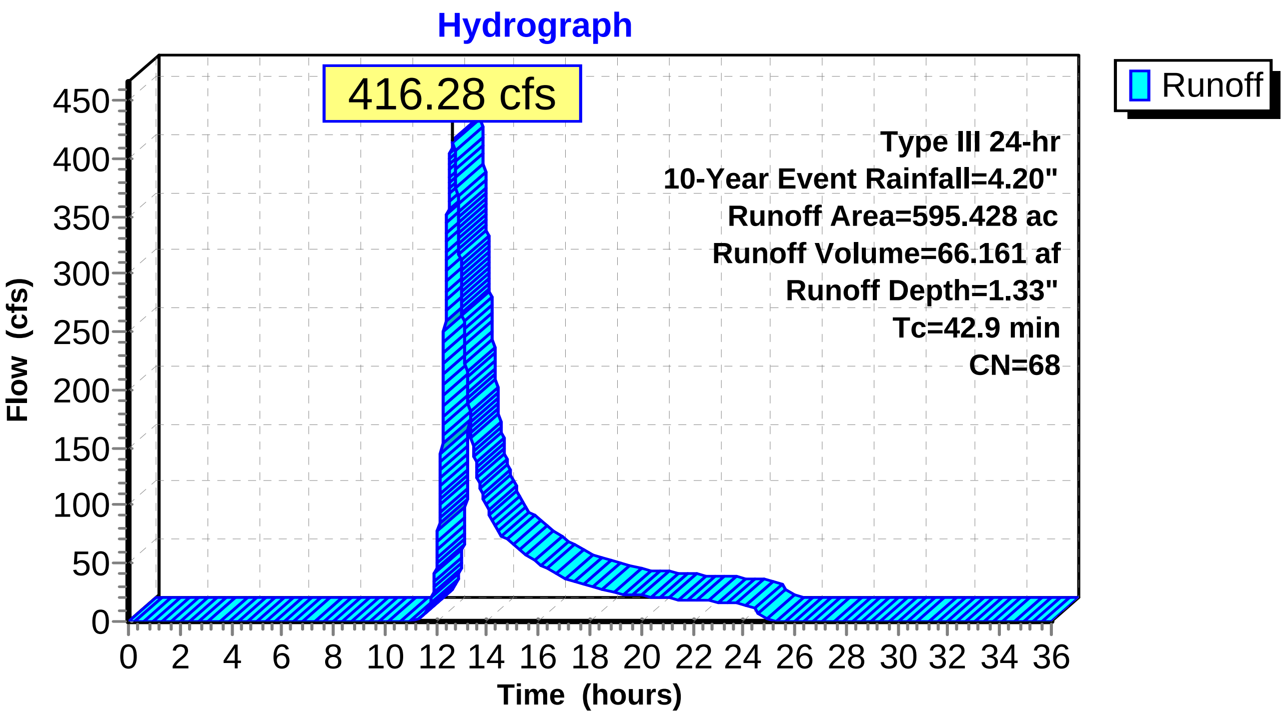
Runoff = 416.28 cfs @ 12.63 hrs, Volume= 66.161 af, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.281	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	8.692	71	Meadow, non-grazed, HSG C
	44.996	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	429.554	70	Woods, Good, HSG C
	44.046	77	Woods, Good, HSG D
	595.428	68	Weighted Average
	595.186		99.96% Pervious Area
	0.242		0.04% Impervious Area

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

Subcatchment 2W:



Summary for Subcatchment 3W:

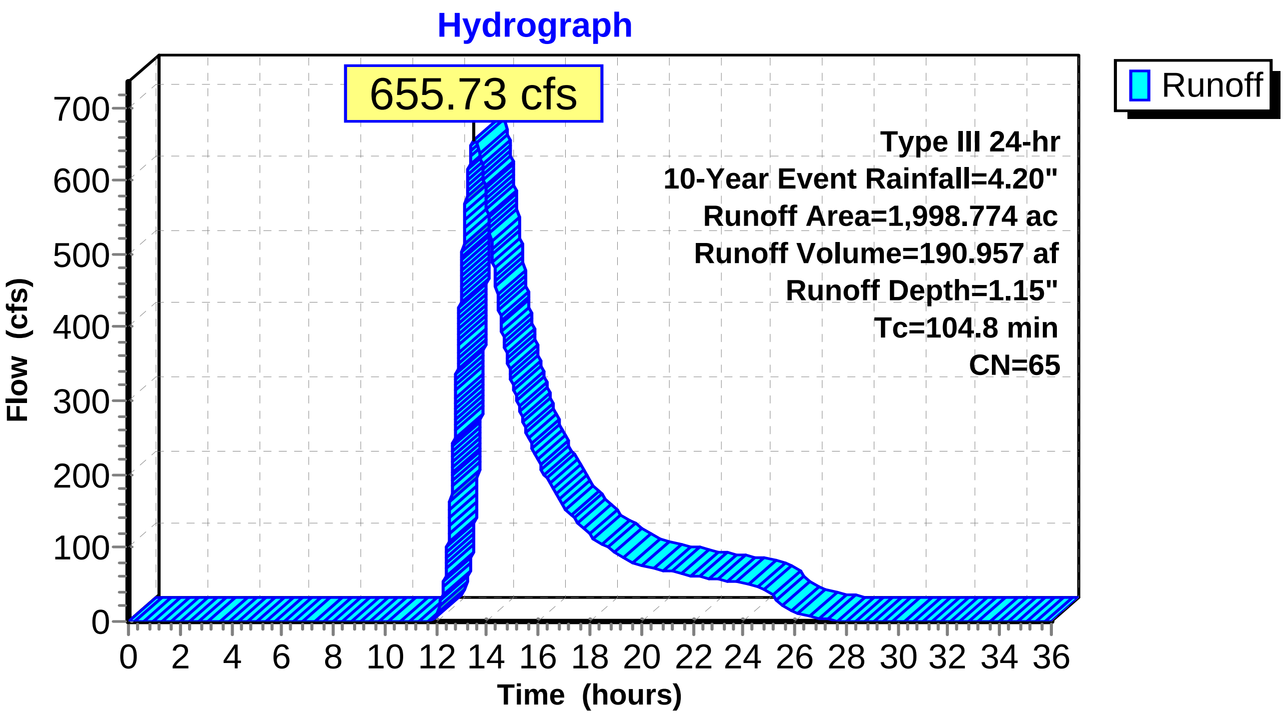
Runoff = 655.73 cfs @ 13.51 hrs, Volume= 190.957 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	9.003	89	Gravel roads, HSG C
	0.489	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	68.766	71	Meadow, non-grazed, HSG C
	88.224	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,089.085	70	Woods, Good, HSG C
	75.505	77	Woods, Good, HSG D
	1,998.774	65	Weighted Average
	1,997.858		99.95% Pervious Area
	0.916		0.05% Impervious Area

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

Subcatchment 3W:

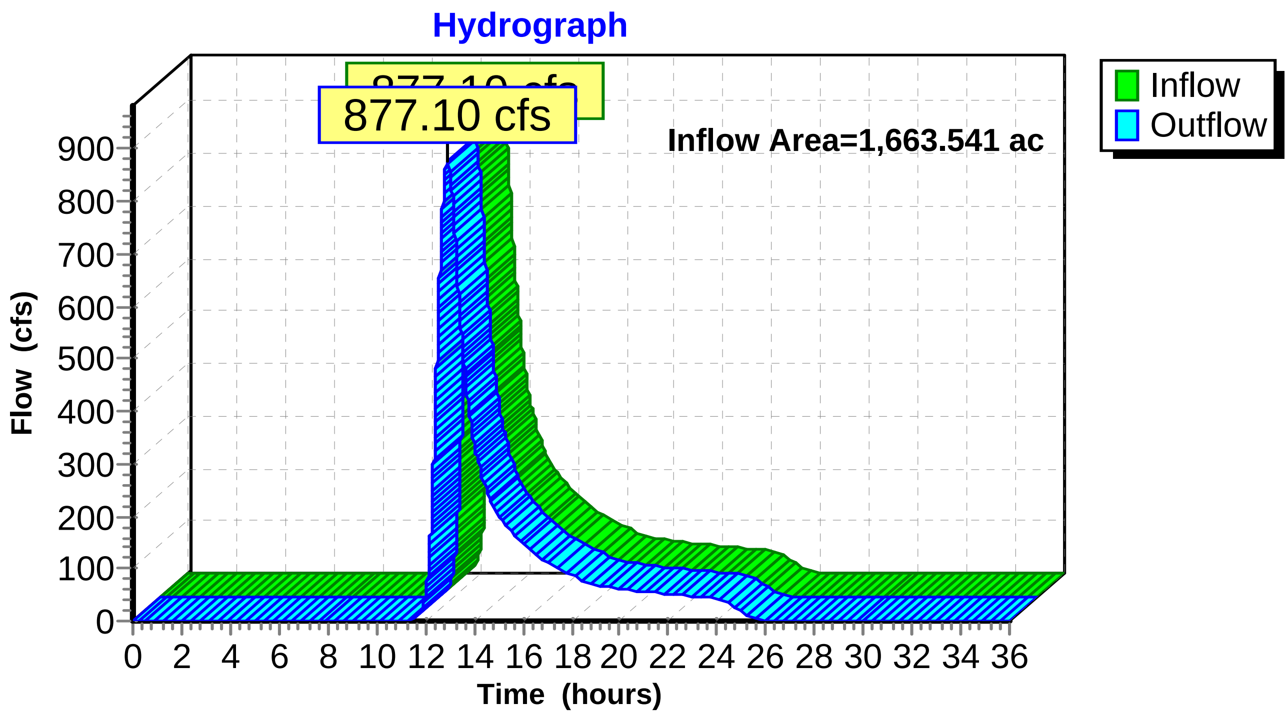


Summary for Reach SP-1: Study Point

Inflow Area =	1,663.541 ac,	0.25% Impervious,	Inflow Depth = 1.27"	for 10-Year Event event
Inflow =	877.10 cfs @	12.91 hrs,	Volume=	176.017 af
Outflow =	877.10 cfs @	12.91 hrs,	Volume=	176.017 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-1: Study Point

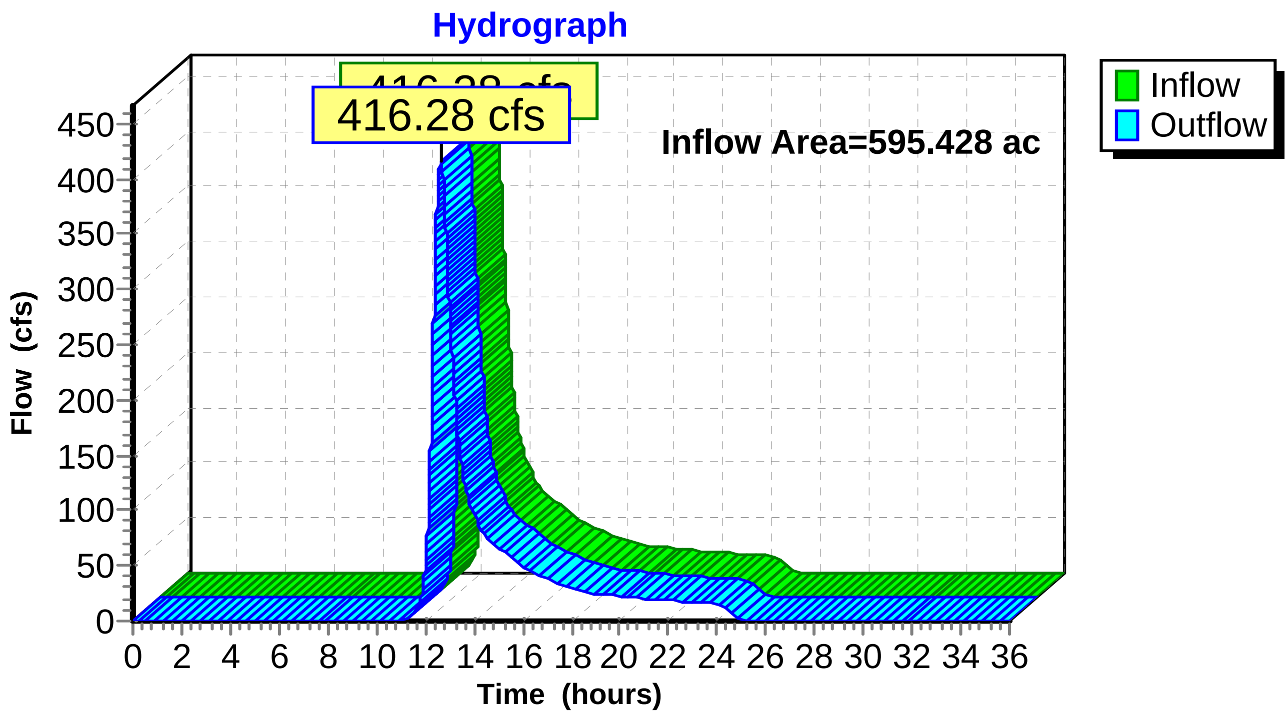


Summary for Reach SP-2: Study Point

Inflow Area =	595.428 ac,	0.04% Impervious, Inflow Depth = 1.33"		for 10-Year Event event
Inflow =	416.28 cfs @	12.63 hrs, Volume=	66.161 af	
Outflow =	416.28 cfs @	12.63 hrs, Volume=	66.161 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-2: Study Point

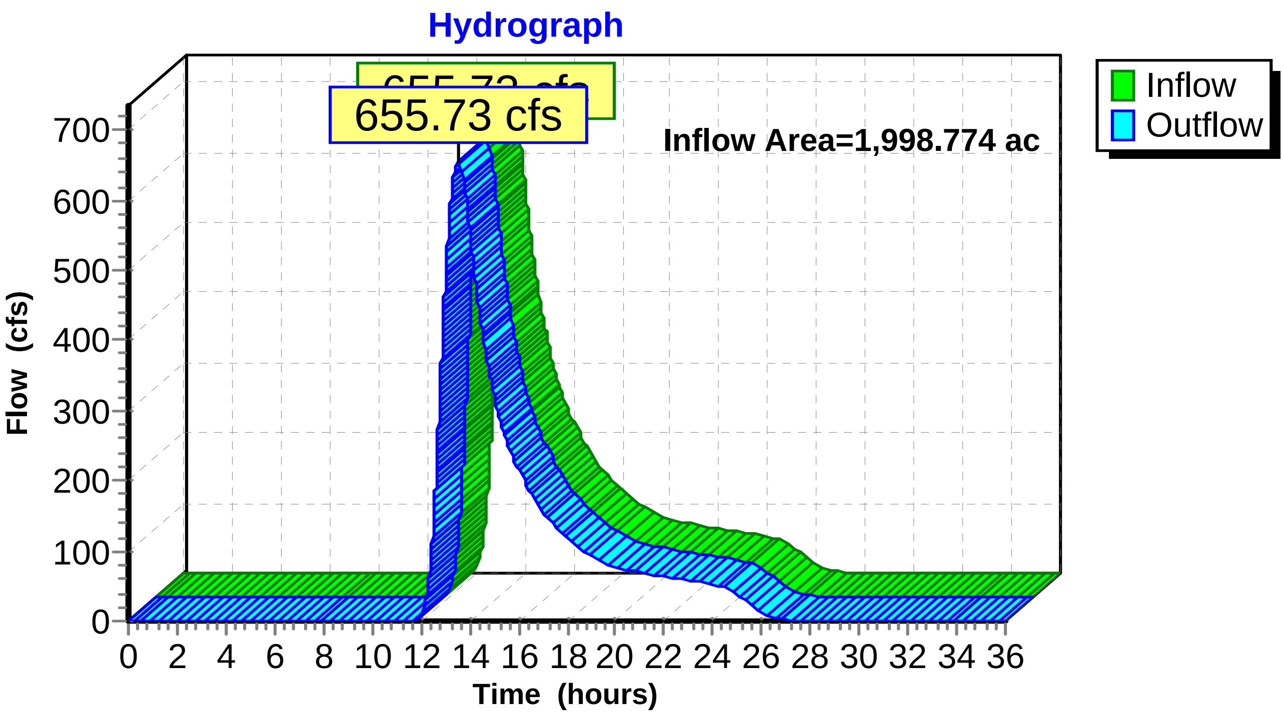


Summary for Reach SP-3: Study Point

Inflow Area = 1,998.774 ac, 0.05% Impervious, Inflow Depth = 1.15" for 10-Year Event event
Inflow = 655.73 cfs @ 13.51 hrs, Volume= 190.957 af
Outflow = 655.73 cfs @ 13.51 hrs, Volume= 190.957 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-3: Study Point



Summary for Subcatchment 1W:

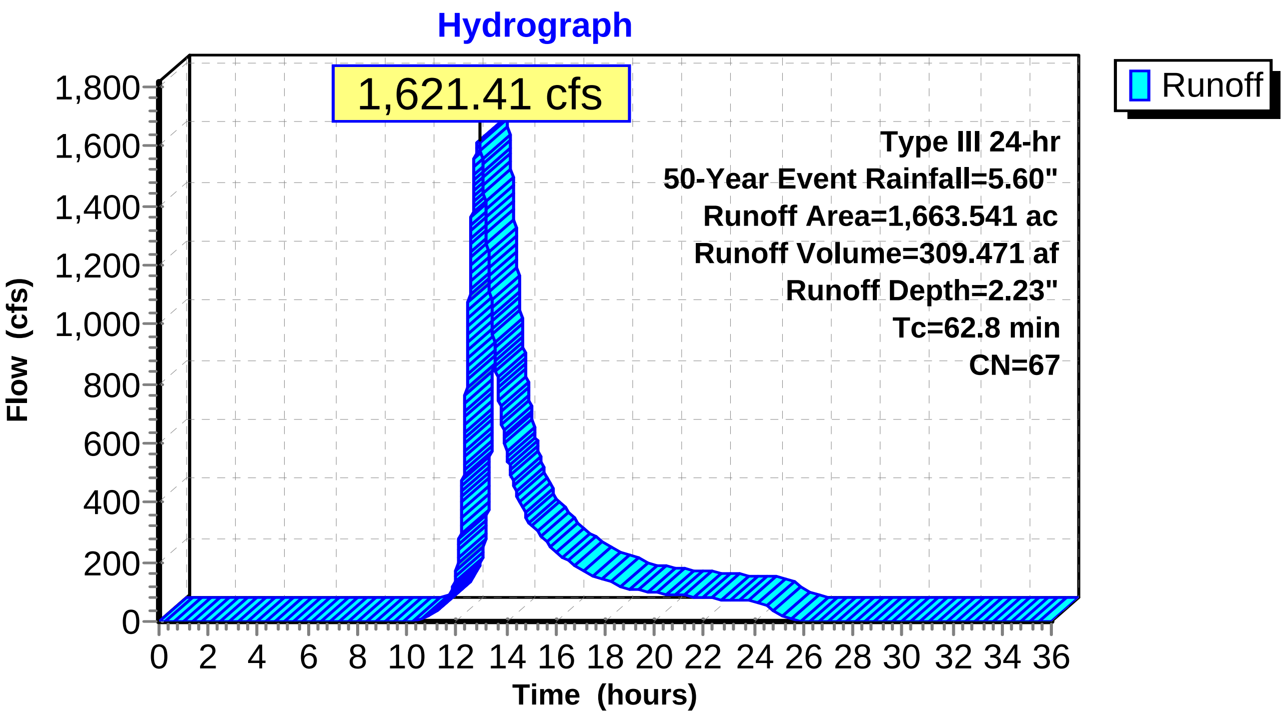
Runoff = 1,621.41 cfs @ 12.91 hrs, Volume= 309.471 af, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.874	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	9.836	89	Gravel roads, HSG C
	1.689	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	64.295	71	Meadow, non-grazed, HSG C
	6.747	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,246.217	70	Woods, Good, HSG C
	80.474	77	Woods, Good, HSG D
	1,663.541	67	Weighted Average
	1,659.386		99.75% Pervious Area
	4.155		0.25% Impervious Area

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

Subcatchment 1W:



Summary for Subcatchment 2W:

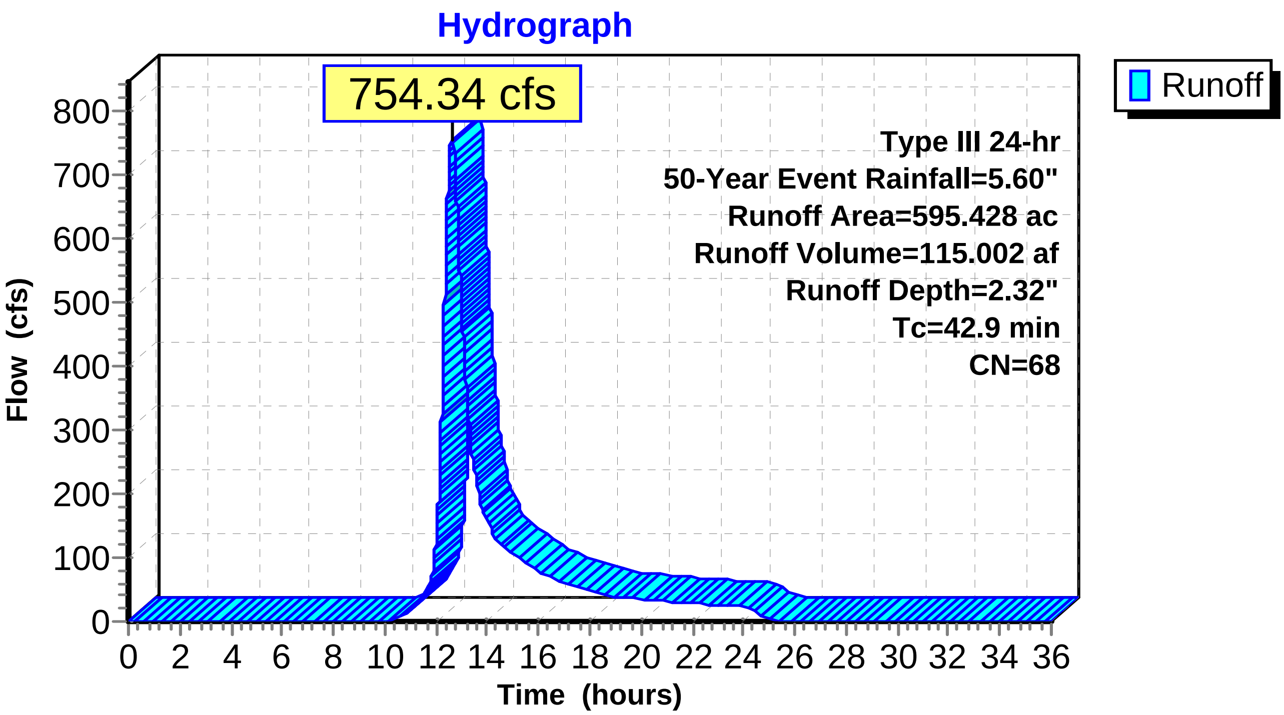
Runoff = 754.34 cfs @ 12.63 hrs, Volume= 115.002 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.281	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	8.692	71	Meadow, non-grazed, HSG C
	44.996	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	429.554	70	Woods, Good, HSG C
	44.046	77	Woods, Good, HSG D
	595.428	68	Weighted Average
	595.186		99.96% Pervious Area
	0.242		0.04% Impervious Area

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

Subcatchment 2W:



Summary for Subcatchment 3W:

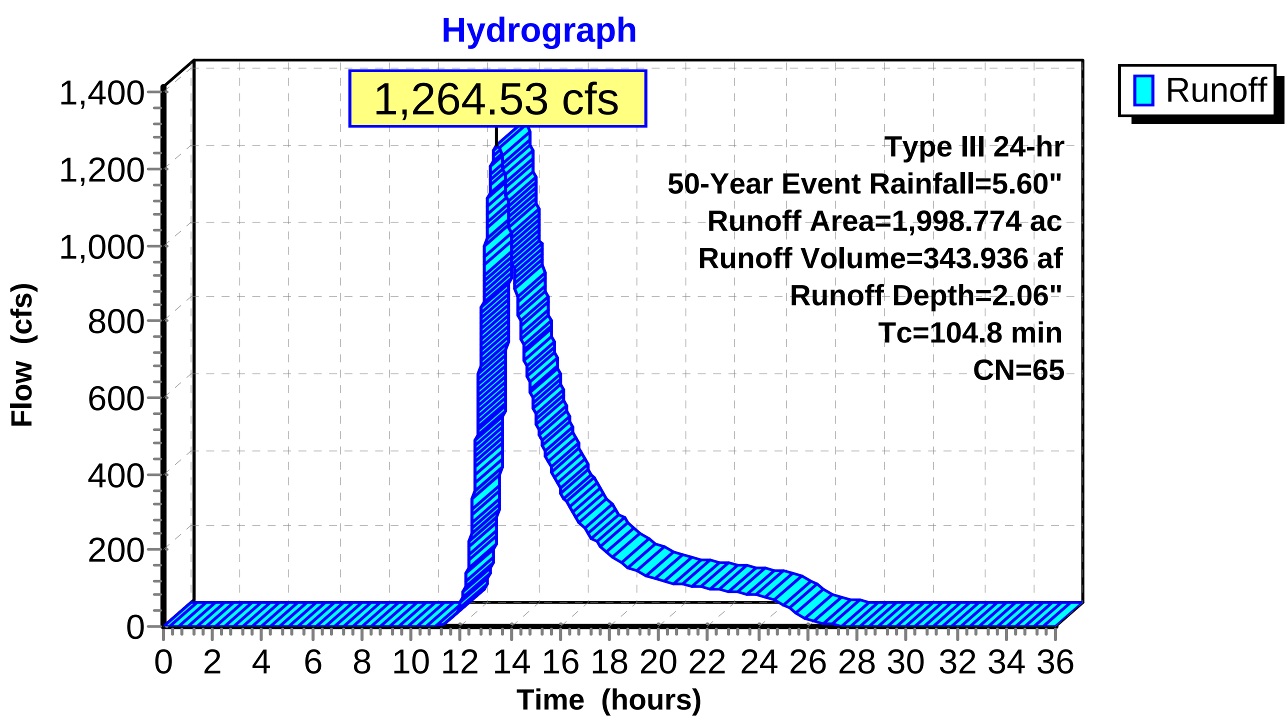
Runoff = 1,264.53 cfs @ 13.40 hrs, Volume= 343.936 af, Depth= 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	9.003	89	Gravel roads, HSG C
	0.489	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	68.766	71	Meadow, non-grazed, HSG C
	88.224	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,089.085	70	Woods, Good, HSG C
	75.505	77	Woods, Good, HSG D
	1,998.774	65	Weighted Average
	1,997.858		99.95% Pervious Area
	0.916		0.05% Impervious Area

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

Subcatchment 3W:

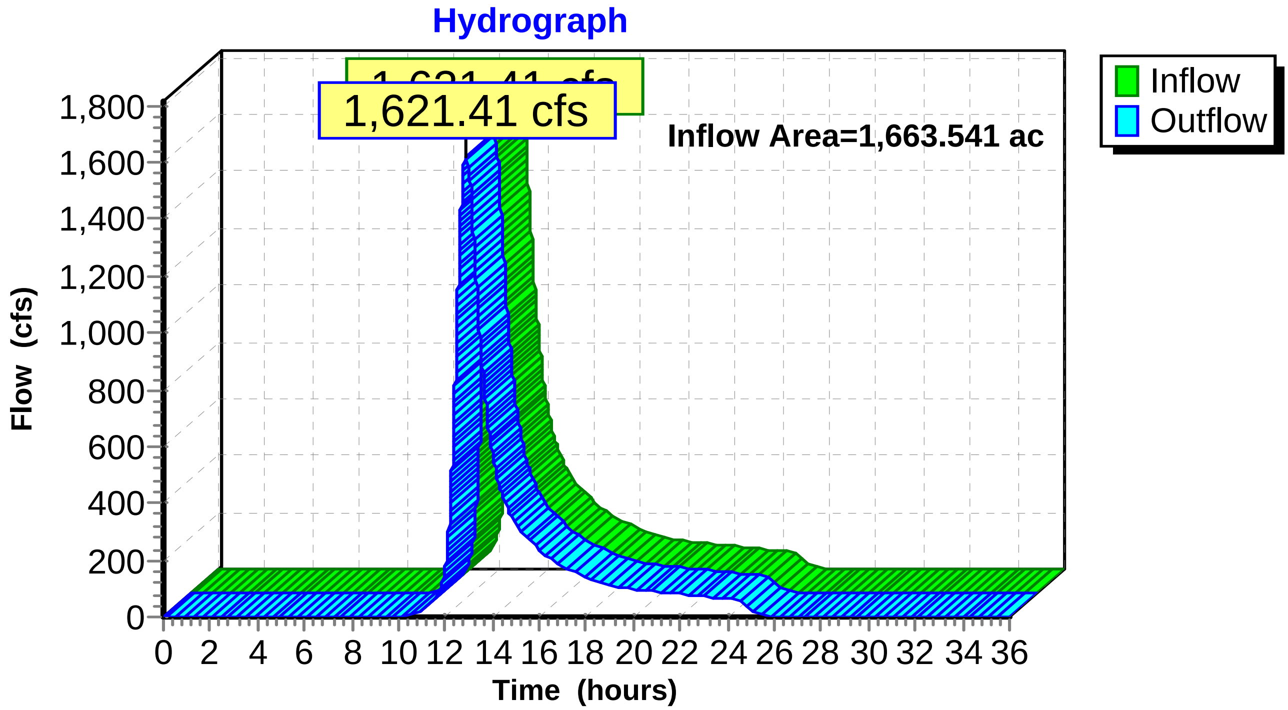


Summary for Reach SP-1: Study Point

Inflow Area = 1,663.541 ac, 0.25% Impervious, Inflow Depth = 2.23" for 50-Year Event event
Inflow = 1,621.41 cfs @ 12.91 hrs, Volume= 309.471 af
Outflow = 1,621.41 cfs @ 12.91 hrs, Volume= 309.471 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-1: Study Point

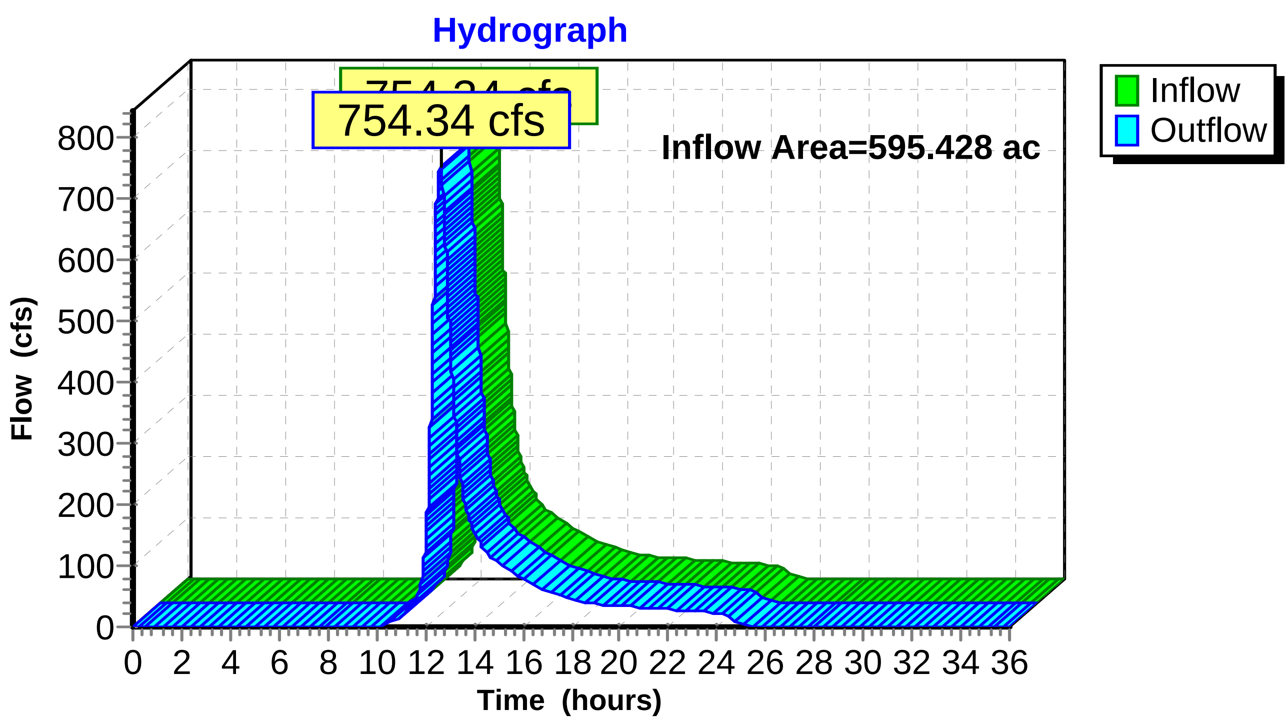


Summary for Reach SP-2: Study Point

Inflow Area =	595.428 ac,	0.04% Impervious,	Inflow Depth = 2.32"	for 50-Year Event event
Inflow =	754.34 cfs @	12.63 hrs, Volume=	115.002 af	
Outflow =	754.34 cfs @	12.63 hrs, Volume=	115.002 af, Atten= 0%, Lag= 0.0 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-2: Study Point

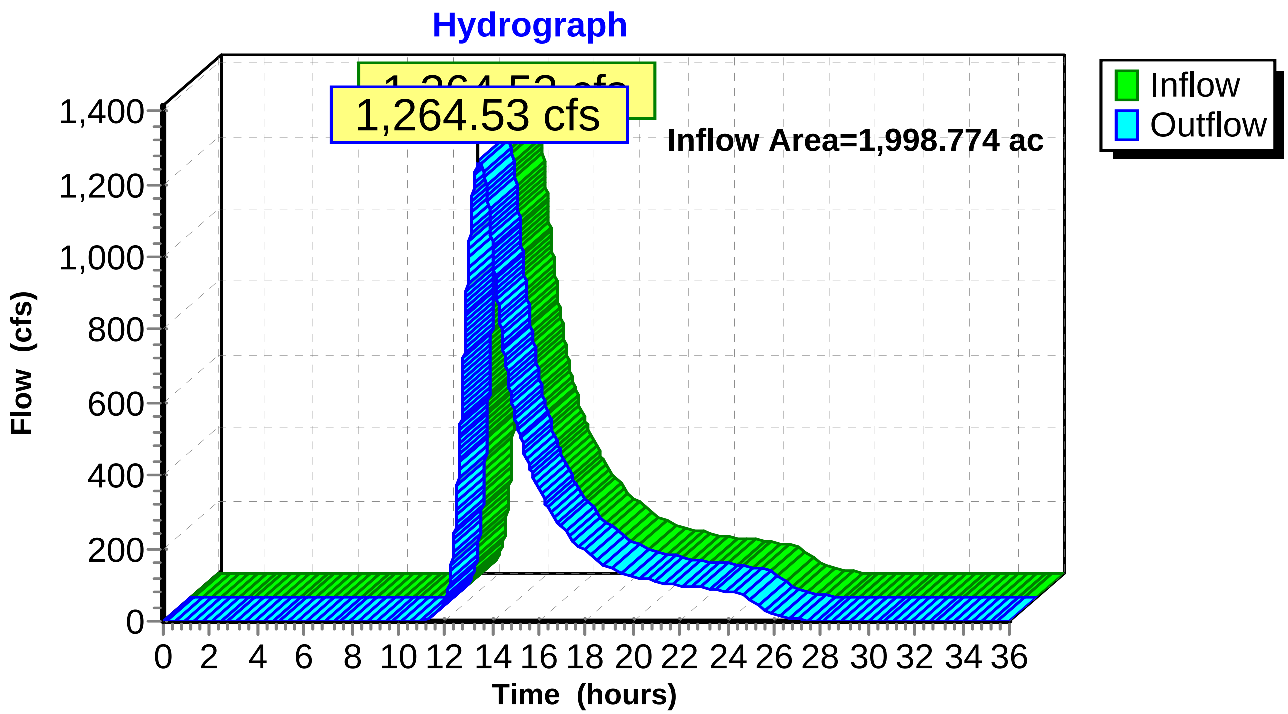


Summary for Reach SP-3: Study Point

Inflow Area = 1,998.774 ac, 0.05% Impervious, Inflow Depth = 2.06" for 50-Year Event event
Inflow = 1,264.53 cfs @ 13.40 hrs, Volume= 343.936 af
Outflow = 1,264.53 cfs @ 13.40 hrs, Volume= 343.936 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-3: Study Point



APPENDIX B

Water Quality Calculations

WQ BMP Summary Table (2 pages)

Bioretention Basin Design Worksheets (14 pages)

Buffer Design Worksheets (56 pages)

Water Quality Swale Design Worksheets (23 pages)

Water Quality Swale Conveyance (10-yr) Model Results (23 pages)

PROJECT: Eolian Renewable Energy, LLC
Antrim Windpower Project
TRC Project: 186317.0000.0000

Calculated By: PMM
Checked By:
Date: March 26, 2015
Revised:

GENERAL BMP WATER QUALITY STANDARDS CALCULATIONS SUMMARY

Impervious area calculations based on:

Final Roadway Width: 16'
Crane Pad Area = 70' X 85'
Foundation Area: D = 50'

1W - North Branch River Watershed
2W - Unnamed Watershed
3W - Gregg Lake Watershed

Roadway						Vegetated Buffer				Treatment Swale						Comments
Section ID	Watershed	Length (ft)	Treated Impervious Area (ac)	Untreated Impervious Area (ac)	BMP ID	Buffer Type	Average Slope	Hydrologic Soil Group	Land Cover	Water Quality Flow (cfs)	Swale Length (ft)	Swale Base Width (ft)	Longitudinal Slope	Velocity (ft/s)	Hydraulic Residence Time (min.)	
Ridge Road																
STA 0+00 L to STA 5+50	1W	550		0.202	-											Deep cut, close to ROW
STA 5+50 to STA 11+00	1W	550		0.202	-											Too close to wetland
SUBSTATION	1W		1.610	0.101	BR1 & 2											Bioretention Systems
STA 11+00 to STA 13+50	1W	250		0.092	-											Too close to ROW
STA 13+50 to STA 17+00	1W	350	0.119		B-1	Ditch Turnout	0.11	C	Wooded							
STA 17+00 to STA 18+50	1W	150	0.055		B-2	Roadway	0.10	C	-							
STA 18+50 to STA 20+00	1W	150		0.055	-											Stream crossing
STA 20+00 to STA 24+25	1W	425	0.156		SW-1					0.16	150	3	0.0075	0.25	10.0	
STA 24+25 to STA 28+25	1W	400	0.147		B-3	Roadway	0.12	C	-							
STA 28+25 to STA 29+50	1W	125		0.046	-											Adjacent to stream
STA 29+50 to STA 32+00	1W	250	0.092		B-4	Ditch Turnout	0.15	C	Wooded							
STA 32+00 to STA 35+55	1W	355	0.130		SW-2					0.13	130	3	0.005	0.20	10.8	
STA 35+55 to STA 41+75	1W	620	0.228		B-5	Roadway	0.12	C	-							
WTG-1	1W		0.182		B-5											
STA 41+75 to STA 45+00	1W	325	0.119		B-6	Ditch Turnout	0.11	C	Wooded							
STA 45+00 to STA 66+75	1W	2175	0.799		B-7	Roadway	0.22	C								
STA 66+75 to STA 68+50	1W	Intersection		0.186	-											Too close to property line
North Spur Road																
STA 0+00 to STA 1+00	1W	See Intersection above														
STA 1+00 to STA 2+25	1W	125		0.046												
STA 2+25 to STA 21+00	1W	1875	0.699		B-23	Roadway	0.25	C	-							
WTG-2	2W		0.144		WTG-2	Small Area	0.05	C	Meadow							
WTG-3	3W		0.182		B-23	Roadway	0.25	C	-							
Ridge Road (Continued)																
STA 68+50 to STA 70+50	3W	200	0.073		SW-3					0.08	130	3	0.01	0.21	10.3	
STA 70+50 to STA 74+25	3W	375	0.138		B-8	Roadway	0.16	D	-							
STA 74+25 to STA 75+00	3W	75		0.028	-											Too close to wetland
STA 75+00 to STA 77+35	3W	235	0.086		SW-4					0.09	125	3	0.0075	0.20	10.4	
STA 77+35 to STA 81+00	3W	365	0.134		B-9	Ditch Turnout	0.09	C	Wooded							
STA 81+00 to STA 85+00	1W	400	0.147		B-10	Roadway	0.08	C	-							
WTG-4	1W		0.182		B-10											
STA 85+00 to STA 87+25	1W	225	0.083		B-11	Ditch Turnout	0.11	C	Wooded							
STA 87+25 to STA 89+00	1W	175	0.064		B-12	Roadway	0.15	C	-							
STA 89+00 to STA 92+25	1W	325	0.119		SW-5					0.12	120	3	0.005	0.20	10.0	
STA 92+25 to STA 99+00	1W	675		0.248	-											Too close to wetlands
WTG-5	1W		0.182		WTG-5	Small Area	0.03	C	Meadow							
STA 99+00 to STA 103+00	1W	400	0.147		B-13	Roadway	0.25	C	-							
STA 103+00 to STA 104+50	1W	150		0.055	-											Too Steep
STA 104+50 to STA 107+00	1W	250	0.092		SW-6					0.11	120	4	0.0075	0.20	10.0	
STA 107+00 to STA 111+75	1W	475		0.174	-											Too steep, near wetland

PROJECT:	Eolian Renewable Energy, LLC	Calculated By:	PMM
	Antrim Windpower Project	Checked By:	
TRC Project:	186317.0000.0000	Date:	March 26, 2015
		Revised:	

GENERAL BMP WATER QUALITY STANDARDS CALCULATIONS SUMMARY

Impervious area calculations based on:

Final Roadway Width: 16'	1W - North Branch River Watershed
Crane Pad Area = 70' X 85'	2W - Unnamed Watershed
Tower Foundation: D = 20'	3W - Gregg Lake Watershed

Roadway						Vegetated Buffer				Treatment Swale						Comments
Section ID	Watershed	Length (ft)	Treated Impervious Area (ac)	Untreated Impervious Area (ac)	BMP ID	Buffer Type	Average Slope	Hydrologic Soil Group	Land Cover	Water Quality Flow (cfs)	Swale Length (ft)	Swale Base Width (ft)	Longitudinal Slope	Velocity (ft/s)	Hydraulic Residence Time (min.)	
STA 111+75 to STA 113+50	1W	175	0.064		SW-7					0.07	120	3	0.0075	0.19	10.5	
STA 113+50 to STA 115+50	1W	200	0.073		B-14	Roadway	0.12	C	-							
WTG-6	3W		0.182		B-14											
STA 115+50 to STA 117+50	1W	200		0.073	-											Too steep
STA 117+50 to STA 119+00	1W	150	0.055		B-15	Roadway	0.15	C	-							
STA 119+00 to STA 119+75	1W	75		0.028	-											
STA 119+75 to STA 123+00	1W	325	0.119		SW-8					0.12	135	3	0.0075	0.22	10.2	
STA 123+00 to STA 124+25	1W	125		0.046	-											Too steep
STA 124+25 to STA 126+00	1W	175	0.064		SW-9					0.07	120	3	0.0075	0.19	10.5	
STA 126+00 to STA 128+50	1W	250	0.092		B-16	Roadway	0.25	C	-							
STA 128+50 to STA 131+50	1W	300	0.110		SW-10					0.11	135	3	0.0075	0.22	10.2	
STA 131+50 to STA 145+25	1W	1375	0.505		B-17	Roadway	0.25	C	-							
Spur Road 2																
STA 0+50 to STA 2+00	3W	150	0.133		SW-11					0.13	125	3	0.005	0.2	10.4	
STA 2+00 to STA 4+75	3W	275	0.101		B-18	Roadway	0.20	C	-							
STA 4+75 to STA 7+65	1W	290	0.107		B-19	Roadway	0.20	C	-							
WTG-7	3W		0.182		B-20	Roadway	0.15	C	-							
Ridge Road 1 (Continued)																
WTG-8	3W		0.182		WTG-8	Small Area	0.12	C	Meadow							
STA 145+25 to STA 147+00	1W	175		0.064	-											
STA 147+00 to STA 149+00	3W	200		0.073	-											Steep, near wetland
STA 149+00 to STA 150+25	3W	125	0.046		B-21	Roadway	0.3	C	Meadow							
STA 150+25 to STA 155+75	3W	550		0.202												Steep, near wetland
STA 155+75 to 158+57.5	3W	282.5	0.104		B-22	Roadway	0.05	C	Meadow							
WTG-9	3W		0.182		WTG-9	Small Area	0.03	C	Meadow							
SUBTOTAL:			8.410	1.921												

Total New Impervious Area:	10.331	(= Treated New Impervious + Untreated New Impervious)
Percent Treated:	81.4%	(= Treated New Impervious / Total New Impervious)

FILTRATION PRACTICE DESIGN CRITERIA (Env-Wq 1508.06)

Type/Node Name: **Bio-Retention Area #1**

Enter the type of filtration practice (e.g., bioretention system) and the node name in the drainage analysis, if applicable

Yes		Have you reviewed the restrictions on unlined systems outlined in Env-Wq 1508.06(b)?	
1.01	ac	A = Area draining to the practice[1]	
0.90	ac	A_I = Impervious area draining to the practice	
0.89	decimal	I = percent impervious area draining to the practice, in decimal form	
0.85	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.86	ac-in	WQV= 1" x Rv x A	
3,107	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
777	cf	25% x WQV (check calc for sediment forebay volume)	
2,330	cf	75% x WQV (check calc for surface sand filter volume)	
None		Method of Pretreatment? (not required for clean or roof runoff)	
-	cf	V_{SED} = sediment forebay volume, if used for pretreatment	← **≥ 25%WQV**
2,735	sf	A_{SA} = surface area of the practice	
2.0	iph	I_{DESIGN} = design infiltration rate[2]	
Yes	Yes/No	If I_{DESIGN} is < 0.50 iph, has an underdrain been provided?	
-	hours	T_{DRAIN} = drain time = V_{PP} / (A_{SA} * I_{DESIGN})	← **≤ 72-hrs**
1,115.75	feet	E_{FC} = elevation of the bottom of the filter course material	
1,114.92	feet	E_{UD} = invert elevation of the underdrain (UD), if applicable	
1,114.33	feet	E_{BTM} = elevation of the bottom of the practice (i.e., bottom of the stone reservoir).	
1,114.00	feet	E_{SHWT} = elevation of SHWT (if none found, enter the lowest elevation of the test pit)	
1,114.00	feet	E_{ROCK} = elevation of bedrock (if none found, enter the lowest elevation of the test pit)	
0.83	feet	$D_{FC\ to\ UD}$ = depth to UD from the bottom of the filter course[3]	← **≥ 1'**
1.75	feet	$D_{FC\ to\ ROCK}$ = depth to bedrock from the bottom of the filter course[3]	← **≥ 1'**
1.75	feet	$D_{FC\ to\ SHWT}$ = depth to SHWT from the bottom of the filter course[3]	← **≥ 1'**
0.33	feet	$D_{BTM\ to\ SHWT}$ = depth to SHWT from the bottom of the practice[3]	← **≥ 2'**
	ft	Peak elevation of the 10-year storm event (infiltration can be used in analysis)	
1,118.00	ft	Elevation of the top of the practice	
-		10 peak elevation ≤ Elevation of the top of the practice	← **yes**

If a surface sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
	inches	D_{FC} = filter course thickness	← **18"**
Sheet		Note what sheet in the plan set contains the filter course specification	
	Yes/No	Access grate provided?	← **yes**
		The filter shall not be covered in grass. What is covering the filter?	

If an underground sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
	inches	D_{FC} = filter course thickness	← **24"**
Sheet		Note what sheet in the plan set contains the filter course specification	
	Yes/No	Access grate provided?	← **yes**

If a bioretention area is proposed:

YES	ac	Drainage Area no larger than 5 ac?	← yes
3,445	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← ≥ WQV
18.0	inches	D_{FC} = filter course thickness	← 18"
Sheet	C-22	Note what sheet in the plan set contains the filter course specification	
3.0	:1	Pond side slopes	← ≥2:1
Sheet	C-22	Note what sheet in the plan set contains the planting plans and surface cover	

If porous pavement is proposed:

		Type of pavement proposed (concrete? Asphalt? Pavers? Etc)	
	sf	A_{SA} = surface area of the pervious pavement	
-	:1	ratio of the contributing area to the pervious surface area	← 5:1
	inches	D_{FC} = filter course thickness	← 12"
Sheet		Note what sheet in the plan set contains the filter course spec.	← 304.1 sand

1. If the practice is a tree box filter, the drainage area shall be < 0.1 acre

2. Rate of the limiting layer (either the filter course or the underlying soil). See Vol. 2 of the NH Stormwater Manual, Ch. 2-4, for guidance on determining the infiltration rate.

3. If not within a GPA or WSIPA: SHWT/Bedrock must be at least 1 foot below the filter course material (or an underdrain must drain the SHWT to at least one foot below the filter course material). If within a GPA or WSIPA: SHWT must be at least two feet below the bottom of the practice OR the filter course material must be at least twice as thick as required and the SHWT must be at least one foot below the filter course material.

4. Volume without depending on infiltration. The storage above the filter media shall not include the volume above the outlet structure, if any.

5. The volume includes the storage above the filter but below the invert of the outlet structure (if any), the filter media voids, and the pretreatment area.

Designer's Notes:

Due to site (space) constraints, the bio-retention basin was not designed to detain the 10-year event.

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	3/26/2015
		Revised:	

Bio-Retention Area 1 - Stage/Storage Table

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
1,115.75	2,735	0
1,115.80	2,735	55
1,115.85	2,735	109
1,115.90	2,735	164
1,115.95	2,735	219
1,116.00	2,735	274
1,116.05	2,735	328
1,116.10	2,735	383
1,116.15	2,735	438
1,116.20	2,735	492
1,116.25	2,735	547
1,116.30	2,735	602
1,116.35	2,735	656
1,116.40	2,735	711
1,116.45	2,735	766
1,116.50	2,735	821
1,116.55	2,735	875
1,116.60	2,735	930
1,116.65	2,735	985
1,116.70	2,735	1,039
1,116.75	2,735	1,094
1,116.80	2,735	1,149
1,116.85	2,735	1,203
1,116.90	2,735	1,258
1,116.95	2,735	1,313
1,117.00	2,735	1,368

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
1,117.05	2,735	1,422
1,117.10	2,735	1,477
1,117.15	2,735	1,532
1,117.20	2,735	1,586
1,117.25	2,735	1,641
1,117.30	2,735	1,696
1,117.35	2,735	1,750
1,117.40	2,735	1,805
1,117.45	2,735	1,860
1,117.50	2,735	1,915
1,117.55	2,798	2,053
1,117.60	2,862	2,194
1,117.65	2,927	2,339
1,117.70	2,992	2,487
1,117.75	3,058	2,638
1,117.80	3,125	2,793
1,117.85	3,193	2,951
1,117.90	3,261	3,112
1,117.95	3,330	3,277
1,118.00	3,400	3,445

FILTRATION PRACTICE DESIGN CRITERIA (Env-Wq 1508.06)

Type/Node Name: **Bio-Retention Area #2**

Enter the type of filtration practice (e.g., bioretention system) and the node name in the drainage analysis, if applicable

Yes		Have you reviewed the restrictions on unlined systems outlined in Env-Wq 1508.06(b)?	
0.98	ac	A = Area draining to the practice[1]	
0.71	ac	A_I = Impervious area draining to the practice	
0.72	decimal	I = percent impervious area draining to the practice, in decimal form	
0.70	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.68	ac-in	WQV= 1" x Rv x A	
2,481	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
620	cf	25% x WQV (check calc for sediment forebay volume)	
1,861	cf	75% x WQV (check calc for surface sand filter volume)	
None		Method of Pretreatment? (not required for clean or roof runoff)	
-	cf	V_{SED} = sediment forebay volume, if used for pretreatment	← **≥ 25%WQV**
1,995	sf	A_{SA} = surface area of the practice	
2.0	iph	I_{DESIGN} = design infiltration rate[2]	
Yes	Yes/No	If I_{DESIGN} is < 0.50 iph, has an underdrain been provided?	
-	hours	T_{DRAIN} = drain time = V_{PP} / (A_{SA} * I_{DESIGN})	← **≤ 72-hrs**
1,110.75	feet	E_{FC} = elevation of the bottom of the filter course material	
1,109.92	feet	E_{UD} = invert elevation of the underdrain (UD), if applicable	
1,109.33	feet	E_{BTM} = elevation of the bottom of the practice (i.e., bottom of the stone reservoir).	
1,108.00	feet	E_{SHWT} = elevation of SHWT (if none found, enter the lowest elevation of the test pit)	
1,108.00	feet	E_{ROCK} = elevation of bedrock (if none found, enter the lowest elevation of the test pit)	
0.83	feet	$D_{FC\ to\ UD}$ = depth to UD from the bottom of the filter course[3]	← **≥ 1'**
2.75	feet	$D_{FC\ to\ ROCK}$ = depth to bedrock from the bottom of the filter course[3]	← **≥ 1'**
2.75	feet	$D_{FC\ to\ SHWT}$ = depth to SHWT from the bottom of the filter course[3]	← **≥ 1'**
1.33	feet	$D_{BTM\ to\ SHWT}$ = depth to SHWT from the bottom of the practice[3]	← **≥ 2'**
	ft	Peak elevation of the 10-year storm event (infiltration can be used in analysis)	
1,113.00	ft	Elevation of the top of the practice	
-		10 peak elevation ≤ Elevation of the top of the practice	← **yes**

If a surface sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
	inches	D_{FC} = filter course thickness	← **18"**
Sheet		Note what sheet in the plan set contains the filter course specification	
	Yes/No	Access grate provided?	← **yes**
		The filter shall not be covered in grass. What is covering the filter?	

If an underground sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
	inches	D_{FC} = filter course thickness	← **24"**
Sheet		Note what sheet in the plan set contains the filter course specification	
	Yes/No	Access grate provided?	← **yes**

If a bioretention area is proposed:

YES	ac	Drainage Area no larger than 5 ac?	← **yes**
2,653	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ WQV**
18.0	inches	D_{FC} = filter course thickness	← **18"**
Sheet	C-22	Note what sheet in the plan set contains the filter course specification	
3.0	:1	Pond side slopes	← **≥2:1**
Sheet	C-22	Note what sheet in the plan set contains the planting plans and surface cover	

If porous pavement is proposed:

		Type of pavement proposed (concrete? Asphalt? Pavers? Etc)	
	sf	A_{SA} = surface area of the pervious pavement	
-	:1	ratio of the contributing area to the pervious surface area	← **5:1**
	inches	D_{FC} = filter course thickness	← **12"**
Sheet		Note what sheet in the plan set contains the filter course spec.	← **304.1 sand**

1. If the practice is a tree box filter, the drainage area shall be < 0.1 acre

2. Rate of the limiting layer (either the filter course or the underlying soil). See Vol. 2 of the NH Stormwater Manual, Ch. 2-4, for guidance on determining the infiltration rate.

3. If not within a GPA or WSIPA: SHWT/Bedrock must be at least 1 foot below the filter course material (or an underdrain must drain the SHWT to at least one foot below the filter course material). If within a GPA or WSIPA: SHWT must be at least two feet below the bottom of the practice OR the filter course material must be at least twice as thick as required and the SHWT must be at least one foot below the filter course material.

4. Volume without depending on infiltration. The storage above the filter media shall not include the volume above the outlet structure, if any.

5. The volume includes the storage above the filter but below the invert of the outlet structure (if any), the filter media voids, and the pretreatment area.

Designer's Notes:

Due to site (space) constraints, the bio-retention basin was not designed to detain the 10-year event.

PROJECT:	Eolian Renewable Energy LLC	Calculated By:	PMM
	Antrim Wind Project	Checked By:	
Proj. No.:	186317.0000.0000	Date:	3/26/2015
		Revised:	

Bio-Retention Area 2 - Stage/Storage Table

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
1,110.75	1,995	0	1,112.05	1,995	1,037
1,110.80	1,995	40	1,112.10	1,995	1,077
1,110.85	1,995	80	1,112.15	1,995	1,117
1,110.90	1,995	120	1,112.20	1,995	1,157
1,110.95	1,995	160	1,112.25	1,995	1,197
1,111.00	1,995	200	1,112.30	1,995	1,237
1,111.05	1,995	239	1,112.35	1,995	1,277
1,111.10	1,995	279	1,112.40	1,995	1,317
1,111.15	1,995	319	1,112.45	1,995	1,357
1,111.20	1,995	359	1,112.50	1,995	1,397
1,111.25	1,995	399	1,112.55	2,092	1,499
1,111.30	1,995	439	1,112.60	2,192	1,606
1,111.35	1,995	479	1,112.65	2,293	1,718
1,111.40	1,995	519	1,112.70	2,397	1,835
1,111.45	1,995	559	1,112.75	2,504	1,958
1,111.50	1,995	599	1,112.80	2,612	2,086
1,111.55	1,995	638	1,112.85	2,723	2,219
1,111.60	1,995	678	1,112.90	2,837	2,358
1,111.65	1,995	718	1,112.95	2,952	2,503
1,111.70	1,995	758	1,113.00	3,070	2,653
1,111.75	1,995	798			
1,111.80	1,995	838			
1,111.85	1,995	878			
1,111.90	1,995	918			
1,111.95	1,995	958			
1,112.00	1,995	998			

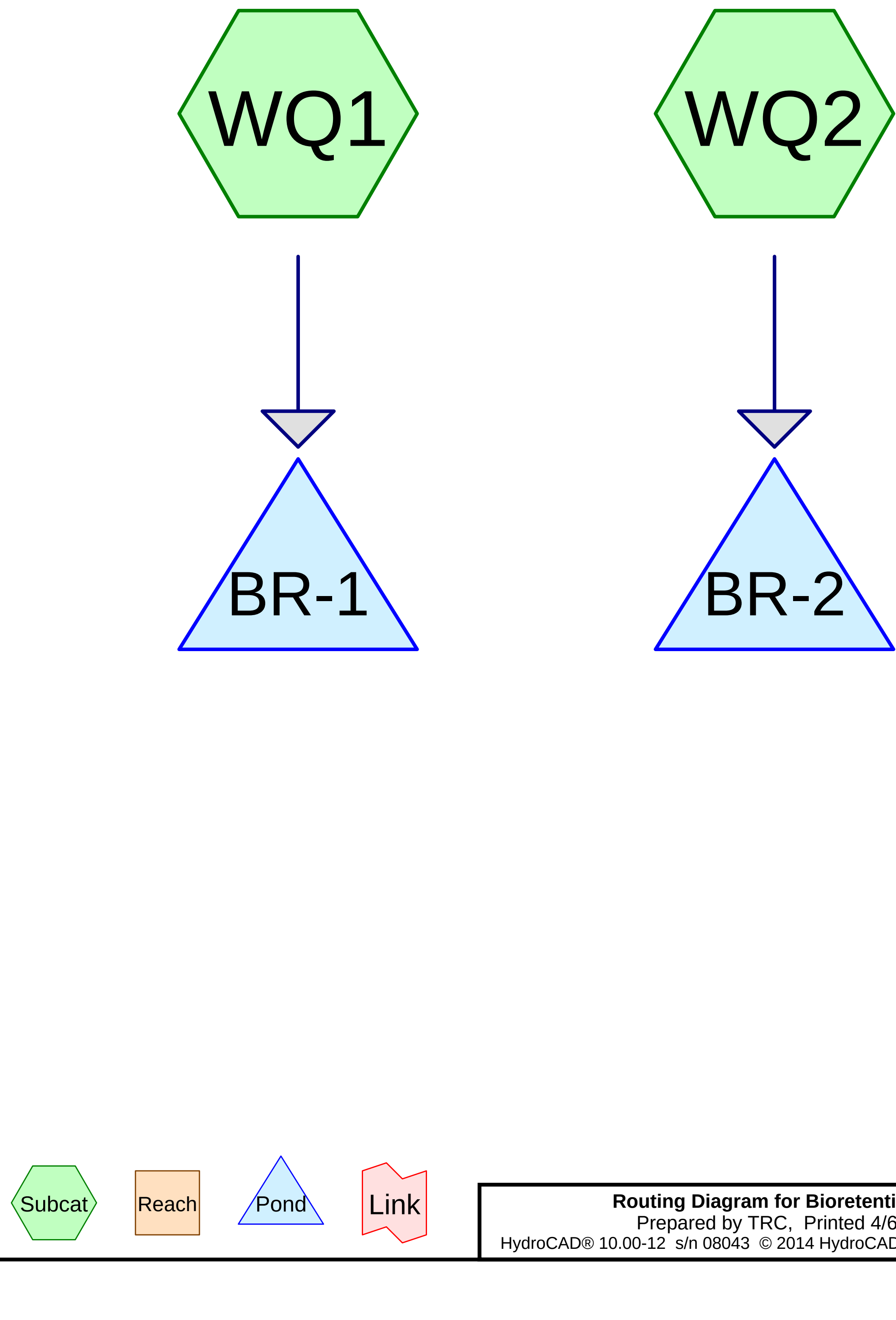
Groundwater Recharge Volume (GRV) Calculation

	ac	Area of HSG A soil that was replaced by impervious cover	0.40"
	ac	Area of HSG B soil that was replaced by impervious cover	0.25"
	ac	Area of HSG C soil that was replaced by impervious cover	0.10"
	ac	Area of HSG D soil or impervious cover that was replaced by impervious cover	0.0"
-	inches	Rd = weighted groundwater recharge depth	
-	ac-in	GRV = AI * Rd	
-	cf	GRV conversion (ac-in x 43,560 sf/ac x 1ft/12”)	

Provide calculations below showing that the project meets the groundwater recharge requirements (Env-Wq 1507.04):

Chapter 2 Section 3 of the "New Hampshire Stormwater Manual, Volume 2" states that the Groundwater Recharge Volume (GRV) is calculated by the equation: GRV = (Ai)(Rd) where Ai is the Effective Impervious Area and Rd is the groundwater recharge depth. In addition, Chapter 5 Section 2 of the "New Hampshire Stormwater Manual, Volume 1" defines Effective Impervious Area as "the portion of the total impervious cover that is directly connected to the storm drain network."

The stormwater management system proposed for this project is designed to convert concentrated flows to sheet flow and release it overland. No direct connections to a storm drain network are proposed, therefore the effective impervious area and GRV are zero.



Routing Diagram for Bioretention Model
Prepared by TRC, Printed 4/6/2015
HydroCAD® 10.00-12 s/n 08043 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment WQ1:

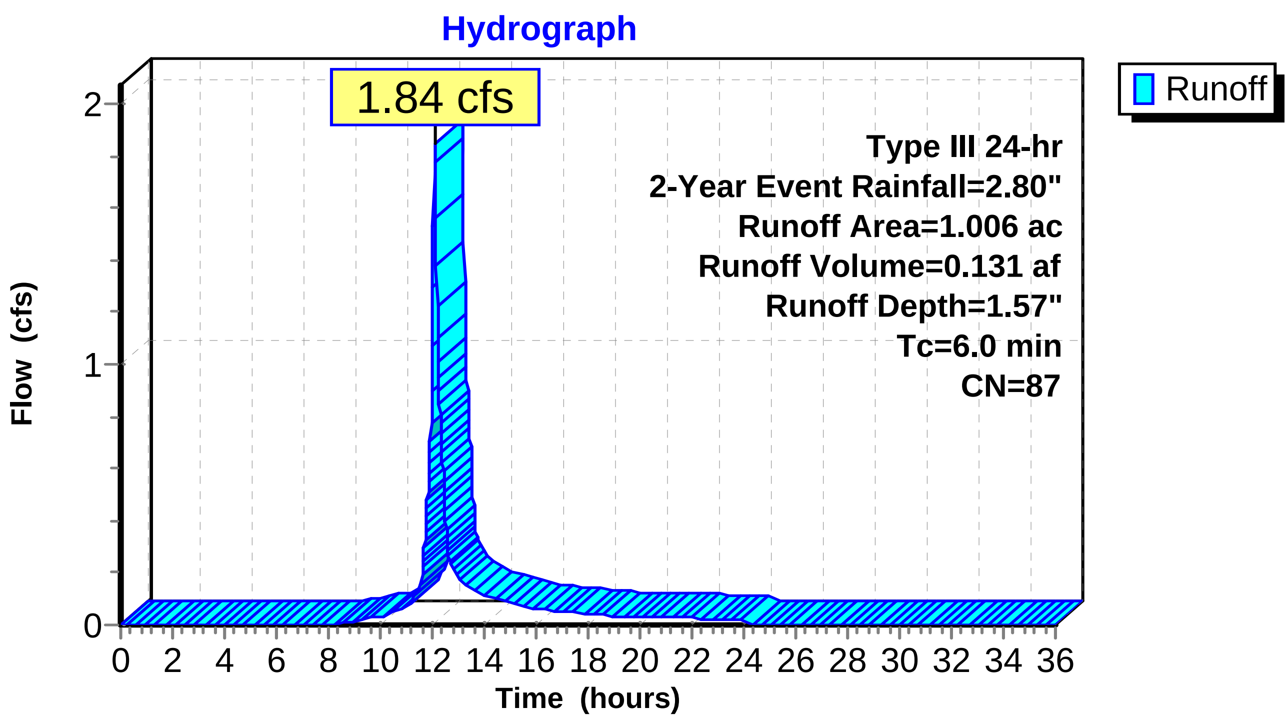
Runoff = 1.84 cfs @ 12.09 hrs, Volume= 0.131 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.895	89	Yard stone/Gravel roads, HSG C
	0.111	71	Meadow, non-grazed, HSG C
	1.006	87	Weighted Average
	1.006		100.00% Pervious Area

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

Subcatchment WQ1:



Summary for Subcatchment WQ2:

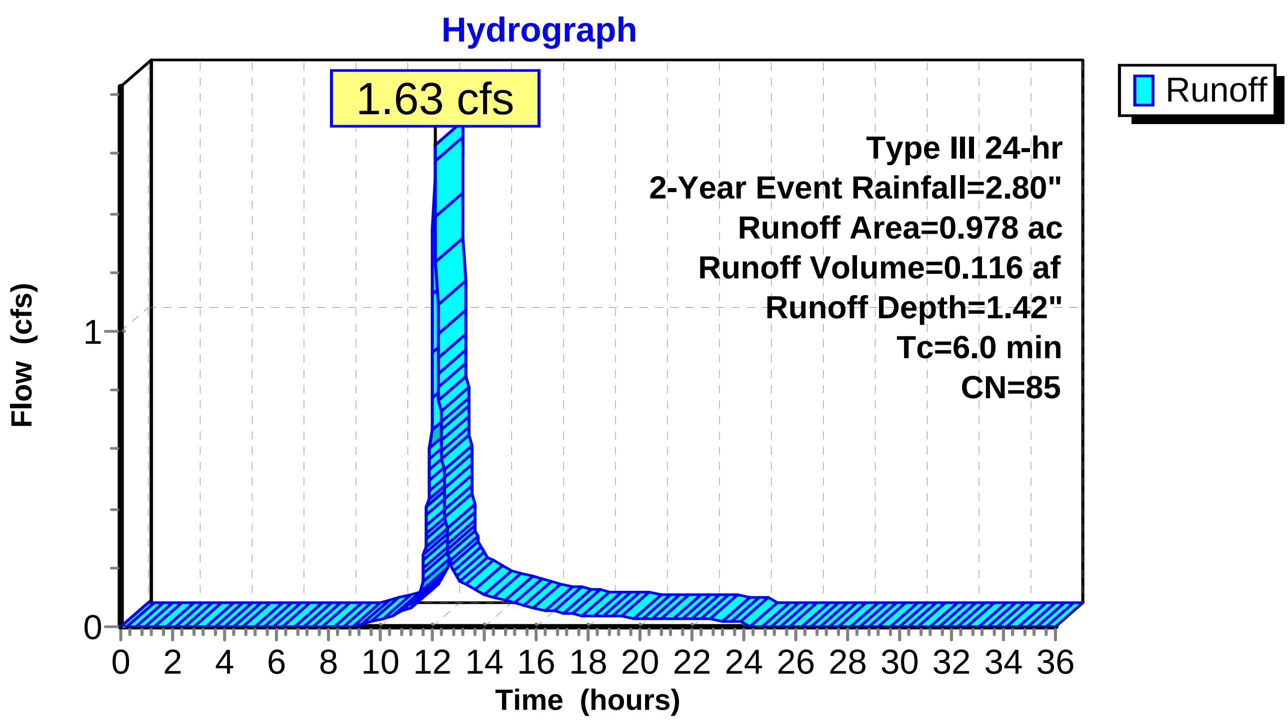
Runoff = 1.63 cfs @ 12.09 hrs, Volume= 0.116 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.086	98	Roofs
*	0.619	89	Yard stone/Gravel roads, HSG C
	0.273	71	Meadow, non-grazed, HSG C
	0.978	85	Weighted Average
	0.892		91.21% Pervious Area
	0.086		8.79% Impervious Area

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

Subcatchment WQ2:



Summary for Pond BR-1:

Inflow Area = 1.006 ac, 0.00% Impervious, Inflow Depth = 1.57" for 2-Year Event event
Inflow = 1.84 cfs @ 12.09 hrs, Volume= 0.131 af
Outflow = 0.14 cfs @ 13.64 hrs, Volume= 0.131 af, Atten= 93%, Lag= 93.0 min
Primary = 0.14 cfs @ 13.64 hrs, Volume= 0.131 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Peak Elev= 1,117.67' @ 13.64 hrs Surf.Area= 2,959 sf Storage= 2,411 cf
Flood Elev= 1,118.00' Surf.Area= 3,400 sf Storage= 3,445 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 168.9 min (993.5 - 824.6)

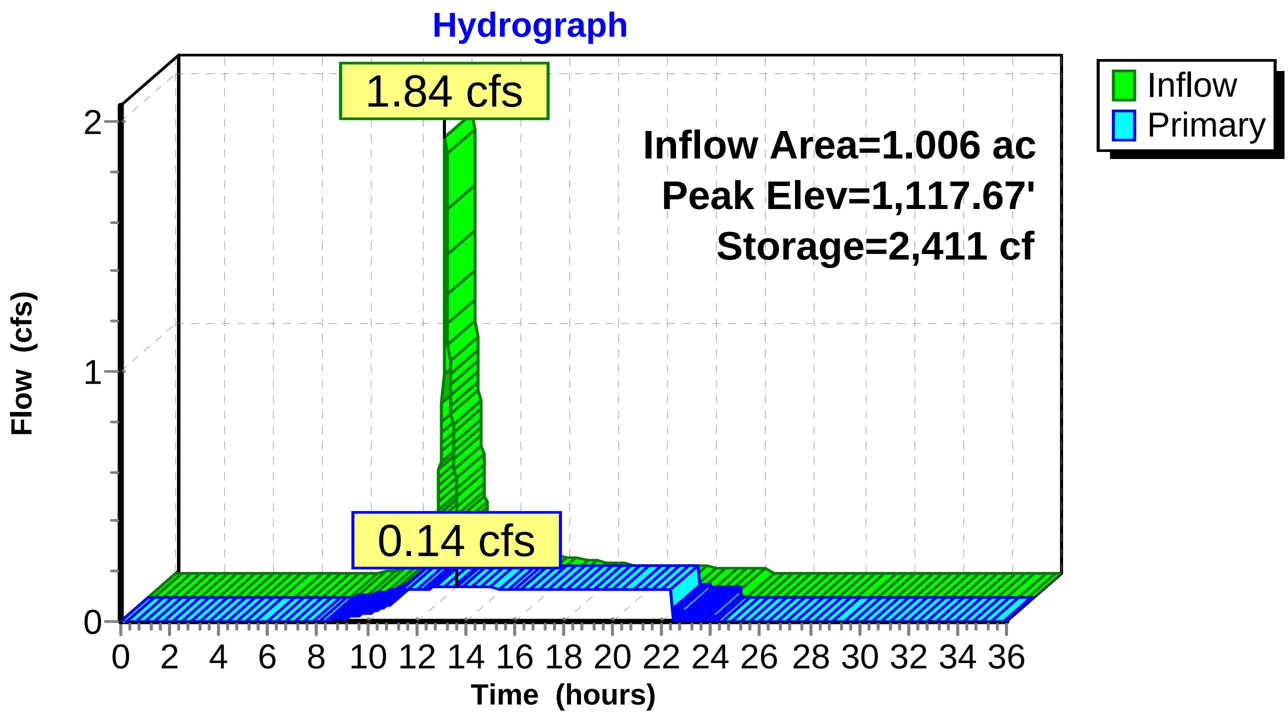
Volume	Invert	Avail.Storage	Storage Description
#1	1,115.75'	3,445 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,115.75	2,735	440.0	0.0	0	0	2,735
1,117.50	2,735	440.0	40.0	1,915	1,915	3,505
1,118.00	3,400	450.0	100.0	1,531	3,445	4,247

Device	Routing	Invert	Outlet Devices
#1	Primary	1,115.75'	**2.000 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Primary OutFlow Max=0.14 cfs @ 13.64 hrs HW=1,117.67' (Free Discharge)
1=Exfiltration (Controls 0.14 cfs)

Pond BR-1:


Hydrograph
1.84 cfs
0.14 cfs
Inflow Area=1.006 ac
Peak Elev=1,117.67'
Storage=2,411 cf
Inflow
Primary
Flow (cfs)
0
1
2
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

Summary for Pond BR-2:

Inflow Area = 0.978 ac, 8.79% Impervious, Inflow Depth = 1.42" for 2-Year Event event
Inflow = 1.63 cfs @ 12.09 hrs, Volume= 0.116 af
Outflow = 0.12 cfs @ 13.66 hrs, Volume= 0.116 af, Atten= 92%, Lag= 94.2 min
Primary = 0.12 cfs @ 13.66 hrs, Volume= 0.116 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Peak Elev= 1,112.84' @ 13.66 hrs Surf.Area= 2,695 sf Storage= 2,185 cf
Flood Elev= 1,113.00' Surf.Area= 3,070 sf Storage= 2,653 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 195.1 min (1,027.3 - 832.2)

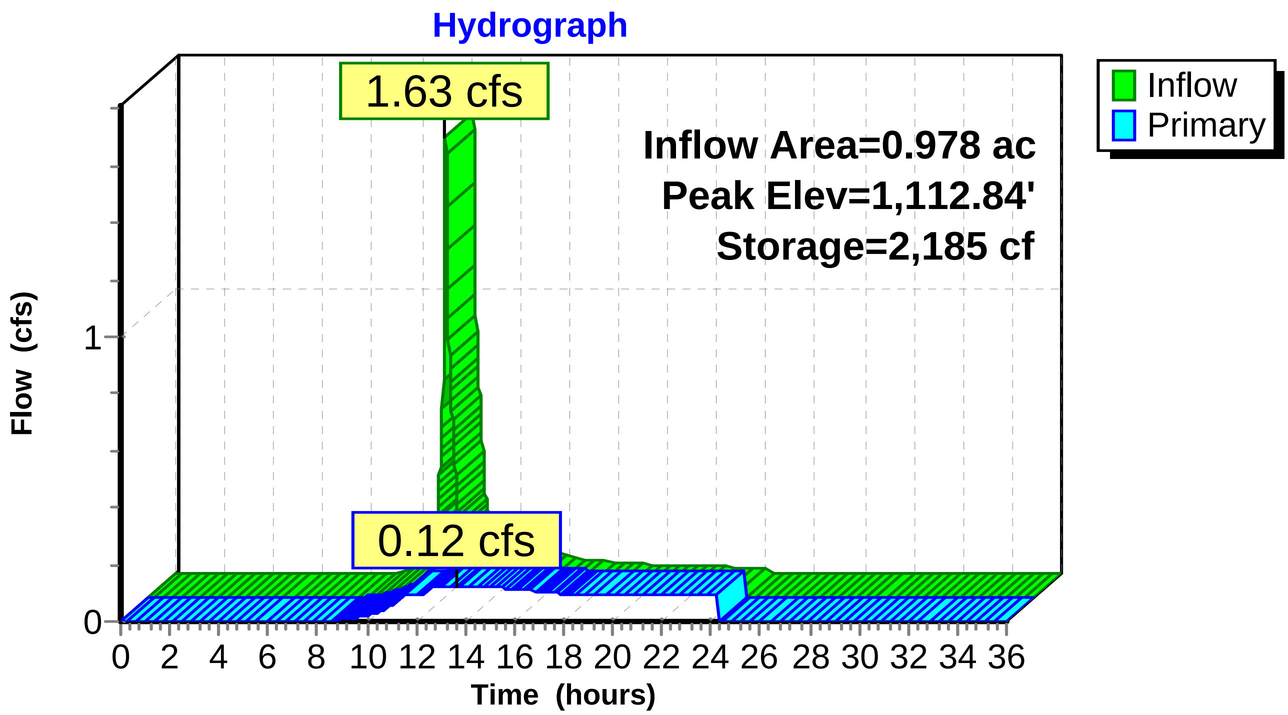
Volume	Invert	Avail.Storage	Storage Description
#1	1,110.75'	2,653 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,110.75	1,995	715.0	0.0	0	0	1,995
1,112.50	1,995	715.0	40.0	1,397	1,397	3,246
1,113.00	3,070	725.0	100.0	1,257	2,653	4,447

Device	Routing	Invert	Outlet Devices
#1	Primary	1,110.75'	**2.000 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Primary OutFlow Max=0.12 cfs @ 13.66 hrs HW=1,112.84' (Free Discharge)
└─**1=Exfiltration** (Controls 0.12 cfs)

Pond BR-2:


Hydrograph
1.63 cfs
0.12 cfs
Inflow Area=0.978 ac
Peak Elev=1,112.84'
Storage=2,185 cf
Inflow
Primary
Flow (cfs)
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Time (hours)

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-1 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
11.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
82	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← yes
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
10,063	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
151	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
173	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 173' is not available for a 20' level spreader.
For a 30' level spreader and an equivalent buffer area: Buffer length = (20' * 173') / 30' = 115'

As designed: Level spreader length = 30 feet
Buffer length = 115 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-2 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
10.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
80	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
15.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-3 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
10.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
80	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
15.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-4 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
15.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
90	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← yes
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
11,920	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
179	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
209	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 209' is not available for a 20' level spreader.
For a 35' level spreader and an equivalent buffer area: Buffer length = (20' * 209') / 35' = 120'

As designed: Level spreader length = 35 feet
Buffer length = 120 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-5 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) <u>in buffer</u> (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
12.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
84	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = <u>total</u> length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Site restrictions require that part of the work area at WTG-1 is graded to this buffer. Threfore the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-6 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
11.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
82	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← yes
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
16,850	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
253	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
275	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 275' is not available for a 20' level spreader.
For a 30' level spreader and an equivalent buffer area: Buffer length = (20' * 275') / 30' = 185'

As designed: Level spreader length = 30 feet
Buffer length = 185 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-7 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
22.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
44	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
104	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Too Steep		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Too Steep		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
44	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

The uphill swale discharges under the road and into this buffer, and the buffer slope exceeds 20%.
Therefore, the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-8 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) <u>in buffer</u> (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
-	%C		
100.0	%D		
16.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **$\leq$ 15%**
142	feet	Buffer base length due to soil type (weighted based on HSG)	
32	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
174	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = <u>total</u> length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Too Steep		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
32	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

The uphill swale discharges under the road and into this buffer, and the buffer slope exceeds 20%.
Therefore, the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-9 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
9.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
18	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
78	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← yes
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
16,823	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
252	feet	Buffer base length due to soil type (weighted based on HSG)	
18	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
270	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 270' is not available for a 20' level spreader.
For a 40' level spreader and an equivalent buffer area: Buffer length = (20' * 270') / 40' = 135'

As designed: Level spreader length = 40 feet
Buffer length = 135 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-10 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
8.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
16	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
76	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	←	≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	←	0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer		
50.0		Minimum buffer flow path (L_{MIN})		
75.0	feet	Buffer flow path	←	≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	←	yes
	feet	Level Spreader Length [7]		
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	←	no
	sf	Drainage Area to the ditch	←	≤ 6000 sf
Good		Slope check	←	≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)		
16	feet	Buffer length adjustment due to steepness of buffer		
-	feet	Buffer length adjustment due to percent of meadow in buffer		
50	feet	Minimum buffer length required [8]		

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Site restrictions require that part of the work area at WTG-4 is graded to this buffer. Threfore the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-11 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
11.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
82	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← yes
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
9,650	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
145	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
167	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 167' is not available for a 20' level spreader.
For a 25' level spreader and an equivalent buffer area: Buffer length = (20' * 167') / 25' = 135'

As designed: Level spreader length = 25 feet
Buffer length = 135 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-12 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
15.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
90	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-5A - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
3.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.19	ac	A = area draining to the buffer	
0.08	ac	A_{IMP} = impervious area draining to the buffer	
40.9	%	I = percent impervious area draining to the buffer	← **≤ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
6	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
96	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
6	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 120 feet is provided.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-5B - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
6.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.08	ac	A = area draining to the buffer	
0.07	ac	A_{IMP} = impervious area draining to the buffer	
82.9	%	I = percent impervious area draining to the buffer	← **≤ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
12	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
102	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
12	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 110 feet is provided.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-13 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
25.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
110	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Too Steep		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Too Steep		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 75 feet is provided due to the steepness of the slope.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-14 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
12.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
84	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← $\leq$ **20%**
-	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← $\geq$ $\mathbf{L_{MIN}}$

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← $\leq$ **6000 sf**
Good		Slope check	← $\leq$ **15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 75 feet is provided due to the steepness of the slope.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-15 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
15.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
90	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-16 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
25.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I ≤ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
110	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Too Steep		Natural slope check [5]	← ≤ 20%
15.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Too Steep		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

The uphill swale discharges under the road and into this buffer, and the buffer slope exceeds 20%.
Therefore, the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-17 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) <u>in buffer</u> (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
25.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
110	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = <u>total</u> length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Too Steep		Natural slope check [5]	← $\leq$ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← $\geq L_{MIN}$

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← $\leq$ 6000 sf
Too Steep		Slope check	← $\leq$ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

The uphill swale discharges under the road and into this buffer, and the buffer slope exceeds 20%.
Therefore, the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-18 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) <u>in buffer</u> (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
20.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
100	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = <u>total</u> length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← $\leq$ 20%
15.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← $\geq L_{MIN}$

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← $\leq$ 6000 sf
Too Steep		Slope check	← $\leq$ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-19 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
20.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
100	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
10.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← $\geq L_{MIN}$

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Too Steep		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-20 - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
64.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
36.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
9.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.67	ac	A = area draining to the buffer	
0.14	ac	A_{IMP} = impervious area draining to the buffer	
21.4	%	I = percent impervious area draining to the buffer	← **≤ 10%**
TRUE		Option A check: A_{IMP} ≤ 1 ac & L_{FP} ≤ 100'	← **yes for**
FALSE		Option B check: I ≤ 10% & L_{FP} ≤ 150'	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
18	feet	Buffer length adjustment due to steepness of buffer	
11	feet	Buffer length adjustment due to percent of meadow in buffer	
89	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
18	feet	Buffer length adjustment due to steepness of buffer	
11	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Site constraints limit the length of this buffer to 50 feet.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-8 - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) <u>in buffer</u> (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
12.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.56	ac	A = area draining to the buffer	
0.14	ac	A_{IMP} = impervious area draining to the buffer	
25.6	%	I = percent impervious area draining to the buffer	← **≤ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
114	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = <u>total</u> length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
54	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Site constraints limit the length of this buffer to 50 feet.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-21 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
30.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
60	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
150	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
No	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Too Steep		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Too Steep		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
60	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
90	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 75 feet is provided due to the steepness of the slope.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-9 - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) <u>in buffer</u> (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
3.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
160.0		L_{FP} = maximum flow path to the buffer	
0.30	ac	A = area draining to the buffer	
0.13	ac	A_{IMP} = impervious area draining to the buffer	
45.3	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
6	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
96	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = <u>total</u> length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
6	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 120 feet is provided.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-22 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
3.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
6	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
96	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
No	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
6	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-23 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
25.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
140	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Too Steep		Natural slope check [5]	← $\leq$ 20%
20.0	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← $\geq L_{MIN}$

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← $\leq$ 6000 sf
Too Steep		Slope check	← $\leq$ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
80	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 75 feet is provided due to the steepness of the slope.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-2 - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
No	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
5.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.22	ac	A = area draining to the buffer	
0.14	ac	A_{IMP} = impervious area draining to the buffer	
63.6	%	I = percent impervious area draining to the buffer	← **≤ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
No		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
10	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
100	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

No		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

No	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**

Good		Natural slope check [5]	← ≤ 20%
	feet	How much embankment slope counts toward the buffer? [6]	← 0 - 20 feet
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← ≥ L_{MIN}

If a Ditch Turn Out Buffer is proposed:

No		Level Spreader proposed?	← yes
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← no
	sf	Drainage Area to the ditch	← ≤ 6000 sf
Good		Slope check	← ≤ 15%
-	feet	Buffer base length due to soil type (weighted based on HSG)	
10	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 120 feet is provided.

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-1**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.41	ac	A = Area draining to the practice	
0.16	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.38	decimal	I = percent impervious area draining to the practice, in decimal form	
0.39	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.16	ac-in	WQV= 1" x Rv x A	
584	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.39	inches	Q = water quality depth. Q = WQV/A	
92	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
0.90	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.180	inches	Ia = initial abstraction. Ia = 0.2S	
630	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.16	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
150.00	feet	L = swale length [1]	← ≥ 100'
3.00	feet	w = bottom of the swale width[2]	← 0 - 8 feet [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,206.50	feet	E_{BTM} = elevation of the bottom of the practice	← ≥ E_{SHWT}
3.0	:1	SS_{RIGHT} = right Side slope	← ≥3:1
3.0	:1	SS_{LEFT} = left Side slope	← ≥3:1
0.008	ft/ft	S = slope of swale in decimal form[3]	← 0.005 - .05
2.2	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← ≤ 4"
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.64	ft^2	Cross-sectional area check (assume trapezoidal channel)	
4.14	feet	Check wetted perimeter	
0.16	cfs	WQF_{check}.[5] ← WQF_{check} = WQF	
-1%		Percent difference between WQF_{check} and WQF [5]	← +/- 10%
10	minutes	HRT = hydraulic residence time during the WQF	← ≥ 10 min
1,206.92	ft	Peak elevation of the 10-year storm event	
1,208.00	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← yes

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes: ______________________

Worksheet for SW-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00750	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.16	ft³/s

Results

Normal Depth	0.18	ft
Flow Area	0.64	ft²
Wetted Perimeter	4.15	ft
Hydraulic Radius	0.16	ft
Top Width	4.09	ft
Critical Depth	0.04	ft
Critical Slope	0.94604	ft/ft
Velocity	0.25	ft/s
Velocity Head	0.00	ft
Specific Energy	0.18	ft
Froude Number	0.11	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.18	ft
Critical Depth	0.04	ft
Channel Slope	0.00750	ft/ft
Critical Slope	0.94604	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-2**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?
No	Yes/No	Is the system lined?
0.27	ac	A = Area draining to the practice
0.13	ac	A_I = Impervious area draining to the practice
6.0	minutes	T_c = Time of Concentration
0.49	decimal	I = percent impervious area draining to the practice, in decimal form
0.49	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.13	ac-in	WQV= 1" x Rv x A
473	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")
1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.49	inches	Q = water quality depth. Q = WQV/A
94	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$
0.67	inches	S = potential maximum retention. S = (1000/CN) - 10
0.135	inches	Ia = initial abstraction. Ia = 0.2S
640	$cfs/mi^2/in$	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.13	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$
130.00	feet	L = swale length [1] ← **≥ 100'**
3.00	feet	w = bottom of the swale width[2] ← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit
1,354.00	feet	E_{BTM} = elevation of the bottom of the practice ← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope ← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope ← **≥3:1**
0.005	ft/ft	S = slope of swale in decimal form[3] ← **0.005 - .05**
2.2	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4] ← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15
0.64	ft^2	Cross-sectional area check (assume trapezoidal channel)
4.14	feet	Check wetted perimeter
0.13	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**
-1%		Percent difference between WQF_{check} and WQF [5] ← **+/- 10%**
11	minutes	HRT = hydraulic residence time during the WQF ← **≥ 10 min**
1,354.38	ft	Peak elevation of the 10-year storm event
1,355.50	ft	Elevation of the top of the swale
YES	Yes/No	10 peak elevation ≤ the top of swale ← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.13	ft^3/s

Results

Normal Depth	0.18	ft
Flow Area	0.64	ft^2
Wetted Perimeter	4.15	ft
Hydraulic Radius	0.16	ft
Top Width	4.09	ft
Critical Depth	0.04	ft
Critical Slope	0.99010	ft/ft
Velocity	0.20	ft/s
Velocity Head	0.00	ft
Specific Energy	0.18	ft
Froude Number	0.09	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.18	ft
Critical Depth	0.04	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.99010	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-3**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?
No	Yes/No	Is the system lined?
0.31	ac	A = Area draining to the practice
0.07	ac	A_I = Impervious area draining to the practice
6.0	minutes	T_c = Time of Concentration
0.24	decimal	I = percent impervious area draining to the practice, in decimal form
0.26	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.08	ac-in	WQV= 1" x Rv x A
294	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")
1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.26	inches	Q = water quality depth. Q = WQV/A
88	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)
1.32	inches	S = potential maximum retention. S = (1000/CN) - 10
0.264	inches	Ia = initial abstraction. Ia = 0.2S
620	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.08	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac
130.00	feet	L = swale length [1] ← **≥ 100'**
3.00	feet	w = bottom of the swale width[2] ← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit
1,758.00	feet	E_{BTM} = elevation of the bottom of the practice ← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope ← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope ← **≥3:1**
0.010	ft/ft	S = slope of swale in decimal form[3] ← **0.005 - .05**
1.3	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4] ← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15
0.37	ft^2	Cross-sectional area check (assume trapezoidal channel)
3.70	feet	Check wetted perimeter
0.08	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**
-1%		Percent difference between WQF_{check} and WQF [5] ← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF ← **≥ 10 min**
1,758.34	ft	Peak elevation of the 10-year storm event
1,759.50	ft	Elevation of the top of the swale
YES	Yes/No	10 peak elevation ≤ the top of swale ← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.01000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.08	ft^3/s

Results

Normal Depth	0.11	ft
Flow Area	0.37	ft^2
Wetted Perimeter	3.71	ft
Hydraulic Radius	0.10	ft
Top Width	3.67	ft
Critical Depth	0.03	ft
Critical Slope	1.09773	ft/ft
Velocity	0.21	ft/s
Velocity Head	0.00	ft
Specific Energy	0.11	ft
Froude Number	0.12	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.11	ft
Critical Depth	0.03	ft
Channel Slope	0.01000	ft/ft
Critical Slope	1.09773	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-4**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.25	ac	A = Area draining to the practice	
0.09	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.34	decimal	I = percent impervious area draining to the practice, in decimal form	
0.36	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.09	ac-in	WQV= 1" x Rv x A	
326	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.36	inches	Q = water quality depth. Q = WQV/A	
91	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$	
0.99	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.198	inches	Ia = initial abstraction. Ia = 0.2S	
625	$cfs/mi^2/in$	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.09	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$	
125.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,628.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
1.6	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.44	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.82	feet	Check wetted perimeter	
0.09	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
2%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,628.37	ft	Peak elevation of the 10-year storm event	
1,629.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00750	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.09	ft³/s

Results

Normal Depth	0.13	ft
Flow Area	0.44	ft²
Wetted Perimeter	3.82	ft
Hydraulic Radius	0.12	ft
Top Width	3.78	ft
Critical Depth	0.03	ft
Critical Slope	1.07143	ft/ft
Velocity	0.20	ft/s
Velocity Head	0.00	ft
Specific Energy	0.13	ft
Froude Number	0.11	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.13	ft
Critical Depth	0.03	ft
Channel Slope	0.00750	ft/ft
Critical Slope	1.07143	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-5**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.40	ac	A = Area draining to the practice	
0.12	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.30	decimal	I = percent impervious area draining to the practice, in decimal form	
0.32	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.13	ac-in	WQV= 1" x Rv x A	
461	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.32	inches	Q = water quality depth. Q = WQV/A	
90	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
1.11	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.222	inches	Ia = initial abstraction. Ia = 0.2S	
625	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.12	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
120.00	feet	L = swale length [1]	← ≥ 100'
3.00	feet	w = bottom of the swale width[2]	← 0 - 8 feet [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,682.50	feet	E_{BTM} = elevation of the bottom of the practice	← ≥ E_{SHWT}
3.0	:1	SS_{RIGHT} = right Side slope	← ≥3:1
3.0	:1	SS_{LEFT} = left Side slope	← ≥3:1
0.005	ft/ft	S = slope of swale in decimal form[3]	← 0.005 - .05
2.0	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← ≤ 4"
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.60	ft^2	Cross-sectional area check (assume trapezoidal channel)	
4.08	feet	Check wetted perimeter	
0.12	cfs	WQF_{check}.[5] ← WQF_{check} = WQF	
-6%		Percent difference between WQF_{check} and WQF [5]	← +/- 10%
10	minutes	HRT = hydraulic residence time during the WQF	← ≥ 10 min
1,682.94	ft	Peak elevation of the 10-year storm event	
1,684.00	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← yes

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-5

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.12	ft³/s

Results

Normal Depth	0.17	ft
Flow Area	0.61	ft²
Wetted Perimeter	4.10	ft
Hydraulic Radius	0.15	ft
Top Width	4.04	ft
Critical Depth	0.04	ft
Critical Slope	1.00681	ft/ft
Velocity	0.20	ft/s
Velocity Head	0.00	ft
Specific Energy	0.17	ft
Froude Number	0.09	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.17	ft
Critical Depth	0.04	ft
Channel Slope	0.00500	ft/ft
Critical Slope	1.00681	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-6**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?
No	Yes/No	Is the system lined?
0.59	ac	A = Area draining to the practice
0.09	ac	A_I = Impervious area draining to the practice
6.0	minutes	T_c = Time of Concentration
0.16	decimal	I = percent impervious area draining to the practice, in decimal form
0.19	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.11	ac-in	WQV= 1" x Rv x A
408	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")
1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.19	inches	Q = water quality depth. Q = WQV/A
86	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$
1.67	inches	S = potential maximum retention. S = (1000/CN) - 10
0.334	inches	Ia = initial abstraction. Ia = 0.2S
610	$cfs/mi^2/in$	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.11	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$
120.00	feet	L = swale length [1] ← ≥ 100'
4.00	feet	w = bottom of the swale width[2] ← 0 - 8 feet [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit
1,579.50	feet	E_{BTM} = elevation of the bottom of the practice ← ≥ E_{SHWT}
3.0	:1	SS_{RIGHT} = right Side slope ← ≥3:1
3.0	:1	SS_{LEFT} = left Side slope ← ≥3:1
0.008	ft/ft	S = slope of swale in decimal form[3] ← 0.005 - .05
1.4	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4] ← ≤ 4"
0.15	unitless	d must be < 4", therefore Manning's n = 0.15
0.52	ft^2	Cross-sectional area check (assume trapezoidal channel)
4.76	feet	Check wetted perimeter
0.10	cfs	WQF_{check}.[5] ← WQF_{check} = WQF
-4%		Percent difference between WQF_{check} and WQF [5] ← +/- 10%
10	minutes	HRT = hydraulic residence time during the WQF ← ≥ 10 min
1,579.92	ft	Peak elevation of the 10-year storm event
1,581.00	ft	Elevation of the top of the swale
YES	Yes/No	10 peak elevation ≤ the top of swale ← yes

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00750	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	0.11	ft^3/s

Results

Normal Depth	0.12	ft
Flow Area	0.55	ft^2
Wetted Perimeter	4.79	ft
Hydraulic Radius	0.11	ft
Top Width	4.75	ft
Critical Depth	0.03	ft
Critical Slope	1.08626	ft/ft
Velocity	0.20	ft/s
Velocity Head	0.00	ft
Specific Energy	0.13	ft
Froude Number	0.10	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.12	ft
Critical Depth	0.03	ft
Channel Slope	0.00750	ft/ft
Critical Slope	1.08626	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-7**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Value	Unit	Description	Criteria
Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.25	ac	A = Area draining to the practice	
0.06	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.25	decimal	I = percent impervious area draining to the practice, in decimal form	
0.28	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.07	ac-in	WQV= 1" x Rv x A	
255	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.28	inches	Q = water quality depth. Q = WQV/A	
89	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
1.27	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.253	inches	Ia = initial abstraction. Ia = 0.2S	
615	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.07	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
120.00	feet	L = swale length [1]	← $\geq$ 100'
3.00	feet	w = bottom of the swale width[2]	← 0 - 8 feet [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,503.00	feet	E_{BTM} = elevation of the bottom of the practice	← $\geq E_{SHWT}$
3.0	:1	SS_{RIGHT} = right Side slope	← $\geq$3:1
3.0	:1	SS_{LEFT} = left Side slope	← $\geq$3:1
0.008	ft/ft	S = slope of swale in decimal form[3]	← 0.005 - .05
1.3	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← $\leq$ 4"
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.37	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.70	feet	Check wetted perimeter	
0.07	cfs	WQF_{check}.[5] ← WQF_{check} = WQF	
0%		Percent difference between WQF_{check} and WQF [5]	← +/- 10%
11	minutes	HRT = hydraulic residence time during the WQF	← $\geq$ 10 min
1,503.33	ft	Peak elevation of the 10-year storm event	
1,540.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation $\leq$ the top of swale	← yes

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00750	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.07	ft³/s

Results

Normal Depth	0.11	ft
Flow Area	0.38	ft²
Wetted Perimeter	3.71	ft
Hydraulic Radius	0.10	ft
Top Width	3.68	ft
Critical Depth	0.03	ft
Critical Slope	1.12920	ft/ft
Velocity	0.19	ft/s
Velocity Head	0.00	ft
Specific Energy	0.11	ft
Froude Number	0.10	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.11	ft
Critical Depth	0.03	ft
Channel Slope	0.00750	ft/ft
Critical Slope	1.12920	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-8**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.37	ac	A = Area draining to the practice	
0.12	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.32	decimal	I = percent impervious area draining to the practice, in decimal form	
0.34	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.13	ac-in	WQV= 1" x Rv x A	
455	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.34	inches	Q = water quality depth. Q = WQV/A	
91	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
1.04	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.208	inches	Ia = initial abstraction. Ia = 0.2S	
625	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.12	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
135.00	feet	L = swale length [1]	← ≥ 100'
3.00	feet	w = bottom of the swale width[2]	← 0 - 8 feet [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,471.00	feet	E_{BTM} = elevation of the bottom of the practice	← ≥ E_{SHWT}
3.0	:1	SS_{RIGHT} = right Side slope	← ≥3:1
3.0	:1	SS_{LEFT} = left Side slope	← ≥3:1
0.008	ft/ft	S = slope of swale in decimal form[3]	← 0.005 - .05
1.8	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← ≤ 4"
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.52	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.95	feet	Check wetted perimeter	
0.11	cfs	WQF_{check}.[5] ← WQF_{check} = WQF	
-7%		Percent difference between WQF_{check} and WQF [5]	← +/- 10%
10	minutes	HRT = hydraulic residence time during the WQF	← ≥ 10 min
1,471.40	ft	Peak elevation of the 10-year storm event	
1,472.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← yes

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-8

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00750	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.12	ft³/s

Results

Normal Depth	0.15	ft
Flow Area	0.53	ft²
Wetted Perimeter	3.98	ft
Hydraulic Radius	0.13	ft
Top Width	3.93	ft
Critical Depth	0.04	ft
Critical Slope	1.00815	ft/ft
Velocity	0.22	ft/s
Velocity Head	0.00	ft
Specific Energy	0.15	ft
Froude Number	0.11	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.15	ft
Critical Depth	0.04	ft
Channel Slope	0.00750	ft/ft
Critical Slope	1.00815	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-9**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.18	ac	A = Area draining to the practice	
0.06	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.35	decimal	I = percent impervious area draining to the practice, in decimal form	
0.36	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.07	ac-in	WQV= 1" x Rv x A	
242	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.36	inches	Q = water quality depth. Q = WQV/A	
91	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P] $^{0.5}$)	
0.97	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.195	inches	Ia = initial abstraction. Ia = 0.2S	
625	$cfs/mi^2/in$	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.07	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$	
120.00	feet	L = swale length [1]	← ≥ 100'
3.00	feet	w = bottom of the swale width[2]	← 0 - 8 feet [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,521.00	feet	E_{BTM} = elevation of the bottom of the practice	← ≥ E_{SHWT}
3.0	:1	SS_{RIGHT} = right Side slope	← ≥3:1
3.0	:1	SS_{LEFT} = left Side slope	← ≥3:1
0.008	ft/ft	S = slope of swale in decimal form[3]	← 0.005 - .05
1.3	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← ≤ 4"
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.37	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.70	feet	Check wetted perimeter	
0.07	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
3%		Percent difference between WQF_{check} and WQF [5]	← +/- 10%
11	minutes	HRT = hydraulic residence time during the WQF	← ≥ 10 min
1,521.28	ft	Peak elevation of the 10-year storm event	
1,522.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← yes

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-9

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00750	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.07	ft³/s

Results

Normal Depth	0.11	ft
Flow Area	0.38	ft²
Wetted Perimeter	3.71	ft
Hydraulic Radius	0.10	ft
Top Width	3.68	ft
Critical Depth	0.03	ft
Critical Slope	1.12920	ft/ft
Velocity	0.19	ft/s
Velocity Head	0.00	ft
Specific Energy	0.11	ft
Froude Number	0.10	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.11	ft
Critical Depth	0.03	ft
Channel Slope	0.00750	ft/ft
Critical Slope	1.12920	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-10**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.29	ac	A = Area draining to the practice	
0.11	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.37	decimal	I = percent impervious area draining to the practice, in decimal form	
0.39	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.11	ac-in	WQV= 1" x Rv x A	
413	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.39	inches	Q = water quality depth. Q = WQV/A	
92	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
0.91	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.182	inches	Ia = initial abstraction. Ia = 0.2S	
625	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.11	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
135.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,571.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
1.8	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.52	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.95	feet	Check wetted perimeter	
0.11	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
3%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,571.36	ft	Peak elevation of the 10-year storm event	
1,572.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-10

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00750	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.11	ft³/s

Results

Normal Depth	0.15	ft
Flow Area	0.50	ft²
Wetted Perimeter	3.93	ft
Hydraulic Radius	0.13	ft
Top Width	3.88	ft
Critical Depth	0.03	ft
Critical Slope	1.02484	ft/ft
Velocity	0.22	ft/s
Velocity Head	0.00	ft
Specific Energy	0.15	ft
Froude Number	0.11	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.15	ft
Critical Depth	0.03	ft
Channel Slope	0.00750	ft/ft
Critical Slope	1.02484	ft/ft

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-11**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.18	ac	A = Area draining to the practice	
0.13	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.73	decimal	I = percent impervious area draining to the practice, in decimal form	
0.70	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.13	ac-in	WQV= 1" x Rv x A	
468	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.70	inches	Q = water quality depth. Q = WQV/A	
97	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
0.31	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.062	inches	Ia = initial abstraction. Ia = 0.2S	
650	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.13	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
125.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,688.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.005	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
2.2	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.64	ft^2	Cross-sectional area check (assume trapezoidal channel)	
4.14	feet	Check wetted perimeter	
0.13	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
-2%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,688.36	ft	Peak elevation of the 10-year storm event	
1,689.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Worksheet for SW-11

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.150	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.13	ft³/s

Results

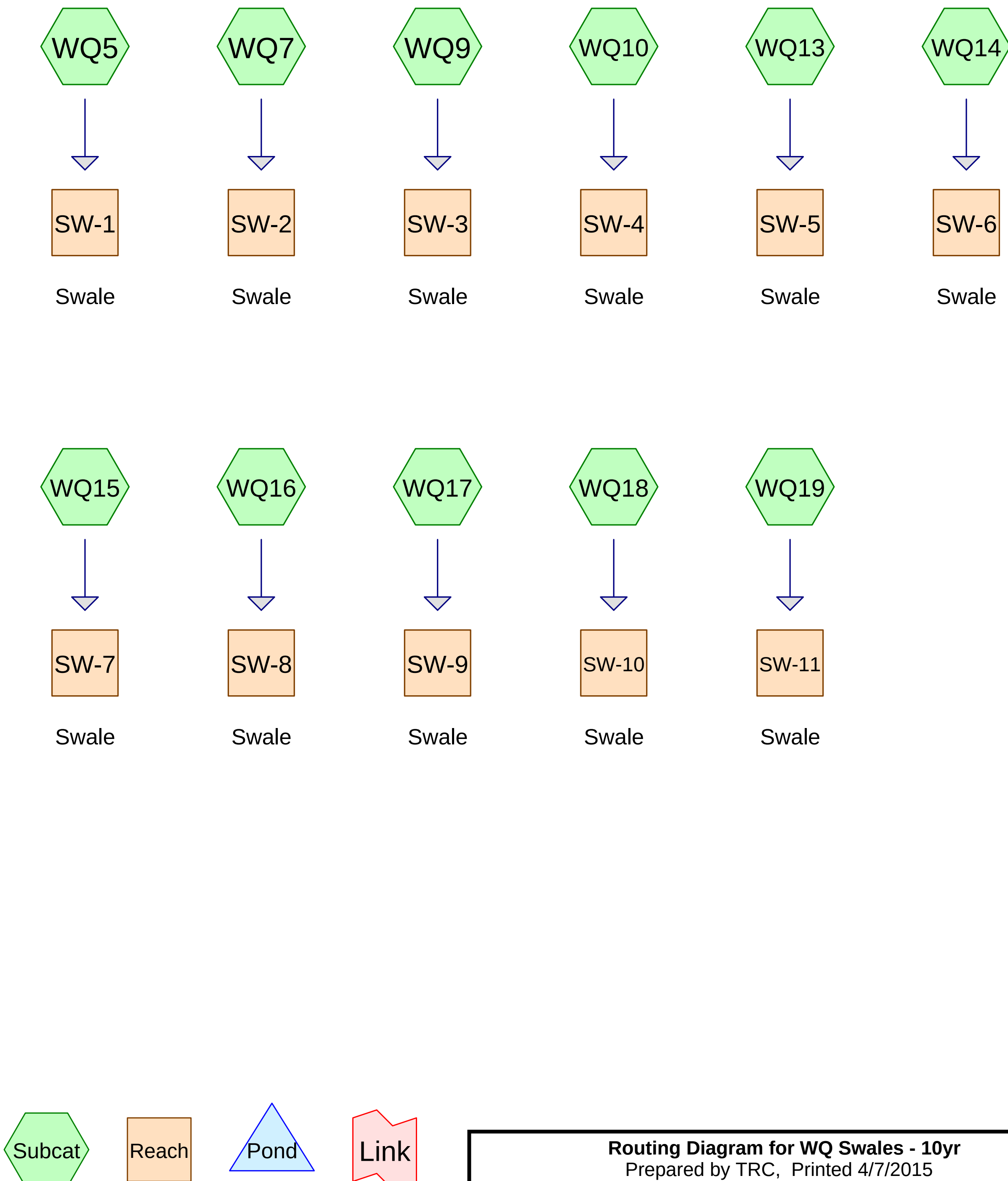
Normal Depth	0.18	ft
Flow Area	0.64	ft²
Wetted Perimeter	4.15	ft
Hydraulic Radius	0.16	ft
Top Width	4.09	ft
Critical Depth	0.04	ft
Critical Slope	0.99010	ft/ft
Velocity	0.20	ft/s
Velocity Head	0.00	ft
Specific Energy	0.18	ft
Froude Number	0.09	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.18	ft
Critical Depth	0.04	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.99010	ft/ft



Routing Diagram for WQ Swales - 10yr
Prepared by TRC, Printed 4/7/2015

Summary for Subcatchment WQ10:

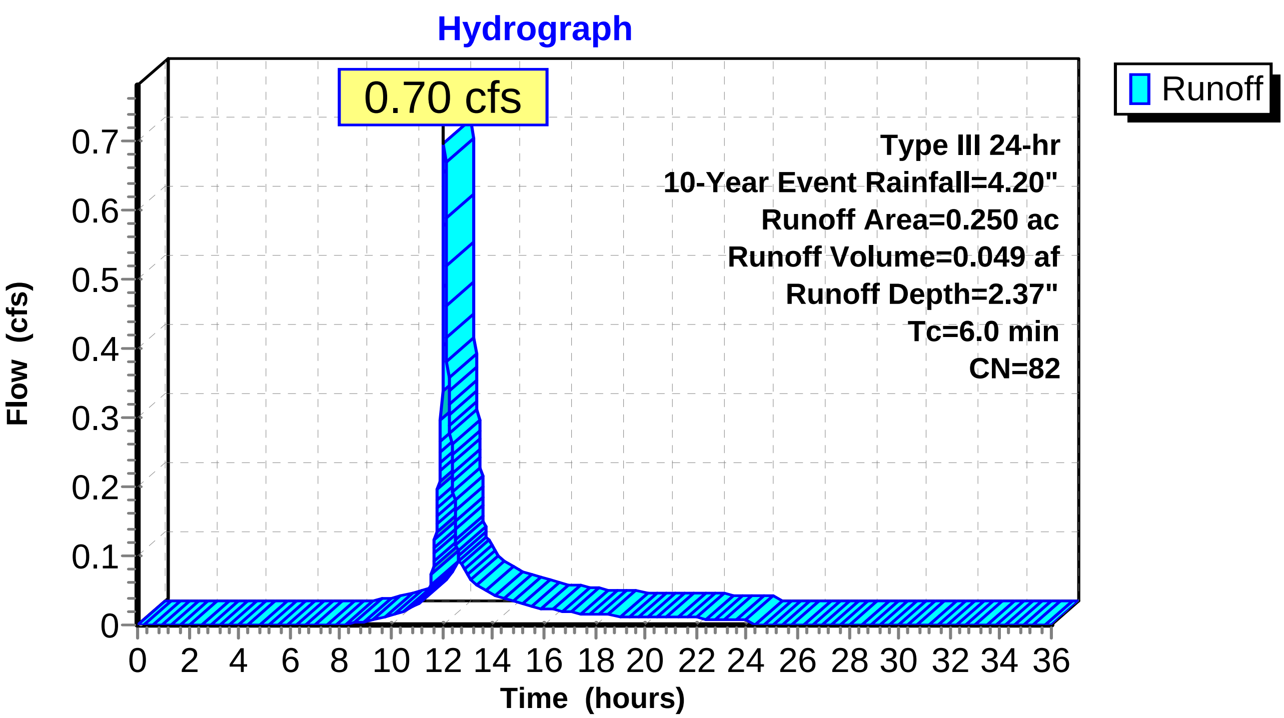
Runoff = 0.70 cfs @ 12.09 hrs, Volume= 0.049 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.086	91	Gravel roads, HSG D
0.164	78	Meadow, non-grazed, HSG D
0.250	82	Weighted Average
0.250		100.00% Pervious Area

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

Subcatchment WQ10:



Summary for Subcatchment WQ13:

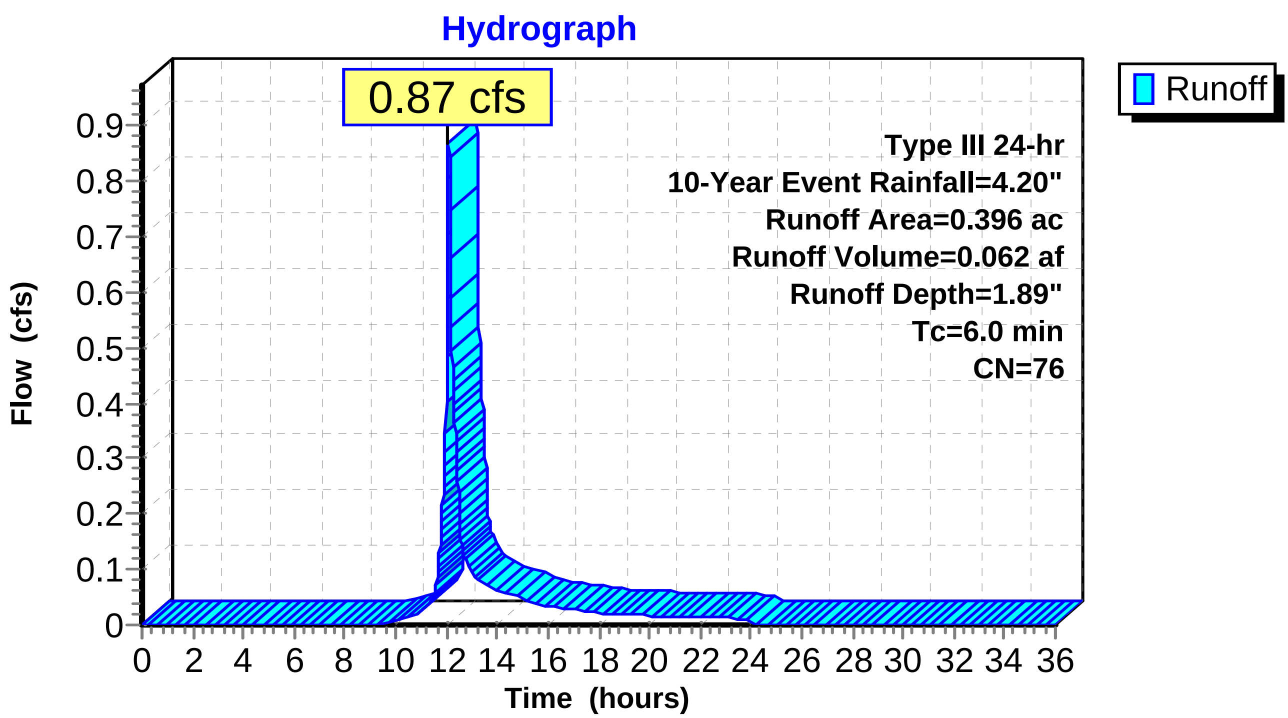
Runoff = 0.87 cfs @ 12.09 hrs, Volume= 0.062 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.119	89	Gravel roads, HSG C
0.277	71	Meadow, non-grazed, HSG C
0.396	76	Weighted Average
0.396		100.00% Pervious Area

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

Subcatchment WQ13:



Summary for Subcatchment WQ14:

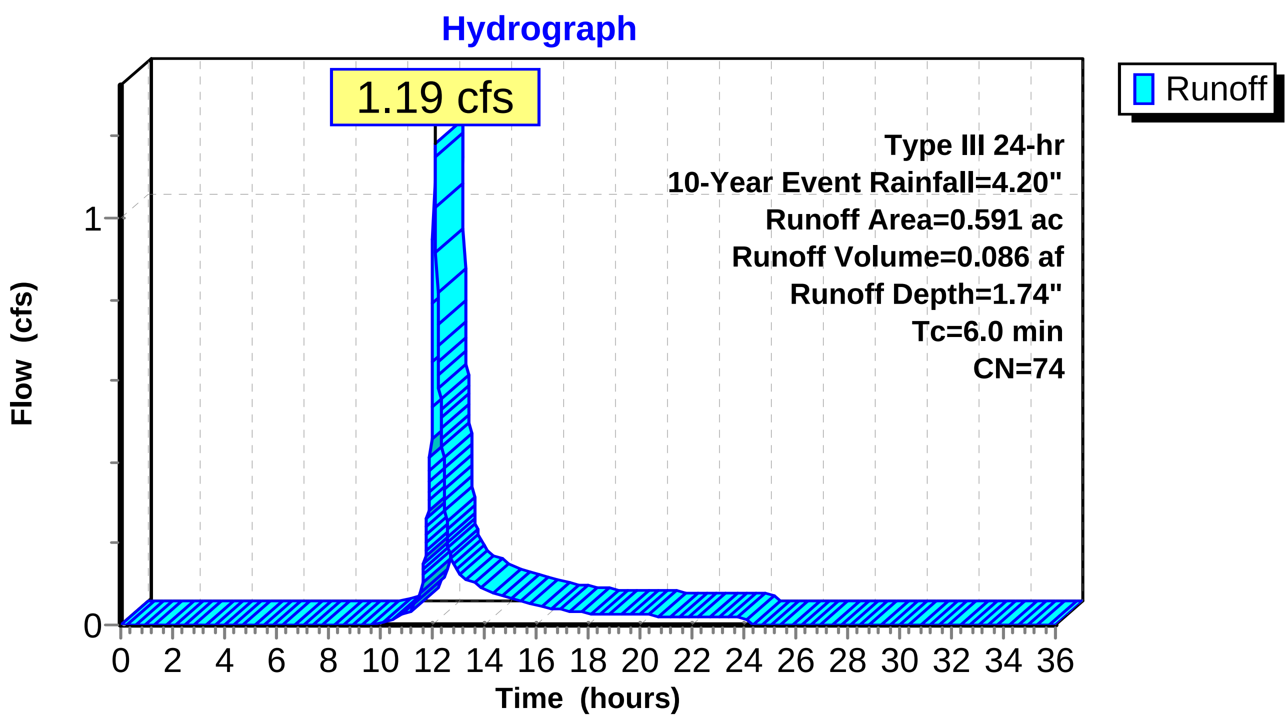
Runoff = 1.19 cfs @ 12.09 hrs, Volume= 0.086 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.092	89	Gravel roads, HSG C
0.499	71	Meadow, non-grazed, HSG C
0.591	74	Weighted Average
0.591		100.00% Pervious Area

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

Subcatchment WQ14:



Summary for Subcatchment WQ15:

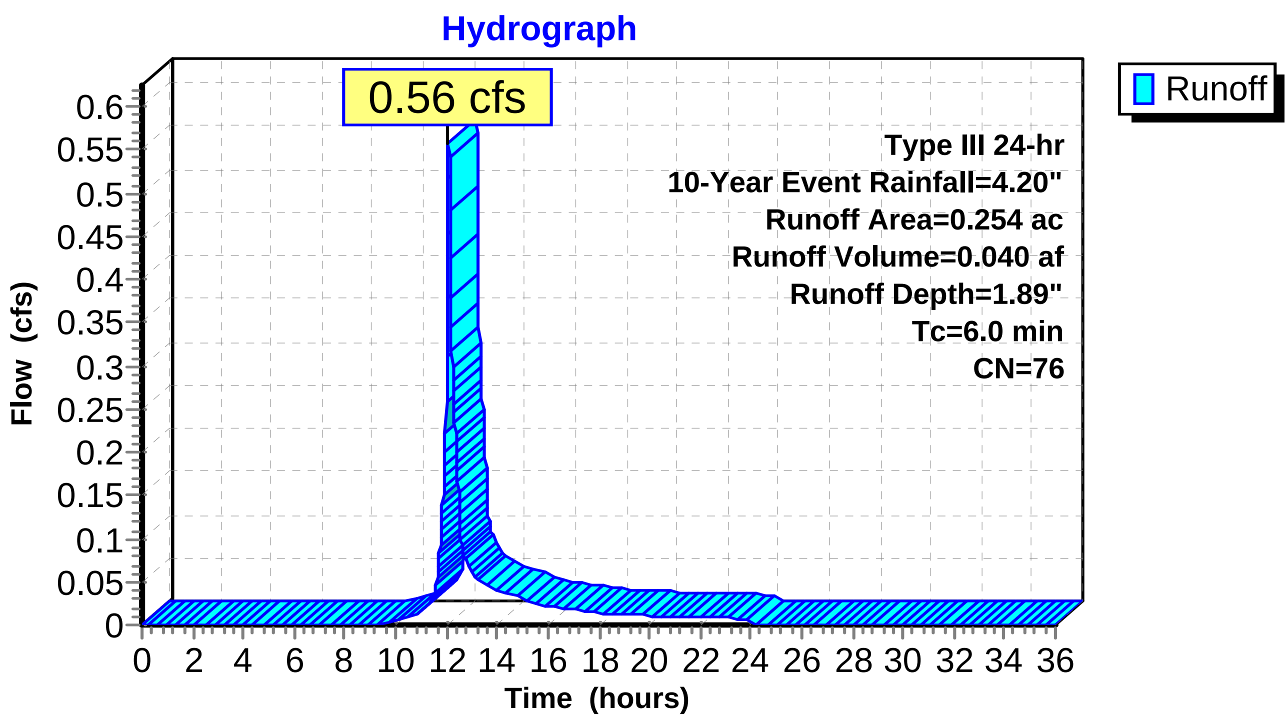
Runoff = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.064	89	Gravel roads, HSG C
0.190	71	Meadow, non-grazed, HSG C
0.254	76	Weighted Average
0.254		100.00% Pervious Area

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

Subcatchment WQ15:



Summary for Subcatchment WQ16:

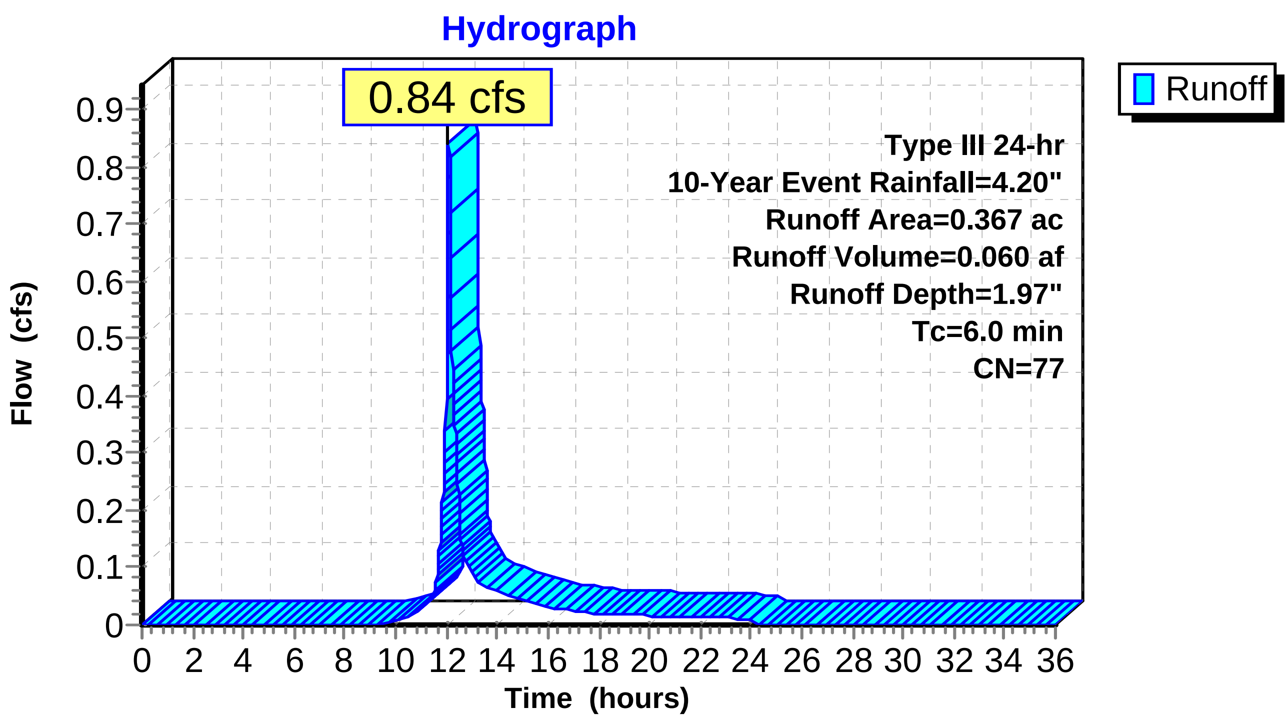
Runoff = 0.84 cfs @ 12.09 hrs, Volume= 0.060 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.119	89	Gravel roads, HSG C
0.248	71	Meadow, non-grazed, HSG C
0.367	77	Weighted Average
0.367		100.00% Pervious Area

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

Subcatchment WQ16:



Summary for Subcatchment WQ17:

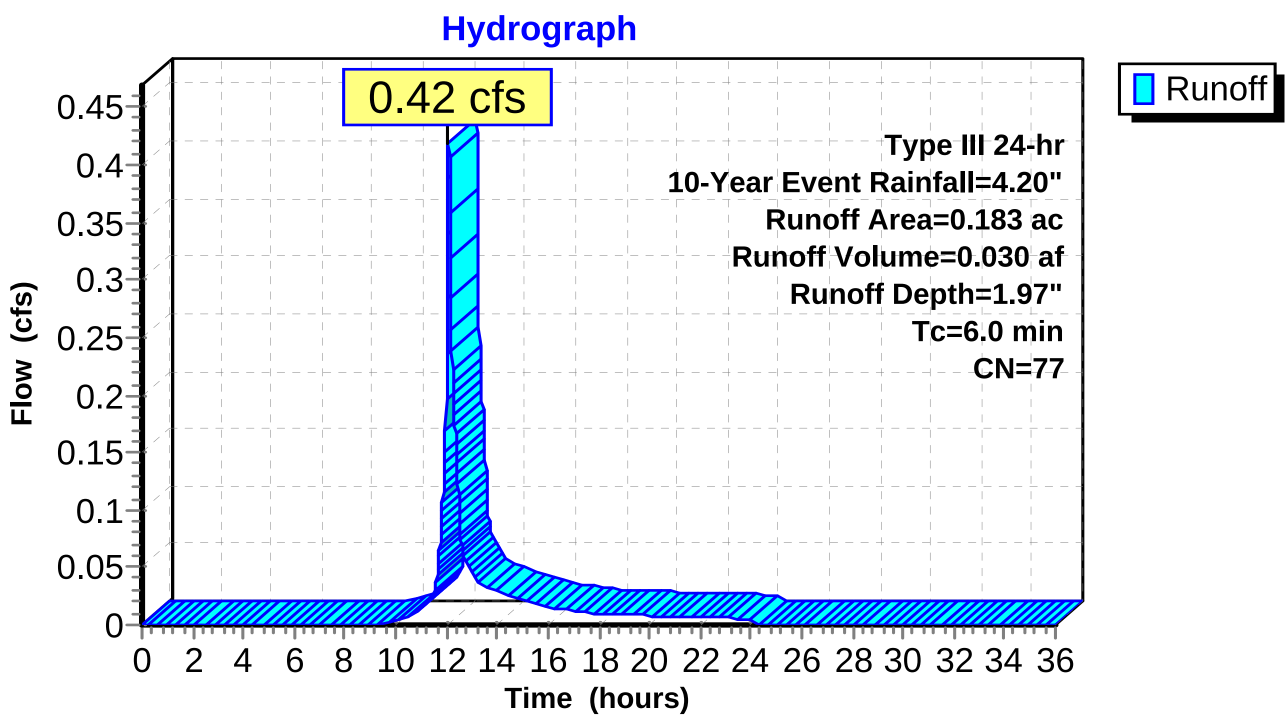
Runoff = 0.42 cfs @ 12.09 hrs, Volume= 0.030 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.064	89	Gravel roads, HSG C
0.119	71	Meadow, non-grazed, HSG C
0.183	77	Weighted Average
0.183		100.00% Pervious Area

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

Subcatchment WQ17:



Summary for Subcatchment WQ18:

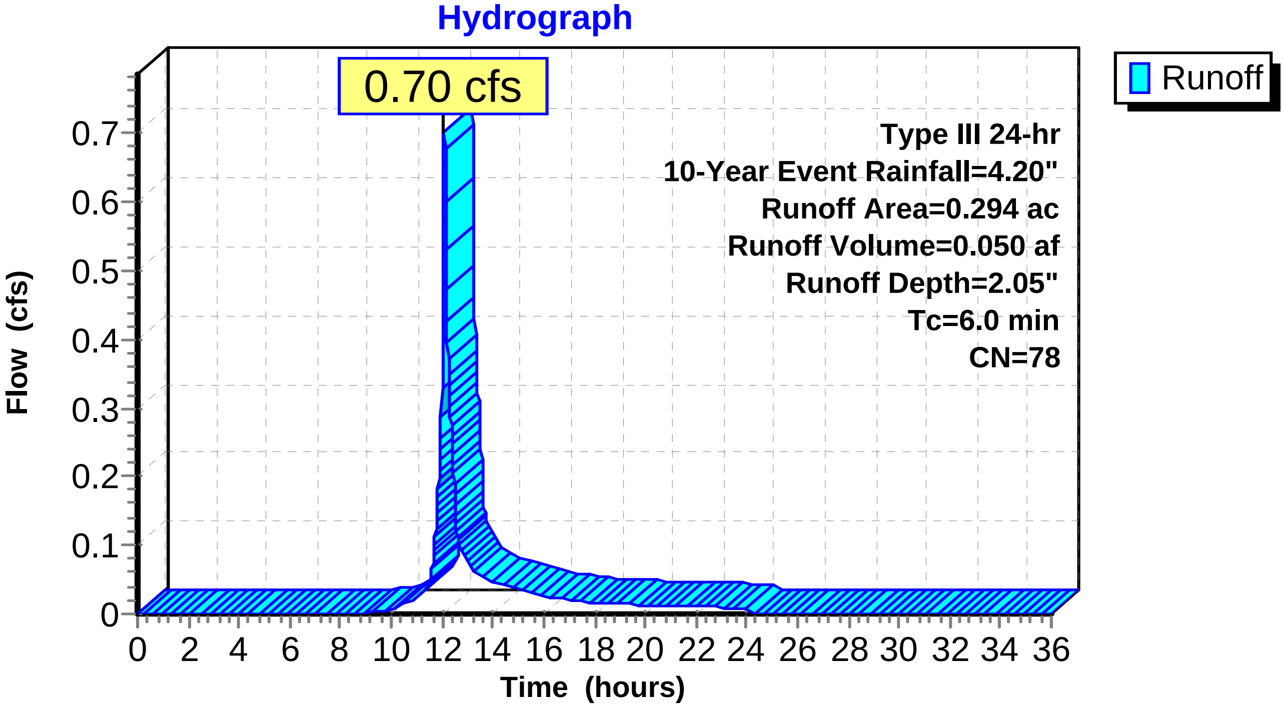
Runoff = 0.70 cfs @ 12.09 hrs, Volume= 0.050 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.110	89	Gravel roads, HSG C
0.184	71	Meadow, non-grazed, HSG C
0.294	78	Weighted Average
0.294		100.00% Pervious Area

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

Subcatchment WQ18:



Summary for Subcatchment WQ19:

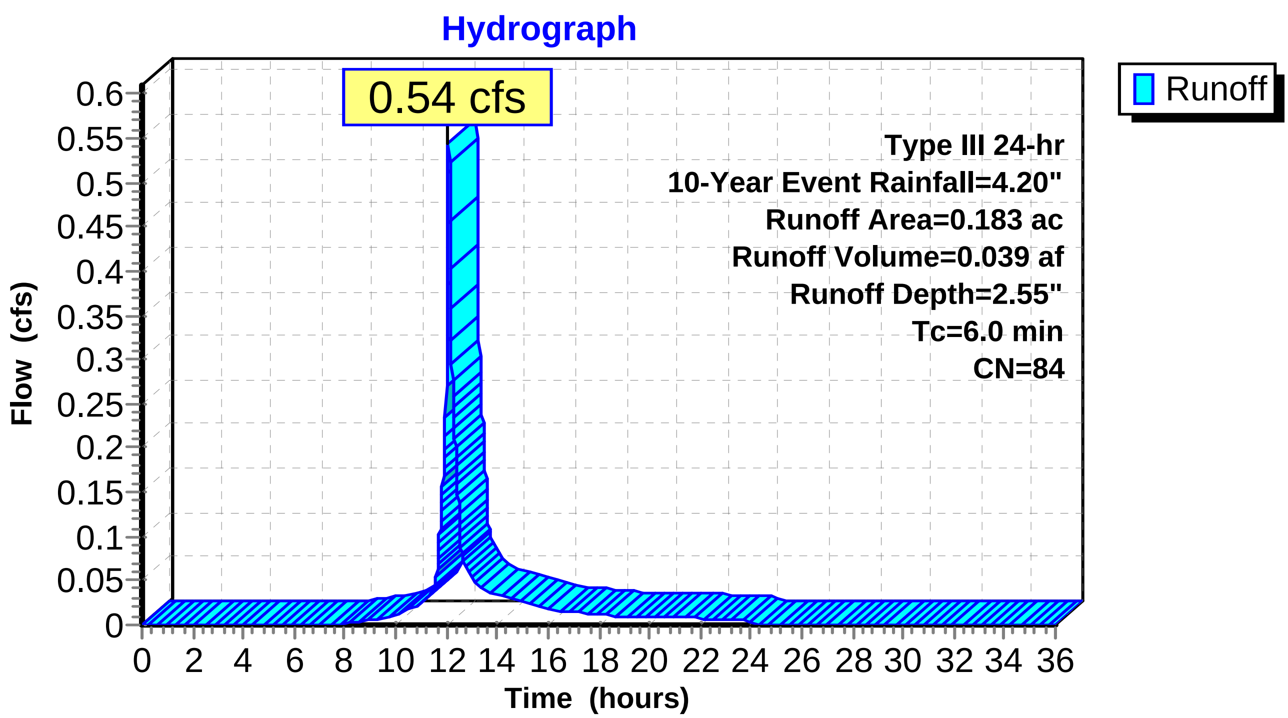
Runoff = 0.54 cfs @ 12.09 hrs, Volume= 0.039 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.133	89	Gravel roads, HSG C
0.050	71	Meadow, non-grazed, HSG C
0.183	84	Weighted Average
0.183		100.00% Pervious Area

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

Subcatchment WQ19:



Summary for Subcatchment WQ5:

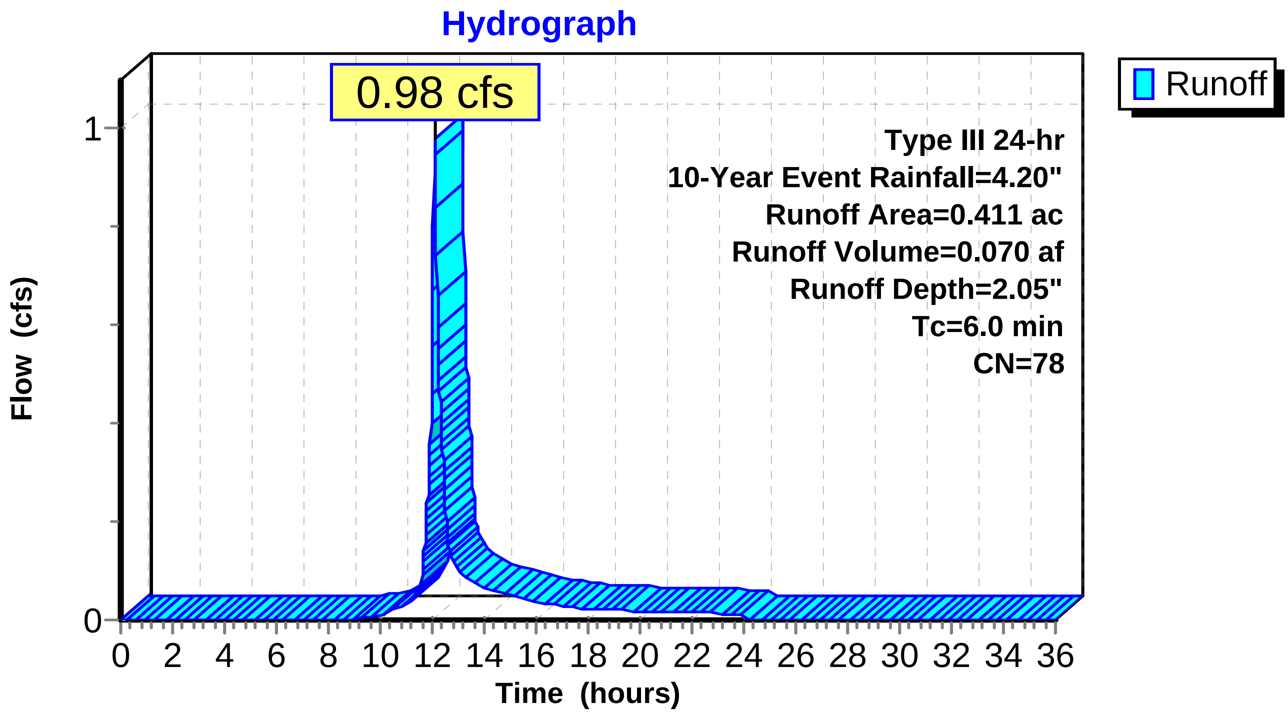
Runoff = 0.98 cfs @ 12.09 hrs, Volume= 0.070 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.156	89	Gravel roads, HSG C
0.255	71	Meadow, non-grazed, HSG C
0.411	78	Weighted Average
0.411		100.00% Pervious Area

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

Subcatchment WQ5:



Summary for Subcatchment WQ7:

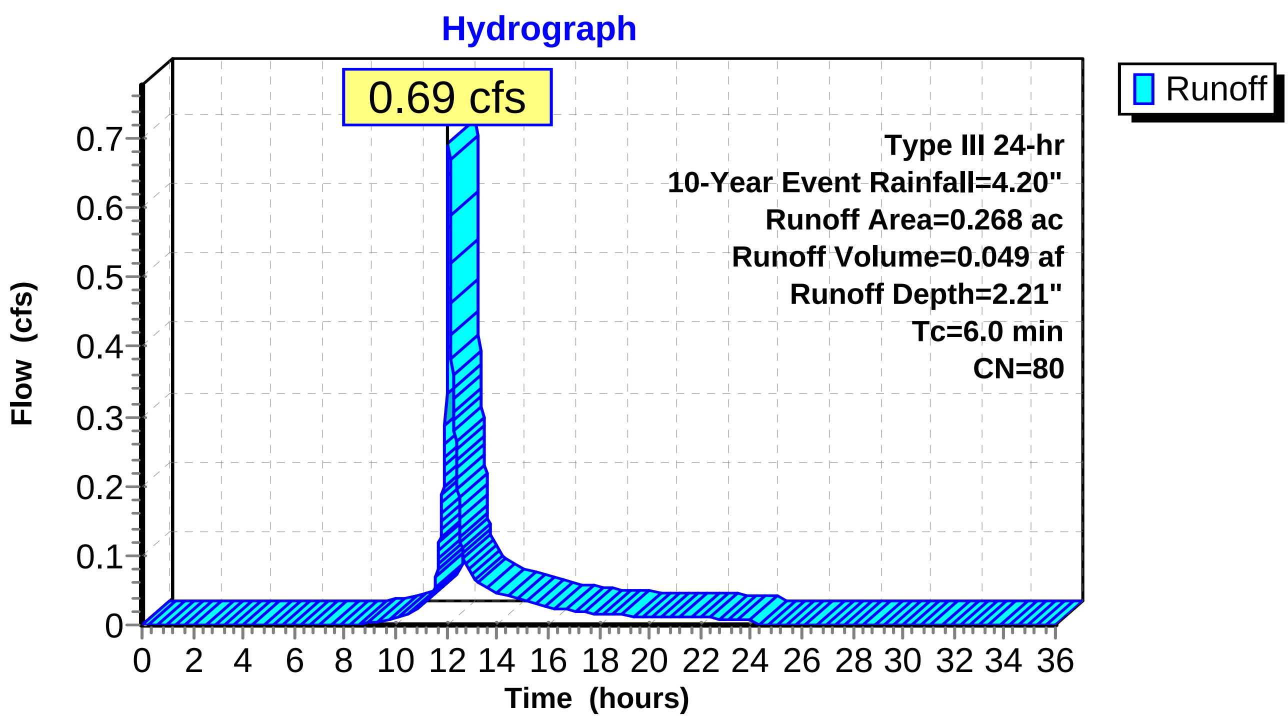
Runoff = 0.69 cfs @ 12.09 hrs, Volume= 0.049 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.130	89	Gravel roads, HSG C
0.138	71	Meadow, non-grazed, HSG C
0.268	80	Weighted Average
0.268		100.00% Pervious Area

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

Subcatchment WQ7:



Summary for Subcatchment WQ9:

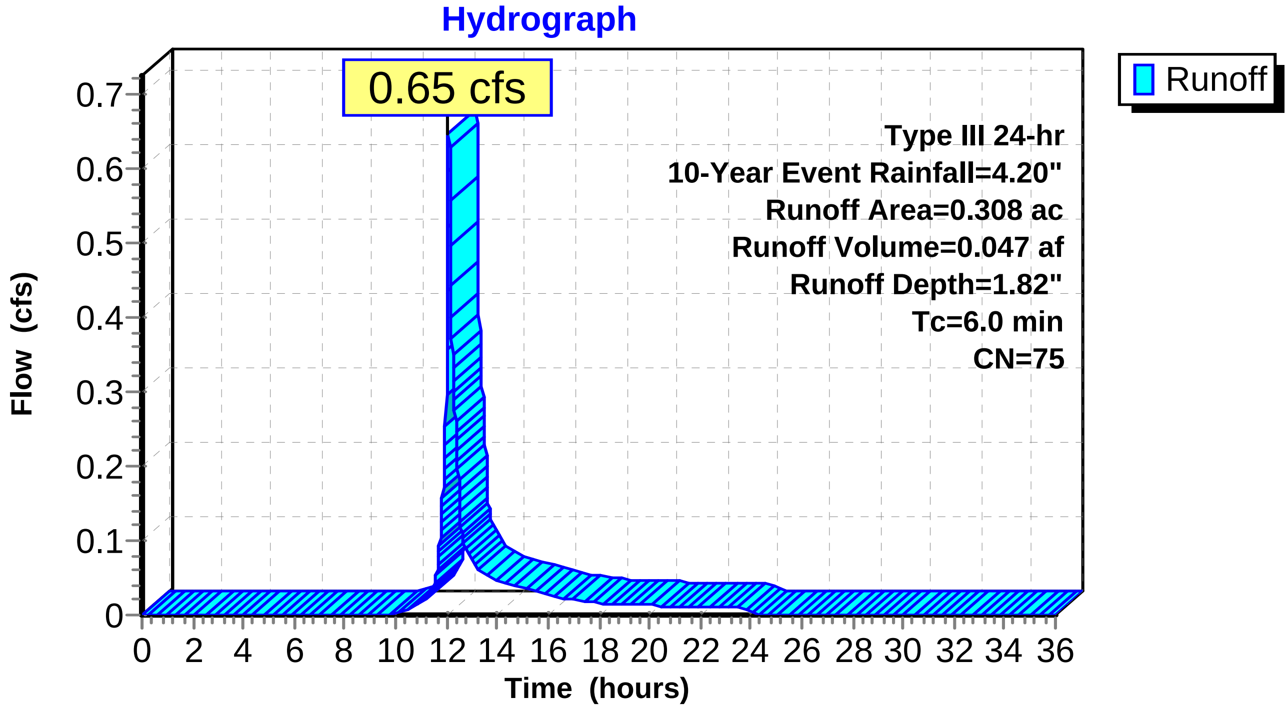
Runoff = 0.65 cfs @ 12.09 hrs, Volume= 0.047 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.073	89	Gravel roads, HSG C
0.235	71	Meadow, non-grazed, HSG C
0.308	75	Weighted Average
0.308		100.00% Pervious Area

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

Subcatchment WQ9:



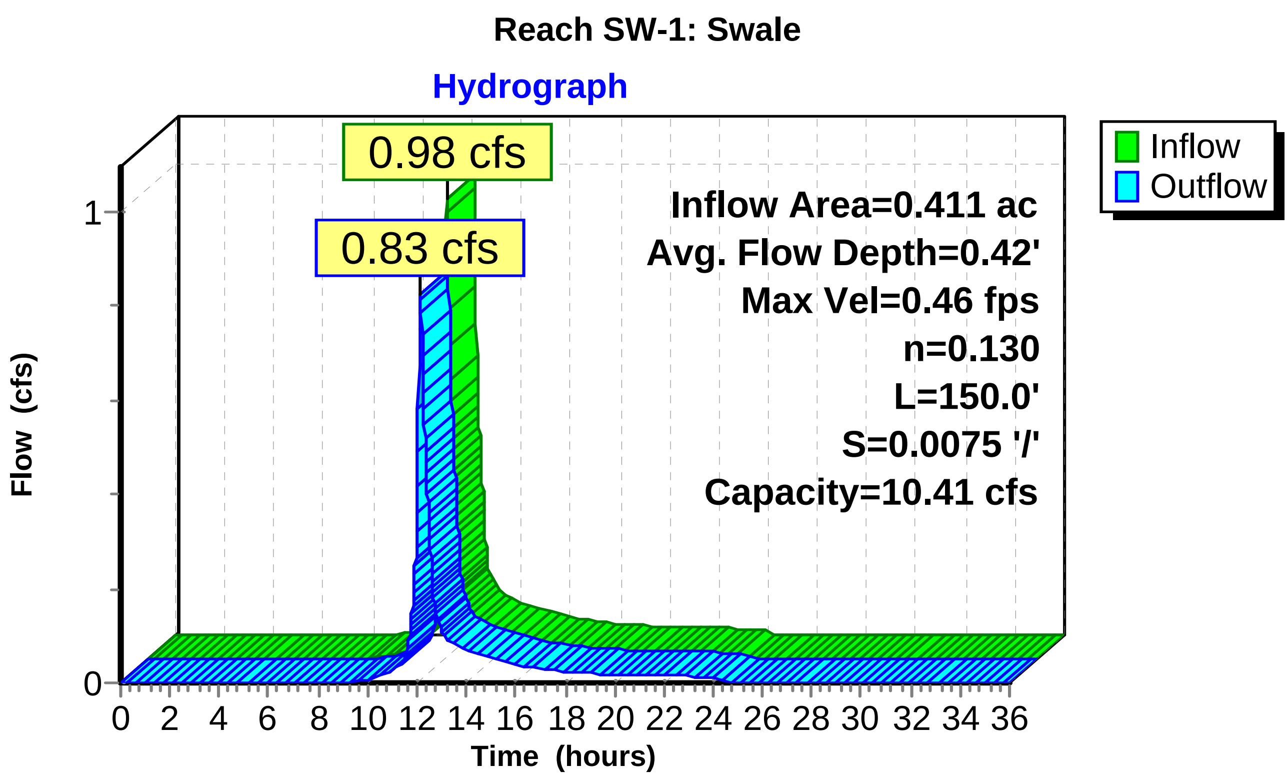
Summary for Reach SW-1: Swale

Inflow Area = 0.411 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10-Year Event event
Inflow = 0.98 cfs @ 12.09 hrs, Volume= 0.070 af
Outflow = 0.83 cfs @ 12.14 hrs, Volume= 0.070 af, Atten= 16%, Lag= 3.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.46 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.13 fps, Avg. Travel Time= 18.7 min

Peak Storage= 269 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 10.41 cfs

3.00' x 1.50' deep channel, n= 0.130
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 150.0' Slope= 0.0075 '/'
Inlet Invert= 1,206.50', Outlet Invert= 1,205.37'



Summary for Reach SW-10: Swale

Inflow Area = 0.294 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10-Year Event event
Inflow = 0.70 cfs @ 12.09 hrs, Volume= 0.050 af
Outflow = 0.59 cfs @ 12.15 hrs, Volume= 0.050 af, Atten= 17%, Lag= 3.3 min

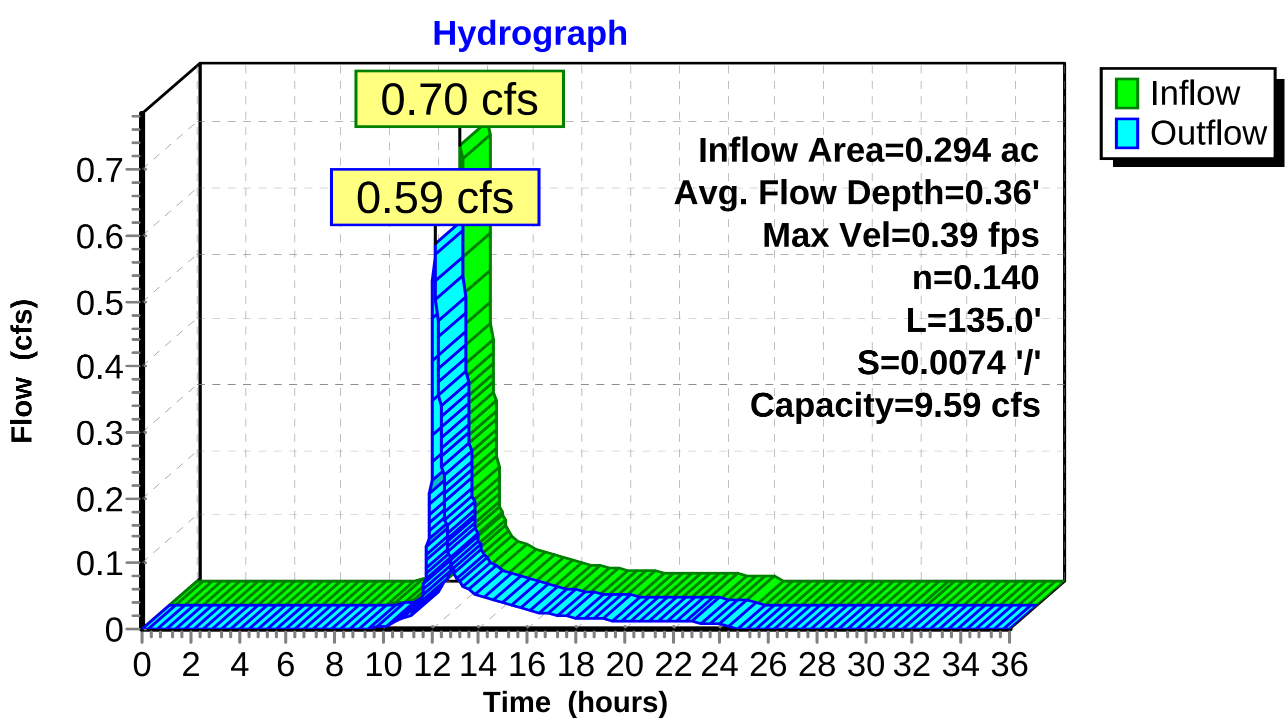
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.39 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 19.7 min

Peak Storage= 202 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.59 cfs

3.00' x 1.50' deep channel, n= 0.140
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 135.0' Slope= 0.0074 '/'
Inlet Invert= 1,571.00', Outlet Invert= 1,570.00'

‡

Reach SW-10: Swale



Summary for Reach SW-11: Swale

Inflow Area = 0.183 ac, 0.00% Impervious, Inflow Depth = 2.55" for 10-Year Event event
Inflow = 0.54 cfs @ 12.09 hrs, Volume= 0.039 af
Outflow = 0.44 cfs @ 12.15 hrs, Volume= 0.039 af, Atten= 20%, Lag= 3.6 min

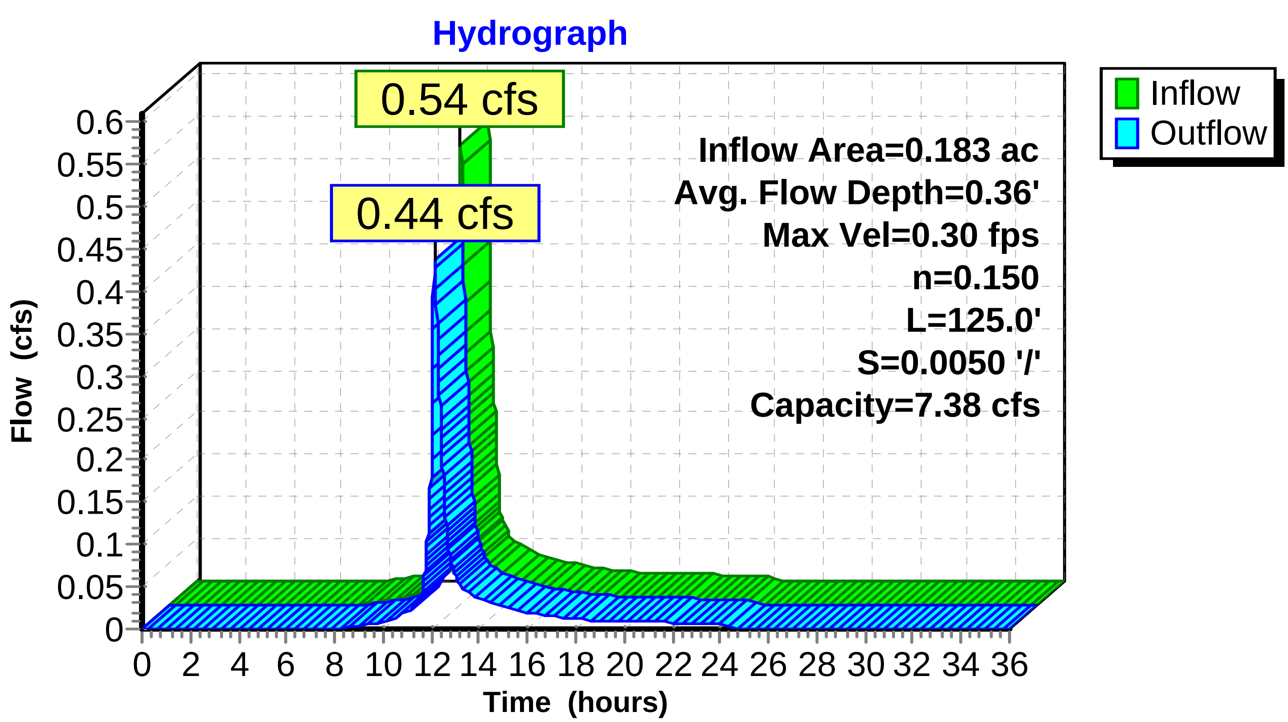
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.30 fps, Min. Travel Time= 7.0 min
Avg. Velocity = 0.08 fps, Avg. Travel Time= 25.0 min

Peak Storage= 182 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 7.38 cfs

3.00' x 1.50' deep channel, n= 0.150
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 125.0' Slope= 0.0050 '/'
Inlet Invert= 1,688.00', Outlet Invert= 1,687.37'

‡

Reach SW-11: Swale



Summary for Reach SW-2: Swale

Inflow Area = 0.268 ac, 0.00% Impervious, Inflow Depth = 2.21" for 10-Year Event event
Inflow = 0.69 cfs @ 12.09 hrs, Volume= 0.049 af
Outflow = 0.57 cfs @ 12.15 hrs, Volume= 0.049 af, Atten= 18%, Lag= 3.4 min

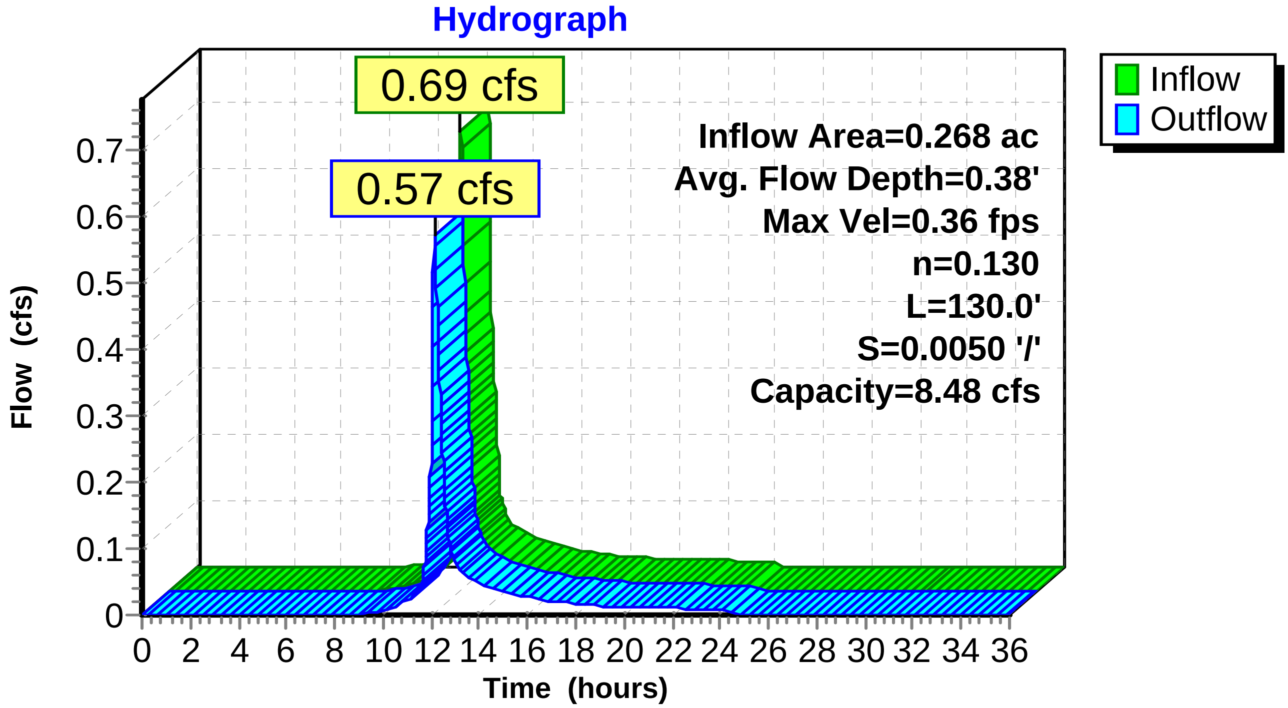
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.36 fps, Min. Travel Time= 6.1 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 21.2 min

Peak Storage= 208 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 8.48 cfs

3.00' x 1.50' deep channel, n= 0.130
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 130.0' Slope= 0.0050 '/'
Inlet Invert= 1,354.00', Outlet Invert= 1,353.35'

‡

Reach SW-2: Swale



Summary for Reach SW-3: Swale

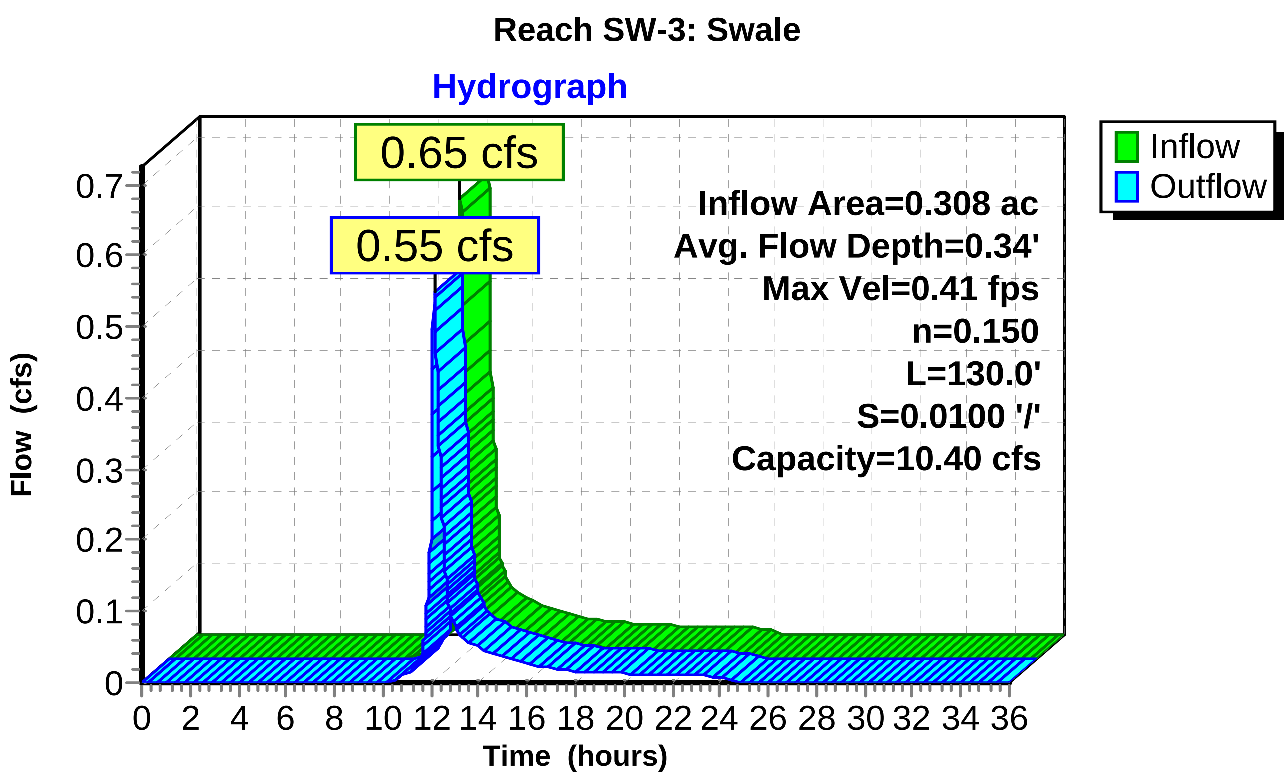
Inflow Area = 0.308 ac, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year Event event
Inflow = 0.65 cfs @ 12.09 hrs, Volume= 0.047 af
Outflow = 0.55 cfs @ 12.14 hrs, Volume= 0.047 af, Atten= 15%, Lag= 3.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.41 fps, Min. Travel Time= 5.3 min
Avg. Velocity = 0.12 fps, Avg. Travel Time= 17.9 min

Peak Storage= 175 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 10.40 cfs

3.00' x 1.50' deep channel, n= 0.150
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 130.0' Slope= 0.0100 '/'
Inlet Invert= 1,758.00', Outlet Invert= 1,756.70'

‡



Summary for Reach SW-4: Swale

Inflow Area = 0.250 ac, 0.00% Impervious, Inflow Depth = 2.37" for 10-Year Event event
Inflow = 0.70 cfs @ 12.09 hrs, Volume= 0.049 af
Outflow = 0.59 cfs @ 12.14 hrs, Volume= 0.049 af, Atten= 15%, Lag= 3.1 min

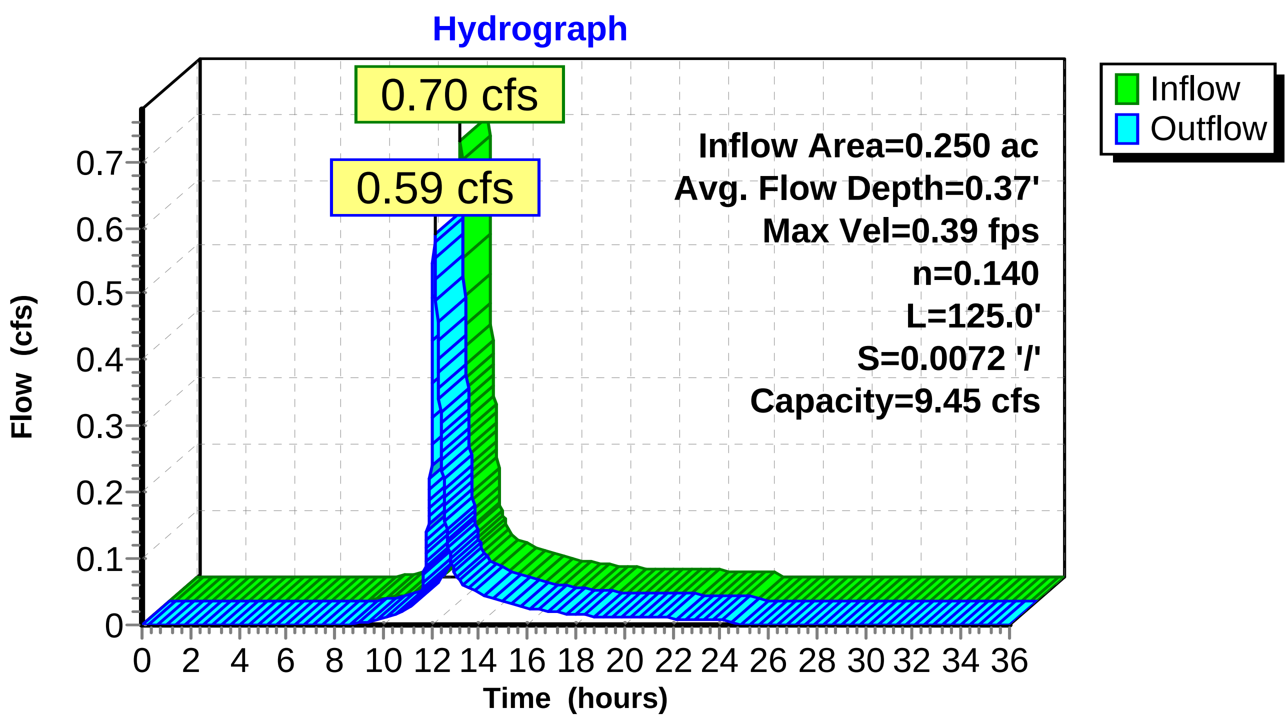
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.39 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 18.8 min

Peak Storage= 189 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.45 cfs

3.00' x 1.50' deep channel, n= 0.140
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 125.0' Slope= 0.0072 '/'
Inlet Invert= 1,628.00', Outlet Invert= 1,627.10'

‡

Reach SW-4: Swale



Summary for Reach SW-5: Swale

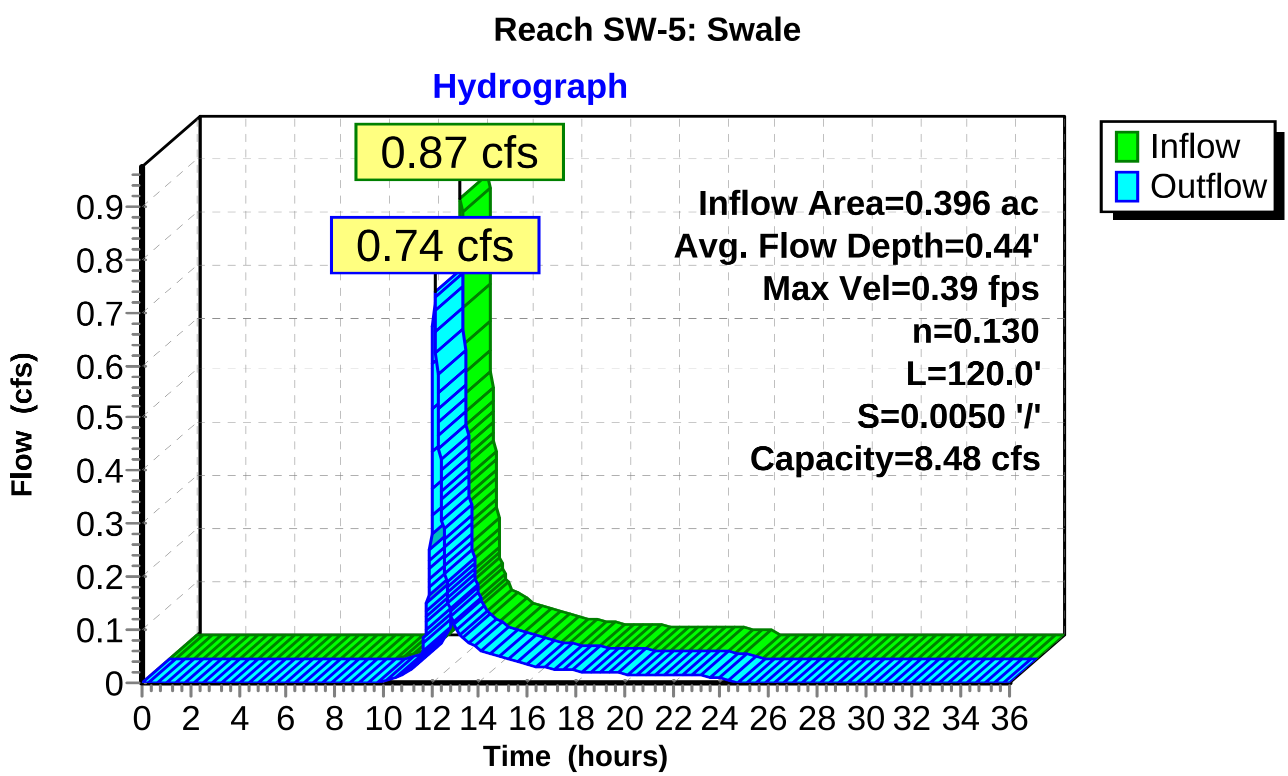
Inflow Area = 0.396 ac, 0.00% Impervious, Inflow Depth = 1.89" for 10-Year Event event
Inflow = 0.87 cfs @ 12.09 hrs, Volume= 0.062 af
Outflow = 0.74 cfs @ 12.14 hrs, Volume= 0.062 af, Atten= 15%, Lag= 3.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.39 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 17.6 min

Peak Storage= 230 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 8.48 cfs

3.00' x 1.50' deep channel, n= 0.130
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 120.0' Slope= 0.0050 '/'
Inlet Invert= 1,682.50', Outlet Invert= 1,681.90'

‡



Summary for Reach SW-6: Swale

Inflow Area = 0.591 ac, 0.00% Impervious, Inflow Depth = 1.74" for 10-Year Event event
Inflow = 1.19 cfs @ 12.09 hrs, Volume= 0.086 af
Outflow = 1.05 cfs @ 12.14 hrs, Volume= 0.086 af, Atten= 12%, Lag= 2.7 min

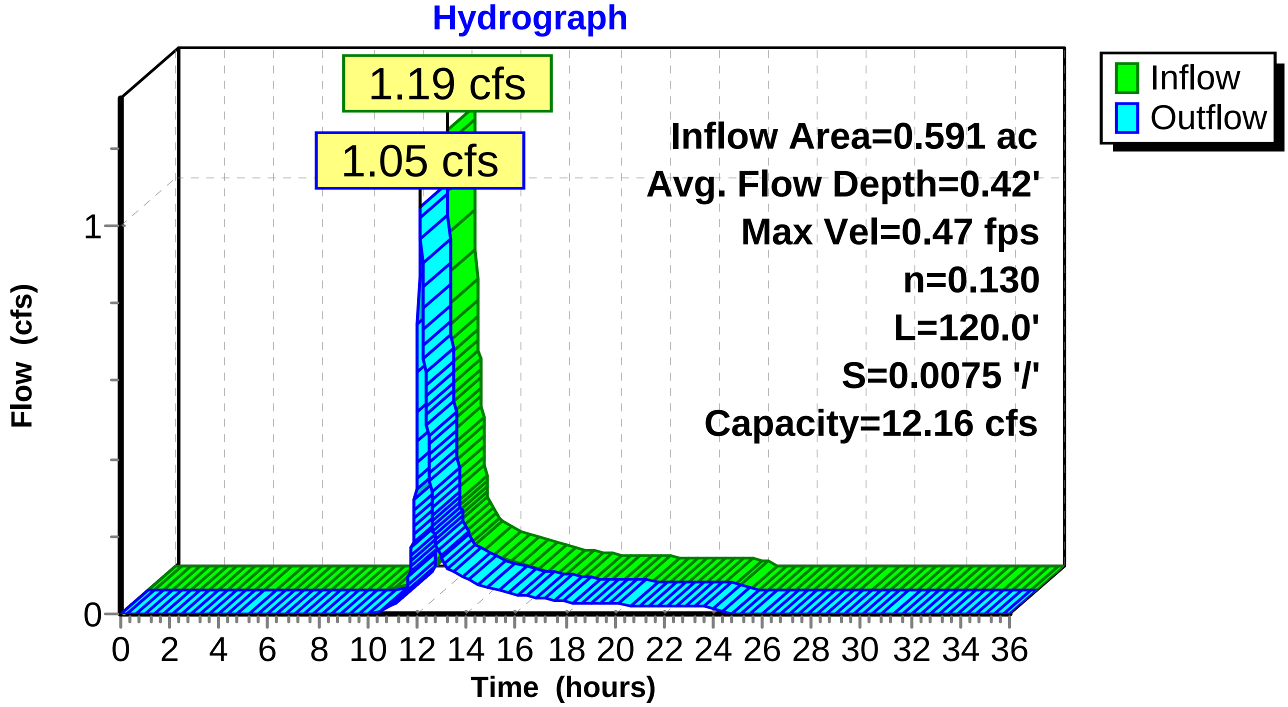
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.47 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 14.5 min

Peak Storage= 265 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 12.16 cfs

4.00' x 1.50' deep channel, n= 0.130
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 120.0' Slope= 0.0075 '/'
Inlet Invert= 1,579.50', Outlet Invert= 1,578.60'

‡

Reach SW-6: Swale



Summary for Reach SW-7: Swale

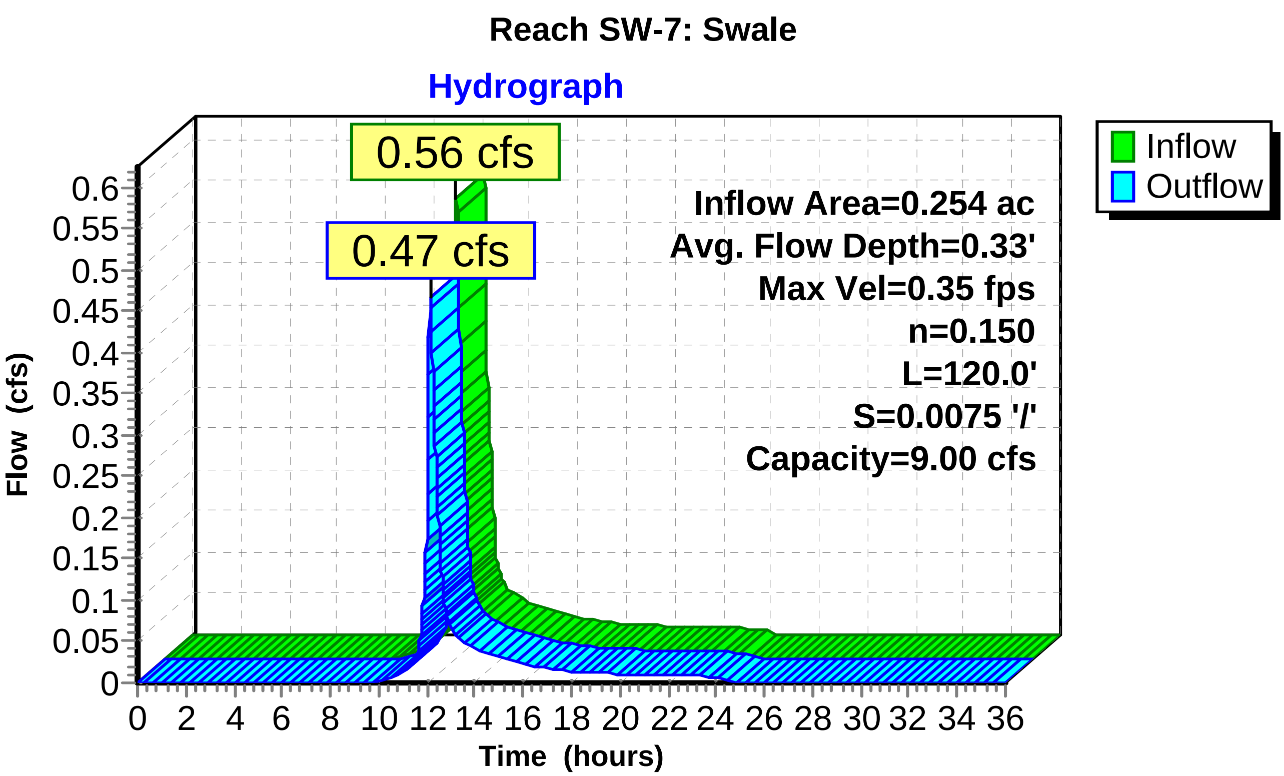
Inflow Area = 0.254 ac, 0.00% Impervious, Inflow Depth = 1.89" for 10-Year Event event
Inflow = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af
Outflow = 0.47 cfs @ 12.15 hrs, Volume= 0.040 af, Atten= 17%, Lag= 3.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.35 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 19.3 min

Peak Storage= 160 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.00 cfs

3.00' x 1.50' deep channel, n= 0.150
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 120.0' Slope= 0.0075 '/'
Inlet Invert= 1,503.00', Outlet Invert= 1,502.10'

‡



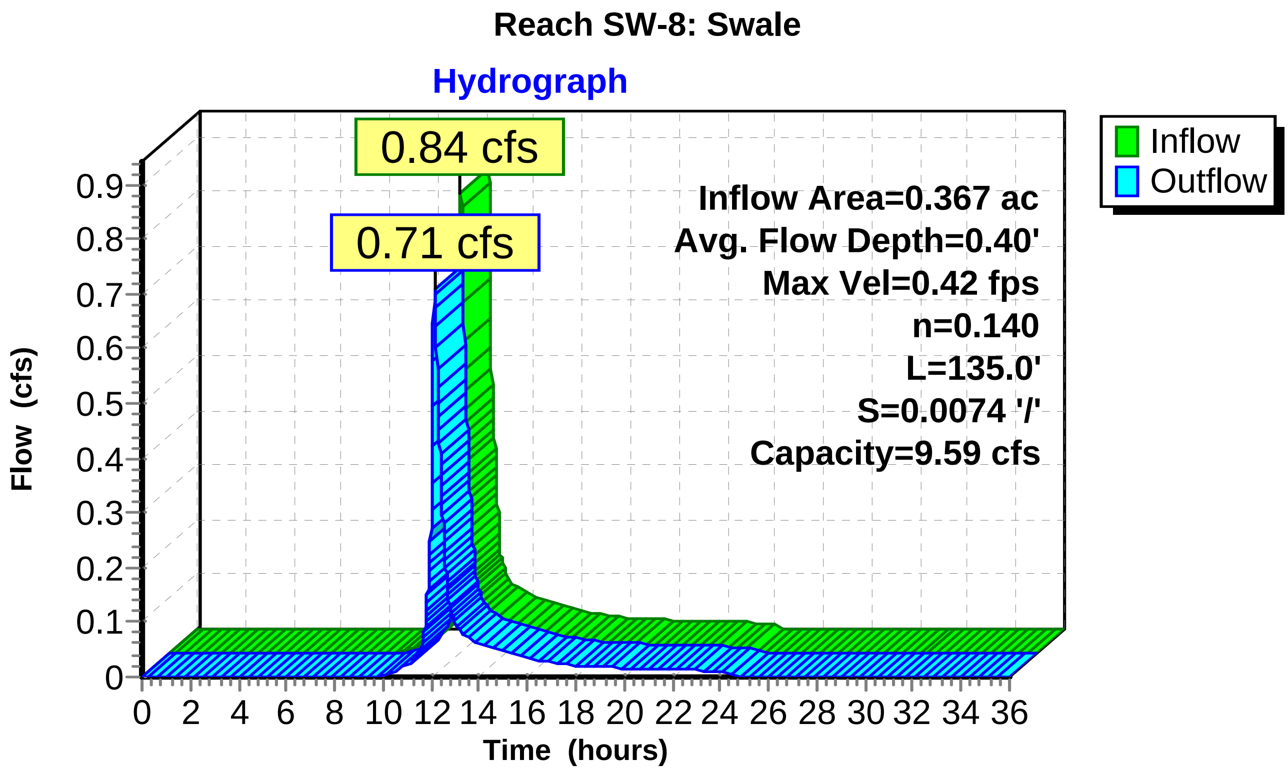
Summary for Reach SW-8: Swale

Inflow Area = 0.367 ac, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year Event event
Inflow = 0.84 cfs @ 12.09 hrs, Volume= 0.060 af
Outflow = 0.71 cfs @ 12.14 hrs, Volume= 0.060 af, Atten= 16%, Lag= 3.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.42 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.12 fps, Avg. Travel Time= 18.5 min

Peak Storage= 230 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.59 cfs

3.00' x 1.50' deep channel, n= 0.140
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 135.0' Slope= 0.0074 '/'
Inlet Invert= 1,471.00', Outlet Invert= 1,470.00'



Summary for Reach SW-9: Swale

Inflow Area = 0.183 ac, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year Event event
Inflow = 0.42 cfs @ 12.09 hrs, Volume= 0.030 af
Outflow = 0.34 cfs @ 12.15 hrs, Volume= 0.030 af, Atten= 18%, Lag= 3.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.32 fps, Min. Travel Time= 6.3 min
Avg. Velocity = 0.09 fps, Avg. Travel Time= 21.2 min

Peak Storage= 129 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.00 cfs

3.00' x 1.50' deep channel, n= 0.150
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 120.0' Slope= 0.0075 '/'
Inlet Invert= 1,521.00', Outlet Invert= 1,520.10'

‡

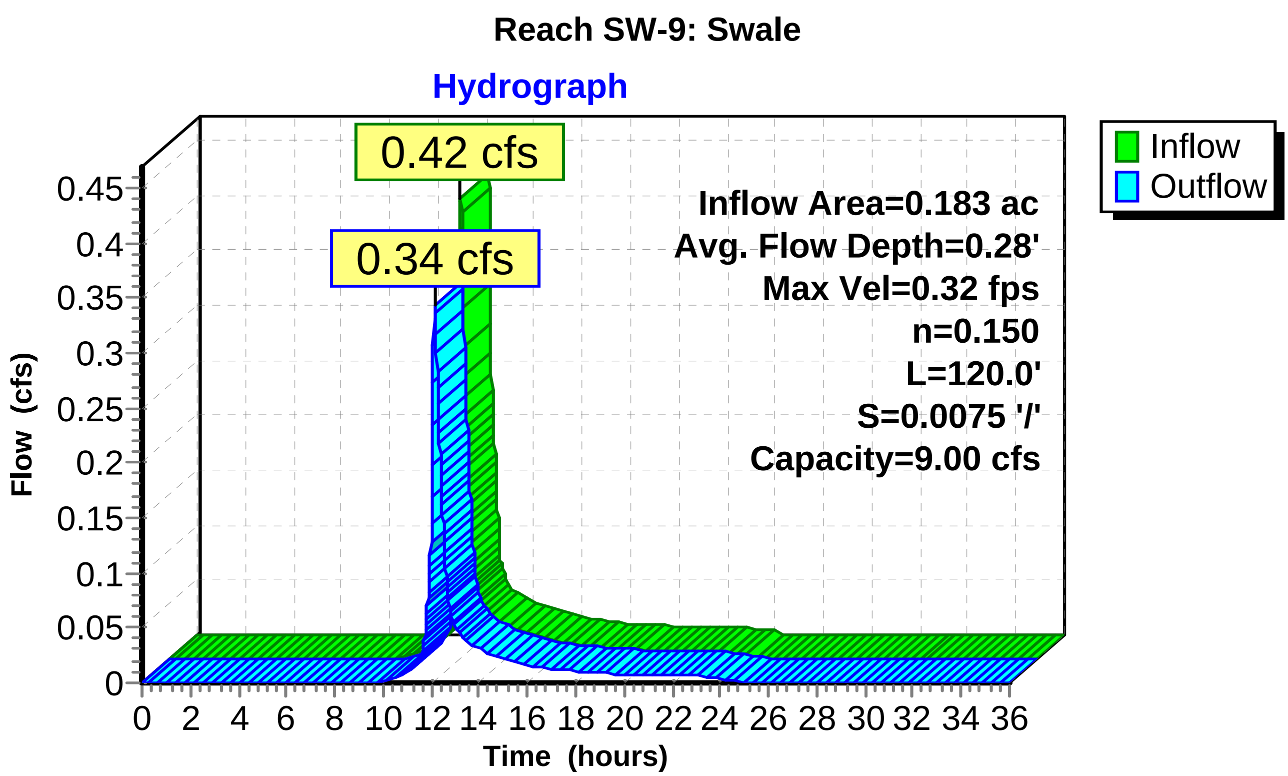
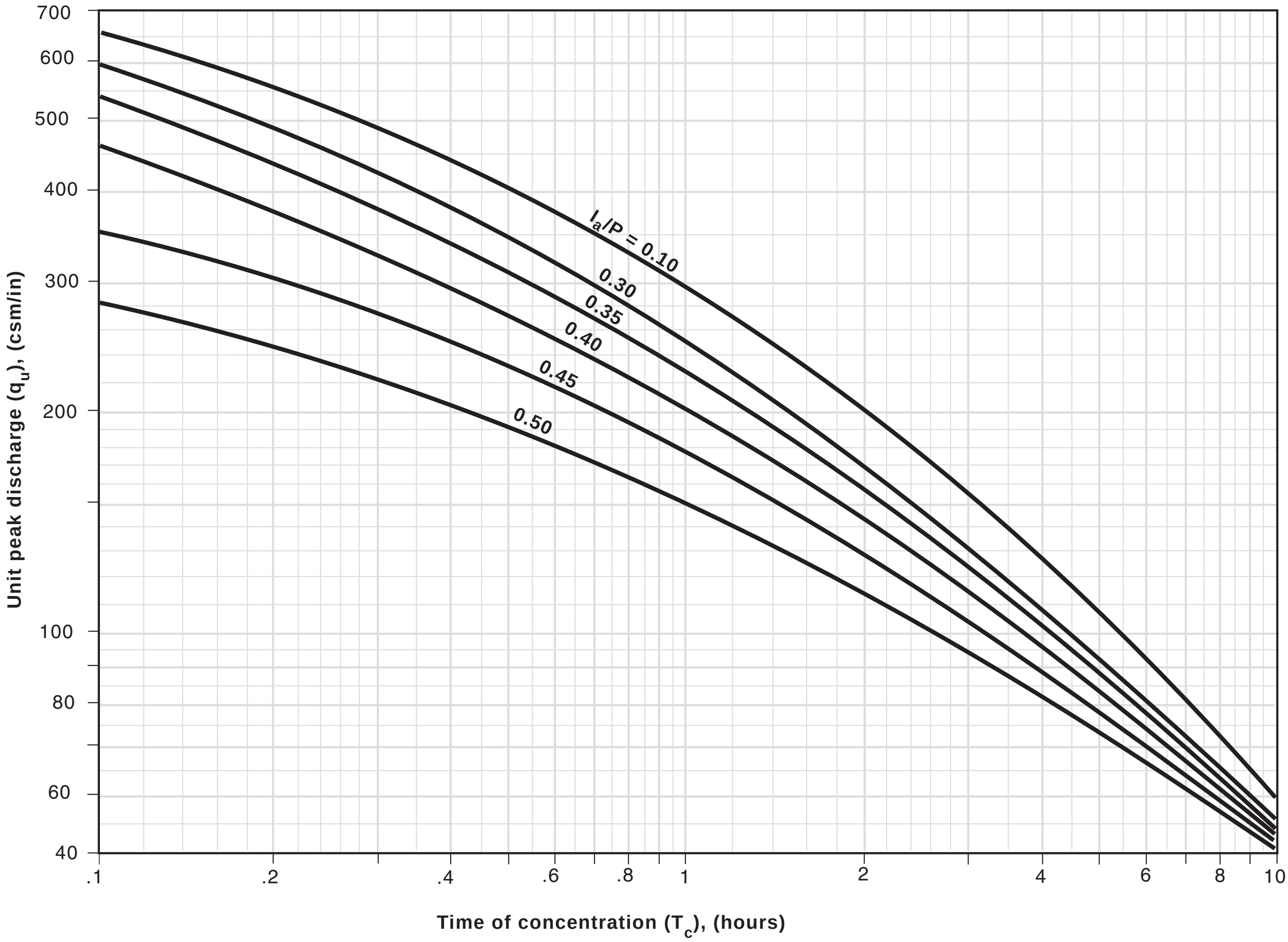


Exhibit 4-III Unit peal discharge (q_u) for NRCS (SCS) type III rainfall distribution



APPENDIX C

Conveyance and Stabilization Calculations

Summary Table with Riprap Sizing Calculations (1 page)

Conveyance Tc Calculations (19 pages)

Conveyance Runoff Model Results – 10 year & 25 year (196 pages)

PROJECT:	Eolian Renewable Energy, LLC	Calculated By:	PMM
	Antrim Windpower Project	Checked By:	PGT
TRC Project:	186317.0000.0000	Date:	March 27, 2015
		Revised:	

RIPRAP CHANNEL PROTECTION CALCULATIONS

1. Channel riprap design is based on criteria published by Maine DEP in "Maine Erosion and Sediment Control BMPs" (2003). Refer to Section E-6 Riprap Waterways.
2. All channels with slopes greater than 8% require riprap reinforcement.
3. Flows and velocities are based on a 10-year design storm event. Flows are determined using "HydroCAD" software. Velocities and flow depths are determined using "FlowMaster" software unless otherwise indicated.

4. Riprap Manning's "n" calculation based on:

$$n = \frac{y^{1/8}}{[21.6*\log_{10}(y/D_{50})+14.0]}$$

LOCATION	HydroCAD Node	Q_{10} (cfs)	Flow Depth, y (ft)	Minimum D_{50} (ft)	Manning's "n"	V_{10} (fps)	Comments
Sta 0+00 to Sta 2+50 R	1.1R	5.75	0.51	0.50	0.065	3.76	Velocity and depth from HydroCAD model
Sta 2+50 to Sta 5+75 R	1.2R	4.44	0.48	0.50	0.067	3.16	Velocity and depth from HydroCAD model
Sta 0+00 to Sta 2+50 L	1.1	-	-	0.50	-	-	Only a small portion of SC 1.1 contributes to channel flow. Use D_{50}=6" for simplified construction.
Sta 2+50 to Sta 5+00 L	1.3	2.05	0.33	0.50	0.086	2.37	
Sta 8+50 to Sta 10+25 R	1.2R	4.44	0.48	0.50	0.067	3.16	Velocity and depth from HydroCAD model
Sta 9+00 to Sta 10+25 L	1.5	3.93	0.44	0.50	0.070	3.13	
Sta 11+50 to Sta 13+50 R	1.4A	0.45	0.14	0.25	0.091	1.40	
Sta 13+50 to Sta 17+00 R	WQ4	0.62	0.16	0.25	0.081	1.68	
Sta 12+25 to Sta 16+00 L	1.5	3.93	0.44	0.50	0.071	3.13	
Sta 19+00 to Sta 24+50 R	WQ5	0.98	0.19	0.25	0.071	2.14	See calculations for WQ Swales
Sta 19+00 to Sta 24+00 L	1.6	-	-	0.25	-	-	Only a small portion of SC 1.6 contributes to channel flow. Assume equivalent to WQ5.
Sta 29+50 to Sta 32+00 L	WQ 6	-	-	0.25	-	-	No distinct channel
Sta 32+00 to Sta 35+50 R	WQ7	0.69	0.17	0.25	0.078	1.79	See calculations for WQ Swales
Sta 32+00 to Sta 36+00 L	1.6	10.0	0.63	0.50	0.059	4.92	Based on contributing area, assume flow is 25% of Q_{10} for SC1.6
Sta 41+75 L (Slope)	1.8/6P	17.0	0.58	0.83	0.088	6.88	Design based on Q25
Sta 41+75 to Sta 45+00 R	WQ 8	-	-	0.25	-	-	No distinct channel
Sta 45+00 to Sta 49+50 L	1.9	8.42	0.58	0.50	0.061	4.58	Assumes full flow to all culverts
Sta 54+00 to Sta 57+50 L	1.10	9.63	0.61	0.50	0.059	4.87	Assumes full flow to all culverts
Sta 57+50 to Sta 63+50 L	1.11	5.40	0.48	0.50	0.067	3.77	
Sta 63+50 to Sta 66+75 L	1.12	1.54	0.23	0.25	0.062	2.72	Use D_{50}=6" for simplified construction.
Sta 67+75 to Sta 74+50	3.1	3.46	0.39	0.50	0.076		Based on contributing area, assume flow is 33% of Q_{10} for SC3.1
Sta 68+00 to Sta 69+75 L	WQ9	0.65	0.16	0.25	0.081	1.71	See calculations for WQ Swales
Sta 68+00 to Sta 69+75 R	-	-	-	0.25	-	-	Small contributing area. Assume equivalent to WQ9.
Sta 75+00 to Sta 77+50 L	WQ 10	-	-	0.25	-	-	No distinct channel
Sta 77+50 to Sta 80+25 L	WQ11	0.76	0.18	0.25	0.074	1.80	
Sta 77+00 to Sta 80+25 R	-	-	-	0.25	-	-	Small contributing area. Assume equivalent to WQ11.
Sta 85+00 to Sta 87+25 R	WQ 12	0.47	0.21	0.25	0.067	0.91	
Sta 89+00 to Sta 92+25 R	WQ 13	0.87	0.21	0.25	0.067	1.76	See calculations for WQ Swales
Sta 97+00 to Sta 98+50 R	-	-	-	0.25	-	-	Minimal contributing area.
Sta 101+75 to Sta 103+25 L	-	-	-	0.25	-	-	Minimal contributing area.
Sta 104+25 to Sta 106+50 L	-	-	-	0.25	-	-	Minimal contributing area.
Sta 104+50 to Sta 104+00 R	WQ 14	-	-	0.25	-	-	Natural channel
Sta 111+50 to Sta 113+25 L	-	-	-	0.25	-	-	Minimal contributing area.
Sta 111+75 to Sta 113+50	WQ 15	-	-	0.25	-	-	Natural channel
Sta 120+00 to Sta 123+00 R	WQ16	0.84	0.18	0.25	0.074	1.98	
Sta 124+50 to Sta 126+00 R	WQ17	0.42	0.14	0.25	0.091	1.36	
Sta 128+00 to Sta 131+50 L	1.15	2.64	0.29	0.25	0.055	3.50	
Sta 128+50 to Sta 131+50 R	WQ18	0.70	0.17	0.25	0.077	1.81	
Sta 131+50 to Sta 137+00 L	1.16	2.40	0.28	0.25	0.057	3.31	
Sta 137+00 to Sta 139+00 L	1.17	0.33	0.13	0.25	0.099	1.19	
Sta 1+00 to Sta 3+25 L	3.2	0.53	0.15	0.25	0.086	1.53	

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
	Time of Concentration Summary		

Time of Concentration Equations:

1. Where $T_t := \frac{0.007 \cdot (N \cdot L)^{0.8}}{P_2^{0.5} \cdot S^{0.4}}$ from SCS TR-55. For Sheet Flow (300 feet or less)

2. Where $V := 20.3282 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* For Shallow Concentrated Flow (Paved surfaces)

3. Where $T_t := \frac{L}{3600 \cdot V}$ from the SCS Upland Method *Channel Flow Chart* Travel time equation

4. Where $V := 16.1345 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* For Shallow Concentrated Flow (Unpaved surfaces)

5. Where: $v = 7 \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* For Shallow Concentrated Flow (Short Grass Pasture)

6. Where: $v = 5 \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* For Shallow Concentrated Flow (Woodland)

7. Where $V := 12 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* For Channel Flow - Waterways and Swamps, No Channels

8. Where $V := 15 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* For Channel Flow - Grassed Waterways and Roadside Ditches

9. Where $V := 21 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* For Channel Flow - Small Tributary & Swamp w/Channels

10. Where $V := 35 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* For Channel Flow - Large Tributary

11. Where $V := 60 \cdot \sqrt{S}$ from the SCS Upland Method *Channel Flow Chart* For Channel Flow - Main River

12. Where $V := \frac{1.49 \cdot R^{.667} \cdot \sqrt{S}}{N}$ For Channel Flow - Culvert Flow

13. Where P_2 = 2-Year, 24 Hour Rainfall (in) (Antrim, NH: P2= 2.8 inches)

Mannings Roughness Coefficients Table

Surface Description	n - value
Smooth surfaces	0.011
Crush Stone/Substation Yards	0.025
Fallow	0.050
Cultivated: Residue<=20%	0.060
Cultivated: Residue>=20%	0.170
Grass: Short	0.150
Grass: Dense	0.240
Grass: Bermuda	0.410
Range	0.130
Woods: Light underbrush	0.400
Woods: Dense underbrush	0.800

PROJECT:	**Eolian Renewable Energy LLC**					**Calculated By:**	PMM		
	Antrim Wind Project					**Checked By:**			
Proj. No.:	**186317.0000.0000**					**Date:**	March 27, 2015		
Subcatchment:	**1.1 - Post-development**					**Revised:**			

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.09								
T_t^1, hr	0.365								0.3650
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity^4, ft/sec									
T_t^3, hr									0.0000
Woodland									
Length, ft		1070							
Slope, ft/ft		0.094							
Velocity^5, ft/sec		1.5330							
T_t^3, hr		0.194							0.1939
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft			185		700	25			
Slope, ft/ft			0.081		0.082	0.4			
Velocity^6, ft/sec			3.415		3.436	7.589			
T_t^3, hr			0.015		0.057	0.001			0.0725
Grassed Waterways/Roadside Ditches									
Length, ft				360			245		
Slope, ft/ft				0.007			0.016		
Velocity^7, ft/sec				1.255			1.897		
T_t, hr				0.080			0.036		0.1156
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity^{11}, ft/sec									
Length, L, ft									
T_t, hr									0.0000
								HR	0.747
								Min	**44.82**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.3 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.025	0.24							
Length, ft	35	65							
P2 , in	2.8	2.8							
Slope, ft/ft	0.028	0.023							
T_t[1], hr	0.016	0.170							0.1861
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft			170						
Slope, ft/ft			0.044						
Velocity[2], ft/sec			3.384						
T_t[3], hr			0.014						0.0140
Short Grass Pasture									
Length, ft				150					
Slope, ft/ft				0.113					
Velocity[4], ft/sec				2.3531					
T_t[3], hr				0.018					0.0177
Woodland									
Length, ft									
Slope, ft/ft									
Velocity[5], ft/sec									
T_t[3], hr									0.0000
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft					235				
Slope, ft/ft					0.119				
Velocity[8], ft/sec					7.244				
T_t, hr					0.009				0.0090
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.227
Min	**13.60**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.5 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.80								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.07								
T_t^1, hr	0.404								0.4036
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
$Velocity^2$, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
$Velocity^2$, ft/sec									
T_t^3, hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
$Velocity^4$, ft/sec									
T_t^3, hr									0.0000
Woodland									
Length, ft		540			190				
Slope, ft/ft		0.085			0.063				
$Velocity^5$, ft/sec		1.4577			1.2550				
T_t^3, hr		0.103			0.042				0.1450
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
$Velocity^6$, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft			200	430		100			
Slope, ft/ft			0.035	0.102		0.11			
$Velocity^7$, ft/sec			2.806	4.791		4.975			
T_t, hr			0.020	0.025		0.006			0.0503
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
$Velocity^8$, ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
$Velocity^8$, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
$Velocity^{11}$, ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.599
Min	**35.93**

PROJECT:	Eolian Renewable Energy LLC	Calculated By:	PMM
	Antrim Wind Project	Checked By:	
Proj. No.:	186317.0000.0000	Date:	March 27, 2015
Subcatchment:	1.6 - Post-development	Revised:	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.17								
T_t^1, hr	0.283								0.2830
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity^4, ft/sec									
T_t^3, hr									0.0000
Woodland									
Length, ft		1760							
Slope, ft/ft		0.262							
Velocity^5, ft/sec		2.5593							
T_t^3, hr		0.191							0.1910
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity^6, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity^7, ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft			225						
Slope, ft/ft			0.071						
Velocity^8, ft/sec			5.596						
T_t, hr			0.011						0.0112
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity^{11}, ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.485
Min	**29.11**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.7 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.025	0.24	0.8						
Length, ft	16	30	54						
P2 , in	2.8	2.8	2.8						
Slope, ft/ft	0.02	0.5	0.185						
T_t[1], hr	0.010	0.027	0.167						0.2035
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity[4], ft/sec									
T_t[3], hr									0.0000
Woodland									
Length, ft				645					
Slope, ft/ft				0.186					
Velocity[5], ft/sec				2.1564					
T_t[3], hr				0.083					0.0831
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.287
Min	**17.20**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.8 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.23								
T_t[1], hr	0.251								0.2508
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity[4], ft/sec									
T_t[3], hr									0.0000
Woodland									
Length, ft		1240							
Slope, ft/ft		0.235							
Velocity[5], ft/sec		2.4238							
T_t[3], hr		0.142							0.1421
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.393
Min	**23.57**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.9 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.025	0.24	0.8						
Length, ft	16	15	69						
P2 , in	2.8	2.8	2.8						
Slope, ft/ft	0.02	0.5	0.29						
T_t[1], hr	0.010	0.015	0.170						0.1949
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity[4], ft/sec									
T_t[3], hr									0.0000
Woodland									
Length, ft				175	500				
Slope, ft/ft				0.468	0.236				
Velocity[5], ft/sec				3.4205	2.4290				
T_t[3], hr				0.014	0.057				0.0714
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft						460			
Slope, ft/ft						0.124			
Velocity[7], ft/sec						5.282			
T_t, hr						0.024			0.0242
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.290
Min	**17.43**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.10 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.24								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.02								
T_t^1, hr	0.254								0.2543
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
$Velocity^2$, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft			16						
Slope, ft/ft			0.02						
$Velocity^2$, ft/sec			2.282						
T_t^3, hr			0.002						0.0019
Short Grass Pasture									
Length, ft		100		9	30				
Slope, ft/ft		0.08		0.02	0.5				
$Velocity^4$, ft/sec		1.9799		0.9899	4.9497				
T_t^3, hr		0.014		0.003	0.002				0.0182
Woodland									
Length, ft						725			
Slope, ft/ft						0.207			
$Velocity^5$, ft/sec						2.2749			
T_t^3, hr						0.089			0.0885
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
$Velocity^6$, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
$Velocity^7$, ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
$Velocity^8$, ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
$Velocity^8$, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
$Velocity^{11}$, ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.363
Min	**21.78**

PROJECT:	Eolian Renewable Energy LLC	Calculated By:	PMM
	Antrim Wind Project	Checked By:	
Proj. No.:	186317.0000.0000	Date:	March 27, 2015
Subcatchment:	1.11 - Post-development	Revised:	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.025	0.24	0.8						
Length, ft	16	18	66						
P2 , in	2.8	2.8	2.8						
Slope, ft/ft	0.02	0.042	0.045						
T_t^1, hr	0.010	0.048	0.345						0.4030
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Short Grass Pasture									
Length, ft					50				
Slope, ft/ft					0.500				
Velocity^4, ft/sec					4.9497				
T_t^3, hr					0.003				0.0028
Woodland									
Length, ft				200					
Slope, ft/ft				0.195					
Velocity^5, ft/sec				2.2079					
T_t^3, hr				0.025					0.0252
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity^6, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft						490			
Slope, ft/ft						0.12			
Velocity^7, ft/sec						5.196			
T_t, hr						0.026			0.0262
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity^{11}, ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.457
Min	**27.43**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.12 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.05								
T_t^1, hr	0.462								0.4617
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
$Velocity^2$, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
$Velocity^2$, ft/sec									
T_t^3, hr									0.0000
Short Grass Pasture									
Length, ft			55						
Slope, ft/ft			0.5						
$Velocity^4$, ft/sec			4.9497						
T_t^3, hr			0.003						0.0031
Woodland									
Length, ft		100							
Slope, ft/ft		0.210							
$Velocity^5$, ft/sec		2.2913							
T_t^3, hr		0.012							0.0121
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
$Velocity^6$, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
$Velocity^7$, ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
$Velocity^8$, ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
$Velocity^8$, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
$Velocity^{11}$, ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.477
Min	**28.62**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**3.1 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.06								
T_t^1, hr	0.429								0.4293
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity^4, ft/sec									
T_t^3, hr									0.0000
Woodland									
Length, ft		590							
Slope, ft/ft		0.218							
Velocity^5, ft/sec		2.3345							
T_t^3, hr		0.070							0.0702
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity^6, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity^7, ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity^{11}, ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.499
Min	**29.97**

PROJECT:	Eolian Renewable Energy LLC	Calculated By:	PMM
	Antrim Wind Project	Checked By:	
Proj. No.:	186317.0000.0000	Date:	March 27, 2015
Subcatchment:	1.13 - Post-development	Revised:	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.045								
T_t^1, hr	0.482								0.4816
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity^4, ft/sec									
T_t^3, hr									0.0000
Woodland									
Length, ft		175							
Slope, ft/ft		0.068							
Velocity^5, ft/sec		1.3038							
T_t^3, hr		0.037							0.0373
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity^6, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity^7, ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity^{11}, ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.519
Min	**31.13**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.14 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.100								
T_t[1], hr	0.350								0.3499
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity[4], ft/sec									
T_t[3], hr									0.0000
Woodland									
Length, ft		120							
Slope, ft/ft		0.017							
Velocity[5], ft/sec		0.6519							
T_t[3], hr		0.051							0.0511
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.401
Min	**24.06**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.15 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.24								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.05								
T_t^1, hr	0.176								0.1762
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft			85						
Slope, ft/ft			0.024						
Velocity^2, ft/sec			2.500						
T_t^3, hr			0.009						0.0094
Short Grass Pasture									
Length, ft		95			80				
Slope, ft/ft		0.04			0.5				
Velocity^4, ft/sec		1.4000			4.9497				
T_t^3, hr		0.019			0.004				0.0233
Woodland									
Length, ft				145					
Slope, ft/ft				0.234					
Velocity^5, ft/sec				2.4187					
T_t^3, hr				0.017					0.0167
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity^6, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft						300			
Slope, ft/ft						0.12			
Velocity^7, ft/sec						5.196			
T_t, hr						0.016			0.0160
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity^{11}, ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.242
Min	**14.50**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.16 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.10								
T_t[1], hr	0.350								0.3499
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft			25						
Slope, ft/ft			0.5						
Velocity[4], ft/sec			4.9497						
T_t[3], hr			0.001						0.0014
Woodland									
Length, ft		130							
Slope, ft/ft		0.154							
Velocity[5], ft/sec		1.9621							
T_t[3], hr		0.018							0.0184
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft				300					
Slope, ft/ft				0.117					
Velocity[7], ft/sec				5.131					
T_t, hr				0.016					0.0162
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000
								HR	0.386
								Min	**23.16**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**1.17 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.13								
T_t[1], hr	0.315								0.3151
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft		25							
Slope, ft/ft		0.5							
Velocity[4], ft/sec		4.9497							
T_t[3], hr		0.001							0.0014
Woodland									
Length, ft									
Slope, ft/ft									
Velocity[5], ft/sec									
T_t[3], hr									0.0000
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.316
Min	**18.99**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	
Proj. No.:	**186317.0000.0000**	**Date:**	March 27, 2015
Subcatchment:	**3.2 - Post-development**	**Revised:**	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.8								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.08								
T_t[1], hr	0.383								0.383
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.000
Short Grass Pasture									
Length, ft			15						
Slope, ft/ft			0.5						
Velocity[4], ft/sec			4.9497						
T_t[3], hr			0.001						0.001
Woodland									
Length, ft		15							
Slope, ft/ft		0.133							
Velocity[5], ft/sec		1.8235							
T_t[3], hr		0.002							0.002
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.000

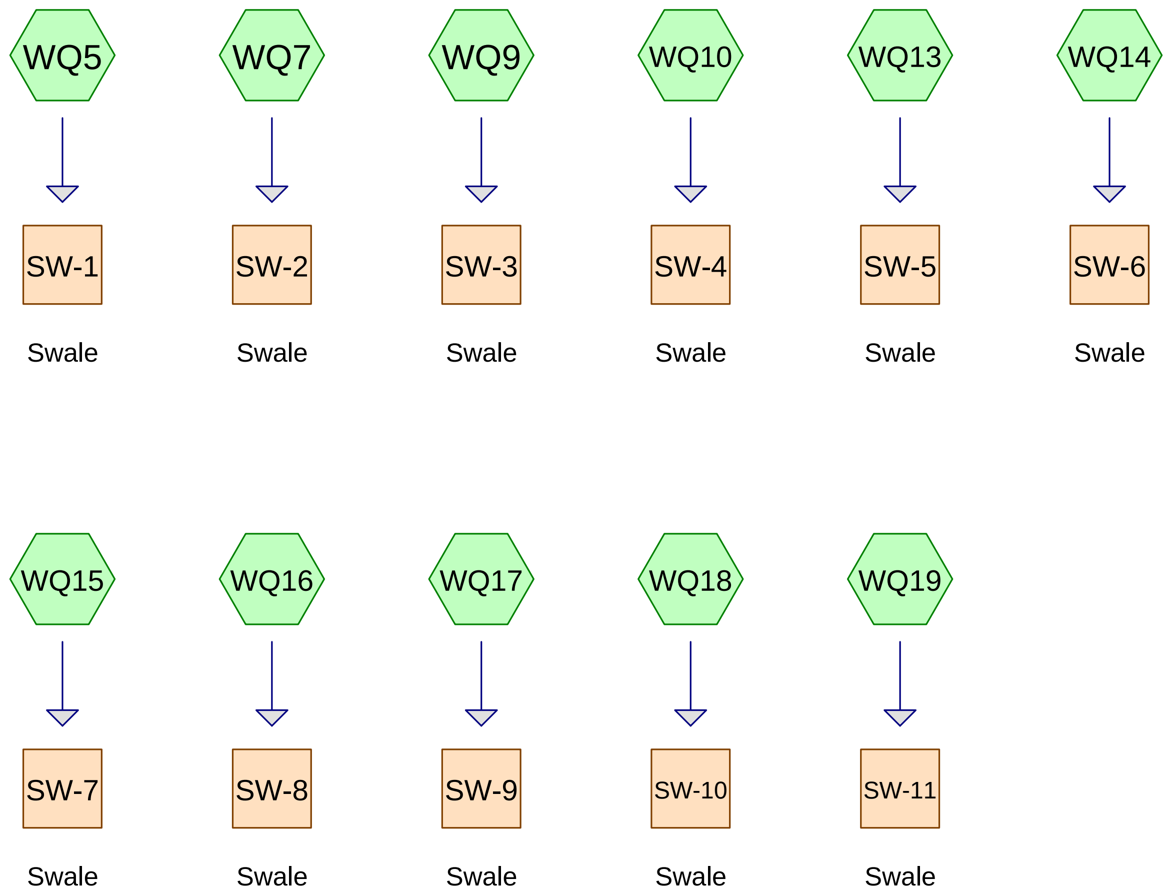
HR	0.386
Min	**23.14**

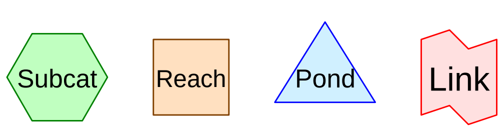
PROJECT:	Eolian Renewable Energy LLC	Calculated By:	PMM
	Antrim Wind Project	Checked By:	
Proj. No.:	186317.0000.0000	Date:	March 27, 2015
Subcatchment:	3.3 - Post-development	Revised:	

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.025								
Length, ft	60								
P2 , in	2.8								
Slope, ft/ft	0.033								
T_t^1, hr	0.023								0.023
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.000
Short Grass Pasture									
Length, ft		130	85						
Slope, ft/ft		0.029	0.353						
Velocity^4, ft/sec		1.1921	4.1590						
T_t^3, hr		0.030	0.006						0.036
Woodland									
Length, ft									
Slope, ft/ft									
Velocity^5, ft/sec									
T_t^3, hr									0.000
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft				400					
Slope, ft/ft				0.03					
Velocity^6, ft/sec				2.078					
T_t^3, hr				0.053					0.053
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity^7, ft/sec									
T_t, hr									0.000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity^{11}, ft/sec									
Length, L, ft									
T_t, hr									0.000

HR	0.112
Min	**6.72**





Routing Diagram for WQ Swales - 10yr
Prepared by TRC, Printed 4/7/2015
HydroCAD® 10.00-12 s/n 08043 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment WQ10:

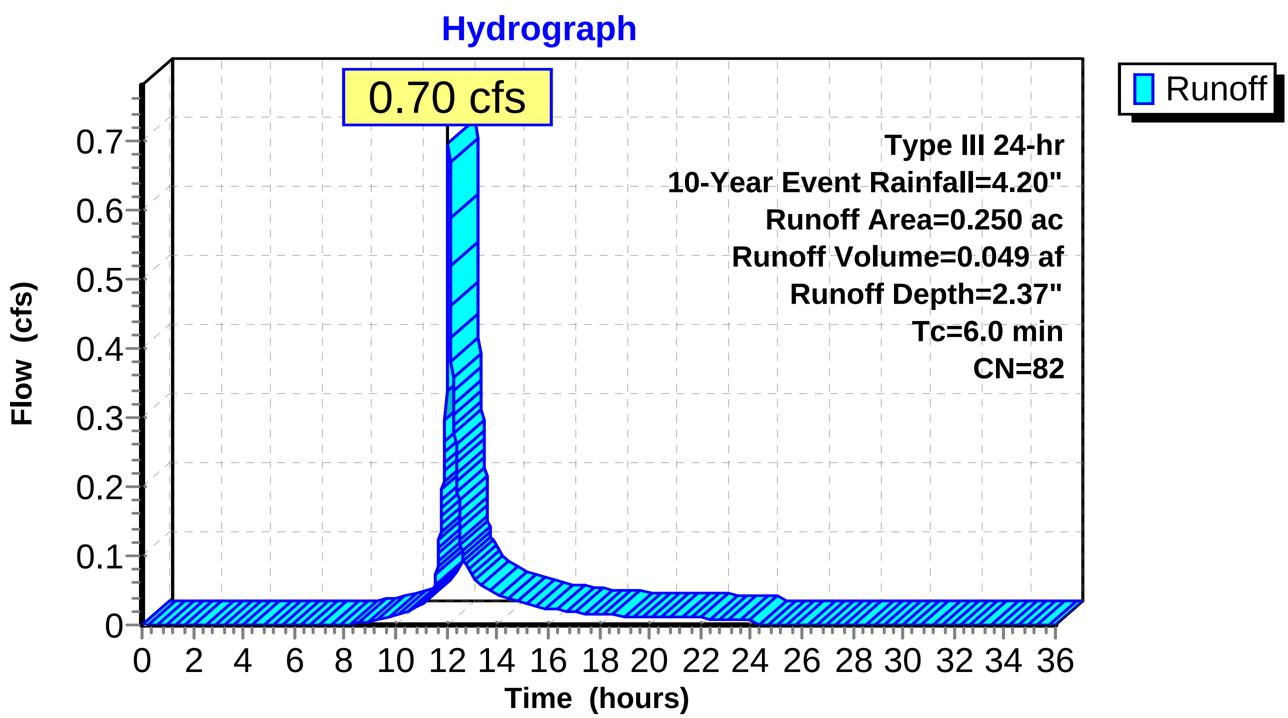
Runoff = 0.70 cfs @ 12.09 hrs, Volume= 0.049 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.086	91	Gravel roads, HSG D
0.164	78	Meadow, non-grazed, HSG D
0.250	82	Weighted Average
0.250		100.00% Pervious Area

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

Subcatchment WQ10:



Summary for Subcatchment WQ13:

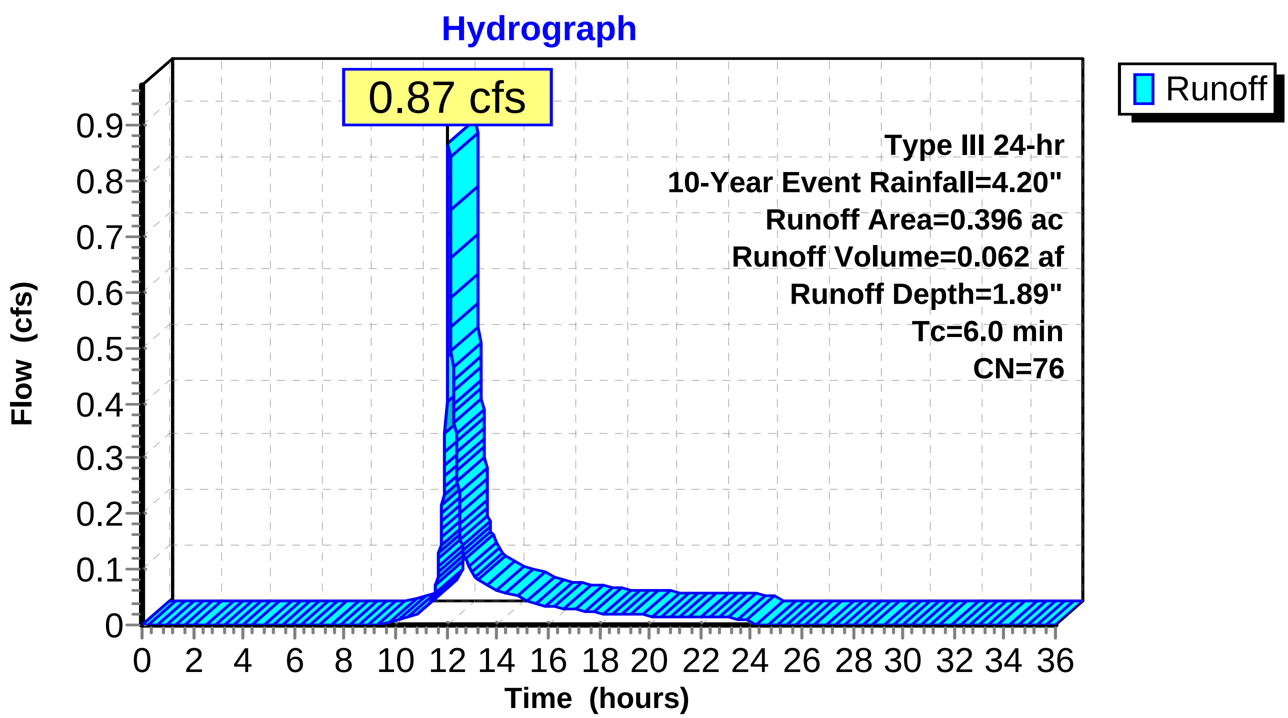
Runoff = 0.87 cfs @ 12.09 hrs, Volume= 0.062 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.119	89	Gravel roads, HSG C
0.277	71	Meadow, non-grazed, HSG C
0.396	76	Weighted Average
0.396		100.00% Pervious Area

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

Subcatchment WQ13:



Worksheet for WQ 13

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.067	
Channel Slope	0.06700	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.87	ft³/s

Results

Normal Depth	0.21	ft
Flow Area	0.49	ft²
Wetted Perimeter	2.92	ft
Hydraulic Radius	0.17	ft
Top Width	2.82	ft
Critical Depth	0.17	ft
Critical Slope	0.12853	ft/ft
Velocity	1.76	ft/s
Velocity Head	0.05	ft
Specific Energy	0.25	ft
Froude Number	0.74	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.17	ft
Channel Slope	0.06700	ft/ft
Critical Slope	0.12853	ft/ft

Summary for Subcatchment WQ14:

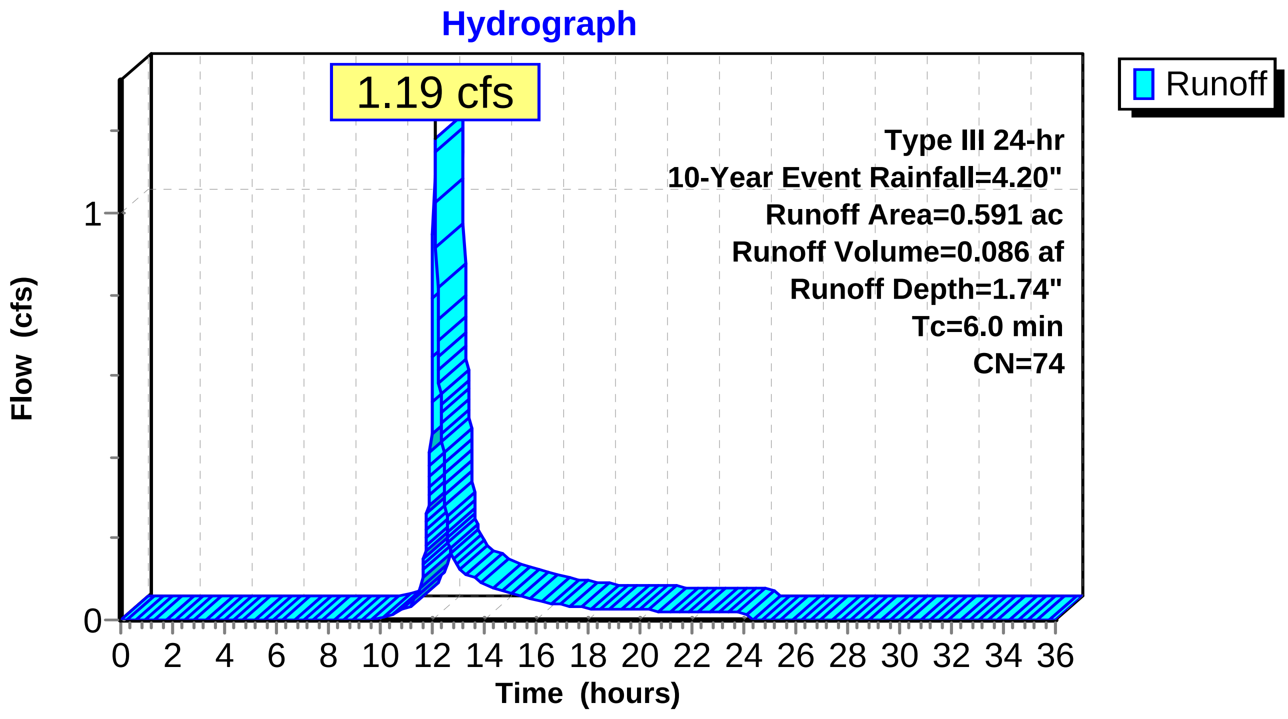
Runoff = 1.19 cfs @ 12.09 hrs, Volume= 0.086 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.092	89	Gravel roads, HSG C
0.499	71	Meadow, non-grazed, HSG C
0.591	74	Weighted Average
0.591		100.00% Pervious Area

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

Subcatchment WQ14:



Summary for Subcatchment WQ15:

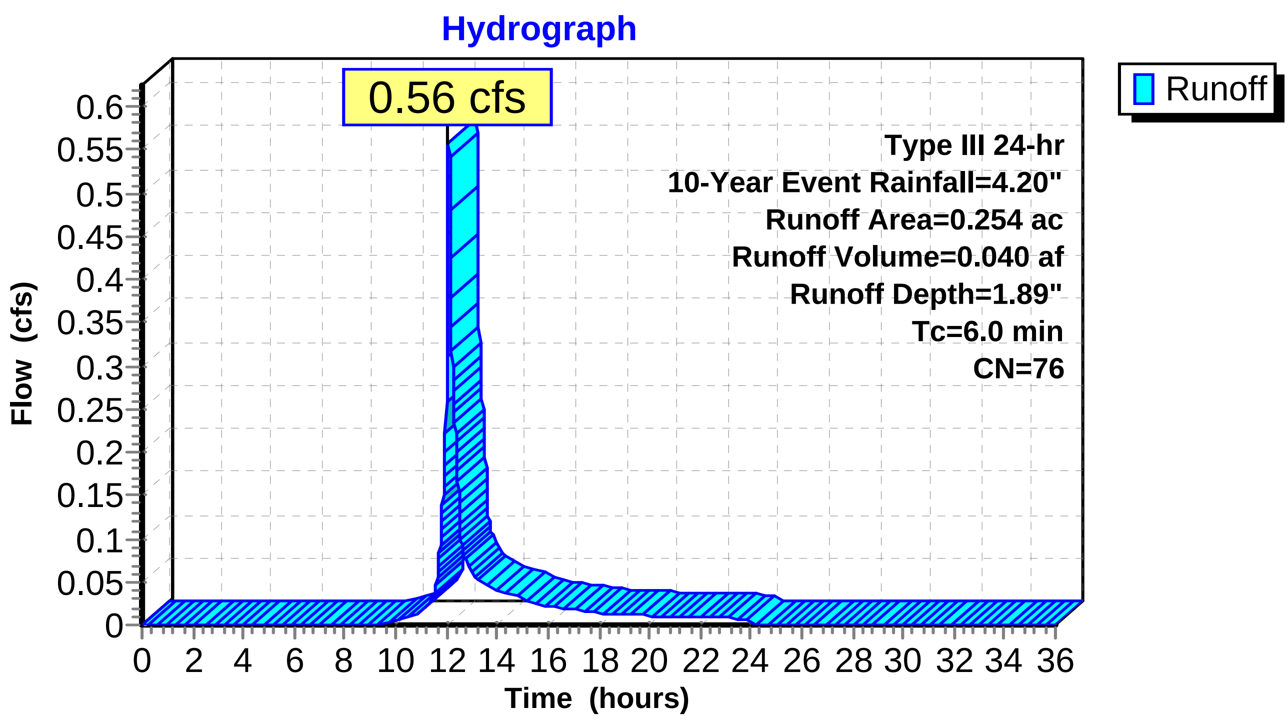
Runoff = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.064	89	Gravel roads, HSG C
0.190	71	Meadow, non-grazed, HSG C
0.254	76	Weighted Average
0.254		100.00% Pervious Area

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

Subcatchment WQ15:



Summary for Subcatchment WQ16:

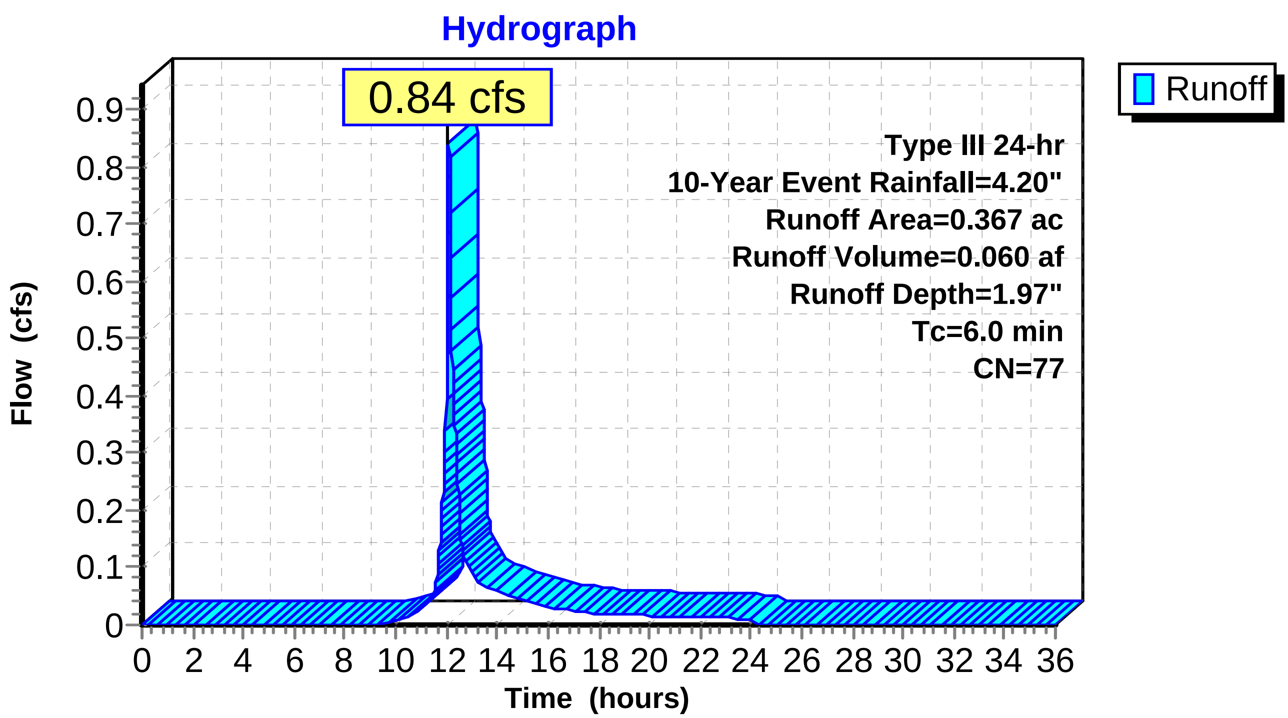
Runoff = 0.84 cfs @ 12.09 hrs, Volume= 0.060 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.119	89	Gravel roads, HSG C
0.248	71	Meadow, non-grazed, HSG C
0.367	77	Weighted Average
0.367		100.00% Pervious Area

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

Subcatchment WQ16:



Worksheet for WQ16

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.074	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.84	ft^3/s

Results

Normal Depth	0.18	ft
Flow Area	0.42	ft^2
Wetted Perimeter	2.80	ft
Hydraulic Radius	0.15	ft
Top Width	2.72	ft
Critical Depth	0.17	ft
Critical Slope	0.15761	ft/ft
Velocity	1.98	ft/s
Velocity Head	0.06	ft
Specific Energy	0.24	ft
Froude Number	0.88	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.18	ft
Critical Depth	0.17	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.15761	ft/ft

Summary for Subcatchment WQ17:

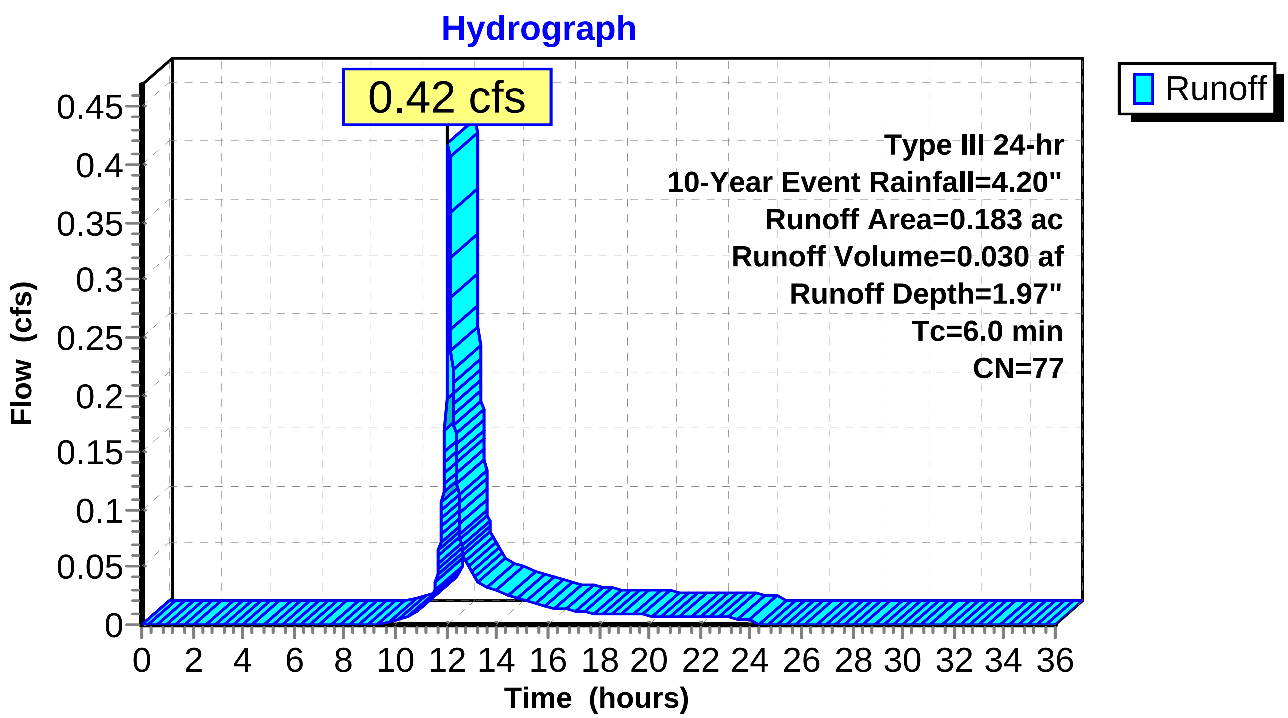
Runoff = 0.42 cfs @ 12.09 hrs, Volume= 0.030 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.064	89	Gravel roads, HSG C
0.119	71	Meadow, non-grazed, HSG C
0.183	77	Weighted Average
0.183		100.00% Pervious Area

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

Subcatchment WQ17:



Worksheet for WQ17

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.091	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.42	ft³/s

Results

Normal Depth	0.14	ft
Flow Area	0.31	ft²
Wetted Perimeter	2.61	ft
Hydraulic Radius	0.12	ft
Top Width	2.54	ft
Critical Depth	0.11	ft
Critical Slope	0.26925	ft/ft
Velocity	1.36	ft/s
Velocity Head	0.03	ft
Specific Energy	0.16	ft
Froude Number	0.69	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.14	ft
Critical Depth	0.11	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.26925	ft/ft

Summary for Subcatchment WQ18:

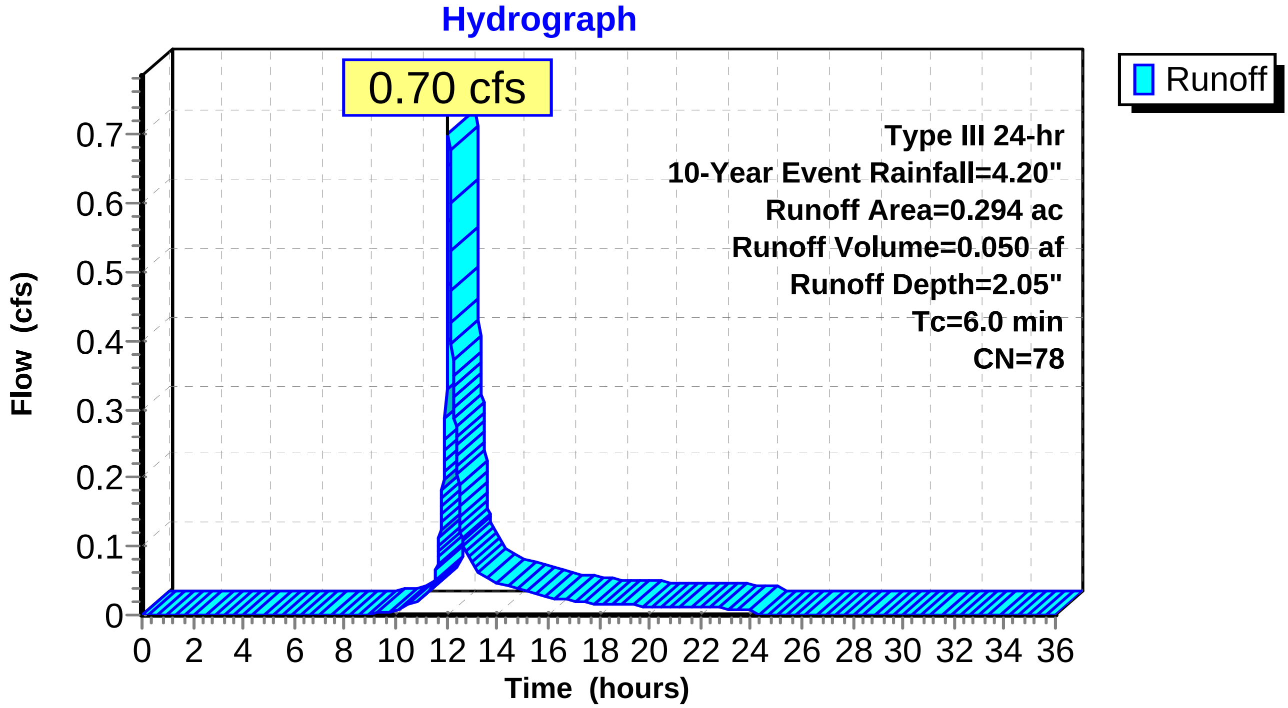
Runoff = 0.70 cfs @ 12.09 hrs, Volume= 0.050 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.110	89	Gravel roads, HSG C
0.184	71	Meadow, non-grazed, HSG C
0.294	78	Weighted Average
0.294		100.00% Pervious Area

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

Subcatchment WQ18:



Worksheet for WQ18

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.077	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.70	ft³/s

Results

Normal Depth	0.17	ft
Flow Area	0.39	ft²
Wetted Perimeter	2.74	ft
Hydraulic Radius	0.14	ft
Top Width	2.66	ft
Critical Depth	0.15	ft
Critical Slope	0.17608	ft/ft
Velocity	1.81	ft/s
Velocity Head	0.05	ft
Specific Energy	0.22	ft
Froude Number	0.84	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.17	ft
Critical Depth	0.15	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.17608	ft/ft

Summary for Subcatchment WQ19:

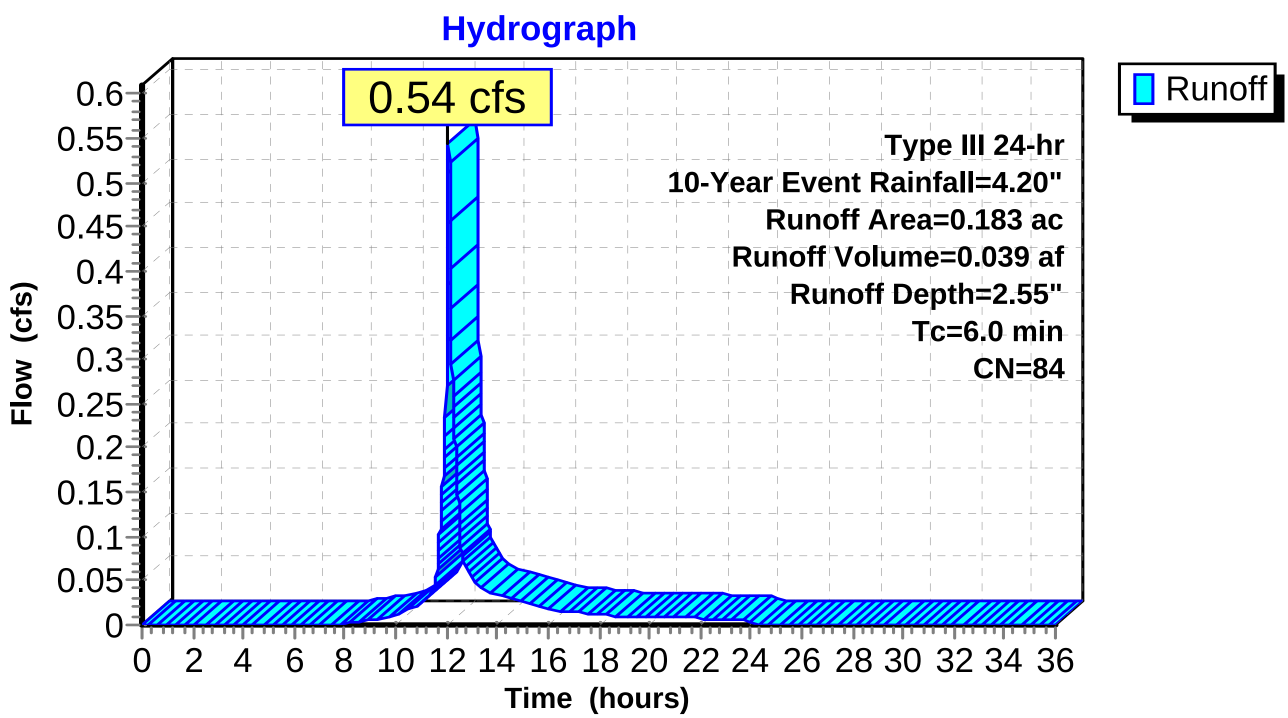
Runoff = 0.54 cfs @ 12.09 hrs, Volume= 0.039 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.133	89	Gravel roads, HSG C
0.050	71	Meadow, non-grazed, HSG C
0.183	84	Weighted Average
0.183		100.00% Pervious Area

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

Subcatchment WQ19:



Worksheet for WQ 19

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.067	
Channel Slope	0.06500	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.54	ft³/s

Results

Normal Depth	0.16	ft
Flow Area	0.36	ft²
Wetted Perimeter	2.70	ft
Hydraulic Radius	0.13	ft
Top Width	2.63	ft
Critical Depth	0.13	ft
Critical Slope	0.13952	ft/ft
Velocity	1.48	ft/s
Velocity Head	0.03	ft
Specific Energy	0.19	ft
Froude Number	0.70	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.16	ft
Critical Depth	0.13	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.13952	ft/ft

Summary for Subcatchment WQ5:

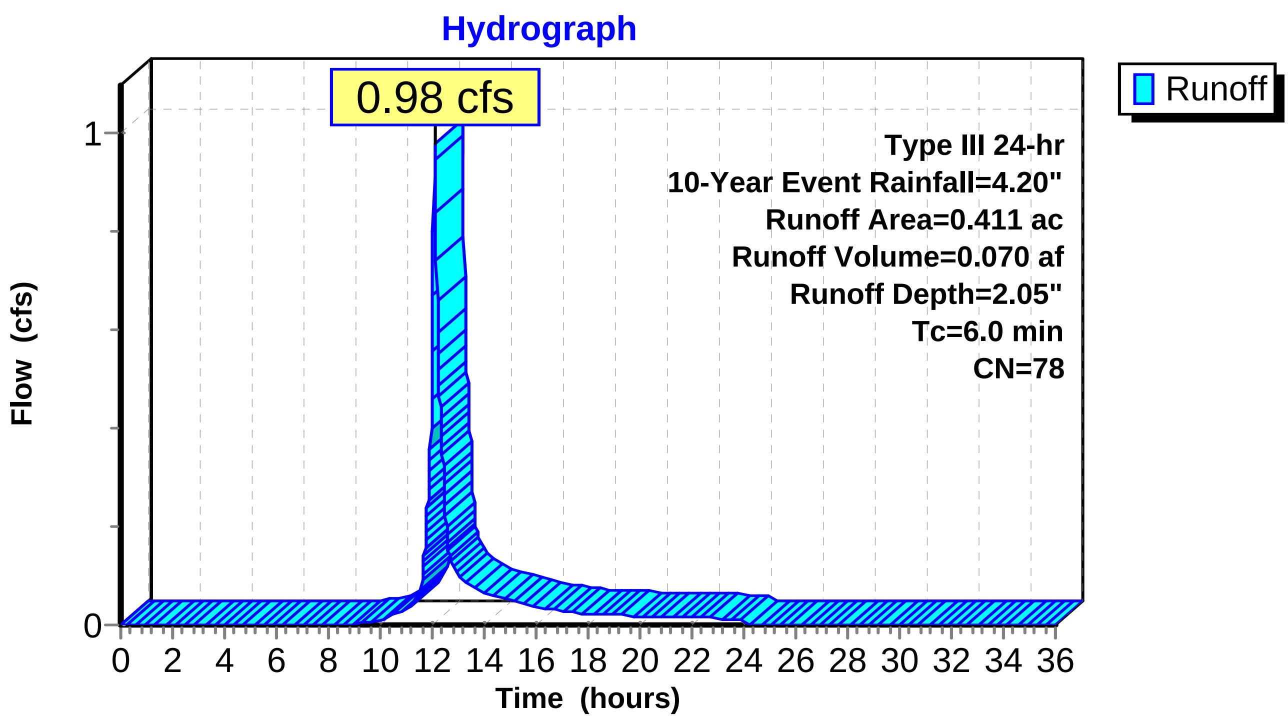
Runoff = 0.98 cfs @ 12.09 hrs, Volume= 0.070 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.156	89	Gravel roads, HSG C
0.255	71	Meadow, non-grazed, HSG C
0.411	78	Weighted Average
0.411		100.00% Pervious Area

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

Subcatchment WQ5:



Worksheet for WQ5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.071	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.98	ft^3/s

Results

Normal Depth	0.19	ft
Flow Area	0.46	ft^2
Wetted Perimeter	2.86	ft
Hydraulic Radius	0.16	ft
Top Width	2.77	ft
Critical Depth	0.18	ft
Critical Slope	0.14141	ft/ft
Velocity	2.14	ft/s
Velocity Head	0.07	ft
Specific Energy	0.26	ft
Froude Number	0.93	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.19	ft
Critical Depth	0.18	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.14141	ft/ft

Summary for Subcatchment WQ7:

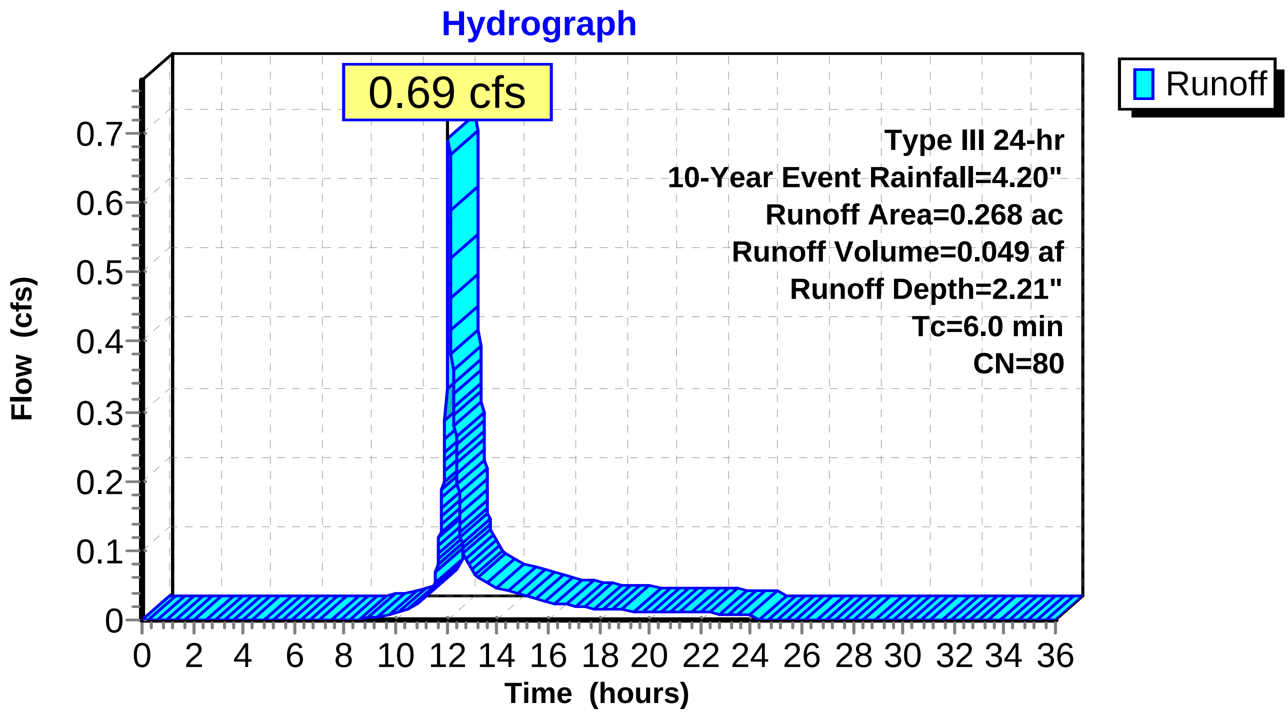
Runoff = 0.69 cfs @ 12.09 hrs, Volume= 0.049 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.130	89	Gravel roads, HSG C
0.138	71	Meadow, non-grazed, HSG C
0.268	80	Weighted Average
0.268		100.00% Pervious Area

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

Subcatchment WQ7:



Worksheet for WQ7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.078	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.69	ft³/s

Results

Normal Depth	0.17	ft
Flow Area	0.39	ft²
Wetted Perimeter	2.74	ft
Hydraulic Radius	0.14	ft
Top Width	2.66	ft
Critical Depth	0.15	ft
Critical Slope	0.18111	ft/ft
Velocity	1.79	ft/s
Velocity Head	0.05	ft
Specific Energy	0.22	ft
Froude Number	0.83	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.17	ft
Critical Depth	0.15	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.18111	ft/ft

Summary for Subcatchment WQ9:

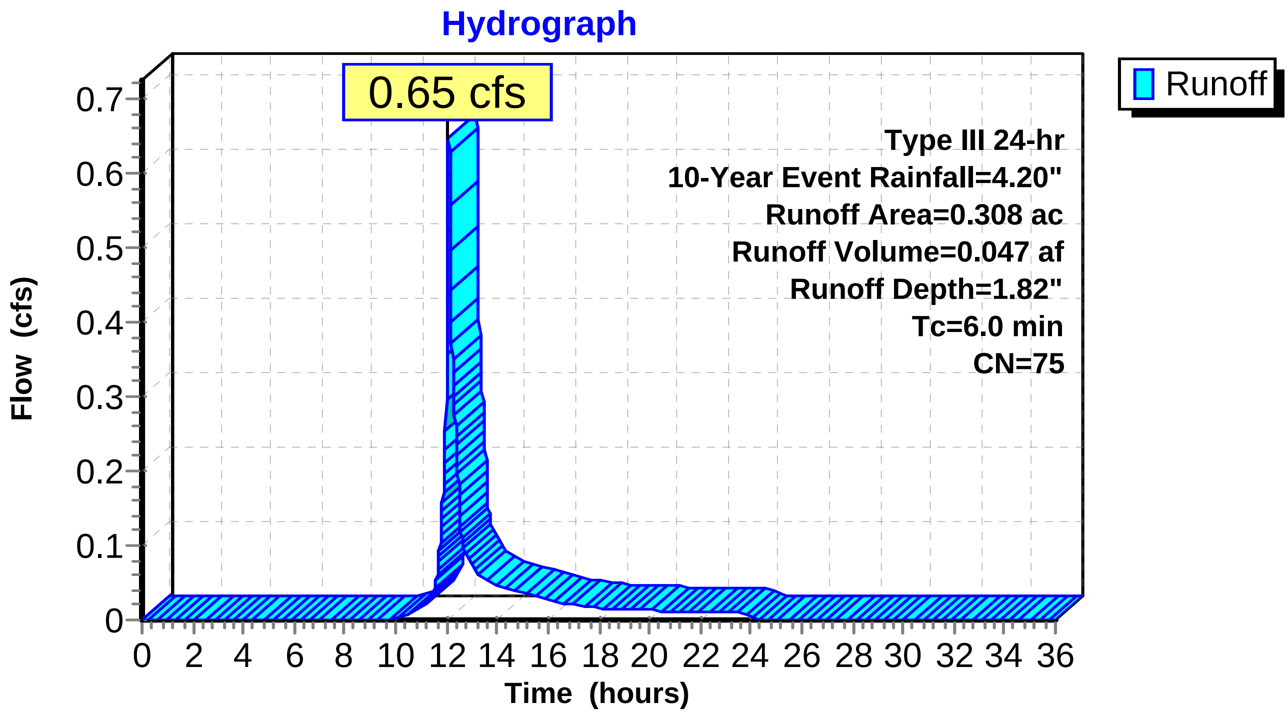
Runoff = 0.65 cfs @ 12.09 hrs, Volume= 0.047 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.073	89	Gravel roads, HSG C
0.235	71	Meadow, non-grazed, HSG C
0.308	75	Weighted Average
0.308		100.00% Pervious Area

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

Subcatchment WQ9:



Worksheet for WQ9

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.081	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.65	ft^3/s

Results

Normal Depth	0.16	ft
Flow Area	0.38	ft^2
Wetted Perimeter	2.73	ft
Hydraulic Radius	0.14	ft
Top Width	2.65	ft
Critical Depth	0.14	ft
Critical Slope	0.19736	ft/ft
Velocity	1.71	ft/s
Velocity Head	0.05	ft
Specific Energy	0.21	ft
Froude Number	0.80	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.16	ft
Critical Depth	0.14	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.19736	ft/ft

Summary for Reach SW-1: Swale

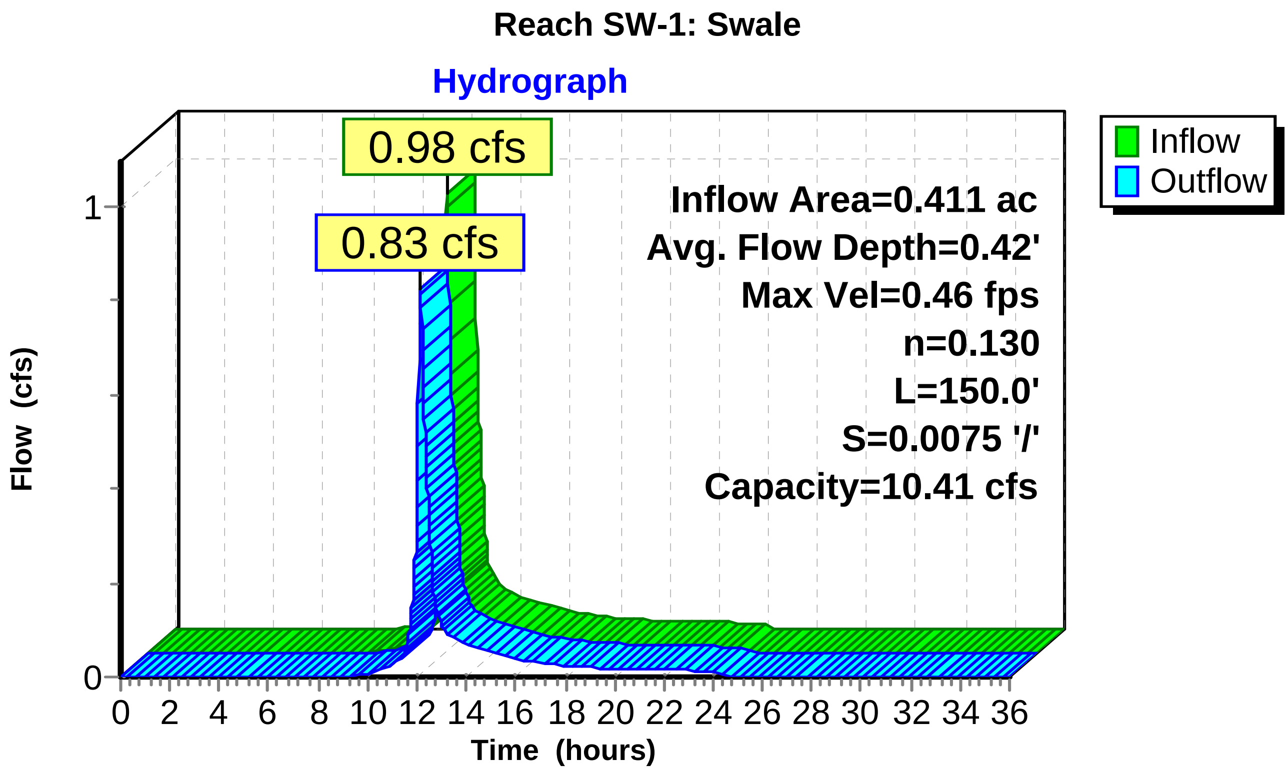
Inflow Area = 0.411 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10-Year Event event
Inflow = 0.98 cfs @ 12.09 hrs, Volume= 0.070 af
Outflow = 0.83 cfs @ 12.14 hrs, Volume= 0.070 af, Atten= 16%, Lag= 3.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.46 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.13 fps, Avg. Travel Time= 18.7 min

Peak Storage= 269 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 10.41 cfs

3.00' x 1.50' deep channel, n= 0.130
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 150.0' Slope= 0.0075 '/'
Inlet Invert= 1,206.50', Outlet Invert= 1,205.37'

‡



Summary for Reach SW-10: Swale

Inflow Area = 0.294 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10-Year Event event
Inflow = 0.70 cfs @ 12.09 hrs, Volume= 0.050 af
Outflow = 0.59 cfs @ 12.15 hrs, Volume= 0.050 af, Atten= 17%, Lag= 3.3 min

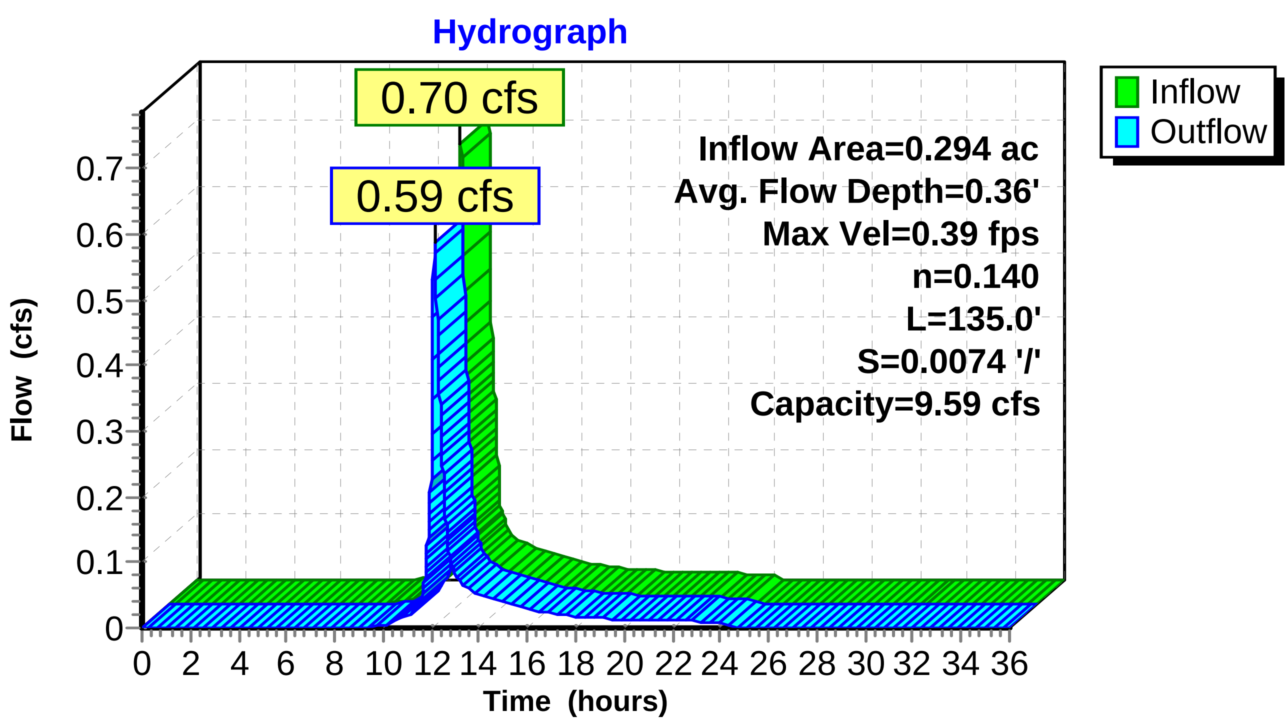
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.39 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 19.7 min

Peak Storage= 202 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.59 cfs

3.00' x 1.50' deep channel, n= 0.140
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 135.0' Slope= 0.0074 '/'
Inlet Invert= 1,571.00', Outlet Invert= 1,570.00'

‡

Reach SW-10: Swale



Summary for Reach SW-11: Swale

Inflow Area = 0.183 ac, 0.00% Impervious, Inflow Depth = 2.55" for 10-Year Event event
Inflow = 0.54 cfs @ 12.09 hrs, Volume= 0.039 af
Outflow = 0.44 cfs @ 12.15 hrs, Volume= 0.039 af, Atten= 20%, Lag= 3.6 min

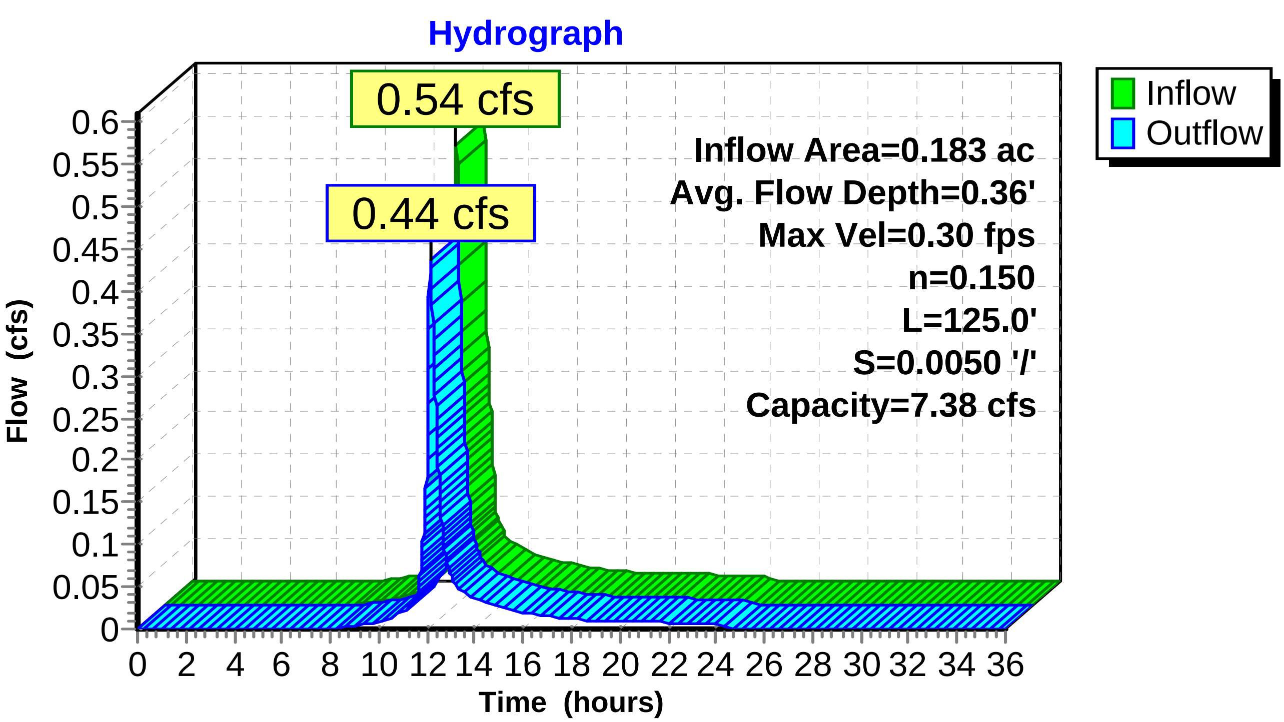
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.30 fps, Min. Travel Time= 7.0 min
Avg. Velocity = 0.08 fps, Avg. Travel Time= 25.0 min

Peak Storage= 182 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 7.38 cfs

3.00' x 1.50' deep channel, n= 0.150
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 125.0' Slope= 0.0050 '/'
Inlet Invert= 1,688.00', Outlet Invert= 1,687.37'

‡

Reach SW-11: Swale



Summary for Reach SW-2: Swale

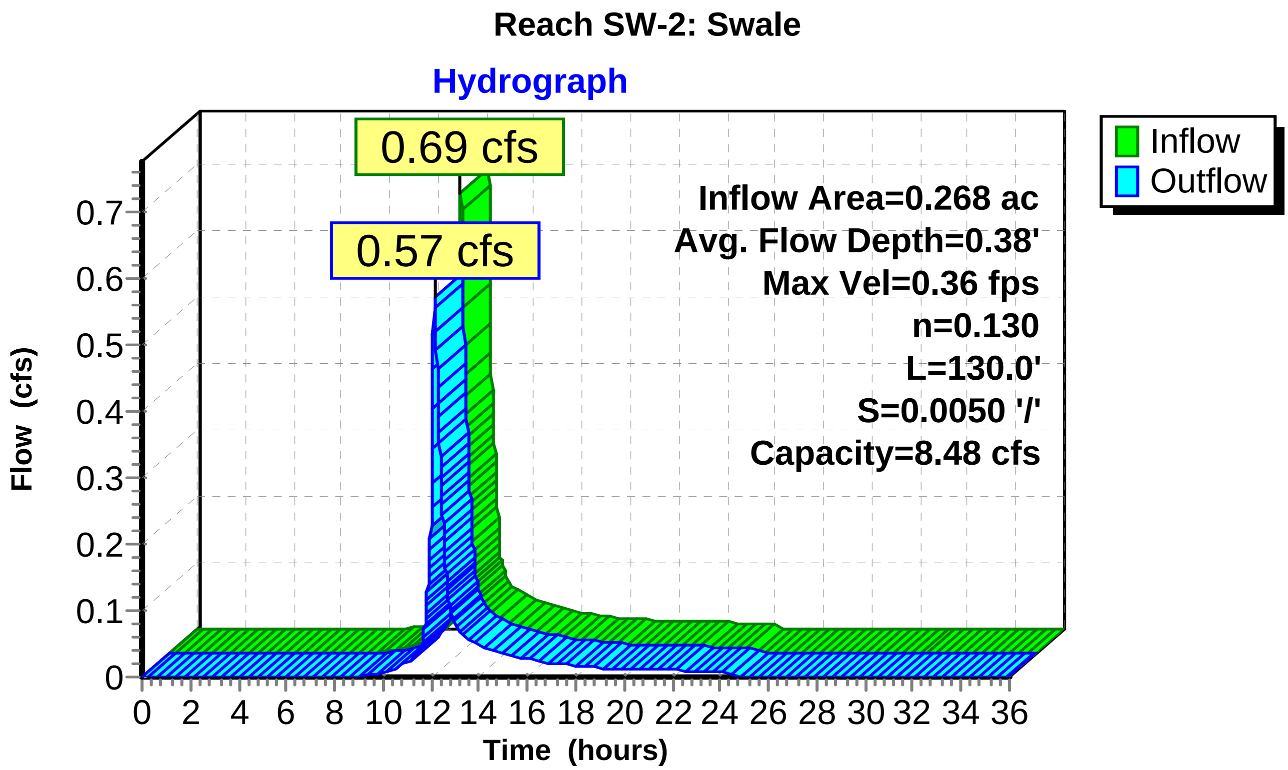
Inflow Area = 0.268 ac, 0.00% Impervious, Inflow Depth = 2.21" for 10-Year Event event
Inflow = 0.69 cfs @ 12.09 hrs, Volume= 0.049 af
Outflow = 0.57 cfs @ 12.15 hrs, Volume= 0.049 af, Atten= 18%, Lag= 3.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.36 fps, Min. Travel Time= 6.1 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 21.2 min

Peak Storage= 208 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 8.48 cfs

3.00' x 1.50' deep channel, n= 0.130
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 130.0' Slope= 0.0050 '/'
Inlet Invert= 1,354.00', Outlet Invert= 1,353.35'

‡



Summary for Reach SW-3: Swale

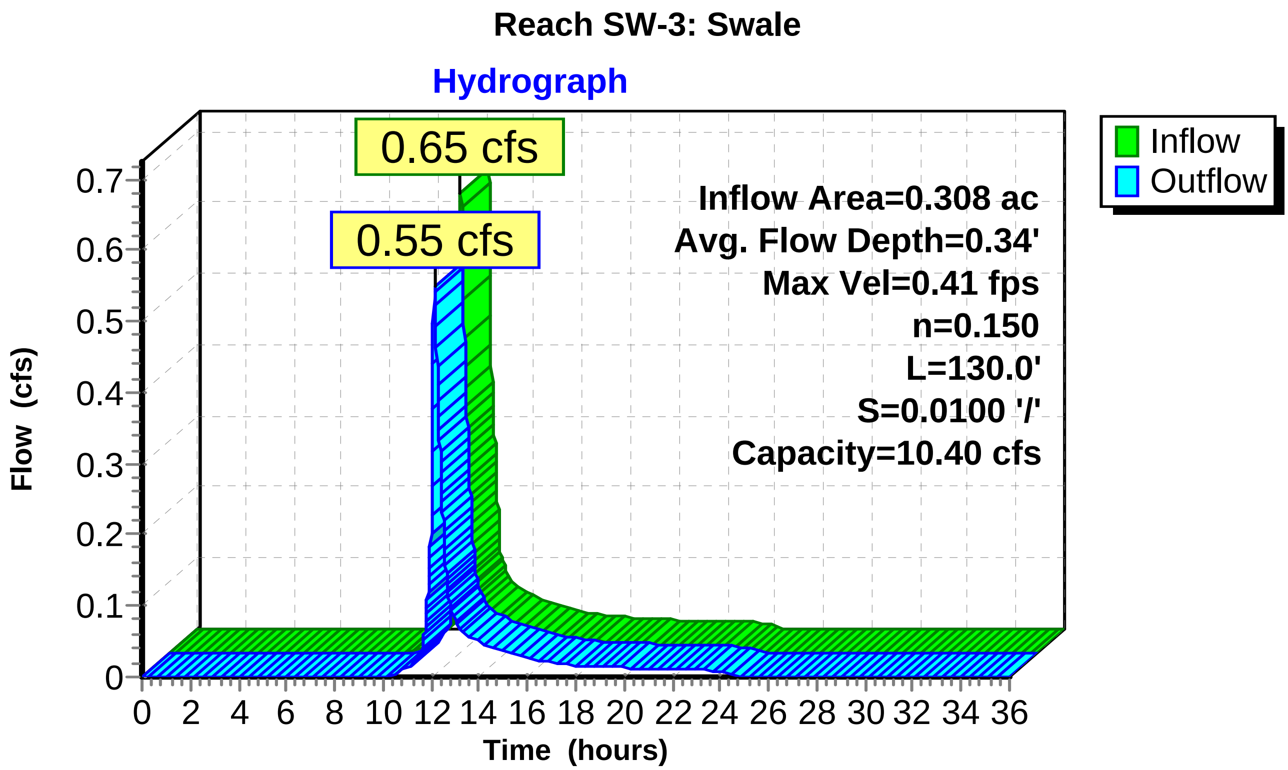
Inflow Area = 0.308 ac, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year Event event
Inflow = 0.65 cfs @ 12.09 hrs, Volume= 0.047 af
Outflow = 0.55 cfs @ 12.14 hrs, Volume= 0.047 af, Atten= 15%, Lag= 3.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.41 fps, Min. Travel Time= 5.3 min
Avg. Velocity = 0.12 fps, Avg. Travel Time= 17.9 min

Peak Storage= 175 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 10.40 cfs

3.00' x 1.50' deep channel, n= 0.150
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 130.0' Slope= 0.0100 '/'
Inlet Invert= 1,758.00', Outlet Invert= 1,756.70'

‡



Summary for Reach SW-4: Swale

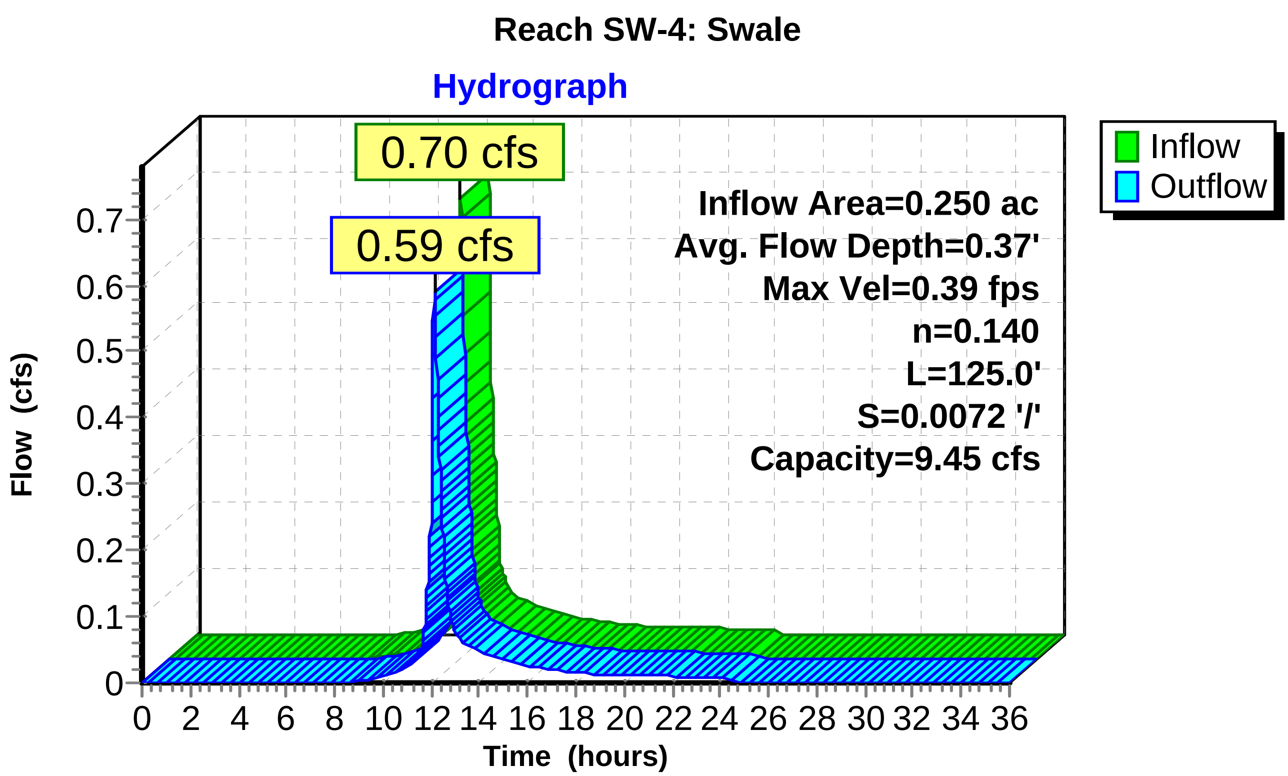
Inflow Area = 0.250 ac, 0.00% Impervious, Inflow Depth = 2.37" for 10-Year Event event
Inflow = 0.70 cfs @ 12.09 hrs, Volume= 0.049 af
Outflow = 0.59 cfs @ 12.14 hrs, Volume= 0.049 af, Atten= 15%, Lag= 3.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.39 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 18.8 min

Peak Storage= 189 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.45 cfs

3.00' x 1.50' deep channel, n= 0.140
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 125.0' Slope= 0.0072 '/'
Inlet Invert= 1,628.00', Outlet Invert= 1,627.10'

‡



Summary for Reach SW-5: Swale

Inflow Area = 0.396 ac, 0.00% Impervious, Inflow Depth = 1.89" for 10-Year Event event
Inflow = 0.87 cfs @ 12.09 hrs, Volume= 0.062 af
Outflow = 0.74 cfs @ 12.14 hrs, Volume= 0.062 af, Atten= 15%, Lag= 3.1 min

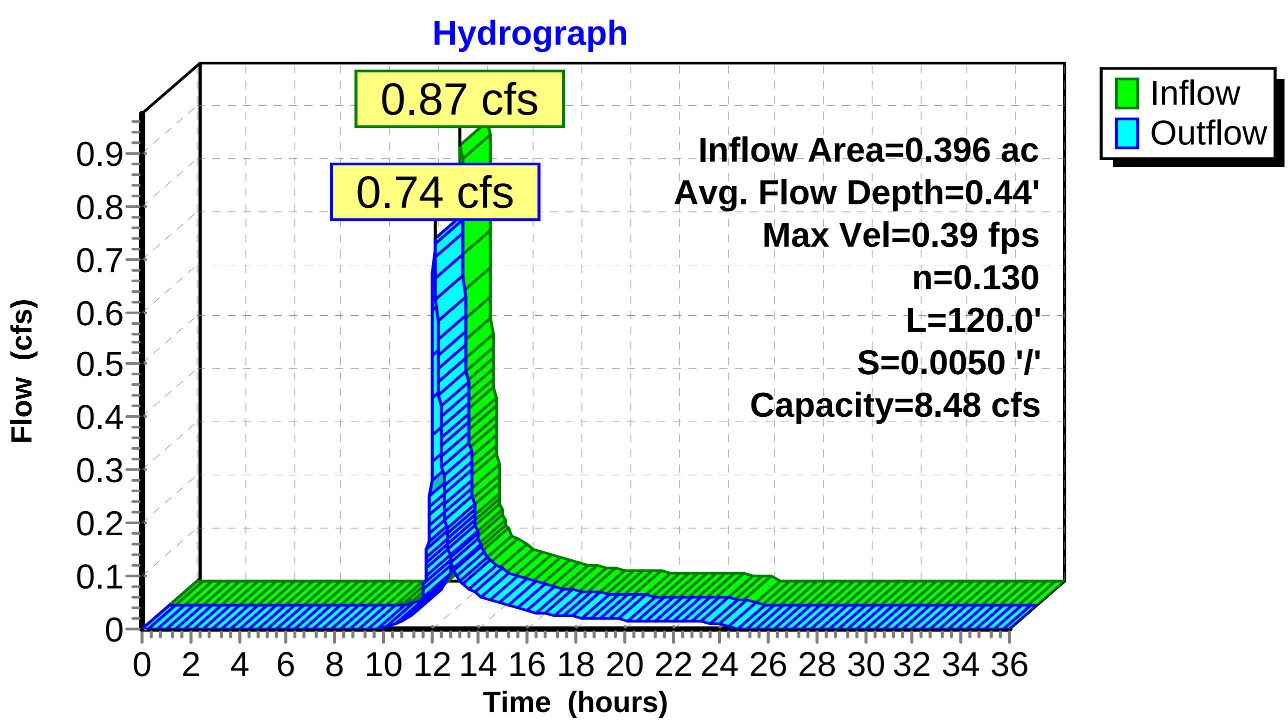
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.39 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 17.6 min

Peak Storage= 230 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 8.48 cfs

3.00' x 1.50' deep channel, n= 0.130
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 120.0' Slope= 0.0050 '/'
Inlet Invert= 1,682.50', Outlet Invert= 1,681.90'

‡

Reach SW-5: Swale



Summary for Reach SW-6: Swale

Inflow Area = 0.591 ac, 0.00% Impervious, Inflow Depth = 1.74" for 10-Year Event event
Inflow = 1.19 cfs @ 12.09 hrs, Volume= 0.086 af
Outflow = 1.05 cfs @ 12.14 hrs, Volume= 0.086 af, Atten= 12%, Lag= 2.7 min

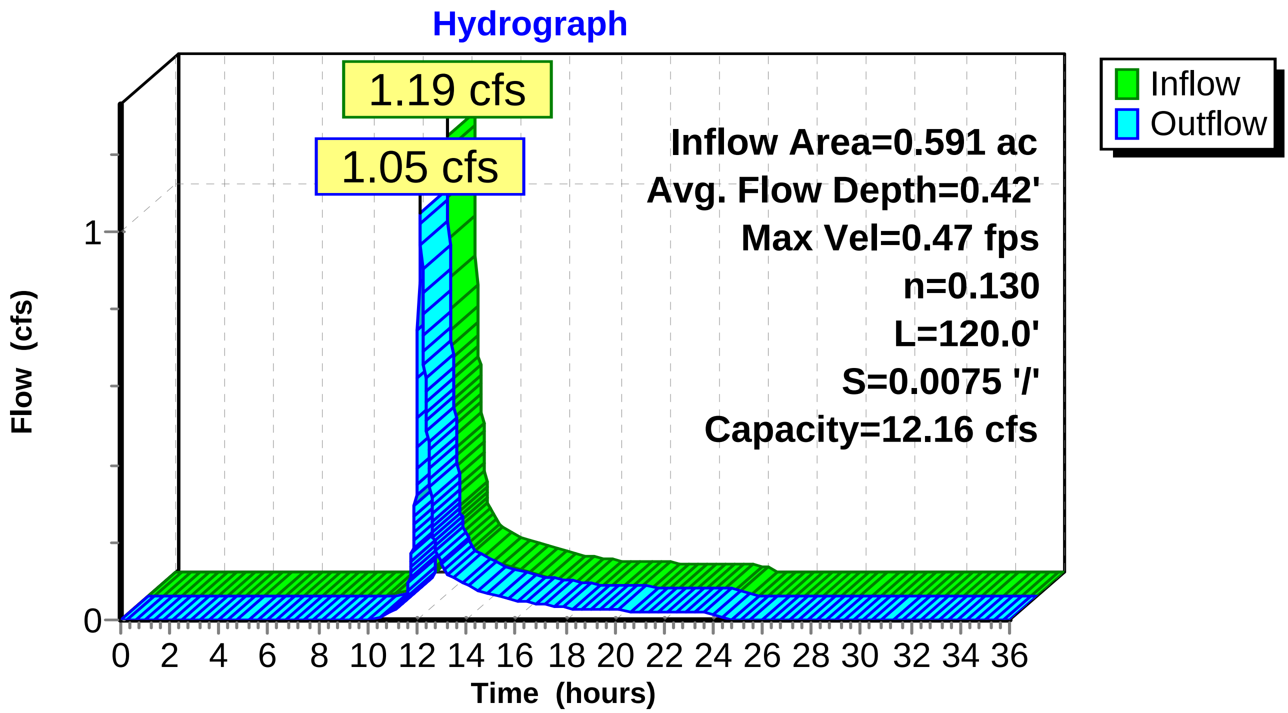
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.47 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 14.5 min

Peak Storage= 265 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 12.16 cfs

4.00' x 1.50' deep channel, n= 0.130
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 120.0' Slope= 0.0075 '/'
Inlet Invert= 1,579.50', Outlet Invert= 1,578.60'

‡

Reach SW-6: Swale



Summary for Reach SW-7: Swale

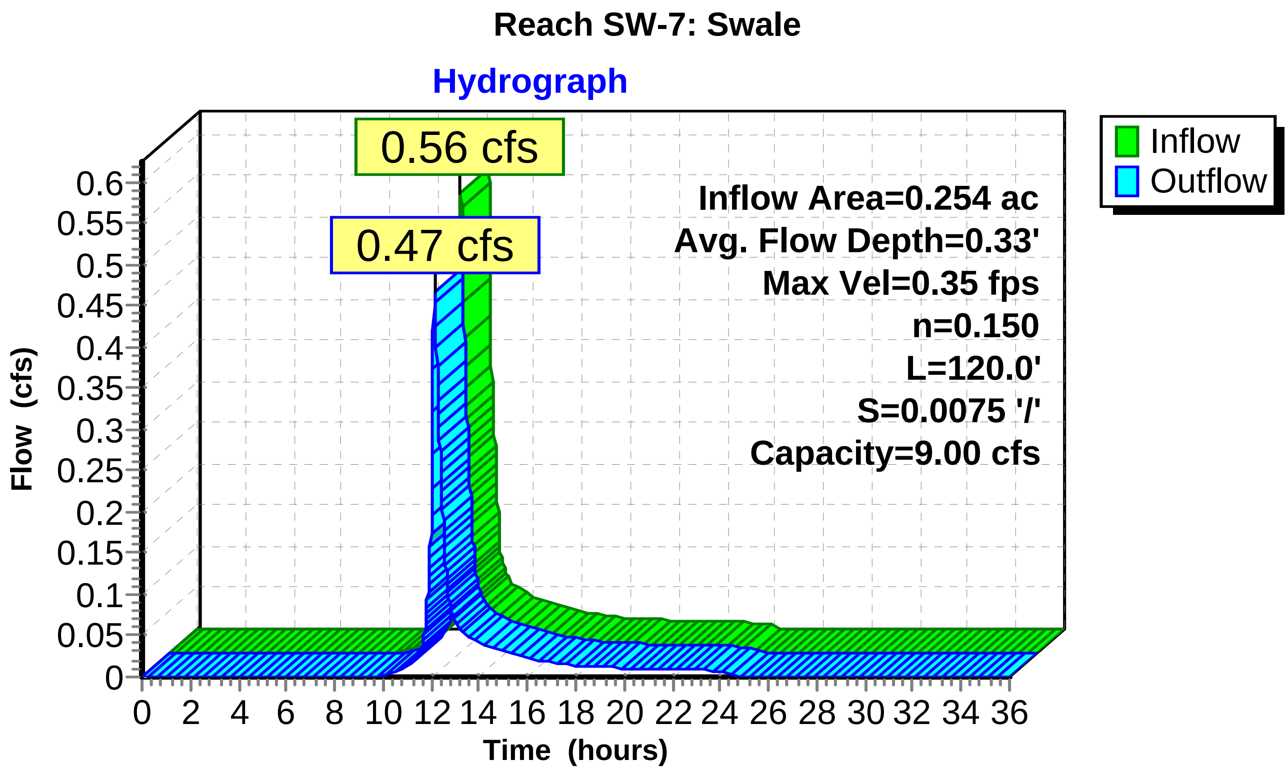
Inflow Area = 0.254 ac, 0.00% Impervious, Inflow Depth = 1.89" for 10-Year Event event
Inflow = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af
Outflow = 0.47 cfs @ 12.15 hrs, Volume= 0.040 af, Atten= 17%, Lag= 3.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.35 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 19.3 min

Peak Storage= 160 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.00 cfs

3.00' x 1.50' deep channel, n= 0.150
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 120.0' Slope= 0.0075 '/'
Inlet Invert= 1,503.00', Outlet Invert= 1,502.10'

‡



Summary for Reach SW-8: Swale

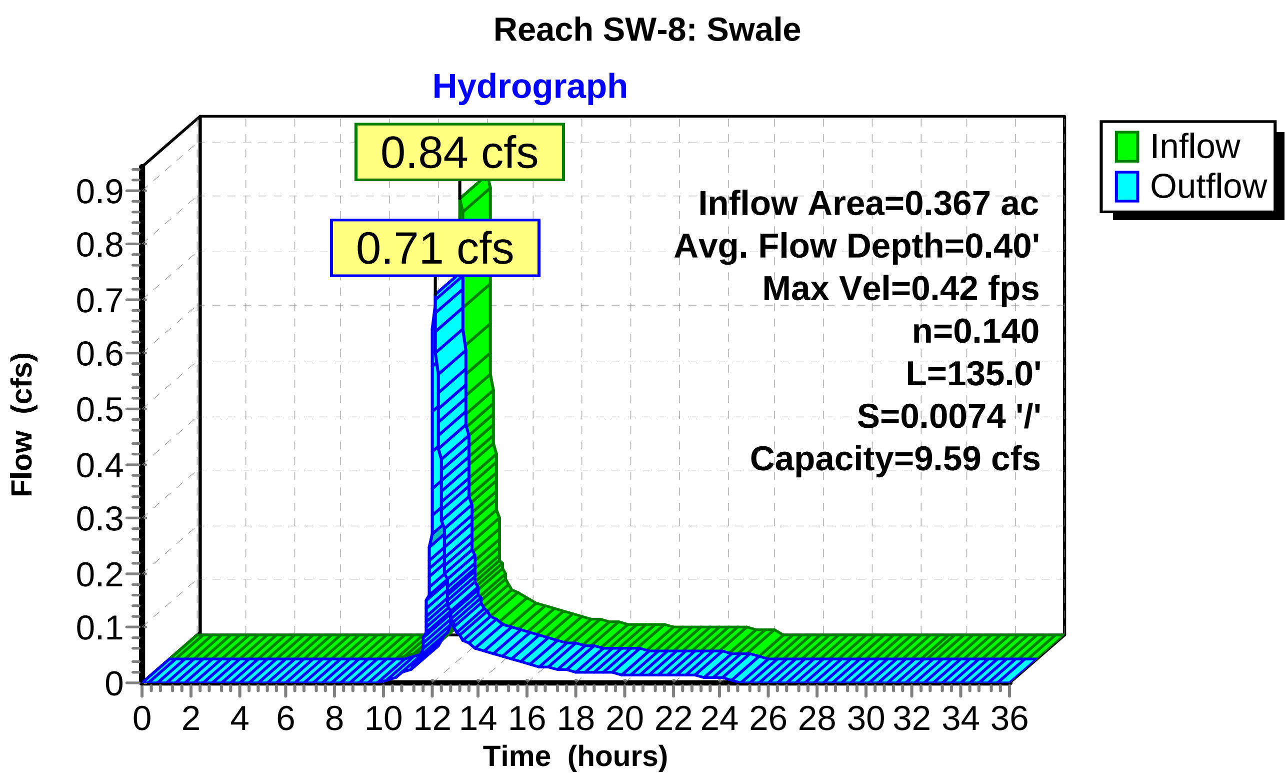
Inflow Area = 0.367 ac, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year Event event
Inflow = 0.84 cfs @ 12.09 hrs, Volume= 0.060 af
Outflow = 0.71 cfs @ 12.14 hrs, Volume= 0.060 af, Atten= 16%, Lag= 3.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.42 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.12 fps, Avg. Travel Time= 18.5 min

Peak Storage= 230 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.59 cfs

3.00' x 1.50' deep channel, n= 0.140
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 135.0' Slope= 0.0074 '/'
Inlet Invert= 1,471.00', Outlet Invert= 1,470.00'

‡



Summary for Reach SW-9: Swale

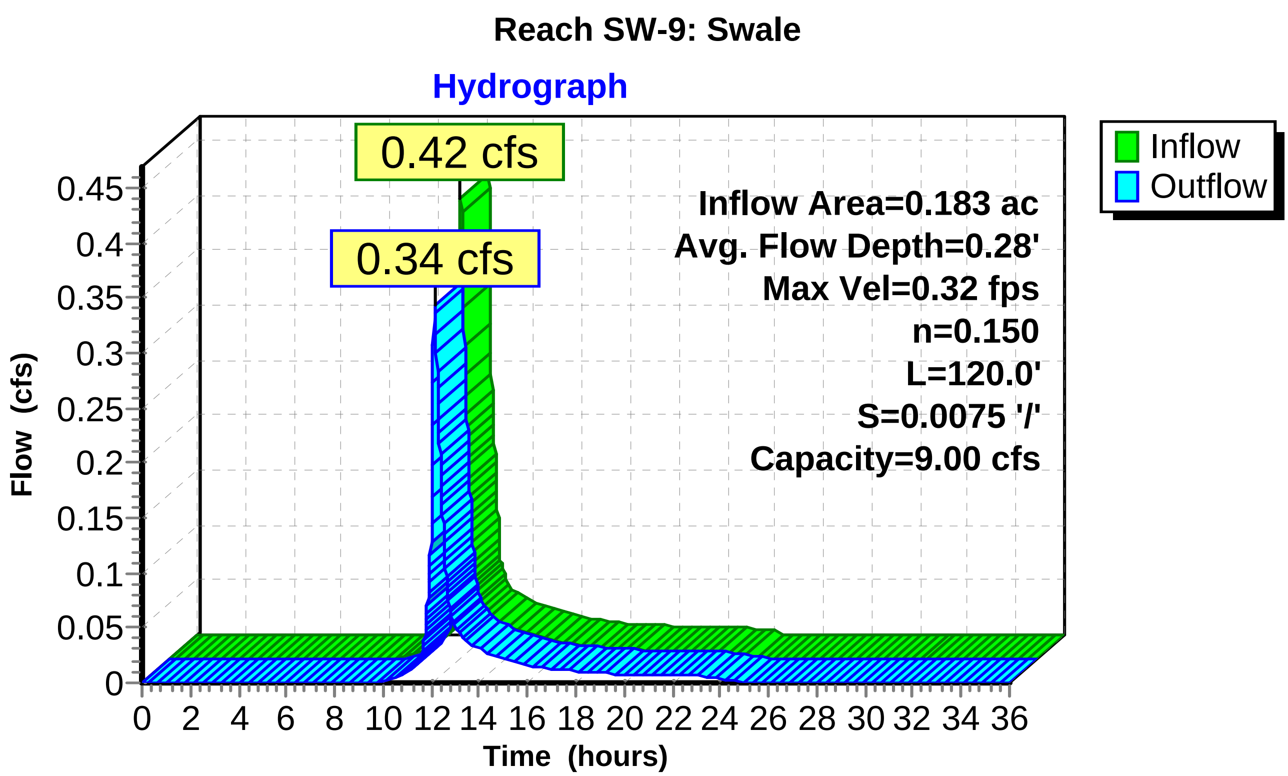
Inflow Area = 0.183 ac, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year Event event
Inflow = 0.42 cfs @ 12.09 hrs, Volume= 0.030 af
Outflow = 0.34 cfs @ 12.15 hrs, Volume= 0.030 af, Atten= 18%, Lag= 3.5 min

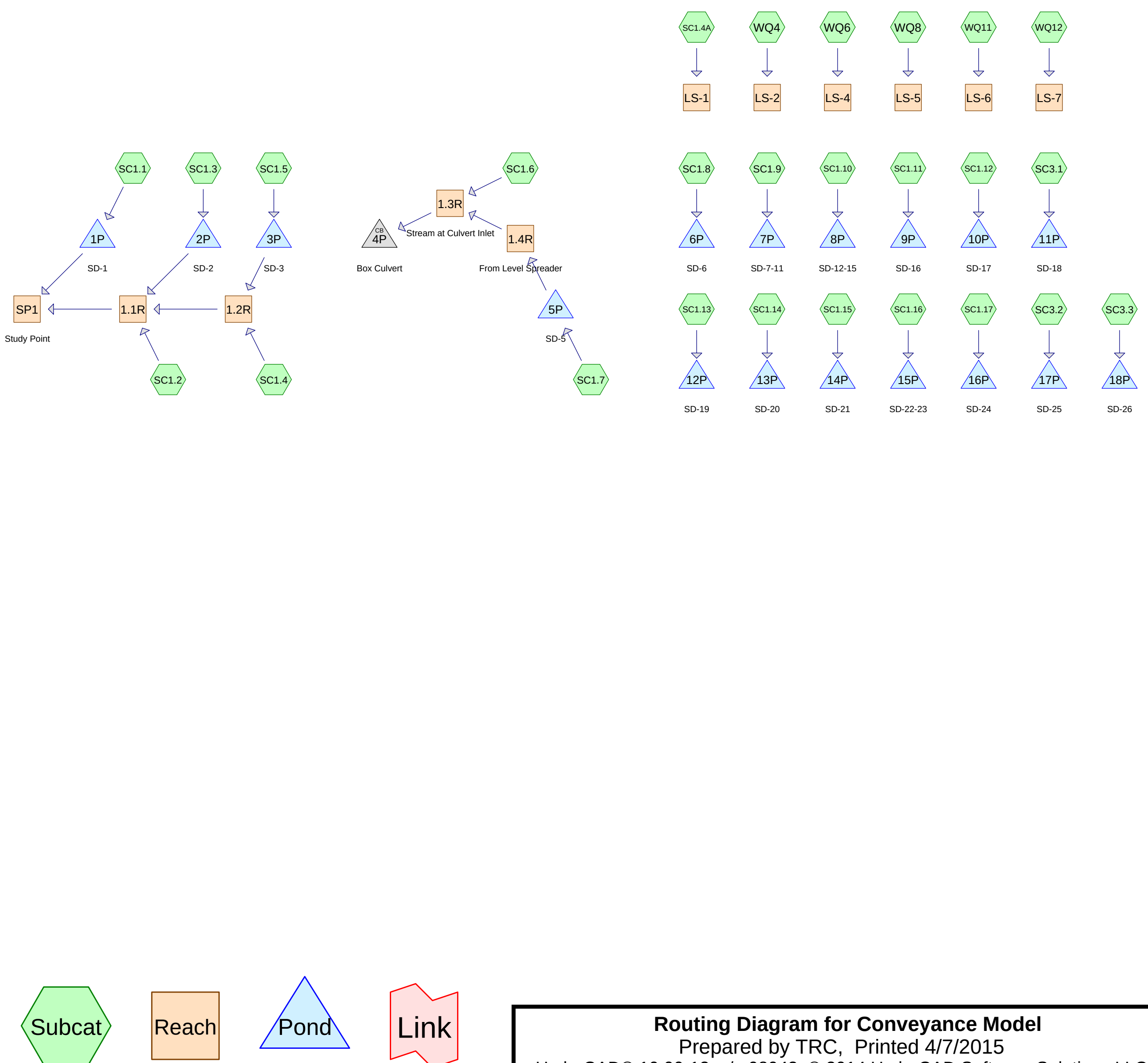
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.32 fps, Min. Travel Time= 6.3 min
Avg. Velocity = 0.09 fps, Avg. Travel Time= 21.2 min

Peak Storage= 129 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 9.00 cfs

3.00' x 1.50' deep channel, n= 0.150
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 120.0' Slope= 0.0075 '/'
Inlet Invert= 1,521.00', Outlet Invert= 1,520.10'

‡





Routing Diagram for Conveyance Model
Prepared by TRC, Printed 4/7/2015
HydroCAD® 10.00-12 s/n 08043 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment SC1.1:

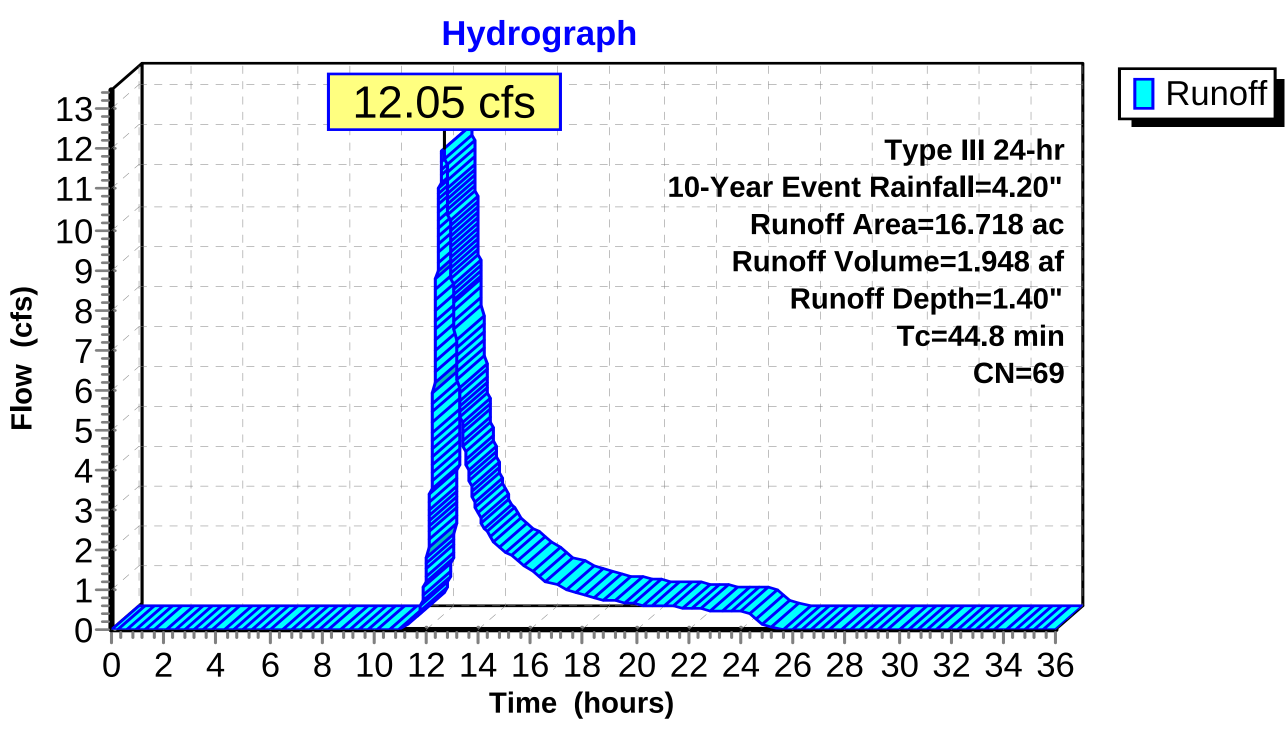
Runoff = 12.05 cfs @ 12.68 hrs, Volume= 1.948 af, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
	13.096	70	Woods, Good, HSG C
	2.446	71	Meadow, non-grazed, HSG C
*	0.118	98	Paved roads, HSG C
*	1.058	55	Yard stone, HSG C
	16.718	69	Weighted Average
	16.600		99.29% Pervious Area
	0.118		0.71% Impervious Area

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

Subcatchment SC1.1:



Summary for Subcatchment SC1.10:

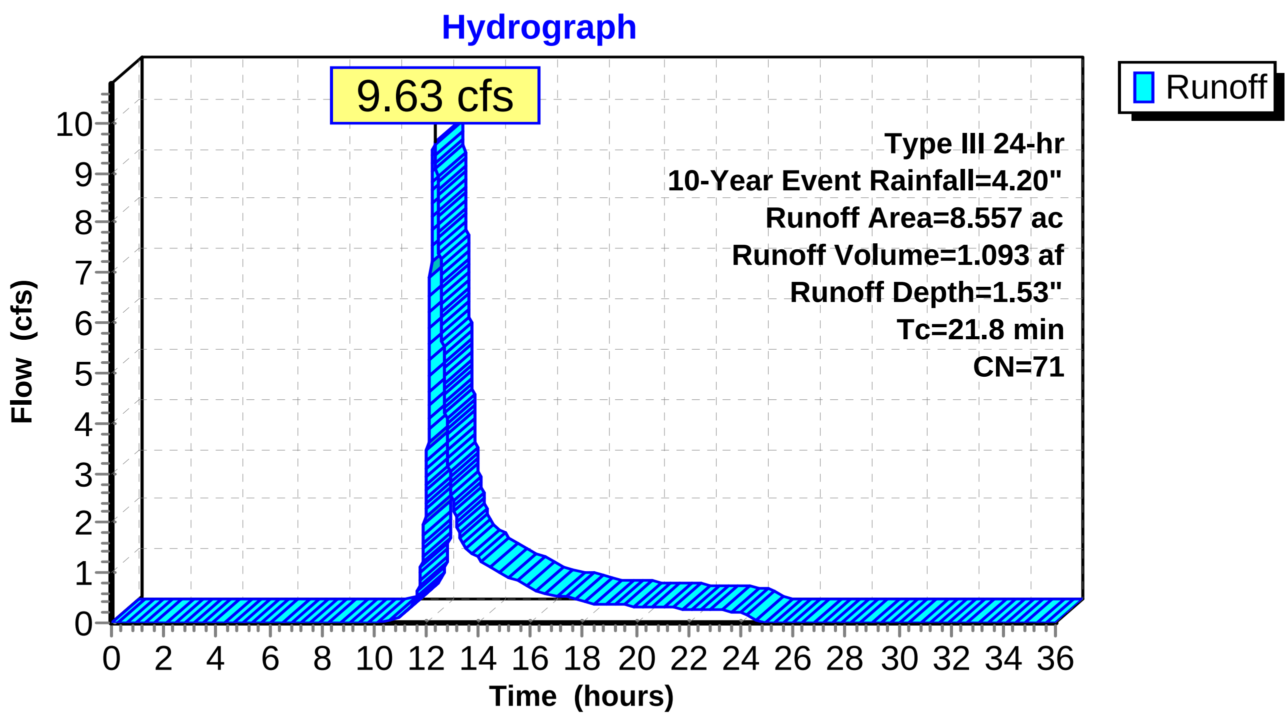
Runoff = 9.63 cfs @ 12.33 hrs, Volume= 1.093 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
6.492	70	Woods, Good, HSG C
1.567	71	Meadow, non-grazed, HSG C
0.498	89	Gravel roads, HSG C
8.557	71	Weighted Average
8.557		100.00% Pervious Area

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

Subcatchment SC1.10:



Worksheet for SC1.10

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.059	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	9.63	ft³/s

Results

Normal Depth	0.61	ft
Flow Area	1.98	ft²
Wetted Perimeter	4.74	ft
Hydraulic Radius	0.42	ft
Top Width	4.45	ft
Critical Depth	0.71	ft
Critical Slope	0.06992	ft/ft
Velocity	4.87	ft/s
Velocity Head	0.37	ft
Specific Energy	0.98	ft
Froude Number	1.29	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.61	ft
Critical Depth	0.71	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.06992	ft/ft

Summary for Subcatchment SC1.11:

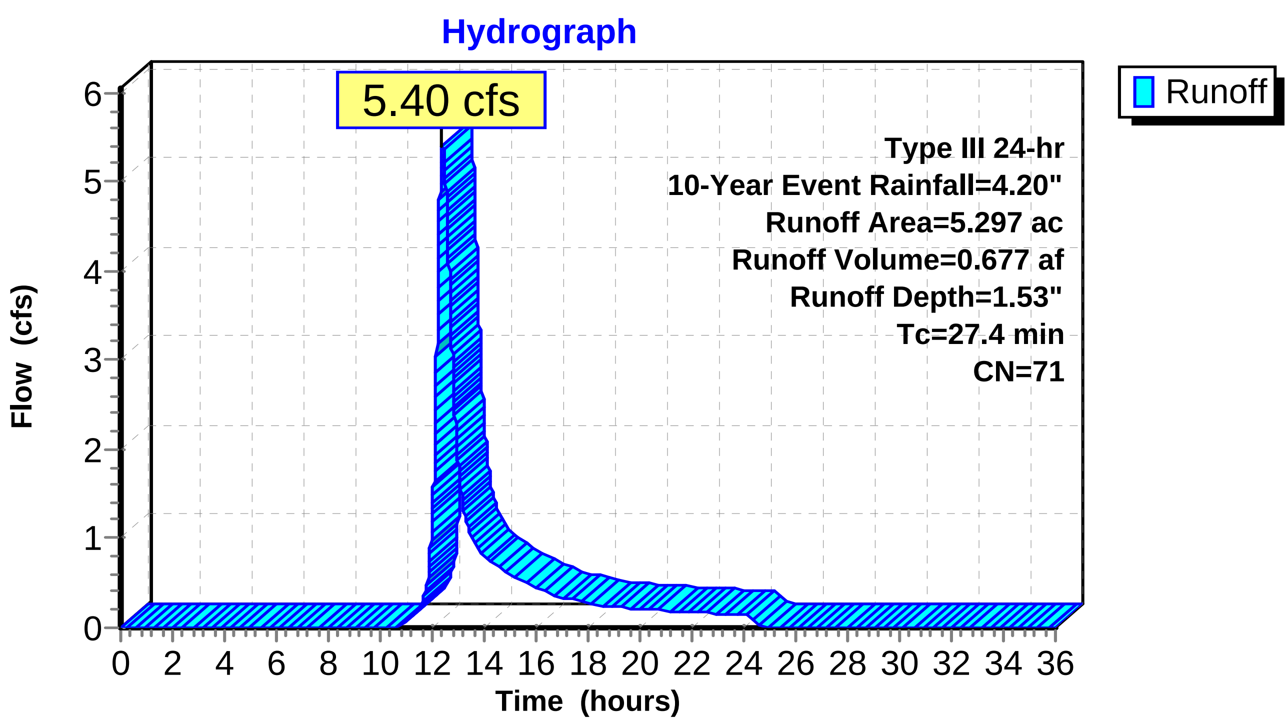
Runoff = 5.40 cfs @ 12.40 hrs, Volume= 0.677 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
4.038	70	Woods, Good, HSG C
1.081	71	Meadow, non-grazed, HSG C
0.178	89	Gravel roads, HSG C
5.297	71	Weighted Average
5.297		100.00% Pervious Area

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

Subcatchment SC1.11:



Worksheet for SC1.11

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.067	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	5.40	ft³/s

Results

Normal Depth	0.48	ft
Flow Area	1.43	ft²
Wetted Perimeter	4.16	ft
Hydraulic Radius	0.34	ft
Top Width	3.93	ft
Critical Depth	0.51	ft
Critical Slope	0.09745	ft/ft
Velocity	3.77	ft/s
Velocity Head	0.22	ft
Specific Energy	0.70	ft
Froude Number	1.10	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.51	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.09745	ft/ft

Summary for Subcatchment SC1.12:

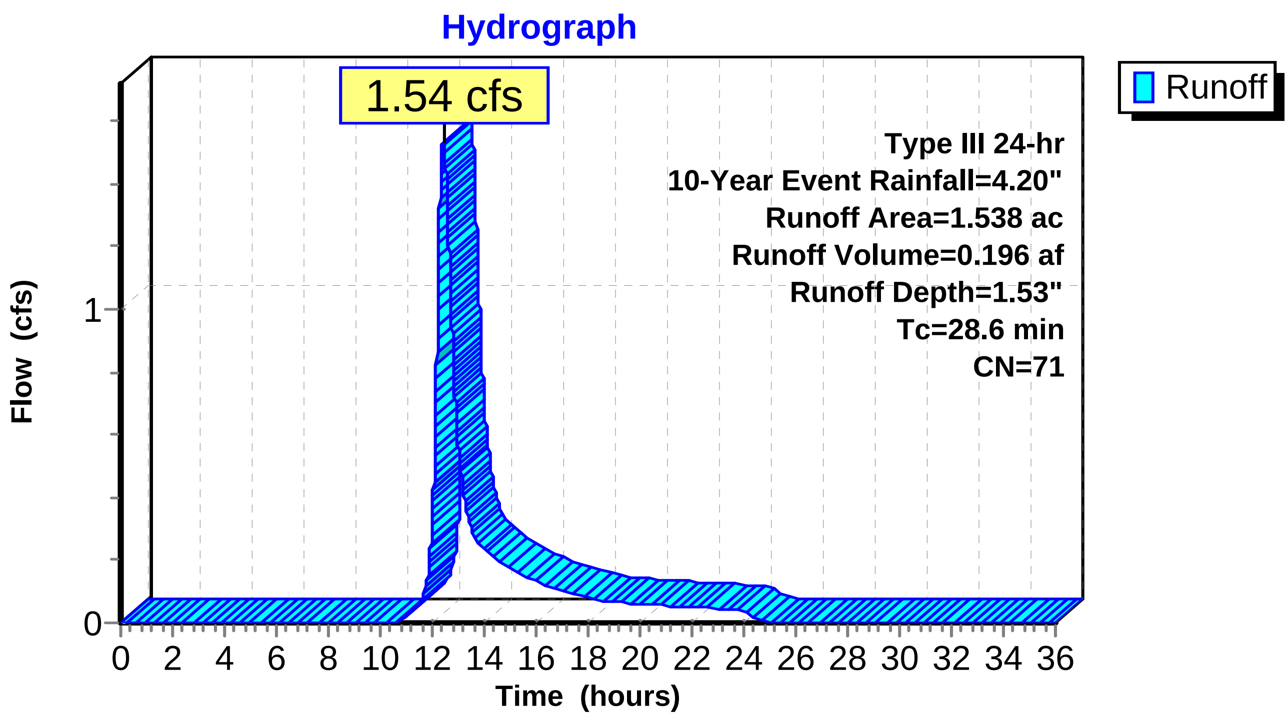
Runoff = 1.54 cfs @ 12.43 hrs, Volume= 0.196 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.916	70	Woods, Good, HSG C
0.547	71	Meadow, non-grazed, HSG C
0.075	89	Gravel roads, HSG C
1.538	71	Weighted Average
1.538		100.00% Pervious Area

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

Subcatchment SC1.12:



Worksheet for SC1.12

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.062	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	1.54	ft^3/s

Results

Normal Depth	0.23	ft
Flow Area	0.57	ft^2
Wetted Perimeter	3.03	ft
Hydraulic Radius	0.19	ft
Top Width	2.92	ft
Critical Depth	0.24	ft
Critical Slope	0.10025	ft/ft
Velocity	2.72	ft/s
Velocity Head	0.11	ft
Specific Energy	0.35	ft
Froude Number	1.09	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.23	ft
Critical Depth	0.24	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.10025	ft/ft

Summary for Subcatchment SC1.13:

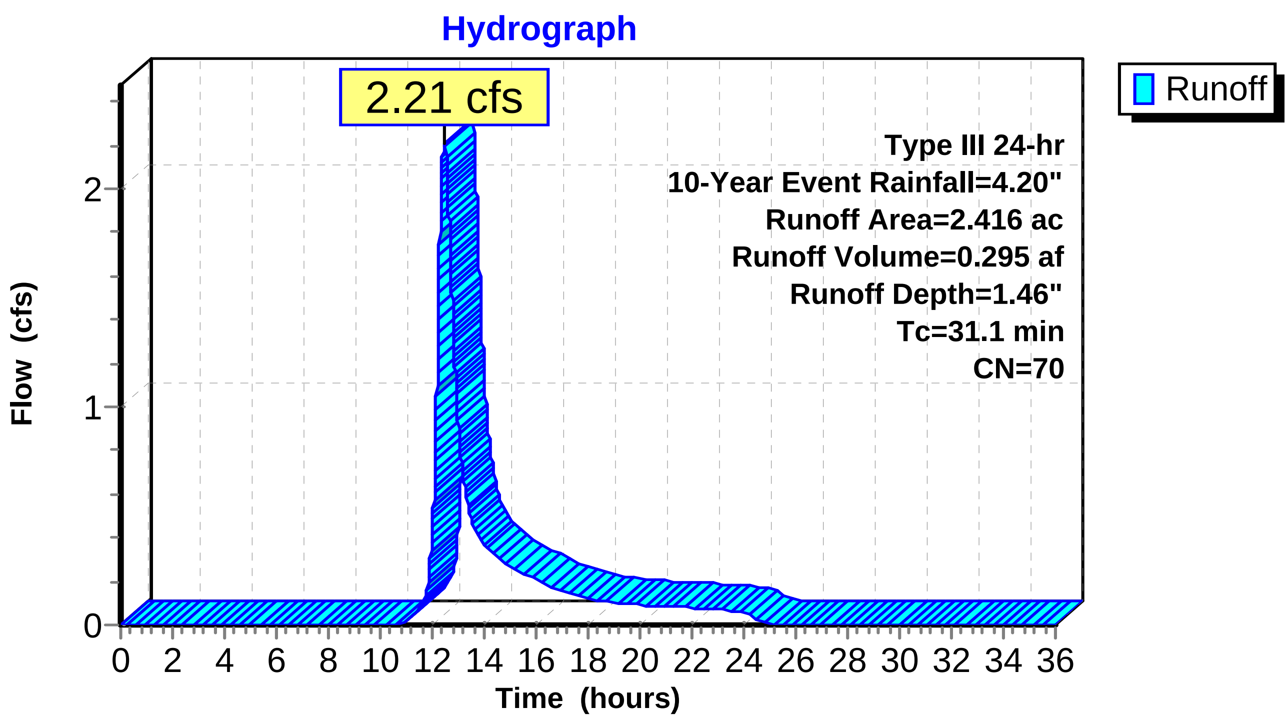
Runoff = 2.21 cfs @ 12.47 hrs, Volume= 0.295 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
1.885	70	Woods, Good, HSG C
0.531	71	Meadow, non-grazed, HSG C
2.416	70	Weighted Average
2.416		100.00% Pervious Area

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

Subcatchment SC1.13:



Summary for Subcatchment SC1.14:

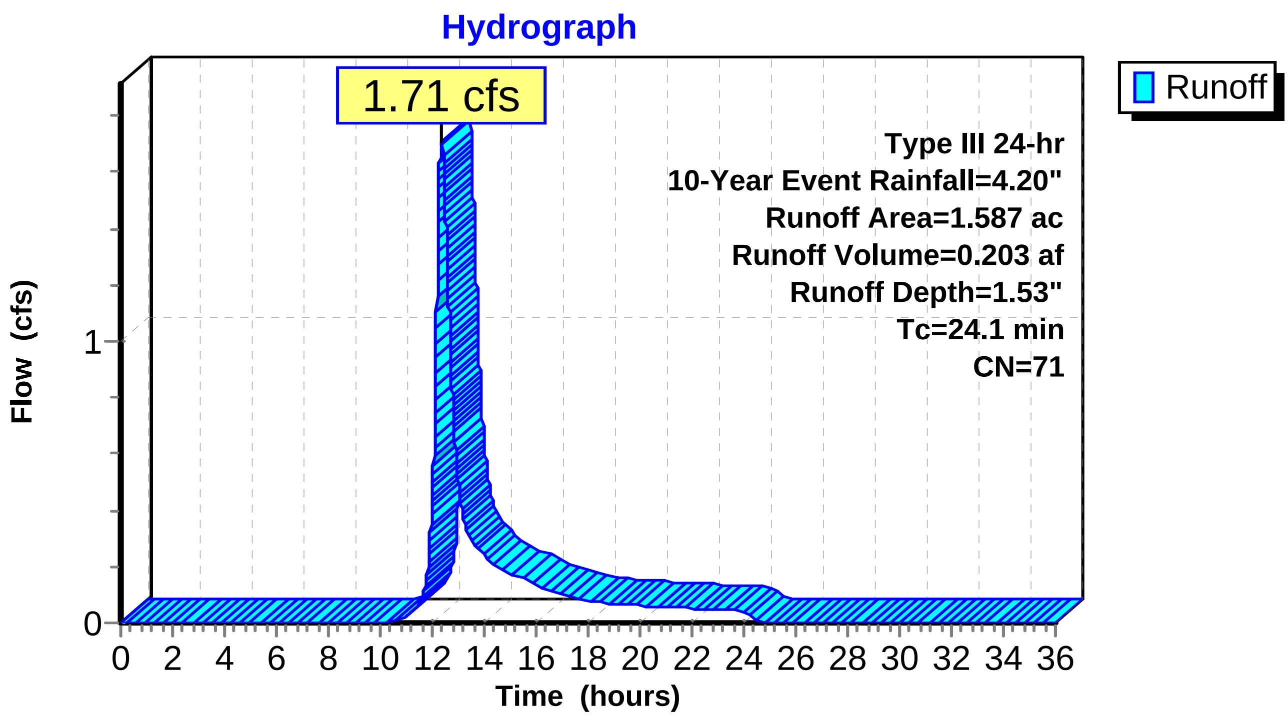
Runoff = 1.71 cfs @ 12.35 hrs, Volume= 0.203 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.623	70	Woods, Good, HSG C
0.888	71	Meadow, non-grazed, HSG C
0.076	89	Gravel roads, HSG C
1.587	71	Weighted Average
1.587		100.00% Pervious Area

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

Subcatchment SC1.14:



Summary for Subcatchment SC1.15:

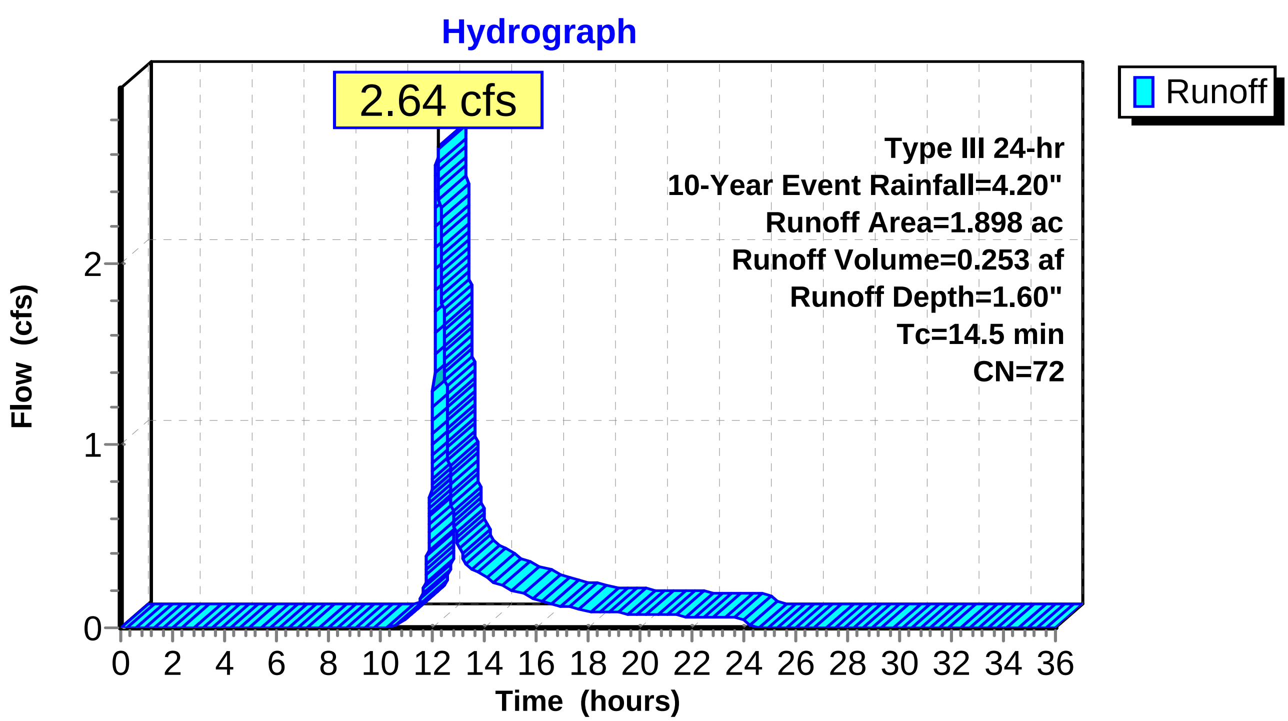
Runoff = 2.64 cfs @ 12.21 hrs, Volume= 0.253 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.806	70	Woods, Good, HSG C
0.955	71	Meadow, non-grazed, HSG C
0.137	89	Gravel roads, HSG C
1.898	72	Weighted Average
1.898		100.00% Pervious Area

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

Subcatchment SC1.15:



Worksheet for SC1.15

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.055	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	2.64	ft^3/s

Results

Normal Depth	0.29	ft
Flow Area	0.76	ft^2
Wetted Perimeter	3.31	ft
Hydraulic Radius	0.23	ft
Top Width	3.17	ft
Critical Depth	0.34	ft
Critical Slope	0.07268	ft/ft
Velocity	3.50	ft/s
Velocity Head	0.19	ft
Specific Energy	0.48	ft
Froude Number	1.26	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.34	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.07268	ft/ft

Summary for Subcatchment SC1.16:

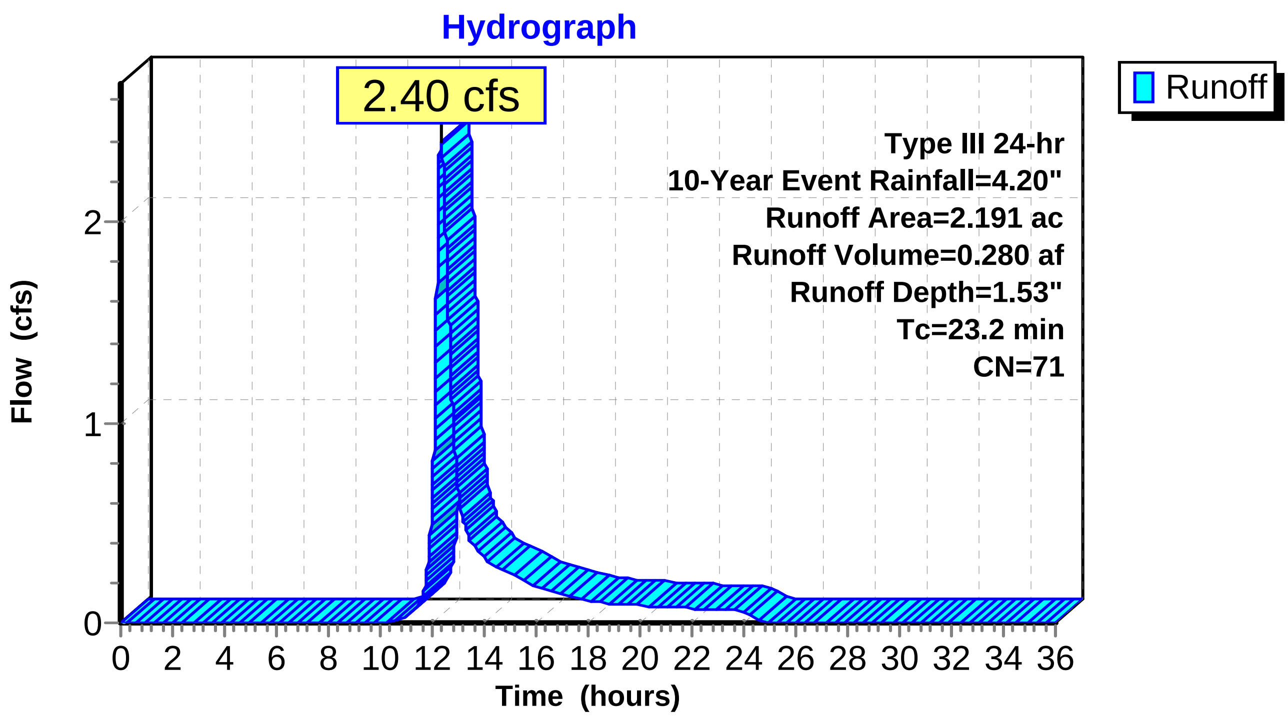
Runoff = 2.40 cfs @ 12.35 hrs, Volume= 0.280 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
1.222	70	Woods, Good, HSG C
0.864	71	Meadow, non-grazed, HSG C
0.105	89	Gravel roads, HSG C
2.191	71	Weighted Average
2.191		100.00% Pervious Area

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

Subcatchment SC1.16:



Worksheet for SC1.16

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.057	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	2.40	ft^3/s

Results

Normal Depth	0.28	ft
Flow Area	0.72	ft^2
Wetted Perimeter	3.26	ft
Hydraulic Radius	0.22	ft
Top Width	3.13	ft
Critical Depth	0.32	ft
Critical Slope	0.07917	ft/ft
Velocity	3.31	ft/s
Velocity Head	0.17	ft
Specific Energy	0.45	ft
Froude Number	1.21	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.28	ft
Critical Depth	0.32	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.07917	ft/ft

Summary for Subcatchment SC1.17:

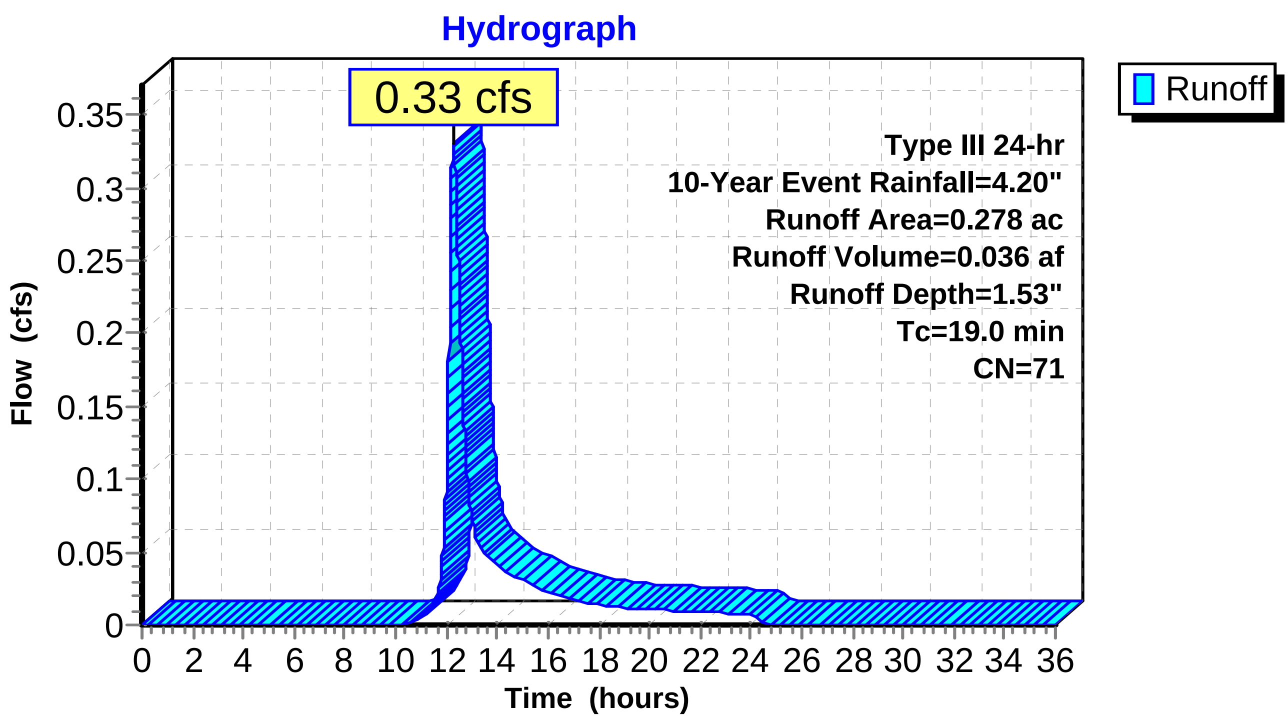
Runoff = 0.33 cfs @ 12.27 hrs, Volume= 0.036 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.119	70	Woods, Good, HSG C
0.159	71	Meadow, non-grazed, HSG C
0.278	71	Weighted Average
0.278		100.00% Pervious Area

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

Subcatchment SC1.17:



Worksheet for SC1.17

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.099	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.33	ft³/s

Results

Normal Depth	0.12	ft
Flow Area	0.28	ft²
Wetted Perimeter	2.55	ft
Hydraulic Radius	0.11	ft
Top Width	2.50	ft
Critical Depth	0.09	ft
Critical Slope	0.33316	ft/ft
Velocity	1.19	ft/s
Velocity Head	0.02	ft
Specific Energy	0.15	ft
Froude Number	0.63	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.12	ft
Critical Depth	0.09	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.33316	ft/ft

Summary for Subcatchment SC1.2:

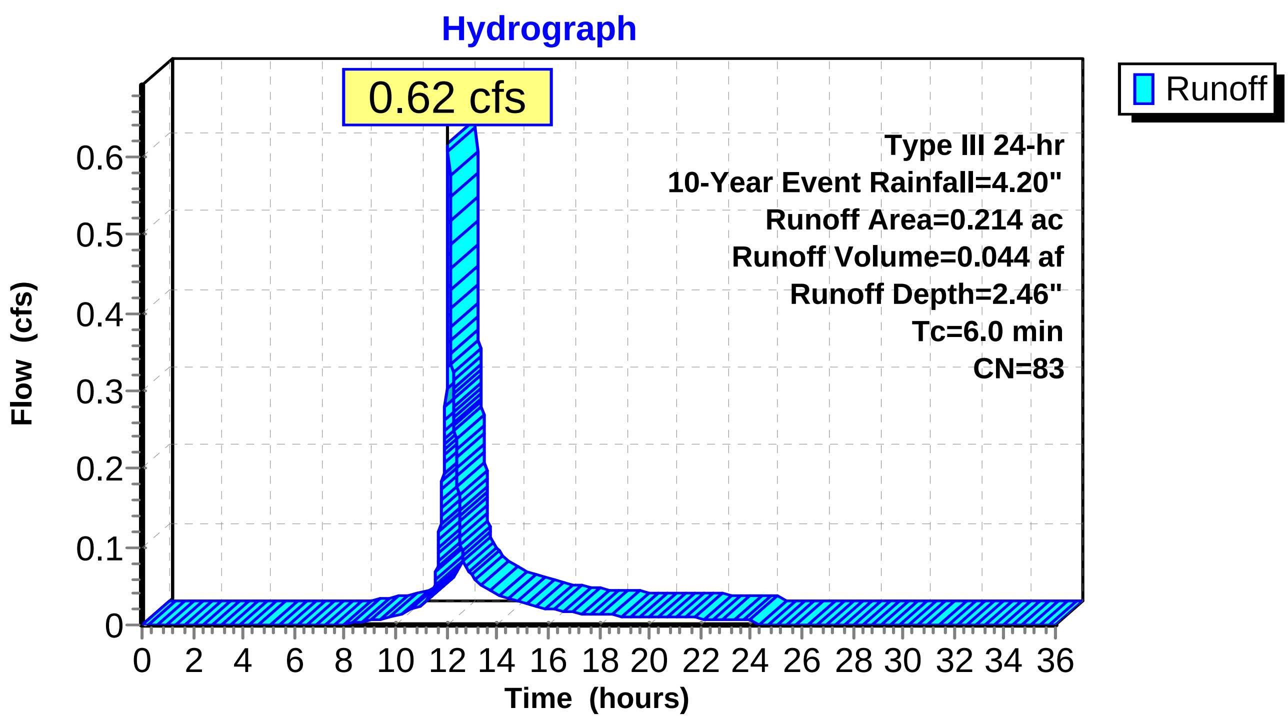
Runoff = 0.62 cfs @ 12.09 hrs, Volume= 0.044 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.100	96	Gravel surface, HSG C
0.114	71	Meadow, non-grazed, HSG C
0.214	83	Weighted Average
0.214		100.00% Pervious Area

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

Subcatchment SC1.2:



Summary for Subcatchment SC1.3:

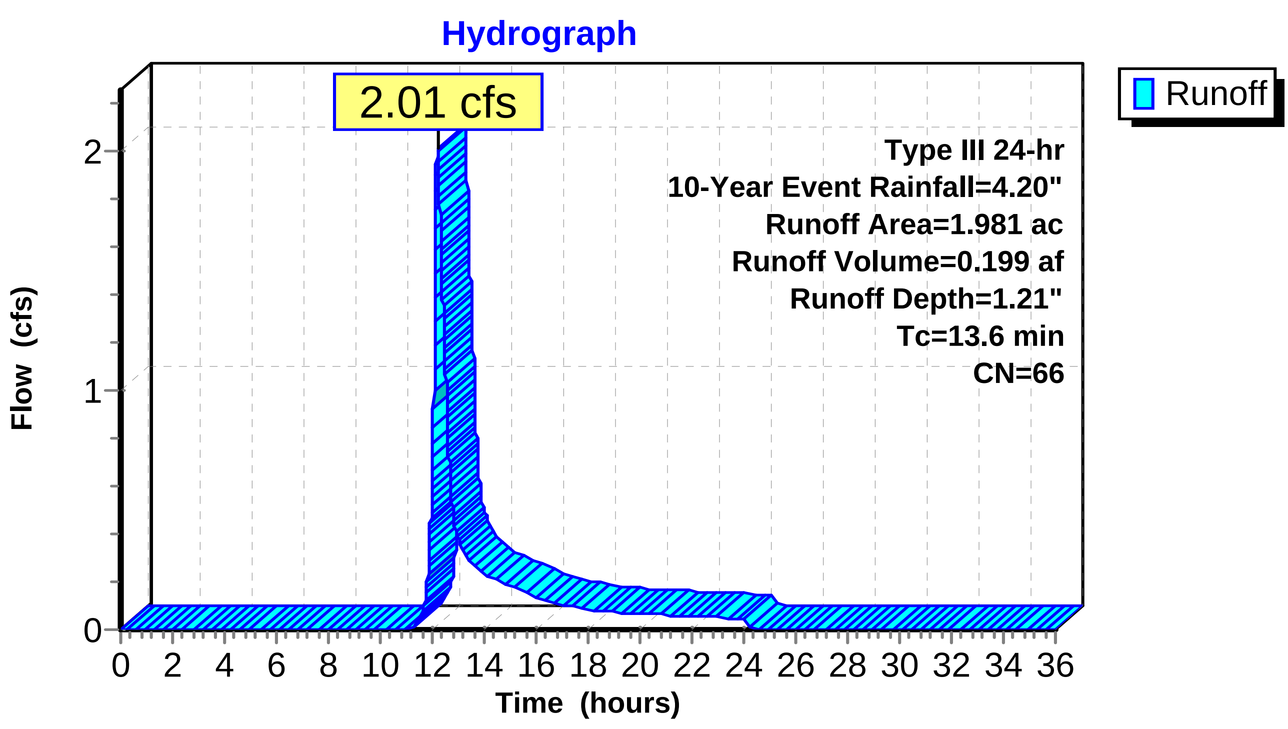
Runoff = 2.01 cfs @ 12.20 hrs, Volume= 0.199 af, Depth= 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
	0.712	70	Woods, Good, HSG C
	0.511	71	Meadow, non-grazed, HSG C
*	0.672	55	Yard stone, HSG C
	0.086	98	Roofs, HSG C
	1.981	66	Weighted Average
	1.895		95.66% Pervious Area
	0.086		4.34% Impervious Area

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

Subcatchment SC1.3:



Worksheet for SC1.3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.086	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	2.05	ft^3/s

Results

Normal Depth	0.33	ft
Flow Area	0.86	ft^2
Wetted Perimeter	3.46	ft
Hydraulic Radius	0.25	ft
Top Width	3.30	ft
Critical Depth	0.29	ft
Critical Slope	0.18457	ft/ft
Velocity	2.37	ft/s
Velocity Head	0.09	ft
Specific Energy	0.41	ft
Froude Number	0.82	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.29	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.18457	ft/ft

Summary for Subcatchment SC1.4:

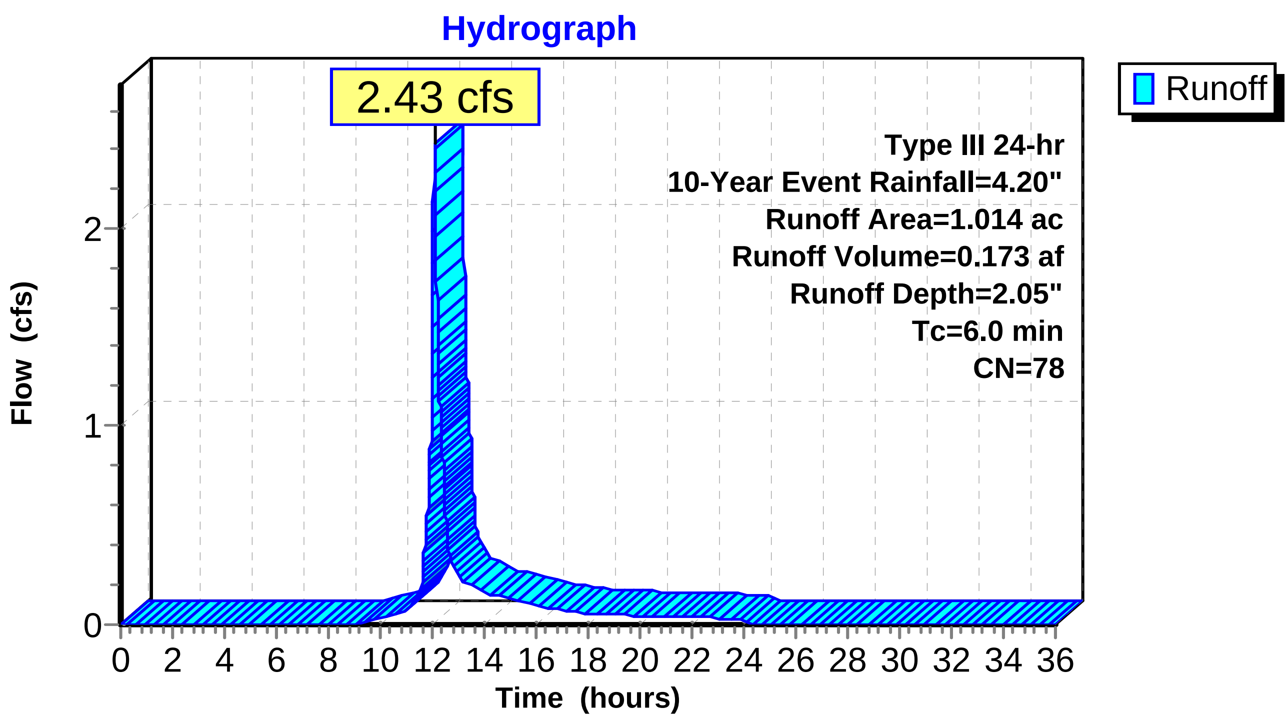
Runoff = 2.43 cfs @ 12.09 hrs, Volume= 0.173 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
	0.275	70	Woods, Good, HSG C
	0.445	71	Meadow, non-grazed, HSG C
*	0.248	98	Paved roads, HSG C
	0.046	89	Gravel roads, HSG C
	1.014	78	Weighted Average
	0.766		75.54% Pervious Area
	0.248		24.46% Impervious Area

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

Subcatchment SC1.4:



Summary for Subcatchment SC1.4A:

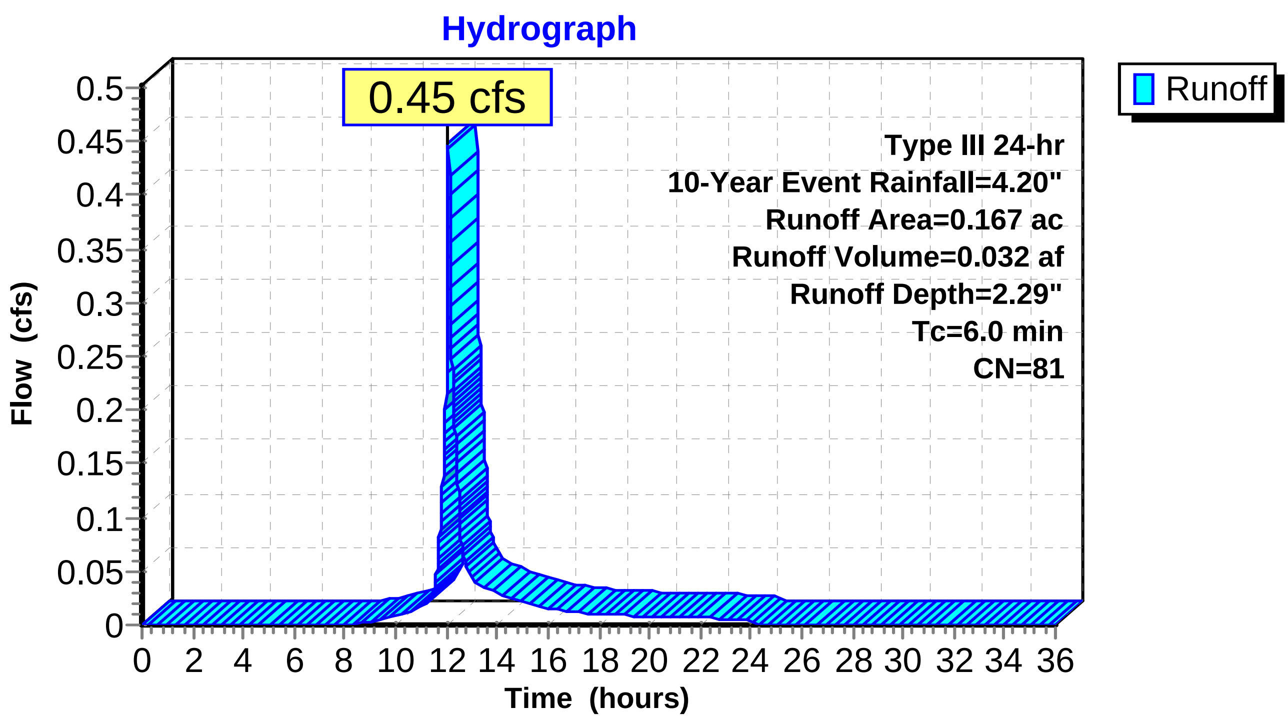
Runoff = 0.45 cfs @ 12.09 hrs, Volume= 0.032 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.075	71	Meadow, non-grazed, HSG C
0.092	89	Gravel roads, HSG C
0.167	81	Weighted Average
0.167		100.00% Pervious Area

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

Subcatchment SC1.4A:



Worksheet for SC1.4A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.091	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.45	ft^3/s

Results

Normal Depth	0.14	ft
Flow Area	0.32	ft^2
Wetted Perimeter	2.63	ft
Hydraulic Radius	0.12	ft
Top Width	2.57	ft
Critical Depth	0.11	ft
Critical Slope	0.26590	ft/ft
Velocity	1.40	ft/s
Velocity Head	0.03	ft
Specific Energy	0.17	ft
Froude Number	0.69	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.14	ft
Critical Depth	0.11	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.26590	ft/ft

Summary for Subcatchment SC1.5:

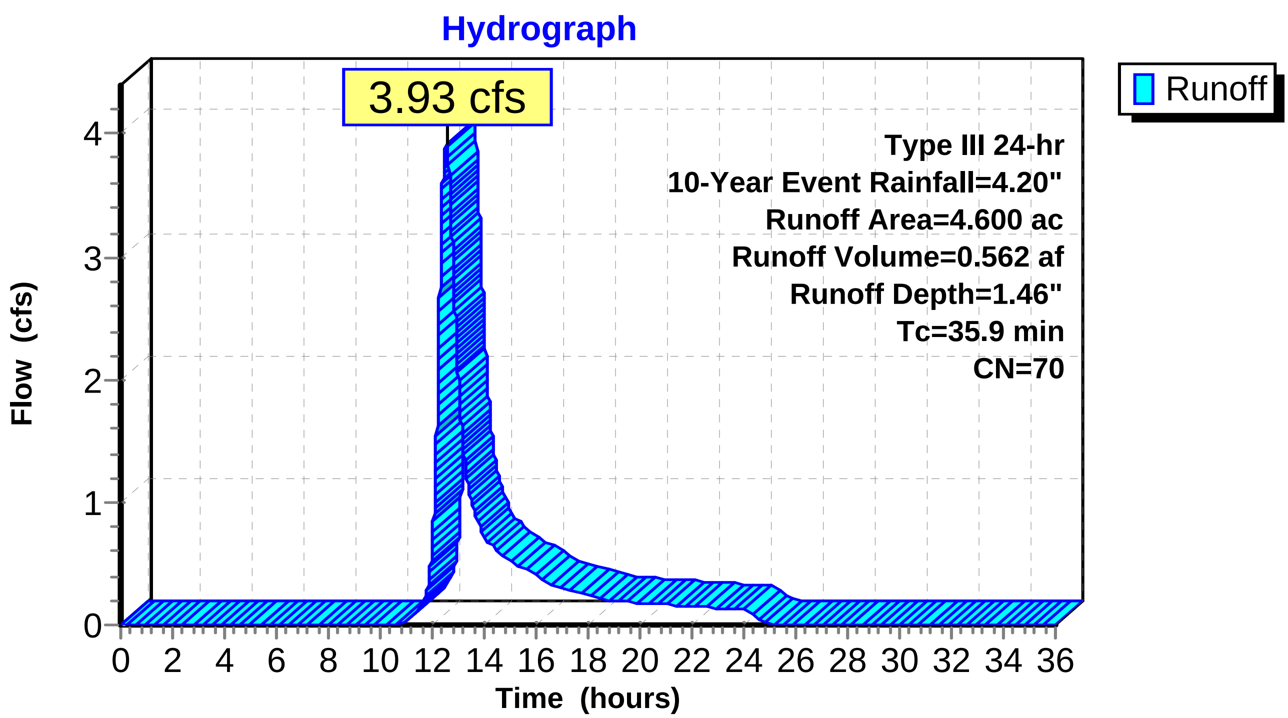
Runoff = 3.93 cfs @ 12.53 hrs, Volume= 0.562 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
4.028	70	Woods, Good, HSG C
0.572	71	Meadow, non-grazed, HSG C
4.600	70	Weighted Average
4.600		100.00% Pervious Area

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

Subcatchment SC1.5:



Worksheet for SC1.5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.070	
Channel Slope	0.10000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	3.93	ft³/s

Results

Normal Depth	0.44	ft
Flow Area	1.26	ft²
Wetted Perimeter	3.96	ft
Hydraulic Radius	0.32	ft
Top Width	3.75	ft
Critical Depth	0.42	ft
Critical Slope	0.11116	ft/ft
Velocity	3.13	ft/s
Velocity Head	0.15	ft
Specific Energy	0.59	ft
Froude Number	0.95	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.44	ft
Critical Depth	0.42	ft
Channel Slope	0.10000	ft/ft
Critical Slope	0.11116	ft/ft

Summary for Subcatchment SC1.6:

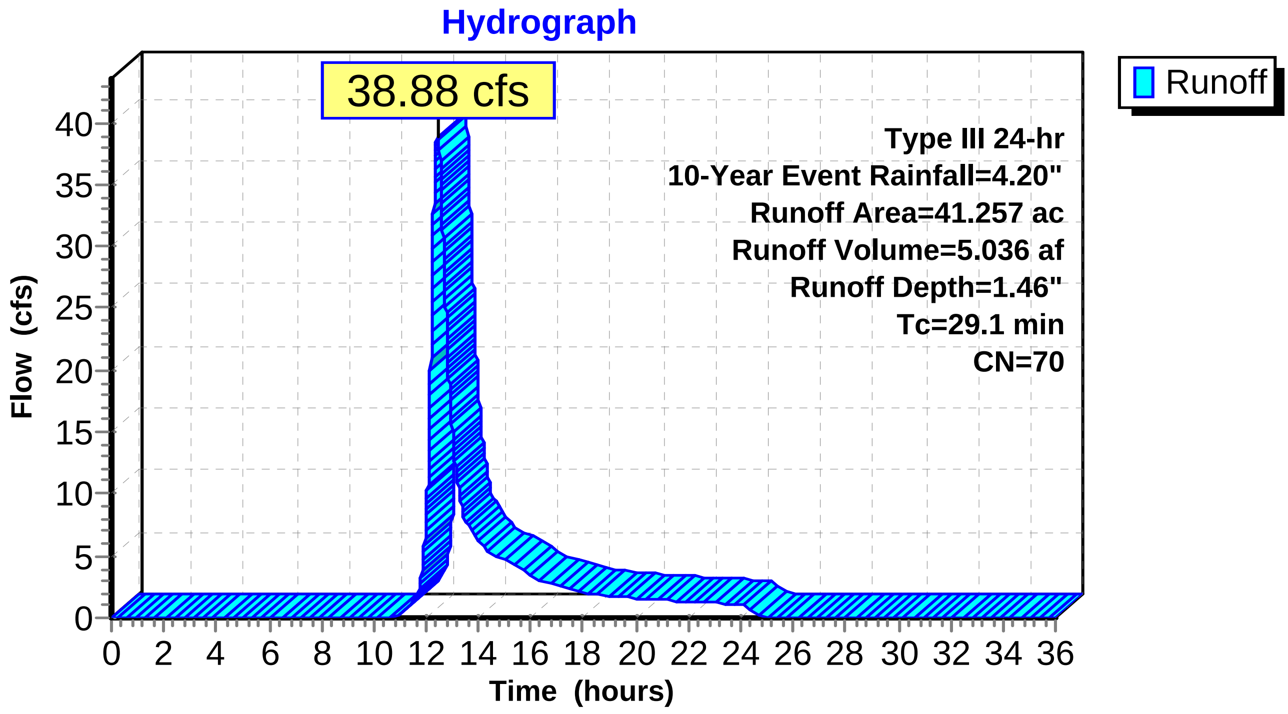
Runoff = 38.88 cfs @ 12.44 hrs, Volume= 5.036 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
39.420	70	Woods, Good, HSG C
0.285	89	Gravel roads, HSG C
1.552	71	Meadow, non-grazed, HSG C
41.257	70	Weighted Average
41.257		100.00% Pervious Area

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

Subcatchment SC1.6:



Worksheet for SC1.6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.059	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	10.00	ft^3/s

Results

Normal Depth	0.63	ft
Flow Area	2.03	ft^2
Wetted Perimeter	4.80	ft
Hydraulic Radius	0.42	ft
Top Width	4.50	ft
Critical Depth	0.72	ft
Critical Slope	0.06957	ft/ft
Velocity	4.92	ft/s
Velocity Head	0.38	ft
Specific Energy	1.00	ft
Froude Number	1.29	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.63	ft
Critical Depth	0.72	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.06957	ft/ft

Summary for Subcatchment SC1.7:

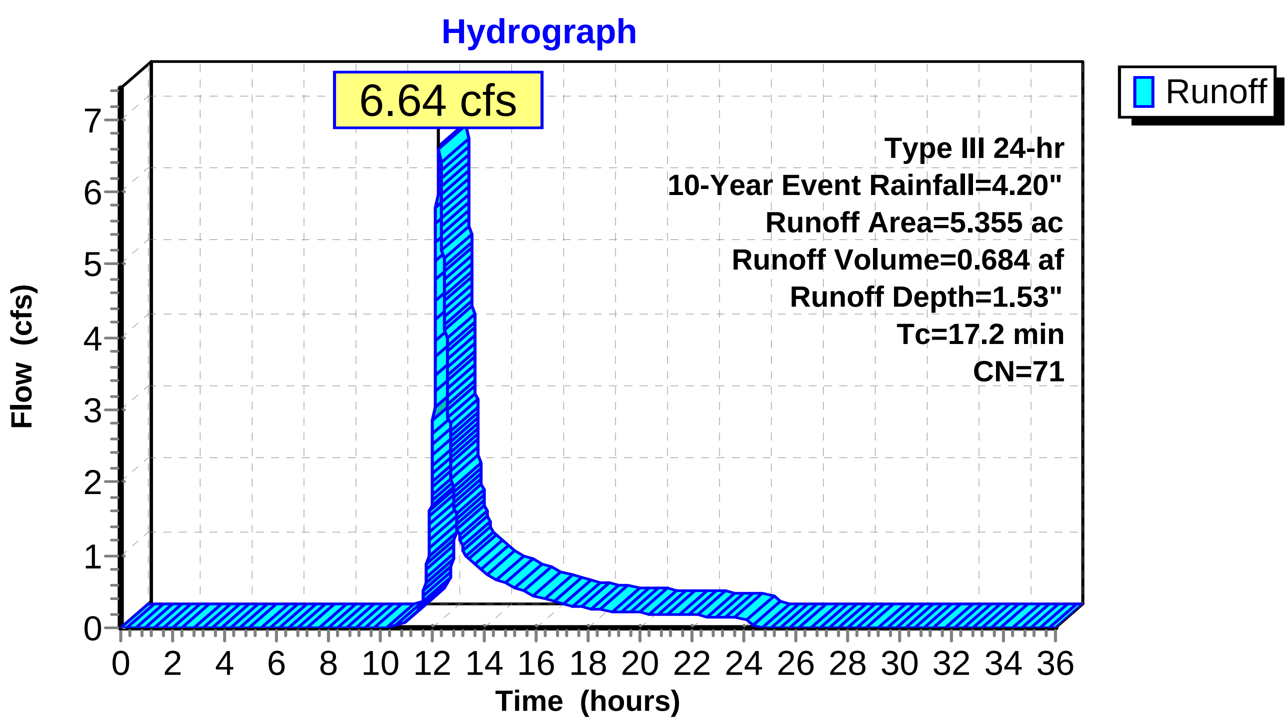
Runoff = 6.64 cfs @ 12.25 hrs, Volume= 0.684 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
4.514	70	Woods, Good, HSG C
0.216	89	Gravel roads, HSG C
0.625	71	Meadow, non-grazed, HSG C
5.355	71	Weighted Average
5.355		100.00% Pervious Area

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

Subcatchment SC1.7:



Summary for Subcatchment SC1.8:

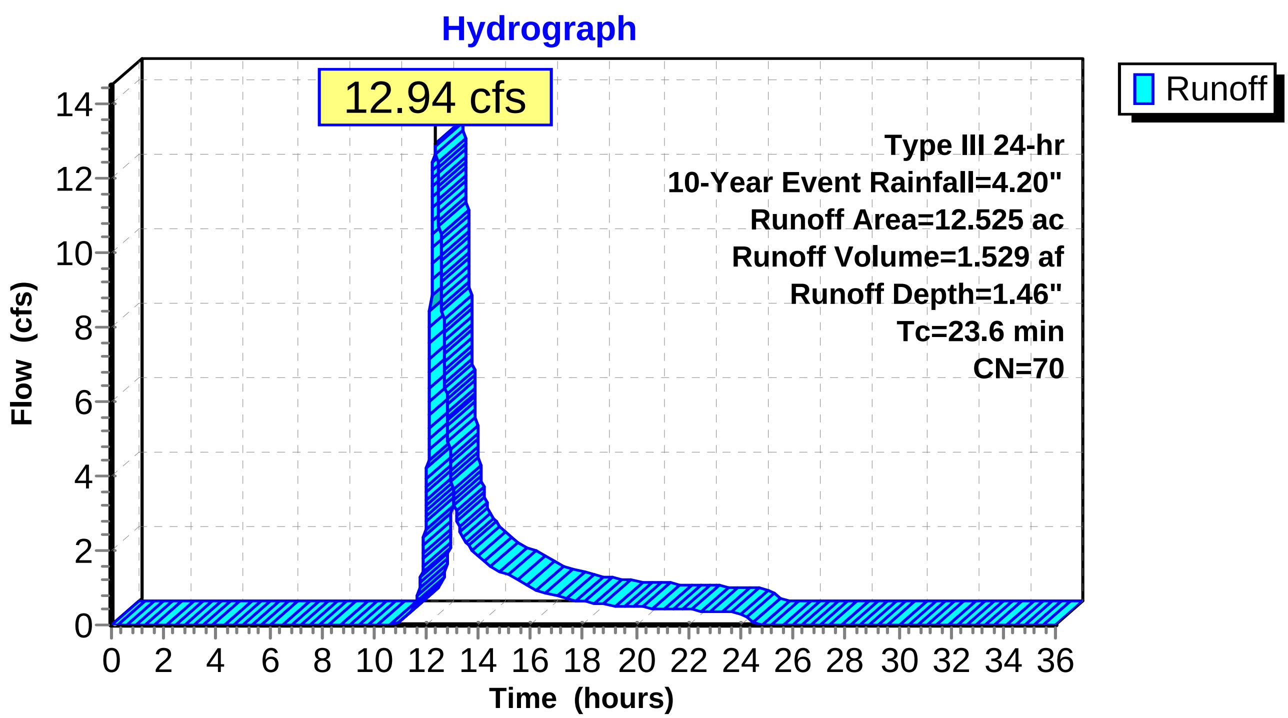
Runoff = 12.94 cfs @ 12.35 hrs, Volume= 1.529 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
11.358	70	Woods, Good, HSG C
1.167	71	Meadow, non-grazed, HSG C
12.525	70	Weighted Average
12.525		100.00% Pervious Area

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

Subcatchment SC1.8:



Worksheet for SC1.8/6P

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.088	
Channel Slope	0.50000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	17.00	ft³/s

Results

Normal Depth	0.59	ft
Flow Area	2.47	ft²
Wetted Perimeter	5.64	ft
Hydraulic Radius	0.44	ft
Top Width	5.36	ft
Critical Depth	0.83	ft
Critical Slope	0.14420	ft/ft
Velocity	6.88	ft/s
Velocity Head	0.74	ft
Specific Energy	1.33	ft
Froude Number	1.79	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.83	ft
Channel Slope	0.50000	ft/ft
Critical Slope	0.14420	ft/ft

Summary for Subcatchment SC1.9:

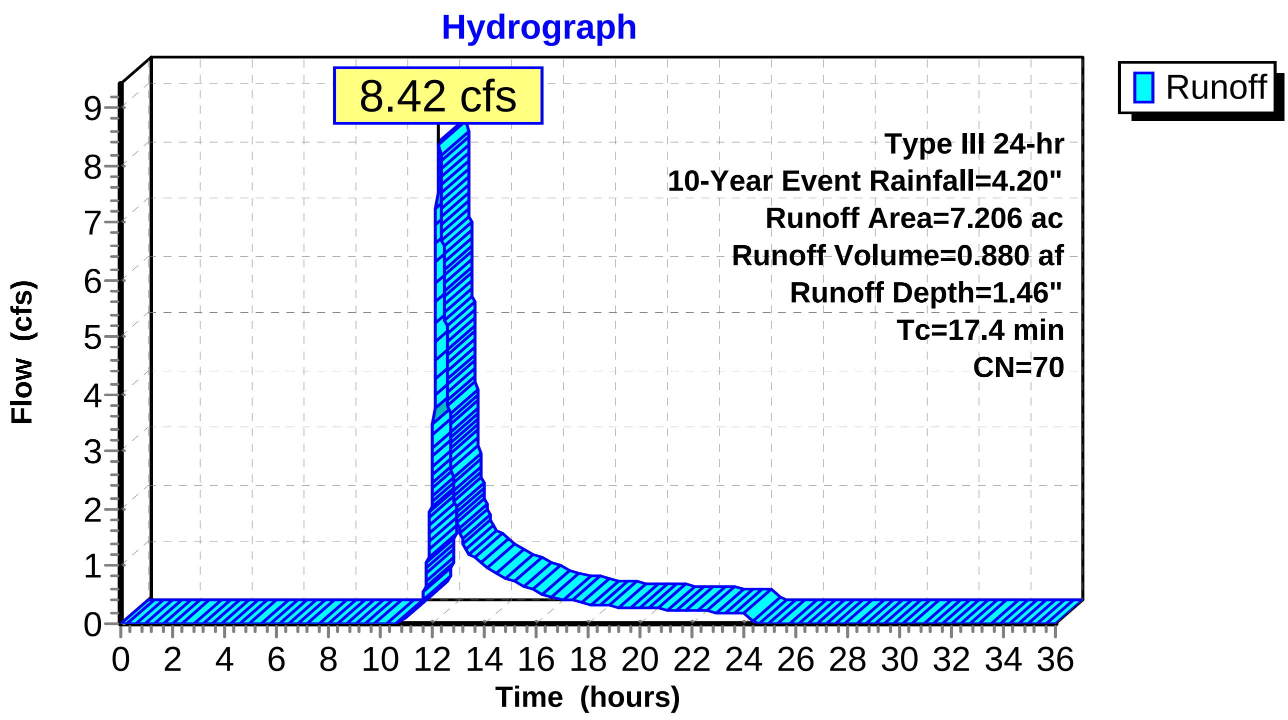
Runoff = 8.42 cfs @ 12.25 hrs, Volume= 0.880 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
6.694	70	Woods, Good, HSG C
0.451	71	Meadow, non-grazed, HSG C
0.061	89	Gravel roads, HSG C
7.206	70	Weighted Average
7.206		100.00% Pervious Area

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

Subcatchment SC1.9:



Worksheet for SC1.9

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.061	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	8.42	ft³/s

Results

Normal Depth	0.58	ft
Flow Area	1.84	ft²
Wetted Perimeter	4.60	ft
Hydraulic Radius	0.40	ft
Top Width	4.33	ft
Critical Depth	0.65	ft
Critical Slope	0.07608	ft/ft
Velocity	4.58	ft/s
Velocity Head	0.33	ft
Specific Energy	0.91	ft
Froude Number	1.24	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.58	ft
Critical Depth	0.65	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.07608	ft/ft

Summary for Subcatchment SC3.1:

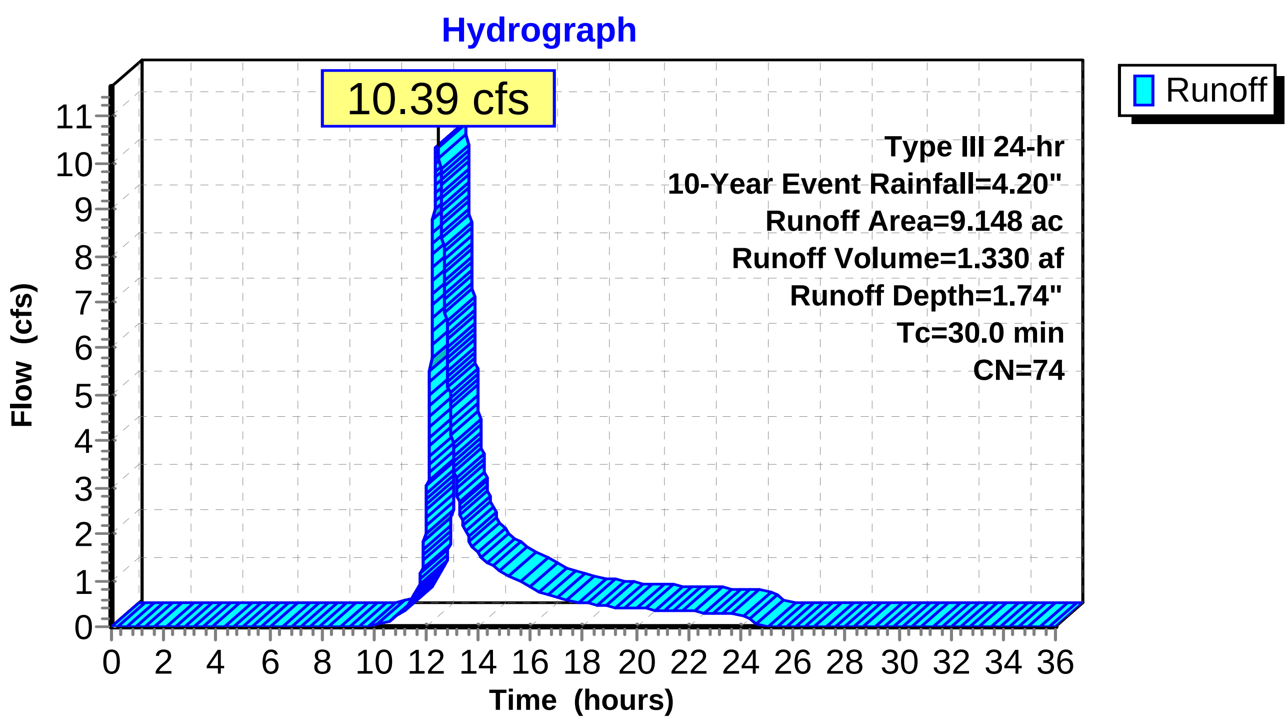
Runoff = 10.39 cfs @ 12.43 hrs, Volume= 1.330 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
3.839	70	Woods, Good, HSG C
0.131	89	Gravel roads, HSG C
4.686	77	Woods, Good, HSG D
0.492	78	Meadow, non-grazed, HSG D
9.148	74	Weighted Average
9.148		100.00% Pervious Area

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

Subcatchment SC3.1:



Worksheet for SC3.1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.076	
Channel Slope	0.13400	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	3.46	ft³/s

Results

Normal Depth	0.39	ft
Flow Area	1.10	ft²
Wetted Perimeter	3.76	ft
Hydraulic Radius	0.29	ft
Top Width	3.58	ft
Critical Depth	0.39	ft
Critical Slope	0.13341	ft/ft
Velocity	3.15	ft/s
Velocity Head	0.15	ft
Specific Energy	0.55	ft
Froude Number	1.00	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.39	ft
Critical Depth	0.39	ft
Channel Slope	0.13400	ft/ft
Critical Slope	0.13341	ft/ft

Summary for Subcatchment SC3.2:

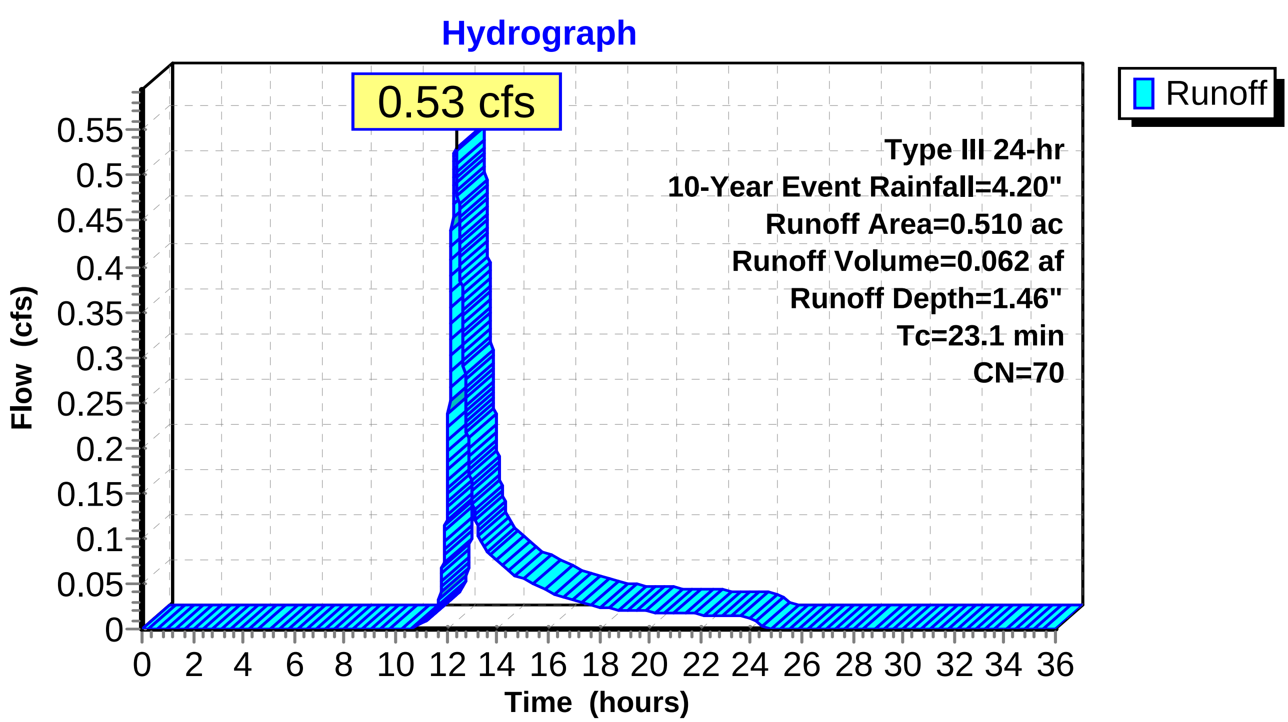
Runoff = 0.53 cfs @ 12.35 hrs, Volume= 0.062 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.372	70	Woods, Good, HSG C
0.138	71	Meadow, non-grazed, HSG C
0.510	70	Weighted Average
0.510		100.00% Pervious Area

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

Subcatchment SC3.2:



Worksheet for SC3.2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.086	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.53	ft³/s

Results

Normal Depth	0.15	ft
Flow Area	0.35	ft²
Wetted Perimeter	2.67	ft
Hydraulic Radius	0.13	ft
Top Width	2.60	ft
Critical Depth	0.12	ft
Critical Slope	0.23060	ft/ft
Velocity	1.53	ft/s
Velocity Head	0.04	ft
Specific Energy	0.19	ft
Froude Number	0.74	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.15	ft
Critical Depth	0.12	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.23060	ft/ft

Summary for Subcatchment SC3.3:

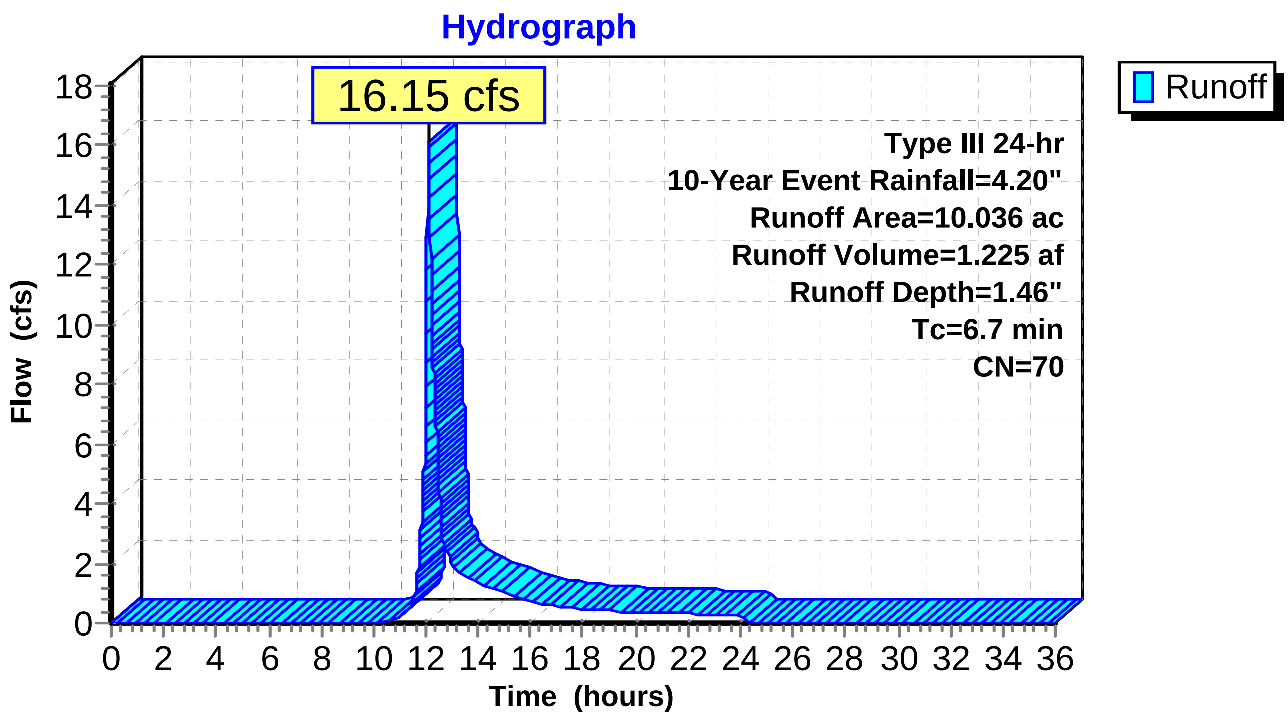
Runoff = 16.15 cfs @ 12.10 hrs, Volume= 1.225 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
8.861	70	Woods, Good, HSG C
1.116	71	Meadow, non-grazed, HSG C
0.059	89	Gravel roads, HSG C
10.036	70	Weighted Average
10.036		100.00% Pervious Area

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

Subcatchment SC3.3:



Summary for Subcatchment WQ11:

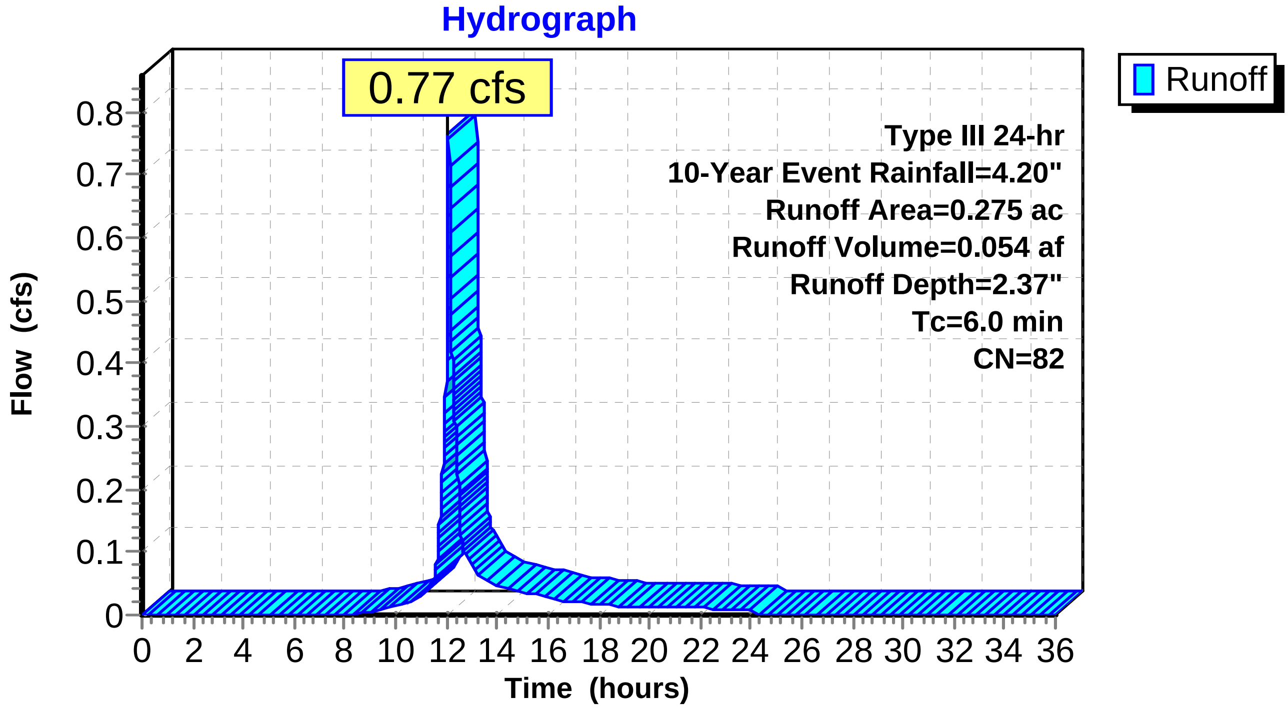
Runoff = 0.77 cfs @ 12.09 hrs, Volume= 0.054 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.092	91	Gravel roads, HSG D
0.183	78	Meadow, non-grazed, HSG D
0.275	82	Weighted Average
0.275		100.00% Pervious Area

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

Subcatchment WQ11:



Worksheet for WQ11

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.074	
Channel Slope	0.10000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.76	ft^3/s

Results

Normal Depth	0.18	ft
Flow Area	0.42	ft^2
Wetted Perimeter	2.80	ft
Hydraulic Radius	0.15	ft
Top Width	2.72	ft
Critical Depth	0.16	ft
Critical Slope	0.16032	ft/ft
Velocity	1.80	ft/s
Velocity Head	0.05	ft
Specific Energy	0.23	ft
Froude Number	0.80	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.18	ft
Critical Depth	0.16	ft
Channel Slope	0.10000	ft/ft
Critical Slope	0.16032	ft/ft

Summary for Subcatchment WQ12:

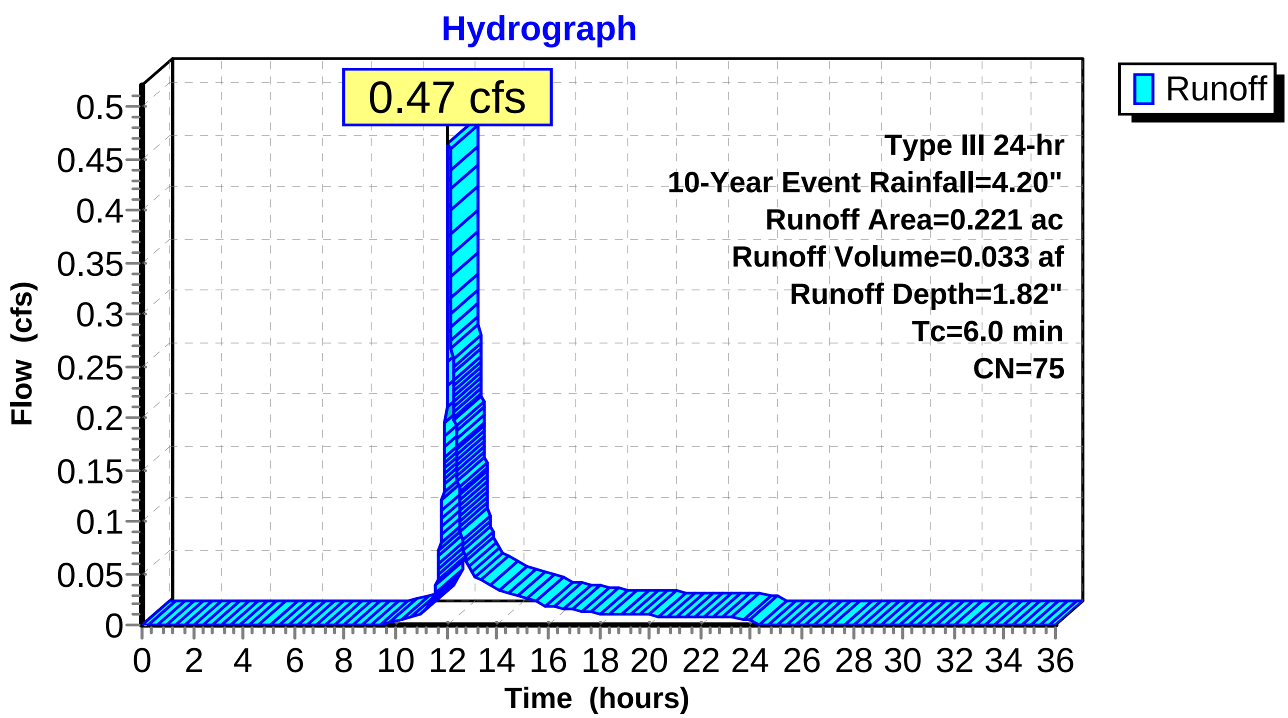
Runoff = 0.47 cfs @ 12.09 hrs, Volume= 0.033 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.046	89	Gravel roads, HSG C
0.175	71	Meadow, non-grazed, HSG C
0.221	75	Weighted Average
0.221		100.00% Pervious Area

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

Subcatchment WQ12:



Worksheet for WQ 12

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.067	
Channel Slope	0.01700	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.47	ft³/s

Results

Normal Depth	0.21	ft
Flow Area	0.52	ft²
Wetted Perimeter	2.96	ft
Hydraulic Radius	0.18	ft
Top Width	2.85	ft
Critical Depth	0.11	ft
Critical Slope	0.14311	ft/ft
Velocity	0.91	ft/s
Velocity Head	0.01	ft
Specific Energy	0.23	ft
Froude Number	0.37	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.11	ft
Channel Slope	0.01700	ft/ft
Critical Slope	0.14311	ft/ft

Summary for Subcatchment WQ4:

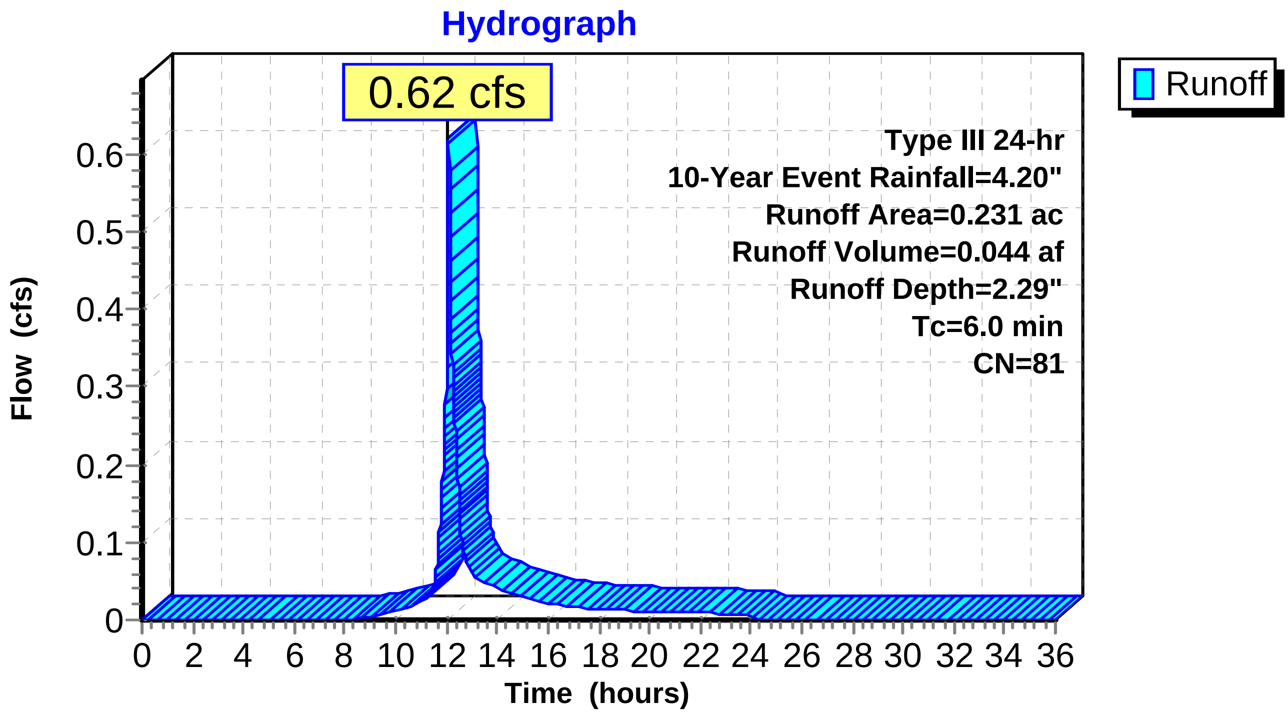
Runoff = 0.62 cfs @ 12.09 hrs, Volume= 0.044 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.128	89	Gravel roads, HSG C
0.103	71	Meadow, non-grazed, HSG C
0.231	81	Weighted Average
0.231		100.00% Pervious Area

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

Subcatchment WQ4:



Worksheet for WQ4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.081	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	0.62	ft³/s

Results

Normal Depth	0.16	ft
Flow Area	0.37	ft²
Wetted Perimeter	2.71	ft
Hydraulic Radius	0.14	ft
Top Width	2.64	ft
Critical Depth	0.14	ft
Critical Slope	0.19901	ft/ft
Velocity	1.68	ft/s
Velocity Head	0.04	ft
Specific Energy	0.20	ft
Froude Number	0.79	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.16	ft
Critical Depth	0.14	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.19901	ft/ft

Summary for Subcatchment WQ6:

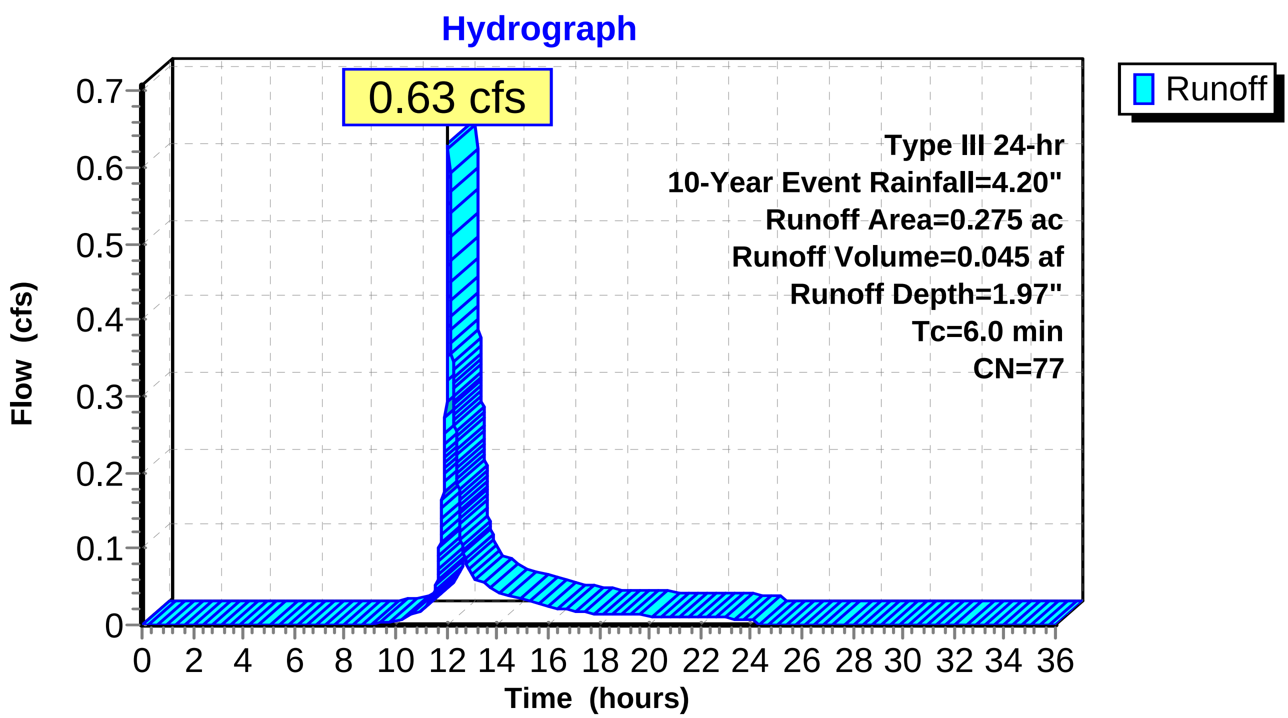
Runoff = 0.63 cfs @ 12.09 hrs, Volume= 0.045 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.092	89	Gravel roads, HSG C
0.183	71	Meadow, non-grazed, HSG C
0.275	77	Weighted Average
0.275		100.00% Pervious Area

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

Subcatchment WQ6:



Summary for Subcatchment WQ8:

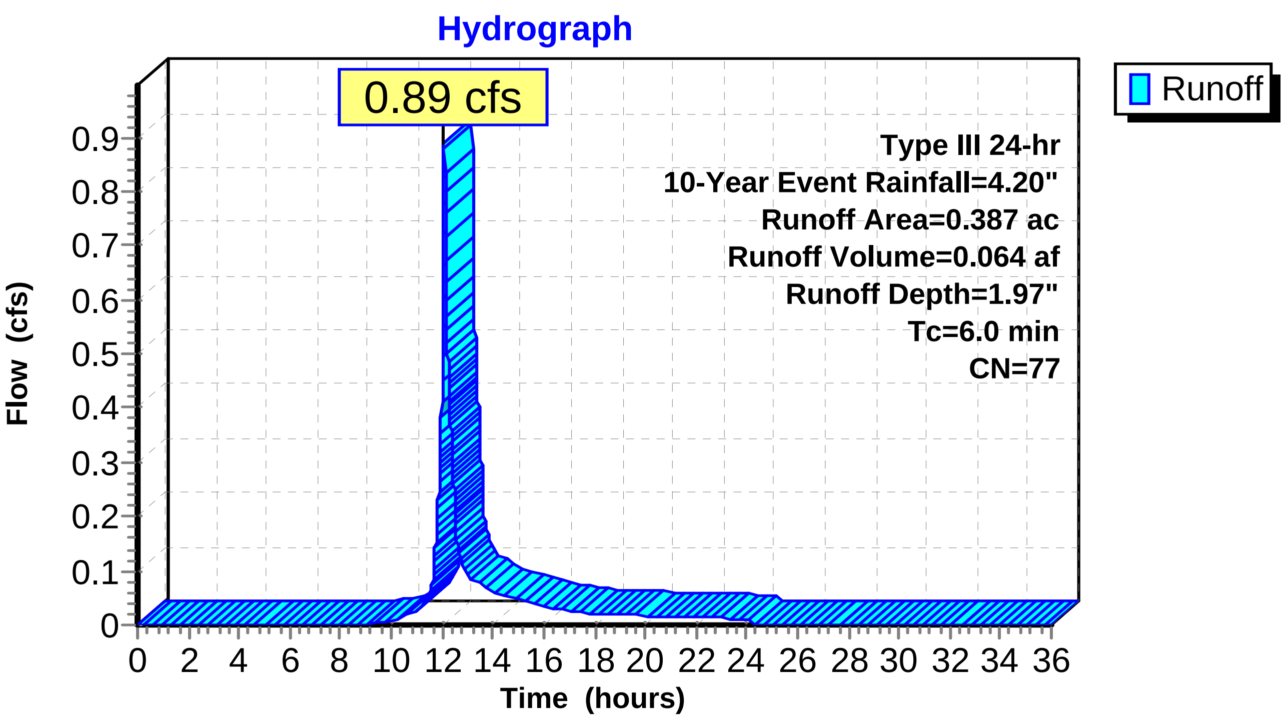
Runoff = 0.89 cfs @ 12.09 hrs, Volume= 0.064 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.119	89	Gravel roads, HSG C
0.268	71	Meadow, non-grazed, HSG C
0.387	77	Weighted Average
0.387		100.00% Pervious Area

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

Subcatchment WQ8:



Summary for Reach 1.1R:

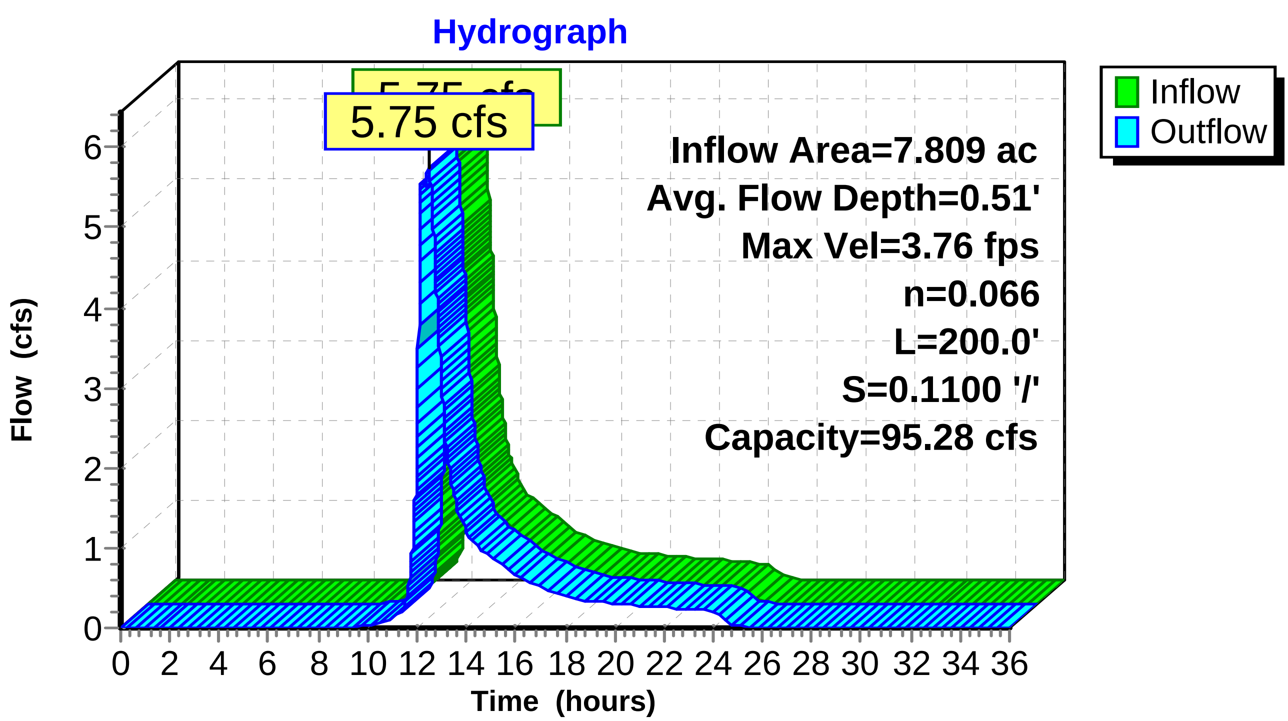
Inflow Area = 7.809 ac, 4.28% Impervious, Inflow Depth = 1.50" for 10-Year Event event
Inflow = 5.75 cfs @ 12.44 hrs, Volume= 0.978 af
Outflow = 5.75 cfs @ 12.45 hrs, Volume= 0.978 af, Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 3.76 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.41 fps, Avg. Travel Time= 2.4 min

Peak Storage= 305 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 95.28 cfs

2.00' x 2.00' deep channel, n= 0.066
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 200.0' Slope= 0.1100 '/'
Inlet Invert= 1,064.00', Outlet Invert= 1,042.00'

Reach 1.1R:



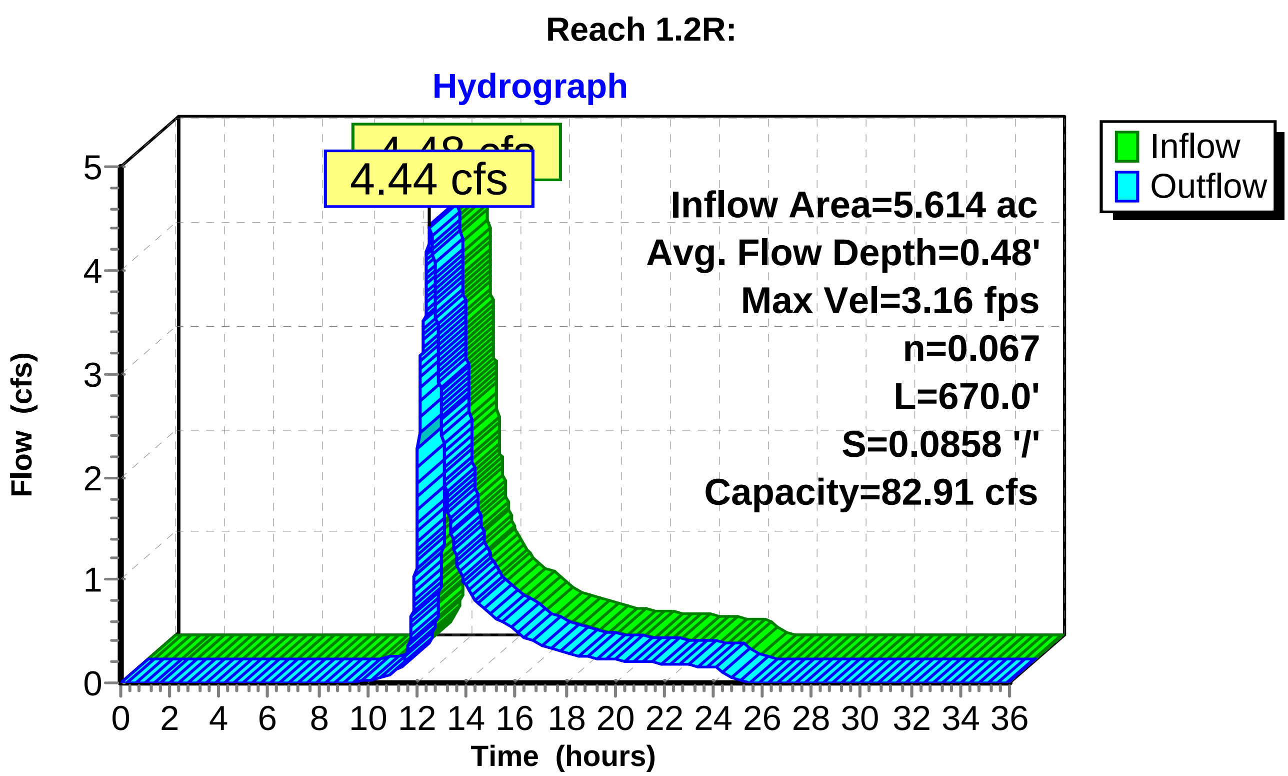
Summary for Reach 1.2R:

Inflow Area = 5.614 ac, 4.42% Impervious, Inflow Depth = 1.57" for 10-Year Event event
Inflow = 4.48 cfs @ 12.49 hrs, Volume= 0.735 af
Outflow = 4.44 cfs @ 12.53 hrs, Volume= 0.735 af, Atten= 1%, Lag= 2.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 3.16 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 1.22 fps, Avg. Travel Time= 9.1 min

Peak Storage= 939 cf @ 12.53 hrs
Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 82.91 cfs

2.00' x 2.00' deep channel, n= 0.067
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 670.0' Slope= 0.0858 '/'
Inlet Invert= 1,121.50', Outlet Invert= 1,064.00'



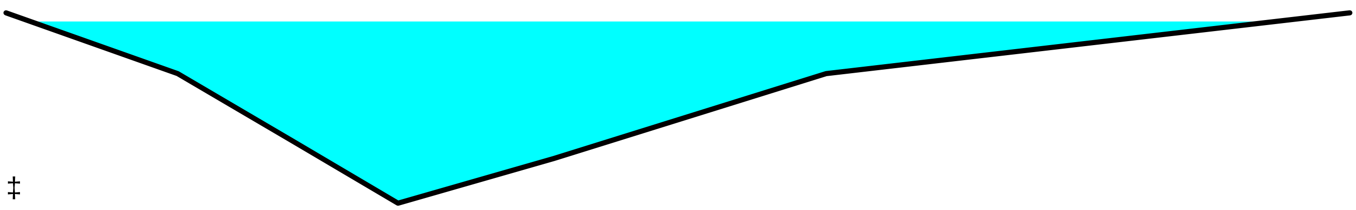
Summary for Reach 1.3R: Stream at Culvert Inlet

Inflow Area = 46.612 ac, 0.00% Impervious, Inflow Depth = 1.47" for 10-Year Event event
Inflow = 43.18 cfs @ 12.45 hrs, Volume= 5.720 af
Outflow = 42.99 cfs @ 12.46 hrs, Volume= 5.720 af, Atten= 0%, Lag= 1.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 5.87 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 2.20 fps, Avg. Travel Time= 4.5 min

Peak Storage= 4,393 cf @ 12.46 hrs
Average Depth at Peak Storage= 1.14'
Defined Flood Depth= 3.00' Flow Area= 39.0 sf, Capacity= 277.60 cfs
Bank-Full Depth= 1.19' Flow Area= 8.2 sf, Capacity= 49.53 cfs

Custom cross-section, Length= 600.0' Slope= 0.0713 '/' (101 Elevation Intervals)
Constant n= 0.040 Mountain streams
Inlet Invert= 1,242.00', Outlet Invert= 1,199.19'

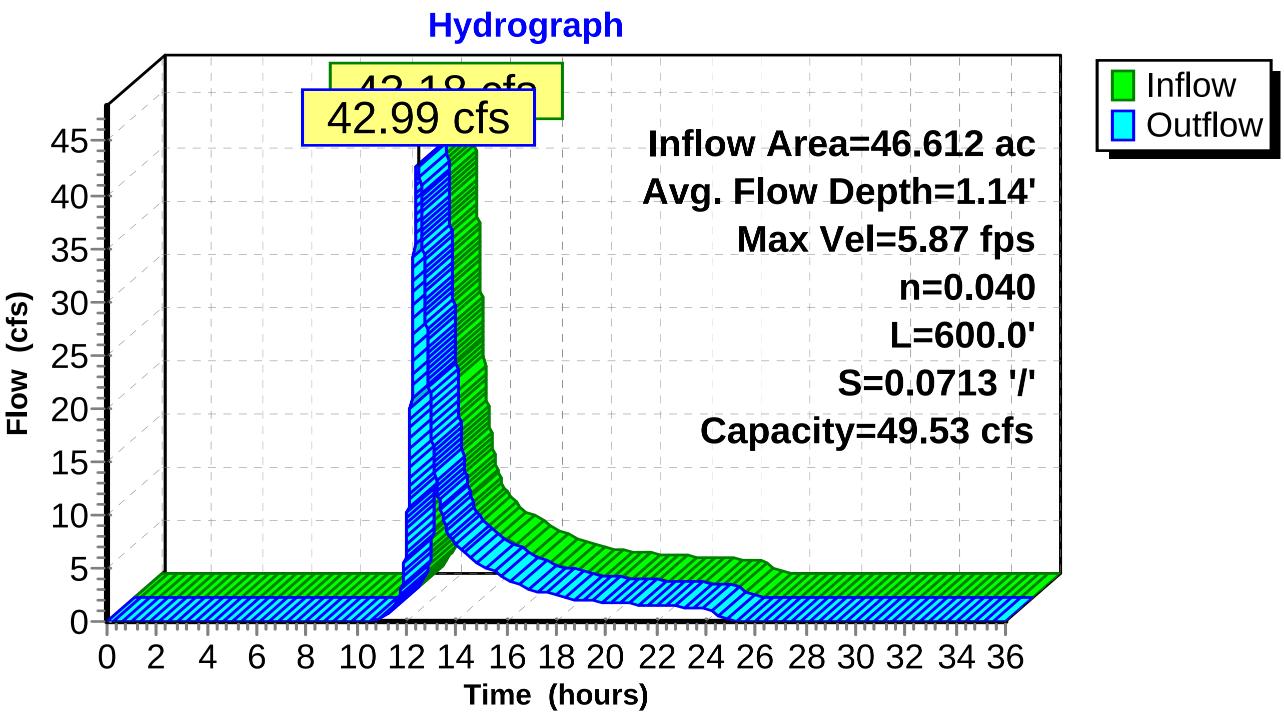


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1,200.38	0.00
2.19	1,200.00	0.38
3.65	1,199.58	0.80
5.00	1,199.19	1.19
6.99	1,199.47	0.91
10.46	1,200.00	0.38
17.14	1,200.38	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
0.28	0.4	3.0	249	1.09
0.39	0.8	4.1	480	2.65
0.81	3.4	8.4	2,034	18.29
1.19	8.2	17.4	4,931	49.53

Reach 1.3R: Stream at Culvert Inlet



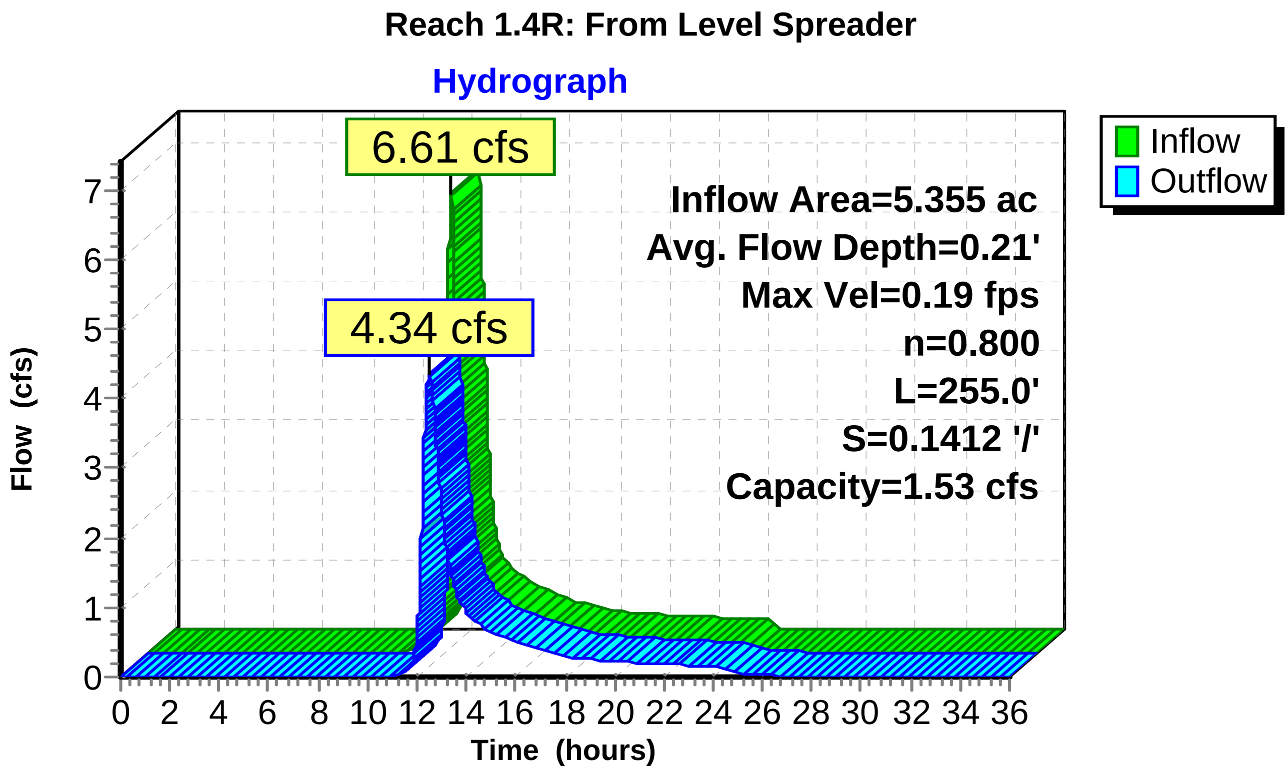
Summary for Reach 1.4R: From Level Spreader

Inflow Area = 5.355 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-Year Event event
Inflow = 6.61 cfs @ 12.26 hrs, Volume= 0.684 af
Outflow = 4.34 cfs @ 12.50 hrs, Volume= 0.683 af, Atten= 34%, Lag= 14.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 0.19 fps, Min. Travel Time= 22.1 min
Avg. Velocity = 0.05 fps, Avg. Travel Time= 78.7 min

Peak Storage= 5,737 cf @ 12.50 hrs
Average Depth at Peak Storage= 0.21'
Bank-Full Depth= 0.10' Flow Area= 10.5 sf, Capacity= 1.53 cfs

100.00' x 0.10' deep channel, n= 0.800
Side Slope Z-value= 50.0 '/' Top Width= 110.00'
Length= 255.0' Slope= 0.1412 '/'
Inlet Invert= 1,258.00', Outlet Invert= 1,222.00'

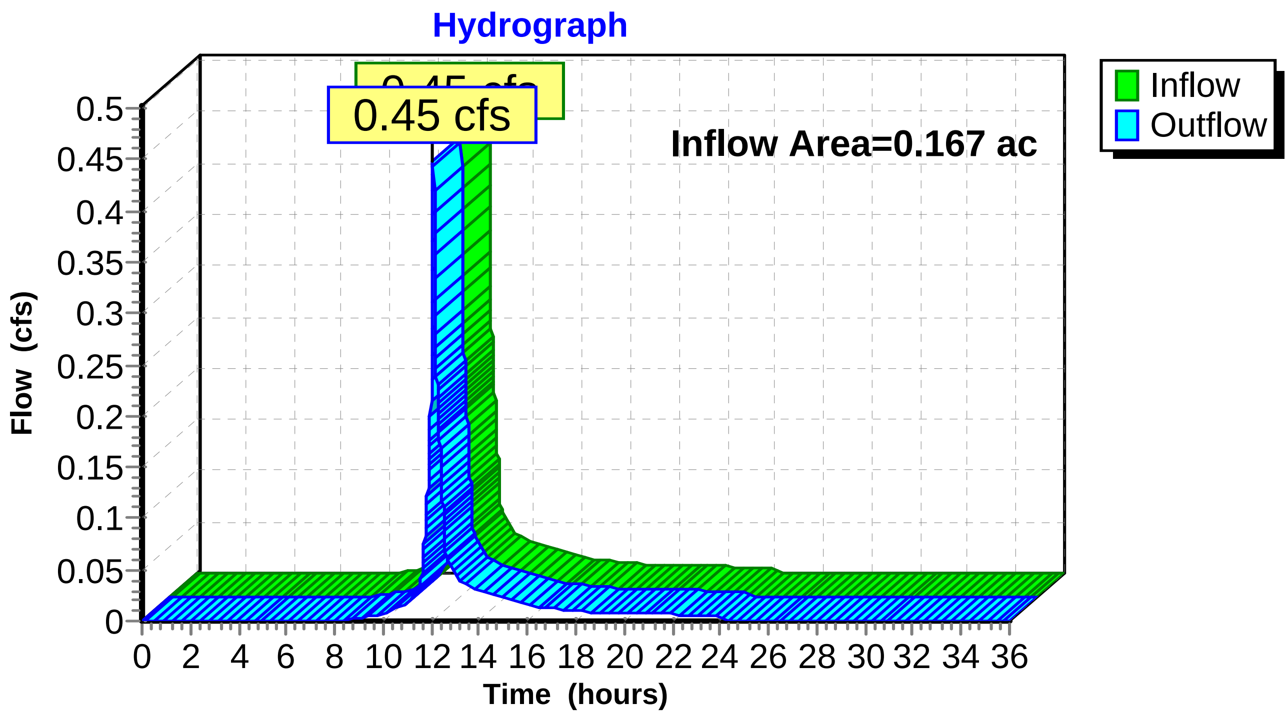


Summary for Reach LS-1:

Inflow Area =	0.167 ac,	0.00% Impervious, Inflow Depth = 2.29"	for 10-Year Event event	
Inflow =	0.45 cfs @	12.09 hrs, Volume=	0.032 af	
Outflow =	0.45 cfs @	12.09 hrs, Volume=	0.032 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach LS-1:

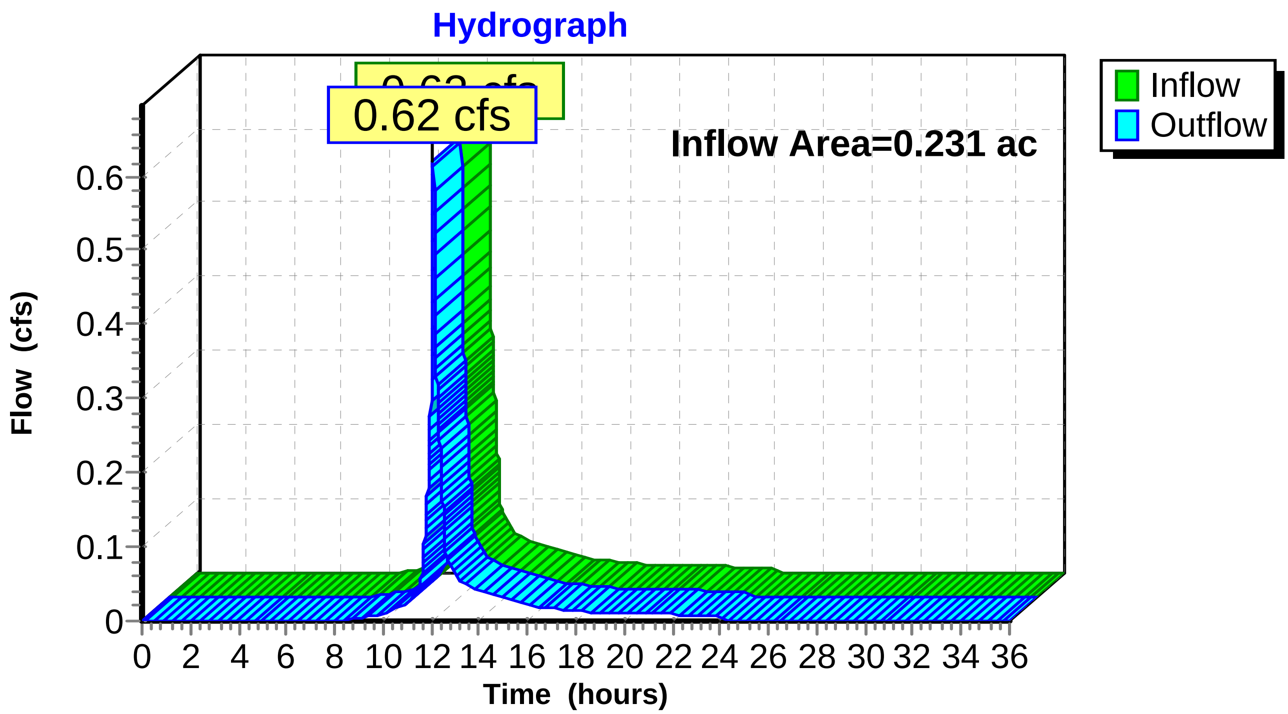


Summary for Reach LS-2:

Inflow Area = 0.231 ac, 0.00% Impervious, Inflow Depth = 2.29" for 10-Year Event event
Inflow = 0.62 cfs @ 12.09 hrs, Volume= 0.044 af
Outflow = 0.62 cfs @ 12.09 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach LS-2:

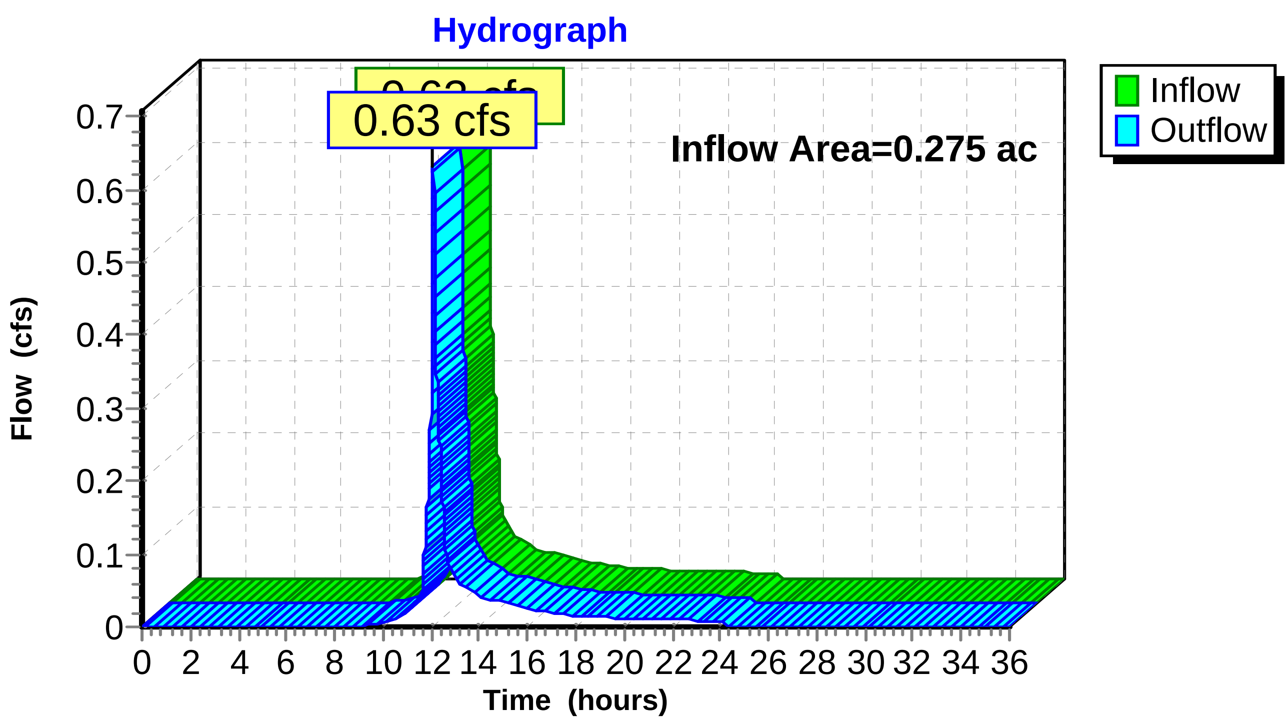


Summary for Reach LS-4:

Inflow Area =	0.275 ac,	0.00% Impervious,	Inflow Depth = 1.97"	for 10-Year Event event	
Inflow =	0.63 cfs @	12.09 hrs,	Volume=	0.045 af	
Outflow =	0.63 cfs @	12.09 hrs,	Volume=	0.045 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach LS-4:

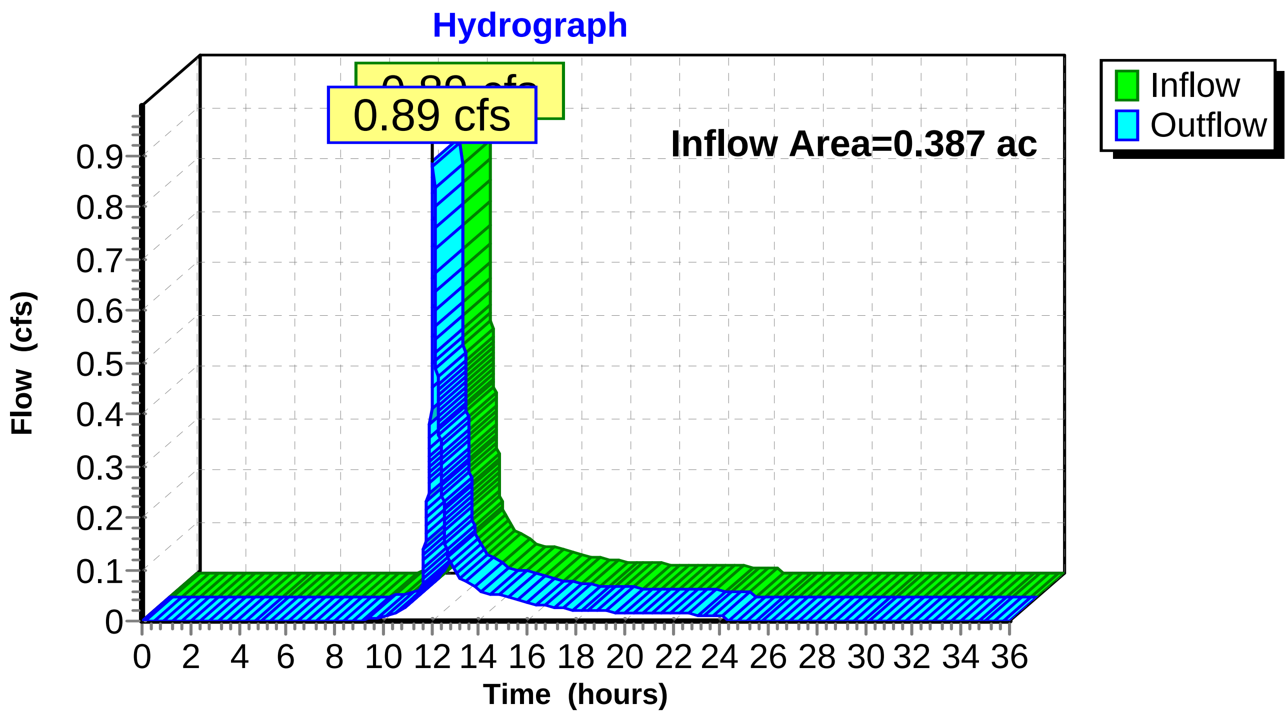


Summary for Reach LS-5:

Inflow Area = 0.387 ac, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year Event event
Inflow = 0.89 cfs @ 12.09 hrs, Volume= 0.064 af
Outflow = 0.89 cfs @ 12.09 hrs, Volume= 0.064 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach LS-5:

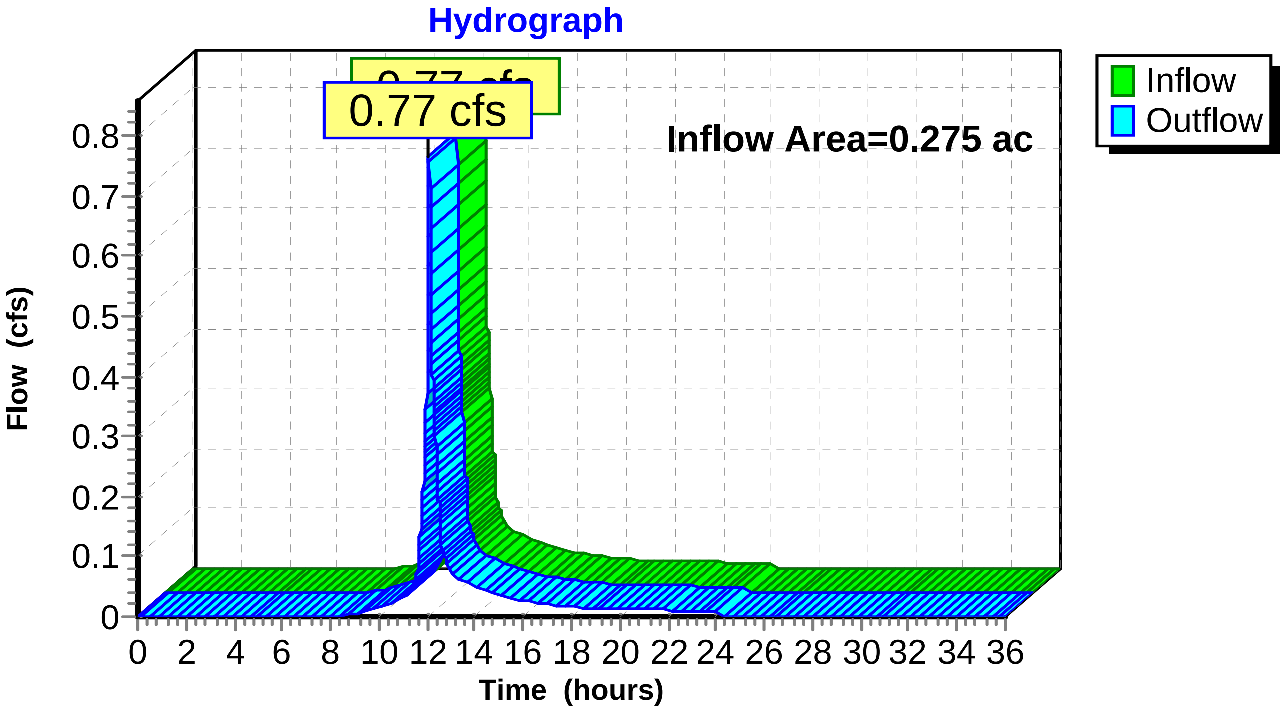


Summary for Reach LS-6:

Inflow Area = 0.275 ac, 0.00% Impervious, Inflow Depth = 2.37" for 10-Year Event event
Inflow = 0.77 cfs @ 12.09 hrs, Volume= 0.054 af
Outflow = 0.77 cfs @ 12.09 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

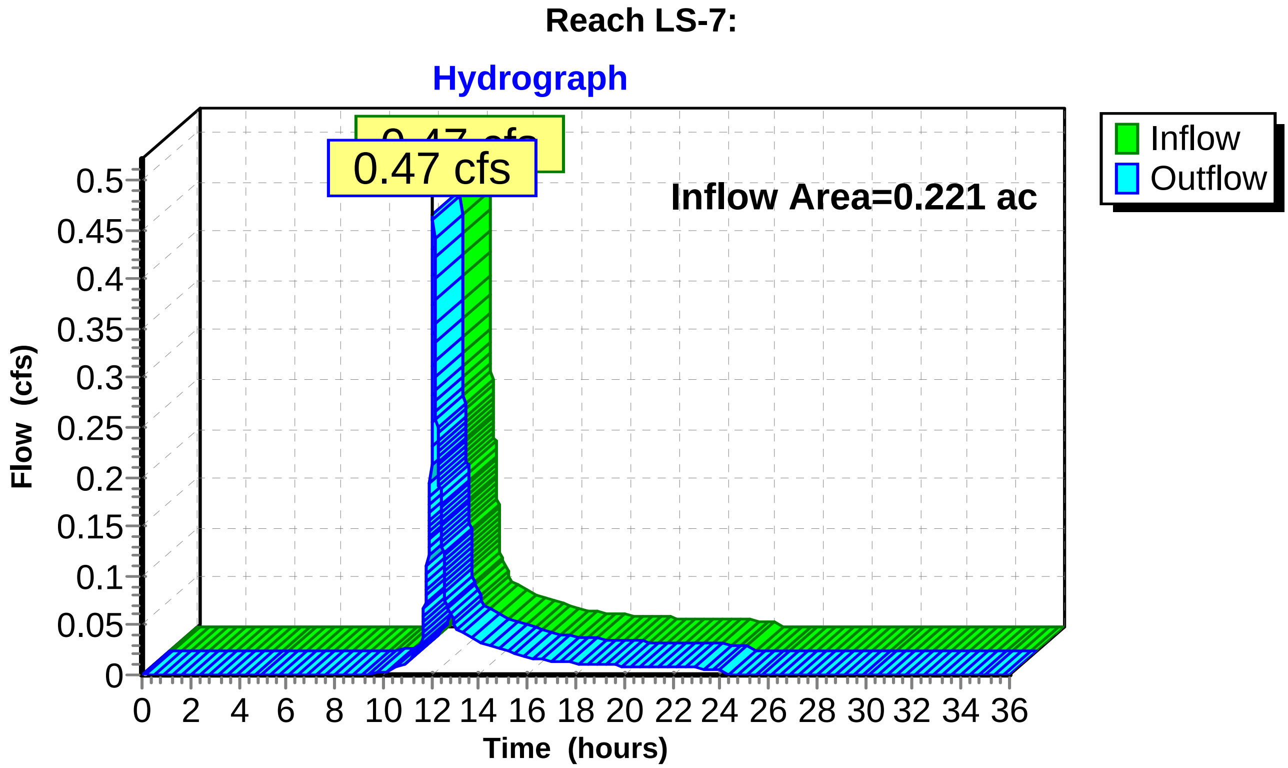
Reach LS-6:



Summary for Reach LS-7:

Inflow Area = 0.221 ac, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year Event event
Inflow = 0.47 cfs @ 12.09 hrs, Volume= 0.033 af
Outflow = 0.47 cfs @ 12.09 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3



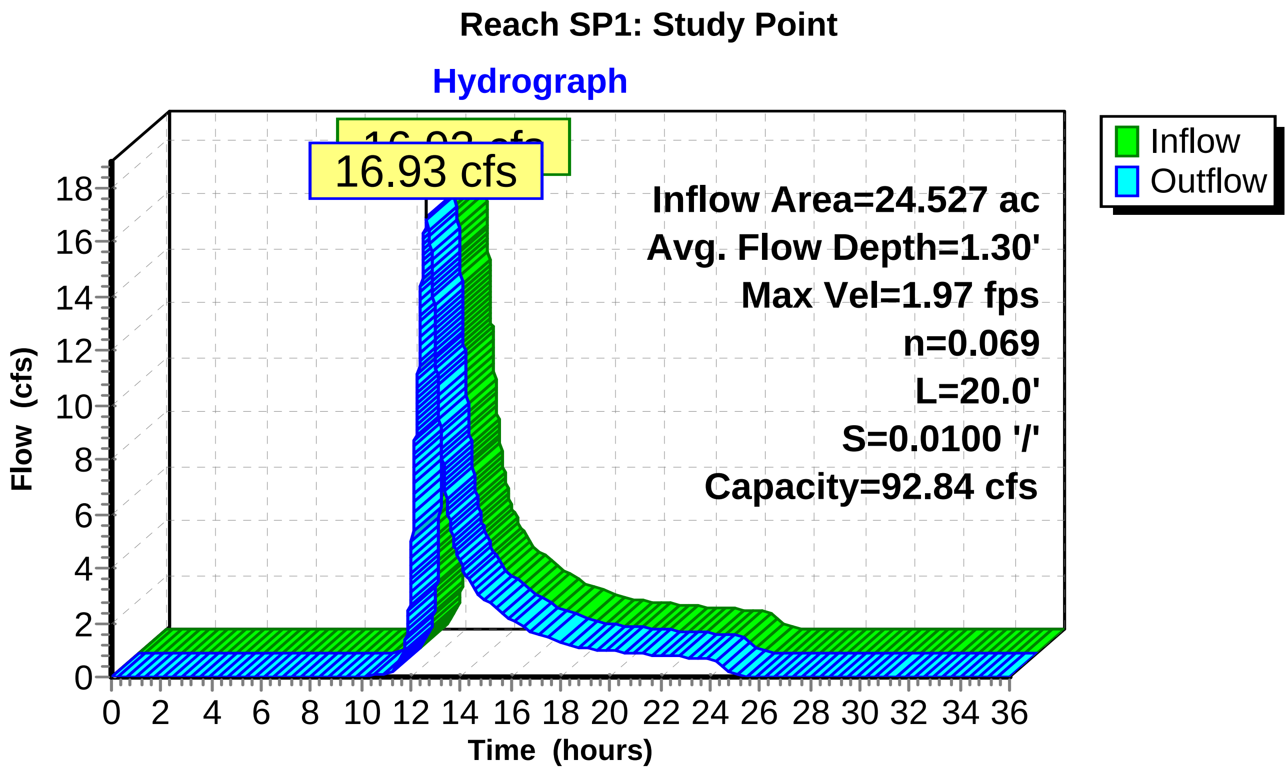
Summary for Reach SP1: Study Point

Inflow Area = 24.527 ac, 1.84% Impervious, Inflow Depth = 1.43" for 10-Year Event event
Inflow = 16.93 cfs @ 12.64 hrs, Volume= 2.926 af
Outflow = 16.93 cfs @ 12.65 hrs, Volume= 2.926 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 1.97 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.58 fps, Avg. Travel Time= 0.6 min

Peak Storage= 172 cf @ 12.65 hrs
Average Depth at Peak Storage= 1.30'
Bank-Full Depth= 3.00' Flow Area= 30.0 sf, Capacity= 92.84 cfs

4.00' x 3.00' deep channel, n= 0.069
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 20.0' Slope= 0.0100 '/'
Inlet Invert= 1,042.00', Outlet Invert= 1,041.80'



Summary for Pond 1P: SD-1

Inflow Area = 16.718 ac, 0.71% Impervious, Inflow Depth = 1.40" for 10-Year Event event
Inflow = 12.05 cfs @ 12.68 hrs, Volume= 1.948 af
Outflow = 12.01 cfs @ 12.71 hrs, Volume= 1.948 af, Atten= 0%, Lag= 1.8 min
Primary = 12.01 cfs @ 12.71 hrs, Volume= 1.948 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,044.31' @ 12.70 hrs Surf.Area= 847 sf Storage= 1,170 cf
Flood Elev= 1,047.00' Surf.Area= 1,875 sf Storage= 4,794 cf

Plug-Flow detention time= 2.3 min calculated for 1.948 af (100% of inflow)
Center-of-Mass det. time= 2.2 min (898.6 - 896.4)

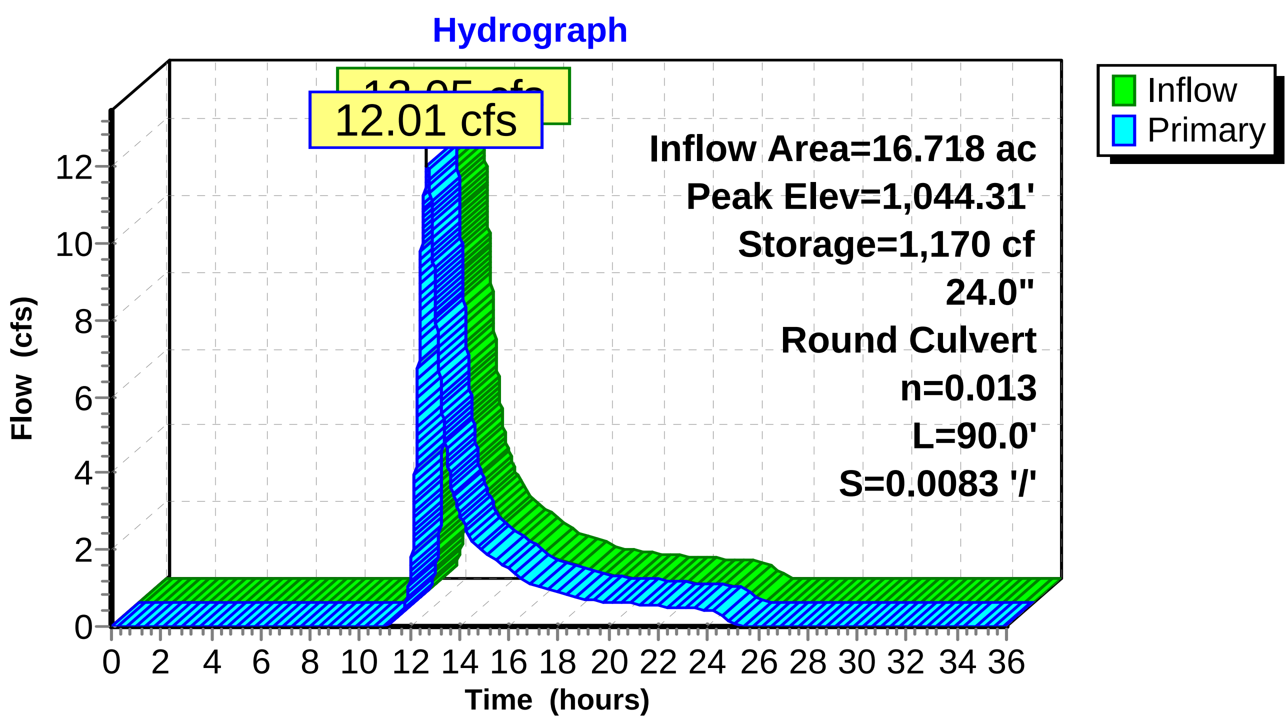
Volume	Invert	Avail.Storage	Storage Description
#1	1,042.00'	4,794 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,042.00	225	70.0	0	0	225
1,044.00	750	135.0	924	924	1,305
1,046.00	1,485	190.0	2,194	3,117	2,764
1,047.00	1,875	200.0	1,676	4,794	3,131

Device	Routing	Invert	Outlet Devices
#1	Primary	1,042.00'	**24.0" Round SD-1** L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,042.00' / 1,041.25' S= 0.0083 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=12.01 cfs @ 12.71 hrs HW=1,044.31' TW=1,043.29' (Dynamic Tailwater)
└─**1=SD-1** (Inlet Controls 12.01 cfs @ 3.82 fps)

Pond 1P: SD-1


Hydrograph
12.05 cfs
12.01 cfs
Inflow Area=16.718 ac
Peak Elev=1,044.31'
Storage=1,170 cf
24.0"
Round Culvert
n=0.013
L=90.0'
S=0.0083 '/'
Inflow
Primary
Flow (cfs)
0
2
4
6
8
10
12
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Time (hours)

Summary for Pond 2P: SD-2

Inflow Area = 1.981 ac, 4.34% Impervious, Inflow Depth = 1.21" for 10-Year Event event
Inflow = 2.01 cfs @ 12.20 hrs, Volume= 0.199 af
Outflow = 2.01 cfs @ 12.20 hrs, Volume= 0.199 af, Atten= 0%, Lag= 0.1 min
Primary = 2.01 cfs @ 12.20 hrs, Volume= 0.199 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,064.87' @ 12.20 hrs Surf.Area= 34 sf Storage= 19 cf

Plug-Flow detention time= 0.4 min calculated for 0.199 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (876.8 - 876.4)

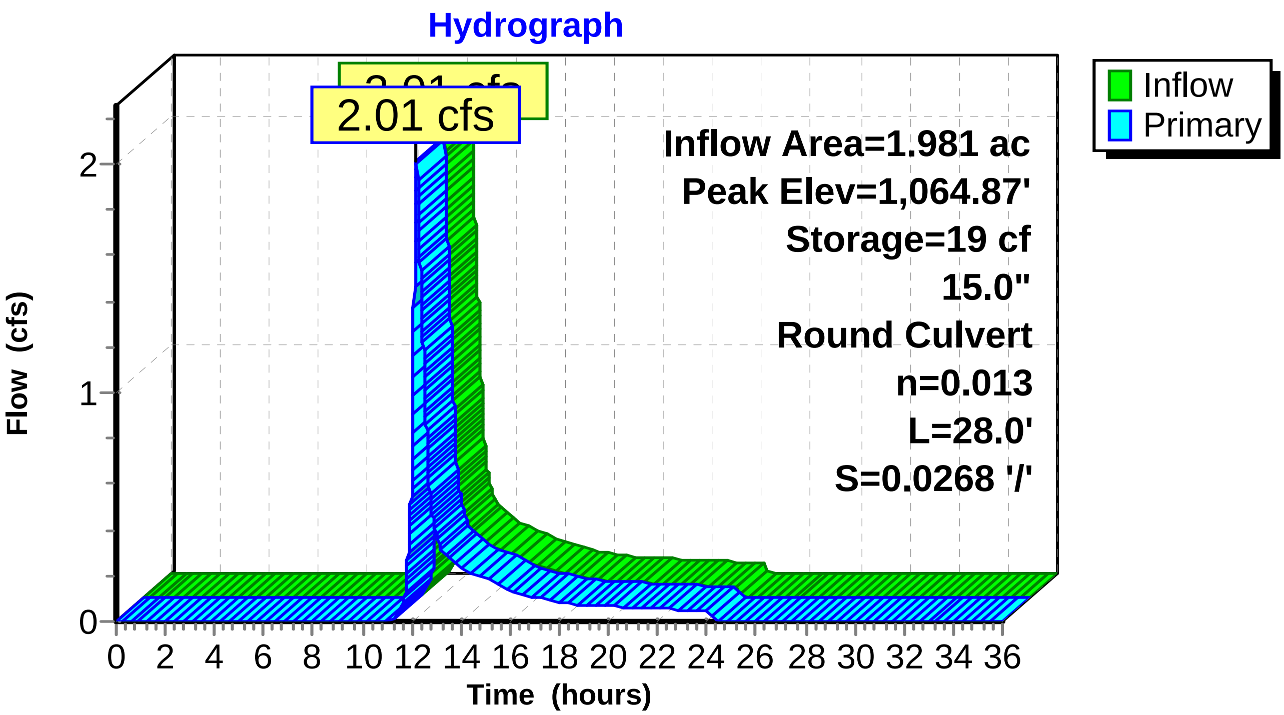
Volume	Invert	Avail.Storage	Storage Description
#1	1,064.00'	195 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,064.00	12	15.0	0	0	12
1,066.00	80	35.0	82	82	106
1,067.00	150	50.0	113	195	216

Device	Routing	Invert	Outlet Devices
#1	Primary	1,064.00'	**15.0" Round SD-2** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,064.00' / 1,063.25' S= 0.0268 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=2.01 cfs @ 12.20 hrs HW=1,064.87' TW=1,064.50' (Dynamic Tailwater)
└─**1=SD-2** (Outlet Controls 2.01 cfs @ 3.09 fps)

Pond 2P: SD-2


Hydrograph
2.01 cfs
2.01 cfs
Inflow Area=1.981 ac
Peak Elev=1,064.87'
Storage=19 cf
15.0"
Round Culvert
n=0.013
L=28.0'
S=0.0268 '/'
Inflow
Primary
Flow (cfs)
0
1
2
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Time (hours)

Summary for Pond 3P: SD-3

Inflow Area = 4.600 ac, 0.00% Impervious, Inflow Depth = 1.46" for 10-Year Event event
Inflow = 3.93 cfs @ 12.53 hrs, Volume= 0.562 af
Outflow = 3.92 cfs @ 12.56 hrs, Volume= 0.562 af, Atten= 0%, Lag= 1.5 min
Primary = 3.92 cfs @ 12.56 hrs, Volume= 0.562 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,123.33' @ 12.56 hrs Surf.Area= 180 sf Storage= 149 cf

Plug-Flow detention time= 0.8 min calculated for 0.561 af (100% of inflow)
Center-of-Mass det. time= 0.8 min (886.1 - 885.3)

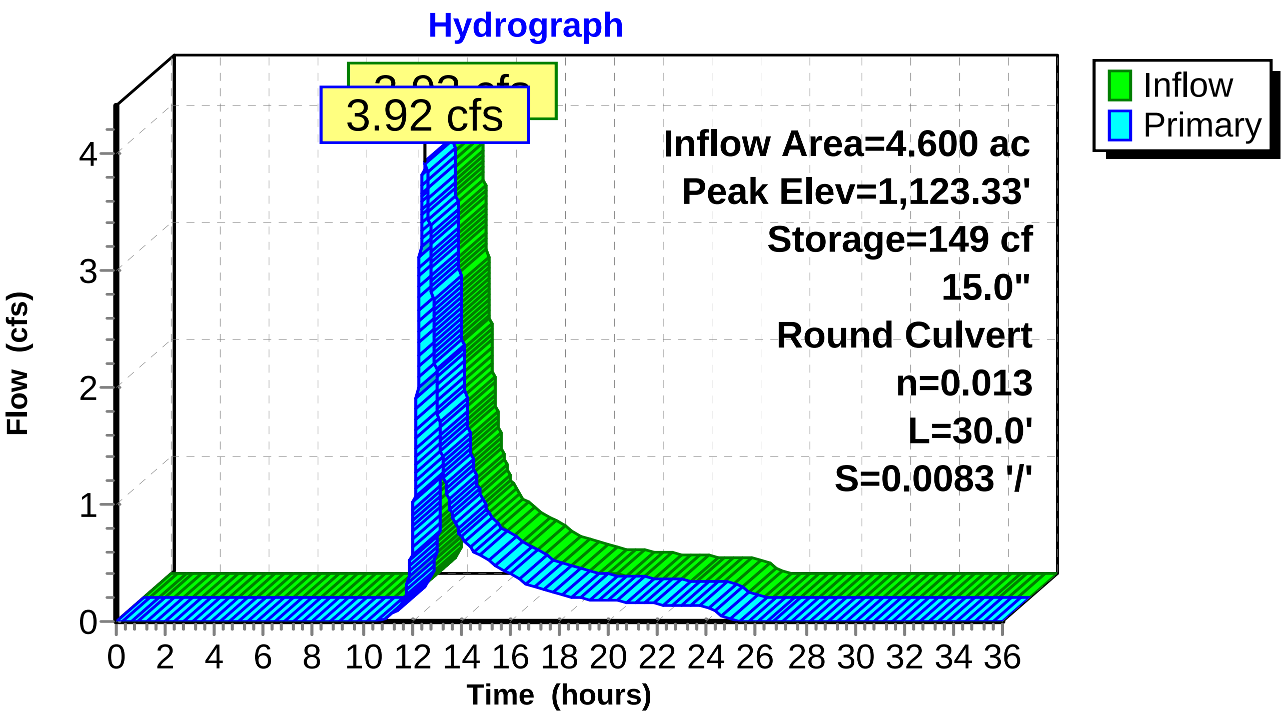
Volume	Invert	Avail.Storage	Storage Description
#1	1,122.00'	666 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,122.00	55	30.0	0	0	55
1,124.00	270	70.0	298	298	389
1,125.00	475	90.0	368	666	656

Device	Routing	Invert	Outlet Devices
#1	Primary	1,122.00'	**15.0" Round SD-3** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,122.00' / 1,121.75' S= 0.0083 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=3.92 cfs @ 12.56 hrs HW=1,123.33' TW=1,121.97' (Dynamic Tailwater)
└─**1=SD-3** (Inlet Controls 3.92 cfs @ 3.20 fps)

Pond 3P: SD-3


Hydrograph
3.92 cfs
3.92 cfs
Inflow
Primary
Inflow Area=4.600 ac
Peak Elev=1,123.33'
Storage=149 cf
15.0"
Round Culvert
n=0.013
L=30.0'
S=0.0083 '/'
Flow (cfs)
0
1
2
3
4
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Time (hours)

Summary for Pond 4P: Box Culvert

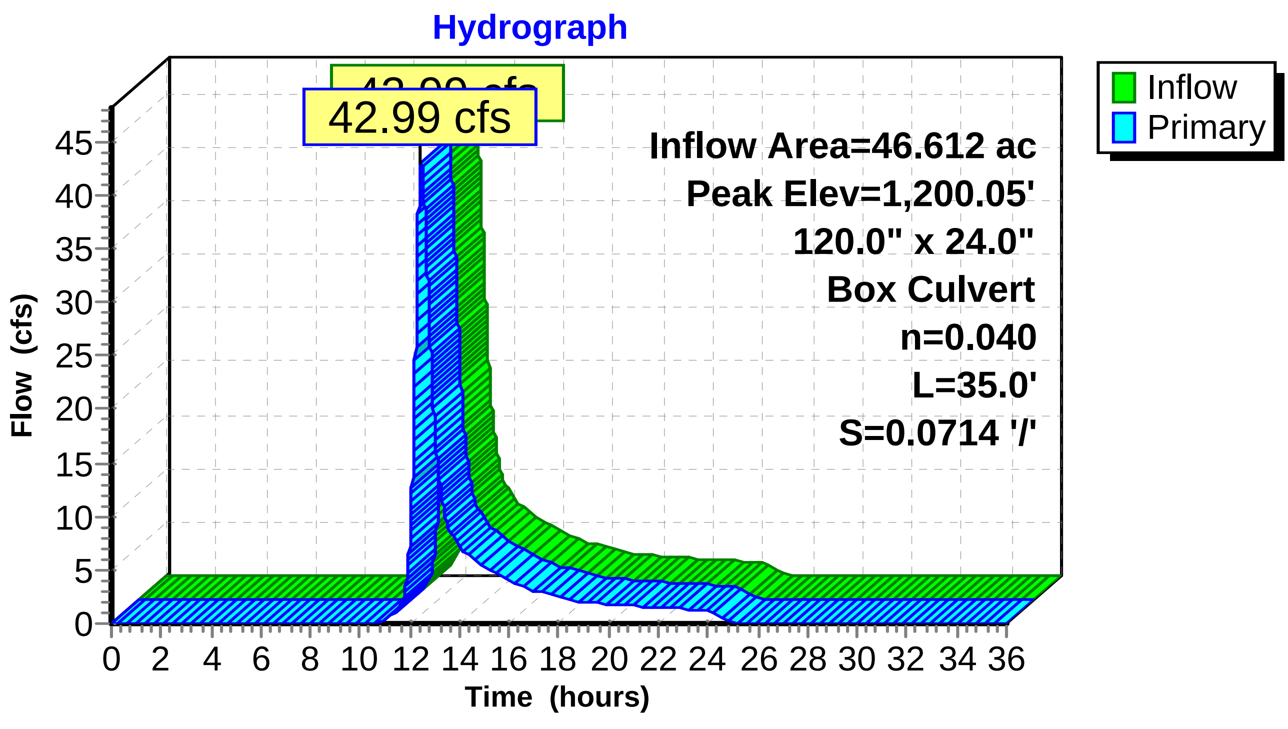
Inflow Area =	46.612 ac,	0.00% Impervious, Inflow Depth = 1.47"	for 10-Year Event event	
Inflow =	42.99 cfs @	12.46 hrs, Volume=	5.720 af	
Outflow =	42.99 cfs @	12.46 hrs, Volume=	5.720 af,	Atten= 0%, Lag= 0.0 min
Primary =	42.99 cfs @	12.46 hrs, Volume=	5.720 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,200.05' @ 12.46 hrs
Flood Elev= 1,201.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,199.00'	**120.0" W x 24.0" H Box SD-4** L= 35.0' Box, headwall w/3 rounded edges, Ke= 0.200 Inlet / Outlet Invert= 1,199.00' / 1,196.50' S= 0.0714 '/' Cc= 0.900 n= 0.040 Mountain streams, Flow Area= 20.00 sf

Primary OutFlow Max=42.98 cfs @ 12.46 hrs HW=1,200.05' (Free Discharge)
└─**1=SD-4** (Inlet Controls 42.98 cfs @ 4.11 fps)

Pond 4P: Box Culvert



Summary for Pond 5P: SD-5

Inflow Area = 5.355 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-Year Event event
Inflow = 6.64 cfs @ 12.25 hrs, Volume= 0.684 af
Outflow = 6.61 cfs @ 12.26 hrs, Volume= 0.684 af, Atten= 0%, Lag= 0.7 min
Primary = 6.61 cfs @ 12.26 hrs, Volume= 0.684 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,263.72' @ 12.26 hrs Surf.Area= 154 sf Storage= 124 cf
Flood Elev= 1,266.00' Surf.Area= 525 sf Storage= 859 cf

Plug-Flow detention time= 0.3 min calculated for 0.684 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (865.4 - 865.1)

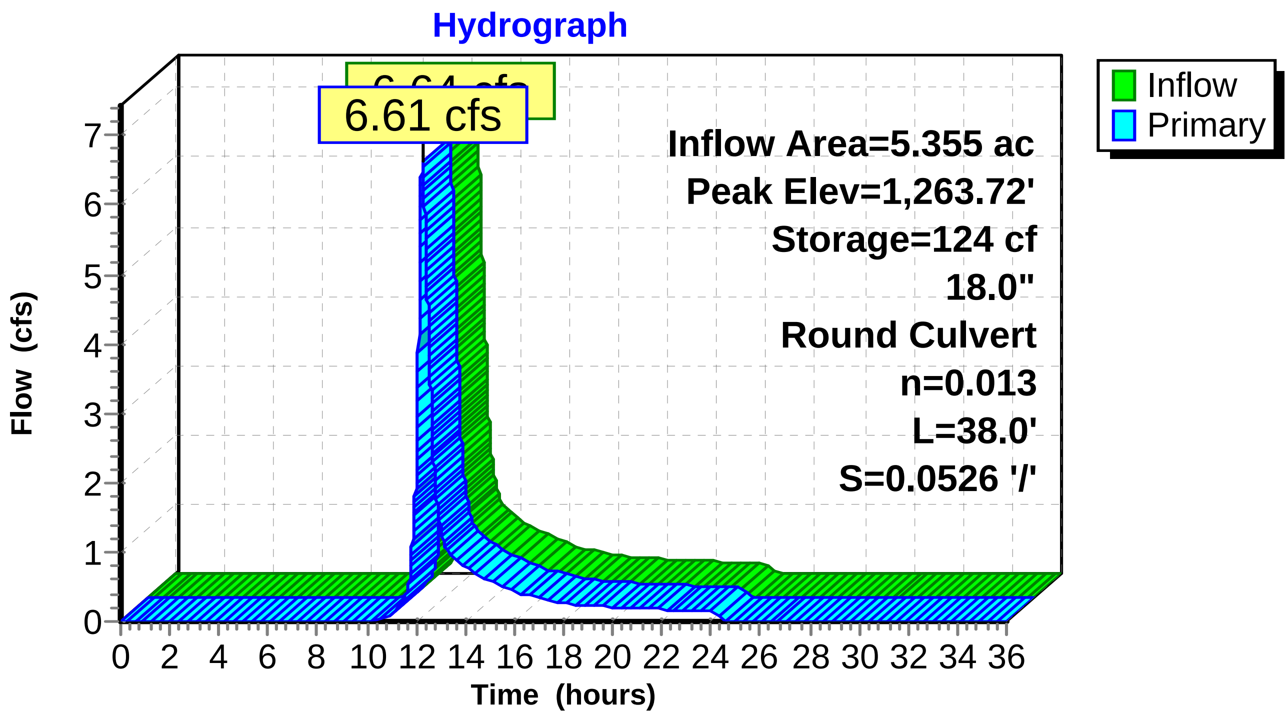
Volume	Invert	Avail.Storage	Storage Description
#1	1,262.00'	859 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,262.00	15	15.0	0	0	15
1,264.00	190	60.0	172	172	294
1,266.00	525	100.0	687	859	828

Device	Routing	Invert	Outlet Devices
#1	Primary	1,262.00'	**18.0" Round SD-5** L= 38.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,262.00' / 1,260.00' S= 0.0526 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=6.61 cfs @ 12.26 hrs HW=1,263.72' TW=1,258.16' (Dynamic Tailwater)
└─**1=SD-5** (Inlet Controls 6.61 cfs @ 3.74 fps)

Pond 5P: SD-5


Hydrograph
6.64 cfs
6.61 cfs
Inflow Area=5.355 ac
Peak Elev=1,263.72'
Storage=124 cf
18.0"
Round Culvert
n=0.013
L=38.0'
S=0.0526 '/'
Inflow
Primary
Flow (cfs)
0
1
2
3
4
5
6
7
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

Summary for Pond 6P: SD-6

Inflow Area =	12.525 ac,	0.00% Impervious, Inflow Depth = 1.46"	for 10-Year Event event	
Inflow =	12.94 cfs @	12.35 hrs, Volume=	1.529 af	
Outflow =	12.61 cfs @	12.40 hrs, Volume=	1.529 af,	Atten= 3%, Lag= 3.2 min
Primary =	12.61 cfs @	12.40 hrs, Volume=	1.529 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,424.12' @ 12.40 hrs Surf.Area= 1,219 sf Storage= 1,108 cf

Plug-Flow detention time= 1.1 min calculated for 1.529 af (100% of inflow)
Center-of-Mass det. time= 1.1 min (875.0 - 873.9)

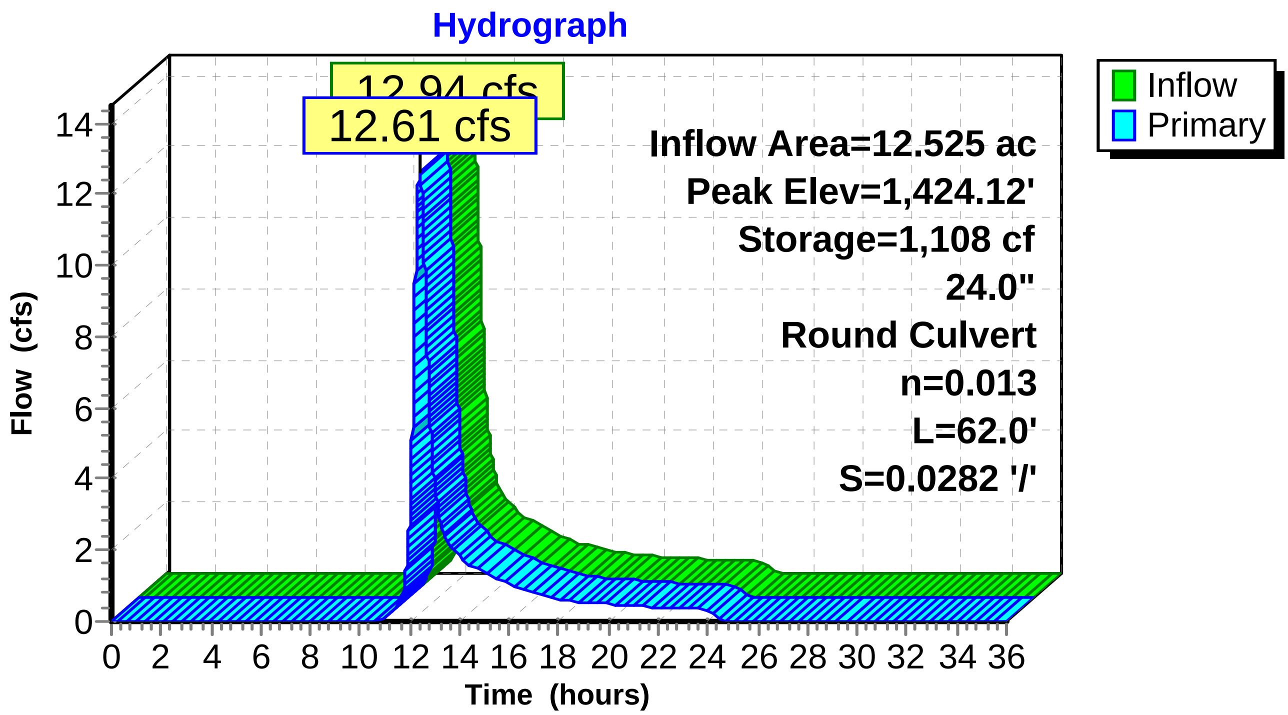
Volume	Invert	Avail.Storage	Storage Description
#1	1,422.00'	5,794 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,422.00	75	55.0	0	0	75
1,424.00	1,100	390.0	975	975	11,946
1,426.00	4,025	975.0	4,819	5,794	75,506

Device	Routing	Invert	Outlet Devices
#1	Primary	1,422.00'	**24.0" Round SD-6** L= 62.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,422.00' / 1,420.25' S= 0.0282 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=12.61 cfs @ 12.40 hrs HW=1,424.11' (Free Discharge)
1=SD-6 (Inlet Controls 12.61 cfs @ 4.01 fps)

Pond 6P: SD-6


Hydrograph
12.94 cfs
12.61 cfs
Inflow Area=12.525 ac
Peak Elev=1,424.12'
Storage=1,108 cf
24.0"
Round Culvert
n=0.013
L=62.0'
S=0.0282 '/'
Inflow
Primary
Flow (cfs)
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36

Summary for Pond 7P: SD-7-11

Inflow Area = 7.206 ac, 0.00% Impervious, Inflow Depth = 1.46" for 10-Year Event event
Inflow = 8.42 cfs @ 12.25 hrs, Volume= 0.880 af
Outflow = 8.42 cfs @ 12.25 hrs, Volume= 0.880 af, Atten= 0%, Lag= 0.0 min
Primary = 8.42 cfs @ 12.25 hrs, Volume= 0.880 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,453.82' @ 12.25 hrs Surf.Area= 46 sf Storage= 24 cf

Plug-Flow detention time= 0.2 min calculated for 0.880 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (868.2 - 868.1)

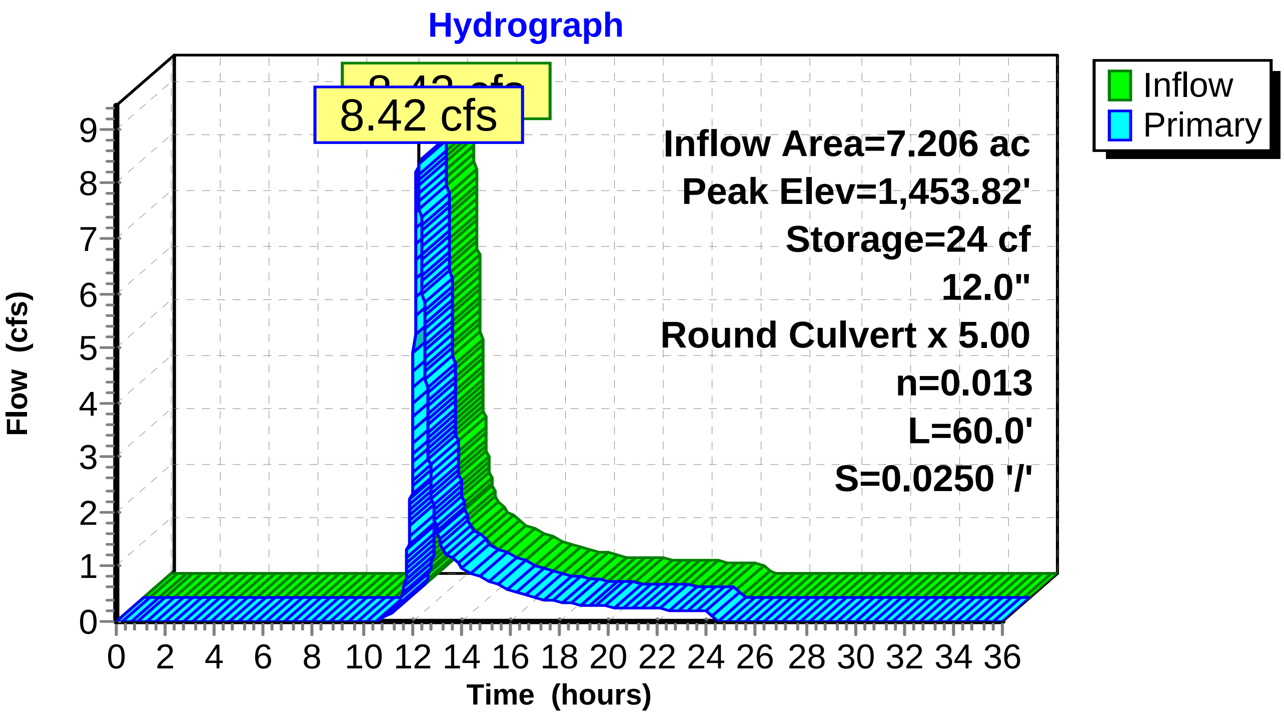
Volume	Invert	Avail.Storage	Storage Description
#1	1,453.00'	273 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,453.00	15	15.0	0	0	15
1,454.00	55	30.0	33	33	73
1,456.00	200	60.0	240	273	306

Device	Routing	Invert	Outlet Devices
#1	Primary	1,453.00'	**12.0" Round SD-7 X 5.00** L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,453.00' / 1,451.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=8.42 cfs @ 12.25 hrs HW=1,453.82' (Free Discharge)
└─**1=SD-7** (Inlet Controls 8.42 cfs @ 2.44 fps)

Pond 7P: SD-7-11



Summary for Pond 8P: SD-12-15

Inflow Area = 8.557 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-Year Event event
Inflow = 9.63 cfs @ 12.33 hrs, Volume= 1.093 af
Outflow = 9.62 cfs @ 12.33 hrs, Volume= 1.093 af, Atten= 0%, Lag= 0.1 min
Primary = 9.62 cfs @ 12.33 hrs, Volume= 1.093 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,558.65' @ 12.33 hrs Surf.Area= 54 sf Storage= 30 cf

Plug-Flow detention time= 0.1 min calculated for 1.093 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (869.4 - 869.4)

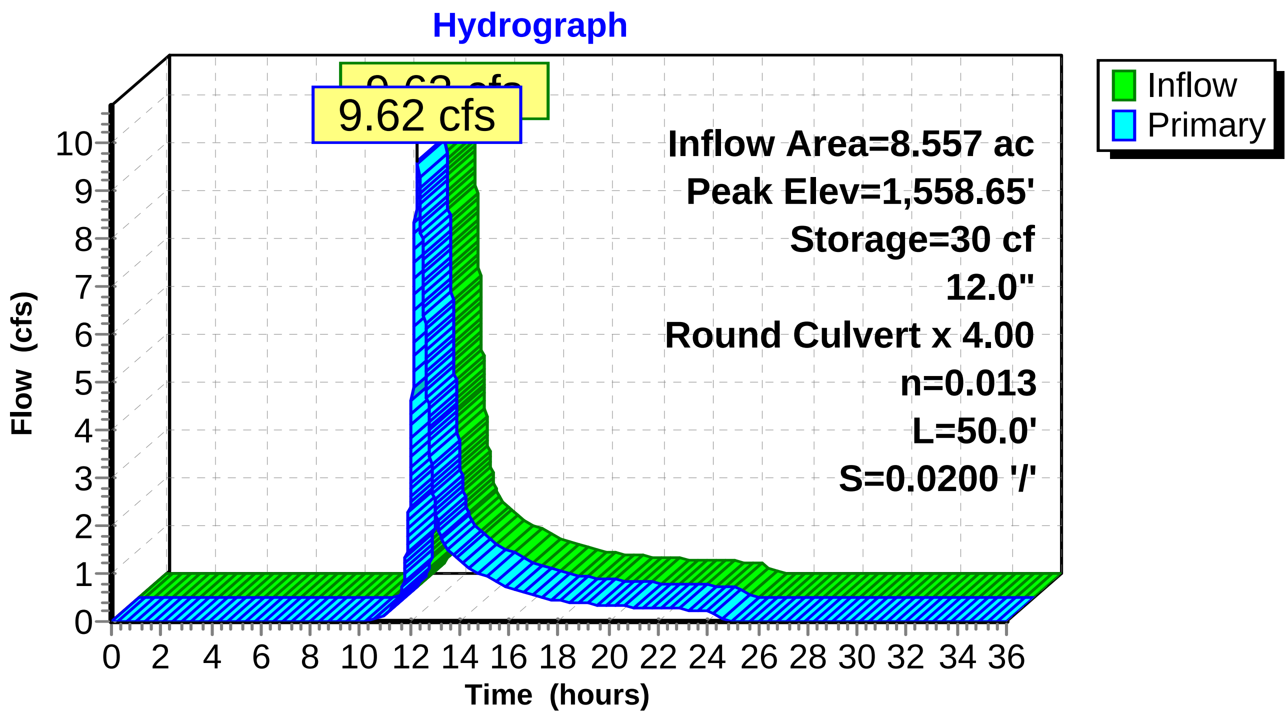
Volume	Invert	Avail.Storage	Storage Description
#1	1,557.50'	798 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,557.50	10	10.0	0	0	10
1,558.00	20	18.0	7	7	29
1,560.00	175	55.0	169	177	256
1,562.00	470	85.0	621	798	619

Device	Routing	Invert	Outlet Devices
#1	Primary	1,557.50'	**12.0" Round SD-12 X 4.00** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,557.50' / 1,556.50' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=9.62 cfs @ 12.33 hrs HW=1,558.65' (Free Discharge)
└─**1=SD-12** (Inlet Controls 9.62 cfs @ 3.06 fps)

Pond 8P: SD-12-15



Summary for Pond 9P: SD-16

Inflow Area = 5.297 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-Year Event event
Inflow = 5.40 cfs @ 12.40 hrs, Volume= 0.677 af
Outflow = 5.40 cfs @ 12.42 hrs, Volume= 0.677 af, Atten= 0%, Lag= 1.1 min
Primary = 5.40 cfs @ 12.42 hrs, Volume= 0.677 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,603.96' @ 12.42 hrs Surf.Area= 88 sf Storage= 83 cf
Flood Elev= 1,606.00' Surf.Area= 210 sf Storage= 378 cf

Plug-Flow detention time= 0.2 min calculated for 0.676 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (874.8 - 874.6)

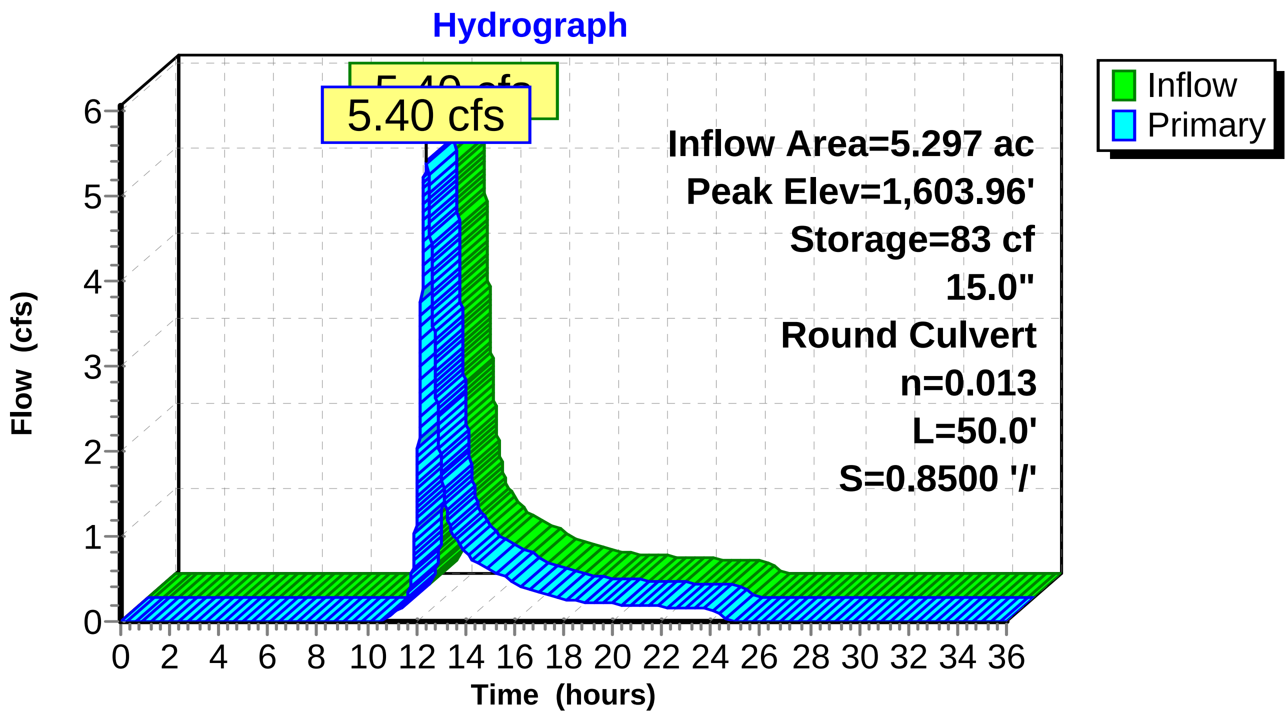
Volume	Invert	Avail.Storage	Storage Description
#1	1,602.00'	378 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,602.00	10	12.0	0	0	10
1,604.00	90	40.0	87	87	137
1,606.00	210	65.0	292	378	371

Device	Routing	Invert	Outlet Devices
#1	Primary	1,602.00'	**15.0" Round SD-16** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,602.00' / 1,559.50' S= 0.8500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=5.40 cfs @ 12.42 hrs HW=1,603.96' (Free Discharge)
└─**1=SD-16** (Inlet Controls 5.40 cfs @ 4.40 fps)

Pond 9P: SD-16


Hydrograph
5.40 cfs
5.40 cfs
Inflow
Primary
Inflow Area=5.297 ac
Peak Elev=1,603.96'
Storage=83 cf
15.0"
Round Culvert
n=0.013
L=50.0'
S=0.8500 '/'
Flow (cfs)
0
1
2
3
4
5
6
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

Summary for Pond 10P: SD-17

Inflow Area = 1.538 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-Year Event event
Inflow = 1.54 cfs @ 12.43 hrs, Volume= 0.196 af
Outflow = 1.54 cfs @ 12.43 hrs, Volume= 0.196 af, Atten= 0%, Lag= 0.2 min
Primary = 1.54 cfs @ 12.43 hrs, Volume= 0.196 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,675.69' @ 12.43 hrs Surf.Area= 43 sf Storage= 17 cf

Plug-Flow detention time= 0.3 min calculated for 0.196 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (875.9 - 875.7)

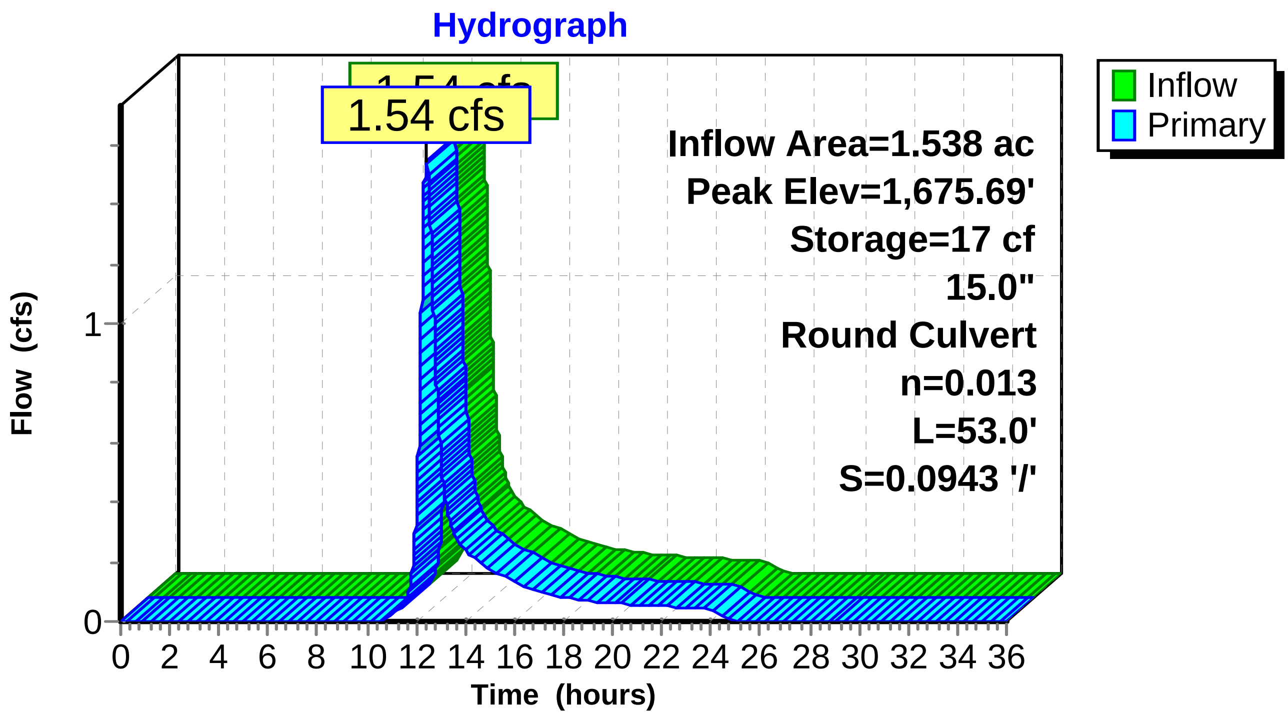
Volume	Invert	Avail.Storage	Storage Description
#1	1,675.00'	295 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,675.00	10	10.0	0	0	10
1,676.00	65	35.0	33	33	102
1,678.00	210	60.0	261	295	314

Device	Routing	Invert	Outlet Devices
#1	Primary	1,675.00'	**15.0" Round SD-17** L= 53.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,675.00' / 1,670.00' S= 0.0943 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=1.54 cfs @ 12.43 hrs HW=1,675.69' (Free Discharge)
└─**1=SD-17** (Inlet Controls 1.54 cfs @ 2.23 fps)

Pond 10P: SD-17



Summary for Pond 11P: SD-18

Inflow Area = 9.148 ac, 0.00% Impervious, Inflow Depth = 1.74" for 10-Year Event event
Inflow = 10.39 cfs @ 12.43 hrs, Volume= 1.330 af
Outflow = 9.81 cfs @ 12.53 hrs, Volume= 1.330 af, Atten= 6%, Lag= 5.9 min
Primary = 9.81 cfs @ 12.53 hrs, Volume= 1.330 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,639.36' @ 12.53 hrs Surf.Area= 4,572 sf Storage= 3,794 cf

Plug-Flow detention time= 10.3 min calculated for 1.330 af (100% of inflow)
Center-of-Mass det. time= 10.2 min (878.8 - 868.6)

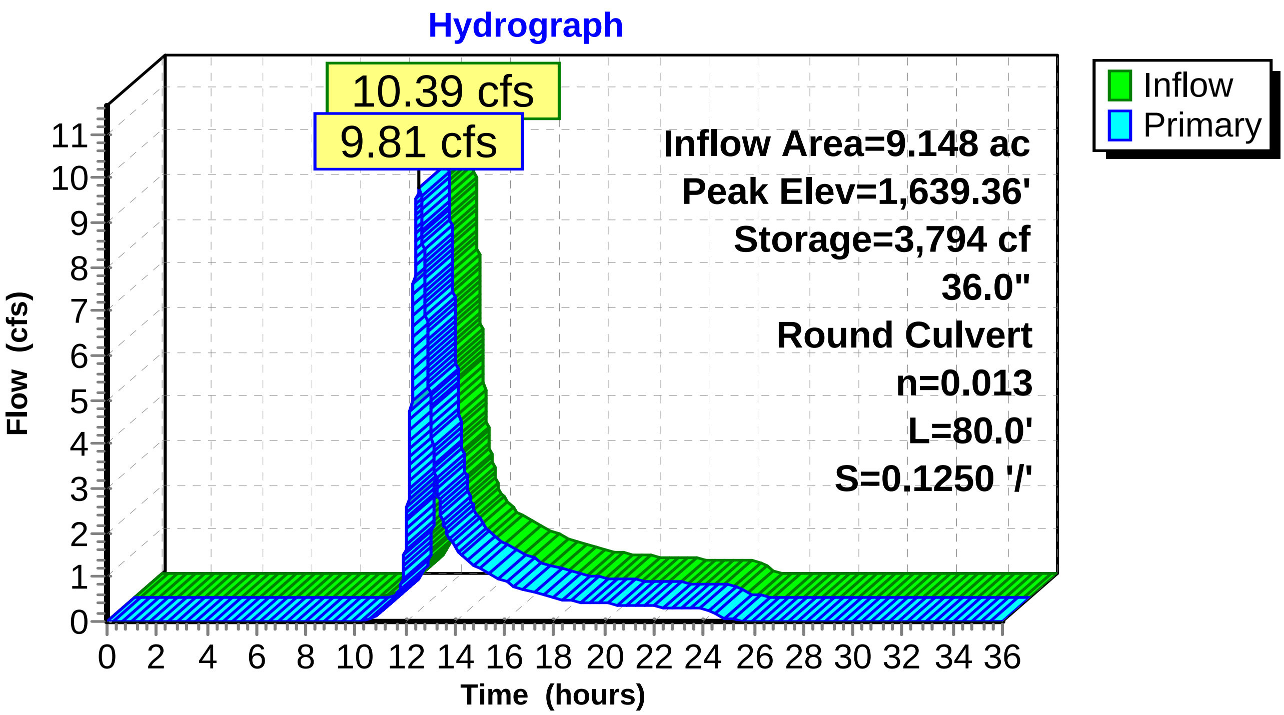
Volume	Invert	Avail.Storage	Storage Description
#1	1,638.00'	46,536 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,638.00	1,320	200.0	0	0	1,320
1,640.00	6,760	450.0	7,378	7,378	14,268
1,642.00	16,100	535.0	22,195	29,573	21,003
1,643.00	17,840	560.0	16,963	46,536	23,249

Device	Routing	Invert	Outlet Devices
#1	Primary	1,638.00'	**36.0" Round SD-18** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,638.00' / 1,628.00' S= 0.1250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=9.81 cfs @ 12.53 hrs HW=1,639.36' (Free Discharge)
└─**1=SD-18** (Inlet Controls 9.81 cfs @ 3.14 fps)

Pond 11P: SD-18



Summary for Pond 12P: SD-19

Inflow Area = 2.416 ac, 0.00% Impervious, Inflow Depth = 1.46" for 10-Year Event event
Inflow = 2.21 cfs @ 12.47 hrs, Volume= 0.295 af
Outflow = 2.14 cfs @ 12.54 hrs, Volume= 0.292 af, Atten= 3%, Lag= 4.1 min
Primary = 2.14 cfs @ 12.54 hrs, Volume= 0.292 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,681.44' @ 12.54 hrs Surf.Area= 1,096 sf Storage= 731 cf

Plug-Flow detention time= 15.7 min calculated for 0.292 af (99% of inflow)
Center-of-Mass det. time= 9.5 min (890.3 - 880.8)

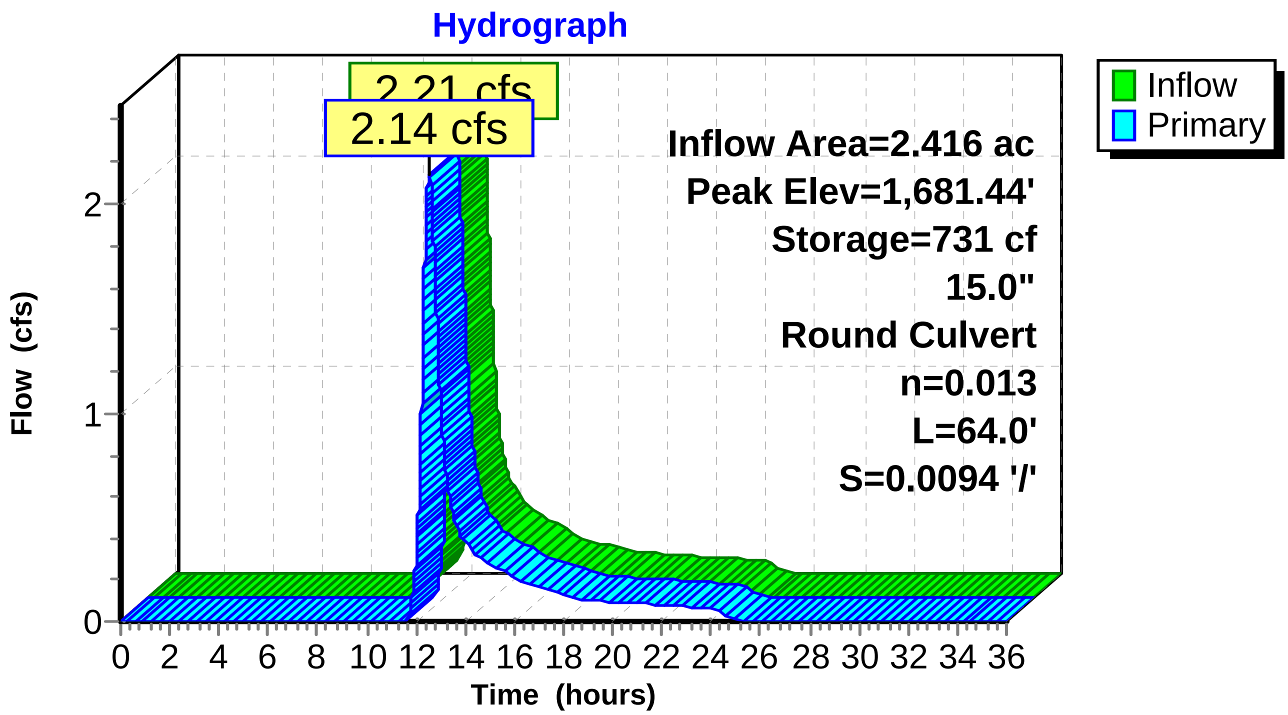
Volume	Invert	Avail.Storage	Storage Description
#1	1,680.00'	1,535 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,680.00	100	45.0	0	0	100
1,682.00	1,780	510.0	1,535	1,535	20,644

Device	Routing	Invert	Outlet Devices
#1	Primary	1,680.60'	**15.0" Round SD-19** L= 64.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,680.60' / 1,680.00' S= 0.0094 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=2.14 cfs @ 12.54 hrs HW=1,681.44' (Free Discharge)
└─**1=SD-19** (Inlet Controls 2.14 cfs @ 2.46 fps)

Pond 12P: SD-19



Summary for Pond 13P: SD-20

Inflow Area = 1.587 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-Year Event event
Inflow = 1.71 cfs @ 12.35 hrs, Volume= 0.203 af
Outflow = 1.71 cfs @ 12.37 hrs, Volume= 0.203 af, Atten= 0%, Lag= 0.9 min
Primary = 1.71 cfs @ 12.37 hrs, Volume= 0.203 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,701.54' @ 12.37 hrs Surf.Area= 281 sf Storage= 81 cf

Plug-Flow detention time= 1.1 min calculated for 0.203 af (100% of inflow)
Center-of-Mass det. time= 1.1 min (872.6 - 871.5)

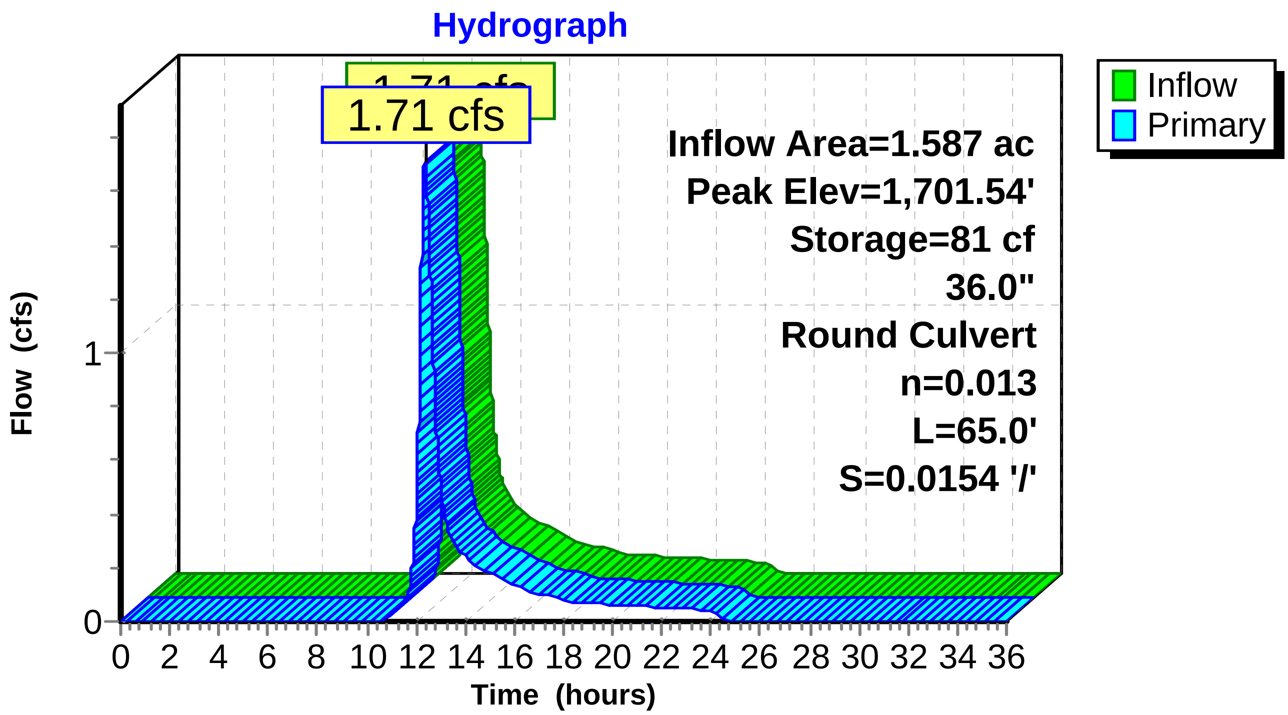
Volume	Invert	Avail.Storage	Storage Description
#1	1,701.00'	7,277 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,701.00	50	25.0	0	0	50
1,702.00	625	105.0	284	284	880
1,704.00	7,675	440.0	6,993	7,277	15,419

Device	Routing	Invert	Outlet Devices
#1	Primary	1,701.00'	**36.0" Round SD-20** L= 65.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,701.00' / 1,700.00' S= 0.0154 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=1.71 cfs @ 12.37 hrs HW=1,701.54' (Free Discharge)
└─**1=SD-20** (Inlet Controls 1.71 cfs @ 1.97 fps)

Pond 13P: SD-20



Summary for Pond 14P: SD-21

Inflow Area =	1.898 ac,	0.00% Impervious, Inflow Depth = 1.60"	for 10-Year Event event	
Inflow =	2.64 cfs @	12.21 hrs, Volume=	0.253 af	
Outflow =	2.65 cfs @	12.21 hrs, Volume=	0.253 af,	Atten= 0%, Lag= 0.1 min
Primary =	2.65 cfs @	12.21 hrs, Volume=	0.253 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,563.96' @ 12.21 hrs Surf.Area= 19 sf Storage= 14 cf

Plug-Flow detention time= 0.3 min calculated for 0.253 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (860.0 - 859.8)

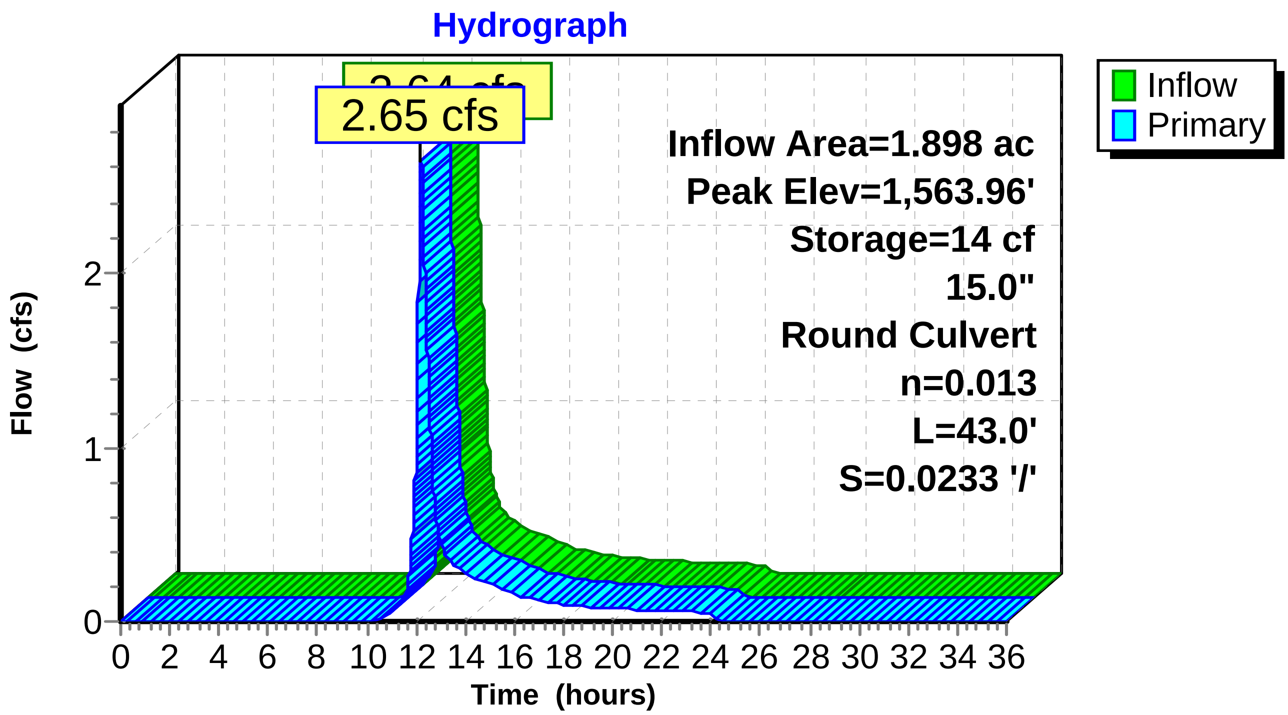
Volume	Invert	Avail.Storage	Storage Description
#1	1,563.00'	153 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,563.00	10	10.0	0	0	10
1,564.00	20	20.0	15	15	38
1,566.00	135	50.0	138	153	219

Device	Routing	Invert	Outlet Devices
#1	Primary	1,563.00'	**15.0" Round SD-21** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,563.00' / 1,562.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=2.64 cfs @ 12.21 hrs HW=1,563.96' (Free Discharge)
1=SD-21 (Inlet Controls 2.64 cfs @ 2.63 fps)

Pond 14P: SD-21



Summary for Pond 15P: SD-22-23

Inflow Area = 2.191 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-Year Event event
Inflow = 2.40 cfs @ 12.35 hrs, Volume= 0.280 af
Outflow = 2.40 cfs @ 12.35 hrs, Volume= 0.280 af, Atten= 0%, Lag= 0.1 min
Primary = 2.40 cfs @ 12.35 hrs, Volume= 0.280 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,605.66' @ 12.35 hrs Surf.Area= 25 sf Storage= 11 cf

Plug-Flow detention time= 0.2 min calculated for 0.280 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (870.8 - 870.7)

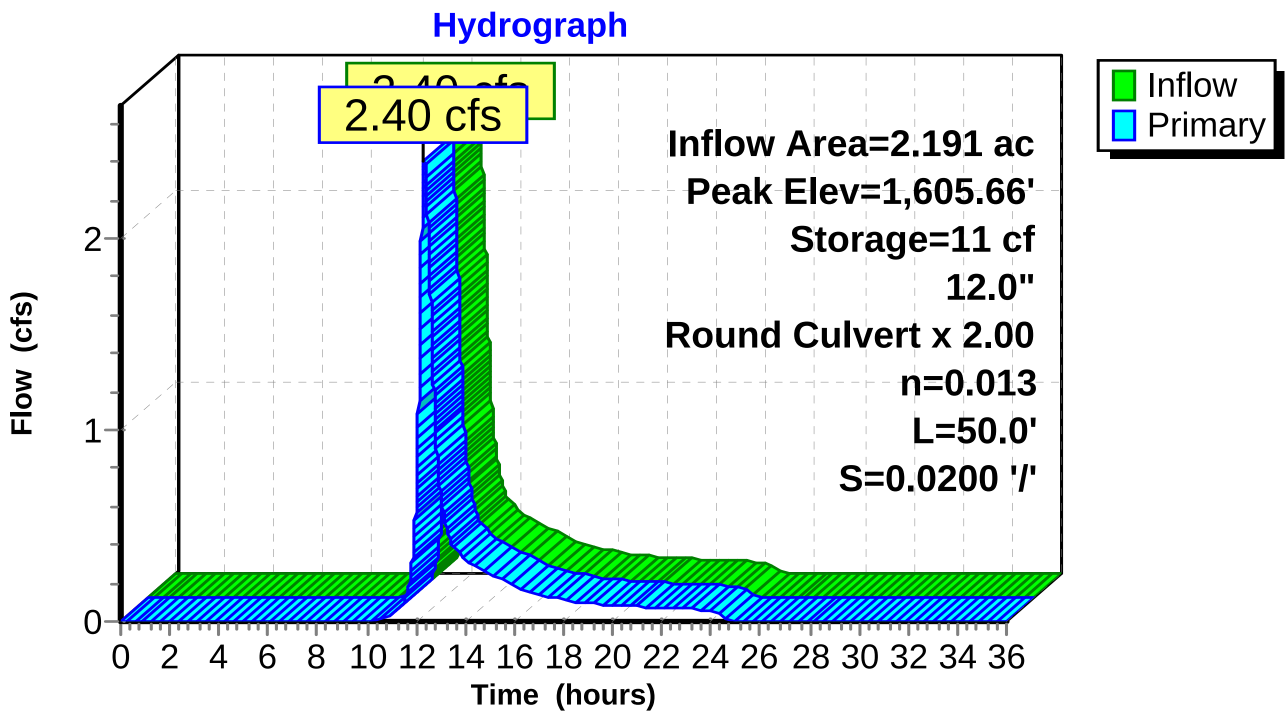
Volume	Invert	Avail.Storage	Storage Description
#1	1,605.00'	205 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,605.00	10	10.0	0	0	10
1,606.00	35	25.0	21	21	55
1,608.00	165	50.0	184	205	222

Device	Routing	Invert	Outlet Devices
#1	Primary	1,605.00'	**12.0" Round SD-22 X 2.00** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,605.00' / 1,604.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.40 cfs @ 12.35 hrs HW=1,605.66' (Free Discharge)
└─**1=SD-22** (Inlet Controls 2.40 cfs @ 2.18 fps)

Pond 15P: SD-22-23



Summary for Pond 16P: SD-24

Inflow Area =	0.278 ac,	0.00% Impervious,	Inflow Depth = 1.53"	for 10-Year Event event
Inflow =	0.33 cfs @	12.27 hrs, Volume=	0.036 af	
Outflow =	0.33 cfs @	12.28 hrs, Volume=	0.036 af, Atten= 0%, Lag= 0.1 min	
Primary =	0.33 cfs @	12.28 hrs, Volume=	0.036 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,671.30' @ 12.28 hrs Surf.Area= 16 sf Storage= 4 cf

Plug-Flow detention time= 0.5 min calculated for 0.036 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (867.2 - 866.8)

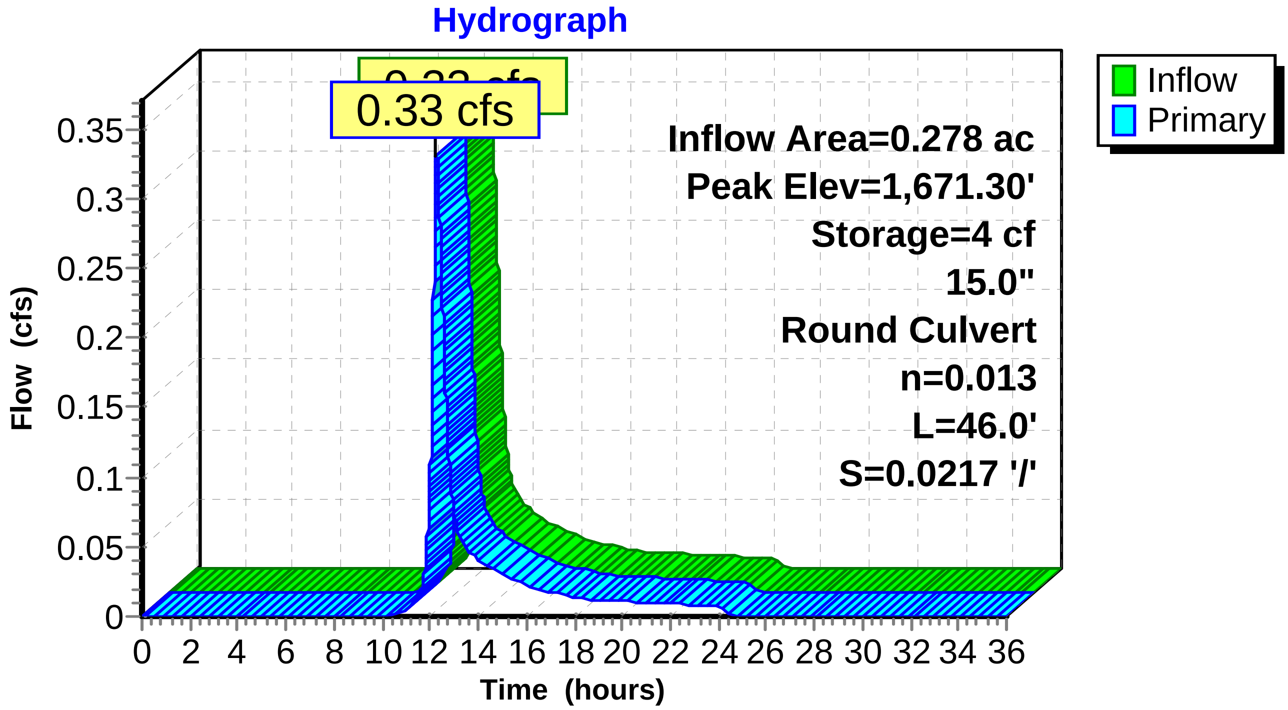
Volume	Invert	Avail.Storage	Storage Description
#1	1,671.00'	201 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,671.00	10	10.0	0	0	10
1,672.00	35	25.0	21	21	55
1,674.00	160	50.0	180	201	222

Device	Routing	Invert	Outlet Devices
#1	Primary	1,671.00'	**15.0" Round SD-24** L= 46.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,671.00' / 1,670.00' S= 0.0217 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.33 cfs @ 12.28 hrs HW=1,671.30' (Free Discharge)
1=SD-24 (Inlet Controls 0.33 cfs @ 1.47 fps)

Pond 16P: SD-24



Summary for Pond 17P: SD-25

Inflow Area = 0.510 ac, 0.00% Impervious, Inflow Depth = 1.46" for 10-Year Event event
Inflow = 0.53 cfs @ 12.35 hrs, Volume= 0.062 af
Outflow = 0.53 cfs @ 12.35 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.1 min
Primary = 0.53 cfs @ 12.35 hrs, Volume= 0.062 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,679.38' @ 12.35 hrs Surf.Area= 18 sf Storage= 5 cf

Plug-Flow detention time= 0.3 min calculated for 0.062 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (873.8 - 873.4)

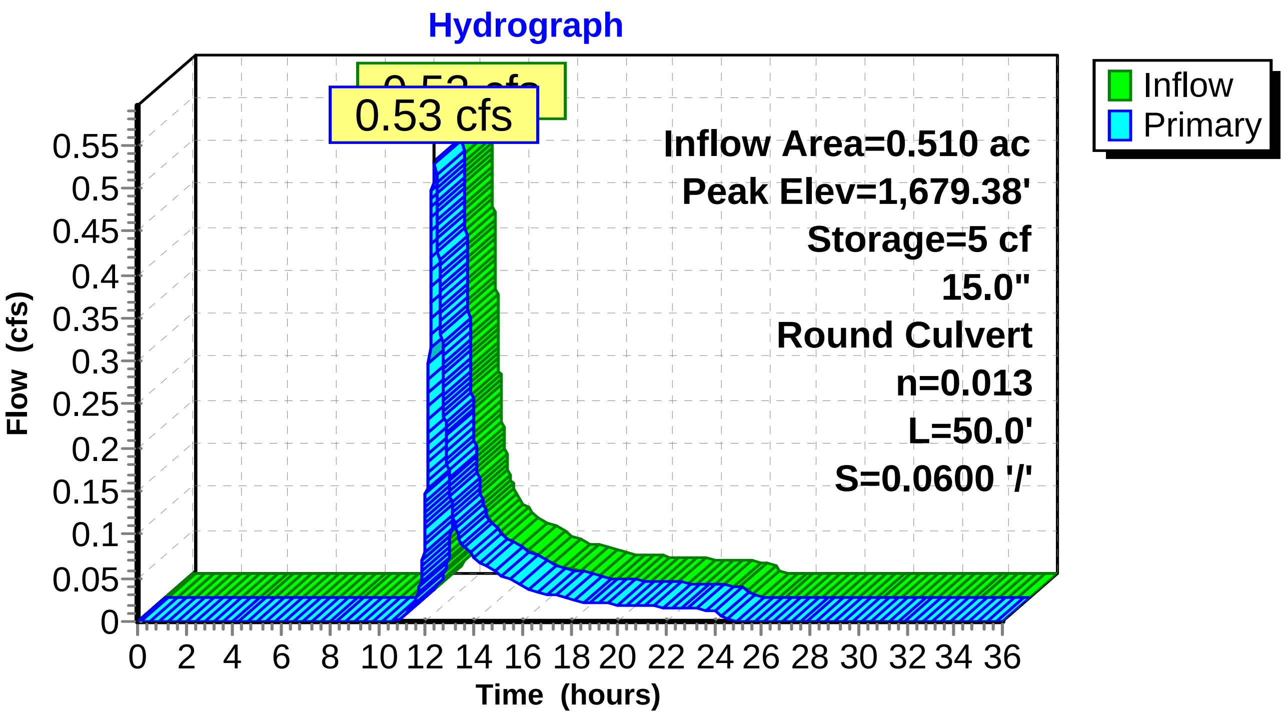
Volume	Invert	Avail.Storage	Storage Description
#1	1,679.00'	305 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,679.00	10	10.0	0	0	10
1,680.00	35	35.0	21	21	102
1,682.00	290	115.0	284	305	1,069

Device	Routing	Invert	Outlet Devices
#1	Primary	1,679.00'	**15.0" Round SD-25** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,679.00' / 1,676.00' S= 0.0600 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.53 cfs @ 12.35 hrs HW=1,679.38' (Free Discharge)
└─**1=SD-25** (Inlet Controls 0.53 cfs @ 1.66 fps)

Pond 17P: SD-25



Summary for Pond 18P: SD-26

Inflow Area = 10.036 ac, 0.00% Impervious, Inflow Depth = 1.46" for 10-Year Event event
Inflow = 16.15 cfs @ 12.10 hrs, Volume= 1.225 af
Outflow = 13.97 cfs @ 12.15 hrs, Volume= 1.225 af, Atten= 13%, Lag= 3.0 min
Primary = 13.97 cfs @ 12.15 hrs, Volume= 1.225 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,601.67' @ 12.15 hrs Surf.Area= 3,510 sf Storage= 2,896 cf

Plug-Flow detention time= 4.4 min calculated for 1.225 af (100% of inflow)
Center-of-Mass det. time= 4.4 min (862.6 - 858.2)

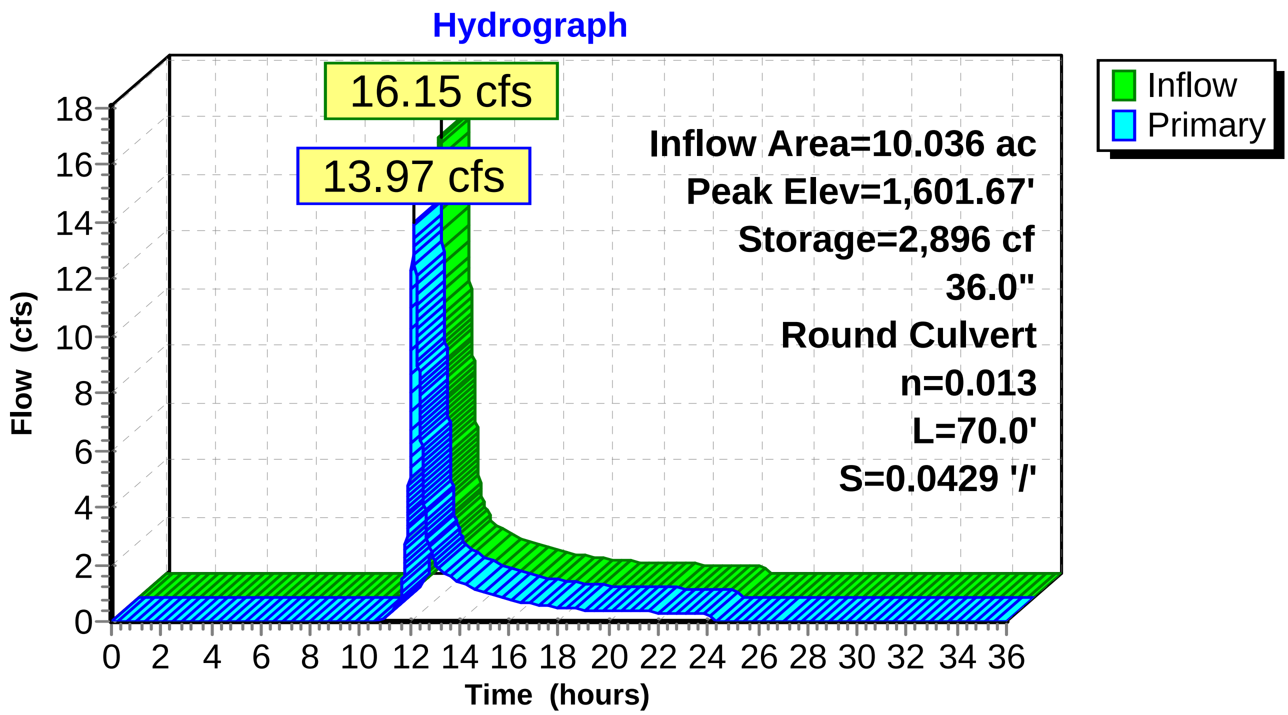
Volume	Invert	Avail.Storage	Storage Description
#1	1,600.00'	9,543 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

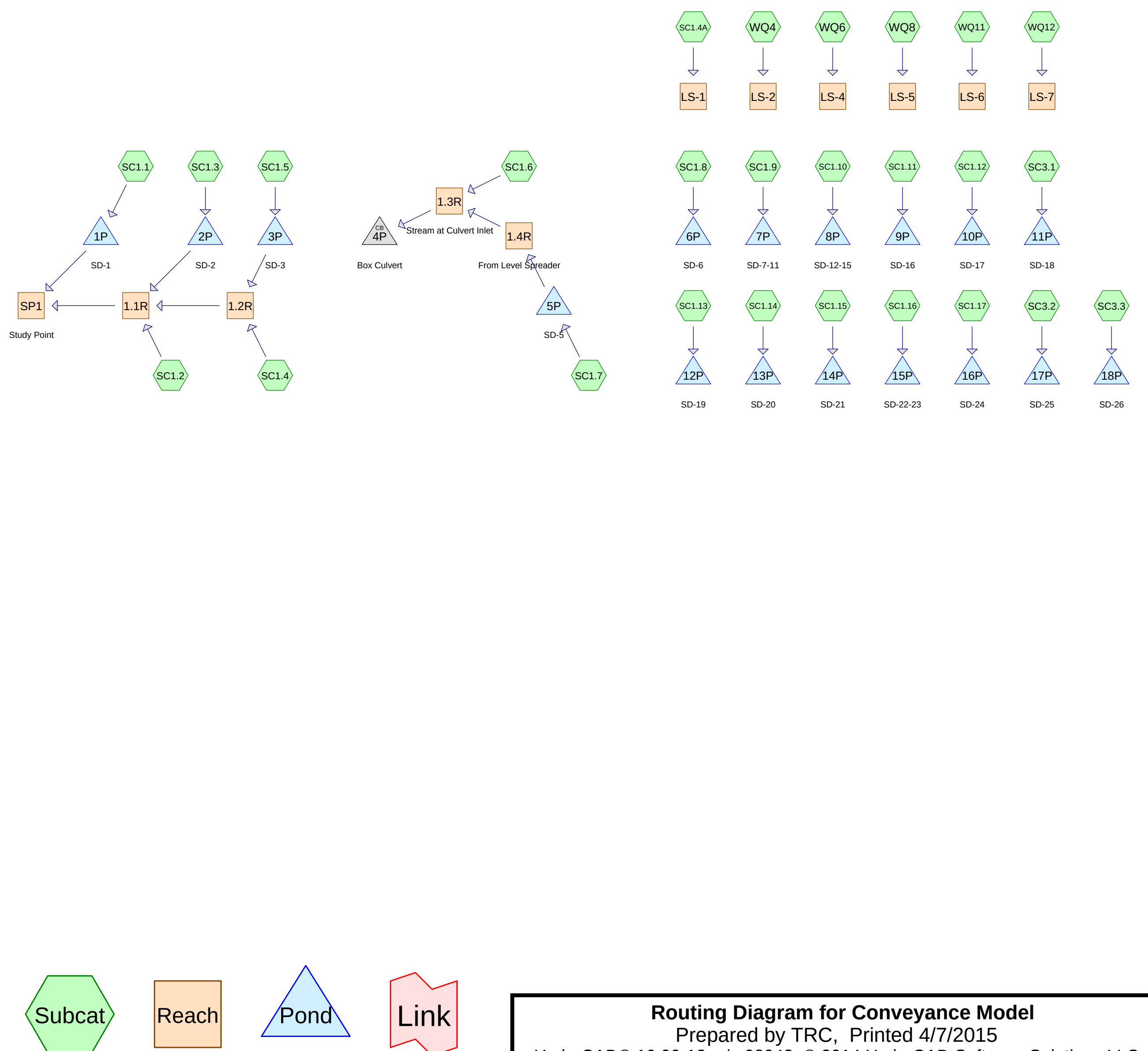
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,600.00	450	100.0	0	0	450
1,602.00	4,475	360.0	4,229	4,229	9,979
1,603.00	6,200	375.0	5,314	9,543	10,930

Device	Routing	Invert	Outlet Devices
#1	Primary	1,600.00'	**36.0" Round SD-26** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,600.00' / 1,597.00' S= 0.0429 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=13.96 cfs @ 12.15 hrs HW=1,601.66' (Free Discharge)
└─**1=SD-26** (Inlet Controls 13.96 cfs @ 3.47 fps)

Pond 18P: SD-26





Routing Diagram for Conveyance Model
Prepared by TRC, Printed 4/7/2015
HydroCAD® 10.00-12 s/n 08043 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment SC1.1:

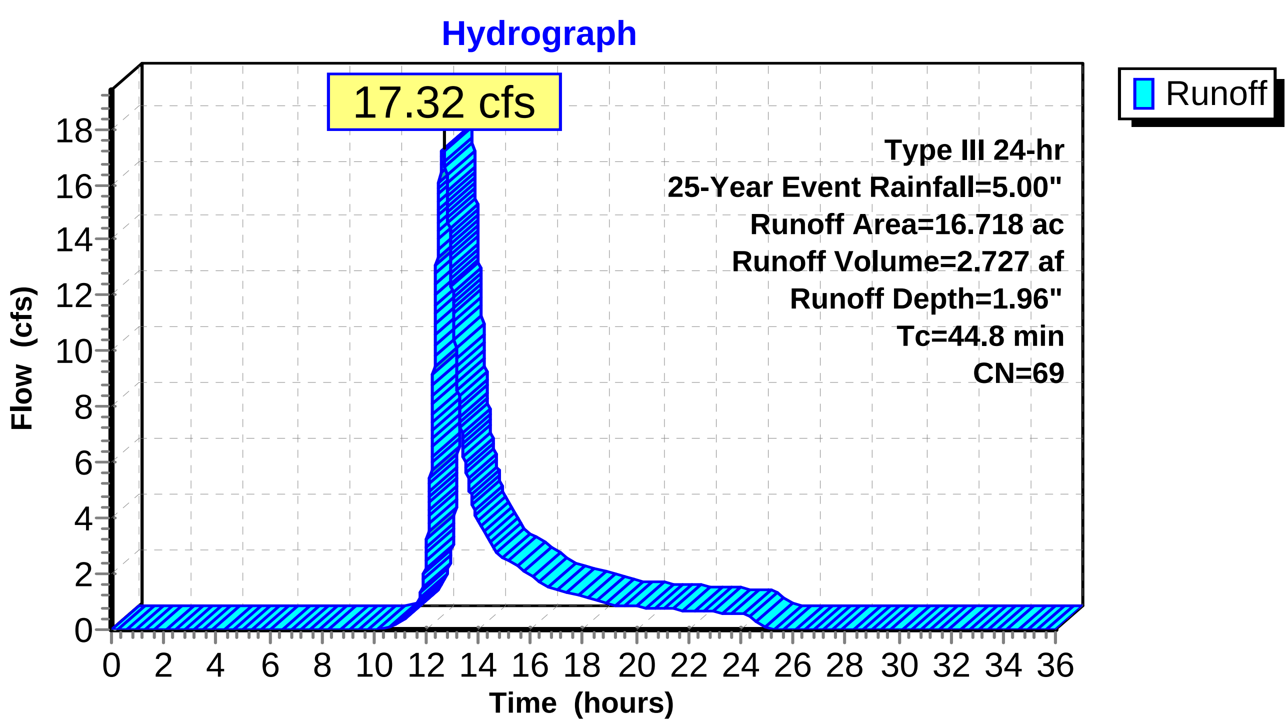
Runoff = 17.32 cfs @ 12.64 hrs, Volume= 2.727 af, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

	Area (ac)	CN	Description
	13.096	70	Woods, Good, HSG C
	2.446	71	Meadow, non-grazed, HSG C
*	0.118	98	Paved roads, HSG C
*	1.058	55	Yard stone, HSG C
	16.718	69	Weighted Average
	16.600		99.29% Pervious Area
	0.118		0.71% Impervious Area

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

Subcatchment SC1.1:



Summary for Subcatchment SC1.10:

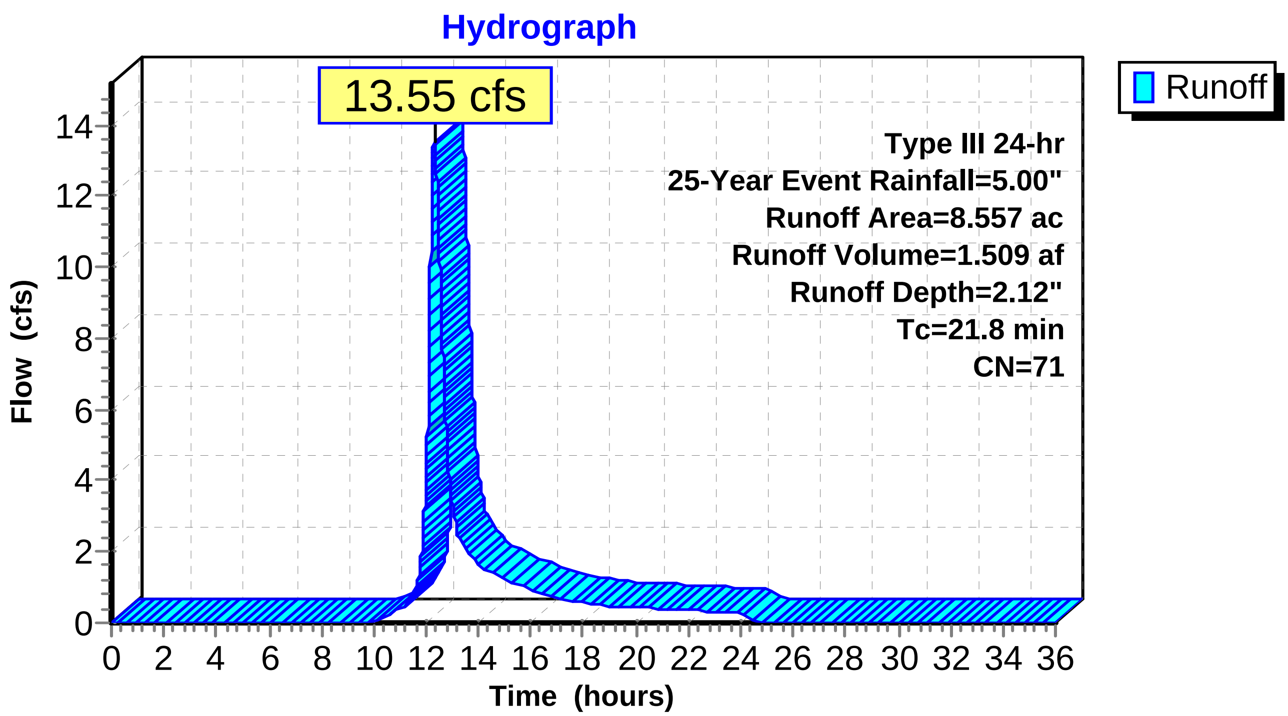
Runoff = 13.55 cfs @ 12.32 hrs, Volume= 1.509 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
6.492	70	Woods, Good, HSG C
1.567	71	Meadow, non-grazed, HSG C
0.498	89	Gravel roads, HSG C
8.557	71	Weighted Average
8.557		100.00% Pervious Area

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

Subcatchment SC1.10:



Summary for Subcatchment SC1.11:

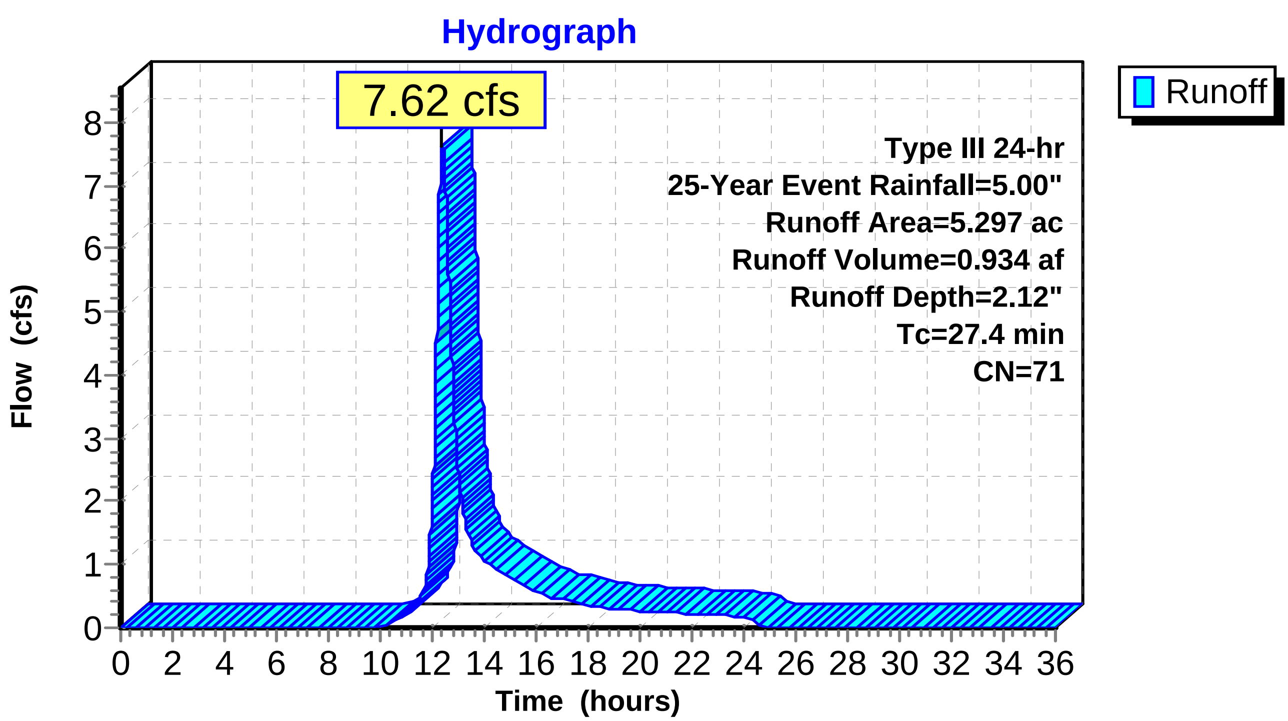
Runoff = 7.62 cfs @ 12.39 hrs, Volume= 0.934 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
4.038	70	Woods, Good, HSG C
1.081	71	Meadow, non-grazed, HSG C
0.178	89	Gravel roads, HSG C
5.297	71	Weighted Average
5.297		100.00% Pervious Area

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

Subcatchment SC1.11:



Summary for Subcatchment SC1.12:

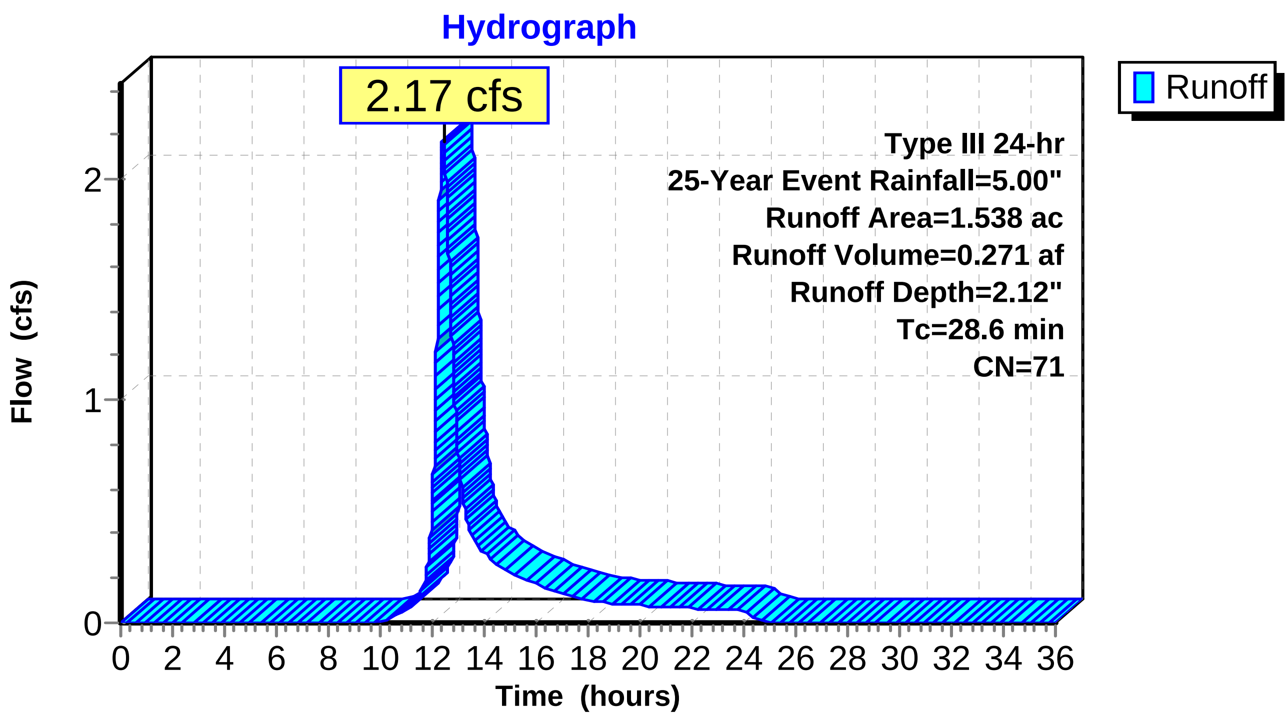
Runoff = 2.17 cfs @ 12.42 hrs, Volume= 0.271 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.916	70	Woods, Good, HSG C
0.547	71	Meadow, non-grazed, HSG C
0.075	89	Gravel roads, HSG C
1.538	71	Weighted Average
1.538		100.00% Pervious Area

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

Subcatchment SC1.12:



Summary for Subcatchment SC1.13:

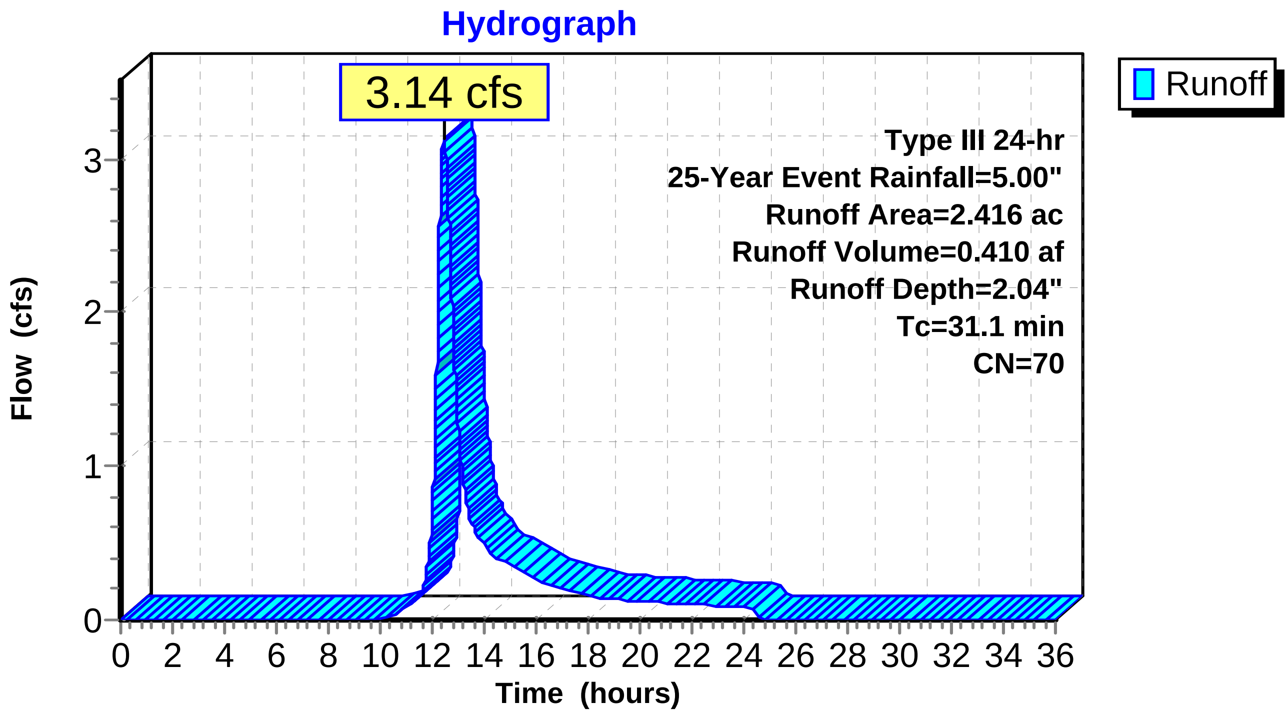
Runoff = 3.14 cfs @ 12.47 hrs, Volume= 0.410 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
1.885	70	Woods, Good, HSG C
0.531	71	Meadow, non-grazed, HSG C
2.416	70	Weighted Average
2.416		100.00% Pervious Area

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

Subcatchment SC1.13:



Summary for Subcatchment SC1.14:

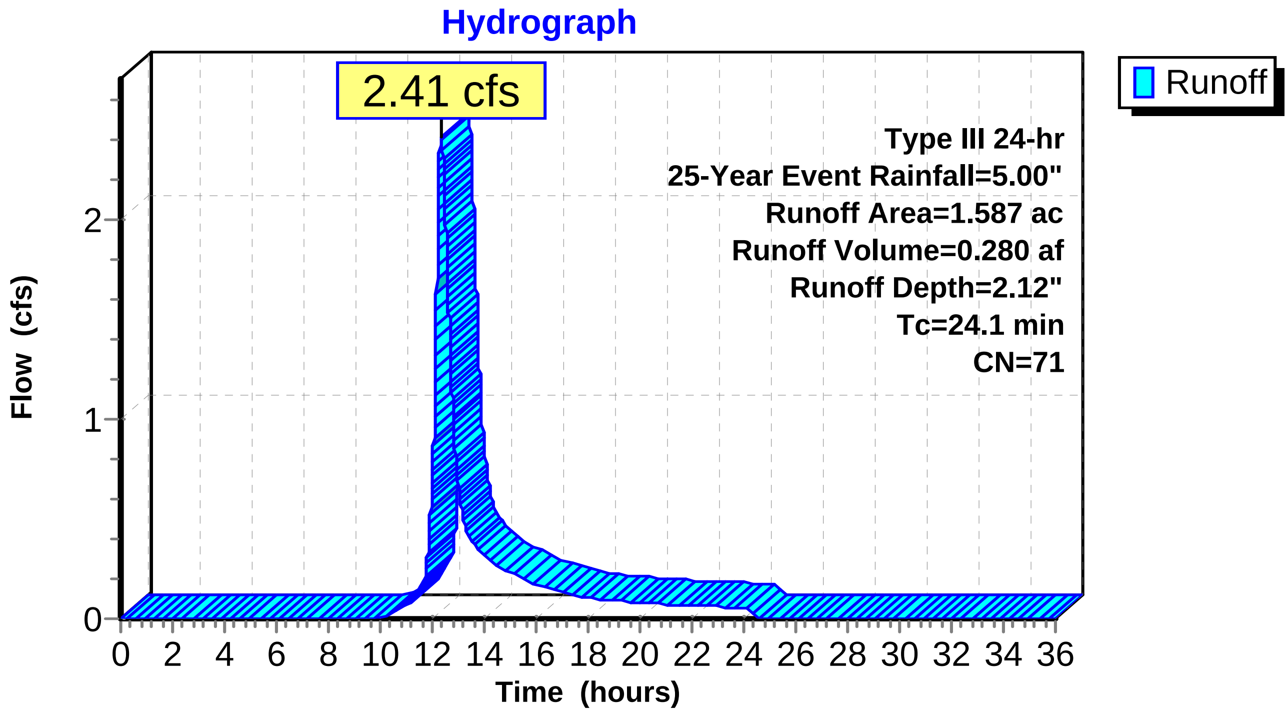
Runoff = 2.41 cfs @ 12.35 hrs, Volume= 0.280 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.623	70	Woods, Good, HSG C
0.888	71	Meadow, non-grazed, HSG C
0.076	89	Gravel roads, HSG C
1.587	71	Weighted Average
1.587		100.00% Pervious Area

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

Subcatchment SC1.14:



Summary for Subcatchment SC1.15:

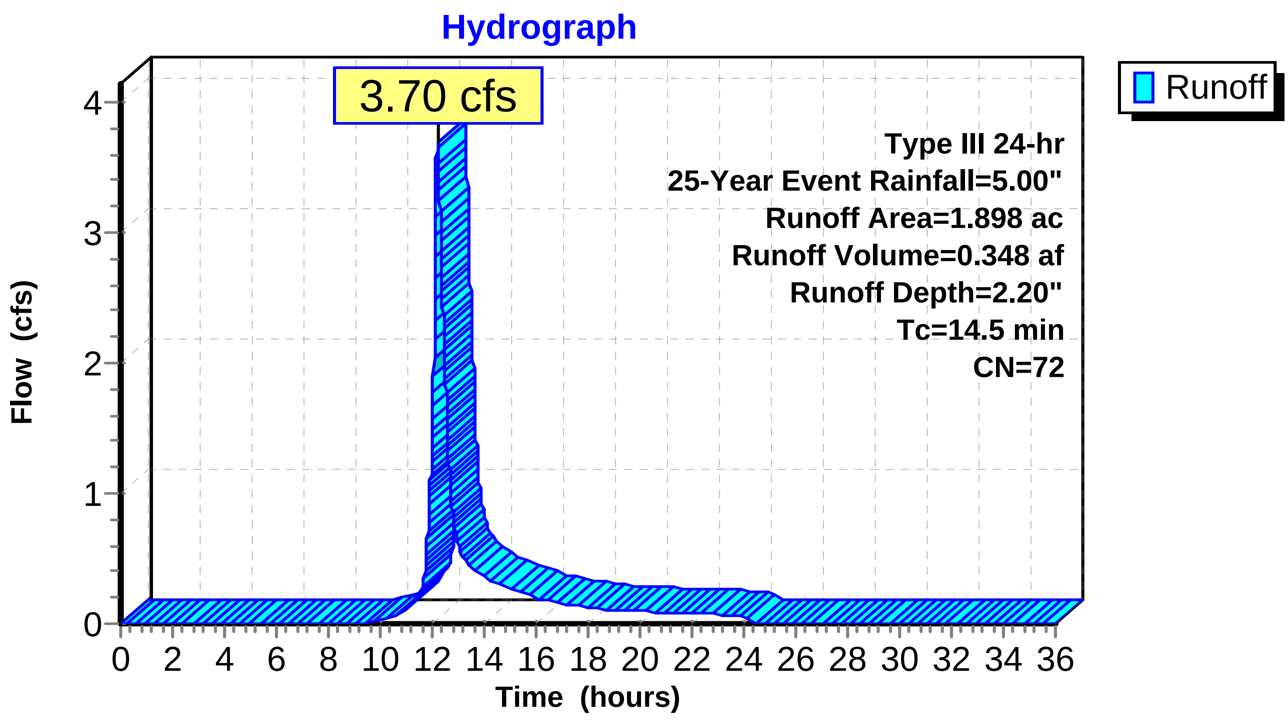
Runoff = 3.70 cfs @ 12.20 hrs, Volume= 0.348 af, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.806	70	Woods, Good, HSG C
0.955	71	Meadow, non-grazed, HSG C
0.137	89	Gravel roads, HSG C
1.898	72	Weighted Average
1.898		100.00% Pervious Area

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

Subcatchment SC1.15:



Summary for Subcatchment SC1.16:

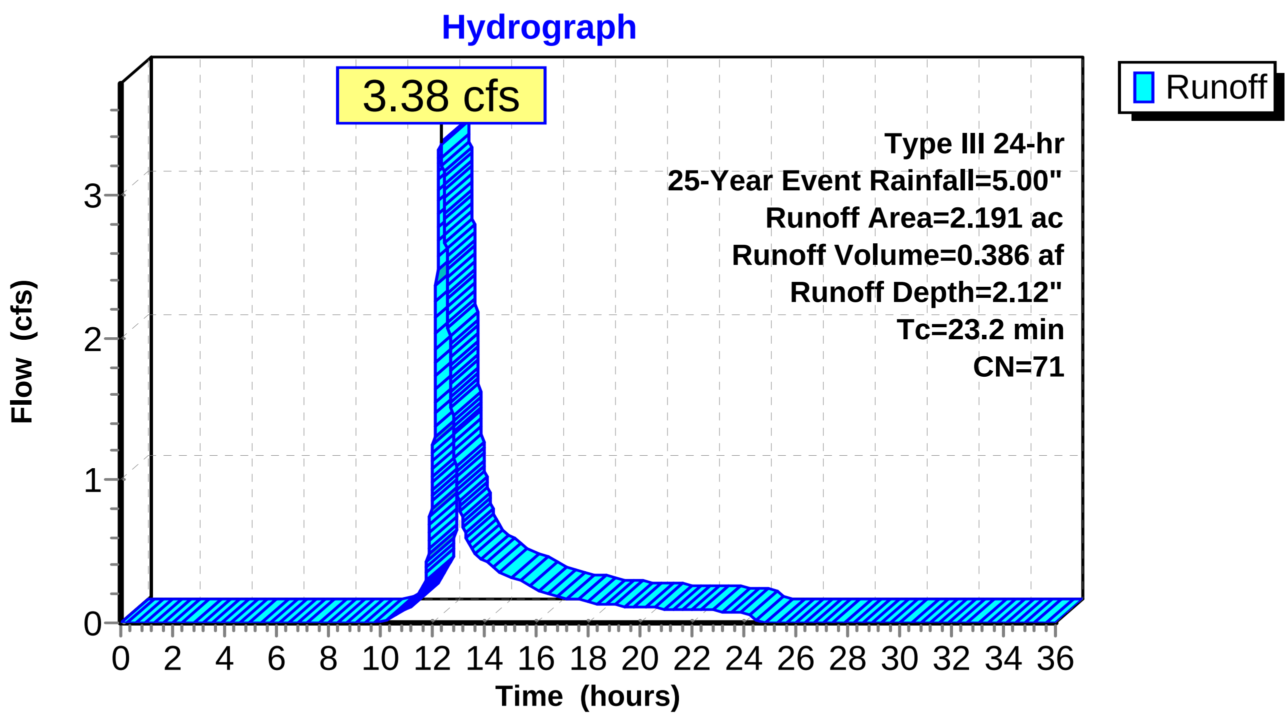
Runoff = 3.38 cfs @ 12.34 hrs, Volume= 0.386 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
1.222	70	Woods, Good, HSG C
0.864	71	Meadow, non-grazed, HSG C
0.105	89	Gravel roads, HSG C
2.191	71	Weighted Average
2.191		100.00% Pervious Area

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

Subcatchment SC1.16:



Summary for Subcatchment SC1.17:

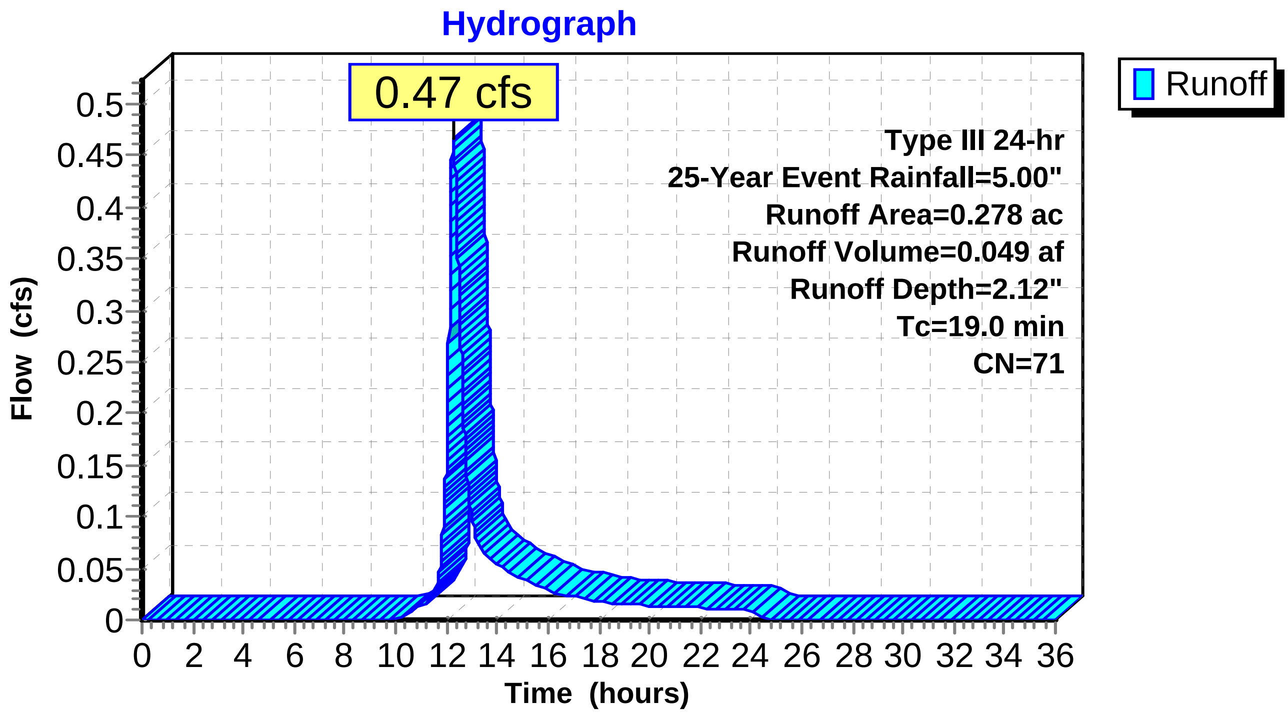
Runoff = 0.47 cfs @ 12.27 hrs, Volume= 0.049 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.119	70	Woods, Good, HSG C
0.159	71	Meadow, non-grazed, HSG C
0.278	71	Weighted Average
0.278		100.00% Pervious Area

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

Subcatchment SC1.17:



Summary for Subcatchment SC1.2:

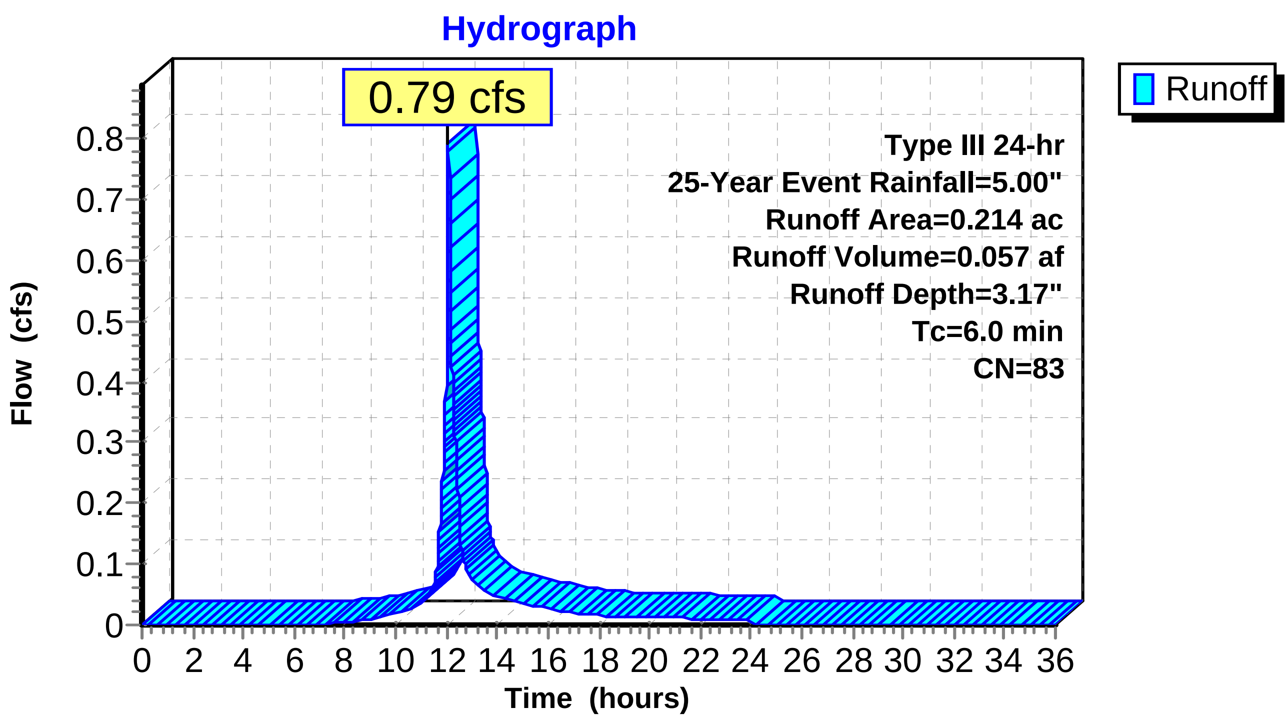
Runoff = 0.79 cfs @ 12.09 hrs, Volume= 0.057 af, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.100	96	Gravel surface, HSG C
0.114	71	Meadow, non-grazed, HSG C
0.214	83	Weighted Average
0.214		100.00% Pervious Area

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

Subcatchment SC1.2:



Summary for Subcatchment SC1.3:

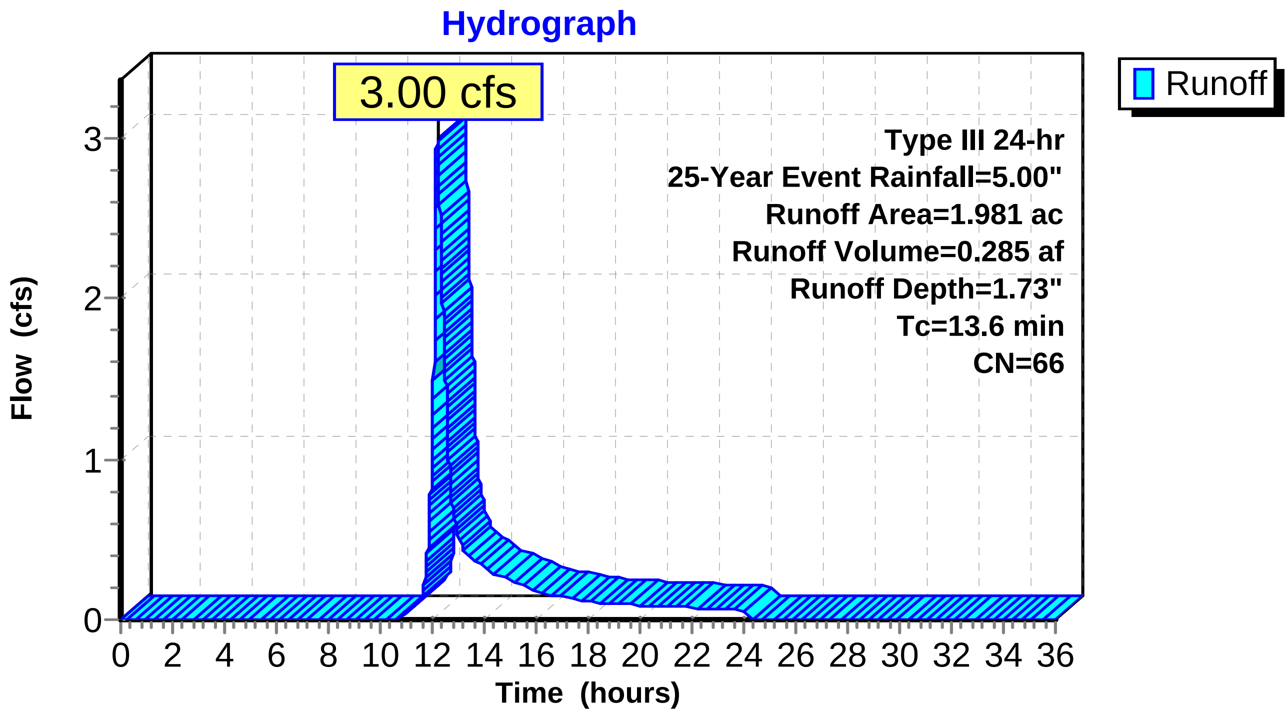
Runoff = 3.00 cfs @ 12.20 hrs, Volume= 0.285 af, Depth= 1.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

	Area (ac)	CN	Description
	0.712	70	Woods, Good, HSG C
	0.511	71	Meadow, non-grazed, HSG C
*	0.672	55	Yard stone, HSG C
	0.086	98	Roofs, HSG C
	1.981	66	Weighted Average
	1.895		95.66% Pervious Area
	0.086		4.34% Impervious Area

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

Subcatchment SC1.3:



Summary for Subcatchment SC1.4:

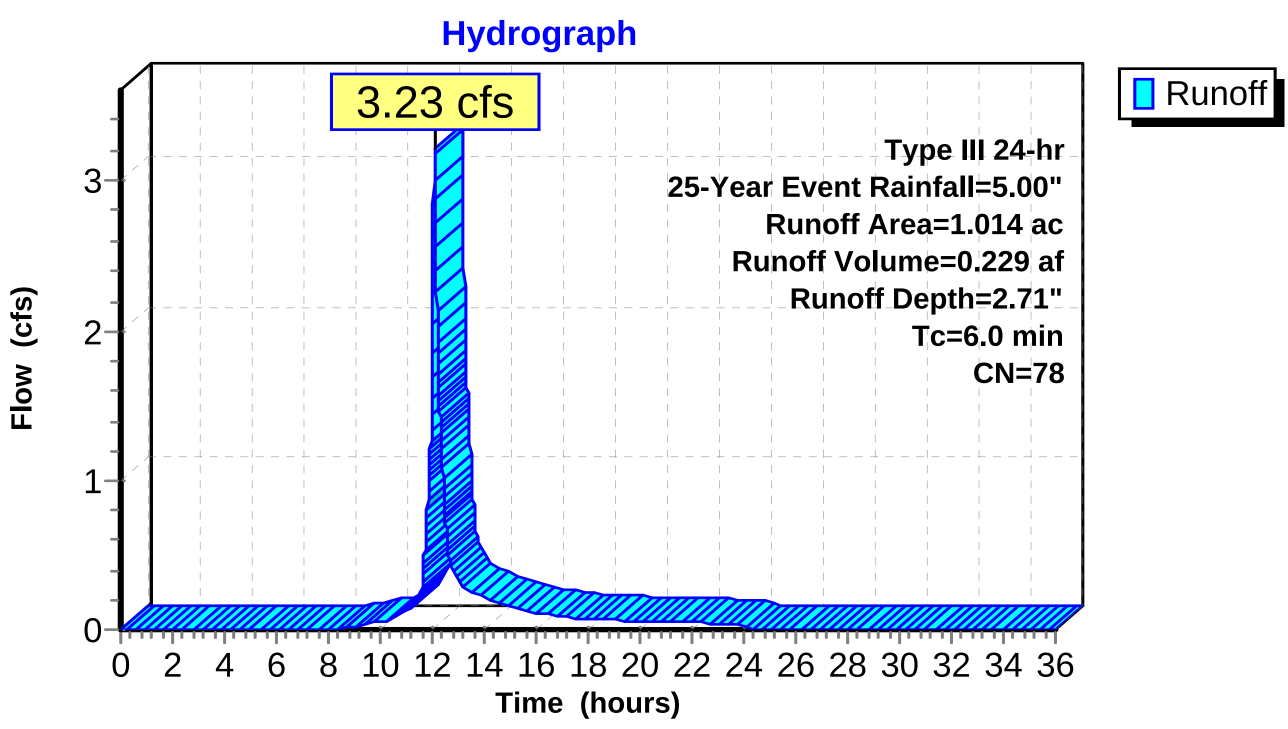
Runoff = 3.23 cfs @ 12.09 hrs, Volume= 0.229 af, Depth= 2.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

	Area (ac)	CN	Description
	0.275	70	Woods, Good, HSG C
	0.445	71	Meadow, non-grazed, HSG C
*	0.248	98	Paved roads, HSG C
	0.046	89	Gravel roads, HSG C
	1.014	78	Weighted Average
	0.766		75.54% Pervious Area
	0.248		24.46% Impervious Area

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

Subcatchment SC1.4:



Summary for Subcatchment SC1.4A:

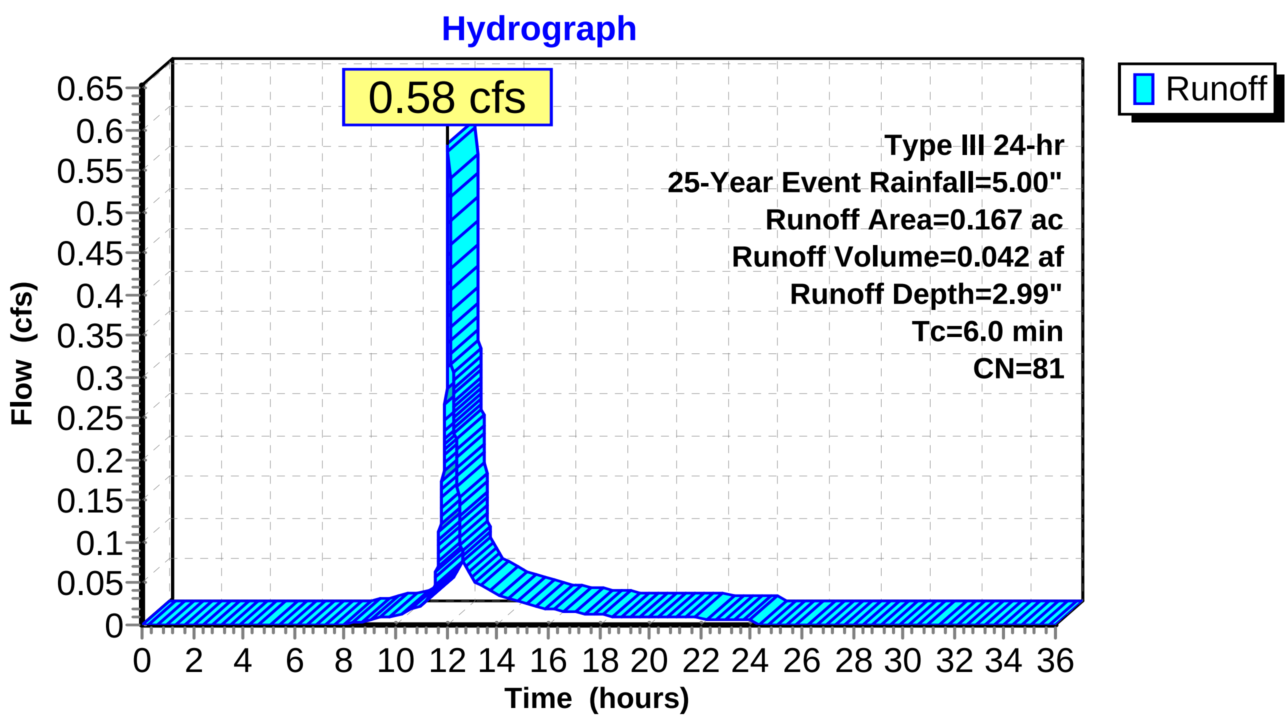
Runoff = 0.58 cfs @ 12.09 hrs, Volume= 0.042 af, Depth= 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.075	71	Meadow, non-grazed, HSG C
0.092	89	Gravel roads, HSG C
0.167	81	Weighted Average
0.167		100.00% Pervious Area

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

Subcatchment SC1.4A:



Summary for Subcatchment SC1.5:

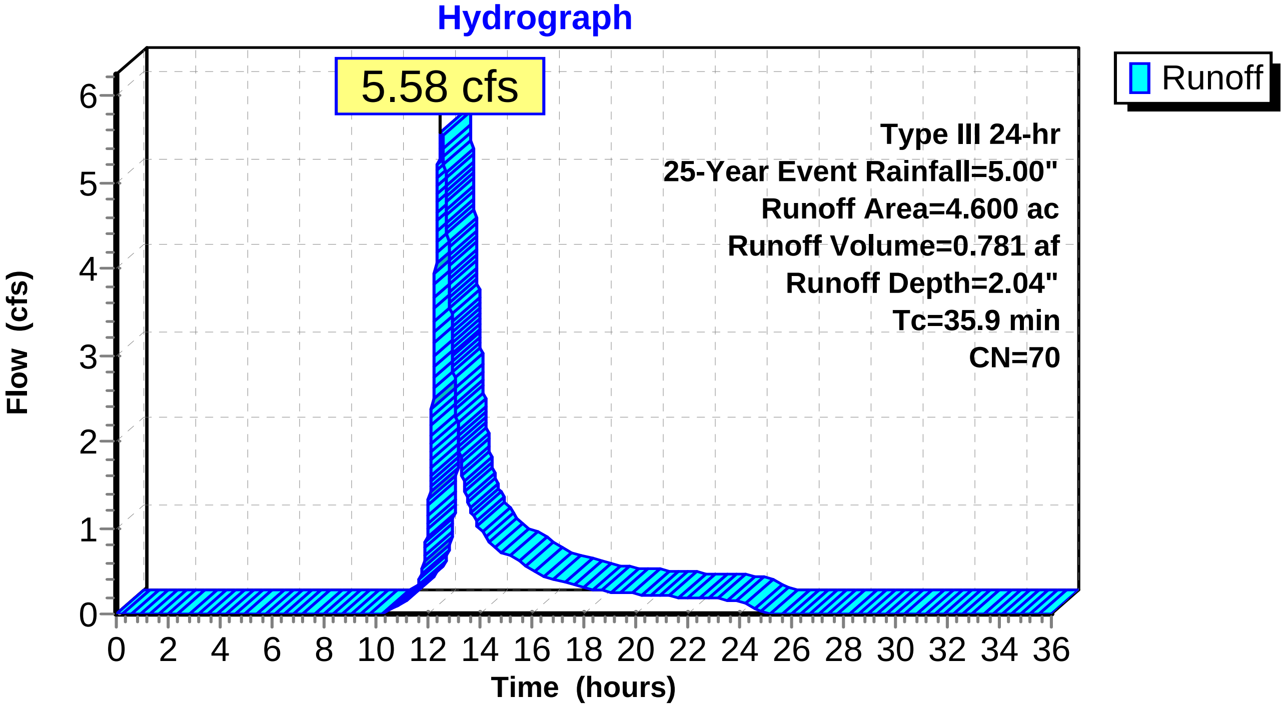
Runoff = 5.58 cfs @ 12.52 hrs, Volume= 0.781 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
4.028	70	Woods, Good, HSG C
0.572	71	Meadow, non-grazed, HSG C
4.600	70	Weighted Average
4.600		100.00% Pervious Area

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

Subcatchment SC1.5:



Summary for Subcatchment SC1.6:

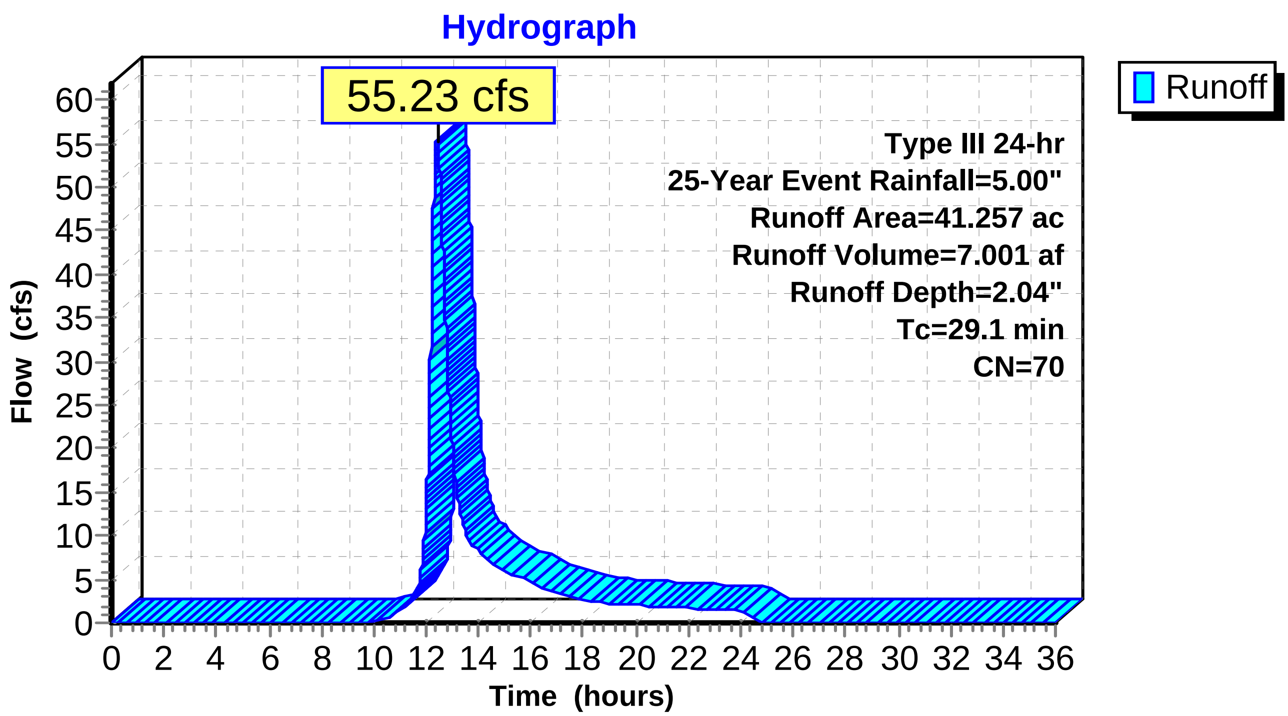
Runoff = 55.23 cfs @ 12.42 hrs, Volume= 7.001 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
39.420	70	Woods, Good, HSG C
0.285	89	Gravel roads, HSG C
1.552	71	Meadow, non-grazed, HSG C
41.257	70	Weighted Average
41.257		100.00% Pervious Area

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

Subcatchment SC1.6:



Summary for Subcatchment SC1.7:

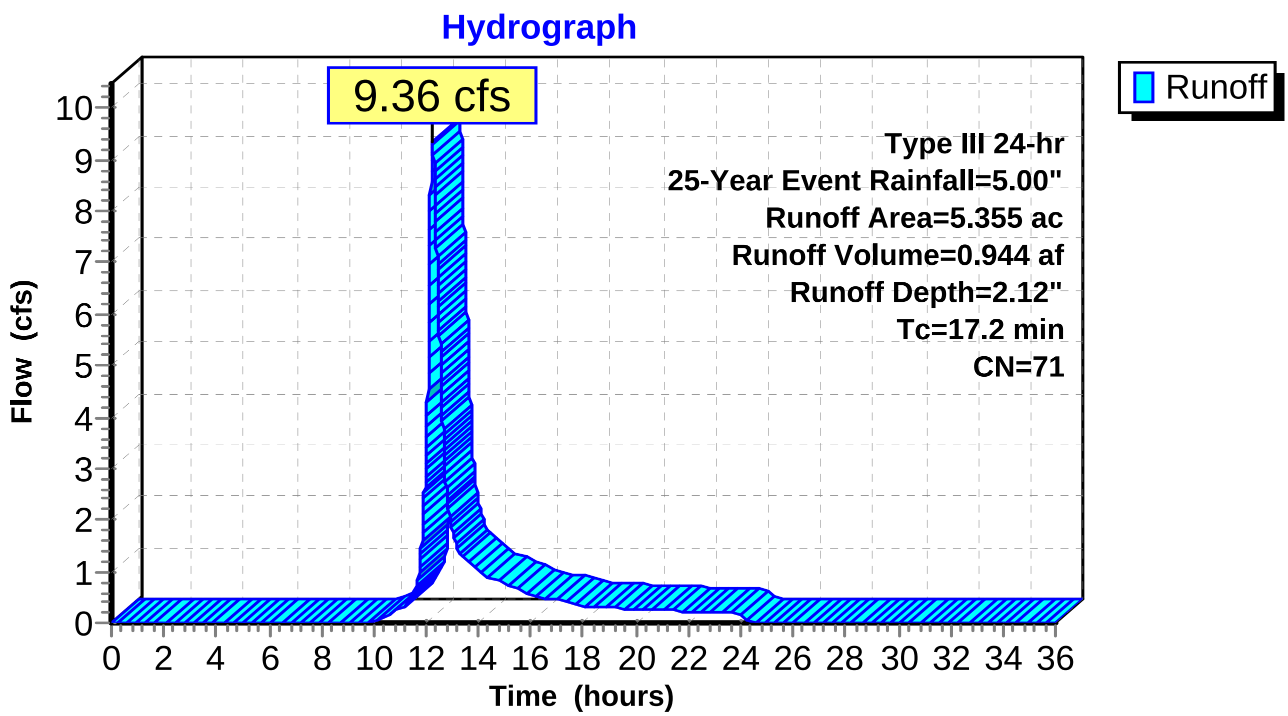
Runoff = 9.36 cfs @ 12.25 hrs, Volume= 0.944 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
4.514	70	Woods, Good, HSG C
0.216	89	Gravel roads, HSG C
0.625	71	Meadow, non-grazed, HSG C
5.355	71	Weighted Average
5.355		100.00% Pervious Area

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

Subcatchment SC1.7:



Summary for Subcatchment SC1.8:

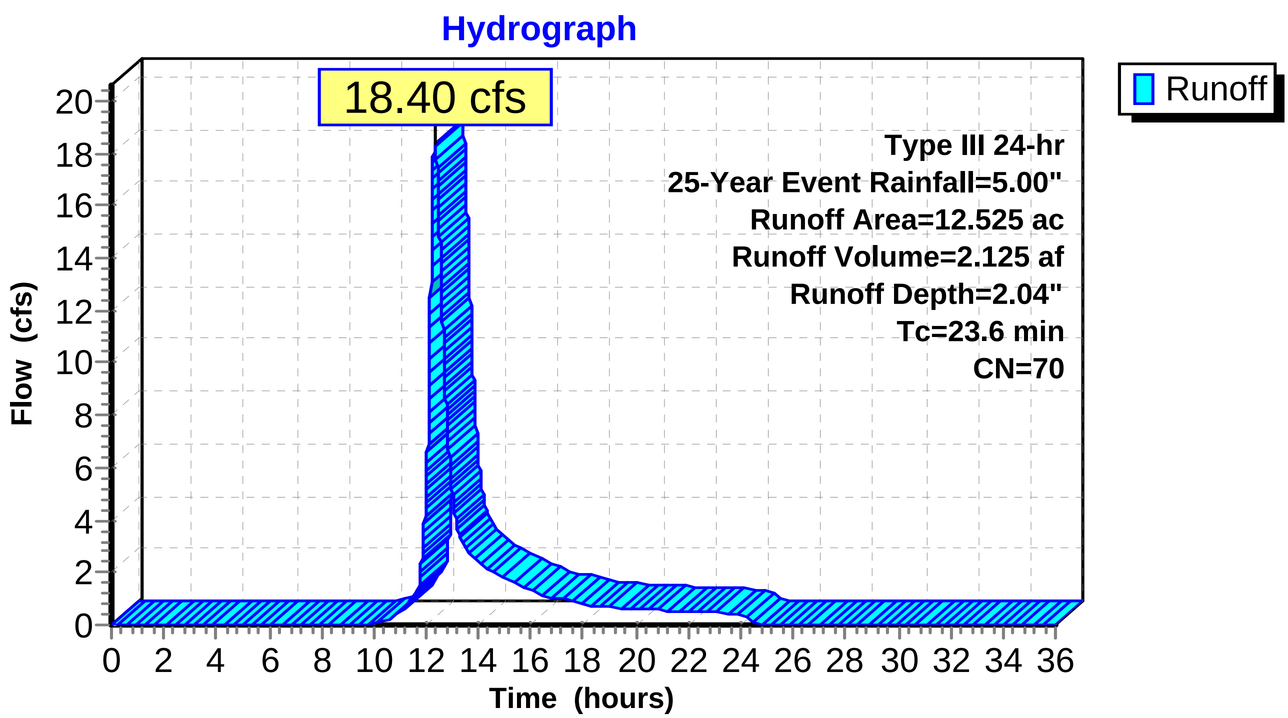
Runoff = 18.40 cfs @ 12.35 hrs, Volume= 2.125 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
11.358	70	Woods, Good, HSG C
1.167	71	Meadow, non-grazed, HSG C
12.525	70	Weighted Average
12.525		100.00% Pervious Area

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

Subcatchment SC1.8:



Summary for Subcatchment SC1.9:

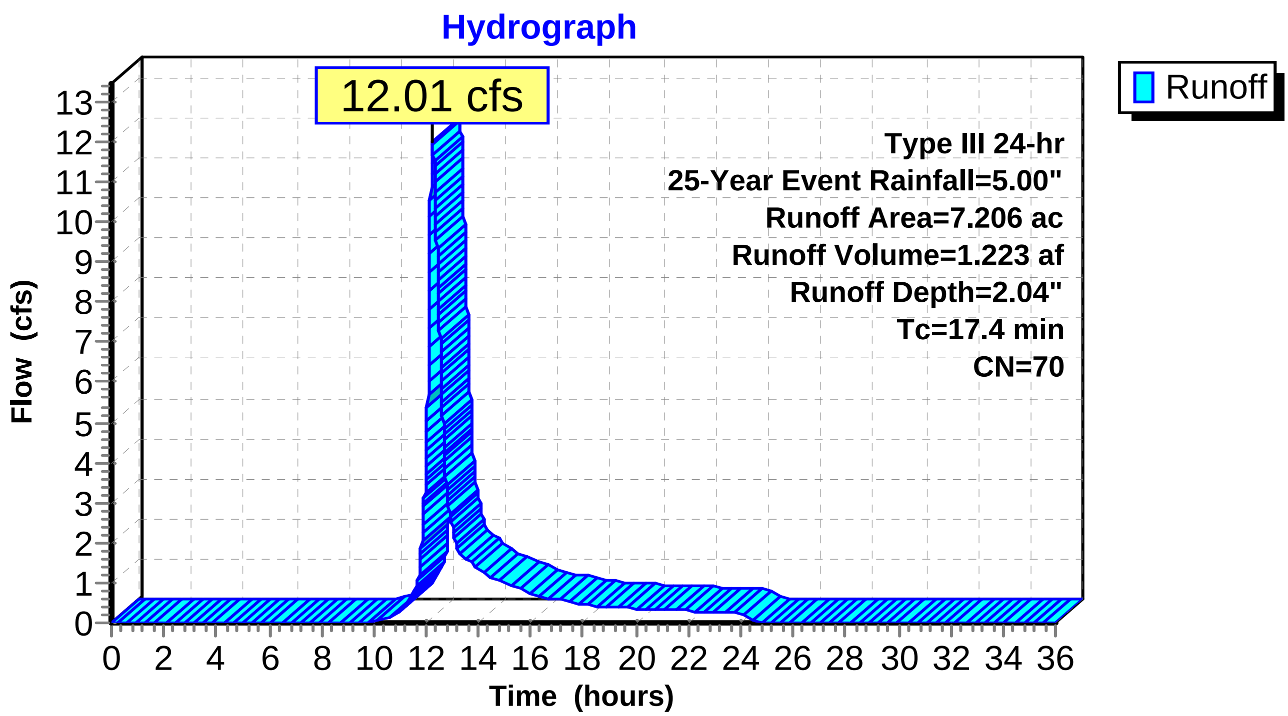
Runoff = 12.01 cfs @ 12.24 hrs, Volume= 1.223 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
6.694	70	Woods, Good, HSG C
0.451	71	Meadow, non-grazed, HSG C
0.061	89	Gravel roads, HSG C
7.206	70	Weighted Average
7.206		100.00% Pervious Area

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

Subcatchment SC1.9:



Summary for Subcatchment SC3.1:

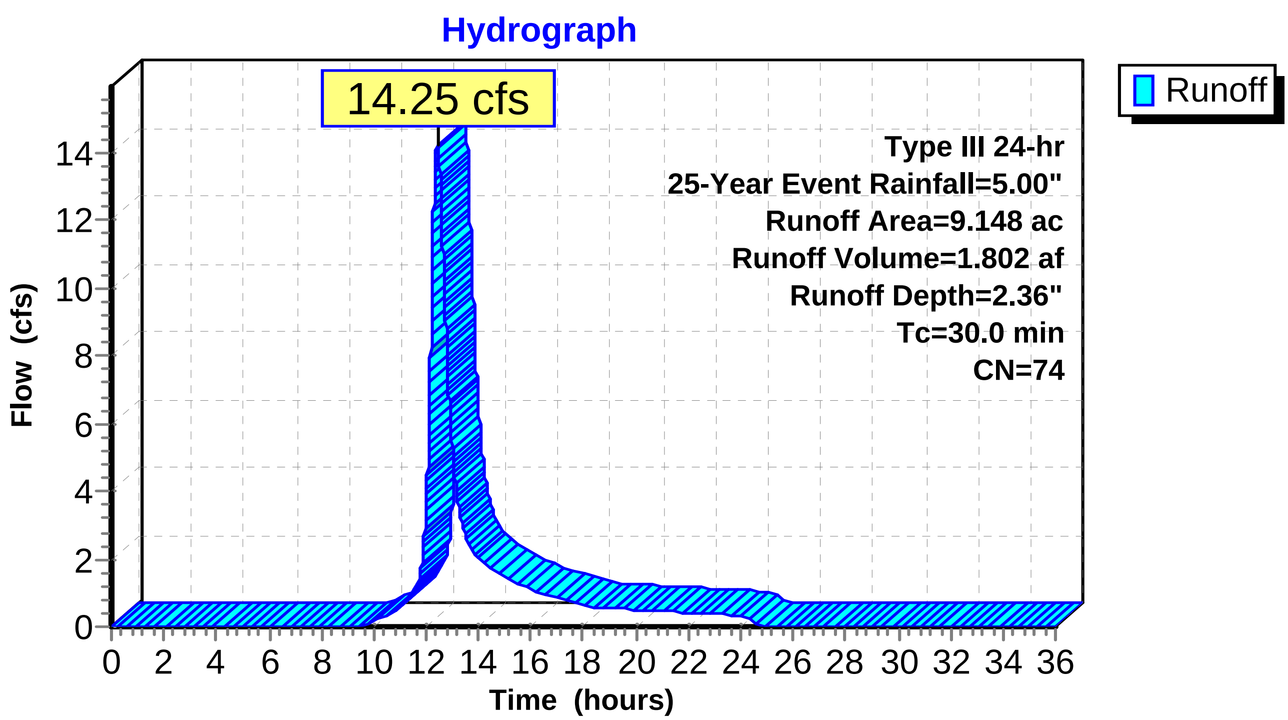
Runoff = 14.25 cfs @ 12.43 hrs, Volume= 1.802 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
3.839	70	Woods, Good, HSG C
0.131	89	Gravel roads, HSG C
4.686	77	Woods, Good, HSG D
0.492	78	Meadow, non-grazed, HSG D
9.148	74	Weighted Average
9.148		100.00% Pervious Area

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

Subcatchment SC3.1:



Summary for Subcatchment SC3.2:

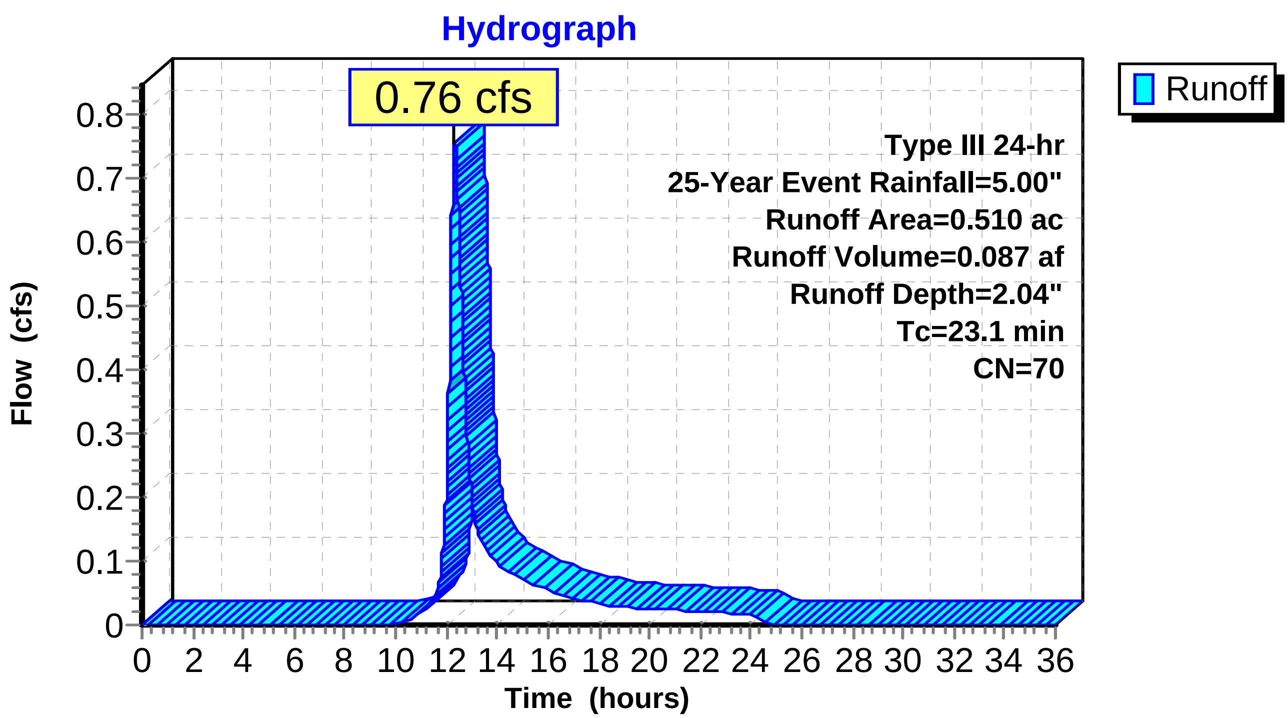
Runoff = 0.76 cfs @ 12.34 hrs, Volume= 0.087 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.372	70	Woods, Good, HSG C
0.138	71	Meadow, non-grazed, HSG C
0.510	70	Weighted Average
0.510		100.00% Pervious Area

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

Subcatchment SC3.2:



Summary for Subcatchment SC3.3:

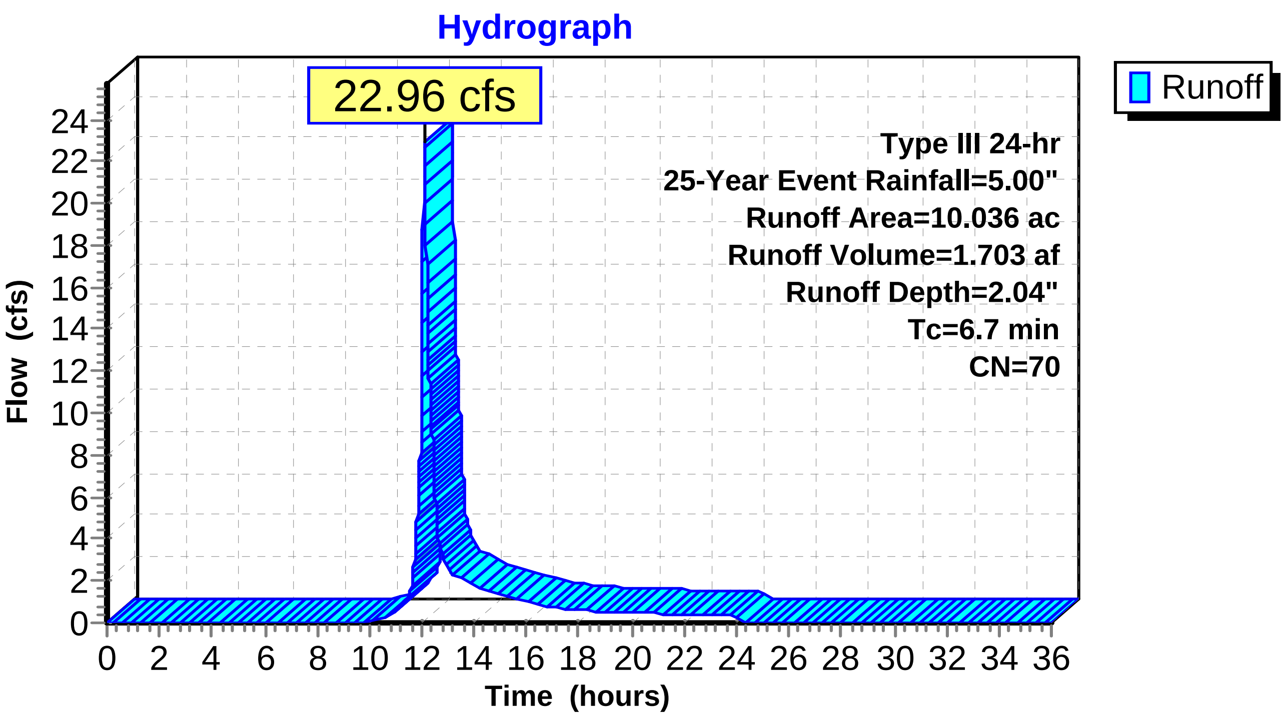
Runoff = 22.96 cfs @ 12.10 hrs, Volume= 1.703 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
8.861	70	Woods, Good, HSG C
1.116	71	Meadow, non-grazed, HSG C
0.059	89	Gravel roads, HSG C
10.036	70	Weighted Average
10.036		100.00% Pervious Area

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

Subcatchment SC3.3:



Summary for Subcatchment WQ11:

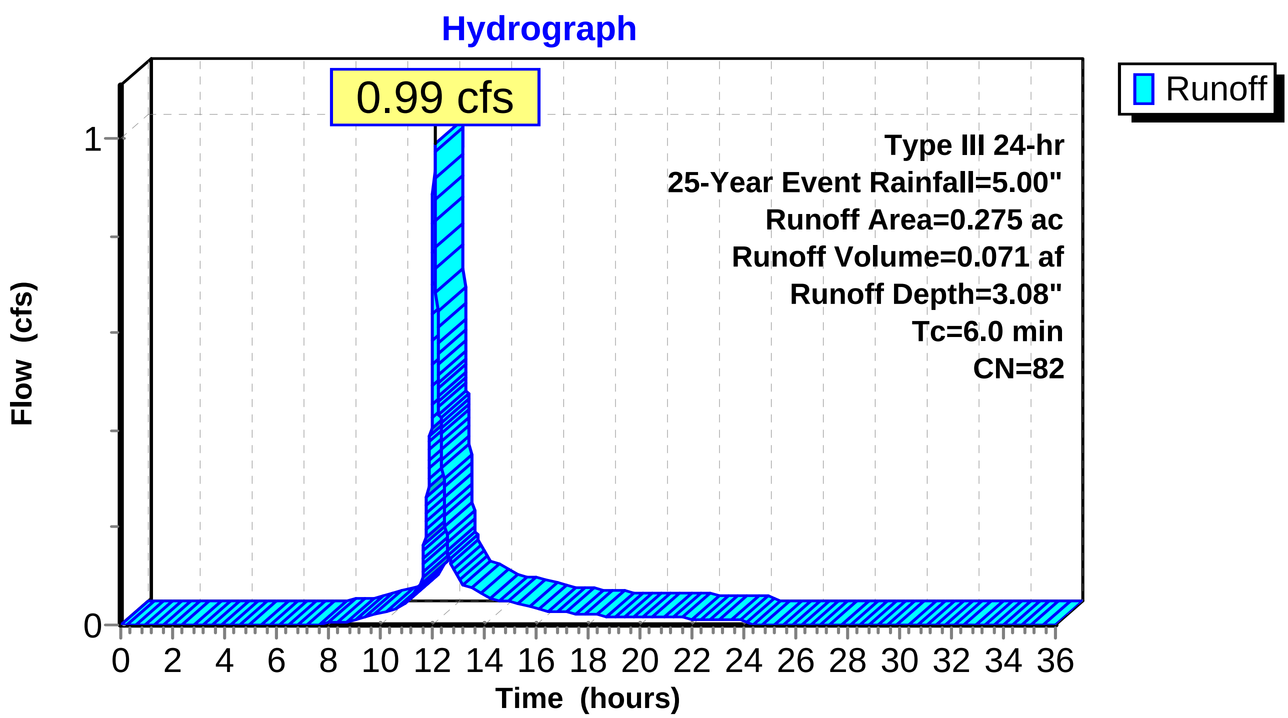
Runoff = 0.99 cfs @ 12.09 hrs, Volume= 0.071 af, Depth= 3.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.092	91	Gravel roads, HSG D
0.183	78	Meadow, non-grazed, HSG D
0.275	82	Weighted Average
0.275		100.00% Pervious Area

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

Subcatchment WQ11:



Summary for Subcatchment WQ12:

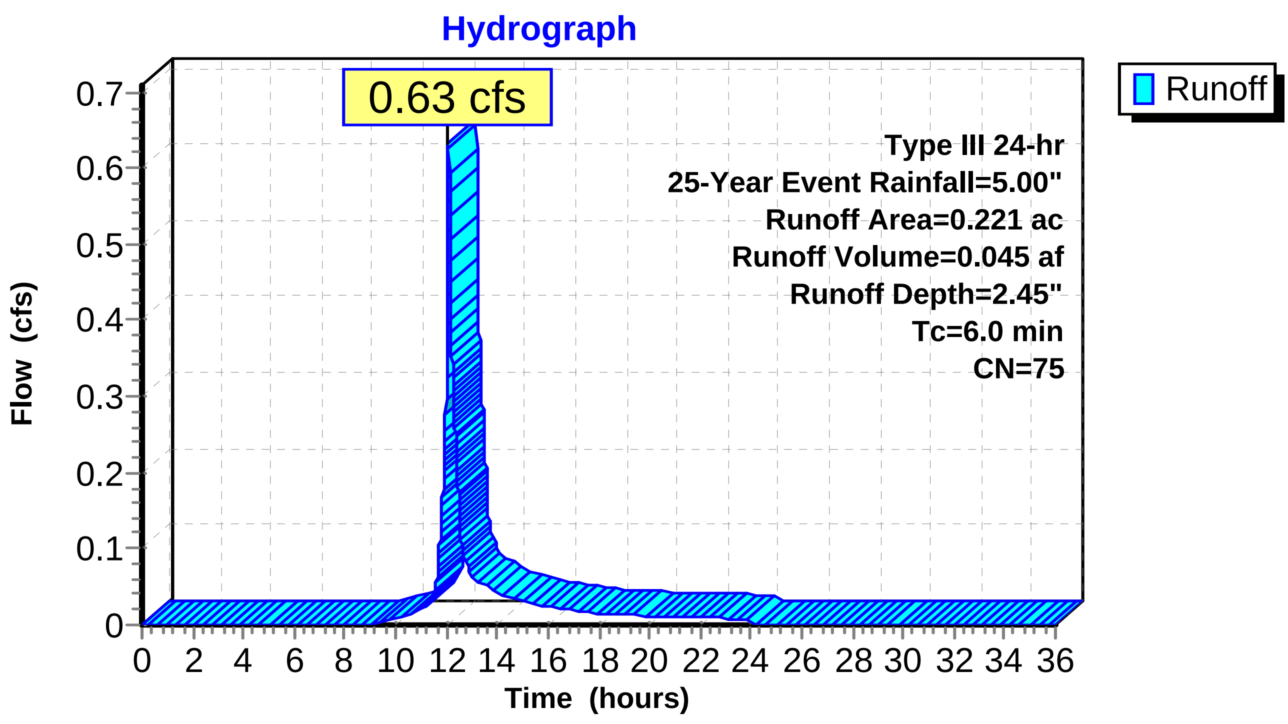
Runoff = 0.63 cfs @ 12.09 hrs, Volume= 0.045 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.046	89	Gravel roads, HSG C
0.175	71	Meadow, non-grazed, HSG C
0.221	75	Weighted Average
0.221		100.00% Pervious Area

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

Subcatchment WQ12:



Summary for Subcatchment WQ4:

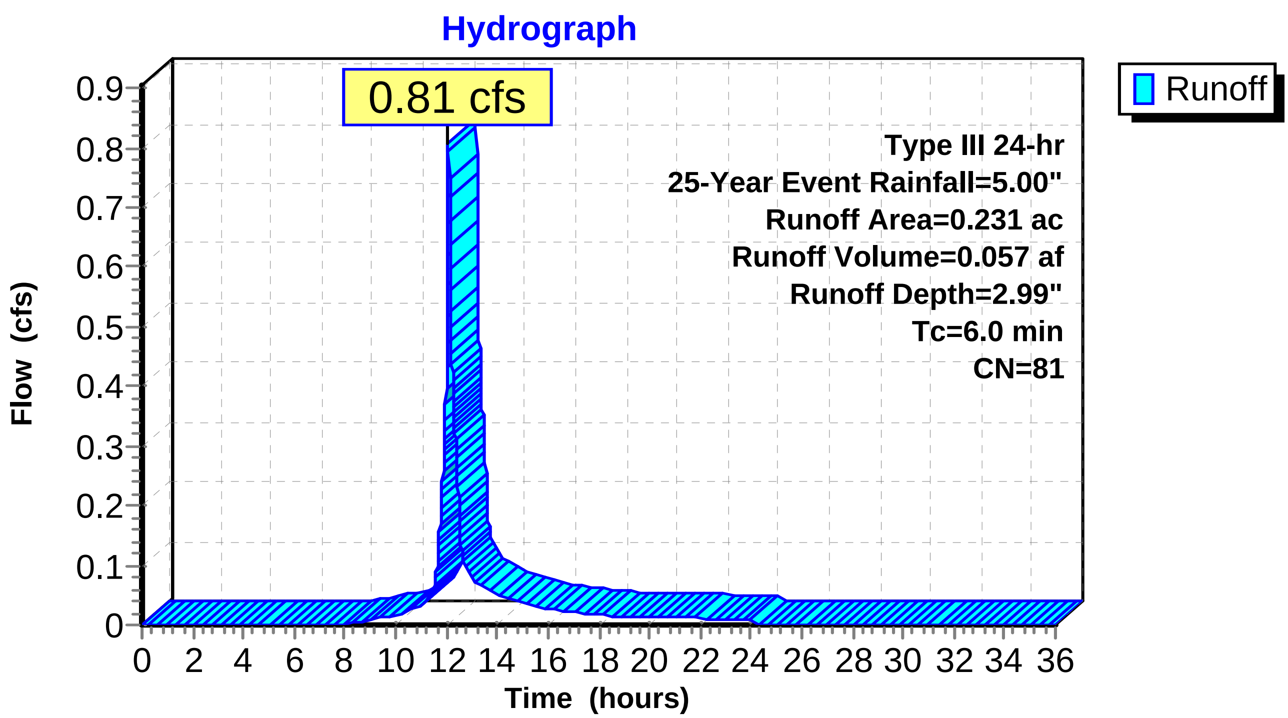
Runoff = 0.81 cfs @ 12.09 hrs, Volume= 0.057 af, Depth= 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.128	89	Gravel roads, HSG C
0.103	71	Meadow, non-grazed, HSG C
0.231	81	Weighted Average
0.231		100.00% Pervious Area

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

Subcatchment WQ4:



Summary for Subcatchment WQ6:

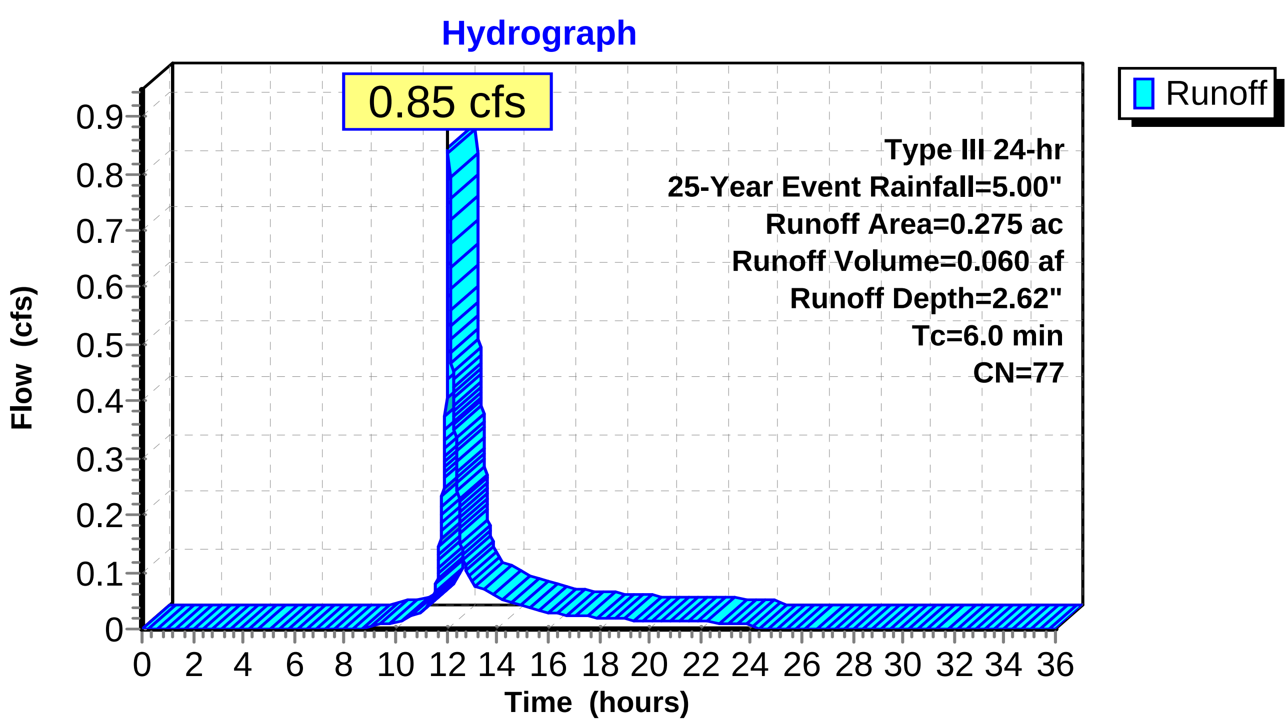
Runoff = 0.85 cfs @ 12.09 hrs, Volume= 0.060 af, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.092	89	Gravel roads, HSG C
0.183	71	Meadow, non-grazed, HSG C
0.275	77	Weighted Average
0.275		100.00% Pervious Area

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

Subcatchment WQ6:



Summary for Subcatchment WQ8:

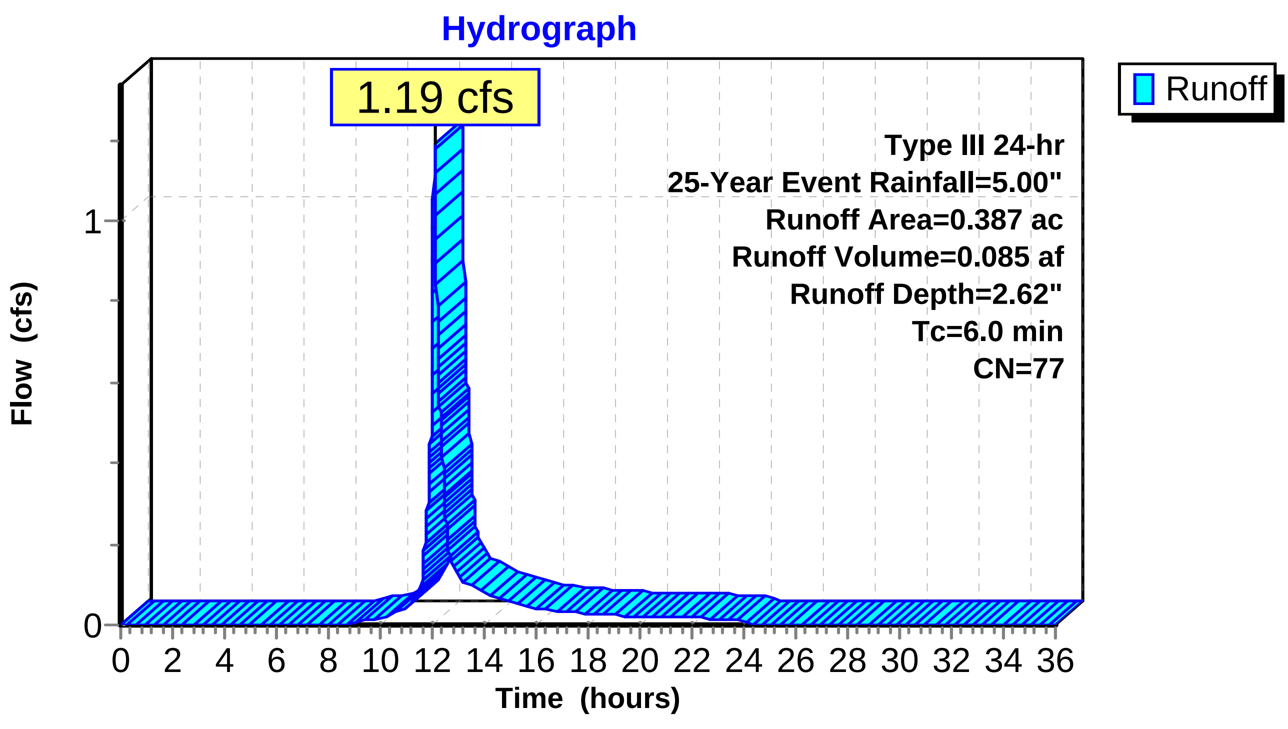
Runoff = 1.19 cfs @ 12.09 hrs, Volume= 0.085 af, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Event Rainfall=5.00"

Area (ac)	CN	Description
0.119	89	Gravel roads, HSG C
0.268	71	Meadow, non-grazed, HSG C
0.387	77	Weighted Average
0.387		100.00% Pervious Area

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

Subcatchment WQ8:



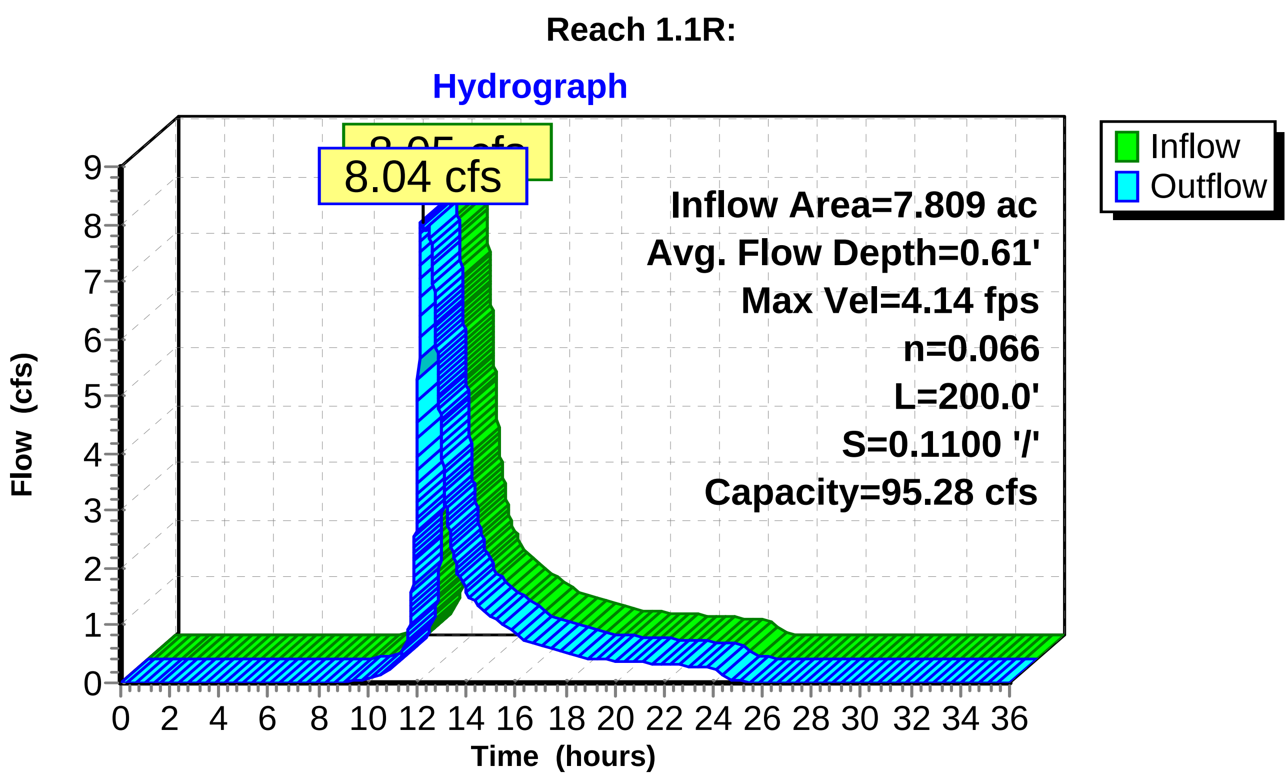
Summary for Reach 1.1R:

Inflow Area = 7.809 ac, 4.28% Impervious, Inflow Depth = 2.08" for 25-Year Event event
Inflow = 8.05 cfs @ 12.18 hrs, Volume= 1.352 af
Outflow = 8.04 cfs @ 12.19 hrs, Volume= 1.352 af, Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 4.14 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.52 fps, Avg. Travel Time= 2.2 min

Peak Storage= 389 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 95.28 cfs

2.00' x 2.00' deep channel, n= 0.066
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 200.0' Slope= 0.1100 '/'
Inlet Invert= 1,064.00', Outlet Invert= 1,042.00'



Summary for Reach 1.2R:

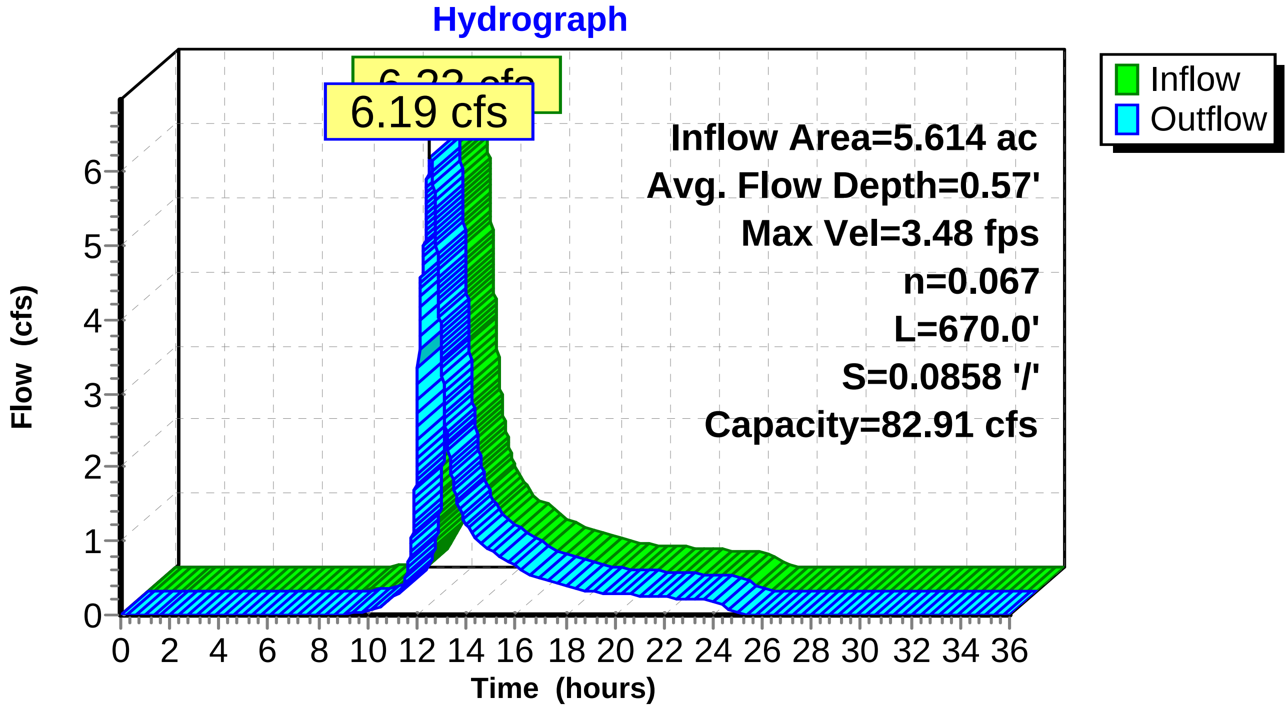
Inflow Area = 5.614 ac, 4.42% Impervious, Inflow Depth = 2.16" for 25-Year Event event
Inflow = 6.23 cfs @ 12.50 hrs, Volume= 1.010 af
Outflow = 6.19 cfs @ 12.53 hrs, Volume= 1.010 af, Atten= 1%, Lag= 2.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 3.48 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 1.32 fps, Avg. Travel Time= 8.5 min

Peak Storage= 1,192 cf @ 12.53 hrs
Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 82.91 cfs

2.00' x 2.00' deep channel, n= 0.067
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 670.0' Slope= 0.0858 '/'
Inlet Invert= 1,121.50', Outlet Invert= 1,064.00'

Reach 1.2R:



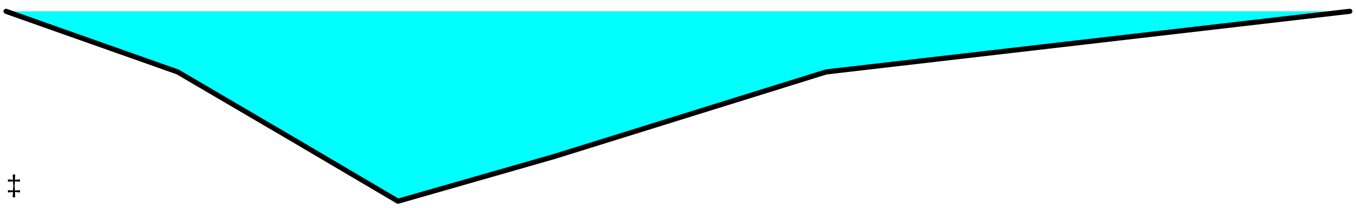
Summary for Reach 1.3R: Stream at Culvert Inlet

Inflow Area = 46.612 ac, 0.00% Impervious, Inflow Depth = 2.05" for 25-Year Event event
Inflow = 61.38 cfs @ 12.44 hrs, Volume= 7.945 af
Outflow = 61.20 cfs @ 12.45 hrs, Volume= 7.945 af, Atten= 0%, Lag= 1.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 6.25 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 2.35 fps, Avg. Travel Time= 4.3 min

Peak Storage= 5,875 cf @ 12.45 hrs
Average Depth at Peak Storage= 1.28'
Defined Flood Depth= 3.00' Flow Area= 39.0 sf, Capacity= 277.60 cfs
Bank-Full Depth= 1.19' Flow Area= 8.2 sf, Capacity= 49.53 cfs

Custom cross-section, Length= 600.0' Slope= 0.0713 '/' (101 Elevation Intervals)
Constant n= 0.040 Mountain streams
Inlet Invert= 1,242.00', Outlet Invert= 1,199.19'

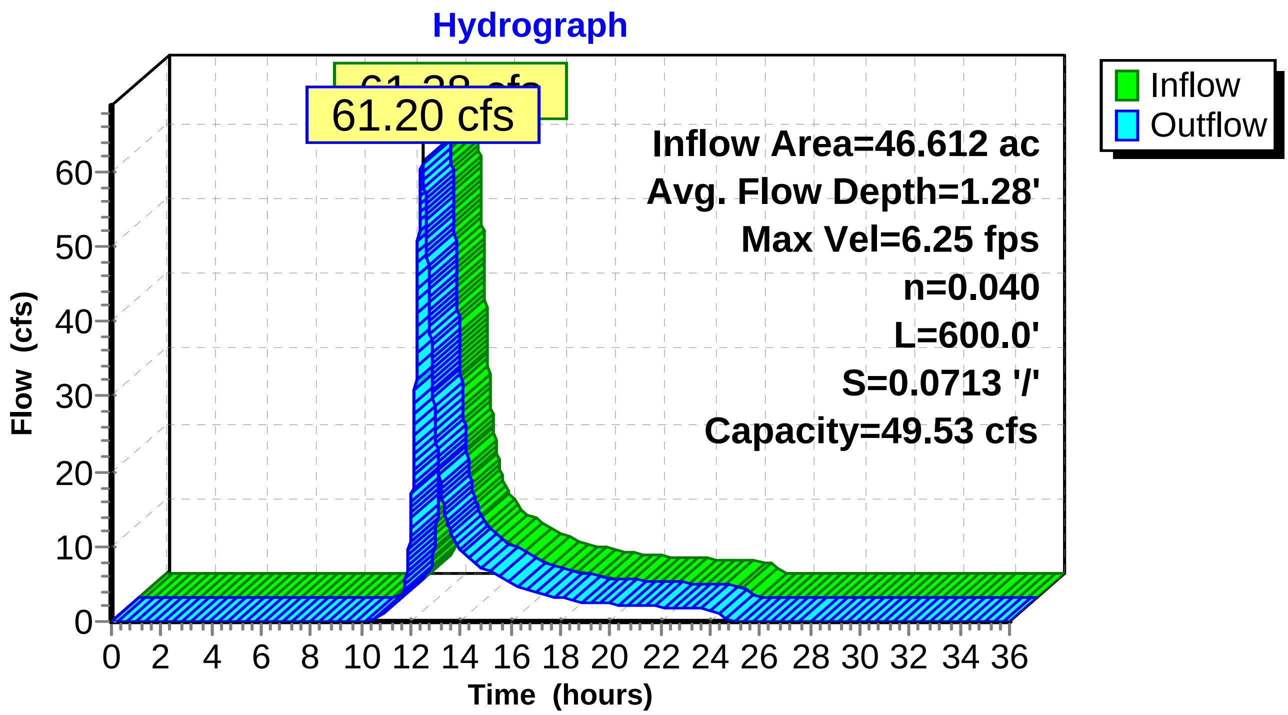


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1,200.38	0.00
2.19	1,200.00	0.38
3.65	1,199.58	0.80
5.00	1,199.19	1.19
6.99	1,199.47	0.91
10.46	1,200.00	0.38
17.14	1,200.38	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
0.28	0.4	3.0	249	1.09
0.39	0.8	4.1	480	2.65
0.81	3.4	8.4	2,034	18.29
1.19	8.2	17.4	4,931	49.53

Reach 1.3R: Stream at Culvert Inlet



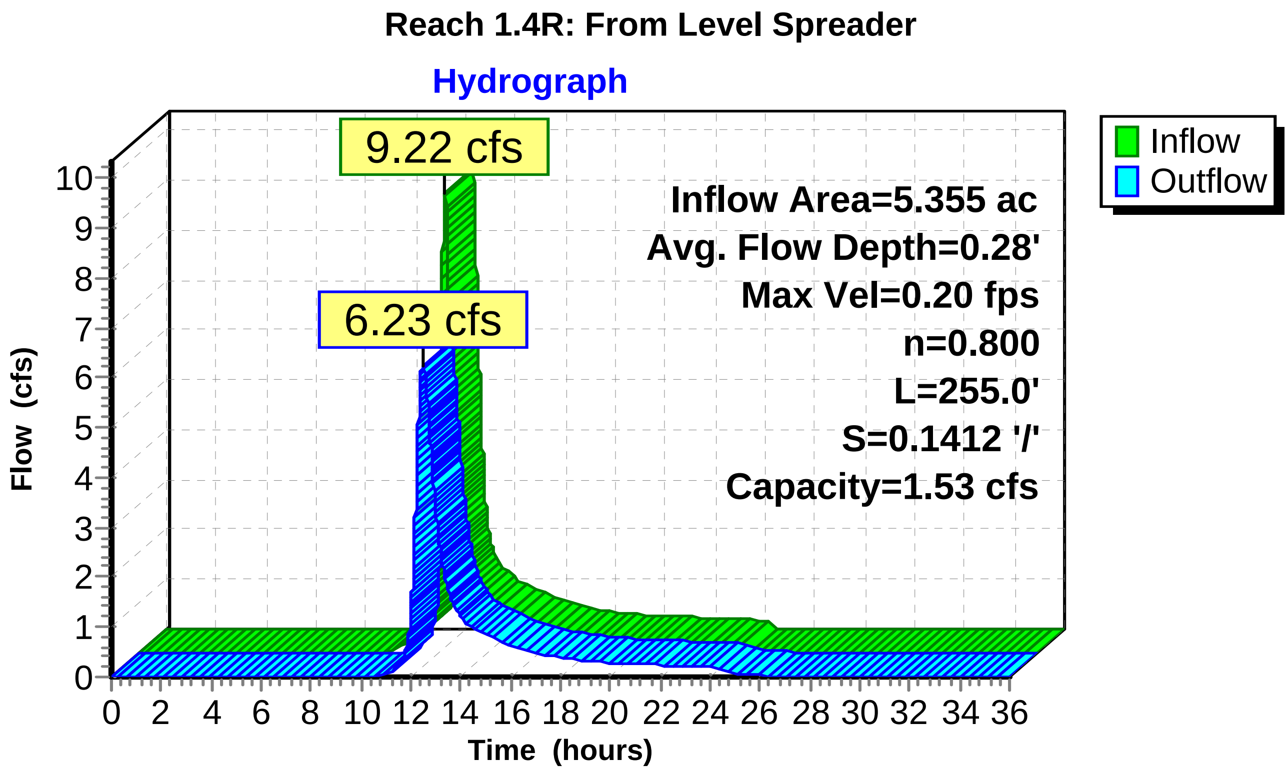
Summary for Reach 1.4R: From Level Spreader

Inflow Area = 5.355 ac, 0.00% Impervious, Inflow Depth = 2.12" for 25-Year Event event
Inflow = 9.22 cfs @ 12.27 hrs, Volume= 0.944 af
Outflow = 6.23 cfs @ 12.48 hrs, Volume= 0.944 af, Atten= 32%, Lag= 12.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 0.20 fps, Min. Travel Time= 20.9 min
Avg. Velocity = 0.06 fps, Avg. Travel Time= 71.9 min

Peak Storage= 7,806 cf @ 12.48 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 0.10' Flow Area= 10.5 sf, Capacity= 1.53 cfs

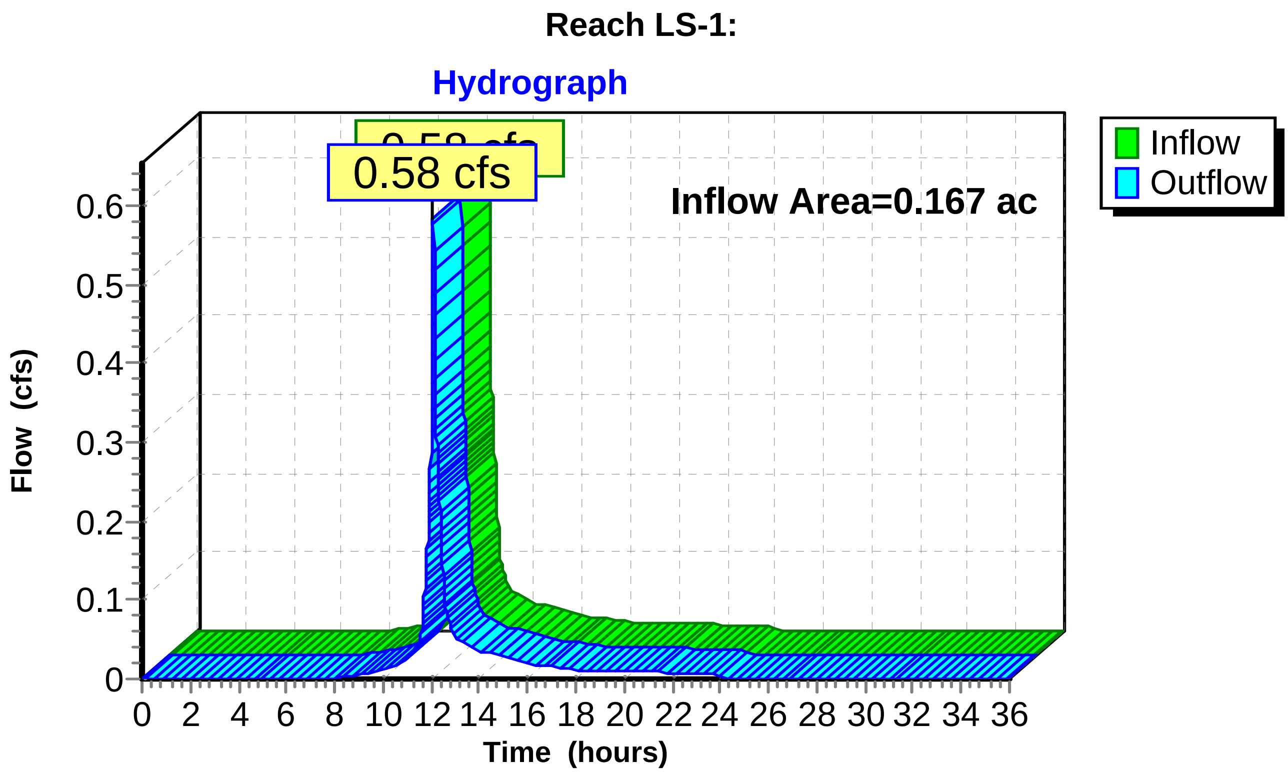
100.00' x 0.10' deep channel, n= 0.800
Side Slope Z-value= 50.0 '/' Top Width= 110.00'
Length= 255.0' Slope= 0.1412 '/'
Inlet Invert= 1,258.00', Outlet Invert= 1,222.00'



Summary for Reach LS-1:

Inflow Area =	0.167 ac,	0.00% Impervious, Inflow Depth =	2.99"	for 25-Year Event event
Inflow =	0.58 cfs @	12.09 hrs, Volume=	0.042 af	
Outflow =	0.58 cfs @	12.09 hrs, Volume=	0.042 af, Atten= 0%, Lag= 0.0 min	

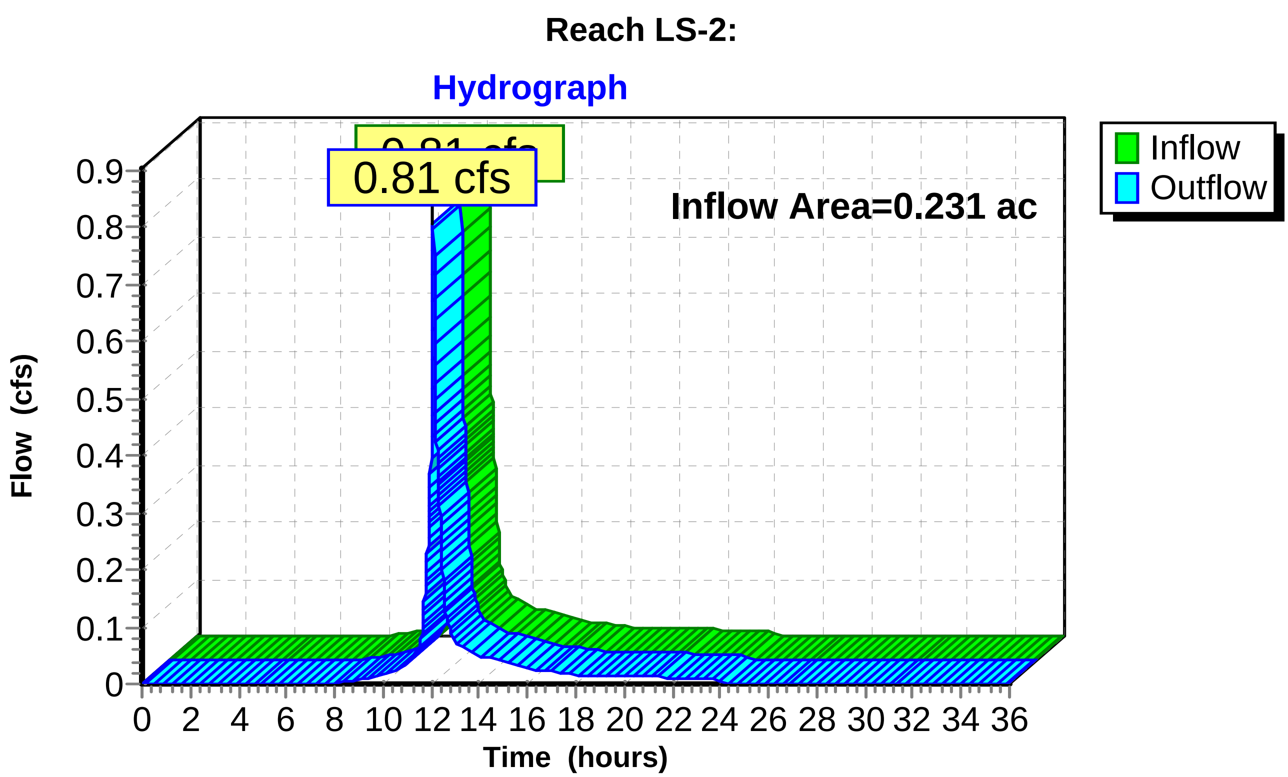
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3



Summary for Reach LS-2:

Inflow Area = 0.231 ac, 0.00% Impervious, Inflow Depth = 2.99" for 25-Year Event event
Inflow = 0.81 cfs @ 12.09 hrs, Volume= 0.057 af
Outflow = 0.81 cfs @ 12.09 hrs, Volume= 0.057 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

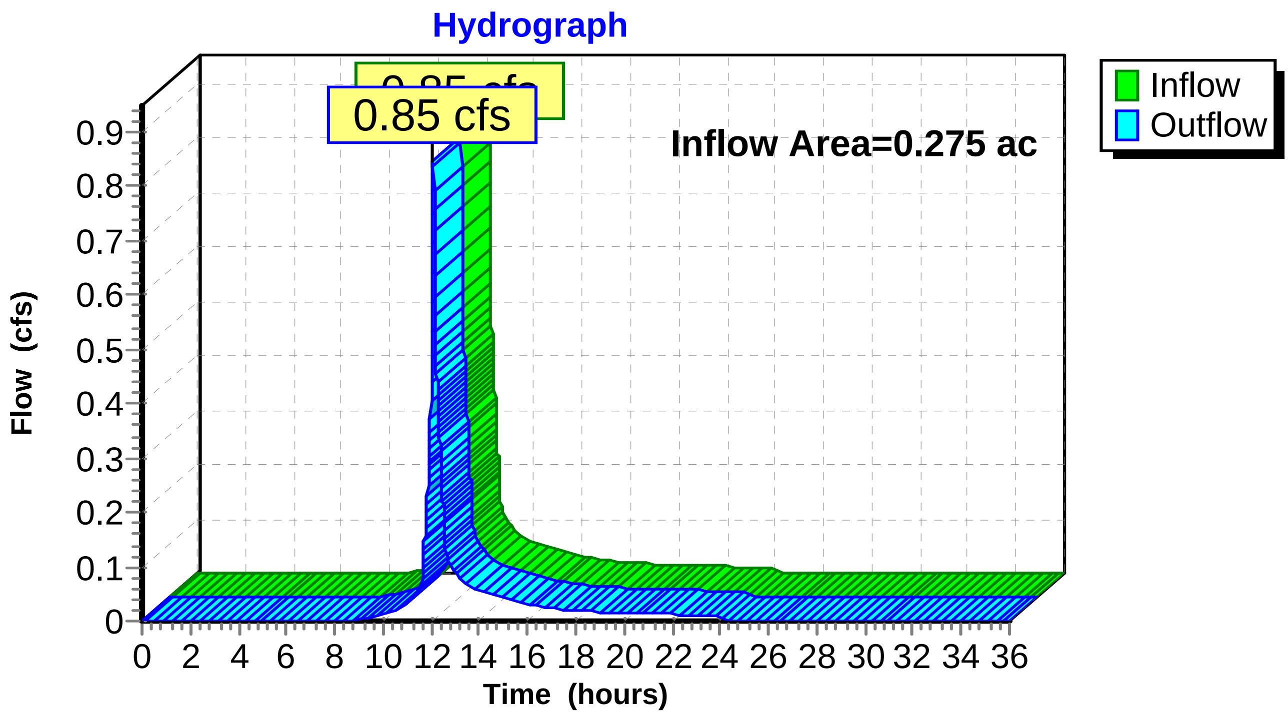


Summary for Reach LS-4:

Inflow Area = 0.275 ac, 0.00% Impervious, Inflow Depth = 2.62" for 25-Year Event event
Inflow = 0.85 cfs @ 12.09 hrs, Volume= 0.060 af
Outflow = 0.85 cfs @ 12.09 hrs, Volume= 0.060 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach LS-4:

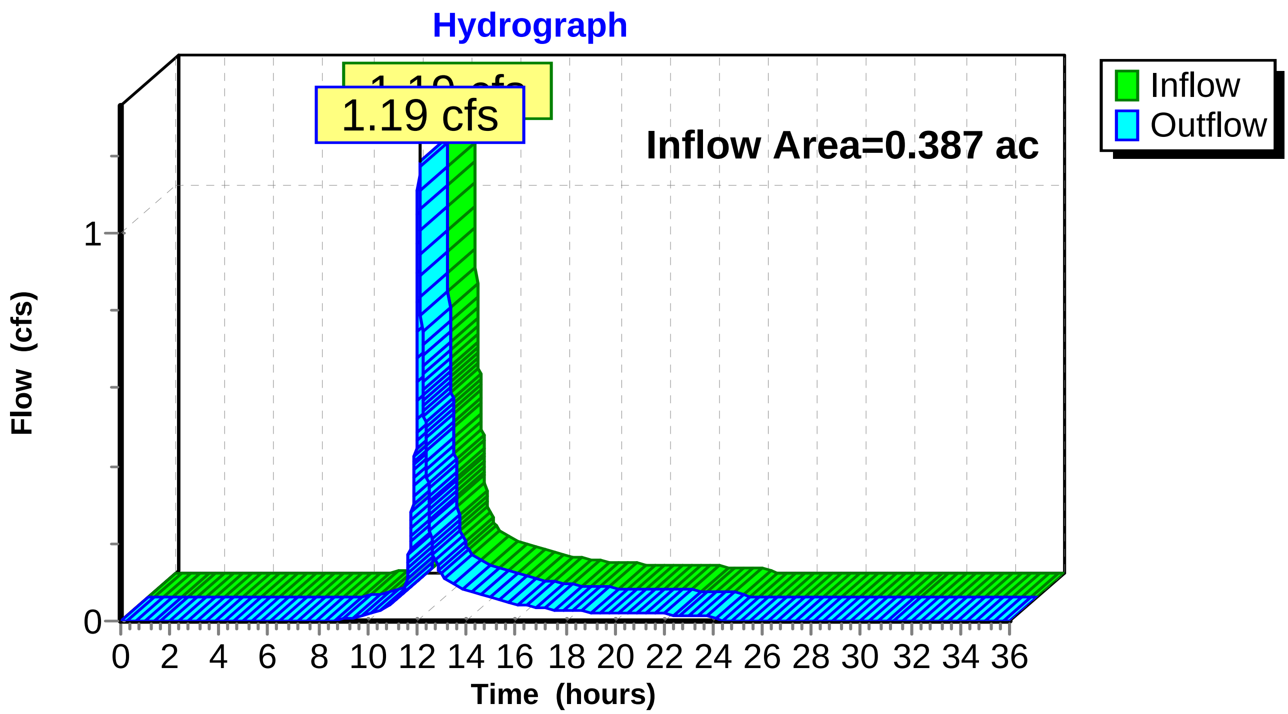


Summary for Reach LS-5:

Inflow Area =	0.387 ac,	0.00% Impervious,	Inflow Depth = 2.62"	for 25-Year Event event	
Inflow =	1.19 cfs @	12.09 hrs,	Volume=	0.085 af	
Outflow =	1.19 cfs @	12.09 hrs,	Volume=	0.085 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach LS-5:

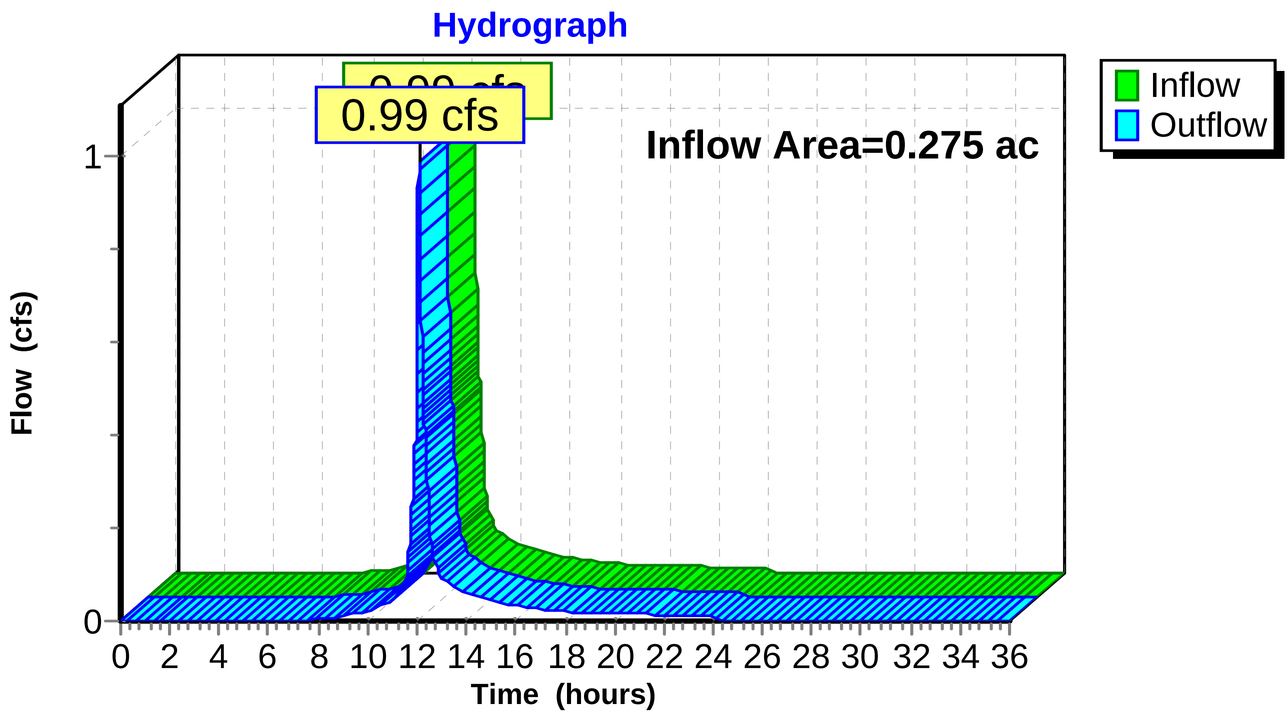


Summary for Reach LS-6:

Inflow Area = 0.275 ac, 0.00% Impervious, Inflow Depth = 3.08" for 25-Year Event event
Inflow = 0.99 cfs @ 12.09 hrs, Volume= 0.071 af
Outflow = 0.99 cfs @ 12.09 hrs, Volume= 0.071 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach LS-6:

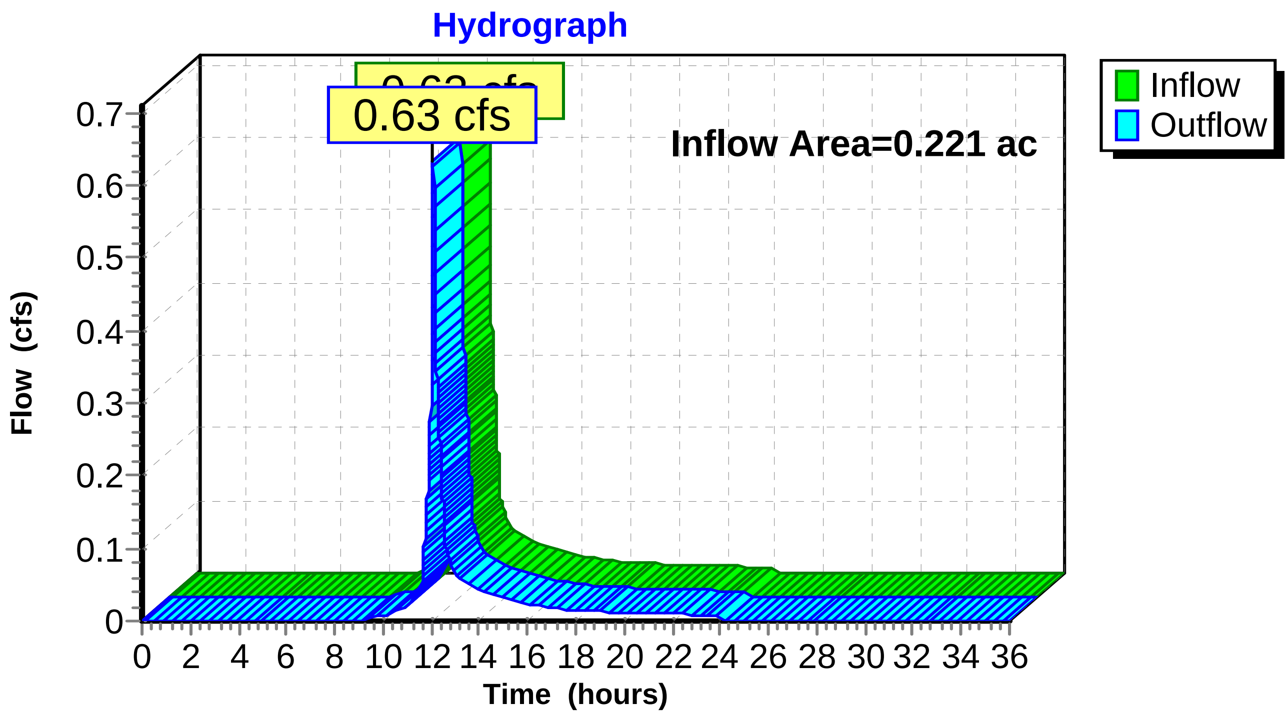


Summary for Reach LS-7:

Inflow Area =	0.221 ac,	0.00% Impervious,	Inflow Depth = 2.45"	for 25-Year Event event	
Inflow =	0.63 cfs @	12.09 hrs,	Volume=	0.045 af	
Outflow =	0.63 cfs @	12.09 hrs,	Volume=	0.045 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach LS-7:



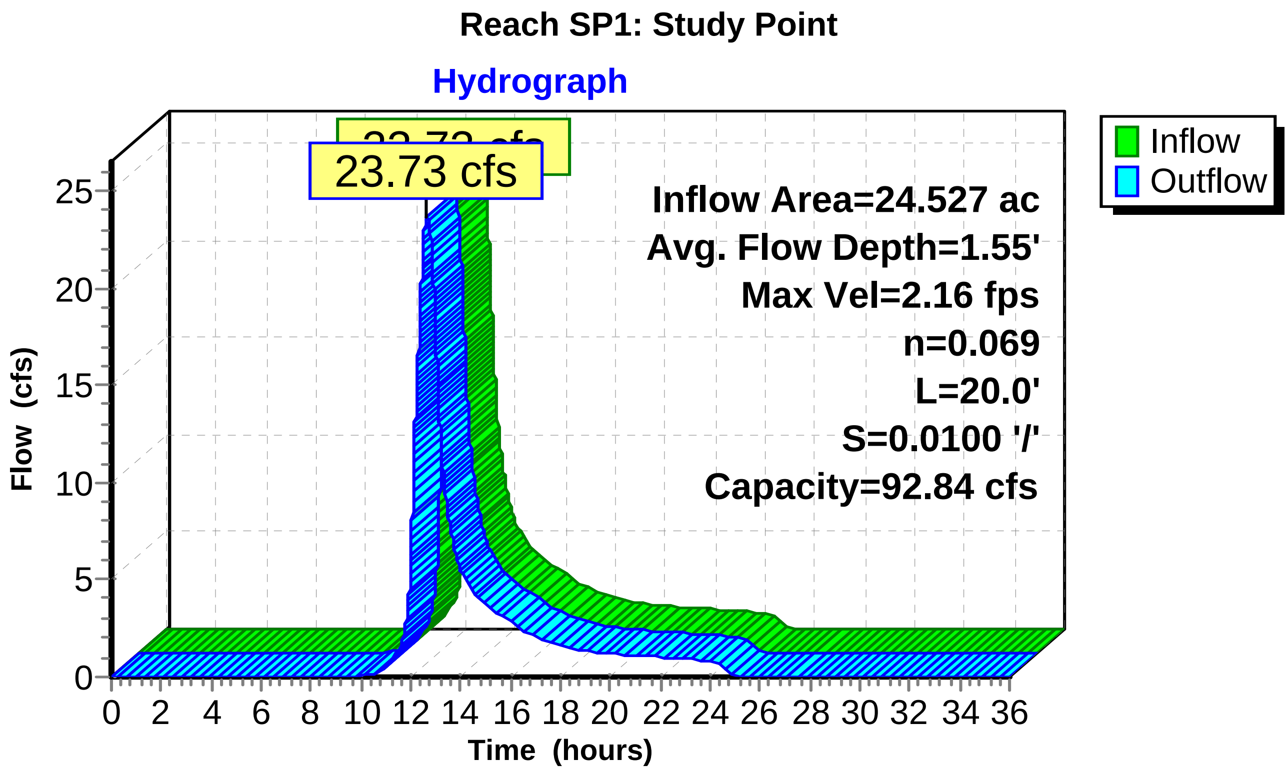
Summary for Reach SP1: Study Point

Inflow Area = 24.527 ac, 1.84% Impervious, Inflow Depth = 2.00" for 25-Year Event event
Inflow = 23.73 cfs @ 12.66 hrs, Volume= 4.078 af
Outflow = 23.73 cfs @ 12.66 hrs, Volume= 4.078 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 2.16 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 0.5 min

Peak Storage= 220 cf @ 12.66 hrs
Average Depth at Peak Storage= 1.55'
Bank-Full Depth= 3.00' Flow Area= 30.0 sf, Capacity= 92.84 cfs

4.00' x 3.00' deep channel, n= 0.069
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 20.0' Slope= 0.0100 '/'
Inlet Invert= 1,042.00', Outlet Invert= 1,041.80'



Summary for Pond 1P: SD-1

Inflow Area = 16.718 ac, 0.71% Impervious, Inflow Depth = 1.96" for 25-Year Event event
Inflow = 17.32 cfs @ 12.64 hrs, Volume= 2.727 af
Outflow = 16.97 cfs @ 12.73 hrs, Volume= 2.727 af, Atten= 2%, Lag= 5.3 min
Primary = 16.97 cfs @ 12.73 hrs, Volume= 2.727 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,045.56' @ 12.72 hrs Surf.Area= 1,302 sf Storage= 2,504 cf
Flood Elev= 1,047.00' Surf.Area= 1,875 sf Storage= 4,794 cf

Plug-Flow detention time= 2.2 min calculated for 2.726 af (100% of inflow)
Center-of-Mass det. time= 2.2 min (888.4 - 886.2)

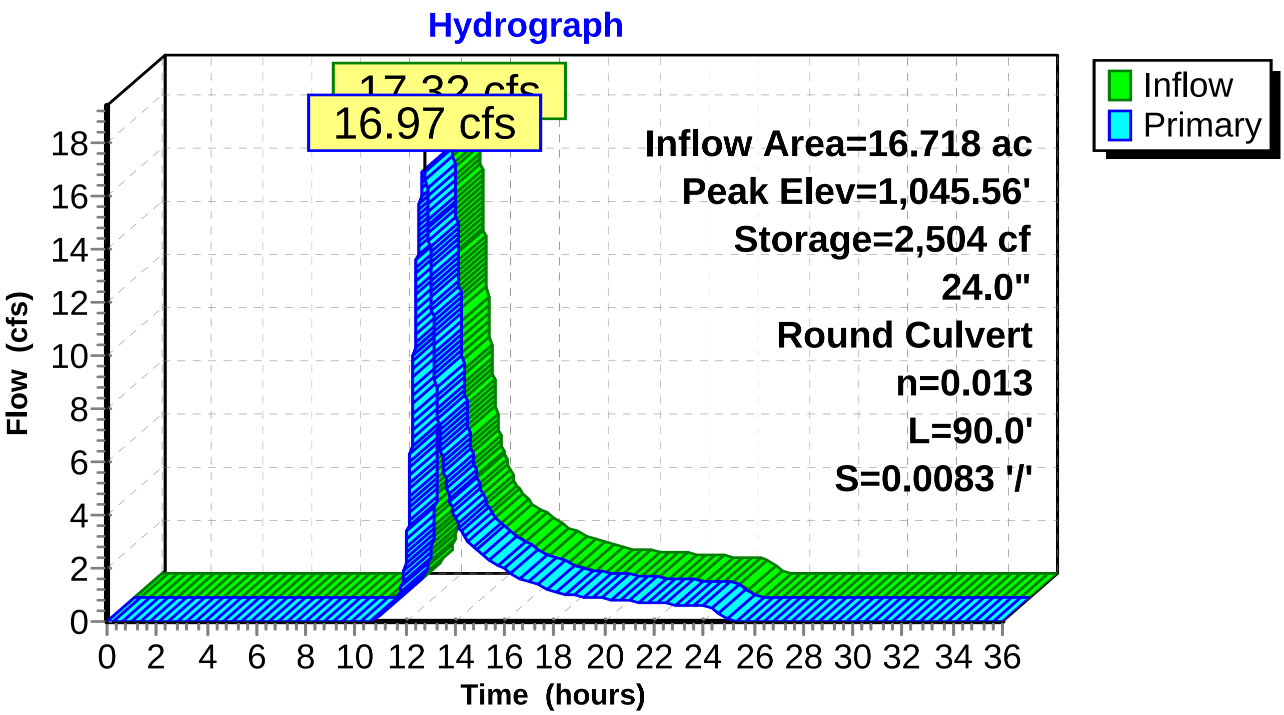
Volume	Invert	Avail.Storage	Storage Description
#1	1,042.00'	4,794 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,042.00	225	70.0	0	0	225
1,044.00	750	135.0	924	924	1,305
1,046.00	1,485	190.0	2,194	3,117	2,764
1,047.00	1,875	200.0	1,676	4,794	3,131

Device	Routing	Invert	Outlet Devices
#1	Primary	1,042.00'	**24.0" Round SD-1** L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,042.00' / 1,041.25' S= 0.0083 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=16.97 cfs @ 12.73 hrs HW=1,045.56' TW=1,043.54' (Dynamic Tailwater)
└─**1=SD-1** (Inlet Controls 16.97 cfs @ 5.40 fps)

Pond 1P: SD-1


Hydrograph
17.32 cfs
16.97 cfs
Inflow Area=16.718 ac
Peak Elev=1,045.56'
Storage=2,504 cf
24.0"
Round Culvert
n=0.013
L=90.0'
S=0.0083 '/'
Inflow
Primary
Flow (cfs)
0
2
4
6
8
10
12
14
16
18
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Time (hours)

Summary for Pond 2P: SD-2

Inflow Area = 1.981 ac, 4.34% Impervious, Inflow Depth = 1.73" for 25-Year Event event
Inflow = 3.00 cfs @ 12.20 hrs, Volume= 0.285 af
Outflow = 3.00 cfs @ 12.20 hrs, Volume= 0.285 af, Atten= 0%, Lag= 0.2 min
Primary = 3.00 cfs @ 12.20 hrs, Volume= 0.285 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,065.09' @ 12.20 hrs Surf.Area= 42 sf Storage= 28 cf

Plug-Flow detention time= 0.4 min calculated for 0.285 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (865.5 - 865.2)

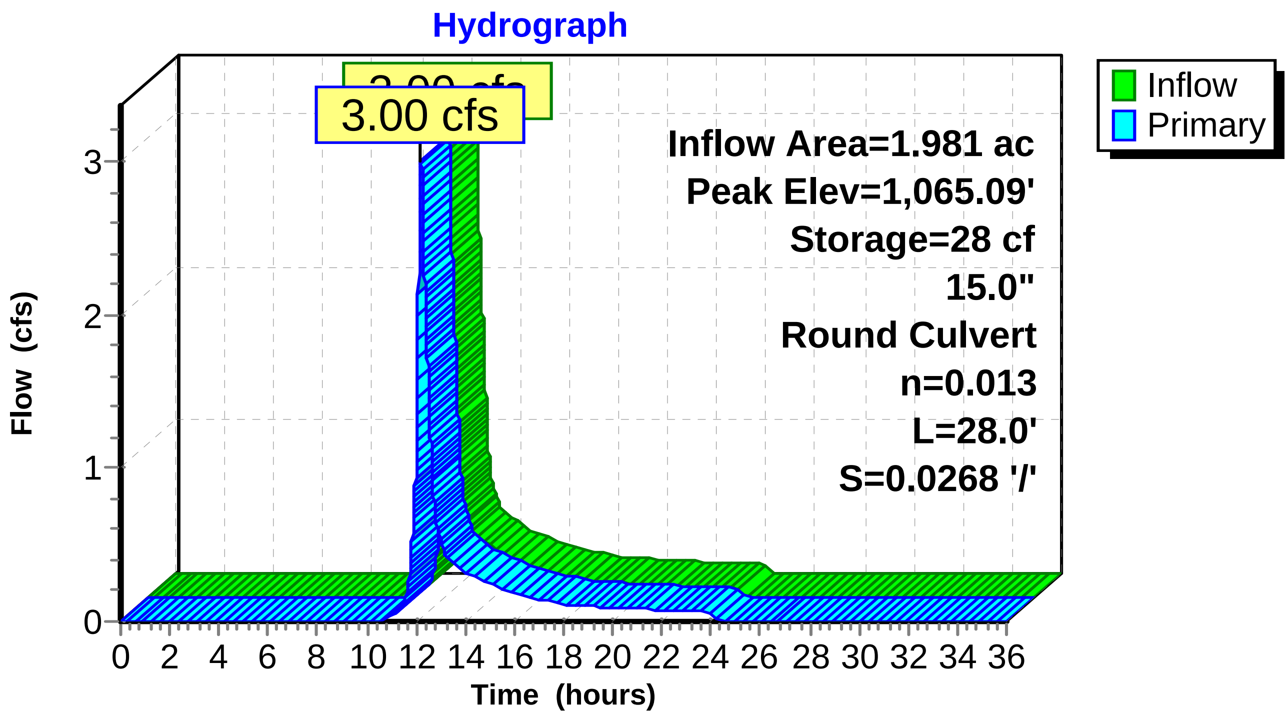
Volume	Invert	Avail.Storage	Storage Description
#1	1,064.00'	195 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,064.00	12	15.0	0	0	12
1,066.00	80	35.0	82	82	106
1,067.00	150	50.0	113	195	216

Device	Routing	Invert	Outlet Devices
#1	Primary	1,064.00'	**15.0" Round SD-2** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,064.00' / 1,063.25' S= 0.0268 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=3.00 cfs @ 12.20 hrs HW=1,065.09' TW=1,064.60' (Dynamic Tailwater)
└─**1=SD-2** (Inlet Controls 3.00 cfs @ 2.65 fps)

Pond 2P: SD-2


Hydrograph
3.00 cfs
3.00 cfs
Inflow
Primary
Inflow Area=1.981 ac
Peak Elev=1,065.09'
Storage=28 cf
15.0"
Round Culvert
n=0.013
L=28.0'
S=0.0268 '/'
Flow (cfs)
0
1
2
3
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Time (hours)

Summary for Pond 3P: SD-3

Inflow Area = 4.600 ac, 0.00% Impervious, Inflow Depth = 2.04" for 25-Year Event event
Inflow = 5.58 cfs @ 12.52 hrs, Volume= 0.781 af
Outflow = 5.55 cfs @ 12.56 hrs, Volume= 0.781 af, Atten= 1%, Lag= 2.4 min
Primary = 5.55 cfs @ 12.56 hrs, Volume= 0.781 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,124.04' @ 12.56 hrs Surf.Area= 277 sf Storage= 309 cf

Plug-Flow detention time= 0.9 min calculated for 0.781 af (100% of inflow)
Center-of-Mass det. time= 0.8 min (876.2 - 875.4)

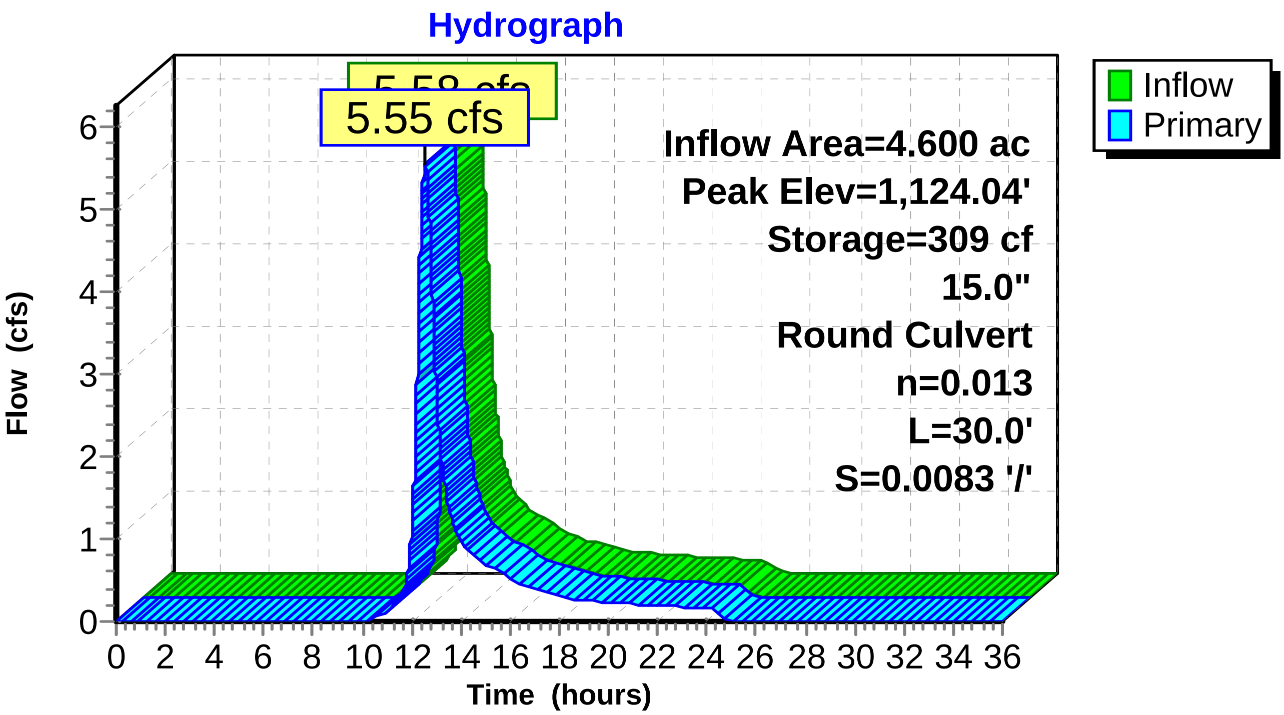
Volume	Invert	Avail.Storage	Storage Description
#1	1,122.00'	666 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,122.00	55	30.0	0	0	55
1,124.00	270	70.0	298	298	389
1,125.00	475	90.0	368	666	656

Device	Routing	Invert	Outlet Devices
#1	Primary	1,122.00'	**15.0" Round SD-3** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,122.00' / 1,121.75' S= 0.0083 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=5.55 cfs @ 12.56 hrs HW=1,124.04' TW=1,122.07' (Dynamic Tailwater)
└─**1=SD-3** (Inlet Controls 5.55 cfs @ 4.52 fps)

Pond 3P: SD-3


Hydrograph
5.58 cfs
5.55 cfs
Inflow Area=4.600 ac
Peak Elev=1,124.04'
Storage=309 cf
15.0"
Round Culvert
n=0.013
L=30.0'
S=0.0083 '/'
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

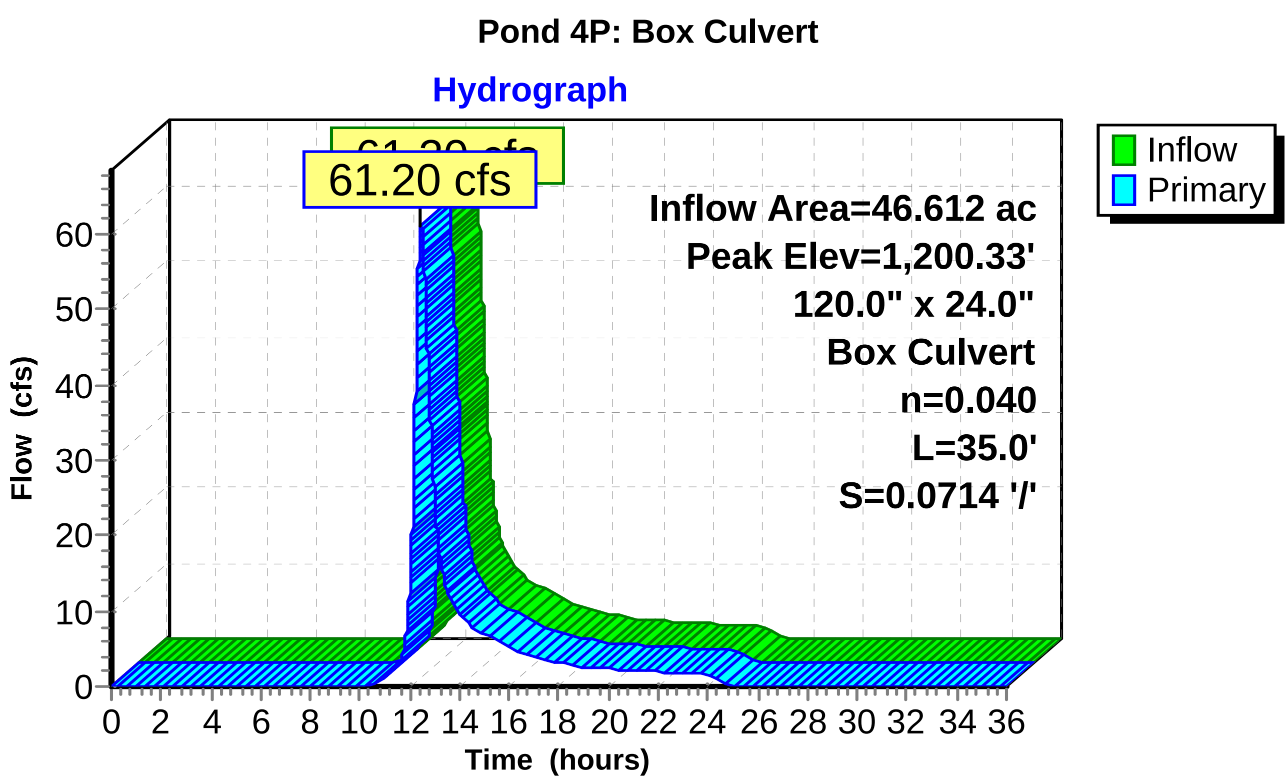
Summary for Pond 4P: Box Culvert

Inflow Area =	46.612 ac,	0.00% Impervious, Inflow Depth =	2.05"	for 25-Year Event event
Inflow =	61.20 cfs @	12.45 hrs, Volume=	7.945 af	
Outflow =	61.20 cfs @	12.45 hrs, Volume=	7.945 af,	Atten= 0%, Lag= 0.0 min
Primary =	61.20 cfs @	12.45 hrs, Volume=	7.945 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,200.33' @ 12.45 hrs
Flood Elev= 1,201.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,199.00'	**120.0" W x 24.0" H Box SD-4** L= 35.0' Box, headwall w/3 rounded edges, Ke= 0.200 Inlet / Outlet Invert= 1,199.00' / 1,196.50' S= 0.0714 '/' Cc= 0.900 n= 0.040 Mountain streams, Flow Area= 20.00 sf

Primary OutFlow Max=61.19 cfs @ 12.45 hrs HW=1,200.32' (Free Discharge)
└**1=SD-4** (Inlet Controls 61.19 cfs @ 4.62 fps)



Summary for Pond 5P: SD-5

Inflow Area = 5.355 ac, 0.00% Impervious, Inflow Depth = 2.12" for 25-Year Event event
Inflow = 9.36 cfs @ 12.25 hrs, Volume= 0.944 af
Outflow = 9.22 cfs @ 12.27 hrs, Volume= 0.944 af, Atten= 1%, Lag= 1.5 min
Primary = 9.22 cfs @ 12.27 hrs, Volume= 0.944 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,264.64' @ 12.27 hrs Surf.Area= 278 sf Storage= 320 cf
Flood Elev= 1,266.00' Surf.Area= 525 sf Storage= 859 cf

Plug-Flow detention time= 0.3 min calculated for 0.944 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (855.8 - 855.5)

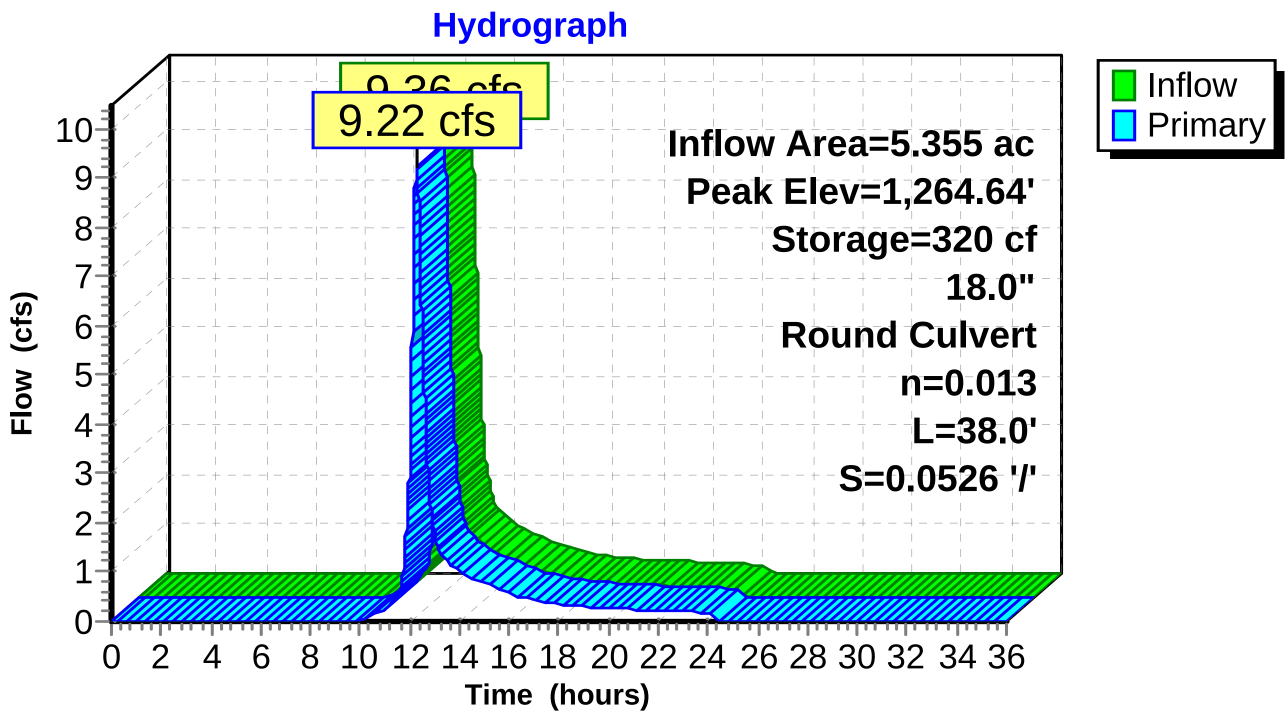
Volume	Invert	Avail.Storage	Storage Description
#1	1,262.00'	859 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,262.00	15	15.0	0	0	15
1,264.00	190	60.0	172	172	294
1,266.00	525	100.0	687	859	828

Device	Routing	Invert	Outlet Devices
#1	Primary	1,262.00'	**18.0" Round SD-5** L= 38.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,262.00' / 1,260.00' S= 0.0526 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=9.22 cfs @ 12.27 hrs HW=1,264.63' TW=1,258.22' (Dynamic Tailwater)
└─**1=SD-5** (Inlet Controls 9.22 cfs @ 5.22 fps)

Pond 5P: SD-5


Hydrograph
9.36 cfs
9.22 cfs
Inflow
Primary
Inflow Area=5.355 ac
Peak Elev=1,264.64'
Storage=320 cf
18.0"
Round Culvert
n=0.013
L=38.0'
S=0.0526 '/'
Flow (cfs)
0
1
2
3
4
5
6
7
8
9
10
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Time (hours)

Summary for Pond 6P: SD-6

Inflow Area = 12.525 ac, 0.00% Impervious, Inflow Depth = 2.04" for 25-Year Event event
Inflow = 18.40 cfs @ 12.35 hrs, Volume= 2.125 af
Outflow = 16.99 cfs @ 12.44 hrs, Volume= 2.125 af, Atten= 8%, Lag= 5.5 min
Primary = 16.99 cfs @ 12.44 hrs, Volume= 2.125 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,425.02' @ 12.44 hrs Surf.Area= 2,370 sf Storage= 2,712 cf

Plug-Flow detention time= 1.5 min calculated for 2.125 af (100% of inflow)
Center-of-Mass det. time= 1.4 min (865.4 - 864.0)

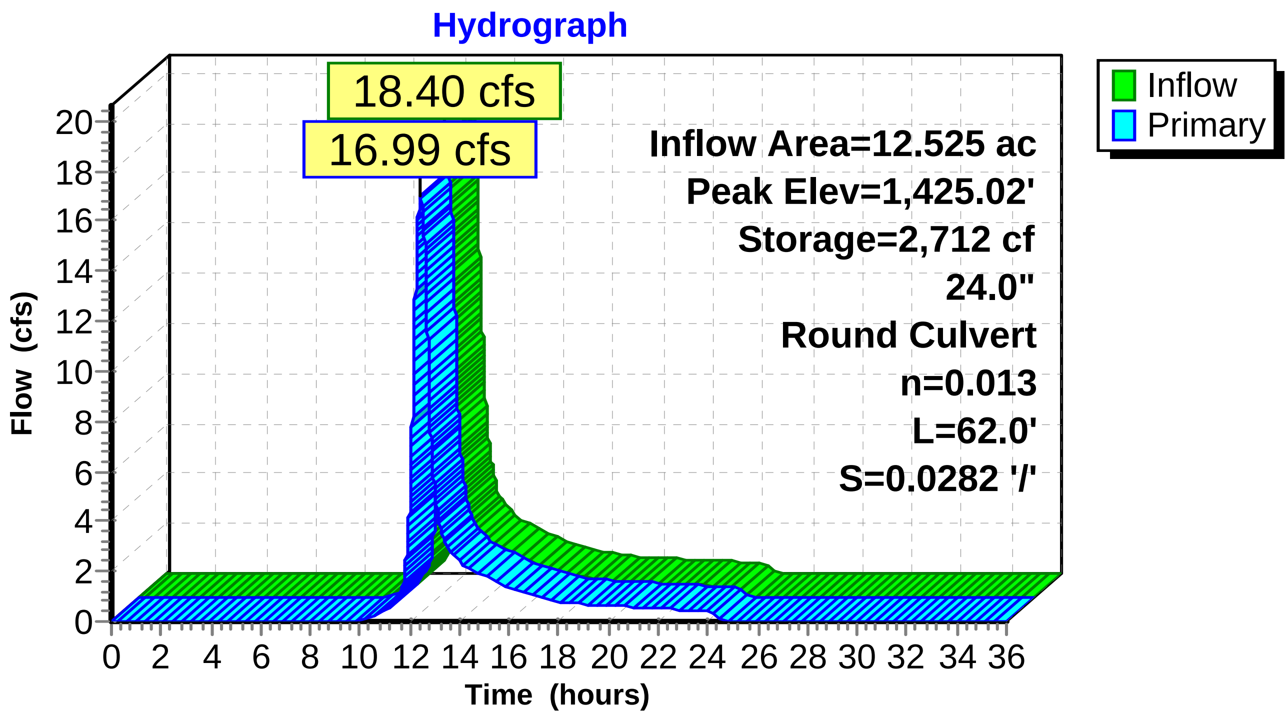
Volume	Invert	Avail.Storage	Storage Description
#1	1,422.00'	5,794 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,422.00	75	55.0	0	0	75
1,424.00	1,100	390.0	975	975	11,946
1,426.00	4,025	975.0	4,819	5,794	75,506

Device	Routing	Invert	Outlet Devices
#1	Primary	1,422.00'	**24.0" Round SD-6** L= 62.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,422.00' / 1,420.25' S= 0.0282 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=16.99 cfs @ 12.44 hrs HW=1,425.02' (Free Discharge)
└─**1=SD-6** (Inlet Controls 16.99 cfs @ 5.41 fps)

Pond 6P: SD-6


Hydrograph
18.40 cfs
16.99 cfs
Inflow Area=12.525 ac
Peak Elev=1,425.02'
Storage=2,712 cf
24.0"
Round Culvert
n=0.013
L=62.0'
S=0.0282 '/'
Inflow
Primary
Flow (cfs)
0
2
4
6
8
10
12
14
16
18
20
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Time (hours)

Summary for Pond 7P: SD-7-11

Inflow Area = 7.206 ac, 0.00% Impervious, Inflow Depth = 2.04" for 25-Year Event event
Inflow = 12.01 cfs @ 12.24 hrs, Volume= 1.223 af
Outflow = 12.00 cfs @ 12.25 hrs, Volume= 1.223 af, Atten= 0%, Lag= 0.3 min
Primary = 12.00 cfs @ 12.25 hrs, Volume= 1.223 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,454.15' @ 12.25 hrs Surf.Area= 63 sf Storage= 41 cf

Plug-Flow detention time= 0.2 min calculated for 1.223 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (858.3 - 858.2)

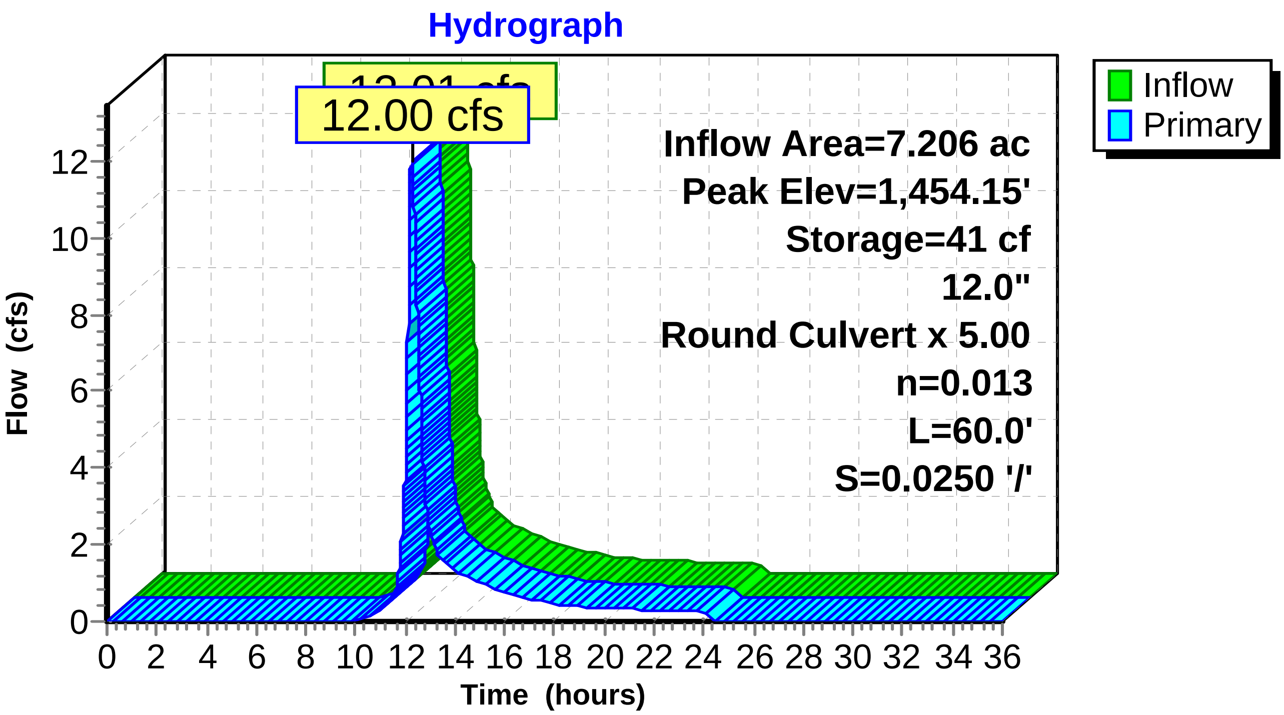
Volume	Invert	Avail.Storage	Storage Description
#1	1,453.00'	273 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,453.00	15	15.0	0	0	15
1,454.00	55	30.0	33	33	73
1,456.00	200	60.0	240	273	306

Device	Routing	Invert	Outlet Devices
#1	Primary	1,453.00'	**12.0" Round SD-7 X 5.00** L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,453.00' / 1,451.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=12.00 cfs @ 12.25 hrs HW=1,454.15' (Free Discharge)
└─**1=SD-7** (Inlet Controls 12.00 cfs @ 3.05 fps)

Pond 7P: SD-7-11



Summary for Pond 8P: SD-12-15

Inflow Area =	8.557 ac,	0.00% Impervious, Inflow Depth = 2.12"	for 25-Year Event event	
Inflow =	13.55 cfs @	12.32 hrs, Volume=	1.509 af	
Outflow =	13.55 cfs @	12.32 hrs, Volume=	1.509 af,	Atten= 0%, Lag= 0.4 min
Primary =	13.55 cfs @	12.32 hrs, Volume=	1.509 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,559.29' @ 12.32 hrs Surf.Area= 102 sf Storage= 79 cf

Plug-Flow detention time= 0.2 min calculated for 1.509 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (859.8 - 859.7)

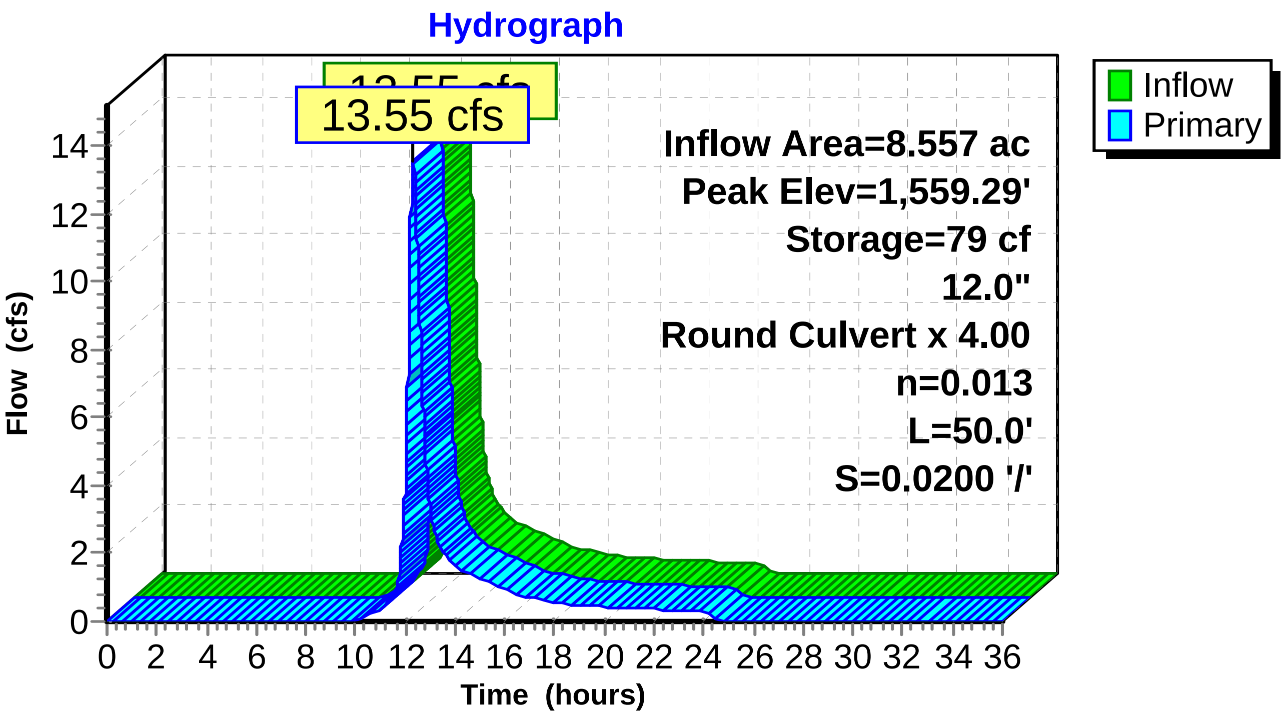
Volume	Invert	Avail.Storage	Storage Description
#1	1,557.50'	798 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,557.50	10	10.0	0	0	10
1,558.00	20	18.0	7	7	29
1,560.00	175	55.0	169	177	256
1,562.00	470	85.0	621	798	619

Device	Routing	Invert	Outlet Devices
#1	Primary	1,557.50'	**12.0" Round SD-12 X 4.00** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,557.50' / 1,556.50' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=13.55 cfs @ 12.32 hrs HW=1,559.29' (Free Discharge)
└─**1=SD-12** (Inlet Controls 13.55 cfs @ 4.31 fps)

Pond 8P: SD-12-15



Summary for Pond 9P: SD-16

Inflow Area = 5.297 ac, 0.00% Impervious, Inflow Depth = 2.12" for 25-Year Event event
Inflow = 7.62 cfs @ 12.39 hrs, Volume= 0.934 af
Outflow = 7.56 cfs @ 12.43 hrs, Volume= 0.934 af, Atten= 1%, Lag= 2.0 min
Primary = 7.56 cfs @ 12.43 hrs, Volume= 0.934 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,605.25' @ 12.43 hrs Surf.Area= 159 sf Storage= 241 cf
Flood Elev= 1,606.00' Surf.Area= 210 sf Storage= 378 cf

Plug-Flow detention time= 0.3 min calculated for 0.934 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (865.2 - 864.9)

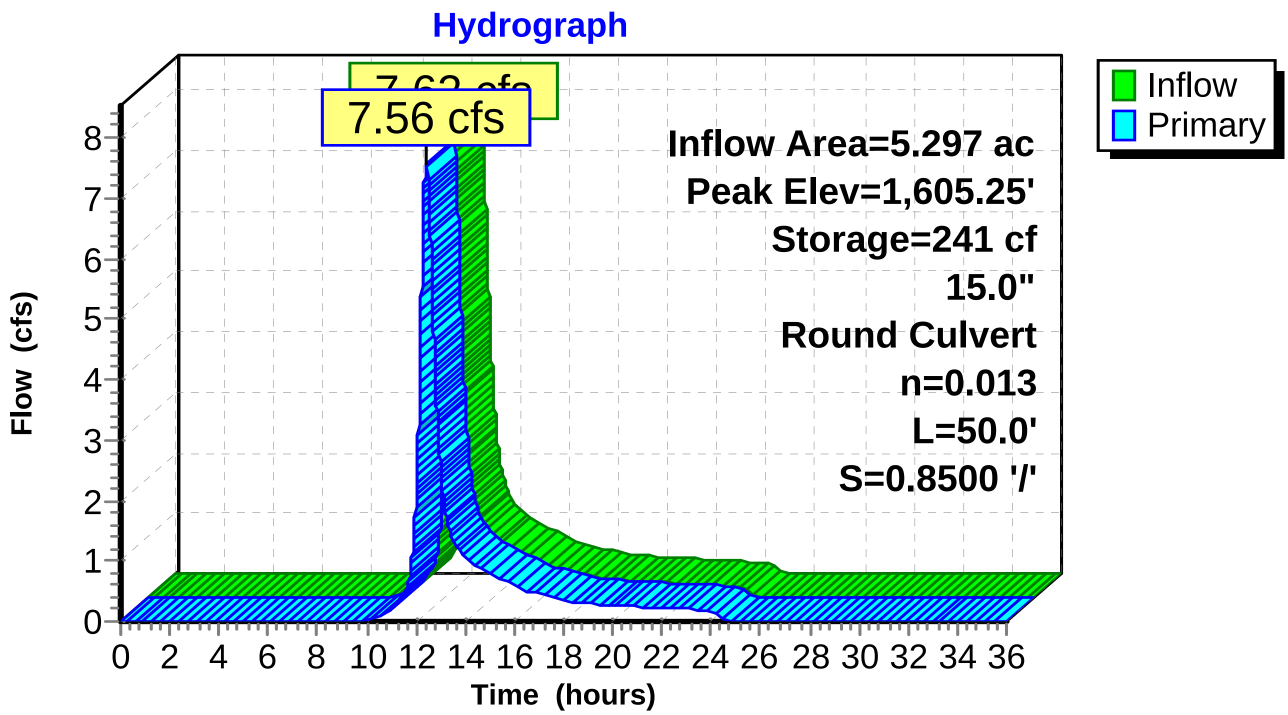
Volume	Invert	Avail.Storage	Storage Description
#1	1,602.00'	378 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,602.00	10	12.0	0	0	10
1,604.00	90	40.0	87	87	137
1,606.00	210	65.0	292	378	371

Device	Routing	Invert	Outlet Devices
#1	Primary	1,602.00'	**15.0" Round SD-16** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,602.00' / 1,559.50' S= 0.8500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=7.56 cfs @ 12.43 hrs HW=1,605.25' (Free Discharge)
└─**1=SD-16** (Inlet Controls 7.56 cfs @ 6.16 fps)

Pond 9P: SD-16


Hydrograph
7.62 cfs
7.56 cfs
Inflow
Primary
Inflow Area=5.297 ac
Peak Elev=1,605.25'
Storage=241 cf
15.0"
Round Culvert
n=0.013
L=50.0'
S=0.8500 '/'
Flow (cfs)
0
1
2
3
4
5
6
7
8
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

Summary for Pond 10P: SD-17

Inflow Area = 1.538 ac, 0.00% Impervious, Inflow Depth = 2.12" for 25-Year Event event
Inflow = 2.17 cfs @ 12.42 hrs, Volume= 0.271 af
Outflow = 2.17 cfs @ 12.42 hrs, Volume= 0.271 af, Atten= 0%, Lag= 0.2 min
Primary = 2.17 cfs @ 12.42 hrs, Volume= 0.271 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,675.84' @ 12.42 hrs Surf.Area= 53 sf Storage= 24 cf

Plug-Flow detention time= 0.2 min calculated for 0.271 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (866.3 - 866.0)

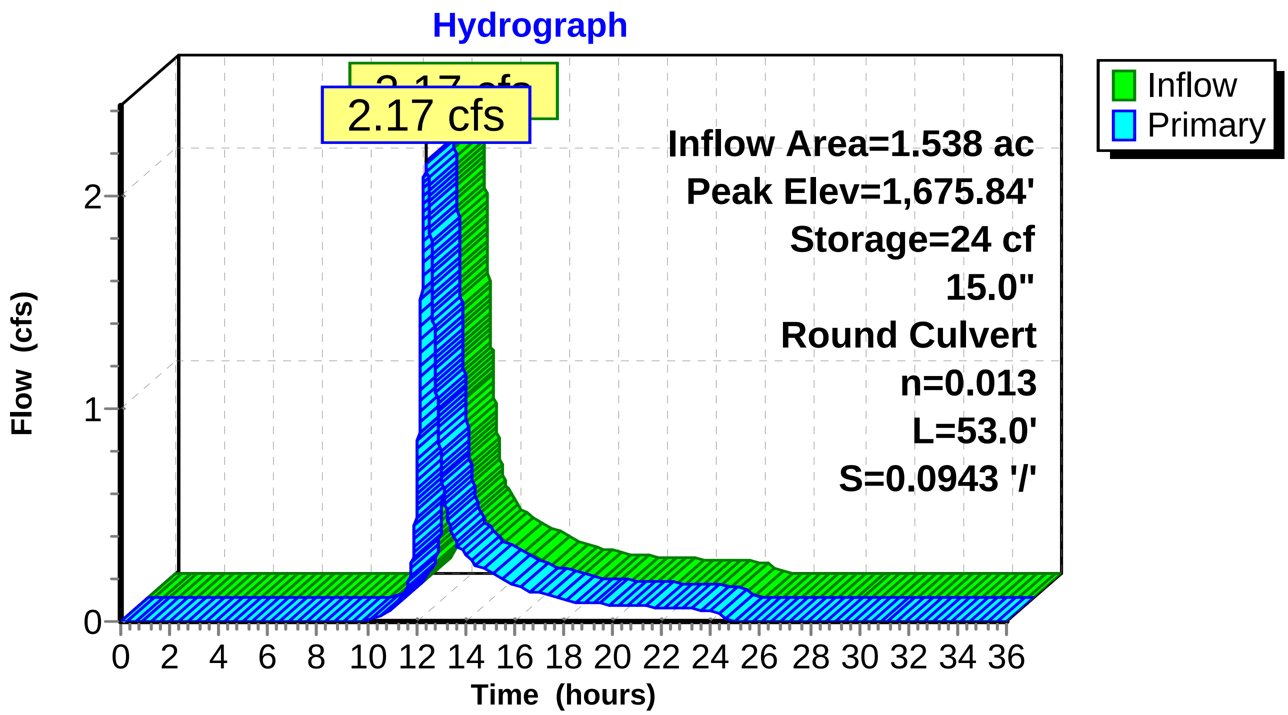
Volume	Invert	Avail.Storage	Storage Description
#1	1,675.00'	295 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,675.00	10	10.0	0	0	10
1,676.00	65	35.0	33	33	102
1,678.00	210	60.0	261	295	314

Device	Routing	Invert	Outlet Devices
#1	Primary	1,675.00'	**15.0" Round SD-17** L= 53.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,675.00' / 1,670.00' S= 0.0943 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=2.17 cfs @ 12.42 hrs HW=1,675.84' (Free Discharge)
└**1=SD-17** (Inlet Controls 2.17 cfs @ 2.47 fps)

Pond 10P: SD-17



Summary for Pond 11P: SD-18

Inflow Area = 9.148 ac, 0.00% Impervious, Inflow Depth = 2.36" for 25-Year Event event
Inflow = 14.25 cfs @ 12.43 hrs, Volume= 1.802 af
Outflow = 13.39 cfs @ 12.53 hrs, Volume= 1.802 af, Atten= 6%, Lag= 5.8 min
Primary = 13.39 cfs @ 12.53 hrs, Volume= 1.802 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,639.63' @ 12.53 hrs Surf.Area= 5,419 sf Storage= 5,099 cf

Plug-Flow detention time= 9.5 min calculated for 1.802 af (100% of inflow)
Center-of-Mass det. time= 9.4 min (869.1 - 859.7)

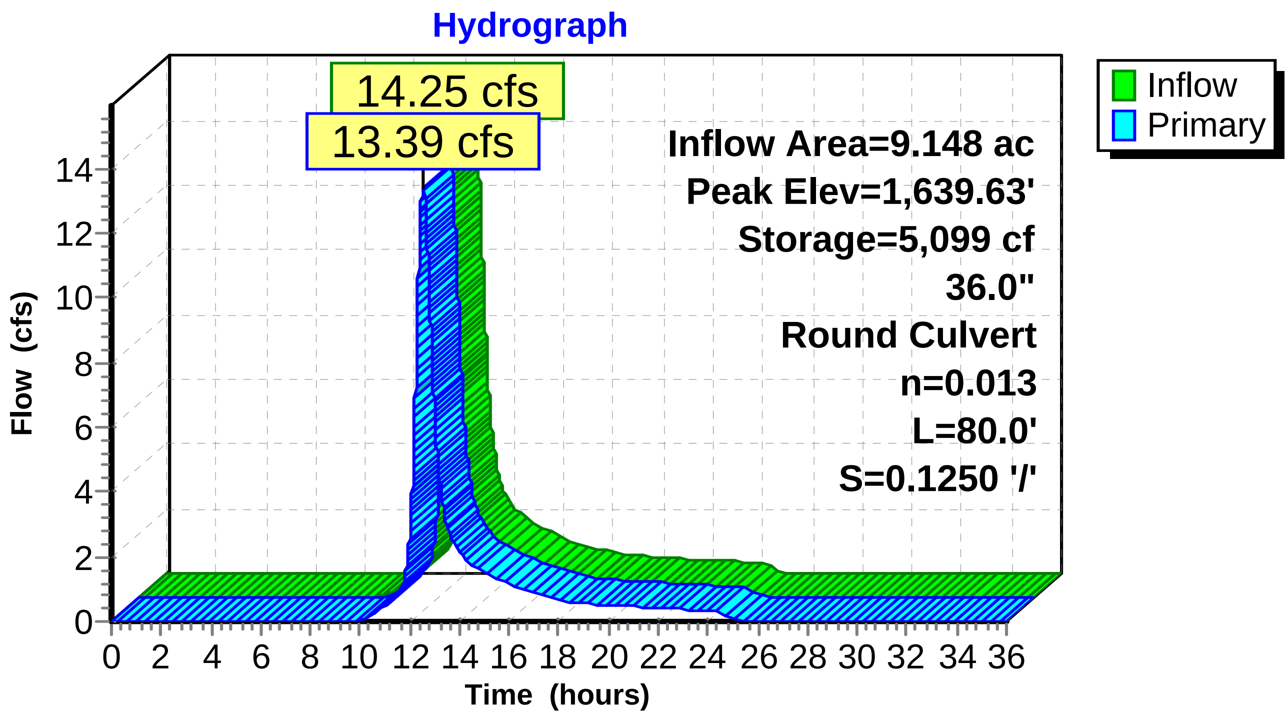
Volume	Invert	Avail.Storage	Storage Description
#1	1,638.00'	46,536 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,638.00	1,320	200.0	0	0	1,320
1,640.00	6,760	450.0	7,378	7,378	14,268
1,642.00	16,100	535.0	22,195	29,573	21,003
1,643.00	17,840	560.0	16,963	46,536	23,249

Device	Routing	Invert	Outlet Devices
#1	Primary	1,638.00'	**36.0" Round SD-18** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,638.00' / 1,628.00' S= 0.1250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=13.39 cfs @ 12.53 hrs HW=1,639.62' (Free Discharge)
└─**1=SD-18** (Inlet Controls 13.39 cfs @ 3.43 fps)

Pond 11P: SD-18



Summary for Pond 12P: SD-19

Inflow Area = 2.416 ac, 0.00% Impervious, Inflow Depth = 2.04" for 25-Year Event event
Inflow = 3.14 cfs @ 12.47 hrs, Volume= 0.410 af
Outflow = 3.01 cfs @ 12.54 hrs, Volume= 0.407 af, Atten= 4%, Lag= 4.4 min
Primary = 3.01 cfs @ 12.54 hrs, Volume= 0.407 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,681.65' @ 12.54 hrs Surf.Area= 1,331 sf Storage= 985 cf

Plug-Flow detention time= 12.9 min calculated for 0.407 af (99% of inflow)
Center-of-Mass det. time= 8.5 min (879.4 - 870.9)

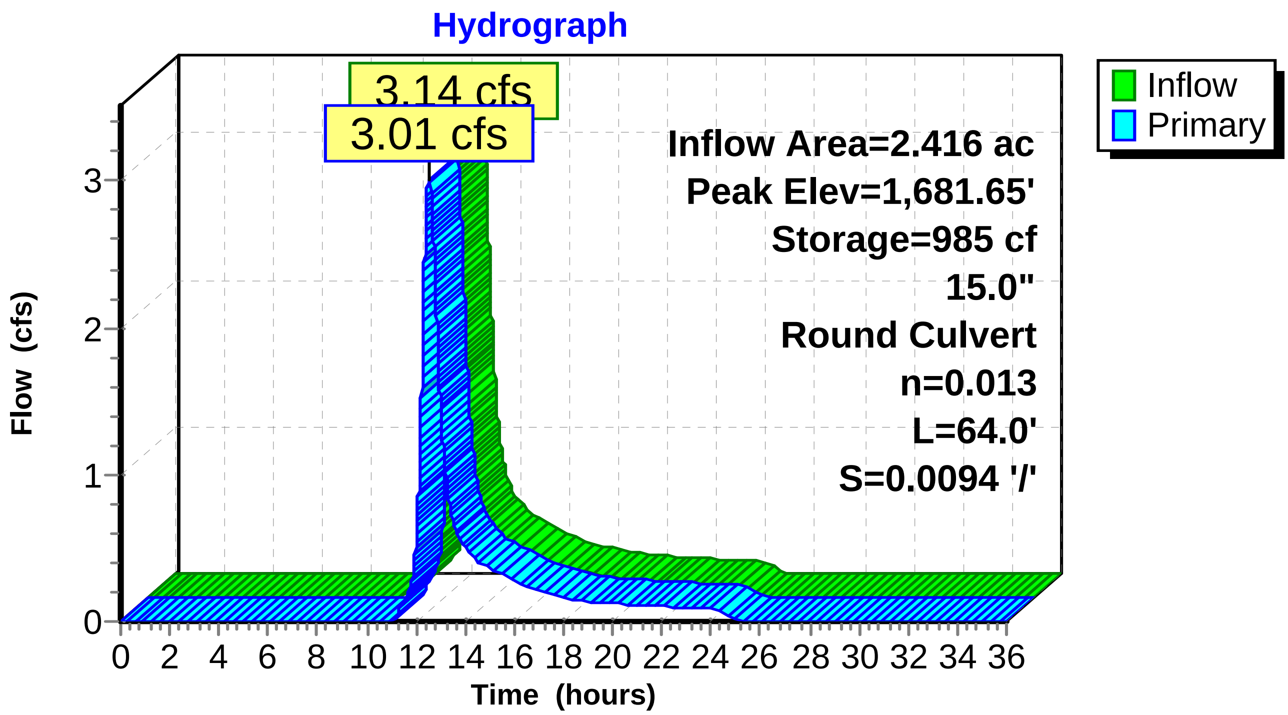
Volume	Invert	Avail.Storage	Storage Description
#1	1,680.00'	1,535 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,680.00	100	45.0	0	0	100
1,682.00	1,780	510.0	1,535	1,535	20,644

Device	Routing	Invert	Outlet Devices
#1	Primary	1,680.60'	**15.0" Round SD-19** L= 64.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,680.60' / 1,680.00' S= 0.0094 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=3.01 cfs @ 12.54 hrs HW=1,681.65' (Free Discharge)
└─**1=SD-19** (Inlet Controls 3.01 cfs @ 2.75 fps)

Pond 12P: SD-19



Summary for Pond 13P: SD-20

Inflow Area = 1.587 ac, 0.00% Impervious, Inflow Depth = 2.12" for 25-Year Event event
Inflow = 2.41 cfs @ 12.35 hrs, Volume= 0.280 af
Outflow = 2.41 cfs @ 12.36 hrs, Volume= 0.280 af, Atten= 0%, Lag= 0.8 min
Primary = 2.41 cfs @ 12.36 hrs, Volume= 0.280 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,701.64' @ 12.36 hrs Surf.Area= 347 sf Storage= 114 cf

Plug-Flow detention time= 1.1 min calculated for 0.280 af (100% of inflow)
Center-of-Mass det. time= 1.1 min (862.9 - 861.9)

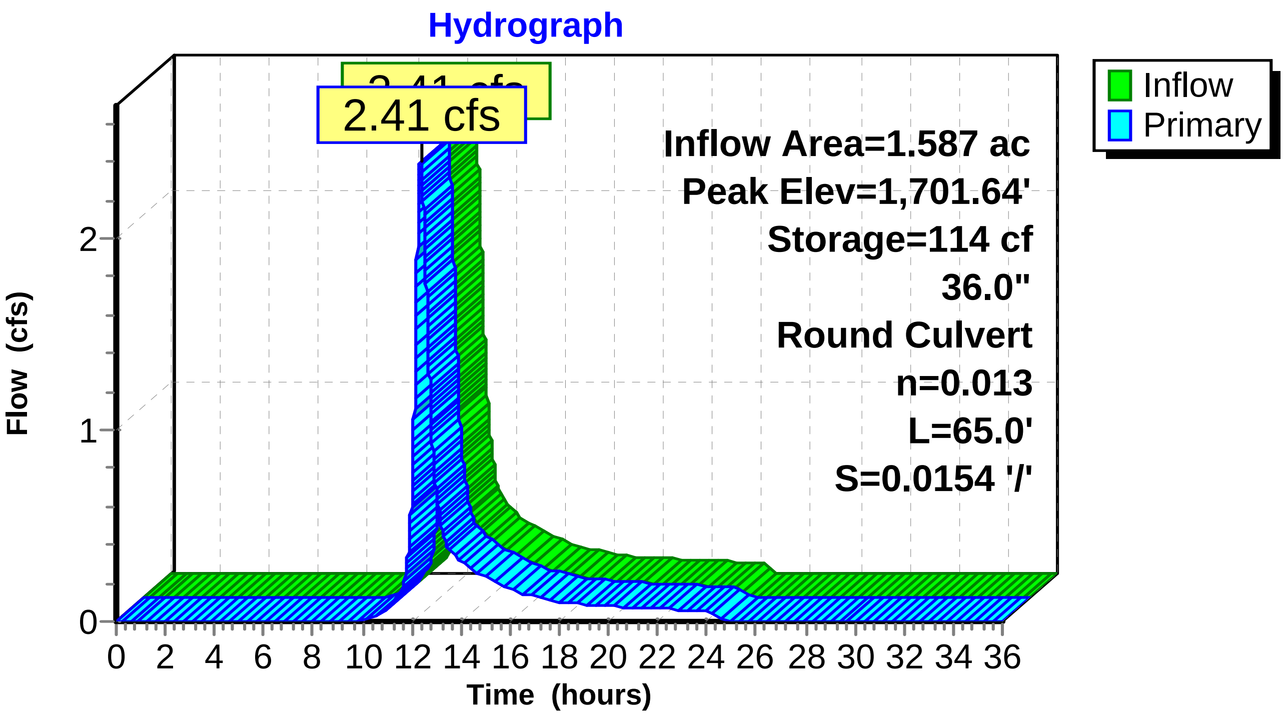
Volume	Invert	Avail.Storage	Storage Description
#1	1,701.00'	7,277 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,701.00	50	25.0	0	0	50
1,702.00	625	105.0	284	284	880
1,704.00	7,675	440.0	6,993	7,277	15,419

Device	Routing	Invert	Outlet Devices
#1	Primary	1,701.00'	**36.0" Round SD-20** L= 65.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,701.00' / 1,700.00' S= 0.0154 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=2.41 cfs @ 12.36 hrs HW=1,701.64' (Free Discharge)
└─**1=SD-20** (Inlet Controls 2.41 cfs @ 2.16 fps)

Pond 13P: SD-20



Summary for Pond 14P: SD-21

Inflow Area = 1.898 ac, 0.00% Impervious, Inflow Depth = 2.20" for 25-Year Event event
Inflow = 3.70 cfs @ 12.20 hrs, Volume= 0.348 af
Outflow = 3.70 cfs @ 12.21 hrs, Volume= 0.348 af, Atten= 0%, Lag= 0.3 min
Primary = 3.70 cfs @ 12.21 hrs, Volume= 0.348 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,564.25' @ 12.21 hrs Surf.Area= 29 sf Storage= 21 cf

Plug-Flow detention time= 0.2 min calculated for 0.348 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (850.6 - 850.4)

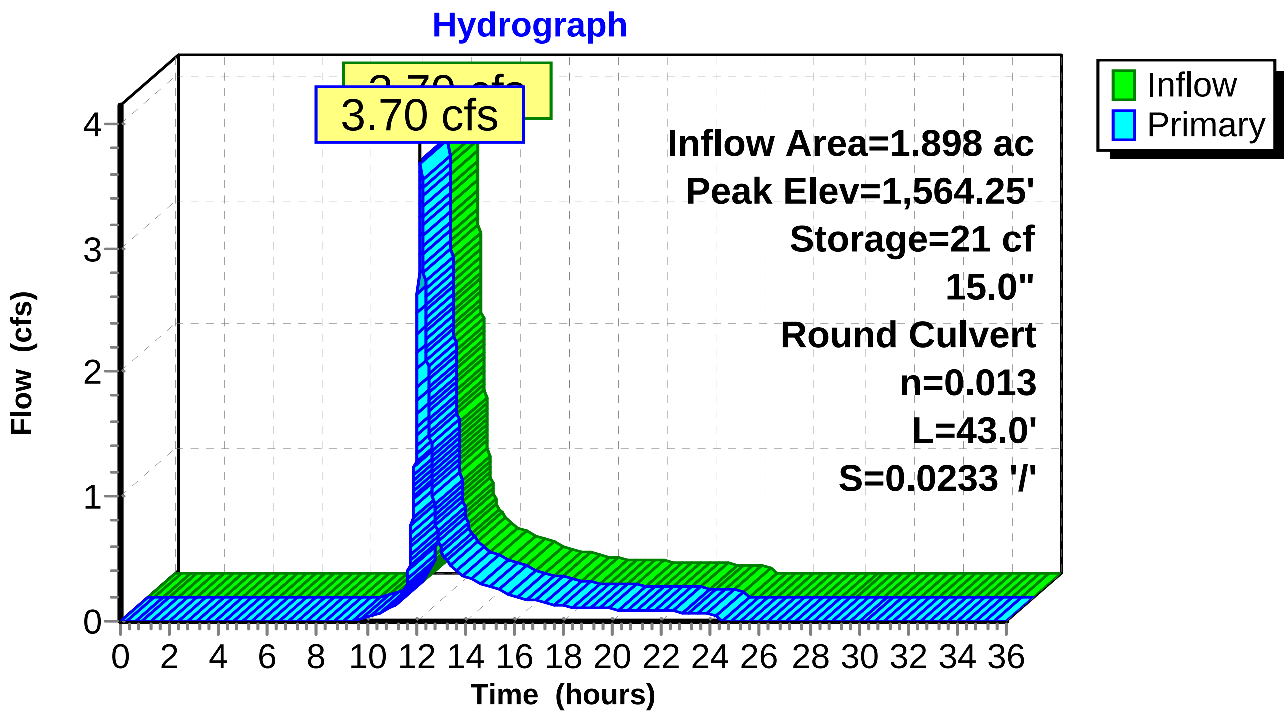
Volume	Invert	Avail.Storage	Storage Description
#1	1,563.00'	153 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,563.00	10	10.0	0	0	10
1,564.00	20	20.0	15	15	38
1,566.00	135	50.0	138	153	219

Device	Routing	Invert	Outlet Devices
#1	Primary	1,563.00'	**15.0" Round SD-21** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,563.00' / 1,562.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=3.70 cfs @ 12.21 hrs HW=1,564.25' (Free Discharge)
└─**1=SD-21** (Inlet Controls 3.70 cfs @ 3.01 fps)

Pond 14P: SD-21



Summary for Pond 15P: SD-22-23

Inflow Area = 2.191 ac, 0.00% Impervious, Inflow Depth = 2.12" for 25-Year Event event
Inflow = 3.38 cfs @ 12.34 hrs, Volume= 0.386 af
Outflow = 3.38 cfs @ 12.34 hrs, Volume= 0.386 af, Atten= 0%, Lag= 0.1 min
Primary = 3.38 cfs @ 12.34 hrs, Volume= 0.386 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,605.82' @ 12.34 hrs Surf.Area= 30 sf Storage= 16 cf

Plug-Flow detention time= 0.1 min calculated for 0.386 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (861.2 - 861.0)

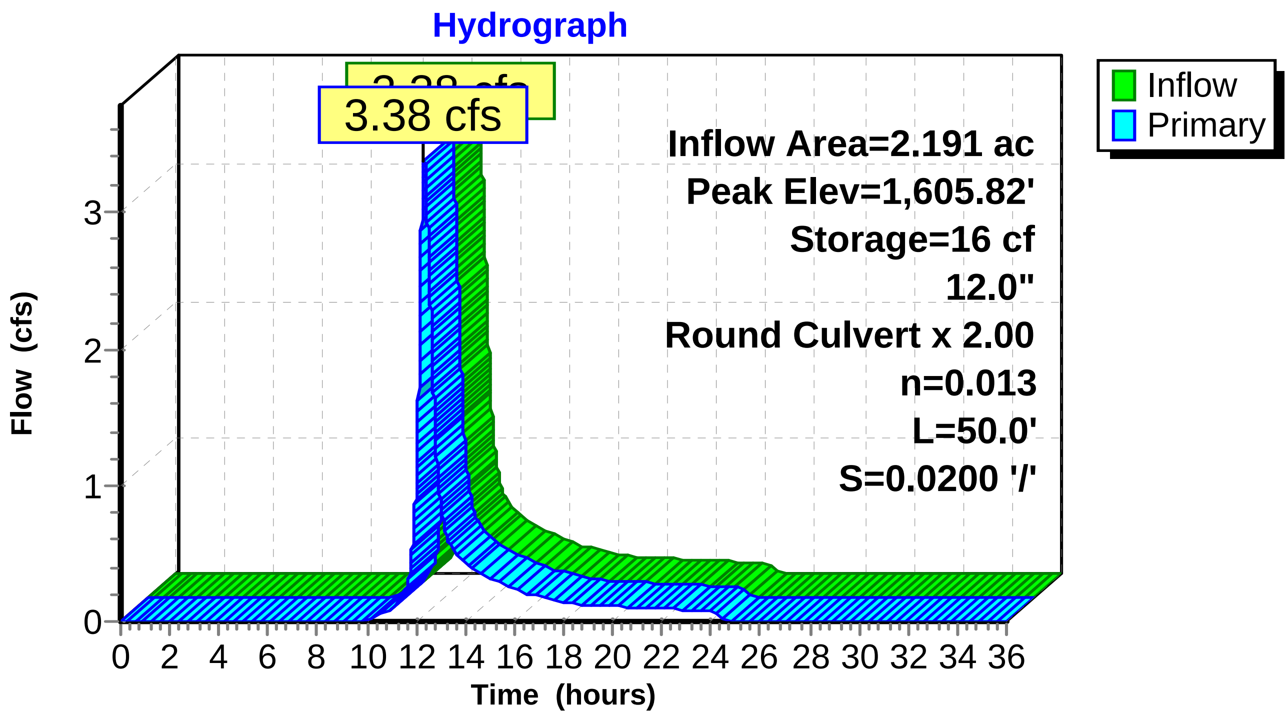
Volume	Invert	Avail.Storage	Storage Description
#1	1,605.00'	205 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,605.00	10	10.0	0	0	10
1,606.00	35	25.0	21	21	55
1,608.00	165	50.0	184	205	222

Device	Routing	Invert	Outlet Devices
#1	Primary	1,605.00'	**12.0" Round SD-22 X 2.00** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,605.00' / 1,604.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.38 cfs @ 12.34 hrs HW=1,605.82' (Free Discharge)
└─**1=SD-22** (Inlet Controls 3.38 cfs @ 2.44 fps)

Pond 15P: SD-22-23



Summary for Pond 16P: SD-24

Inflow Area = 0.278 ac, 0.00% Impervious, Inflow Depth = 2.12" for 25-Year Event event
Inflow = 0.47 cfs @ 12.27 hrs, Volume= 0.049 af
Outflow = 0.47 cfs @ 12.27 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.1 min
Primary = 0.47 cfs @ 12.27 hrs, Volume= 0.049 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,671.36' @ 12.27 hrs Surf.Area= 17 sf Storage= 5 cf

Plug-Flow detention time= 0.4 min calculated for 0.049 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (857.5 - 857.1)

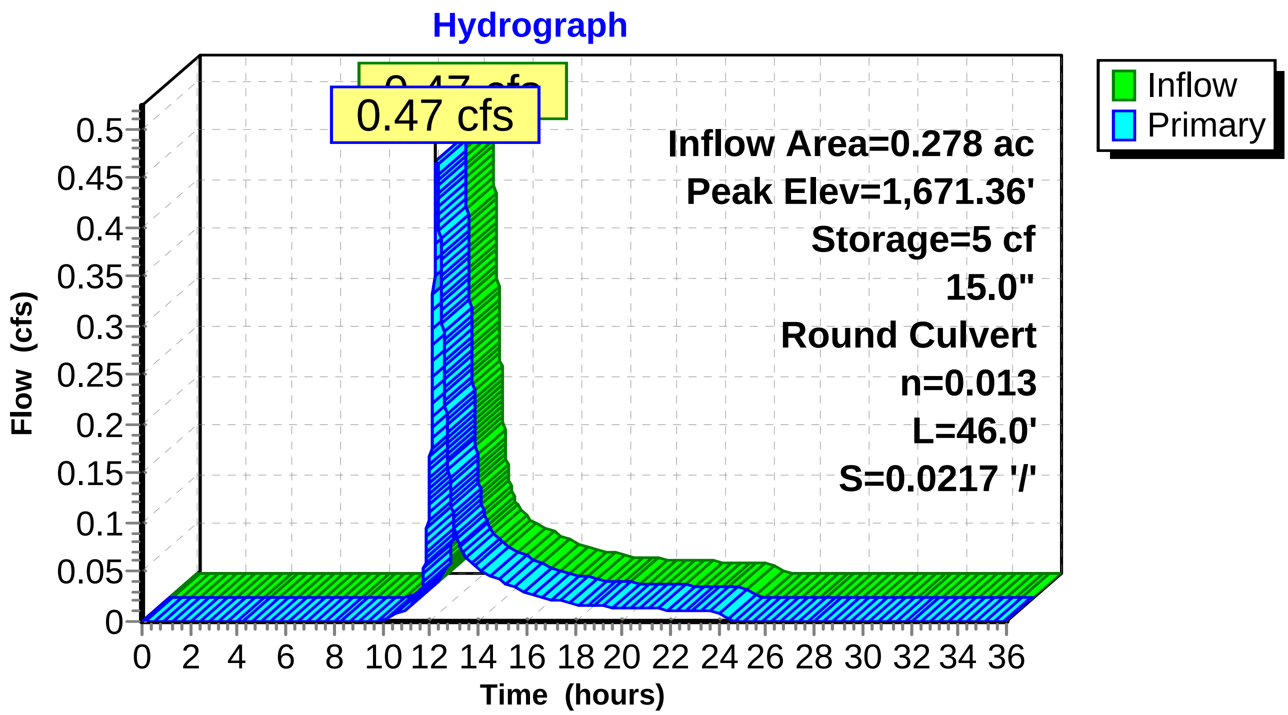
Volume	Invert	Avail.Storage	Storage Description
#1	1,671.00'	201 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,671.00	10	10.0	0	0	10
1,672.00	35	25.0	21	21	55
1,674.00	160	50.0	180	201	222

Device	Routing	Invert	Outlet Devices
#1	Primary	1,671.00'	**15.0" Round SD-24** L= 46.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,671.00' / 1,670.00' S= 0.0217 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.47 cfs @ 12.27 hrs HW=1,671.36' (Free Discharge)
└─**1=SD-24** (Inlet Controls 0.47 cfs @ 1.61 fps)

Pond 16P: SD-24



Summary for Pond 17P: SD-25

Inflow Area = 0.510 ac, 0.00% Impervious, Inflow Depth = 2.04" for 25-Year Event event
Inflow = 0.76 cfs @ 12.34 hrs, Volume= 0.087 af
Outflow = 0.76 cfs @ 12.34 hrs, Volume= 0.087 af, Atten= 0%, Lag= 0.1 min
Primary = 0.76 cfs @ 12.34 hrs, Volume= 0.087 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,679.46' @ 12.34 hrs Surf.Area= 20 sf Storage= 7 cf

Plug-Flow detention time= 0.3 min calculated for 0.087 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (863.8 - 863.5)

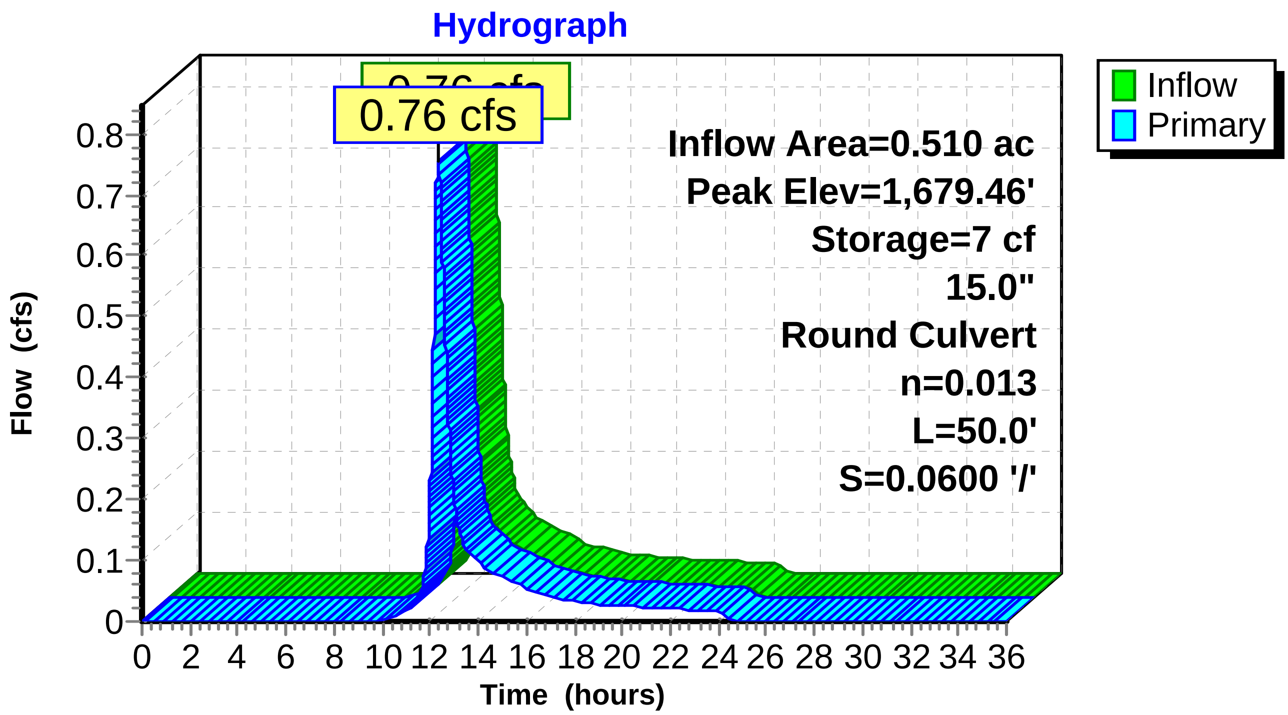
Volume	Invert	Avail.Storage	Storage Description
#1	1,679.00'	305 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,679.00	10	10.0	0	0	10
1,680.00	35	35.0	21	21	102
1,682.00	290	115.0	284	305	1,069

Device	Routing	Invert	Outlet Devices
#1	Primary	1,679.00'	**15.0" Round SD-25** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,679.00' / 1,676.00' S= 0.0600 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.76 cfs @ 12.34 hrs HW=1,679.46' (Free Discharge)
└─**1=SD-25** (Inlet Controls 0.76 cfs @ 1.83 fps)

Pond 17P: SD-25



Summary for Pond 18P: SD-26

Inflow Area = 10.036 ac, 0.00% Impervious, Inflow Depth = 2.04" for 25-Year Event event
Inflow = 22.96 cfs @ 12.10 hrs, Volume= 1.703 af
Outflow = 19.38 cfs @ 12.16 hrs, Volume= 1.703 af, Atten= 16%, Lag= 3.3 min
Primary = 19.38 cfs @ 12.16 hrs, Volume= 1.703 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 1,602.02' @ 12.16 hrs Surf.Area= 4,511 sf Storage= 4,332 cf

Plug-Flow detention time= 4.3 min calculated for 1.703 af (100% of inflow)
Center-of-Mass det. time= 4.2 min (852.5 - 848.3)

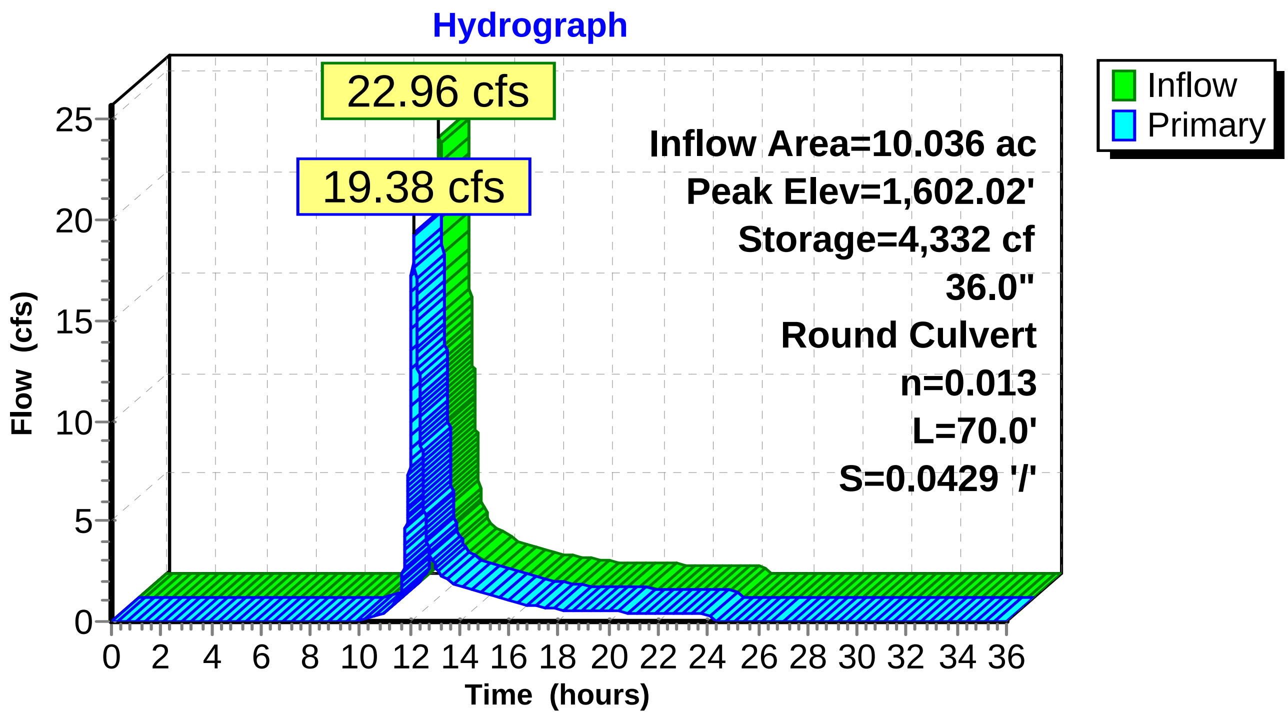
Volume	Invert	Avail.Storage	Storage Description
#1	1,600.00'	9,543 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,600.00	450	100.0	0	0	450
1,602.00	4,475	360.0	4,229	4,229	9,979
1,603.00	6,200	375.0	5,314	9,543	10,930

Device	Routing	Invert	Outlet Devices
#1	Primary	1,600.00'	**36.0" Round SD-26** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,600.00' / 1,597.00' S= 0.0429 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=19.37 cfs @ 12.16 hrs HW=1,602.02' (Free Discharge)
└─**1=SD-26** (Inlet Controls 19.37 cfs @ 3.82 fps)

Pond 18P: SD-26



APPENDIX D

Post-Construction Inspection and Maintenance Plan

ANTRIM WINDPARK PROJECT

POST-CONSTRUCTION STORMWATER MANAGEMENT INSPECTION & MAINTENANCE PLAN

The Antrim Windpark, including the 34.5kV collector substation and Operation and Maintenance facility, will be solely-owned, operated, and maintained by Antrim Wind Energy LLC, of Portsmouth New Hampshire. The 115kV substation will be owned, operated, and maintained by Public Service of New Hampshire (PSNH).

Antrim Wind Energy has designated the following individual(s) as the party responsible for inspection and maintenance of the stormwater management facilities:

Name:

Address: Antrim Wind Energy, LLC
155 Fleet Street
Portsmouth, New Hampshire, 03801

E-mail:

Office Phone:

Cell Phone:

Facilities to be Maintained

The stormwater management facilities to be maintained at the Antrim Windpark include:

- Permanent access road;
- Collector substation and associated swales, bioretention systems, and stabilized slopes;
- Forested and meadow buffers;
- Treatment swales;
- Conveyance swales;

- Permanent check dams
- Culverts with inlet and outlet protection;
- Re-vegetated areas and embankments.

General Inspection and Maintenance Requirements

Generally, the proposed facility will be operated and maintained in a manner consistent with good utility practices, including annual (at minimum) on-site inspections and maintenance of stormwater management system components, as needed. A post-construction maintenance and inspection log is provided.

Maintenance issues associated with specific areas and facilities at the windpark are identified in the following paragraphs.

Substation Yard Area

The substation yard and surrounding area will be inspected annually (at minimum). Any signs of existing or developing erosion, rutting, trash, or unwanted vegetation will be removed/repaired as needed. Vegetated areas will be mowed as needed.

Access Roadway

The access roadway will typically require little on-going maintenance, due to the limited use by heavy vehicles. The roadway will be inspected annually (at minimum), and signs of existing or developing erosion, rutting, trash or unwanted vegetation will be removed/repaired as needed.

Re-vegetated Areas and Embankments

Re-vegetated areas and embankments will be inspected annually (at minimum) for signs of existing or developing erosion, rutting, trash, vegetation loss, or unwanted vegetation. Meadow areas will be mowed as needed to maintain a healthy stand of vegetation. Debris and accumulated sediment will be removed as needed. Any eroded areas will be repaired and replanted with vegetation similar to the surrounding area. The source of the erosion problem shall be identified and eliminated.

Bioretention Systems

The bioretention systems will be inspected at least twice annually, and following any rainfall event exceeding 2.5 inches in 24 hours. Maintenance or rehabilitation shall be performed as needed. Trash and debris shall be removed at each inspection.

System drawdown time shall be inspected annually (at minimum). If the system does not drain within 72 hours following a rainfall event, then a qualified professional will assess the condition of the facility to determine measures required to restore filtration function, including but not limited to removal of accumulated sediments or reconstruction of the filter media. Vegetation shall be inspected annually and maintained in a healthy condition. Pruning, removal and replacement of dead or diseased vegetation, and removal of invasive species shall be performed as needed.

Vegetated Buffers

Small Pervious Area Buffers

Small pervious area buffers are located adjacent to several of the permanent crane pad areas, and are designated as “WTG-_”.

The buffers will be inspected annually (at minimum) for signs of erosion, sediment build-up, or vegetation loss. Meadow buffers will be mowed as needed to maintain a healthy stand of vegetation. Debris and accumulated sediment will be removed as needed. Any eroded areas will be repaired and replanted with vegetation similar to the remaining buffer. The source of the erosion problem shall be identified and eliminated.

Roadway Buffers

Roadway buffers are located adjacent to the access road.

The buffers will be inspected annually (at minimum) for signs of erosion, sediment build-up, or vegetation loss. Meadow buffers will be mowed as needed to maintain a healthy stand of vegetation. Forested buffers will be maintained in an undisturbed condition, unless erosion occurs. Debris and accumulated sediment will be removed as needed. Any eroded areas will be repaired and replanted with vegetation similar to the remaining buffer. The source of the erosion problem shall be identified and eliminated.

Ditch Turnout Buffers

Ditch turnout buffers are located adjacent to the access road, and begin at a stone berm level spreader.

The buffers will be inspected annually (at minimum) for signs of erosion, sediment build-up, or vegetation loss. Forested buffers will be maintained in an undisturbed condition, unless erosion occurs. Debris and accumulated sediment will be removed as needed. Any eroded areas will be repaired and replanted with vegetation similar to the remaining buffer. The source of the erosion problem shall be identified and eliminated.

The stone berm level spreaders will be inspected annually (at minimum) for accumulation of sediment and debris, and for signs of erosion within the approach channel, spreader channel, or down-slope of the spreader. Debris will be removed whenever observed during inspection. Sediment will be removed when accumulation exceeds 25% of spreader channel depth. Vegetated areas will be mowed annually (at minimum), or as required to control growth of woody vegetation. Stone berm material will be replaced/level spreader will be repaired as needed. Spreader shall be reconstructed if down-slope channelization indicates that the spreader is not level or that discharge has become concentrated, and corrections cannot be made through minor regrading.

Treatment Swales

Treatment swales are located adjacent to the access road, and are designated as “SW-_”.

Treatment swales will be inspected annually (at minimum) for signs of erosion, sediment accumulation, vegetation loss, and presence of invasive species. Swales will be mowed as needed. Vegetation shall not be cut shorter than 4 inches. Debris and accumulated sediment shall be removed, and eroded areas repaired, as needed. Invasive species and dead vegetation shall be removed when encountered.

Conveyance Swales

Conveyance swales are located directly adjacent to the access road. The site has both vegetated and riprap swales.

Conveyance swales will be inspected annually (at minimum) for signs of erosion, sediment accumulation, and condition of the surface lining. Repairs, including stone or vegetation replacement, will be made as needed. Vegetated swales will be mowed annually (at minimum) or as needed. Vegetation shall not be cut shorter than 4 inches. Debris and accumulated sediment shall be removed, and eroded areas repaired, as needed.

Conveyance swales that do not discharge via a culvert have been provided with outlet protection in the form of a plunge pool or permanent check dam. Outlet protection will be inspected annually (at minimum) for damage or deterioration. Repairs, including rebuilding or stone replacement, will be made immediately. Debris and accumulated sediment will be removed as needed.

Culverts

Culverts will be inspected annually (at minimum) for signs of blockage, damage or deterioration. Debris and accumulated sediment shall be removed as needed. Repairs to inlet and outlet protection, including rebuilding or stone replacement, will be made immediately.

Antrim Windpark, Antrim, NH				
Stormwater Management System Inspection & Maintenance Log				
	Schedule		**Inspector Initials and Date**	**Inspector Comments**
	Minimum Inspection Frequency	**Maintenance Frequency**		
Re-vegetated Areas and Embankments:				
Inspect all re-vegetated areas and embankments.	**Annual**			
Replant bare areas or areas with sparse growth.		**As Required**		
Armor areas with rill erosion with an appropriate lining or divert the erosive flows to on-site areas able to withstand concentrated flows.		**As Required**		
Drainage Conveyance Systems:				
Inspect drainage swales, natural swales, and plunge pool for evidence of erosion, debris, woody growth, and excessive sediment.	**Annual**			
Remove any obstructions and accumulated sediments or debris.		**As Required**		
Control vegetated growth and woody vegetation.		**As Required**		
Repair any erosion of the swale lining.		**As Required**		
Mow vegetated swales.		**Annually**		
Clean-out any accumulation of sediment within the plunge pool and riprap aprons.		**As Required**		
Remove woody vegetation growing through riprap.		**As Required**		
Repair any slumping side slopes.		**As Required**		
Replace riprap where underlying filter fabric is showing or where stones have dislodged.		**As Required**		
Culverts:				
Inspect culvert inlet, outlet, and structure.	**Annual**			
Remove accumulated sediments and debris at the inlet, at the outlet, and within the conduit.		**As Required**		
Repair any erosion damage at the culvert's inlet and outlet.		**As Required**		

Antrim Windpark, Antrim, NH				
Stormwater Management System Inspection & Maintenance Log				
	Schedule		**Inspector Initials and Date**	**Inspector Comments**
	Monthly Inspection	**Maintenance**		
Roadway Surfaces:				
Inspect access road surfaces and shoulders for erosion, false ditches, and excess accumulation of sand that could impede water flow.	**Annual**			
Remove excess sand either manually or with a front-end loader.		**As Required**		
Grade gravel roads and shoulders.		**As Required**		
Substation yard:				
Inspect for existing or developing erosion, rutting, trash, and unwanted vegetation.	**Annual**			
Correct any erosion/rutting and/or remove trash or vegetation.		**As Required**		
Water Quality Treatment Buffer:				
Inspect treatment buffer for evidence of erosion, concentrated flow, or encroachment by development.	**Annual**			
Manage the buffer's vegetation consistent with the requirements in any deed restrictions.		**As Required**		
Mow vegetation in non-wooded buffers no shorter than six inches and no more than two times per year.		**As Required**		
Repair any sign of erosion within a buffer.		**As Required**		
Inspect and repair down-slope of all drainage outlets for erosion.	**Annual**	**As Required**		

Antrim Windpark, Antrim, NH				
Stormwater Management System Inspection & Maintenance Log				
	Schedule		**Inspector Initials and Date**	**Inspector Comments**
	Monthly Inspection	**Maintenance**		
Maintenance Needed and When:				

Exhibit 5

NHB Documentation

Memo

NH NATURAL HERITAGE BUREAU
NHB DATACHECK RESULTS LETTER

To: Dana Valleau, TRC Environmental Corp.
14 Gabriel Drive
Augusta, ME 04330

From: Amy Lamb, NH Natural Heritage Bureau
Date: 6/11/2015 3:14:08 PM (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau
NHB File ID: NHB15-1904 Town: Antrim Location: Tax Maps: Maps 212, 235, 236, 239; Lots 212-7, 30&34; 235-14; 236-1&2; 239-1

Description: The project is a wind power project located along Tuttle Hill.
cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments: NHB requests surveys for the endangered plant species and exemplary natural community indicated below. Please send the requested information to: Amy.Lamb@dred.nh.gov. Please coordinate with Kim Tuttle of NH Fish & Game for wildlife concerns.

Invertebrate Species	**State[1]**	**Federal**	**Notes**
Ebony Boghaunter (*Williamsonia fletcheri*)	SC	--	Contact the NH Fish & Game Dept (see below).

Natural Community	**State[1]**	**Federal**	**Notes**
Inland Atlantic white cedar swamp	--	--	Changes to the hydrology of the wetland are the greatest threat facing the cedar swamp. Damming which causes pooling for extended periods can flood and drown existing trees, and drainage that results in lower water levels can lead to invasion by other species that can out compete -- and eventually eliminate -- Atlantic white cedar trees. Increased nutrient input from stormwater runoff could also deleteriously impact this acidic, low-nutrient plant community.

Plant species	**State[1]**	**Federal**	**Notes**
Canada shore quillwort (*Isoetes riparia var. canadensis*)	E	--	Threats to aquatic species include changes in water quality, e.g., due to pollution and stormwater runoff, and significant changes in water level.

Vertebrate species	**State[1]**	**Federal**	**Notes**
Marsh Wren (*Cistothorus palustris*)	--	--	Contact the NH Fish & Game Dept (see below).

Memo

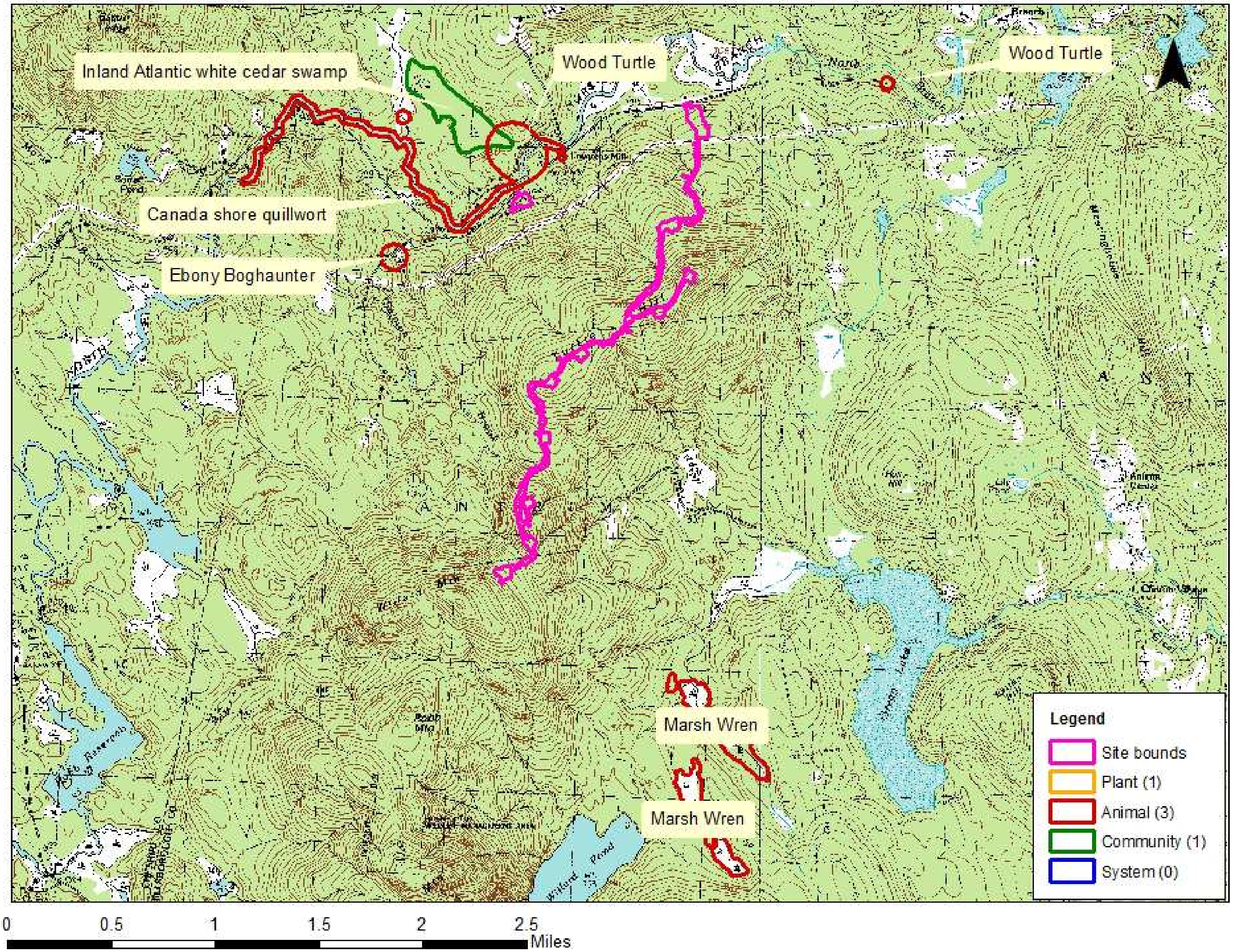
Wood Turtle (*Glyptemys insculpta*)	SC	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

NHB15-1904


Inland Atlantic white cedar swamp
Wood Turtle
Wood Turtle
Canada shore quillwort
Ebony Boghaunter
Marsh Wren
Marsh Wren
Legend
Site bounds
Plant (1)
Animal (3)
Community (1)
System (0)
0 0.5 1 1.5 2 2.5 Miles

New Hampshire Natural Heritage Bureau - Animal Record

Ebony Boghaunter (*Williamsonia fletcheri*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2003: Area 1: Species observed on 5/30.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Salmon Brook
Managed By: The Nature Conservancy #2

County: Hillsborough
Town(s): Antrim
Size: 7.7 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2003-05-30 Last reported: 2003-05-30

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Community Record

Inland Atlantic white cedar swamp

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Excellent quality, condition and landscape context ('A' on a scale of A-D).

Comments on Rank: This site is probably the best, largest and most viable remaining cedar swamp in the western part of the state. It should remain among the highest conservation priorities in the state.

Detailed Description: 2006: Community observed and photographed. 2004: Community observed and photographed. 1993: *Chamaecyparis thyoides* (Atlantic white cedar) is the dominant tree with both *Acer rubrum* (red maple) and *Picea rubens* (red spruce) present in abundance. *Picea mariana* (black spruce) is scattered and less abundant. Occasionally, *Pinus strobus* (white pine) and *Betula alleghaniensis* (yellow birch) are also found. Dominant shrub species are *Gaylussacia baccata* (black huckleberry), *Nemopanthus mucronatus* (mountain holly), *Ilex laevigata* (smooth winterberry), and *Kalmia angustifolia* (sheep laurel). Common boreal components present are *Chamaedaphne calyculata* (leatherleaf), *Gaultheria hispidula* (creeping snowberry), and *Ledum groenlandicum* (Labrador tea). The herbaceous layer is fairly abundant, although richness is somewhat limited. *Osmunda cinnamomea* (cinnamon fern), *Aralia nudicaulis* (wild sarsaparilla), *Maianthemum canadense* (Canada mayflower), *Sarracenia purpurea* (pitcher-plant) and *Carex trisperma* (three-seeded sedge) are commonly present. Sphagnum species are abundant. 1990: Has *Chamaecyparis thyoides*(Atlantic white cedar) to 14 inches dbh and a few larger individuals, abundant in areas away from streams. *Picea mariana* (black spruce), *Picea rubens* (red spruce), *Abies balsamea* (balsam fir), and *Acer rubrum* (red maple) also occur. Lesser amounts of *Pinus strobus* (white pine).

General Area: 1993: Soil type is a mucky peat, with the peat deposits averaging <1 meter. The soil is permanently saturated with a couple of obvious watercourses present. The pH of the groundwater is quite acidic with a range of 3.8-4.0. 1990: Purest and largest cedar around open black spruce bog (90 percent, 10-14 inches average range). Other areas 50-80 percent. Basin is surrounded by gradually sloping uplands which are punctuated by a number of small cliffs. 1961 (Baldwin): a fairly large boggy swamp with *Chamaecyparis thyoides* (Atlantic white cedar). Contains 6 stands of cedar.

General Comments: 1997: New community boundaries mapped based on 1993 field work. 1990: Encroaching urban development.

Management Comments:

Location

Survey Site Name: Loverens Mill Cedar Swamp
Managed By: Loverens Mill Preserve

County: Hillsborough
Town(s): Antrim
Size: 51.3 acres Elevation: 1080 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: From Hillsboro, take Rte. 9 south ca. 5 miles south to Holmes Hill Road. Turn right (north) onto Holmes Hill. Park on the right immediately after crossing the bridge over the river, at the TNC preserve sign kiosk. After ca. 900 feet there will be a gravel road on the left. This is the trailhead. Take the marked trail on this road, up past the old mill, and look for a turnoff to the right. Proceed down this trail (N-NW). The cedar swamp is at the bottom of the basin, to the north.

Dates documented

First reported:	1961	Last reported:	2006-06-13

New Hampshire Natural Heritage Bureau - Plant Record

Canada shore quillwort (*Isoetes riparia var. canadensis*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank: Likely extensive habitat, good population condition, and good landscape context.

Detailed Description: 2009: 200-250 stems, 95% dispersing seeds.1997, 1995?: No details.
General Area: 2009: Fourth-order stream/river. Associated species include royal fern (*Osmunda regalis* var. *spectabilis*), water bulrush (*Schoenoplectus subterminalis*), and several species of algae.
General Comments: 2009: The population is further downstream from where it was first located in the mid-1990s. There are larger numbers of individuals. The presence of potential hybrids in the area suggest that there is some dynamism to the long-term occurrence.
Management Comments: 2009: Some potential damage from bathers in summer who use the rest area, although it is downstream.

Location

Survey Site Name: Loverens Mill, west of
Managed By: The Nature Conservancy #2

County: Hillsborough
Town(s): Antrim
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2009: Take Rte. 9 west from Hillsboro to the only rest area on the north side of the highway in Antrim. Park in the lot and proceed down a trail behind the station to the [North Branch of the] Contoocook River. Head downstream about 250 ft. until the river makes a sharp bend to the south. Look in the current and backwater area above the shallow ledge (above the drop) in 0.5 to 1.5 feet of water amidst cobbles and gravels.

Dates documented

First reported: 1993-1998 Last reported: 2009-09-20

New Hampshire Natural Heritage Bureau - Animal Record

Marsh Wren (*Cistothorus palustris*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Not listed	State:	Not ranked (need more information)

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2002: 5 observed on 6/18, 1 seen gathering nesting material.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Willard Pond, NE of
Managed By:

County: Hillsborough
Town(s): Antrim
Size: 66.0 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2002-06-18
Last reported: 2002-06-18

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Wood Turtle (*Glyptemys insculpta*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank:

Detailed Description: 2010: Area 12723: 1 adult observed.2009: Area 12334: 1 observed. 2008: Area 11603: 1 adult seen. 2006: Area 11693: 1 adult seen. 2005: Area 12135: 1 adult seen. 2002: Area 12069: 1 observed.
General Area: 2010: Area 12723: Roadside along river.2005: Area 12135: Crossing highway towards North Branch of Contoocook River. 2002: Area 12069: Near cedar swamp.
General Comments:
Management Comments:

Location

Survey Site Name: Loverens Mill
Managed By: The Nature Conservancy #2

County: Hillsborough
Town(s): Antrim
Size: 88.3 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2010: Area 12723: Rte. 9 in Antrim.2009: Area 12334: TNC property at Loverens Mill. Drainage into North Branch Contoocook River. 2008: Area 11603: TNC property at Loverens Mill Road. 2002: Area 12069: Loverens Mill property near trail to cedar swamp.

Dates documented

First reported: 2002-07-28 Last reported: 2010-08-05

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau
DRED - Division of Forests & Lands
172 Pembroke Road, Concord, NH 03301
(603) 271-2214

To: Dana Valleau, Environmental Specialist, TRC

From: Amy Lamb, Ecological Information Specialist, NHB

Date: June 26, 2015

Subject: Re: NHB15-1904, NHB10-0644: Antrim Wind Energy, LLC

This is a follow-up to NHB15-1904, which indicated the presence of an exemplary natural community, an Inland Atlantic white cedar swamp, and a state endangered plant, Canada shore quillwort (*Isoetes riparia var. canadensis*), close to the proposed project area. The report also indicated the presence of three wildlife species; please note that the Natural Heritage Bureau does not provide comments regarding wildlife, and that there must be consultation with the NH Fish and Game Department for all wildlife concerns.

In the NHB15-1904 review, we requested that the project area be surveyed for the occurrence of the rare species and natural community within the project area. After this initial recommendation, it came to my attention that community mapping had occurred throughout the project area, through consultation with Melissa Coppola under project number NHB10-0644. Based on the results of those surveys, NHB does not find it likely that the natural community and rare plant identified in NHB15-1904 would be found on the property. As such, NHB no longer recommends a survey for Canada shore quillwort or Inland Atlantic white cedar swamp in the project area.

We look forward to continued communication throughout the SEC process. Please send us any additional application materials as they become available, and include us in any future communications regarding the subject project.

New Hampshire Natural Heritage Bureau
DRED - Division of Forests & Lands
PO Box 1856 -- 172 Pembroke Road, Concord, NH 03302-1856
(603) 271-2214

To: Site Evaluation Committee

From: Melissa Coppola, Environmental Information Specialist

Date: August 2, 2012

Subject: Final Report: Site Evaluation Committee #2012-01
Application for Antrim Wind Energy, LLC

The Natural Heritage Bureau (NHB), under the auspices of the NH Native Plant Protection Act of 1987 (RSA 217-A), has reviewed the application materials for Antrim Wind Energy, LLC.

NHB had requested a final site visit during the growing as a last review step. This site review was conducted on 13 July 2012. The purpose of the visit was to search for a state-listed plant species within a few targeted natural community types with greater potential for rare species. No rare plant species were observed during the surveys.

Based on the observations made during the site visit and the application materials provided, NHB has determined that it is unlikely that the proposed wind facility will impact rare plants species or exemplary natural communities.

Memo

NH Natural Heritage Bureau

To: James Kenworthy, Eolian Renewable Energy, LLC
55 Fleet St.
Portsmouth, NH 03801

From: Melissa Coppola, NH Natural Heritage Bureau
Date: 3/22/2010 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau
NHB File ID: NHB10-0644 | Town: Antrim
Project type: Roads, Driveways, Bridges: Road construction, etc. | Location: Tax Maps: 212-030, 212-027, 212-034, 211-004, 235-014
cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments: NHB has concerns about potential impacts to the exemplary natural community. Please send detailed site plans to mcoppola@dred.state.nh.us for further review.

Natural Community	State[1]	Federal	Notes
Inland Atlantic white cedar swamp	--	--	Changes to the hydrology of the wetland are the greatest threat facing the cedar swamp. Damming which causes pooling for extended periods can flood and drown existing trees, and drainage that results in lower water levels can lead to invasion by other species that can out compete -- and eventually eliminate -- Atlantic white cedar trees. Increased nutrient input from stormwater runoff could also deleteriously impact this acidic, low-nutrient plant community.

Vertebrate species	State[1]	Federal	Notes
Wood Turtle (*Glyptemys insculpta*)	SC	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. For some purposes, including legal requirements for state wetland permits, the fact that no species of concern are known to be present is sufficient. However, an on-site survey would provide better information on what species and communities are indeed present.

Department of Resources and Economic Development
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

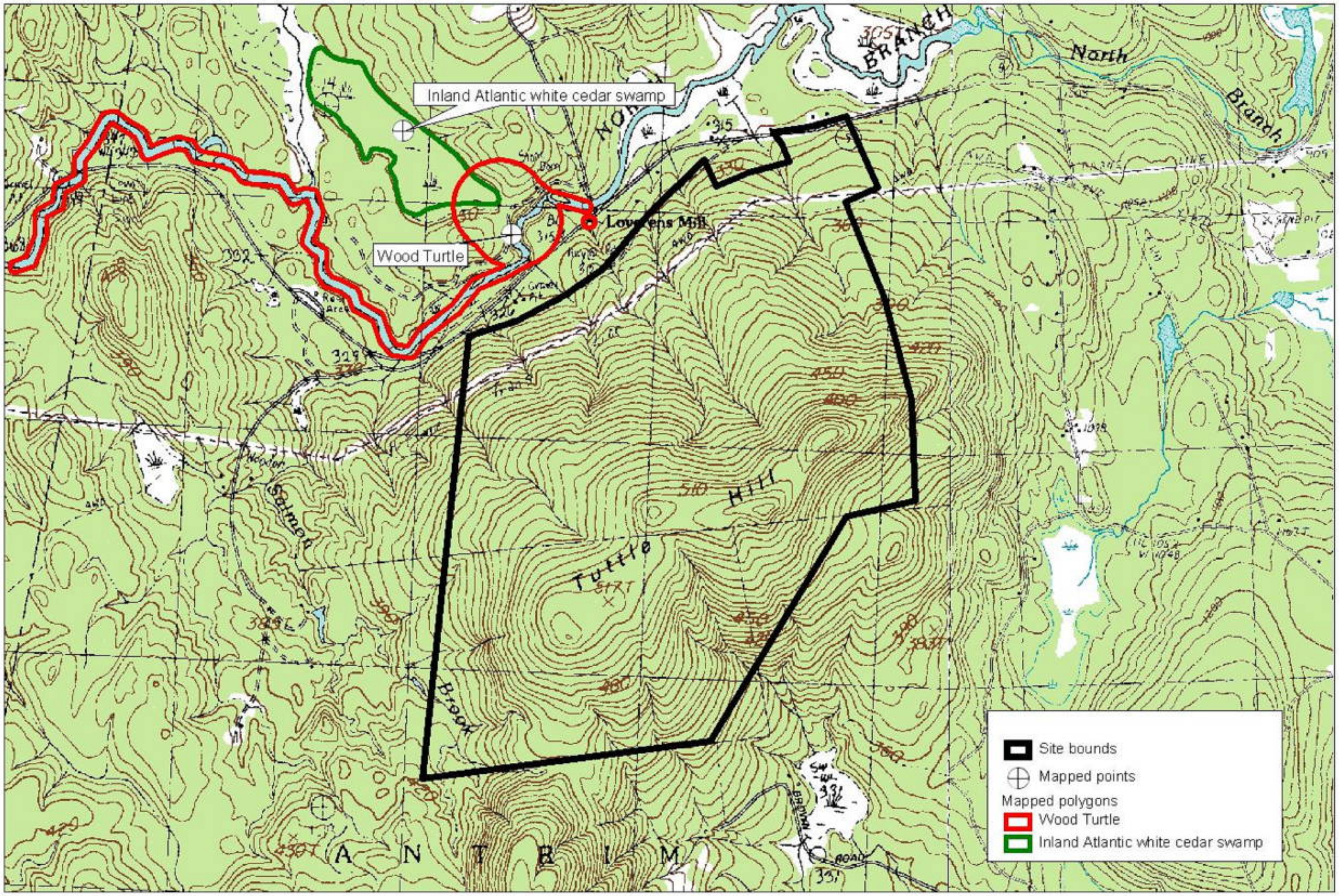
DRED/NHB
PO Box 1856
Concord NH 03302-1856

NHB10-0644

NH NATURAL HERITAGE BUREAU

Known locations of rare species and exemplary natural communities

Note: Mapped locations are not always exact. Occurrences that are not in the vicinity of the project are not shown.



*Historical record

0.25 0 0.25 0.5 0.75 1 Miles

1:24000

Valid for one year from this date: 22 Mar 2010

New Hampshire Natural Heritage Bureau - Community Record

Inland Atlantic white cedar swamp

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Excellent quality, condition and lanscape context ('A' on a scale of A-D).

Comments on Rank: This site is probably the best, largest and most viable remaining cedar swamp in the western part of the state. It should remain among the highest conservation priorities in the state.

Detailed Description: 2006: Community observed and photographed. 2004: Community observed and photographed. 1993: *Chamaecyparis thyoides* (Atlantic white cedar) is the dominant tree with both *Acer rubrum* (red maple) and *Picea rubens* (red spruce) present in abundance. *Picea mariana* (black spruce) is scattered and less abundant. Occasionally, *Pinus strobus* (white pine) and *Betula alleghaniensis* (yellow birch) are also found. Dominant shrub species are *Gaylussacia baccata* (black huckleberry), *Nemopanthus mucronatus* (mountain holly), *Ilex laevigata* (smooth winterberry), and *Kalmia angustifolia* (sheep laurel). Common boreal components present are *Chamaedaphne calyculata* (leather-leaf), *Gaultheria hispidula* (creeping snowberry), and *Ledum groenlandicum* (Labrador-tea). The herbaceous layer is fairly abundant, although richness is somewhat limited. *Osmunda cinnamomea* (cinnamon fern), *Aralia nudicaulis* (wild sarsaparilla), *Maianthemum canadense* (Canada mayflower), *Sarracenia purpurea* (pitcher-plant) and *Carex trisperma* (three-seeded sedge) are commonly present. Sphagnum species are abundant. 1990: Has *Chamaecyparis thyoides*(Atlantic white cedar) to 14 inches dbh and a few larger individuals, abundant in areas away from streams. *Picea mariana* (black spruce), *Picea rubens* (red spruce), *Abies balsamea* (balsam fir), and *Acer rubrum* (red maple) also occur. Lesser amounts of *Pinus strobus* (white pine).

General Area: 1993: Soil type is a mucky peat, with the peat deposits averaging <1 meter. The soil is permanently saturated with a couple of obvious watercourses present. The pH of the groundwater is quite acidic with a range of 3.8-4.0. 1990: Purest and largest cedar around open black spruce bog (90 percent, 10-14 inches average range). Other areas 50-80 percent. Basin is surrounded by gradually sloping uplands which are punctuated by a number of small cliffs. 1961 (Baldwin): a fairly large boggy swamp with *Chamaecyparis thyoides* (Atlantic white cedar). Contains 6 stands of cedar.

General Comments: 1997: New community boundaries mapped based on 1993 field work. 1990: Encroaching urban development.

Management Comments:

Location

Survey Site Name: Loverens Mill Cedar Swamp
Managed By: Loverens Mill Preserve

County:	Hillsborough	USGS quad(s):	Stoddard (4307211)
Town(s):	Antrim	Lat, Long:	430433N, 0720142W
Size:	51.3 acres	Elevation:	1080 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: From Hillsboro, take Rte. 9 south ca. 5 miles south to Holmes Hill Road. Turn right (north) onto Holmes Hill. Park on the right immediately after crossing the bridge over the river, at the TNC preserve sign kiosk. After ca. 900 feet there will be a gravel road on the left. This is the trailhead. Take the marked trail on this road, up past the old mill, and look for a turnoff to the right. Proceed down this trail (N-NW). The cedar swamp is at the bottom of the basin, to the north.

Dates documented

First reported: 1961 Last reported: 2006-06-13

Kimball, Ben, et al. 2006. Field visit to Loverens Mill Cedar Swamp Preserve on June 13.

Sperduto, D. & N. Ritter. 1994. Altantic White Cedar Wetlands of New Hampshire. Environmental Protection Agency, Boston, MA.

New Hampshire Natural Heritage Bureau - Animal Record

Wood Turtle (*Glyptemys insculpta*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	SC	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2008: Area 11603: 1 adult seen.2006: Area 11693: 1 adult seen.2005: Area 12135: 1 adult seen.2002: Area 12069: 1 observed.
General Area: 2005: Area 12135: Crossing highway towards North Branch of Contoocook River.2002: Area 12069: Near cedar swamp.
General Comments:
Management Comments:

Location

Survey Site Name: Loverens Mill
Managed By: The Nature Conservancy #2

County:	Hillsborough	USGS quad(s):	Stoddard (4307211)
Town(s):	Antrim	Lat, Long:	
Size:	84.4 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2008: Area 11603: TNC property at Loverens Mill Road.2002: Area 12069: Loverens Mill property near trail to cedar swamp.

Dates documented

First reported:	2002-07-28	Last reported:	2008-06-01

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

Exhibit 6

Photographs Representative of the Site

PHOTOGRAPHS REPRESENTATIVE OF THE SITE

Typical Tuttle Hill scene near WTG 2.

Typical Tuttle Hill scene near WTG 3.

Typical Tuttle Hill scene near WTG 5.

Typical Tuttle Hill scene near WTG 8.

Exhibit 7

Site Specific Soil Survey Waiver Request

Waiver Request

Site Specific Soil Map

<u>1509.03 (a) (4)</u>

The New Hampshire Code of Administrative Rules, Chapter Env-Wq 1500 “Alteration of Terrain”, Part Env-Wq 1504 “Plans and Calculations”, Section Env-Wq 1504.09 (b) (2)b requires that a site-specific soil map be prepared in accordance with the Society of Soil Scientists of Northern New England (SSSNNE) Special Publication No. 3, Site-Specific Soil Mapping Standards for New Hampshire and Vermont, December 2006, for all proposed areas of disturbance.

<u>1509.03 (a) (5)</u>

The applicant is requesting a waiver of this rule as a result of a conversation with NHDES staff during the original project Alteration of Terrain (AoT) permit pre-application meeting. This waiver has been granted in the past for similar projects. According to the document referenced above, “Site specific soil mapping is conducted for very intensive land uses requiring very detailed information about soils, generally in small areas. … The information can be used in planning individual building sites, experimental agricultural plots, and other uses requiring detailed and precise knowledge of the soils and their variability.”

The proposed project is linear in nature, essentially a three (3) mile long crushed stone roadway that will connect nine (9) wind turbine generator sites. The project site lies predominantly along the top of a ridge, and straddles four (4) expansive, largely undeveloped watersheds. An examination of the Natural Resources Conservation Service (NRCS) Medium Intensity Soil Survey of Hillsborough County, NH indicates that the majority of the project will be built on Hydrologic Soil Group C soils. A relatively short length of road will be built on HSG D soils, through an area of ledge and outcrop. No infiltration BMPs are proposed for the stormwater management system. In addition, sensitive areas such as streams, wetlands and vernal pools have been mapped and are shown on the site plans. This is not the type of project for which a site-specific soil map is intended, nor would the information produced by such a study provide any real benefit. That level of detail is not required.

<u>1509.03 (a) (6)</u>

The waiver will not be temporary.

<u>1509.03 (a) (7)</u>

As an alternative to a site-specific soil map, the site plans have been prepared using delineations from the NRCS Medium Intensity Soil Survey obtained from the Web Soil Survey website.

1509.03 (a) (8)

The applicant believes that having the waiver granted will meet the criteria in Env-Wq 1509.04 for the following reasons:

1. *"Granting the request will not result in an adverse impact on the environment, public health, public safety, or abutting properties that is more significant than that which would result from complying with the rule."*
   Environmentally sensitive areas such as streams, wetlands and vernal pools have been mapped in the project area, so no adverse impacts to the environment are anticipated as a result of the waiver. Due to the nature of the project, the waiver will have no bearing on public health and safety. The impact on abutting properties as a result of the proposed land use will not change as a result of the intensity of the soil study.

2. "*One or more of the following are satisfied:*
   a. *Granting the request is consistent with the intent and purpose of the rule being waived; or*
   b. *Strict compliance with the rule will provide no benefit to the public or the environment."*

   The applicant believes that both conditions are satisfied. In particular, strict compliance with the rule will provide no benefit to the public or the environment. The purpose of the waiver request is to allow the project to be based on a less intensive soil study, not to waive the requirement completely. NRCS soil surveys are commonly used as a basis for projects of this nature. In addition, sensitive areas such as streams, wetlands and vernal pools have already been mapped in the vicinity of the project. Therefore, a site-specific soil survey will not provide any additional benefit to the public or the environment.

Exhibit 8

Post-Construction Stormwater Management, Inspection, & Maintenance Plan

ANTRIM WINDPARK PROJECT

POST-CONSTRUCTION STORMWATER MANAGEMENT INSPECTION & MAINTENANCE PLAN

The Antrim Windpark, including the 34.5kV collector substation and Operation and Maintenance facility, will be solely-owned, operated, and maintained by Antrim Wind Energy LLC, of Portsmouth New Hampshire. The 115kV substation will be owned, operated, and maintained by Public Service of New Hampshire (PSNH).

Antrim Wind Energy has designated the following individual(s) as the party responsible for inspection and maintenance of the stormwater management facilities:

Name:

Address: Antrim Wind Energy, LLC
155 Fleet Street
Portsmouth, New Hampshire, 03801

E-mail:

Office Phone:

Cell Phone:

Facilities to be Maintained

The stormwater management facilities to be maintained at the Antrim Windpark include:

- Permanent access road;
- Collector substation and associated swales, bioretention systems, and stabilized slopes;
- Forested and meadow buffers;
- Treatment swales;
- Conveyance swales;

- Permanent check dams
- Culverts with inlet and outlet protection;
- Re-vegetated areas and embankments.

General Inspection and Maintenance Requirements

Generally, the proposed facility will be operated and maintained in a manner consistent with good utility practices, including annual (at minimum) on-site inspections and maintenance of stormwater management system components, as needed. A post-construction maintenance and inspection log is provided.

Maintenance issues associated with specific areas and facilities at the windpark are identified in the following paragraphs.

Substation Yard Area

The substation yard and surrounding area will be inspected annually (at minimum). Any signs of existing or developing erosion, rutting, trash, or unwanted vegetation will be removed/repaired as needed. Vegetated areas will be mowed as needed.

Access Roadway

The access roadway will typically require little on-going maintenance, due to the limited use by heavy vehicles. The roadway will be inspected annually (at minimum), and signs of existing or developing erosion, rutting, trash or unwanted vegetation will be removed/repaired as needed.

Re-vegetated Areas and Embankments

Re-vegetated areas and embankments will be inspected annually (at minimum) for signs of existing or developing erosion, rutting, trash, vegetation loss, or unwanted vegetation. Meadow areas will be mowed as needed to maintain a healthy stand of vegetation. Debris and accumulated sediment will be removed as needed. Any eroded areas will be repaired and replanted with vegetation similar to the surrounding area. The source of the erosion problem shall be identified and eliminated.

Bioretention Systems

The bioretention systems will be inspected at least twice annually, and following any rainfall event exceeding 2.5 inches in 24 hours. Maintenance or rehabilitation shall be performed as needed. Trash and debris shall be removed at each inspection.

System drawdown time shall be inspected annually (at minimum). If the system does not drain within 72 hours following a rainfall event, then a qualified professional will assess the condition of the facility to determine measures required to restore filtration function, including but not limited to removal of accumulated sediments or reconstruction of the filter media. Vegetation shall be inspected annually and maintained in a healthy condition. Pruning, removal and replacement of dead or diseased vegetation, and removal of invasive species shall be performed as needed.

Vegetated Buffers

Small Pervious Area Buffers

Small pervious area buffers are located adjacent to several of the permanent crane pad areas, and are designated as "WTG-_".

The buffers will be inspected annually (at minimum) for signs of erosion, sediment build-up, or vegetation loss. Meadow buffers will be mowed as needed to maintain a healthy stand of vegetation. Debris and accumulated sediment will be removed as needed. Any eroded areas will be repaired and replanted with vegetation similar to the remaining buffer. The source of the erosion problem shall be identified and eliminated.

Roadway Buffers

Roadway buffers are located adjacent to the access road.

The buffers will be inspected annually (at minimum) for signs of erosion, sediment build-up, or vegetation loss. Meadow buffers will be mowed as needed to maintain a healthy stand of vegetation. Forested buffers will be maintained in an undisturbed condition, unless erosion occurs. Debris and accumulated sediment will be removed as needed. Any eroded areas will be repaired and replanted with vegetation similar to the remaining buffer. The source of the erosion problem shall be identified and eliminated.

Ditch Turnout Buffers

Ditch turnout buffers are located adjacent to the access road, and begin at a stone berm level spreader.

The buffers will be inspected annually (at minimum) for signs of erosion, sediment build-up, or vegetation loss. Forested buffers will be maintained in an undisturbed condition, unless erosion occurs. Debris and accumulated sediment will be removed as needed. Any eroded areas will be repaired and replanted with vegetation similar to the remaining buffer. The source of the erosion problem shall be identified and eliminated.

The stone berm level spreaders will be inspected annually (at minimum) for accumulation of sediment and debris, and for signs of erosion within the approach channel, spreader channel, or down-slope of the spreader. Debris will be removed whenever observed during inspection. Sediment will be removed when accumulation exceeds 25% of spreader channel depth. Vegetated areas will be mowed annually (at minimum), or as required to control growth of woody vegetation. Stone berm material will be replaced/level spreader will be repaired as needed. Spreader shall be reconstructed if down-slope channelization indicates that the spreader is not level or that discharge has become concentrated, and corrections cannot be made through minor regrading.

Treatment Swales

Treatment swales are located adjacent to the access road, and are designated as “SW-_”.

Treatment swales will be inspected annually (at minimum) for signs of erosion, sediment accumulation, vegetation loss, and presence of invasive species. Swales will be mowed as needed. Vegetation shall not be cut shorter than 4 inches. Debris and accumulated sediment shall be removed, and eroded areas repaired, as needed. Invasive species and dead vegetation shall be removed when encountered.

Conveyance Swales

Conveyance swales are located directly adjacent to the access road. The site has both vegetated and riprap swales.

Conveyance swales will be inspected annually (at minimum) for signs of erosion, sediment accumulation, and condition of the surface lining. Repairs, including stone or vegetation replacement, will be made as needed. Vegetated swales will be mowed annually (at minimum) or as needed. Vegetation shall not be cut shorter than 4 inches. Debris and accumulated sediment shall be removed, and eroded areas repaired, as needed.

Conveyance swales that do not discharge via a culvert have been provided with outlet protection in the form of a plunge pool or permanent check dam. Outlet protection will be inspected annually (at minimum) for damage or deterioration. Repairs, including rebuilding or stone replacement, will be made immediately. Debris and accumulated sediment will be removed as needed.

Culverts

Culverts will be inspected annually (at minimum) for signs of blockage, damage or deterioration. Debris and accumulated sediment shall be removed as needed. Repairs to inlet and outlet protection, including rebuilding or stone replacement, will be made immediately.

Antrim Windpark, Antrim, NH				
Stormwater Management System Inspection & Maintenance Log				
	Schedule		**Inspector Initials and Date**	**Inspector Comments**
	Minimum Inspection Frequency	**Maintenance Frequency**		
Re-vegetated Areas and Embankments:				
Inspect all re-vegetated areas and embankments.	**Annual**			
Replant bare areas or areas with sparse growth.		**As Required**		
Armor areas with rill erosion with an appropriate lining or divert the erosive flows to on-site areas able to withstand concentrated flows.		**As Required**		
Drainage Conveyance Systems:				
Inspect drainage swales, natural swales, and plunge pool for evidence of erosion, debris, woody growth, and excessive sediment.	**Annual**			
Remove any obstructions and accumulated sediments or debris.		**As Required**		
Control vegetated growth and woody vegetation.		**As Required**		
Repair any erosion of the swale lining.		**As Required**		
Mow vegetated swales.		**Annually**		
Clean-out any accumulation of sediment within the plunge pool and riprap aprons.		**As Required**		
Remove woody vegetation growing through riprap.		**As Required**		
Repair any slumping side slopes.		**As Required**		
Replace riprap where underlying filter fabric is showing or where stones have dislodged.		**As Required**		
Culverts:				
Inspect culvert inlet, outlet, and structure.	**Annual**			
Remove accumulated sediments and debris at the inlet, at the outlet, and within the conduit.		**As Required**		
Repair any erosion damage at the culvert's inlet and outlet.		**As Required**		

Antrim Windpark, Antrim, NH				
Stormwater Management System Inspection & Maintenance Log				
	Schedule		**Inspector Initials and Date**	**Inspector Comments**
	Monthly Inspection	**Maintenance**		
Roadway Surfaces:				
Inspect access road surfaces and shoulders for erosion, false ditches, and excess accumulation of sand that could impede water flow.	**Annual**			
Remove excess sand either manually or with a front-end loader.		**As Required**		
Grade gravel roads and shoulders.		**As Required**		
Substation yard:				
Inspect for existing or developing erosion, rutting, trash, and unwanted vegetation.	**Annual**			
Correct any erosion/rutting and/or remove trash or vegetation.		**As Required**		
Water Quality Treatment Buffer:				
Inspect treatment buffer for evidence of erosion, concentrated flow, or encroachment by development.	**Annual**			
Manage the buffer's vegetation consistent with the requirements in any deed restrictions.		**As Required**		
Mow vegetation in non-wooded buffers no shorter than six inches and no more than two times per year.		**As Required**		
Repair any sign of erosion within a buffer.		**As Required**		
Inspect and repair down-slope of all drainage outlets for erosion.	**Annual**	**As Required**		

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<tr><th colspan="5">Stormwater Management System Inspection & Maintenance Log</th></tr>
<tr><td rowspan="2"></td><th colspan="2">Schedule</th><th rowspan="2">Inspector Initials and Date</th><th rowspan="2">Inspector Comments</th></tr>
<tr><th>Monthly Inspection</th><th>Maintenance</th></tr>
<tr><td colspan="5">Maintenance Needed and When:</td></tr>
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