Kennedy/Jenks Consultants
Engineers & Scientists

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August 17, 2016

Mr. Gino Carlucci
Town Planner
Town of Dover
5 Springdale Avenue
Dover, MA 02030

Subject: Responses to Stormwater Design Review Comments
Dover Landfill Solar Project
Dover, Massachusetts

Dear Mr. Carlucci,

On behalf of BWC Buckmaster Pond, LLC, Kennedy/Jenks Consultants, Inc. (Kennedy/Jenks) has prepared this responses to the Dover landfill solar project stormwater design review comments provided by Tata and Howard, Inc. (Tata & Howard) on August 9, 2016. Attached to this response letter is an updated Stormwater Report (Rev 1.) dated August 17, 2016.

Comment 1: *Figure 2 – Development Conditions, Stormwater Drainage Basins, is missing proposed site features such as the gravel access road, solar panel footings, concrete pad, etc. This made it impossible to confirm the designer's assumptions.*

Response: Proposed site features have been added to Figure 2.

Comment 2: *Figures 1 and 2 should include the flow path used to calculate the time of concentration in order to confirm the designer's assumptions.*

Response: Flow paths have been added to Figure 1 and Figure 2.

Comment 3: *Page 6: The total drainage area in Table 1 equals 10.6 acres, while the total drainage area in Table 2 equals 10.7 acres.*

Response: This discrepancy was due to a rounding error in the text. The areas were correct in the model. Table 2 has been revised to correct this error.

Comment 4: *The hydrological soil group for any areas within the limit of the existing final cover should be classified as D since it is constructed of "Clay and Silt (low-permeability layer)" as noted on page 3. The calculations indicate a hydrological soil group A, which appears to have been taken from the USDA Soil Report located in Appendix A.*

Response: The hydrological soil group for areas within the limit of the existing final cover were re-classified as Hydrological Soil Group D.

Comment 5: *The calculations use a SCS Type II 24-hour Rainfall Distribution. However, according to Technical Release 55 (TR-55), Figure B-2 Approximate Geographic Boundaries for NRCS (SCS) Rainfall Distributions, Dover, Massachusetts appears to be located in a Type III 24-hour Rainfall Duration boundary.*

Response: The model was revised to assume a Type III 24-hour Rainfall Distribution.

Comment 6: *The drainage calculations use the cover classification, "Woods – Fair". However, according to the USDA if the "woods are protected from grazing, and litter and brush adequately cover the soil", a classification of "Woods – Good" would be more appropriate. Refer to Note 6 of on Table 2-2c of TR-55. This would change the CN from 79 to 77.*

Response: The model was revised to use "Woods – Good."

Comment 7: *The drainage calculations use the cover classification, "50%-75% Grass Cover – Fair". This appears to have been taken from USDA Table 2-2a, Runoff Curve Numbers for Urban Areas. It may be more appropriate to use the classification of "Meadows – continuous grass, protected from grazing and generally mowed for hay," taken from Table 2-2c.*

Response: The model was revised to use "Meadow, continuous grass, non-grazed."

Comment 8: *The Time of Concentration (TC) calculations appear to be high for calculating sheet flow TC. This appears to be due to the use of a 0.4 Manning's Number. According to Table 3-1 (TR-55) Roughness Coefficients for sheet flow, a more appropriate manning's number would be 0.24 based on the existing ground cover.*

Response: The Manning's number for the wooded area was revised to be 0.4 for "Natural, Woods, Light Underbrush" and the Manning's number for the grass area was

revised to be 0.2 for "Grass, Light Turf." These values are presented in Autodesk Storm and Sanitary Analysis and source the following references:

1. USACE, 1998, HEC-1 Flood Hydrograph Package User's Manual, Hydrologic Engineering Center, Davis, CA.
2. Soil Conservation Service, 1986, Urban Hydrology for Small Watersheds, Technical Release 55, U.S. Department of Agriculture, Washington, DC.

Comment 9: *The drainage calculations did not appear to account for the proposed concrete pad and the concrete solar panel mounts. These structures will create an impervious surface and will affect the weighted curve number for several of the drainage areas.*

Response: As stated on page 5, "impervious areas were assumed to include existing impervious areas as well as the proposed ballast units, access road, and impervious pad" in the post-developed model. The impervious areas, presented in acres and percentage in Tables 1 and 2, increased from the pre-developed model to the post-developed model as a result. Proposed impervious areas are now depicted on the Post-Development Basin Figure.

If there are any additional materials that you need in advance of the next Site Plan Review hearing please feel free to contact me at maxlamson@kennedyjenks.com or (978) 770-2043.

Very truly yours,
KENNEDY/JENKS CONSULTANTS, INC.

Max E. Lamson
Senior Project Manager

Attachment: Dover Landfill Solar Project, Stormwater Report Revision 1.

Cc: Mr. Jonathan Mancini, BWC Buckmaster Pond, LLC
Mr. Craig Hughes, Town of Dover
Mr. Jonathan O'Brien, Tata&Howard

Attachment

Kennedy/Jenks Consultants
Engineers & Scientists

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Stormwater Report

Revision 1

Solar Development Project

Dover Landfill
Powisset Street
Dover, Massachusetts

17 August 2016

Prepared for
BWC Buckmaster Pond, LLC
137 Newbury Street
Boston, Massachusetts

Table of Contents

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Executive Summary

On behalf of BWC Buckmaster Pond, LLC, Kennedy/Jenks Consultants (Kennedy/Jenks) prepared this Stormwater Report to support the development of a commercial-scale solar photovoltaic (PV) system on the Dover Landfill (Landfill) located on Powisset Street in Dover, Massachusetts. The Landfill is a closed, unlined municipal solid waste landfill currently owned by Hale Reservation Trust and maintained by the Town of Dover (Town) who previously operated the landfill under a land lease agreement. The Landfill was capped with a low permeability soil cap in 1989.

BWC Buckmaster Pond, LLC has entered into an agreement to lease the property from Hale Reservation Trust for the purpose of developing a commercial-scale solar PV system. The proposed 1.5-megawatt (MW) solar PV project will be installed on approximately 6.5 acres on top of, and adjacent to, the capped landfill.

As documented in this Stormwater Report, the proposed solar PV installation will not adversely affect stormwater drainage and stormwater management at the Landfill.

Section 1: Introduction

On behalf of BWC Buckmaster Pond, LLC, Kennedy/Jenks Consultants (Kennedy/Jenks) prepared this Stormwater Report to support the development of a commercial-scale solar photovoltaic (PV) array on the closed Dover Landfill (Landfill). The proposed development is located on two contiguous parcels on Powisset Street in Dover, Massachusetts (Site). The two parcels are Map 19, Lot 2 (10.6 acres) and Map 19, Lot 4 (49 acres).

The Landfill is a closed, unlined municipal solid waste landfill currently owned by Hale Reservation (Hale) and maintained by the Town of Dover (Town). The Town previously operated the landfill under a land lease agreement with Hale. The Town subsequently purchased an approximately 3-acre parcel on the Landfill (Map 19, Lot 4a) for the construction and operation of a municipal transfer station.

BWC Buckmaster Pond, LLC is proposing to lease the parcels from Hale for the purposes of constructing a commercial-scale solar PV development. A Site Locus is presented as Figure 1.

1.1 Purpose

The purpose of this Application is to support the development of a 1.6-megawatt (MW) direct current (DC) solar PV array on a 6.5-acre portion of the Landfill property. A portion of the proposed solar array will be located directly on top of the Landfill capping system and a portion will be located on land adjacent to the Landfill cap. The Landfill is a closed, unlined municipal solid waste (MSW) landfill located in Dover, Massachusetts. BWC Buckmaster Pond, LLC has entered into an agreement to lease the property from the property owner, Hale, for the purpose of developing a commercial-scale solar PV system.

1.2 Project Scope

The project includes the installation of a 1.5-MWDC solar PV array on top of the Landfill cap. A summary of the project scope is as follows:

- Solar PV Modules
    - 3,542 435-watt (W) PV modules, racked two modules high in portrait orientation
    - Two concrete ballasts, installed above the low-permeability soil layer of the cap, will support each double row of 4 or 5 modules (8 to 10 modules in total)
    - The modules will be interconnected with aboveground electrical wiring in rigid metal conduit or cable trays.
- Inverter Units
    - Two 500-kilowatt (kW) inverter units will be installed on concrete slab foundations

- The main electrical conduit will be installed adjacent to the access roadway above the soil cap.

As discussed in the following sections, the use of the Landfill as a solar power generation system will likely continue for the design life of the equipment (up to 30 years).

Section 2: Background Information

This section presents the background of the Landfill. The information in this section is based on the review of MassDEP, Hale, and Town files.

2.1 Landfill Description

The Landfill is a closed, unlined MSW landfill located adjacent to Powisset Street in Dover, Massachusetts. The approximate coordinates of the Landfill are 42°13'38" north latitude and 71°14'56" west longitude. The Landfill location is depicted on the Locus Plan on Sheet C1 of the attached drawings.

2.2 Site History and Solid Waste Assignment

According to MassDEP files, the Dover Landfill property is currently privately-owned by the Hale Reservation Trust (Hale). The property was operated as an MSW landfill by the Town under a 50-year land lease from approximately 1937 to 1987. After the Landfill operations ceased in 1987, the Town capped the Landfill with a low-permeability soil cap using soil from a pit that had been approved by MassDEP. Additionally, the Town purchased a portion of the Landfill property on November 5, 1986, for the construction and operation of a municipal waste transfer station. The existing conditions of the landfill and the location of the transfer station are depicted on Sheet C2 of the attached drawings.

2.3 Existing Conditions

As discussed previously, post-closure monitoring activities are being performed by the Town and their engineering consultant, Tata & Howard. Additional site assessment activities were performed by Kennedy/Jenks in 2016 to evaluate and document the Landfill conditions, including site observations, a site survey, a limited methane gas survey, hand auger borings, and soil sampling. The average thicknesses of the soil cap observed during the hand borings was as follows:

- Topsoil (vegetative support layer): 6 to 8 inches
- Clay and Silt (low-permeability layer): 18 to 20 inches.

Three soil samples were collected for grain size analysis and plasticity (Atterburg Limits). In addition to the soil sampling, Kennedy/Jenks performed a limited methane gas survey at the Landfill at ambient air locations above the Landfill cap and at the hand auger boring locations. Methane was screened using a Landtec GEM 2000 and was not detected during this assessment.

Visual inspections of the Landfill identified the following landfill conditions:

- Generally well-maintained grass vegetative cover on over 90 percent of the Landfill cap;

- Approximately three locations of woody vegetation growth on the landfill cap (tree or shrub over 5 feet in height);
- A location where former monitoring wells are overgrown with vegetation;
- An area of approximately 1 acre of undulating topography at the top of the Landfill with up to 30 percent of low-spots; and
- Vehicle tire-tracks traversing the Landfill from north to south on the Landfill cap.

During the proposed installation of a solar array, the identified woody growth would be removed and low spots would be filled. The monitoring wells would be cleared of vegetation, inspected, and maintained, as-needed. The area of the tire tracks would be re-vegetated (and redeveloped) and the construction of a new access road is proposed. These improvements would likely improve the overall long-term performance of the Landfill cover system.

Based on the evaluations completed, Kennedy/Jenks did not identify significant stability, settlement, or cover system issues that would preclude the proposed solar PV system installation. Additional information and calculations supporting this initial finding are presented in the following sections of this Application. The soil boring locations are depicted on Sheet C2 of the attached Civil Drawings.

Section 3: Stormwater Evaluation

3.1 Existing Conditions

The Landfill project area consists of approximately 10.6 acres. This area consists of the closed Landfill and the wooded areas directly west, north, and south of the Landfill. The wooded northwestern and southwestern corners of the project area generally are the highest elevation, peaking at approximately 332 feet and 320 feet, respectively. The wooded areas slope down towards the Landfill at a grade of approximately 13 percent and the grass landfill area has a grade of approximately 3 percent. There is an existing dirt path located to the southwest of the project area and an existing partially-paved access road at the northern portion of the project area, from Powisset Street. There are also four wetlands adjacent to the project area, two of which may include vernal pools. An Existing Conditions Plan is presented as Sheet C2 of the civil drawing set.

3.2 Proposed Development

The proposed project involves adding solar panels to the closed Landfill and to the wooded area west of the Landfill. The total area affected by the project will be approximately 7.1 acres. One impervious pad will be installed to support the electrical controls associated with the solar panels, and a new gravel road will be added along the eastern portion of the project, along the boundary of the transfer station. A swale is also proposed along the eastern edge of the western PV array to reduce stormwater flows onto the Landfill capping system. By reducing stormwater flow onto the capping system, this is an additional improvement to the Landfill system that could mitigate potential leaching issues. A Site Development Plan is presented as Sheet C3 of the civil drawing set.

3.3 Stormwater Model

Kennedy/Jenks prepared the following stormwater evaluation to determine the effect of the proposed project on the peak runoff from the Site. The analysis included changes in cover type between the pre- and post-development conditions, including the addition of concrete pads to support the solar array and an access road. The stormwater analysis was conducted in accordance with the Massachusetts Stormwater Handbook (Handbook). In accordance with the Handbook, the pre-and post-development conditions were evaluated for the 2-year, 24-hour; 10-year, 24-hour; and the 100-year, 24-hour storm events.

The hydrology of the Site was modelled using the Autodesk Storm and Sanitary Analysis (SSA) software package. The SSA rainfall designer was used to evaluate peak flows for the drainage basins, which are located in Norfolk County, Massachusetts, using county-specific rainfall data incorporated into the SSA software package. Soil data were obtained from the United States Department of Agriculture (USDA) and Natural Resources Conservation Service (NRCS) Web Soil Survey and revised to reflect soil conditions observed at the site[1]. The project area consists of very poorly drained soils (Hydrologic Soil Group D). The Soil Report is presented in Appendix A.

The Site was divided into six drainage basins for the purposes of runoff estimation. The drainage basin boundaries were based on a topological survey conducted in May 2016 by Meridian Associates.

3.3.1 Pre-Development Conditions

The pre-development conditions of the six drainage basins are show in Table 1, below. Existing dirt paths and access roads were included as impervious areas in these existing conditions.

Table 1: Pre-Development Site Conditions

Drainage Basin	Basin 1	Basin 2	Basin 3	Basin 4	Basin 5	Basin 6
Total area (acres)	2.14	3.22	2.89	1.46	0.56	0.33
Impervious area (acres)	0	0	0.05	0	0.02	0
Percent impervious (%)	0%	0%	2%	0%	3%	0%
Average slope (%)	5%	5%	7%	11%	4%	16%

[1] The Web Soil Survey indicates that the capped landfill area is Hydrologic Soil Group A: however, the construction of the cap modified the surface soil type, and the cap is known to be constructed of "clay and silt" to form a low permeability layer. Therefore this area was assumed to be Hydrologic Soild Group D

3.3.2 Post-Development Conditions

The solar array proposed for this Site does not increase impermeable surfaces because the solar panels are installed on a tilt array that allows rain and snow to drain onto the pervious ground surface. However, the impervious pads that support the inverters and power transformers associated with the solar array, as well as the ballast-block foundations that support the panels, will add impervious surface to the Site. The addition of a new access road will also result in a change in site permeability. These features were added as proposed impervious areas in the post-developed drainage basins and are depicted the post-development stormwater basin figure in Appendix B.

A swale connected to a level spreader is proposed to reduce flows from the western site area to the Landfill. This addition divided Basin 3 into two basins (Basin 3 and Basin 3A[2]) and redefined the drainage basin boundaries between Basin 3 and Basins 1 and 2. The swale was assumed to be 375 feet long, 1 foot wide, and 1.5 feet deep; the level spreader was assumed to be 6 feet long and 1 foot deep, and trapezoidal in shape with 2:1 side slopes.

The post-development conditions of the seven drainage basins are summarized in Table 2. Impervious areas were assumed to include existing impervious areas as well as the proposed ballast units, access road, and impervious pad. The existing impervious areas were assumed to be unaltered during the proposed development. Note that the total area for Basins 1 and 2 both decreased, and Basin 3 was divided into two basins.

Table 2: Post-Development Site Conditions

Drainage Basin	Basin 1	Basin 2	Basin 3	Basin 3A	Basin 4	Basin 5	Basin 6
Total area (acres)	2.02	3.06	2.42	0.75	1.46	0.56	0.33
Impervious area (acres)	0.18	0.08	0.04	0.03	0.02	0.03	0
Percent impervious (%)	9%	3%	2%	3%	2%	5%	0%
Average slope (%)	1%	3%	6%	5%	11%	4%	16%

[2] Basin 3 flows directly to the drainage basin outfall, whereas Basin 3A flows to the swale and level spreader before ultimately joining with Basin 3 flows and flowing to the drainage basin outfall.

3.3.3 Runoff Results

Table 3 summarizes pre- and post-development peak stormwater runoff discharge from the Site as estimated by SSA. The SSA output is presented in Appendix B.

Table 3: Pre- and Post-Development Peak Stormwater Runoff

	Basin 1		Basin 2		Basin 3 (a)	
	Pre-dev. Peak flow (ft^3/s)	Post-dev. Peak flow (ft^3/s)	Pre-dev. Peak flow (ft^3/s)	Post-dev. Peak flow (ft^3/s)	Pre-dev. Peak flow (ft^3/s)	Post-dev. Peak flow (ft^3/s)
2-yr	2.10	1.44	2.75	2.73	3.25	2.68
10-yr	4.16	2.79	5.45	5.38	6.45	5.34
100-yr	7.11	4.70	9.36	9.20	11.04	9.16

	Basin 4		Basin 5		Basin 6	
	Pre-dev. Peak flow (ft^3/s)	Post-dev. Peak flow (ft^3/s)	Pre-dev. Peak flow (ft^3/s)	Post-dev. Peak flow (ft^3/s)	Pre-dev. Peak flow (ft^3/s)	Post-dev. Peak flow (ft^3/s)
2-yr	0.86	0.82	0.21	0.23	0.49	0.49
10-yr	3.35	3.37	1.44	1.45	0.70	0.70
100-yr	5.74	5.76	2.41	2.43	1.20	1.20

Notes:

(a) For comparison purposes, Basin 3 values presented in Table 3 represent the Outfall 3 peak inflows. The Outfall 3 peak inflows include flows from Basin 3 and Basin 3A.

ft^3/s = cubic feet per second

yr = year

Peak stormwater runoff for Basins 3 and 3A are presented individually in Table 4, below.

Table 4: Basin 3 Pre- and Post-Development Peak Stormwater Runoff

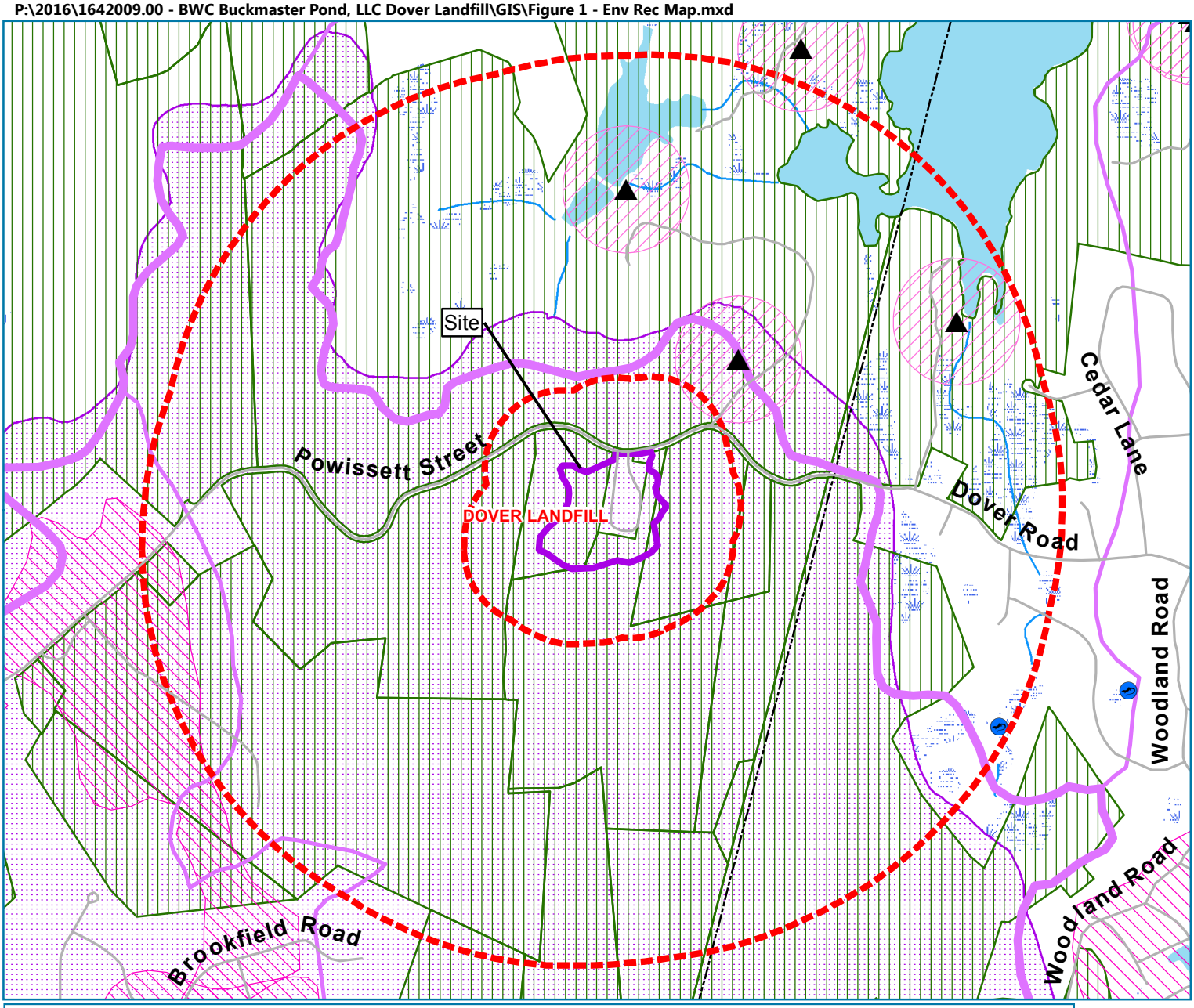
	Basin 3		Basin 3A	
	Pre-dev. Peak flow (ft^3/s)	Post-dev. Peak flow (ft^3/s)	Pre-dev. Peak flow (ft^3/s)	Post-dev. Peak flow (ft^3/s)
2-yr	3.25	2.44	--	0.50
10-yr	6.45	4.86	--	0.99
100-yr	11.04	8.33	--	1.69

The impact of the proposed development on most of the basins is minimal. Basins 4 and 5 saw minimal increases in the three design storm peak runoffs due to the addition of the equipment pad, access road, and solar panels. However, the slight increases in peak flow are much smaller than the decreases in peak flow seen in Basins 1, 2, and 3, and therefore the overall project is not anticipated to increase peak flows for the 2-year, 24-hour storm event or the 10-year, 24-hour storm event, or cause a flooding issue in the 100-year, 24-hour storm event.

In summary, the SSA models indicate the existing drainage features and additional swale/level spreader will support the proposed solar PV system installation including the associated flow rate changes or other possible stormwater drainage impacts. As discussed, by reducing stormwater flow onto the capping system, this is net improvement to the Landfill system as a whole that could mitigate potential leaching issues. The SSA model outputs and related stormwater calculations are presented in Appendix B.

Figures

P:\2016\1642009.00 - BWC Buckmaster Pond, LLC Dover Landfill\GIS\Figure 1 - Env Rec Map.mxd



Legend

- Site Boundary
- 500 Ft and Half Mile Buffers
- Certified Vernal Pools
- Drainage Sub-basin Boundaries
- Major Drainage Basin Boundaries
- Public Water Supply
- Interim Wellhead Protection Areas (IWPAs)
- DEP Approved Zone IIs
- ZONE A
- EPA Designated Sole Source Aquifers
- Landfills
- Dumping Grounds
- Protected Open Space
- ACECs
- NHESP Priority Habitats of Rare Species
- NHESP Estimated Habitats of Rare Wildlife
- Surface Water Features
- Streams, Intermittent Streams, Channels
- MassDEP Wetlands
- 0.1-Percent-Annual-Chance Flood Zone
- Outstanding Resource Waters
- High Yield Aquifer
- Medium Yield Aquifer

Non Potential Drinking Water Source Area

- High Yield
- Medium Yield
- County Boundaries
- Town Boundaries

MassDOT Roads

- Limited Access Highway
- Multi-lane Hwy, not limited access
- Other Numbered Highway
- Major Road, Collector
- Minor Road, Arterial
- Ramp
- Tunnel
- Tunnel (Limited Access Hwy)
- Tunnel (Multi-lane Hwy)
- Tunnel (Other Numbered Hwy)

MBTA Commuter Rail Lines

- Operational
- Proposed
- Used Only for Special Events

MBTA Commuter Rail Stations

- Active
- Proposed
- Open Only for Special Events
- Freight Railroads

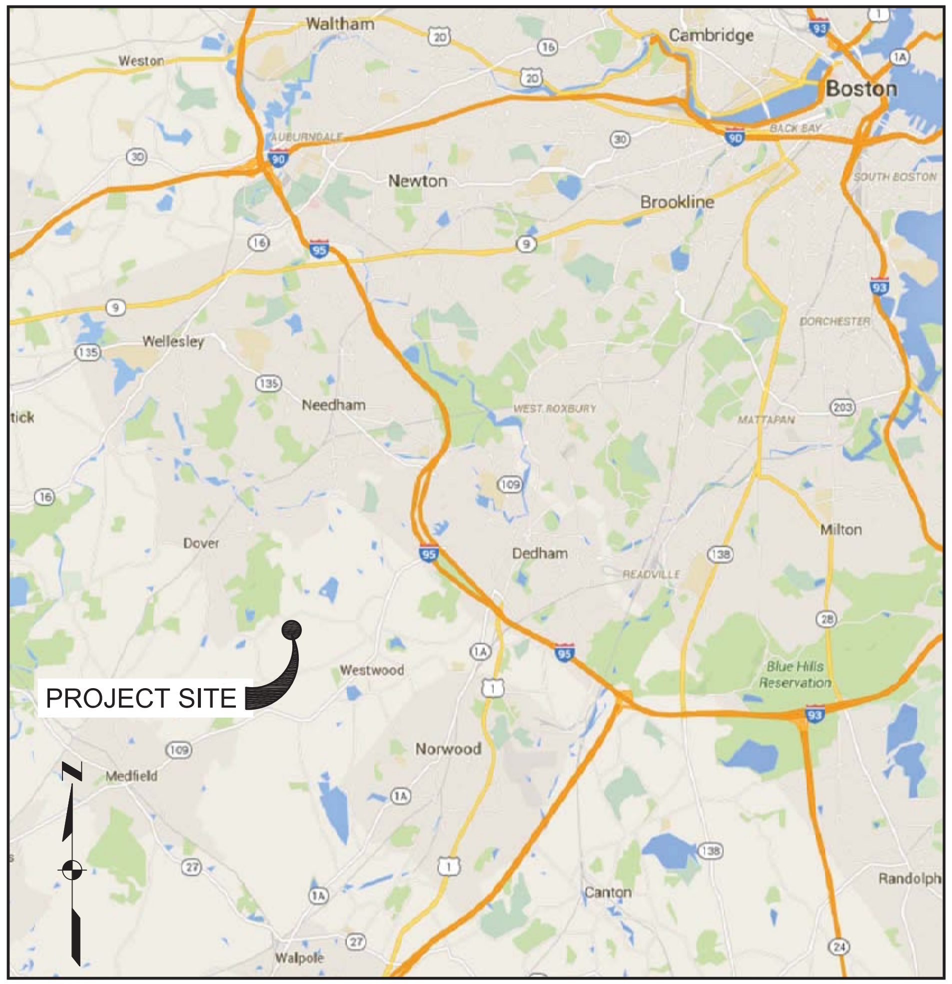
0 1,000 2,000 Feet

Source:
All data layers obtained from MassGIS On-line Database.

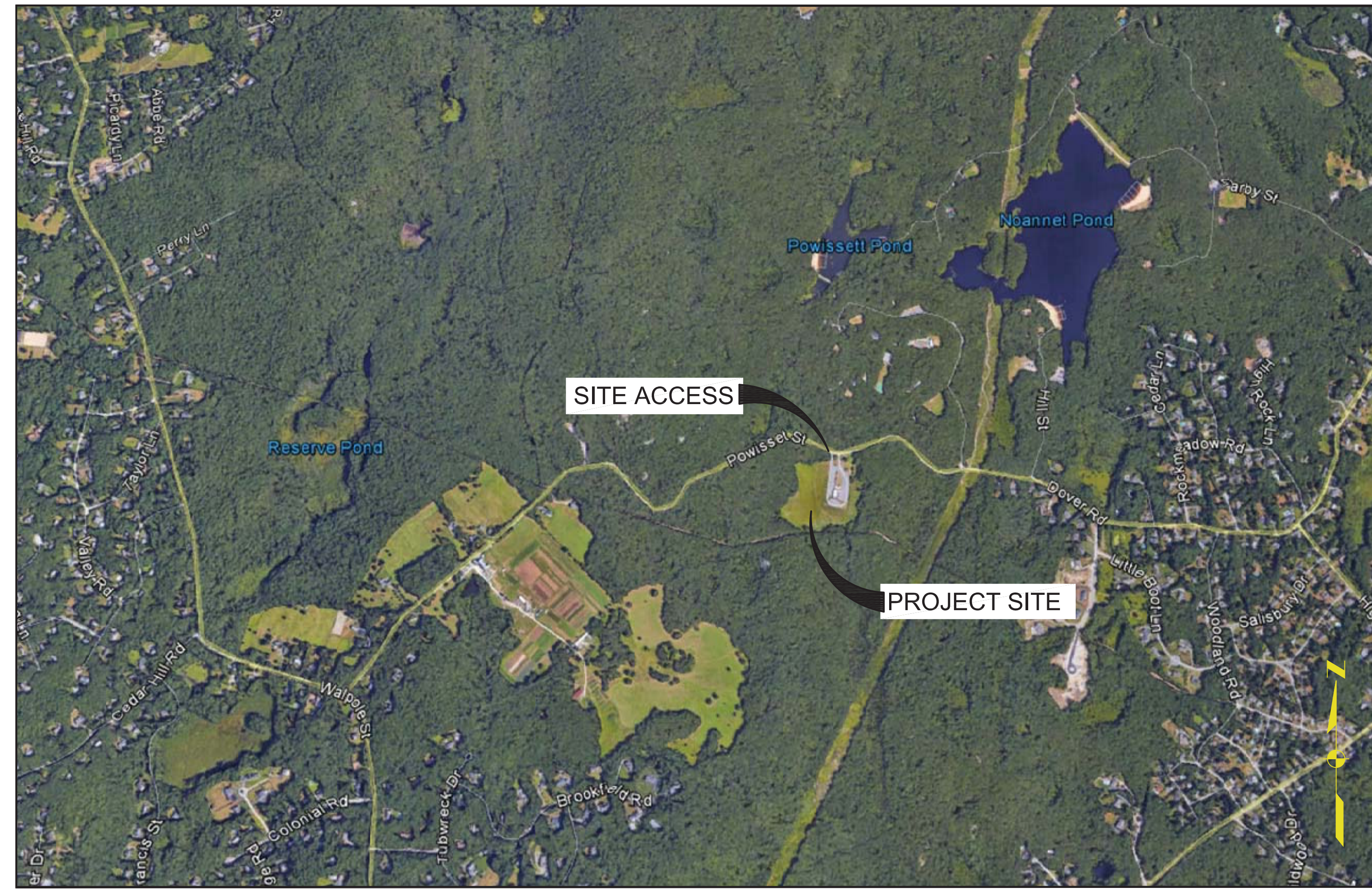
Figure 1 - Environmental Receptors Map
BWC Buckmaster Pond, LLC Dover Landfill
0 Powissett Street
Dover, Massachusetts
Prepared by: Kennedy/Jenks Consultants

Civil Design Drawings

BWC BUCKMASTER POND, LLC
DOVER LANDFILL
SOLAR DEVELOPMENT PROJECT
POWISSET STREET, DOVER, MASSACHUSETTS



VICINITY MAP
NOT TO SCALE



LOCUS MAP
1" = 800'

SHEET INDEX

PROJECT APPLICANT

BWC BUCKMASTER POND, LLC
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PROPERTY OWNER

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PHONE: (781) 326-1770
ATTN: ERIC ARNOLD

PV SYSTEM INSTALLER

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BOSTON, MA 02116
PHONE: (617) 209-3122
ATTN: JON MANCINI

PROJECT ENGINEER

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TEWKSBURY, MA 01876
PHONE: (978) 770-2031
ATTN: MICHAEL CLARK, P.E.

FOR PERMITTING ONLY

Kennedy/Jenks Consultants
TEWKSBURY, MA

NO.	REVISION	DATE	BY
2	REVISED FOR PLANNING BOARD	19 JULY 2016	AEW
1	ISSUED FOR PERMITTING	23 JUN 2016	BRK

SCALES
0 — 1"
0 — 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

DESIGNED J. SMITH
DRAWN B. KIELY
CHECKED M. CLARK

COVER SHEET
BWC BUCKMASTER POND, LLC
BOSTON, MA
DOVER LANDFILL
SOLAR DEVELOPMENT PROJECT

FILE NAME 1642009_COVER
JOB NO. 1642009*00
DATE 20 JULY 2016
SHEET C1 OF 8

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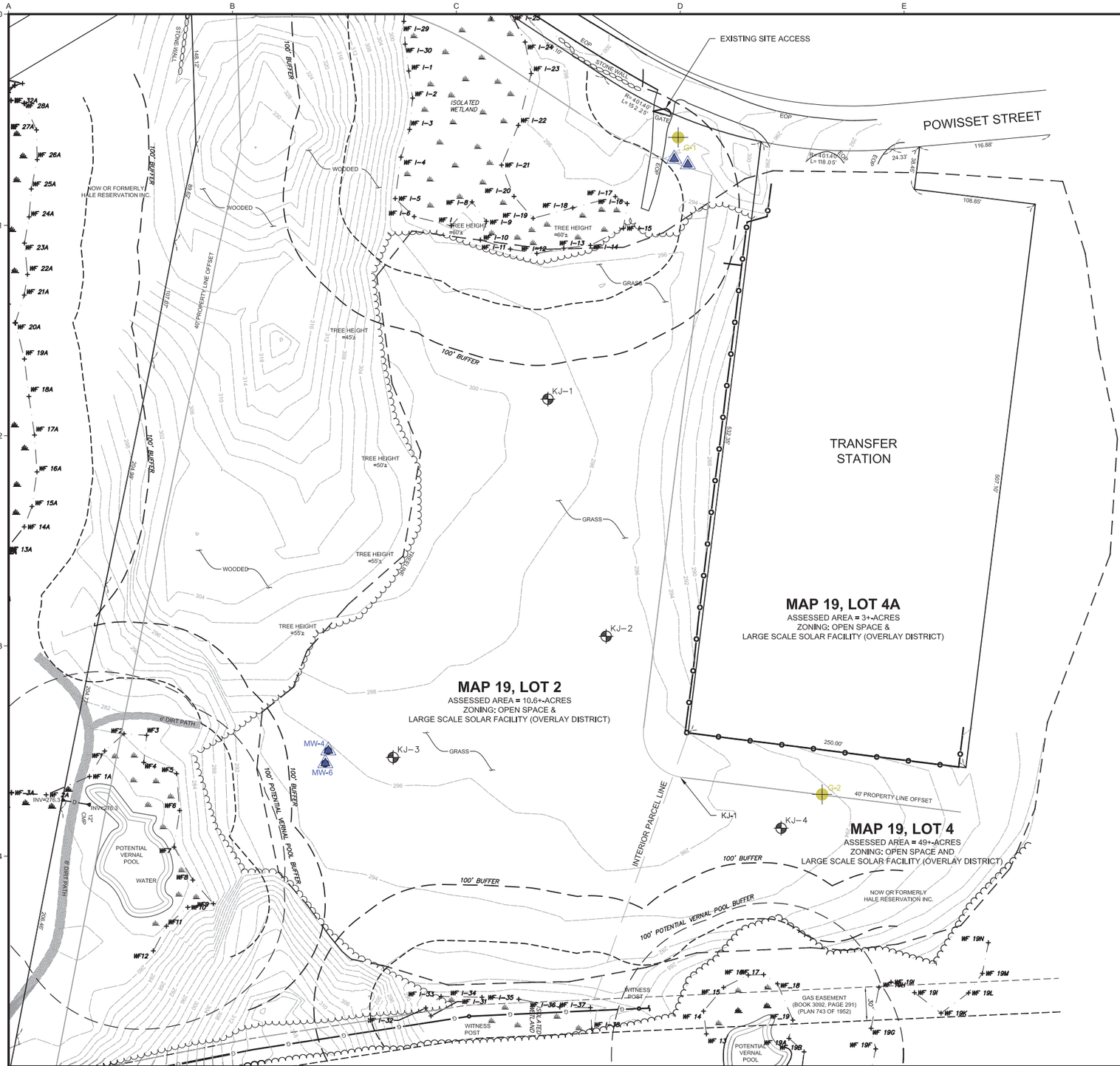
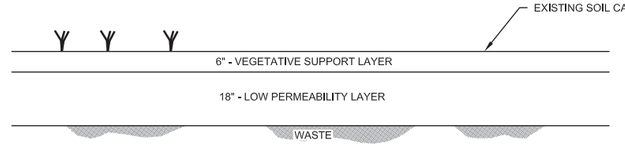
JONATHAN SMITH 7/25/2016 9:07 AM





EXISTING SOIL CAP DETAIL A / C4

LEGEND

WF I-20	WETLANDS FLAG
	WETLANDS SYMBOL
	WETLANDS BOUNDARY
	50' WETLANDS BUFFER
	100' WETLANDS BUFFER
	LIMIT OF LANDFILL CAP
	PROPERTY BOUNDARY
	STONE WALL
	MAJOR ELEVATION CONTOUR (10' INTERVALS)
	MINOR ELEVATION CONTOUR (2' INTERVALS)
	EXISTING CHAIN LINK FENCE
	EXISTING TREE LINE
G G G G	EXISTING UNDERGROUND GAS LINE
EOP	EDGE OF PAVEMENT
INV	INVERT ELEVATION
CMP	CORRUGATED METAL PIPE
G-2	GAS MONITORING WELL
	SURFACE SOIL SAMPLING POINT
MW-2	MONITORING WELL LOCATION

NOTES

1. THE TOPOGRAPHY, SITE DETAIL & SURFACE IMPROVEMENTS DEPICTED HEREON WERE OBTAINED FROM AN ON THE GROUND INSTRUMENT SURVEY CONDUCTED BY MERIDIAN ASSOCIATES, INC. (MAI) BETWEEN APRIL 19-26, 2016.
2. THE LOCATION OF ALL UNDERGROUND UTILITIES SHOWN ARE APPROXIMATE AND ARE BASED UPON A PARTIAL FIELD SURVEY. MERIDIAN ASSOCIATES, INC. DOES NOT WARRANTY NOR GUARANTEE THE LOCATION OF ALL UTILITIES DEPICTED OR NOT DEPICTED. THE CONTRACTOR, PRIOR TO COMMENCEMENT OF CONSTRUCTION, SHALL VERIFY THE LOCATION OF ALL UTILITIES AND CONTACT DIG SAFE AT 1-888-344-7233.
3. THIS PLAN DOES NOT SHOW ANY UNRECORDED OR UNWRITTEN EASEMENTS WHICH MAY EXIST. A REASONABLE AND DILIGENT ATTEMPT HAS BEEN MADE TO OBSERVE ANY APPARENT, VISIBLE USES OF THE LAND; HOWEVER, THIS DOES NOT CONSTITUTE A GUARANTEE THAT NO SUCH EASEMENTS EXIST.
4. THE ELEVATIONS DEPICTED HEREON WERE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88), AS DERIVED FROM GPS OBSERVATIONS.
5. THE WETLAND FLAGS DEPICTED WERE DEMARCATED BY LEC ENVIRONMENTAL CONSULTANTS, INC. ON APRIL 18, 2016.
6. PROPERTY LINES DEPICTED HEREON ARE BASED ON COMPILED DEEDS AND PLANS OF RECORD.

0 50 100
1"=50'

FOR PERMITTING ONLY

Kennedy/Jenks Consultants
TEWKSBURY, MA

NO.	REVISION	DATE	BY
1	ISSUED FOR PERMITTING	23 JUN 2016	BRK

SCALES
0 1"
0 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

COMMONWEALTH OF MASSACHUSETTS MICHAEL J. CLARK REGISTERED PROFESSIONAL ENGINEER

DESIGNED J. SMITH
DRAWN B. KIELY
CHECKED M. CLARK

EXISTING CONDITIONS

BWC BUCKMASTER POND, LLC
BOSTON, MA
DOVER LANDFILL SOLAR DEVELOPMENT PROJECT

FILE NAME 1642009_CIVIL
JOB NO. 1642009*00
DATE 20 JULY 2016
SHEET C2 OF 8

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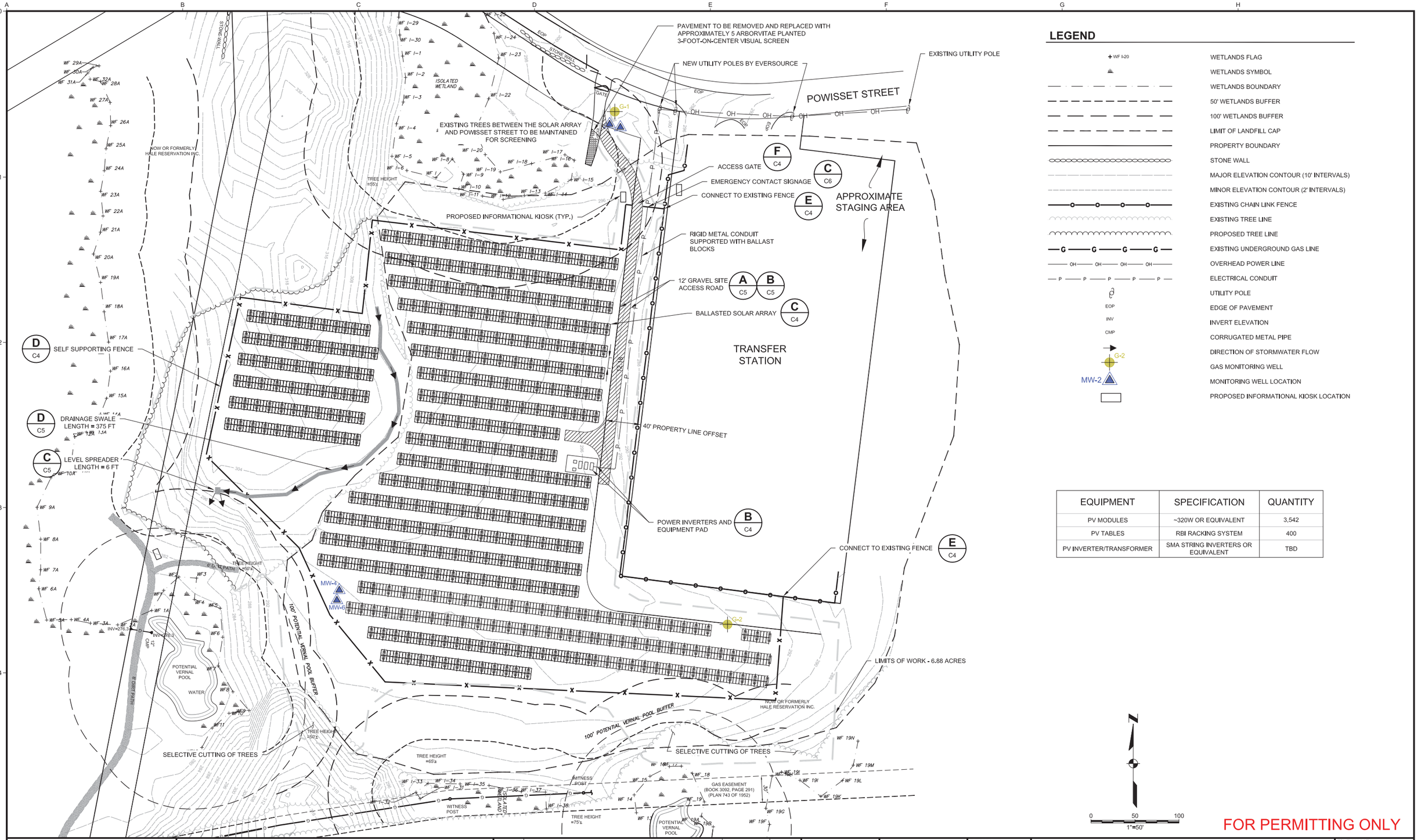
JONATHAN SMITH 7/25/2016 2:52 PM



LEGEND

- WETLANDS FLAG
- WETLANDS SYMBOL
- WETLANDS BOUNDARY
- 50' WETLANDS BUFFER
- 100' WETLANDS BUFFER
- LIMIT OF LANDFILL CAP
- PROPERTY BOUNDARY
- STONE WALL
- MAJOR ELEVATION CONTOUR (10' INTERVALS)
- MINOR ELEVATION CONTOUR (2' INTERVALS)
- EXISTING CHAIN LINK FENCE
- EXISTING TREE LINE
- PROPOSED TREE LINE
- EXISTING UNDERGROUND GAS LINE
- OVERHEAD POWER LINE
- ELECTRICAL CONDUIT
- UTILITY POLE
- EOP — EDGE OF PAVEMENT
- INV — INVERT ELEVATION
- CMP — CORRUGATED METAL PIPE
- DIRECTION OF STORMWATER FLOW
- GAS MONITORING WELL
- MONITORING WELL LOCATION
- PROPOSED INFORMATIONAL KIOSK LOCATION

EQUIPMENT	SPECIFICATION	QUANTITY
PV MODULES	~320W OR EQUIVALENT	3,542
PV TABLES	RBI RACKING SYSTEM	400
PV INVERTER/TRANSFORMER	SMA STRING INVERTERS OR EQUIVALENT	TBD

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Kennedy/Jenks
Consultants
TEWKSBURY, MA

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SCALES
0 1"
0 25mm
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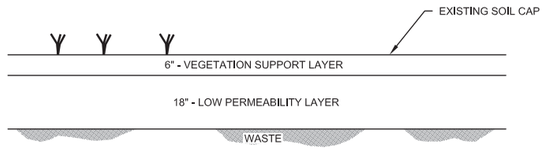
COMMONWEALTH OF MASSACHUSETTS — MICHAEL — REGISTERED PROFESSIONAL ENGINEER

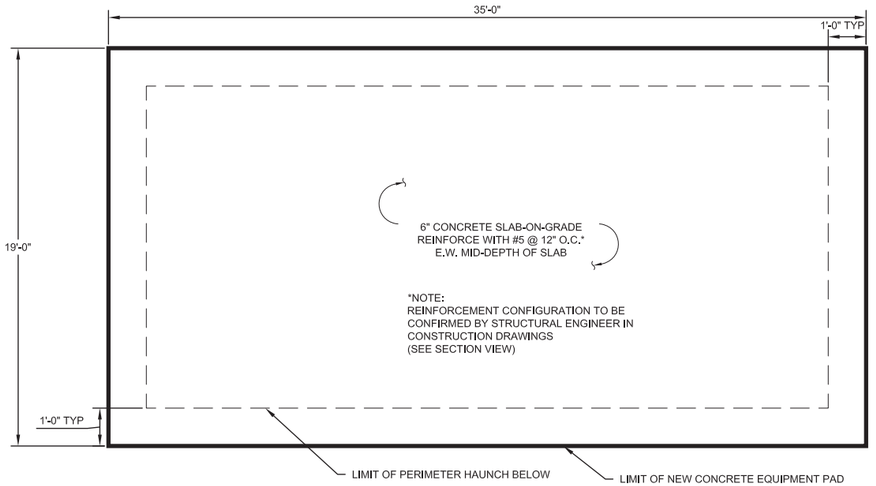
DESIGNED J. SMITH
DRAWN B. KIELY
CHECKED M. CLARK

SITE DEVELOPMENT PLAN
BWC BUCKMASTER POND, LLC
BOSTON, MA
DOVER LANDFILL
SOLAR DEVELOPMENT PROJECT

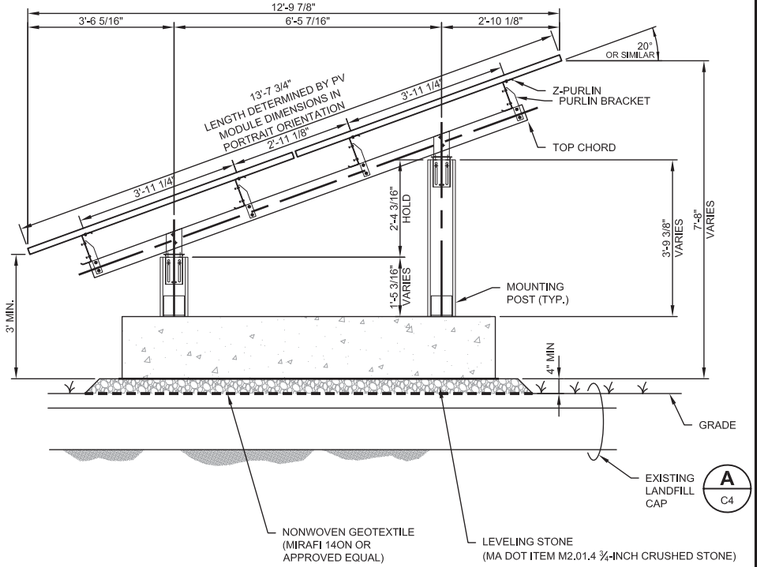
FILE NAME 1642009_CIVIL_Site Plan
JOB NO. 1642009*00
DATE 20 JULY 2016
SHEET C3 OF 8



EXISTING SOIL CAP DETAIL (A, C4) — NOT TO SCALE

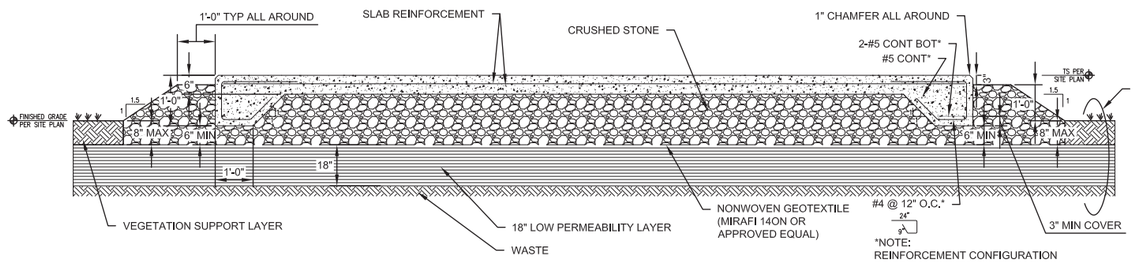


PLAN VIEW



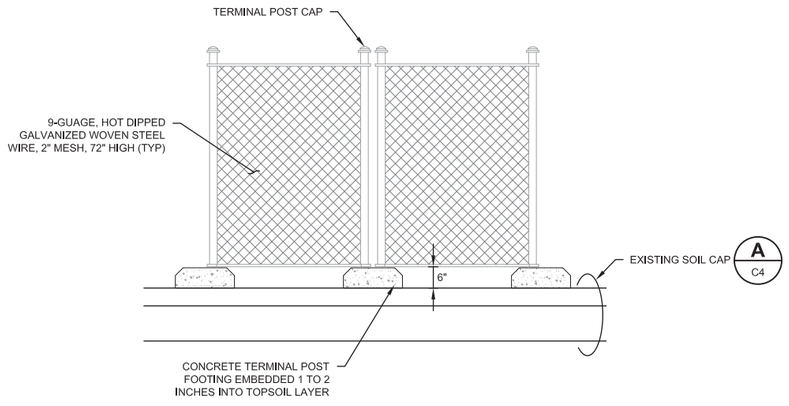
SIDE ELEVATION

SOLAR ARRAY DETAIL (C, C4) — NOT TO SCALE



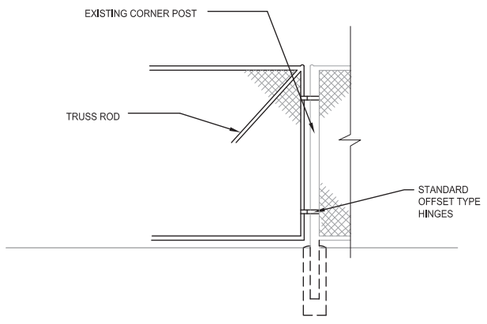
SECTION VIEW

EQUIPMENT PAD SLAB PLAN AND SECTION (B, C4) — NOT TO SCALE

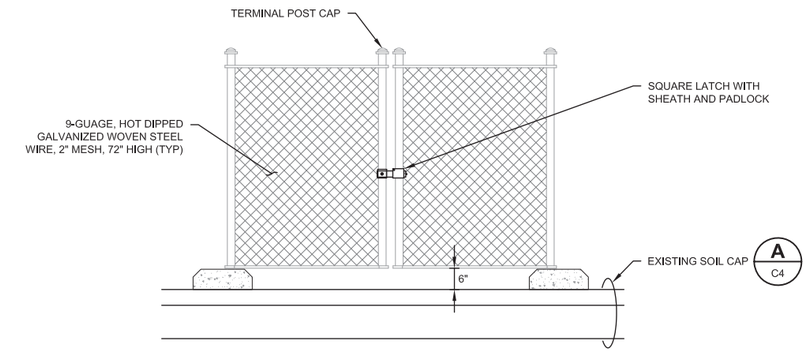


NOTE:
1. CONTRACTOR IS NOT TO DISTURB LOW PERMEABILITY LAYER DURING INSTALLATION.

SELF SUPPORTING FENCE DETAIL (D, C4) — NOT TO SCALE



CONNECTION TO EXISITNG FENCE DETAIL (E, C4) — NOT TO SCALE



SELF SUPPORTING FENCE GATE DETAIL (F, C4) — NOT TO SCALE

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TEWKSBURY, MA

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COMMONWEALTH OF MASSACHUSETTS — MICHAEL J. SMITH — REGISTERED PROFESSIONAL ENGINEER

DESIGNED J. SMITH
DRAWN B. KIELY
CHECKED M. CLARK

DETAILS SHEET 1

BWC BUCKMASTER POND, LLC
BOSTON, MA
DOVER LANDFILL SOLAR DEVELOPMENT PROJECT

FILE NAME 1642009_CIVIL_Details
JOB NO. 1642009*00
DATE 20 JULY 2016
SHEET C4 OF 8

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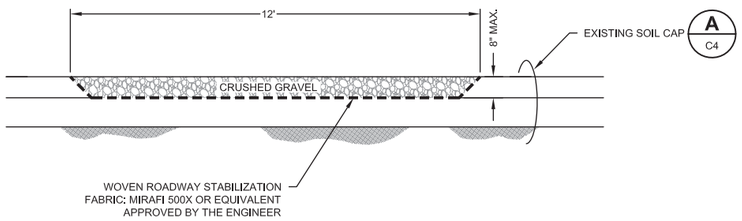
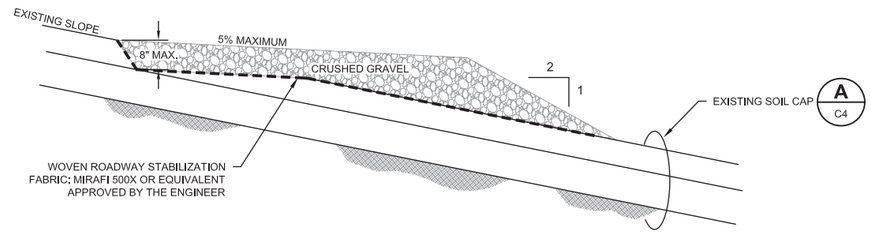


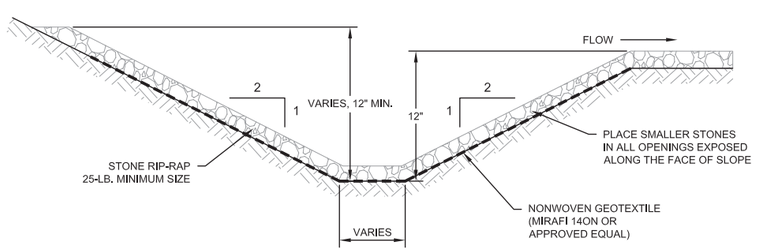
NOTES:
1. PROPOSED GRAVEL ROAD TO BE FLUSH WITH UPGRADIENT EXISTING GROUND SURFACE TO PROMOTE CONTINUED SHEET FLOW OF STORMWATER RUNOFF.
2. MINIMUM 1% SLOPE TO BE MAINTAINED ACROSS ROAD. MAXIMUM CROSS ROAD SLOPE TO BE 5%.

ROAD SECTION DETAIL (A) C5
NOT TO SCALE

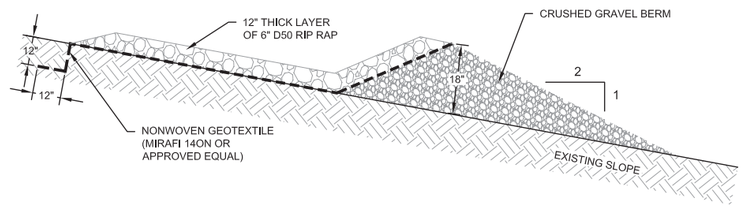


NOTES:
1. PROPOSED GRAVEL ROAD TO BE FLUSH WITH UPGRADIENT EXISTING GROUND SURFACE TO PROMOTE CONTINUED SHEET FLOW OF STORMWATER RUNOFF.
2. MINIMUM 1% SLOPE TO BE MAINTAINED ACROSS ROAD. MAXIMUM 5% SLOPE TO BE MAINTAINED WHERE EXISTING SLOPE EXCEEDS 5%.

SLOPED ROAD SECTION DETAIL (B) C5
NOT TO SCALE



RIP RAP LEVEL SPREADER (C) C5
NOT TO SCALE



STORMWATER SWALE (D) C5
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COMMONWEALTH OF MASSACHUSETTS MICHAEL CLARK 37712 REGISTERED PROFESSIONAL ENGINEER

DESIGNED J. SMITH
DRAWN B. KIELY
CHECKED M. CLARK

DETAILS SHEET 2

BWC BUCKMASTER POND, LLC
BOSTON, MA
DOVER LANDFILL SOLAR DEVELOPMENT PROJECT

FILE NAME 1642009_CIVIL_Details
JOB NO. 1642009*00
DATE 20 JULY 2016
SHEET C5 OF 8

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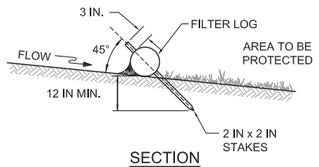
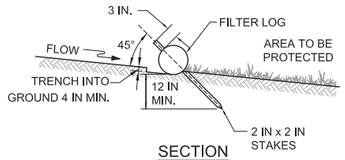


SECTION

OR



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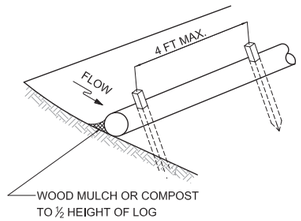
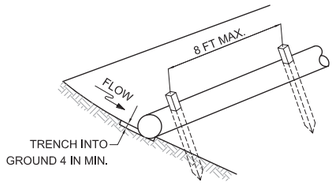


ISOMETRIC VIEW

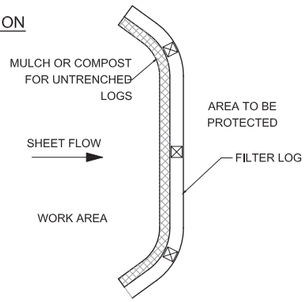
UNTRENCHED INSTALLATION



ISOMETRIC VIEW

ENTRENCHED INSTALLATION*

*THIS APPLICATION MAY NOT BE USED WITH LOGS SMALLER THAN 12 IN.



PLAN

STAKE-DRIVEN FILTER LOG DETAIL (A)

NOT TO SCALE — C6

CONSTRUCTION SPECIFICATIONS:

1. PRIOR TO INSTALLATION, CLEAR ALL OBSTRUCTIONS INCLUDING ROCKS, CLODS, AND DEBRIS GREATER THAN ONE INCH THAT MAY INTERFERE WITH PROPER FUNCTION OF FILTER LOG.
2. FILL LOG NETTING UNIFORMLY WITH COMPOST (IN ACCORDANCE WITH SECTION H-1 MATERIALS), OR OTHER APPROVED BIODEGRADABLE MATERIAL TO DESIRED LENGTH SUCH THAT LOGS DO NOT DEFORM.
3. INSTALL FILTER LOGS PERPENDICULAR TO THE FLOW DIRECTION AND PARALLEL TO THE SLOPE WITH THE BEGINNING AND END OF THE INSTALLATION POINTING SLIGHTLY UP THE SLOPE CREATING A "J" SHAPE AT EACH END TO PREVENT BYPASS.
4. FOR UNTRENCHED INSTALLATION BLOW OR HAND PLACE MULCH OR COMPOST ON UPHILL SIDE OF THE SLOPE ALONG LOG.
5. STAKE FILTER LOG EVERY 4 FEET OR CLOSER ALONG ENTIRE LENGTH OF LOG OR TRENCH LOG INTO GROUND A MINIMUM OF 4 INCHES AND STAKE LOG EVERY 8 FEET OR CLOSER.
6. USE STAKES WITH A MINIMUM NOMINAL CROSS SECTION OF 2X2 INCH AND OF SUFFICIENT LENGTH TO ATTAIN A MINIMUM OF 12 INCHES INTO THE GROUND AND 3 INCHES PROTRUDING ABOVE LOG.
7. WHEN MORE THAN ONE LOG IS NEEDED, OVERLAP ENDS 12 INCHES MINIMUM AND STAKE.
8. REMOVE SEDIMENT WHEN IT HAS ACCUMULATED TO A DEPTH OF 1/2 THE EXPOSED HEIGHT OF LOG AND REPLACE MULCH. REPLACE LOG IF TORN. REINSTALL FILTER LOG IF UNDERMINING OR DISLODGING OCCURS. REPLACE CLOGGED FILTER LOGS. FOR PERMANENT APPLICATIONS, ESTABLISH AND CONTINUOUSLY MEET REQUIREMENTS FOR ADEQUATE VEGETATIVE ESTABLISHMENT IN ACCORDANCE WITH SECTION B-4 VEGETATIVE STABILIZATION.

EROSION AND SEDIMENT CONTROL NOTES

1. ALL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE MASSACHUSETTS EROSION AND SEDIMENTATION CONTROL GUIDELINES FOR URBAN AND SUBURBAN AREAS DATED MARCH 1997, THE U.S.D.A. S.C.S. EROSION AND SEDIMENT CONTROL IN SITE DEVELOPMENT, MASSACHUSETTS CONSERVATION GUIDE, DATED SEPTEMBER 1983 AND ALL LOCAL MUNICIPAL REGULATIONS.
2. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE IN PLACE PRIOR TO THE COMMENCEMENT OF ANY SITE WORK OR EARTHWORK OPERATIONS, SHALL BE MAINTAINED DURING CONSTRUCTION, AND SHALL REMAIN IN PLACE UNTIL ALL SITE WORK IS COMPLETE AND PERMANENT GROUND COVER IS ESTABLISHED.
3. A QUALIFIED ENGINEER WILL OVERSEE CONSTRUCTION ACTIVITIES TO ENSURE THAT MEANS AND METHODS COMPLY WITH APPLICABLE PERMITS AND MGL SOLID WASTE REGULATIONS.
4. ONLY LOW-GROUND PRESSURE EQUIPMENT (7 PSI MAX.) SHALL BE USED WITHIN THE LIMITS OF THE LANDFILL COVER SYSTEM.
5. EACH DAY, GROUND CONDITIONS MUST BE INSPECTED PRIOR TO COMMENCING WORK ACTIVITIES WITHIN THE LIMITS OF THE LANDFILL COVER SYSTEM. NO WORK MAY BE CONDUCTED DURING WET WEATHER THAT COULD LEAD TO RUTTING OR EROSION OF THE LANDFILL COVER SYSTEM.
6. CONSTRUCTION ACTIVITIES MUST BE CEASED IN AREAS WITHIN THE LANDFILL COVER SYSTEM THAT ARE DEMONSTRATING GREATER THAN 1" OF RUTTING UNTIL THOSE AREAS ARE STABILIZED AND REVEGETATED.
7. STOCKPILES SHALL BE OFF THE LIMITS OF THE LANDFILL CAP AND SURROUNDED ON THEIR PERIMETERS WITH STAKED HAY BALES AND/OR SILTATION FENCES TO PREVENT AND/OR CONTROL SILTATION AND EROSION AS REQUIRED.
8. ALL DISTURBED OR EXPOSED AREAS SUBJECT TO EROSION SHALL BE STABILIZED AND SEEDED FOR TEMPORARY/PERMANENT VEGETATIVE COVER WHERE CONSTRUCTION ACTIVITIES HAVE PERMANENTLY CEASED IN ACCORDANCE WITH MASSACHUSETTS DEP EROSION AND SEDIMENT CONTROL GUIDELINES. NO OPEN EXCAVATIONS ARE TO BE LEFT OVERNIGHT WITHIN THE LIMITS OF THE LANDFILL COVER SYSTEM.
9. ALL EROSION CONTROL MEASURES SHALL BE ROUTINELY INSPECTED IN ACCORDANCE WITH THE SWPPP AND THE MASS DEP POST-CLOSURE USE PERMIT.
10. THE CONTRACTOR SHALL KEEP ON SITE AT ALL TIMES ADDITIONAL SILT FENCE AND HAY BALES FOR INSTALLATION AT THE DIRECTION OF THE ENGINEER AND/OR CONSERVATION COMMISSION AGENT TO MITIGATE ANY EMERGENCY CONDITION.
11. THE AREA OF ENTRANCE AND EXIT TO AND FROM THE SITE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAY. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHT-OF-WAY MUST BE REMOVED IMMEDIATELY.
12. UPON COMPLETION OF ALL SITE WORK CONSTRUCTION, THE SITE CONTRACTOR SHALL INSPECT ALL STORMWATER STRUCTURES AND SWALES AND REMOVE ALL SEDIMENT, TRASH AND DEBRIS THAT HAS ACCUMULATED.
13. DUST CONTROL SHALL BE USED DURING EARTHWORK OPERATIONS AND SHALL CONSIST OF DAMPENING THE GROUND WITH WATER.
14. EROSION CONTROL MEASURES SHOWN ON THE DRAWINGS DEPICT THE MINIMUM REQUIRED CONTROL. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SITING, RELOCATION AND AUGMENTATION OF EROSION CONTROL DEVICES TO PROTECT WETLAND RESOURCES AS THE PROJECT PROGRESSES AND SITE DRAINAGE CONDITIONS CHANGE.
15. THE CONTRACTOR SHALL, AT HIS EXPENSE, SURVEY AND MARK OUT IN THE FIELD THE LIMITS OF CLEARING AND EROSION CONTROL (I.E. SILT FENCE LINE) FOR APPROVAL PRIOR TO COMMENCEMENT OF CLEARING AND GRUBBING ACTIVITIES.
16. PRIOR TO COMMENCEMENT OF CONSTRUCTION ACTIVITIES AT THE SITE, THE CONTRACTOR SHALL ENGAGE AN INDIVIDUAL WITH SPECIFIC TRAINING IN EROSION AND SEDIMENT CONTROL. THE EROSION CONTROL MONITOR SHALL PREPARE A WEEKLY REPORT WHICH SHALL BE KEPT ON SITE AT ALL TIMES AND SHALL BE SHOWN TO LOCAL, STATE AND FEDERAL AGENTS UPON REQUEST. THIS REPORT SHALL INDICATE THE STATUS OF THE EROSION CONTROLS AND ANY MAINTENANCE REQUIRED AND PERFORMED. THIS REPORT SHALL CONFORM TO THE REQUIREMENTS OF THE EPA'S NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) CONSTRUCTION GENERAL PERMIT.
17. WOODEN STAKES SHALL NOT BE DRIVEN INTO GROUND WITHIN THE LIMIT OF THE LANDFILL COVER SYSTEM. SILT FENCE AND COMPOST FIBER ROLLS SHALL NOT BE USED FOR EROSION CONTROL WITHIN THE LIMIT OF THE LANDFILL COVER SYSTEM.

SPECIFICATIONS

TOPSOIL:

1. TOPSOIL SHALL BE FERTILE, NATURAL SOIL CAPABLE OF SUSTAINING VIGOROUS PLANT GROWTH, TYPICAL OF THE LOCALITY, FREE FROM STONES GREATER THAN 3 INCHES, ROOTS, STICKS, CLAY, PEAT, WEEDS AND SOD, AND SHALL BE OBTAINED FROM NATURALLY WELL DRAINED AREAS. IT SHALL NOT BE EXCESSIVELY ACIDIC OR ALKALINE NOR CONTAIN TOXIC MATERIAL HARMFUL TO PLANT GROWTH.

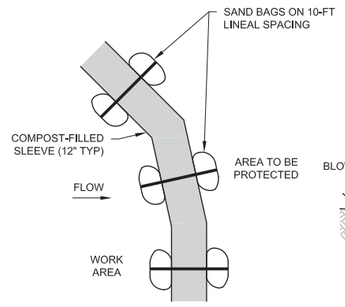
GRASS SEED (FOR DISTURBED AREAS ONLY):

1. GRASS SEED SHALL BE OF THE PREVIOUS YEAR'S CROP AND IN NO CASE SHALL THE WEED CONTENT EXCEED 1% BY WEIGHT. GRASS SEED SHALL BE CONSISTENT WITH TYPE M6.03.0 "FOR SLOPES AND SHOULDERS" OF THE MASSACHUSETTS HIGHWAY DEPARTMENT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES AND CONFORM TO THE REQUIREMENTS WITHIN THE TABLE BELOW.
2. A MANUFACTURER'S CERTIFICATE OF COMPLIANCE SHALL BE SUBMITTED BY WITH EACH SHIPMENT OF EACH TYPE OF SEED INDICATING THE GUARANTEED PERCENTAGE OR PURITY, WEED CONTENT AND GERMINATION OF THE SEED, AND THE NET WEIGHT AND DATE OF SHIPMENT.

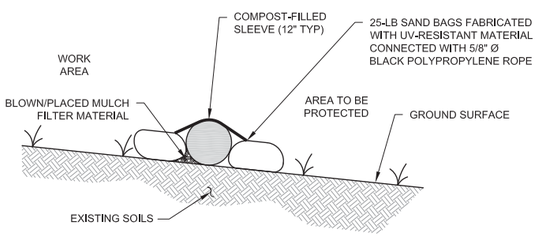
GRASS SEED MIX			
MIXTURE	PROPORTION	GERMINATION MINIMUM	PURITY MINIMUM
CREEPING RED FESCUE	50%	85%	95%
KENTUCKY 31	30%	85%	95%
DOMESTIC RYE	10%	90%	98%
RED TOP	5%	85%	92%
LADINO CLOVER	5%	85%	96%

TREE CLEARING

1. 50% MAXIMUM TREE CLEARING IN WETLANDS BUFFER AREAS PER THE TOWN OF DOVER WETLANDS BY LAWS.
2. TREE CUTTING TO BE COORDINATED WITH THE TOWN OF DOVER CONSERVATION COMMISSION.



PLAN VIEW

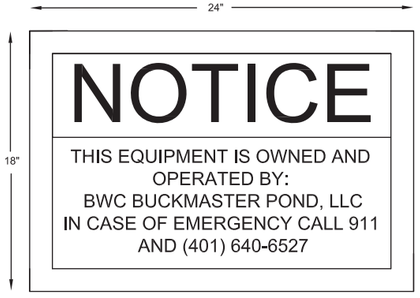


SECTION

NOTE:
1. TUBULAR SEDIMENT CONTROL SHALL BE FILTREXX SILTSOXX OR EQUIVALENT APPROVED BY ENGINEER

FILTER LOG EROSION CONTROL DETAIL (B)

NOT TO SCALE — C6



TO BE INSTALLED ON FENCE ADJACENT TO GATE

EMERGENCY CONTACT SIGNAGE (C)

NOT TO SCALE — C6

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TEWKSBURY, MA

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COMMONWEALTH OF MASSACHUSETTS — MICHAEL — REGISTERED PROFESSIONAL ENGINEER

DESIGNED	J. SMITH
DRAWN	B. KIELY
CHECKED	M. CLARK

DETAILS SHEET 3

BWC BUCKMASTER POND, LLC
BOSTON, MA
DOVER LANDFILL
SOLAR DEVELOPMENT PROJECT

FILE NAME	1642009_CIVIL_Details
JOB NO.	1642009*00
DATE	20 JULY 2016
SHEET	C6 OF 8

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LEGEND

+ WF I-20	WETLANDS FLAG
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	TREE LINE
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EOP	EDGE OF PAVEMENT
INV	INVERT ELEVATION
CMP	CORRUGATED METAL PIPE
MW-2	MONITORING WELL LOCATION
G-2	GAS PROBE LOCATION
	PROPOSED INFORMATIONAL KIOSK LOCATION

FILTER LOGS

ID	LENGTH (LF)
FL-1	432.9
FL-2	426.5
TOTAL	**859.4**

NON PENETRATING FILTER LOGS

ID	LENGTH (LF)
NPFL-1	275.0
NPFL-2	119.5
NPFL-3	80.8
NPFL-4	37.1
NPFL-5	71.4
NPFL-6	197.3
NPFL-7	142.8
NPFL-8	100.5
NPFL-9	87.7
NPFL-10	67.7
NPFL-11	36.9
NPFL-12	231.3
NPFL-13	612.2
TOTAL	**2060.2**

N

0 50 100
1"=50'

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0 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

COMMONWEALTH OF MASSACHUSETTS MICHAEL TRUPIANO REGISTERED PROFESSIONAL ENGINEER

DESIGNED J. SMITH
DRAWN B. KIELY
CHECKED M. CLARK

EROSION AND SEDIMENT CONTROL PLAN

BWC BUCKMASTER POND, LLC
BOSTON, MA
DOVER LANDFILL SOLAR DEVELOPMENT PROJECT

FILE NAME 1642009_CIVIL_ESC
JOB NO. 1642009*00
DATE 20 JULY 2016
SHEET C7 OF 8

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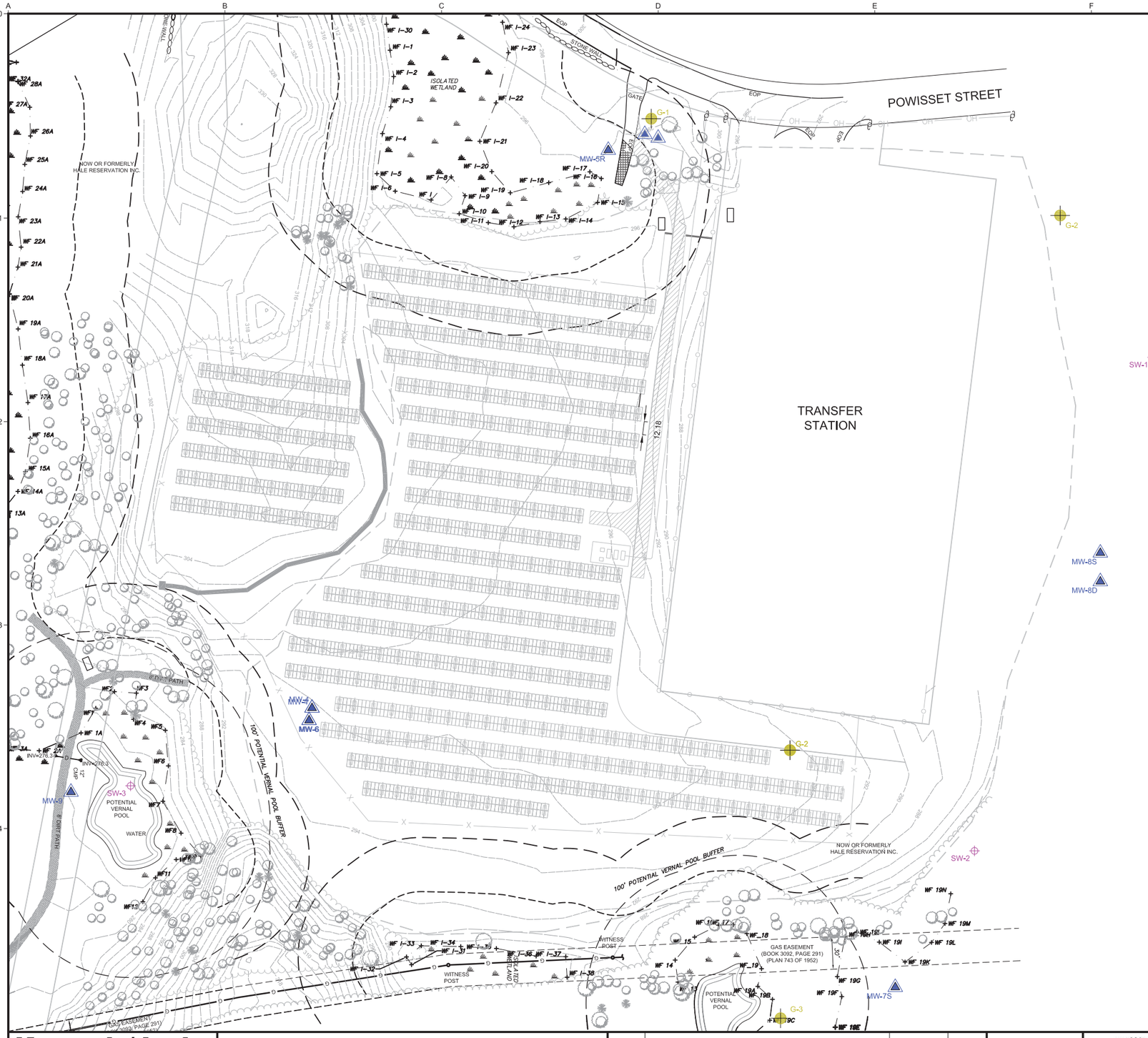

LEGEND

+ WF I-20	WETLANDS FLAG
	WETLANDS SYMBOL
	WETLANDS BOUNDARY
	50' WETLANDS BUFFER
	100' WETLANDS BUFFER
	LIMIT OF LANDFILL CAP
	PROPERTY BOUNDARY
	STONE WALL
	MAJOR ELEVATION CONTOUR (10' INTERVALS)
	MINOR ELEVATION CONTOUR (2' INTERVALS)
	EXISTING CHAIN LINK FENCE
	TREE LINE
G G G G	EXISTING UNDERGROUND GAS LINE
EOP	EDGE OF PAVEMENT
INV	INVERT ELEVATION
CMP	CORRUGATED METAL PIPE
	PROPOSED INFORMATIONAL KIOSK LOCATION

NOTES

THE PURPOSE OF THIS PLAN IS TO DEPICT THE LOCATIONS OF EXISTING ENVIRONMENTAL SAMPLING POINTS PRESENT AT THE SITE. NO ADDITIONAL MONITORING LOCATIONS ARE PROPOSED FOR THIS PROJECT.

ENVIRONMENTAL MONITORING LEGEND

MW-2	MONITORING WELL LOCATION
SW-2	SURFACE WATER MONITORING LOCATION
G-2	GAS PROBE LOCATION

0 50 100
1"=50'

FOR PERMITTING ONLY

Kennedy/Jenks Consultants
TEWKSBURY, MA

USE OF DOCUMENTS:
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NO.	REVISION	DATE	BY
1	ISSUED FOR PERMITTING	23 JUN 2016	BRK

SCALES
0 1"
0 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

COMMONWEALTH OF MASSACHUSETTS MICHAEL J. CLARK REGISTERED PROFESSIONAL ENGINEER

DESIGNED J. SMITH
DRAWN B. KIELY
CHECKED M. CLARK

ENVIRONMENTAL MONITORING PLAN

BWC BUCKMASTER POND, LLC
BOSTON, MA
DOVER LANDFILL SOLAR DEVELOPMENT PROJECT

FILE NAME 1642010_ENV
JOB NO. 1642009*00
DATE 20 JULY 2016
SHEET C8 OF 8

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Stormwater Model

APPENDIX A
Soil Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Norfolk and Suffolk Counties, Massachusetts

May 19, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

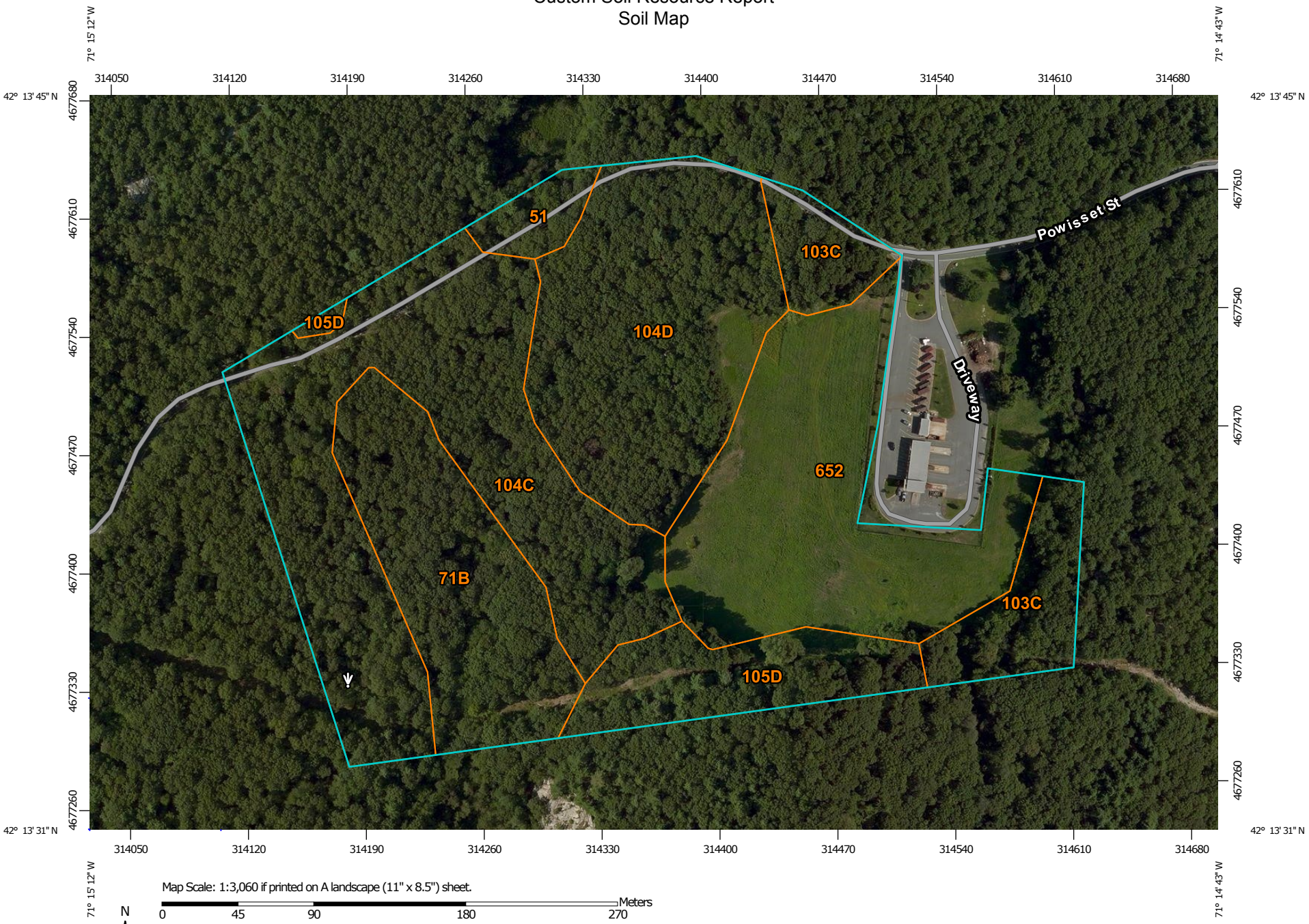
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 11, Sep 28, 2015

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

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

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

Map Unit Legend

Norfolk and Suffolk Counties, Massachusetts (MA616)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
51	Swansea muck, 0 to 1 percent slopes	0.6	2.0%
71B	Ridgebury fine sandy loam, 2 to 8 percent slopes, extremely stony	4.2	13.8%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	2.4	8.0%
104C	Hollis-Rock outcrop-Charlton complex, 3 to 15 percent slopes	8.4	27.9%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 35 percent slopes	6.1	20.1%
105D	Rock outcrop-Hollis complex, 3 to 25 percent slopes	2.3	7.5%
652	Udorthents, refuse substratum	6.3	20.7%
Totals for Area of Interest		**30.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified

by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Norfolk and Suffolk Counties, Massachusetts

51—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Swansea and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Swansea

Setting

Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave

Across-slope shape: Concave

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave

71B—Ridgebury fine sandy loam, 2 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: vkxm
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ridgebury

Setting

Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from granite and gneiss

Typical profile

H1 - 0 to 10 inches: fine sandy loam
H2 - 10 to 19 inches: sandy loam
H3 - 19 to 60 inches: sandy loam

Properties and qualities

Slope: 2 to 8 percent
Percent of area covered with surface fragments: 1.6 percent

Depth to restrictive feature: 14 to 19 inches to densic material
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: Occasional
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D

Minor Components

Whitman

Percent of map unit: 5 percent
Landform: Depressions

Woodbridge

Percent of map unit: 5 percent

Scituate

Percent of map unit: 5 percent

103C—Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: vktg
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton and similar soils: 47 percent
Hollis and similar soils: 18 percent
Rock outcrop: 10 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex

Parent material: Friable coarse-loamy ablation till derived from granite

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 36 inches: fine sandy loam
H3 - 36 to 60 inches: fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A

Description of Hollis

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Shallow, friable loamy ablation till derived from igneous rock

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 14 inches: gravelly fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D

Description of Rock Outcrop

Setting
Parent material: Igneous and metamorphic rock

Properties and qualities
Slope: 3 to 8 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Minor Components

Canton
Percent of map unit: 10 percent

Chatfield
Percent of map unit: 6 percent

Scituate
Percent of map unit: 5 percent

Whitman
Percent of map unit: 2 percent
Landform: Depressions

Montauk
Percent of map unit: 2 percent

104C—Hollis-Rock outcrop-Charlton complex, 3 to 15 percent slopes

Map Unit Setting
National map unit symbol: vkvf
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Hollis and similar soils: 40 percent
Rock outcrop: 25 percent
Charlton and similar soils: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hollis

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Shallow, friable loamy ablation till derived from igneous and metamorphic rock

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 14 inches: gravelly fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Description of Charlton

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy ablation till derived from granite

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 36 inches: fine sandy loam
H3 - 36 to 60 inches: fine sandy loam

Properties and qualities

Slope: 3 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A

Minor Components

Chatfield

Percent of map unit: 5 percent

Canton

Percent of map unit: 5 percent

104D—Hollis-Rock outcrop-Charlton complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: vkvh
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hollis and similar soils: 35 percent
Rock outcrop: 30 percent
Charlton and similar soils: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hollis

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Shallow, friable loamy ablation till derived from igneous and metamorphic rock

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 14 inches: gravelly fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Description of Charlton

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable coarse-loamy ablation till derived from granite

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 36 inches: fine sandy loam
H3 - 36 to 60 inches: fine sandy loam

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A

Minor Components

Canton

Percent of map unit: 5 percent

Chatfield

Percent of map unit: 5 percent

105D—Rock outcrop-Hollis complex, 3 to 25 percent slopes

Map Unit Setting

National map unit symbol: vkxr
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Rock outcrop: 65 percent
Hollis and similar soils: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Description of Hollis

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Shallow, friable loamy ablation till

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 14 inches: gravelly fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 25 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D

Minor Components

Chatfield

Percent of map unit: 7 percent

Swansea

Percent of map unit: 2 percent
Landform: Bogs

Whitman

Percent of map unit: 1 percent
Landform: Depressions

652—Udorthents, refuse substratum

Map Unit Setting

National map unit symbol: vkyg
Elevation: 0 to 3,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Riser, tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Excavated and filled loamy land over made land, refuse

Typical profile

H1 - 0 to 6 inches: variable
H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A

Minor Components

Udorthents

Percent of map unit: 5 percent

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group (Dover)

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.

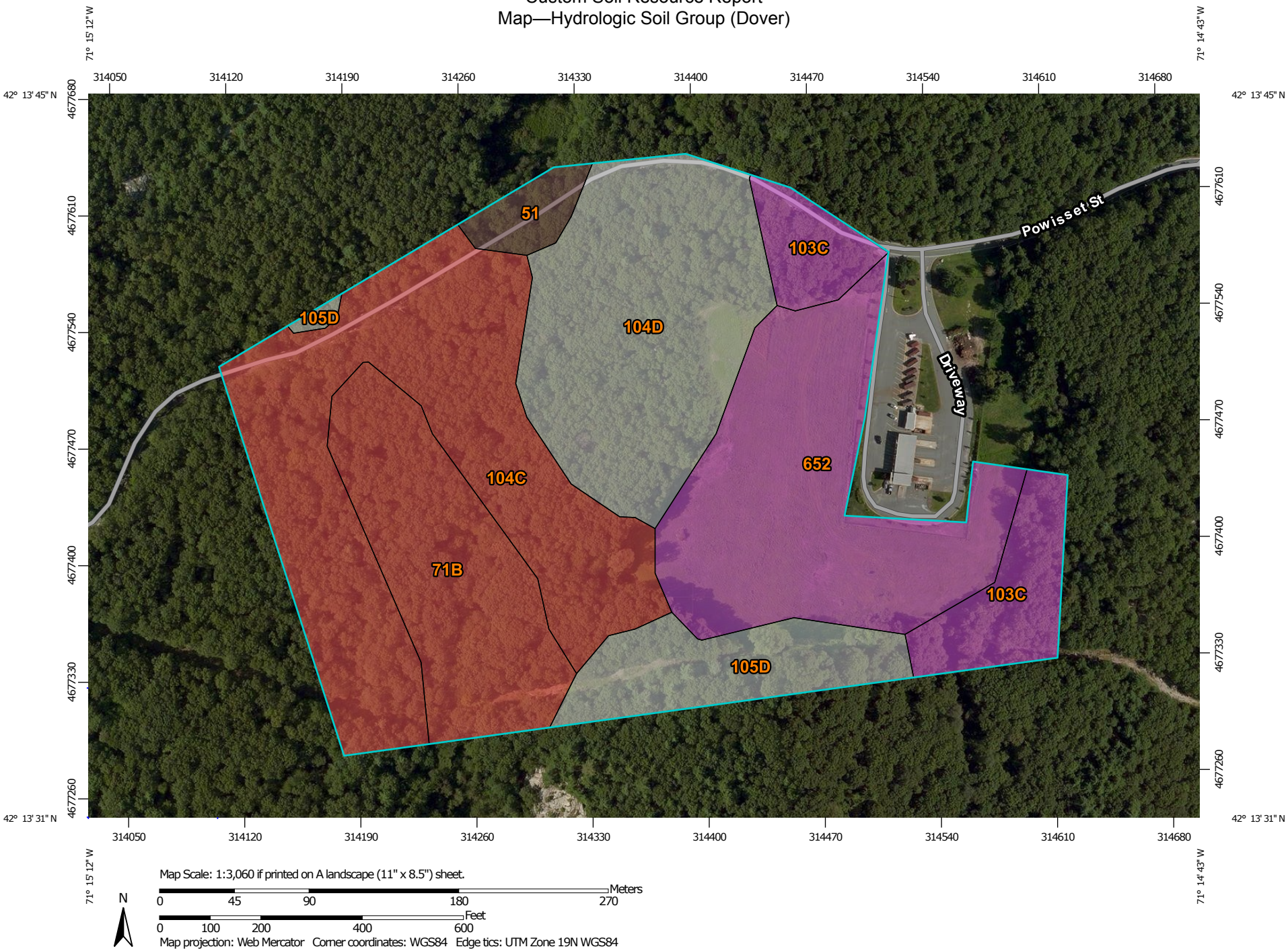
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group (Dover)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 11, Sep 28, 2015

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

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

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

Table—Hydrologic Soil Group (Dover)

Hydrologic Soil Group— Summary by Map Unit — Norfolk and Suffolk Counties, Massachusetts (MA616)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
51	Swansea muck, 0 to 1 percent slopes	B/D	0.6	2.0%
71B	Ridgebury fine sandy loam, 2 to 8 percent slopes, extremely stony	D	4.2	13.8%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	A	2.4	8.0%
104C	Hollis-Rock outcrop-Charlton complex, 3 to 15 percent slopes	D	8.4	27.9%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 35 percent slopes		6.1	20.1%
105D	Rock outcrop-Hollis complex, 3 to 25 percent slopes		2.3	7.5%
652	Udorthents, refuse substratum	A	6.3	20.7%
Totals for Area of Interest			**30.2**	**100.0%**

Rating Options—Hydrologic Soil Group (Dover)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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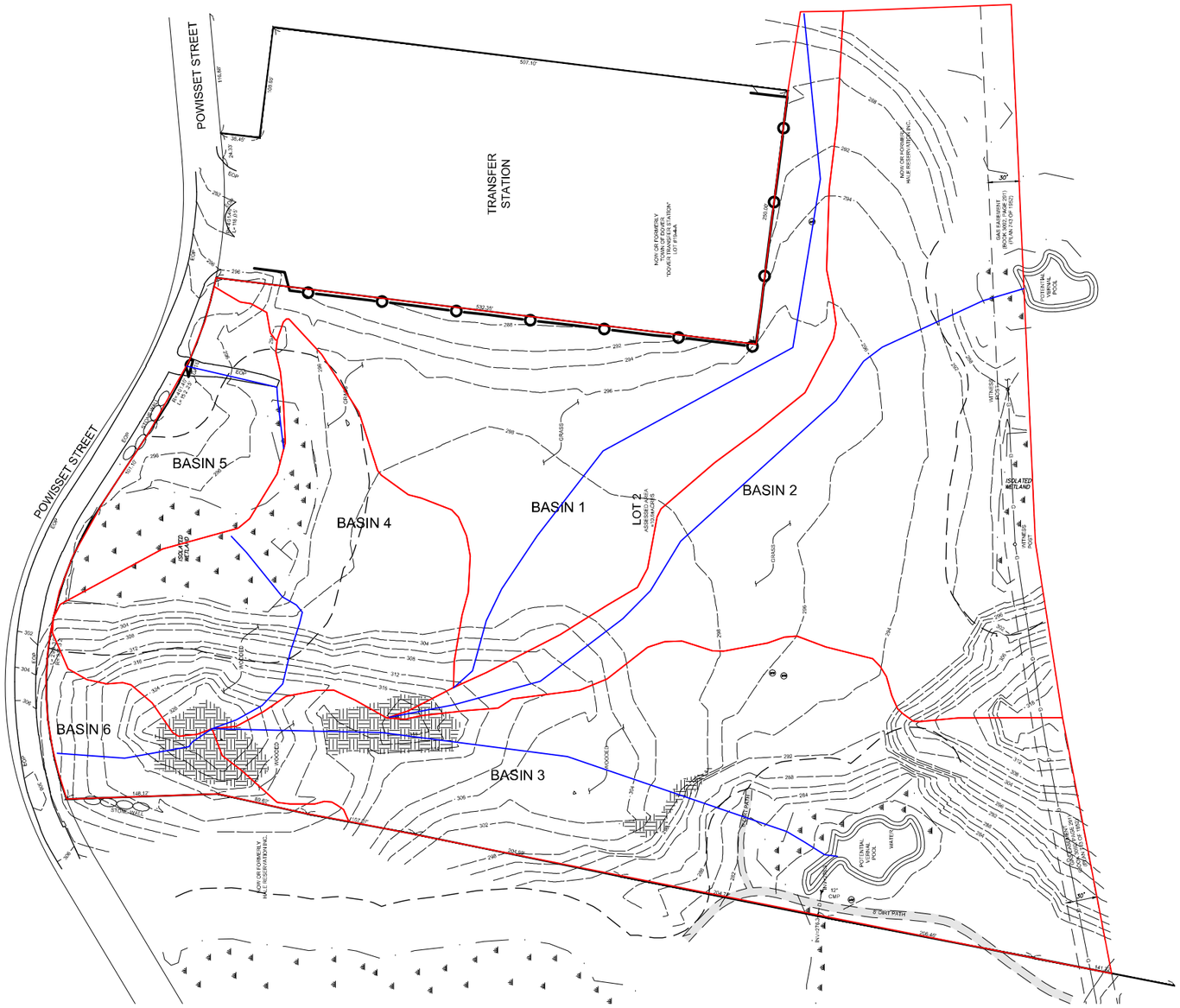
APPENDIX B

Basin Figures and Stormwater Model Output

U:\IS-User\RachelM\Projects\Dover Solar SW\CAD\Dover_SW Basins_PreDev.dwg 8/12/2016 12:22 PM RACHEL MORGAN



NOTE:
1. DRAINAGE BASIN DELINEATION BASED ON SURVEY COMPLETED BY MERIDIAN ASSOCIATES IN MAY 2016.

N

0 60 120
APPROXIMATE SCALE IN FEET

Kennedy/Jenks Consultants

BLUE WAVE CAPITAL
DOVER LANDFILL, MA

PRE-DEVELOPED CONDITION STORMWATER DRAINAGE BASINS

1642009*00
AUGUST 2016

FIGURE 1

Project Description

File Name ..... Dover_PreDev.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	May 19, 2016	00:00:00
End Analysis On	May 20, 2016	00:00:00
Start Reporting On	May 19, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	6
Nodes	6
Junctions	0
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage	Time Series	2YR-24HR	Intensity	inches	Massachusetts	Norfolk	2	3.20	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Basin1	2.14	77.94	3.20	1.27	2.72	2.10	0 00:19:54
2	Basin2	3.22	77.68	3.20	1.25	4.04	2.75	0 00:27:39
3	Basin3	2.89	77.38	3.20	1.24	3.57	3.25	0 00:11:42
4	Basin4	1.46	77.34	3.20	1.23	1.80	1.69	0 00:10:16
5	Basin5	0.56	78.02	3.20	1.27	0.71	0.75	0 00:05:00
6	Basin6	0.33	77.00	3.20	1.21	0.39	0.35	0 00:13:24

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	-1.00					0.00	0.00					
2	Out-02	Outfall	-1.00					0.00	0.00					
3	Out-03	Outfall	-1.00					0.00	0.00					
4	Out-04	Outfall	-1.00					0.00	0.00					
5	Out-05	Outfall	-1.00					0.00	0.00					
6	Out-06	Outfall	-1.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Basin1

Input Data

Area (ac) 2.14
Weighted Curve Number 77.94
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.13	D	77.00
Meadow, non-grazed	2.01	D	78.00
Composite Area & Weighted CN	2.14		77.94

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	132	300	0.00
Slope (%) :	10.6	4.5	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.16	0.23	0.00
Computed Flow Time (min) :	13.76	21.47	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	408	0.00
Slope (%) :	0.00	4.5	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	1.48	0.00
Computed Flow Time (min) :	0.00	4.59	0.00

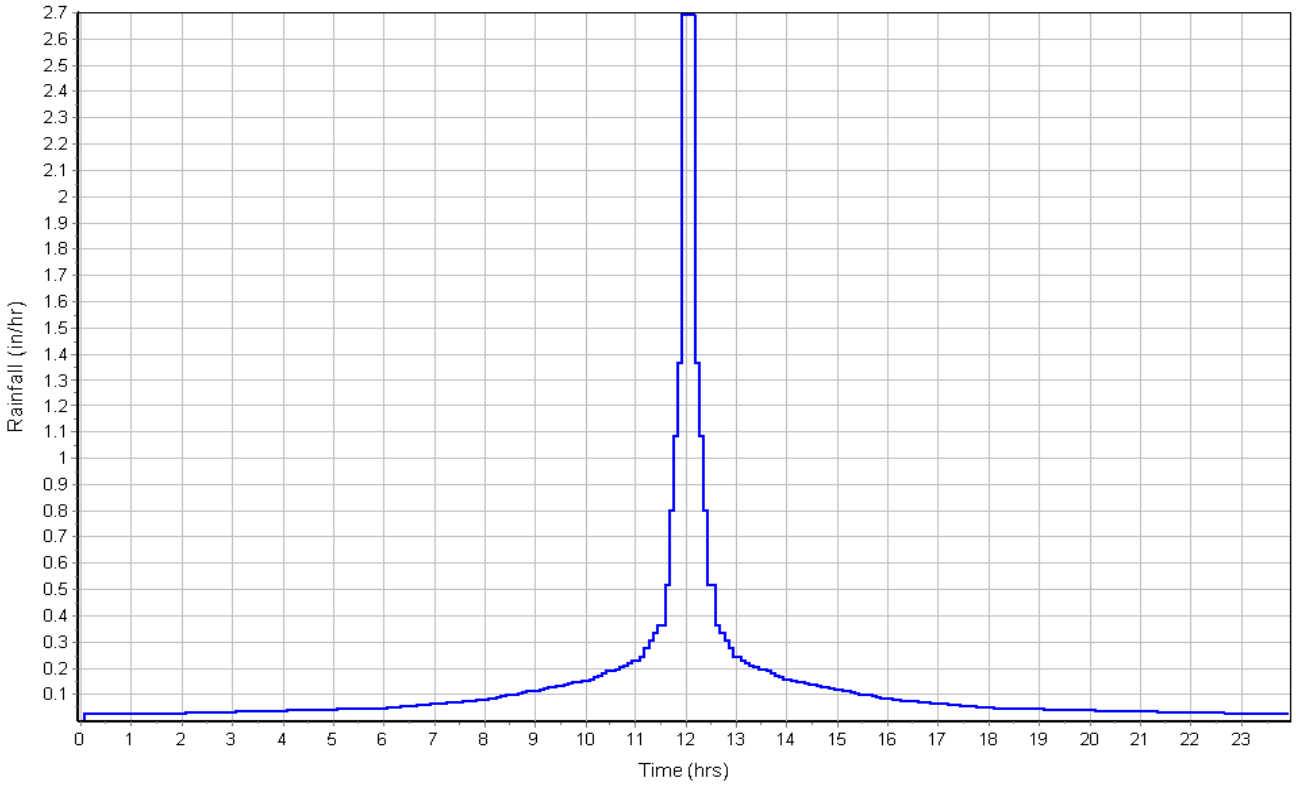
Total TOC (min) 19.91

Subbasin Runoff Results

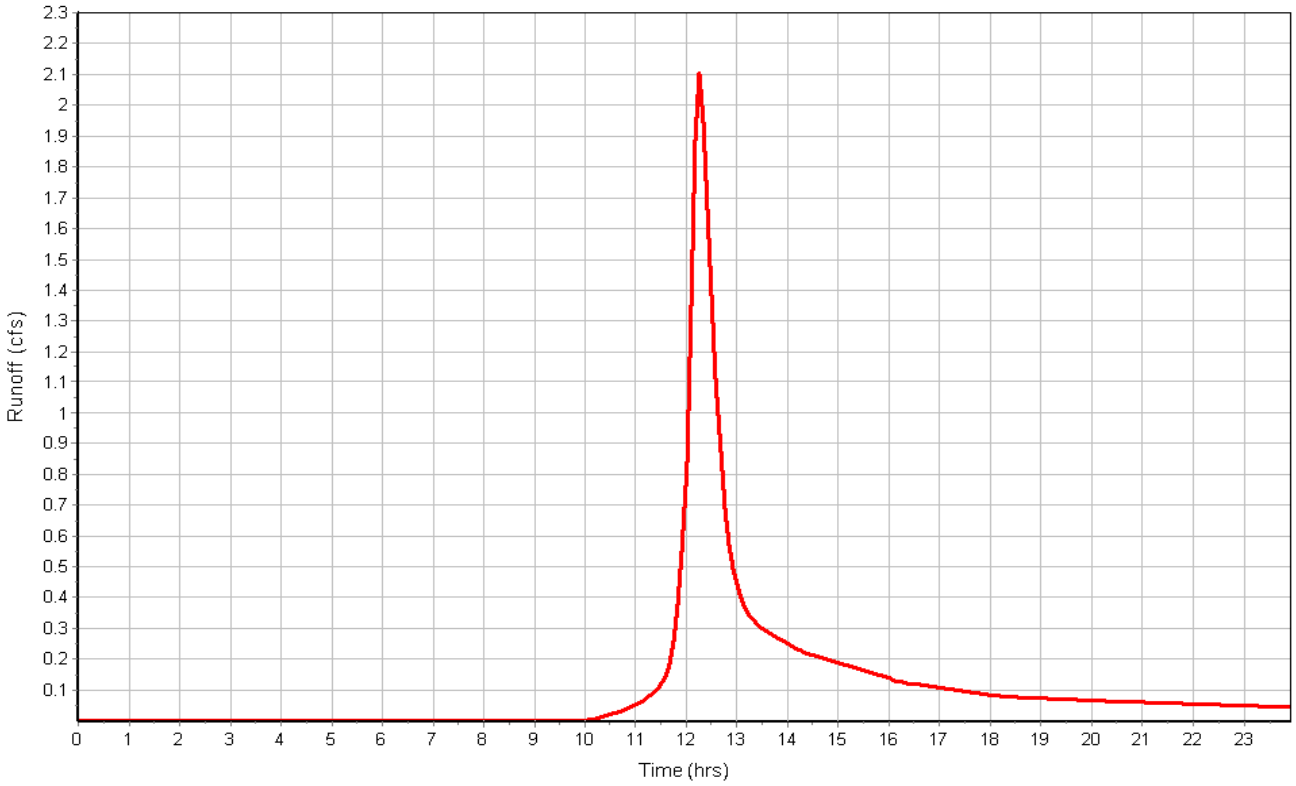
Total Rainfall (in)	3.20
Total Runoff (in)	1.27
Peak Runoff (cfs)	2.10
Weighted Curve Number	77.94
Time of Concentration (days hh:mm:ss)	0 00:19:55

Subbasin : Basin1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin2

Input Data

Area (ac) 3.22
Weighted Curve Number 77.68
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	1.03	D	77.00
Meadow, non-grazed	2.19	D	78.00
Composite Area & Weighted CN	3.22		77.68

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	252	300	0.00
Slope (%) :	6.3	3.4	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.15	0.21	0.00
Computed Flow Time (min) :	28.43	24.02	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	222	0.00
Slope (%) :	0.00	3.4	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	1.29	0.00
Computed Flow Time (min) :	0.00	2.87	0.00

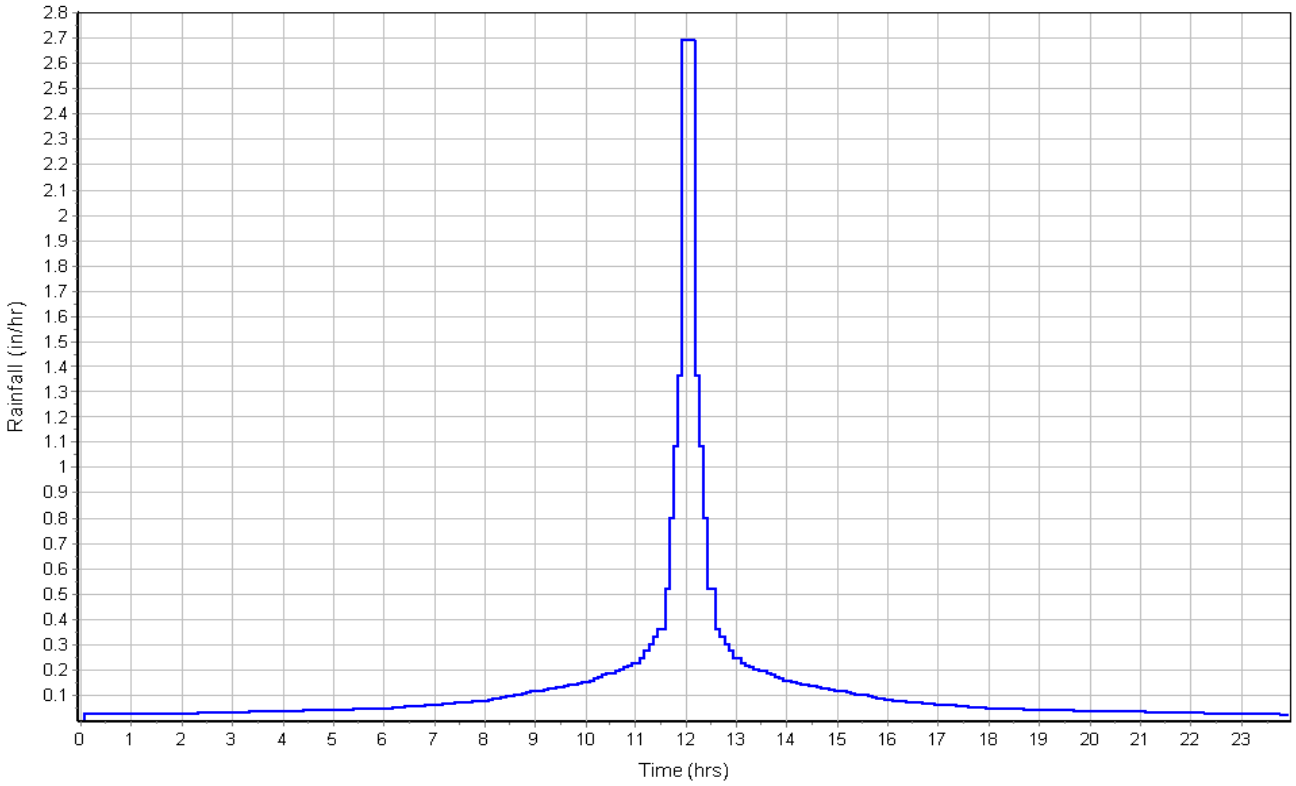
Total TOC (min) 27.66

Subbasin Runoff Results

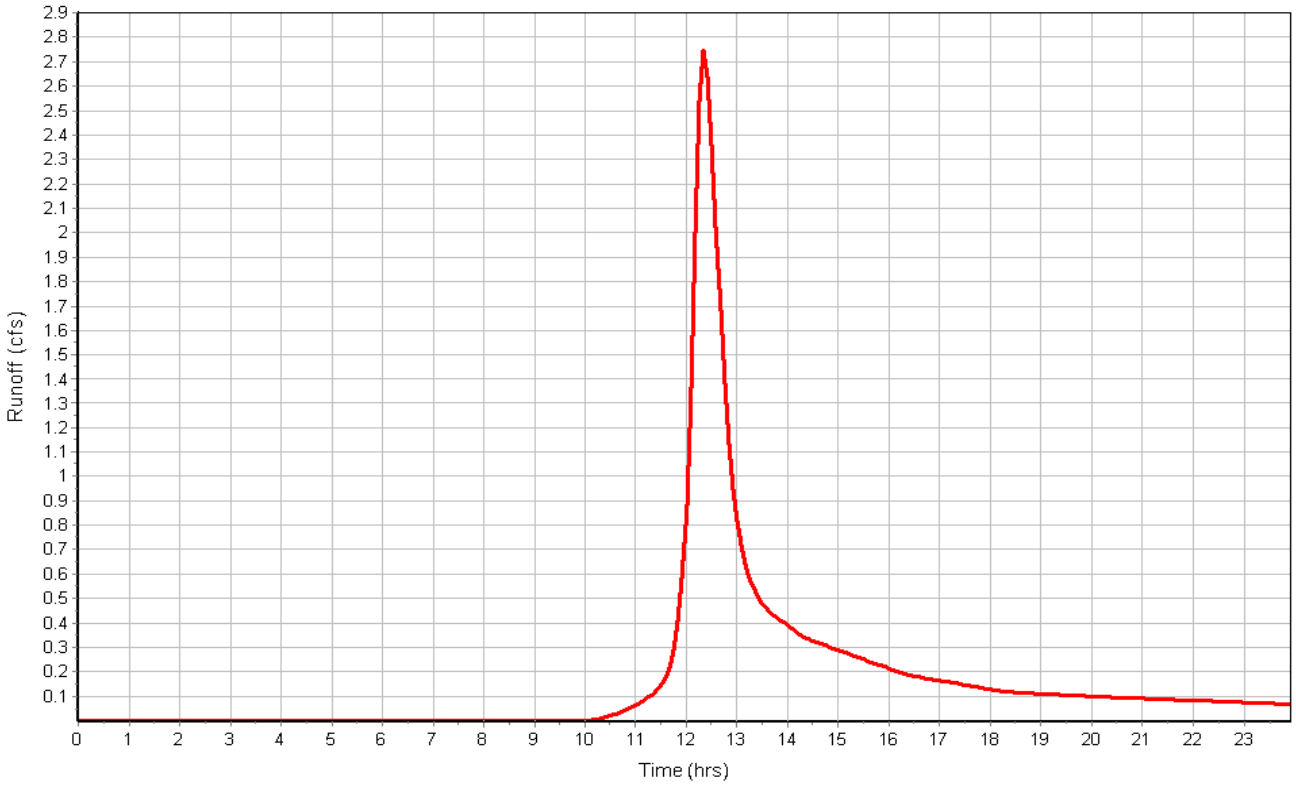
Total Rainfall (in) 3.20
Total Runoff (in) 1.25
Peak Runoff (cfs) 2.75
Weighted Curve Number 77.68
Time of Concentration (days hh:mm:ss) 0 00:27:40

Subbasin : Basin2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin3

Input Data

Area (ac) 2.89
Weighted Curve Number 77.38
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	2.43	D	77.00
Meadow, non-grazed	0.40	D	78.00
Dirt roads	0.06	D	89.00
Composite Area & Weighted CN	2.89		77.38

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	.01
Flow Length (ft) :	300	48	93
Slope (%) :	9.2	12.5	5.4
2 yr, 24 hr Rainfall (in) :	3.20	3.20	3.20
Velocity (ft/sec) :	0.18	0.24	2.18
Computed Flow Time (min) :	28.09	3.29	0.71

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	276	0.00	0.00
Slope (%) :	9.2	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	3.03	0.00	0.00

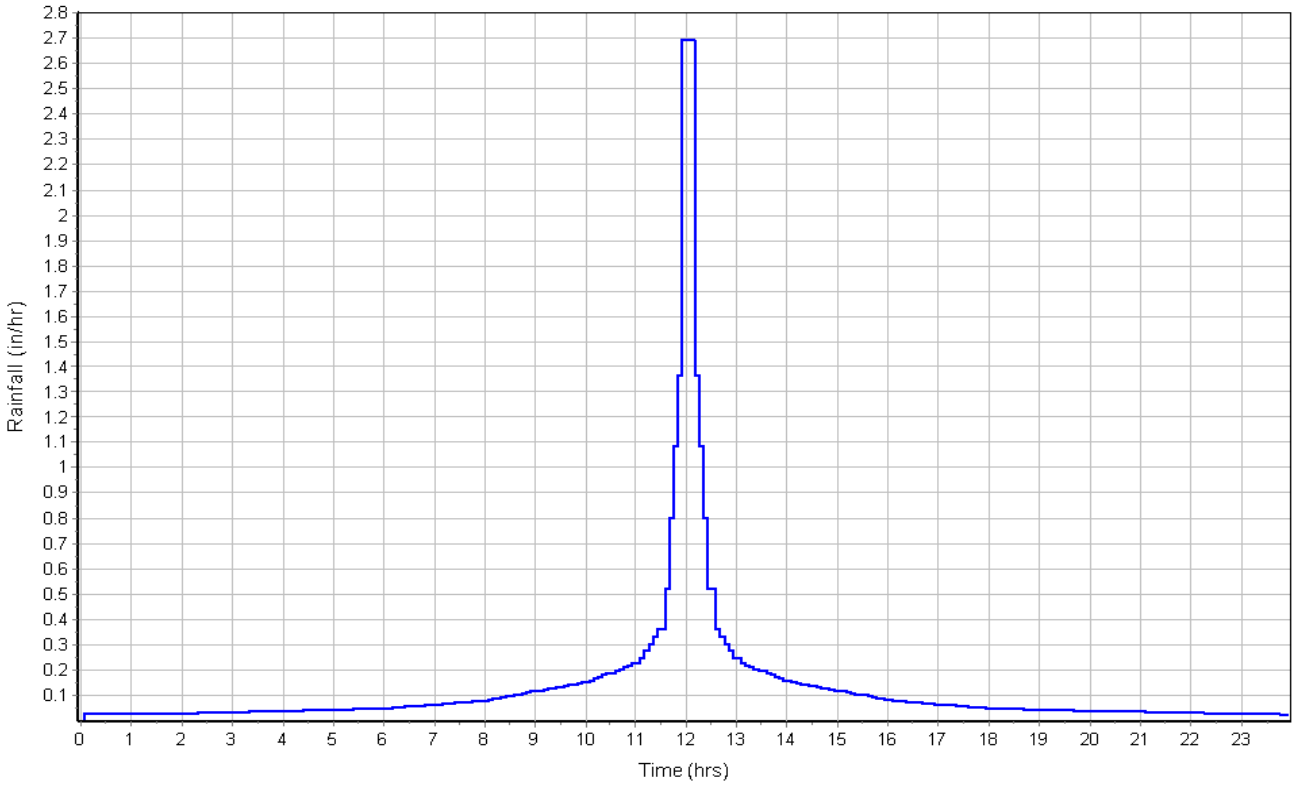
Total TOC (min) 11.71

Subbasin Runoff Results

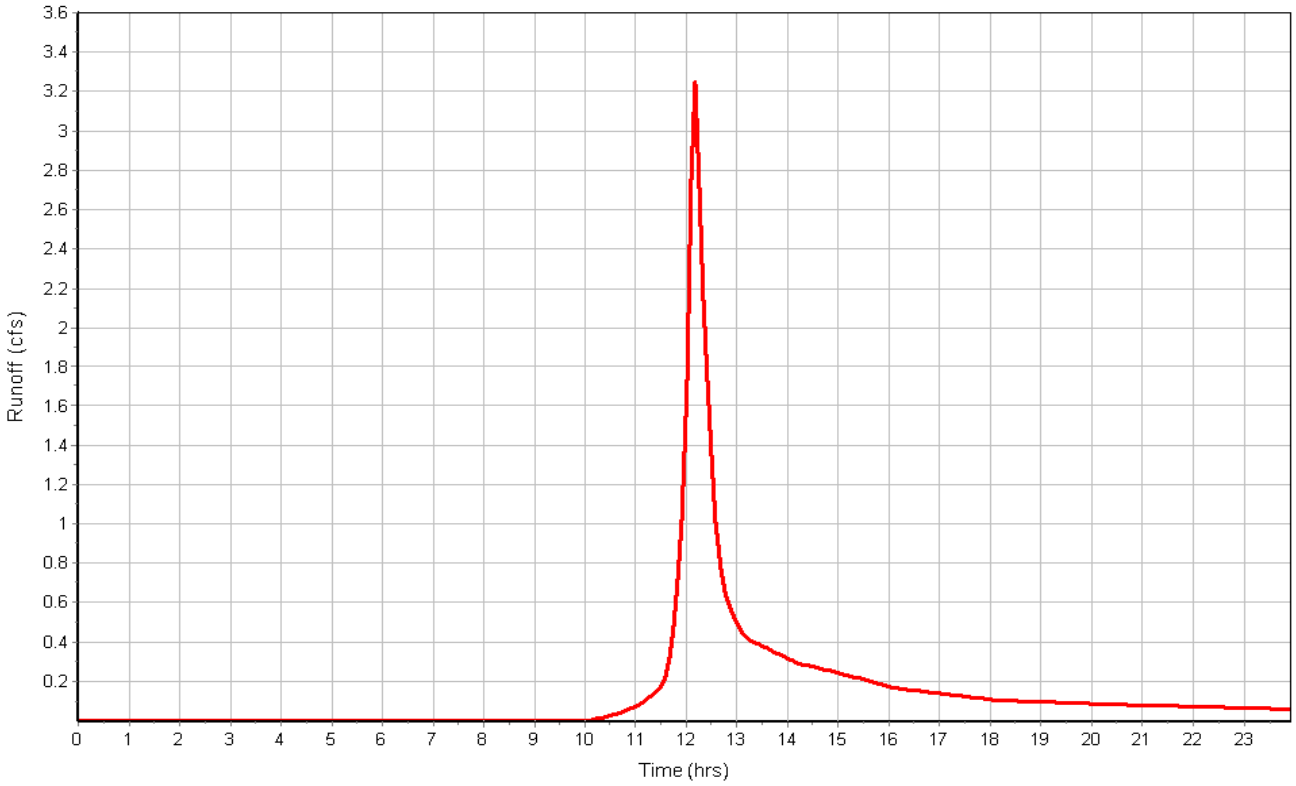
Total Rainfall (in) 3.20
Total Runoff (in) 1.24
Peak Runoff (cfs) 3.25
Weighted Curve Number 77.38
Time of Concentration (days hh:mm:ss) 0 00:11:43

Subbasin : Basin3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin4

Input Data

Area (ac) 1.46
Weighted Curve Number 77.34
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.96	D	77.00
Meadow, non-grazed	0.50	D	78.00
Composite Area & Weighted CN	1.46		77.34

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	144	114	0.00
Slope (%) :	20.8	5.3	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.21	0.20	0.00
Computed Flow Time (min) :	11.27	9.27	0.00

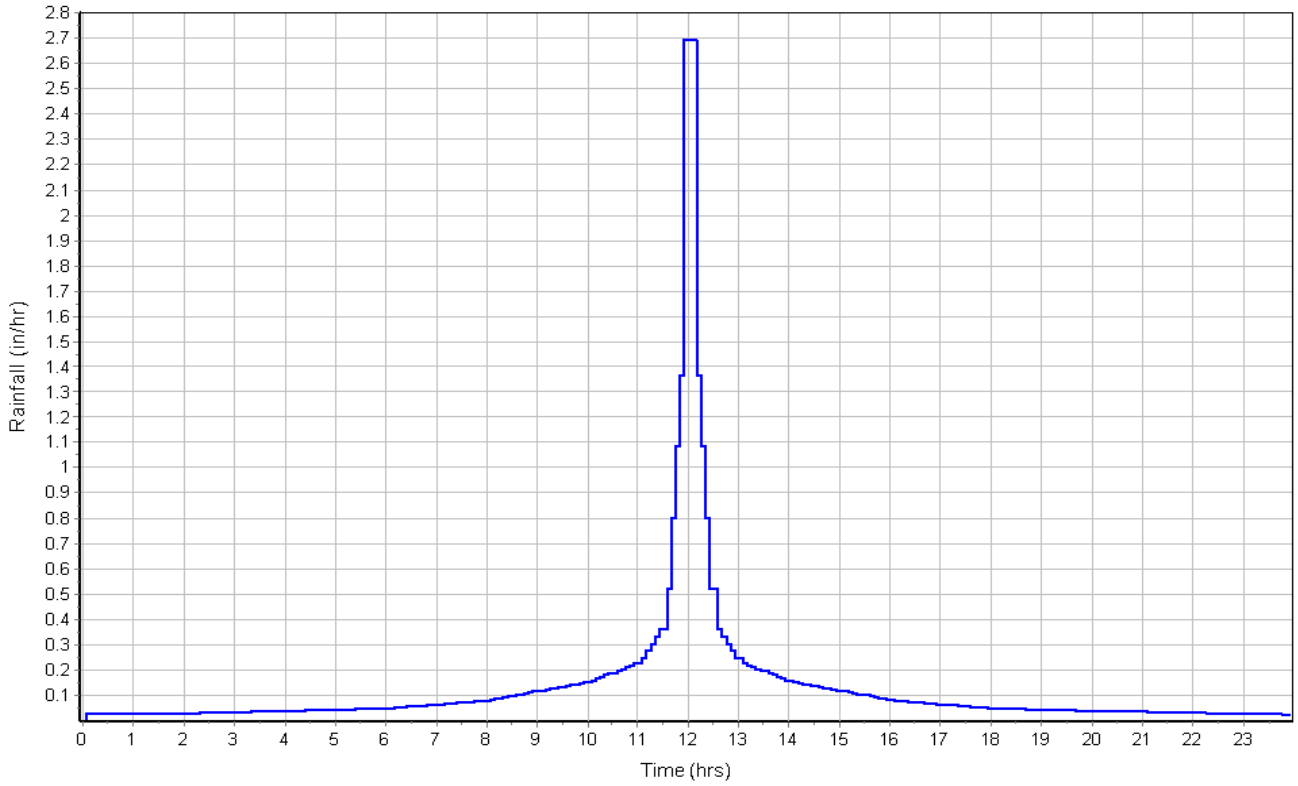
Total TOC (min) 10.27

Subbasin Runoff Results

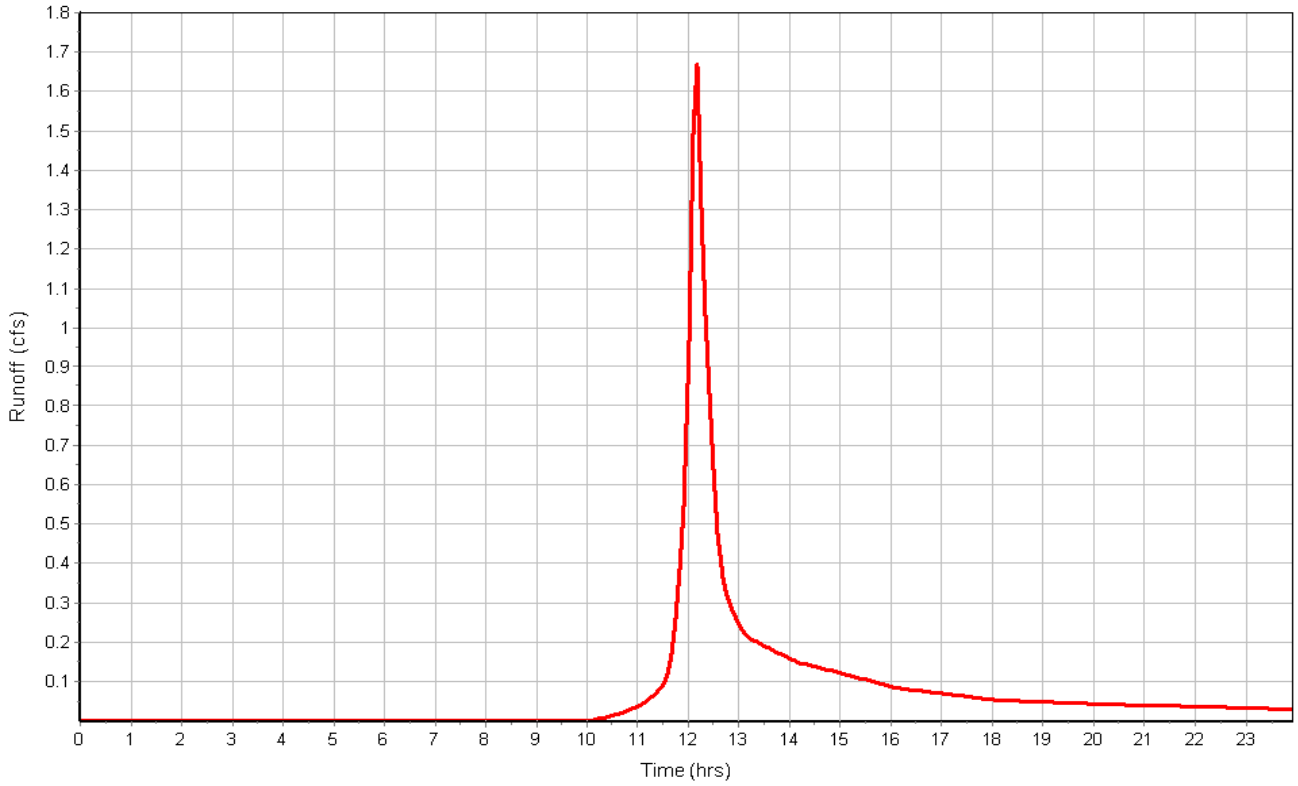
Total Rainfall (in) 3.20
Total Runoff (in) 1.23
Peak Runoff (cfs) 1.69
Weighted Curve Number 77.34
Time of Concentration (days hh:mm:ss) 0 00:10:16

Subbasin : Basin4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin5

Input Data

Area (ac) 0.56
Weighted Curve Number 78.02
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.17	D	77.00
Meadow, non-grazed	0.37	D	78.00
Dirt roads	0.02	D	89.00
Composite Area & Weighted CN	0.56		78.02

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.2	.01	0.00
Flow Length (ft) :	60	90	0.00
Slope (%) :	6.7	2.2	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.20	1.51	0.00
Computed Flow Time (min) :	5.05	0.99	0.00

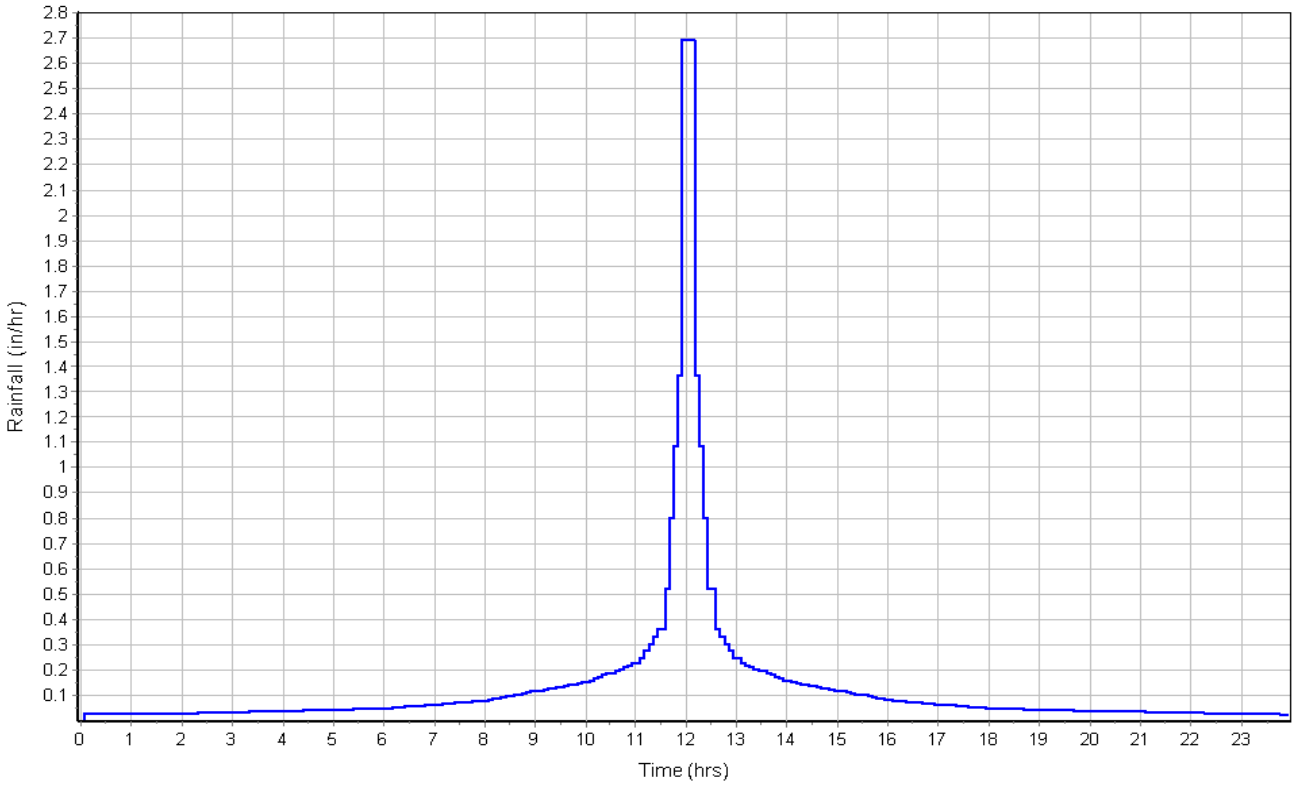
Total TOC (min) 3.02

Subbasin Runoff Results

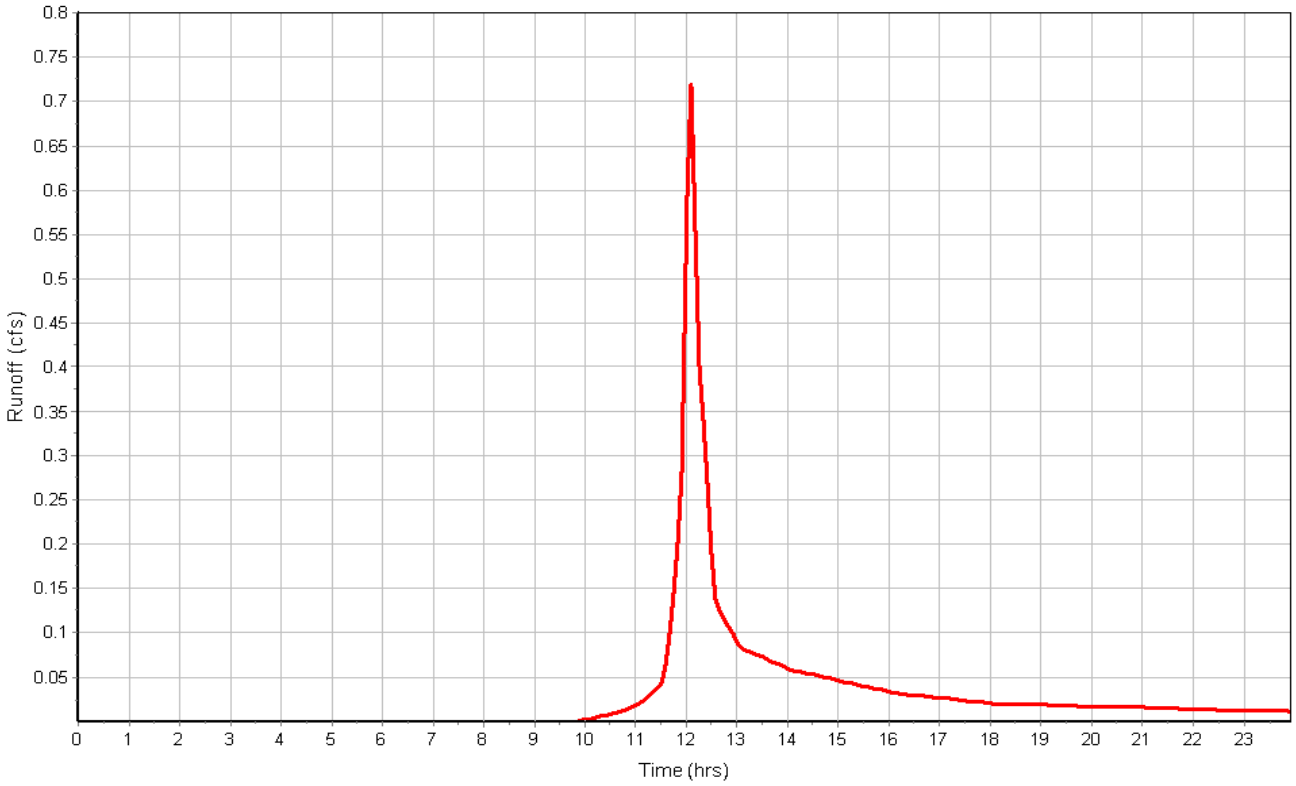
Total Rainfall (in) 3.20
Total Runoff (in) 1.27
Peak Runoff (cfs) 0.75
Weighted Curve Number 78.02
Time of Concentration (days hh:mm:ss) 0 00:03:01

Subbasin : Basin5

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin6

Input Data

Area (ac) 0.33
Weighted Curve Number 77.00
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.33	D	77.00
Composite Area & Weighted CN	0.33		77.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	159	0.00	0.00
Slope (%) :	16.4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.20	0.00	0.00
Velocity (ft/sec) :	0.20	0.00	0.00
Computed Flow Time (min) :	13.41	0.00	0.00

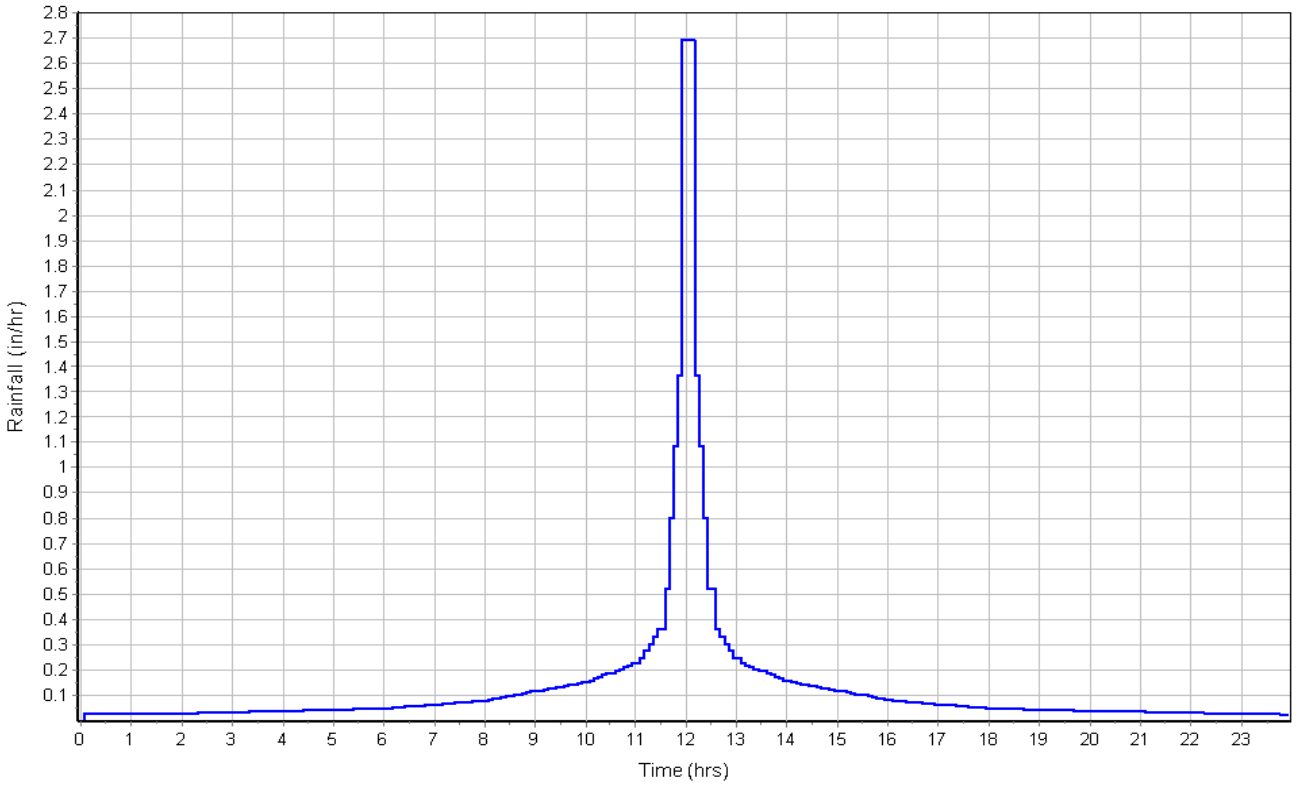
Total TOC (min) 13.41

Subbasin Runoff Results

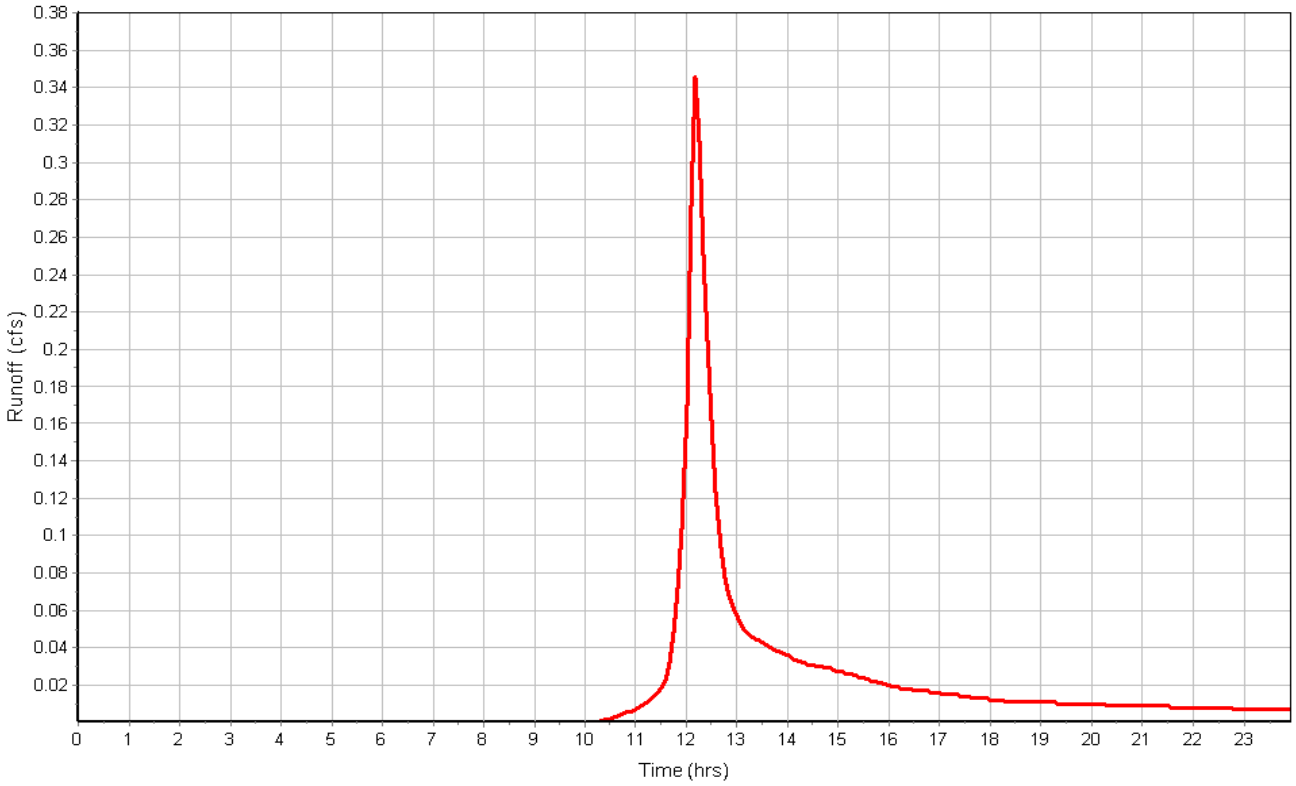
Total Rainfall (in) 3.20
Total Runoff (in) 1.21
Peak Runoff (cfs) 0.35
Weighted Curve Number 77.00
Time of Concentration (days hh:mm:ss) 0 00:13:25

Subbasin : Basin6

Rainfall Intensity Graph



Runoff Hydrograph



Project Description

File Name ..... Dover_PreDev.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	May 19, 2016	00:00:00
End Analysis On	May 20, 2016	00:00:00
Start Reporting On	May 19, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	6
Nodes	6
Junctions	0
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage	Time Series	10YR-24HR	Intensity	inches	Massachusetts	Norfolk	10	4.70	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Basin1	2.14	77.94	4.70	2.45	5.25	4.16	0 00:19:54
2	Basin2	3.22	77.68	4.70	2.43	7.84	5.45	0 00:27:39
3	Basin3	2.89	77.38	4.70	2.41	6.95	6.45	0 00:11:42
4	Basin4	1.46	77.34	4.70	2.40	3.51	3.35	0 00:10:16
5	Basin5	0.56	78.02	4.70	2.46	1.38	1.44	0 00:05:00
6	Basin6	0.33	77.00	4.70	2.37	0.77	0.70	0 00:13:24

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	-1.00					0.00	0.00					
2	Out-02	Outfall	-1.00					0.00	0.00					
3	Out-03	Outfall	-1.00					0.00	0.00					
4	Out-04	Outfall	-1.00					0.00	0.00					
5	Out-05	Outfall	-1.00					0.00	0.00					
6	Out-06	Outfall	-1.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Basin1

Input Data

Area (ac) 2.14
Weighted Curve Number 77.94
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.13	D	77.00
Meadow, non-grazed	2.01	D	78.00
Composite Area & Weighted CN	2.14		77.94

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	132	300	0.00
Slope (%) :	10.6	4.5	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.16	0.23	0.00
Computed Flow Time (min) :	13.76	21.47	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	408	0.00
Slope (%) :	0.00	4.5	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	1.48	0.00
Computed Flow Time (min) :	0.00	4.59	0.00

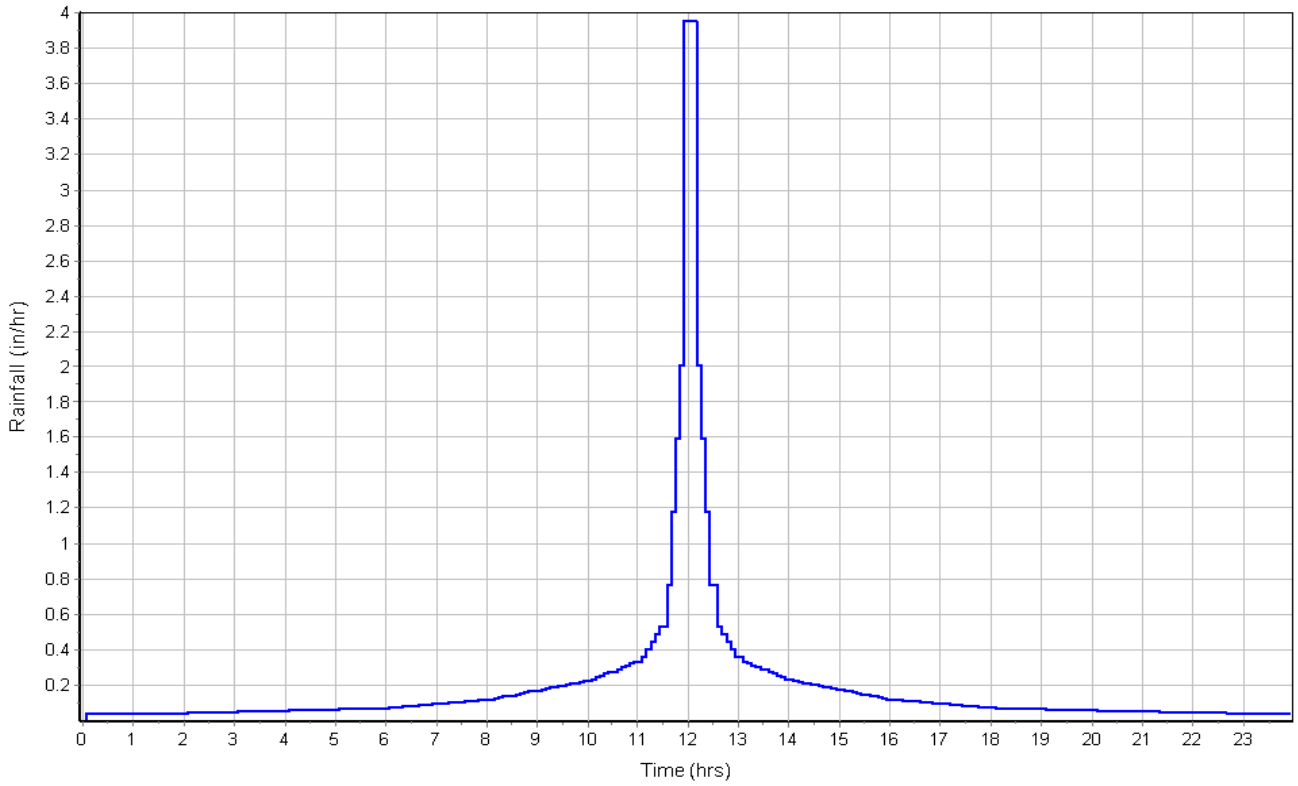
Total TOC (min) 19.91

Subbasin Runoff Results

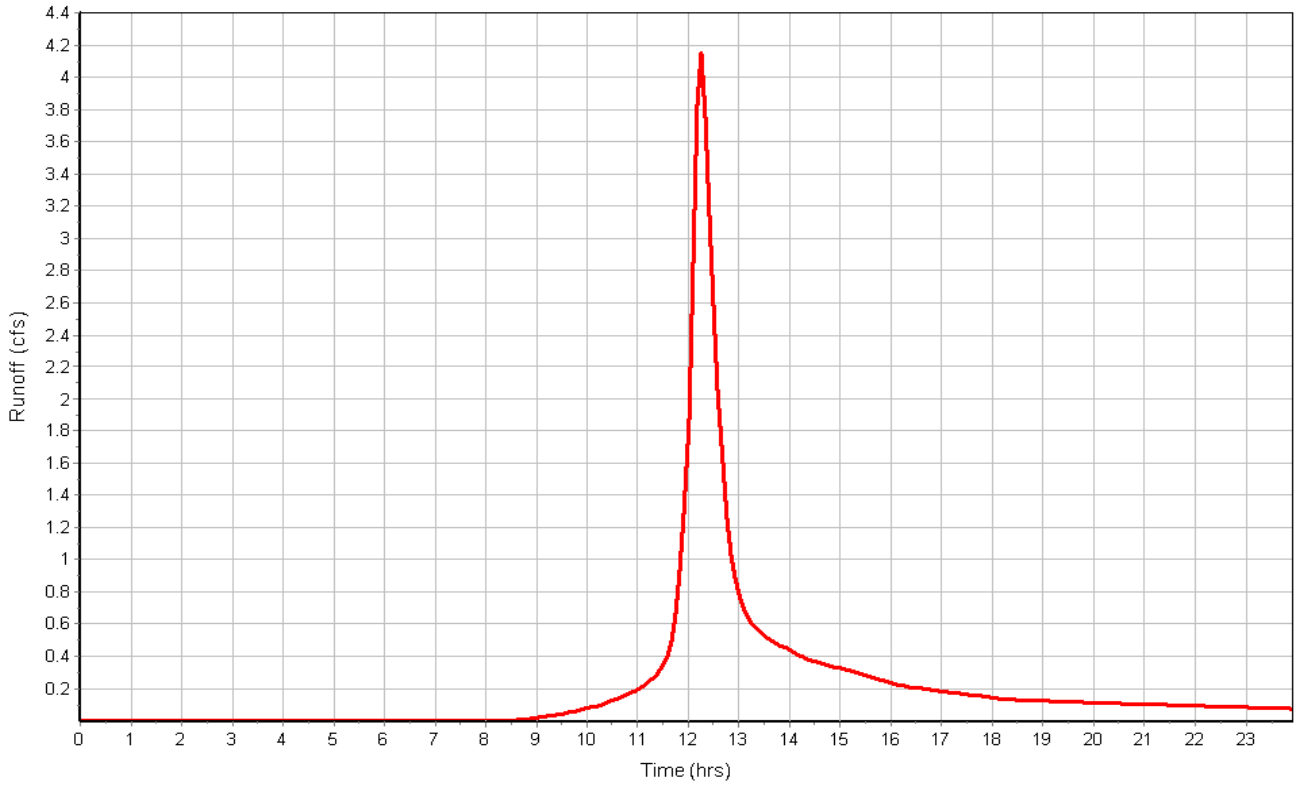
Total Rainfall (in)	4.70
Total Runoff (in)	2.45
Peak Runoff (cfs)	4.16
Weighted Curve Number	77.94
Time of Concentration (days hh:mm:ss)	0 00:19:55

Subbasin : Basin1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin2

Input Data

Area (ac) 3.22
Weighted Curve Number 77.68
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	1.03	D	77.00
Meadow, non-grazed	2.19	D	78.00
Composite Area & Weighted CN	3.22		77.68

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	252	300	0.00
Slope (%) :	6.3	3.4	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.15	0.21	0.00
Computed Flow Time (min) :	28.43	24.02	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	222	0.00
Slope (%) :	0.00	3.4	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	1.29	0.00
Computed Flow Time (min) :	0.00	2.87	0.00

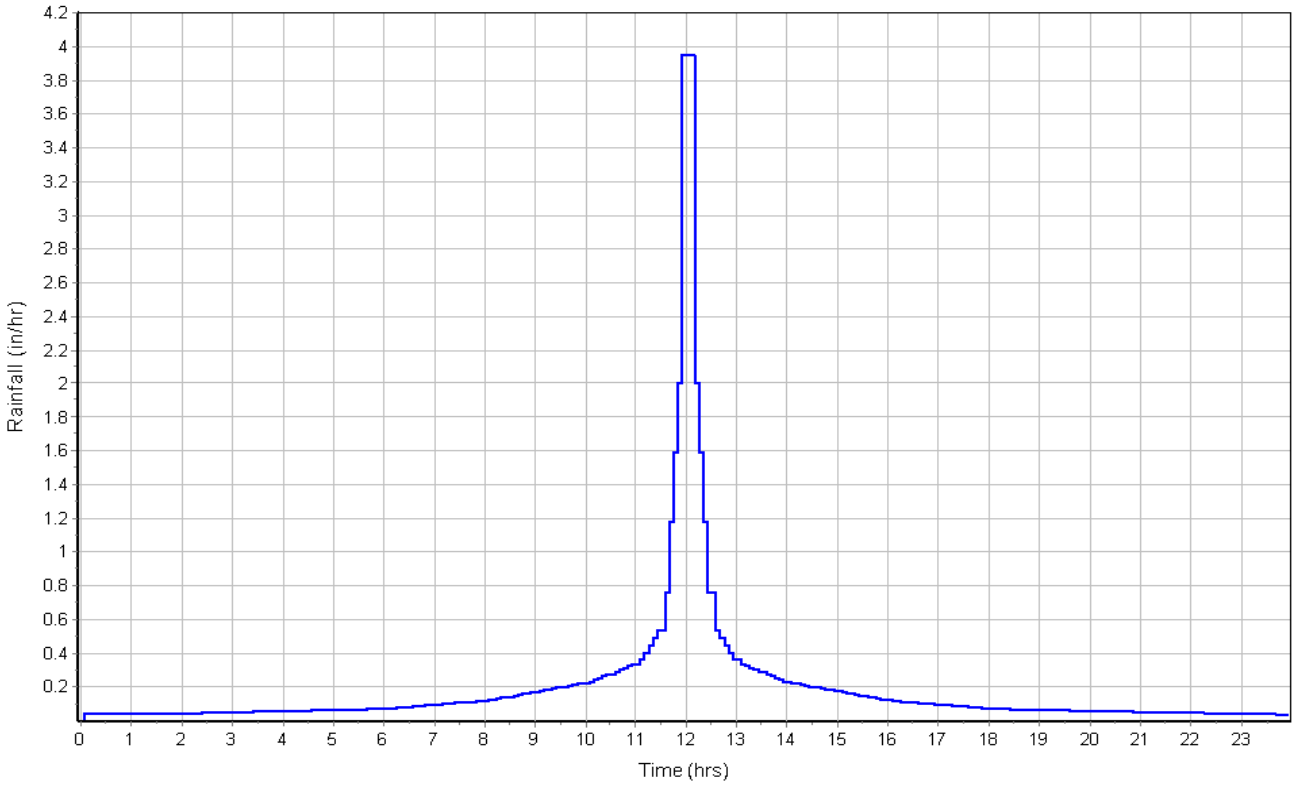
Total TOC (min) 27.66

Subbasin Runoff Results

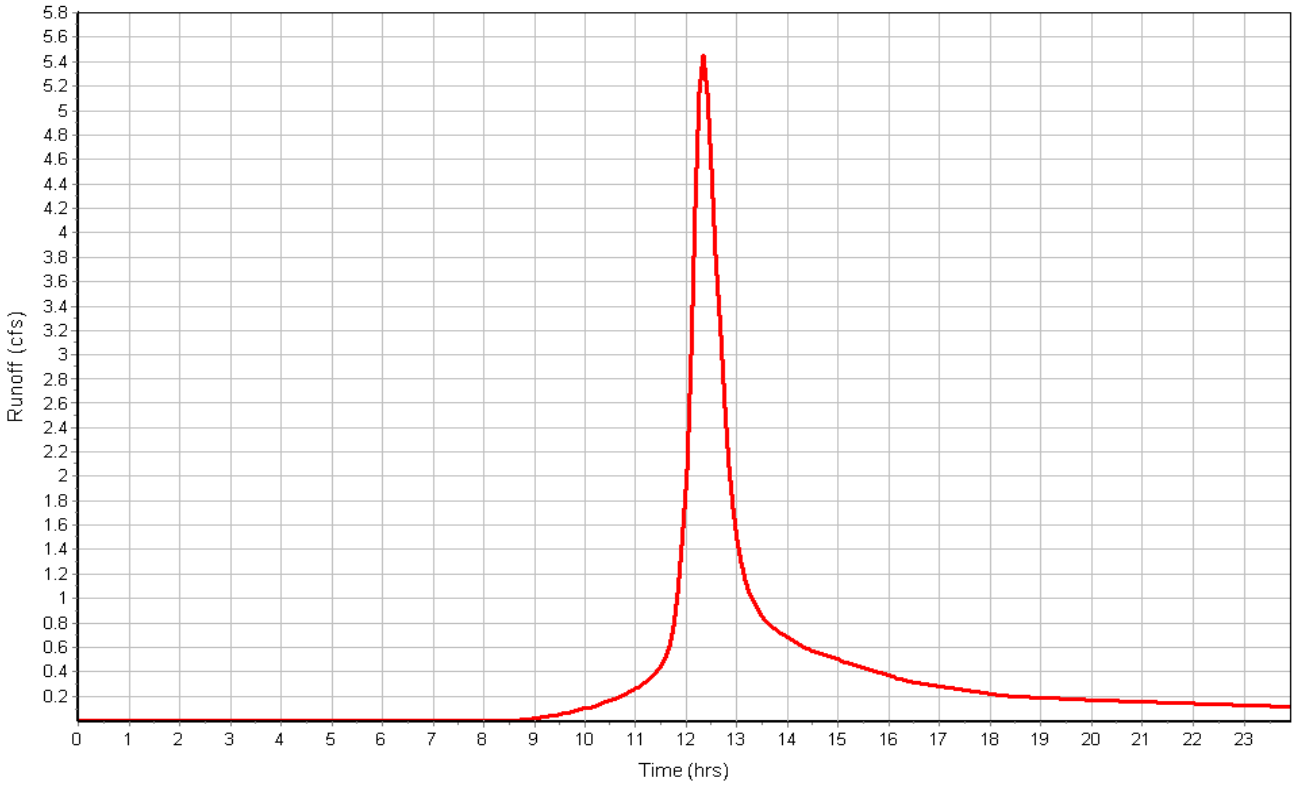
Total Rainfall (in) 4.70
Total Runoff (in) 2.43
Peak Runoff (cfs) 5.45
Weighted Curve Number 77.68
Time of Concentration (days hh:mm:ss) 0 00:27:40

Subbasin : Basin2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin3

Input Data

Area (ac) 2.89
Weighted Curve Number 77.38
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	2.43	D	77.00
Meadow, non-grazed	0.40	D	78.00
Dirt roads	0.06	D	89.00
Composite Area & Weighted CN	2.89		77.38

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	.01
Flow Length (ft) :	300	48	93
Slope (%) :	9.2	12.5	5.4
2 yr, 24 hr Rainfall (in) :	3.20	3.20	3.20
Velocity (ft/sec) :	0.18	0.24	2.18
Computed Flow Time (min) :	28.09	3.29	0.71

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	276	0.00	0.00
Slope (%) :	9.2	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	3.03	0.00	0.00

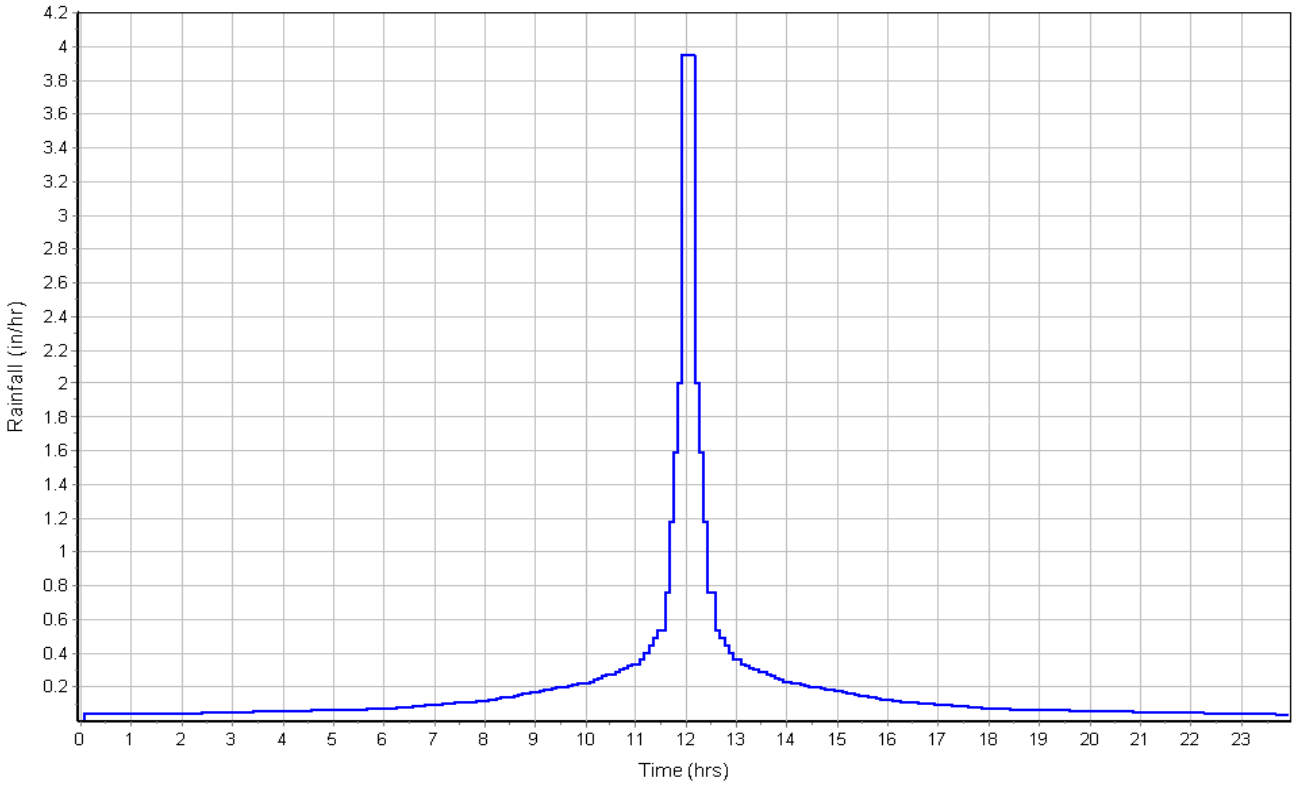
Total TOC (min) 11.71

Subbasin Runoff Results

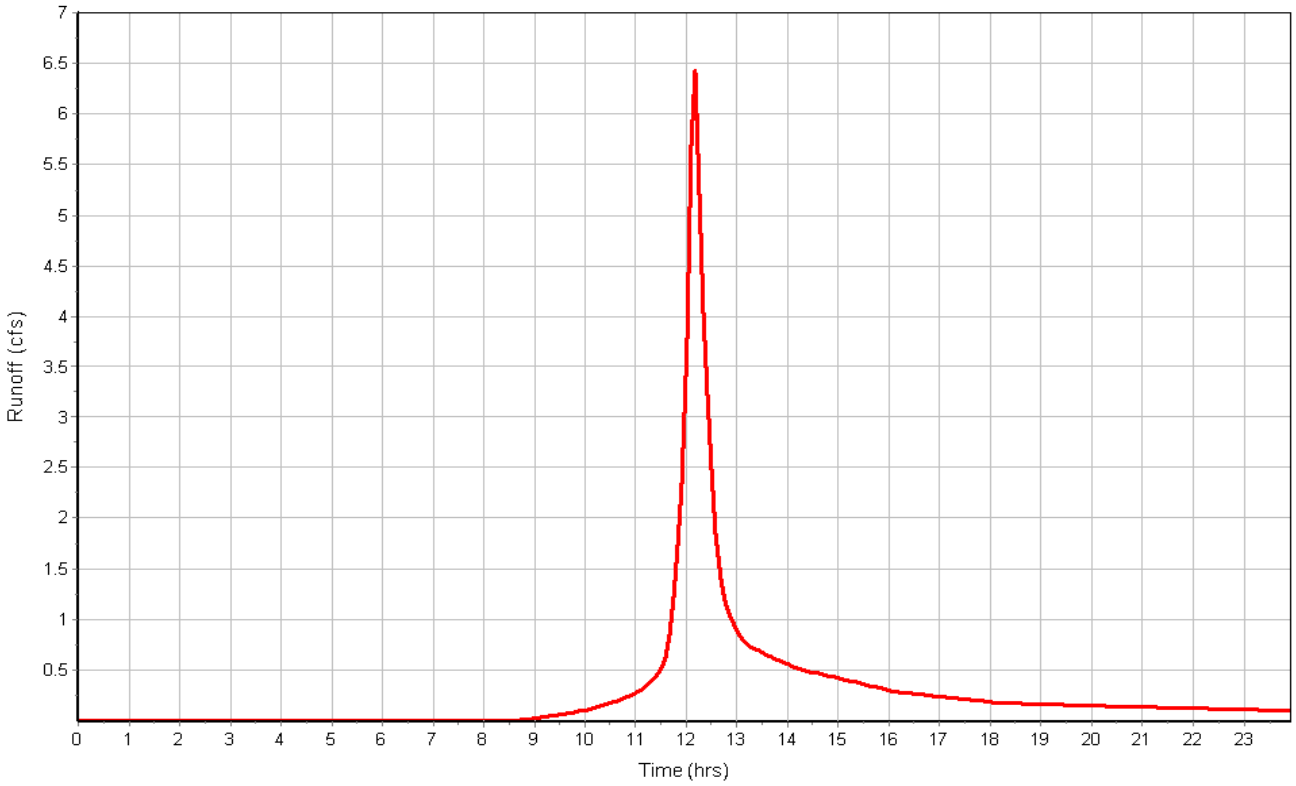
Total Rainfall (in) 4.70
Total Runoff (in) 2.41
Peak Runoff (cfs) 6.45
Weighted Curve Number 77.38
Time of Concentration (days hh:mm:ss) 0 00:11:43

Subbasin : Basin3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin4

Input Data

Area (ac) 1.46
Weighted Curve Number 77.34
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.96	D	77.00
Meadow, non-grazed	0.50	D	78.00
Composite Area & Weighted CN	1.46		77.34

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	144	114	0.00
Slope (%) :	20.8	5.3	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.21	0.20	0.00
Computed Flow Time (min) :	11.27	9.27	0.00

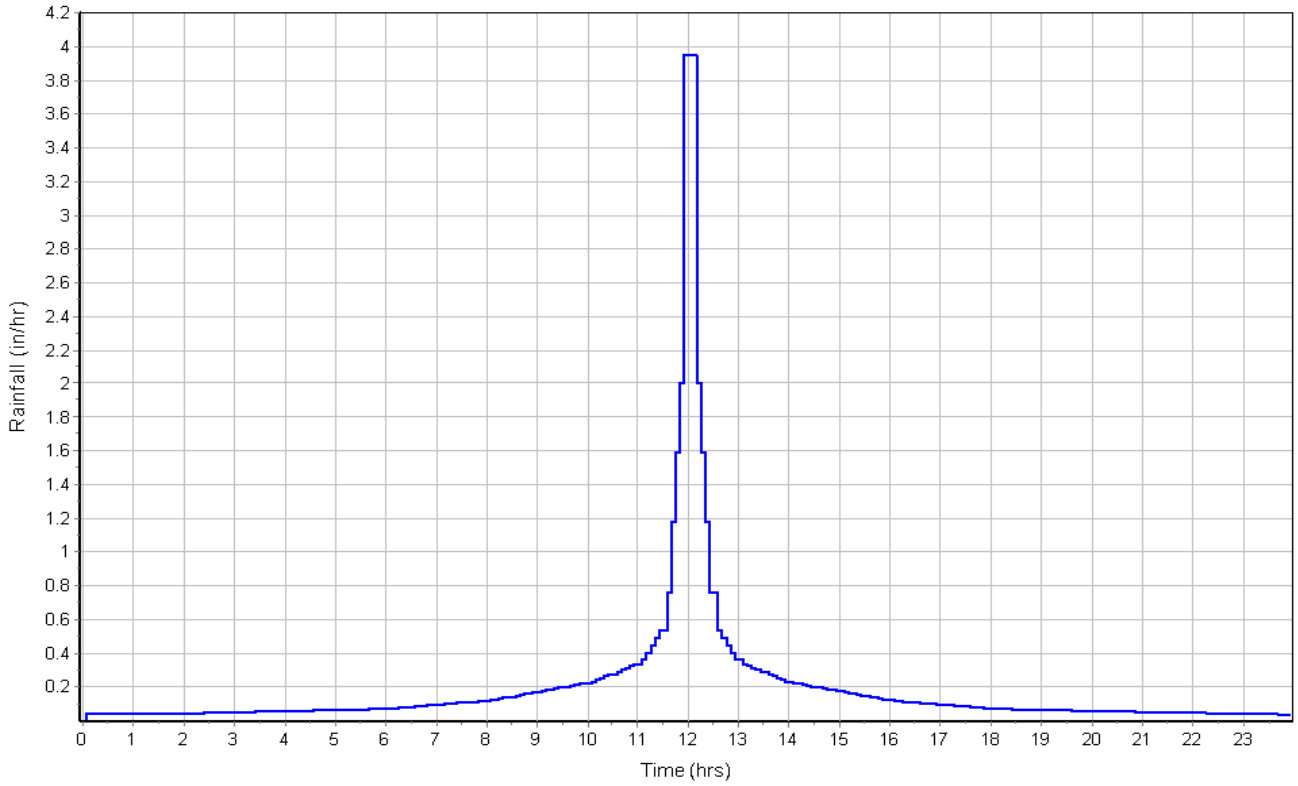
Total TOC (min) 10.27

Subbasin Runoff Results

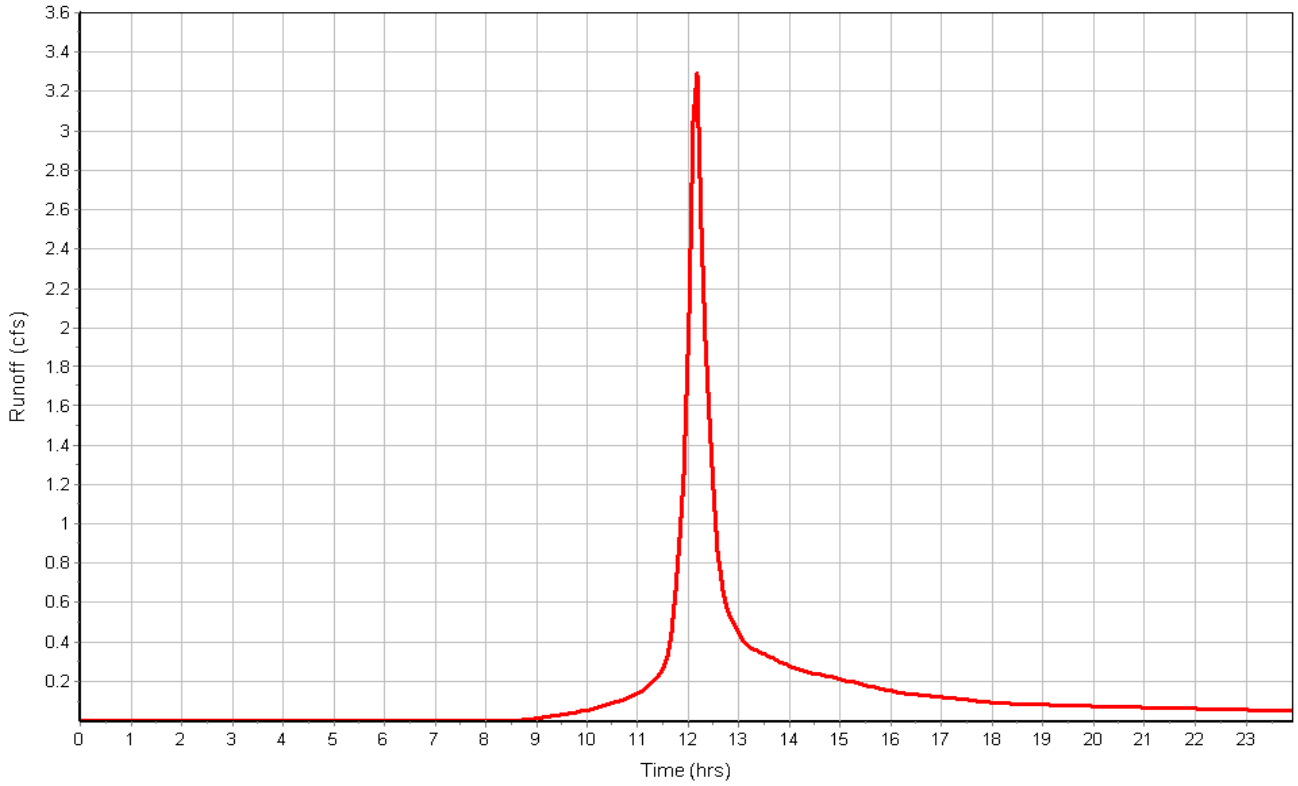
Total Rainfall (in) 4.70
Total Runoff (in) 2.40
Peak Runoff (cfs) 3.35
Weighted Curve Number 77.34
Time of Concentration (days hh:mm:ss) 0 00:10:16

Subbasin : Basin4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin5

Input Data

Area (ac) 0.56
Weighted Curve Number 78.02
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.17	D	77.00
Meadow, non-grazed	0.37	D	78.00
Dirt roads	0.02	D	89.00
Composite Area & Weighted CN	0.56		78.02

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.2	.01	0.00
Flow Length (ft) :	60	90	0.00
Slope (%) :	6.7	2.2	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.20	1.51	0.00
Computed Flow Time (min) :	5.05	0.99	0.00

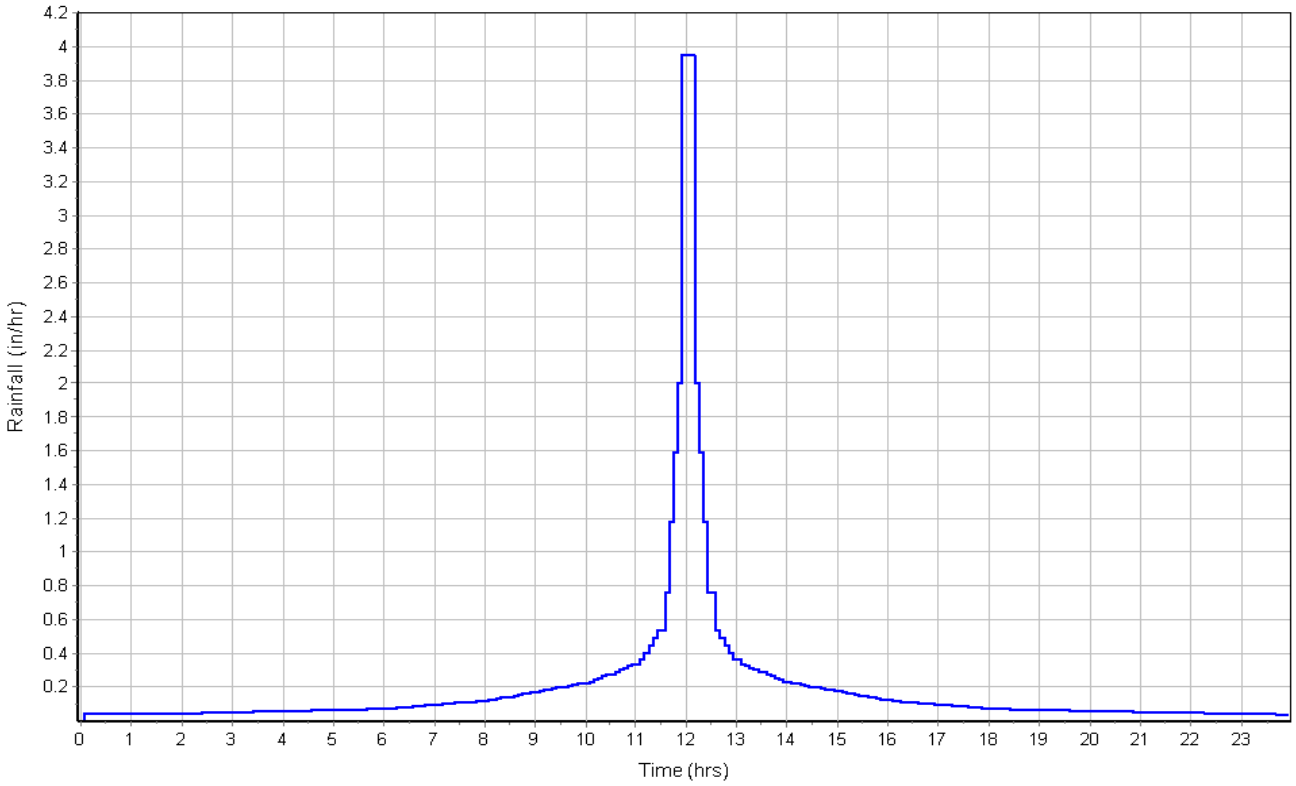
Total TOC (min) 3.02

Subbasin Runoff Results

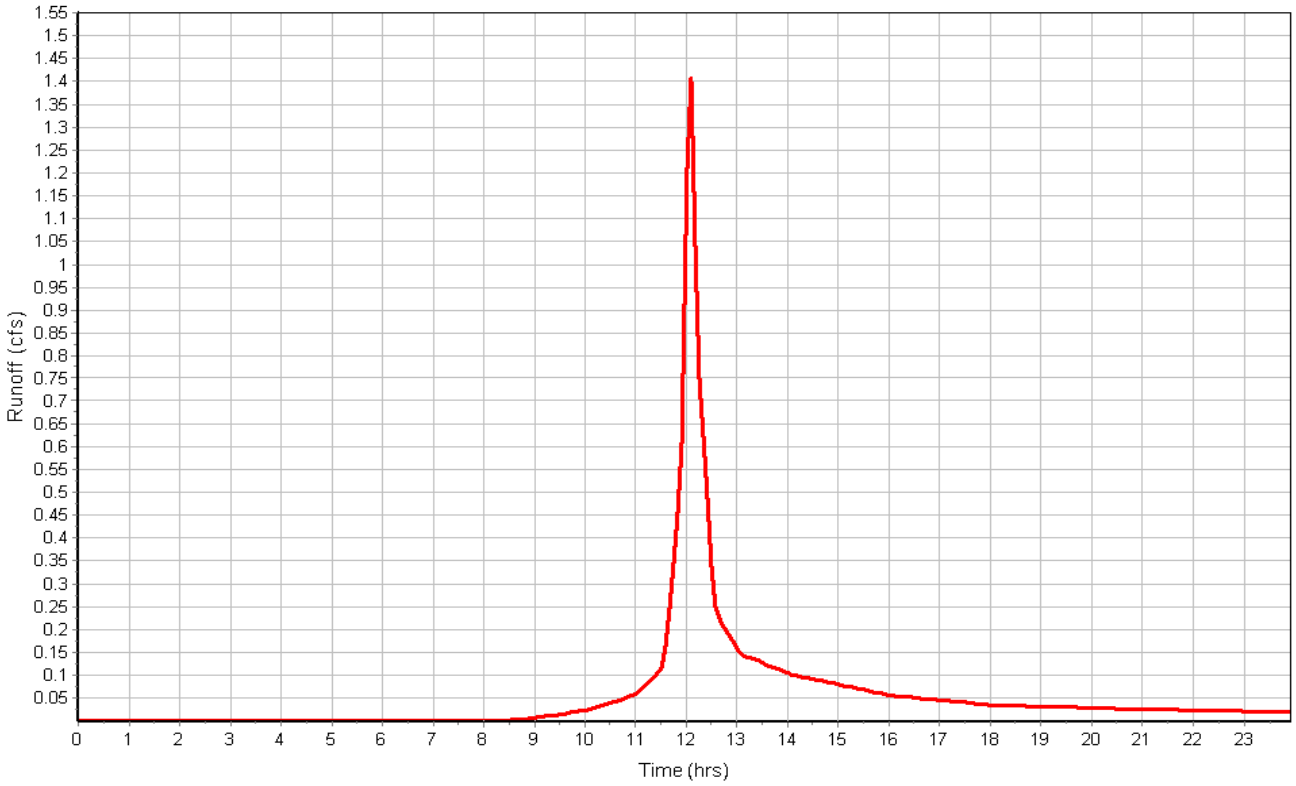
Total Rainfall (in) 4.70
Total Runoff (in) 2.46
Peak Runoff (cfs) 1.44
Weighted Curve Number 78.02
Time of Concentration (days hh:mm:ss) 0 00:03:01

Subbasin : Basin5

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin6

Input Data

Area (ac) 0.33
Weighted Curve Number 77.00
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.33	D	77.00
Composite Area & Weighted CN	0.33		77.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	159	0.00	0.00
Slope (%) :	16.4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.20	0.00	0.00
Velocity (ft/sec) :	0.20	0.00	0.00
Computed Flow Time (min) :	13.41	0.00	0.00

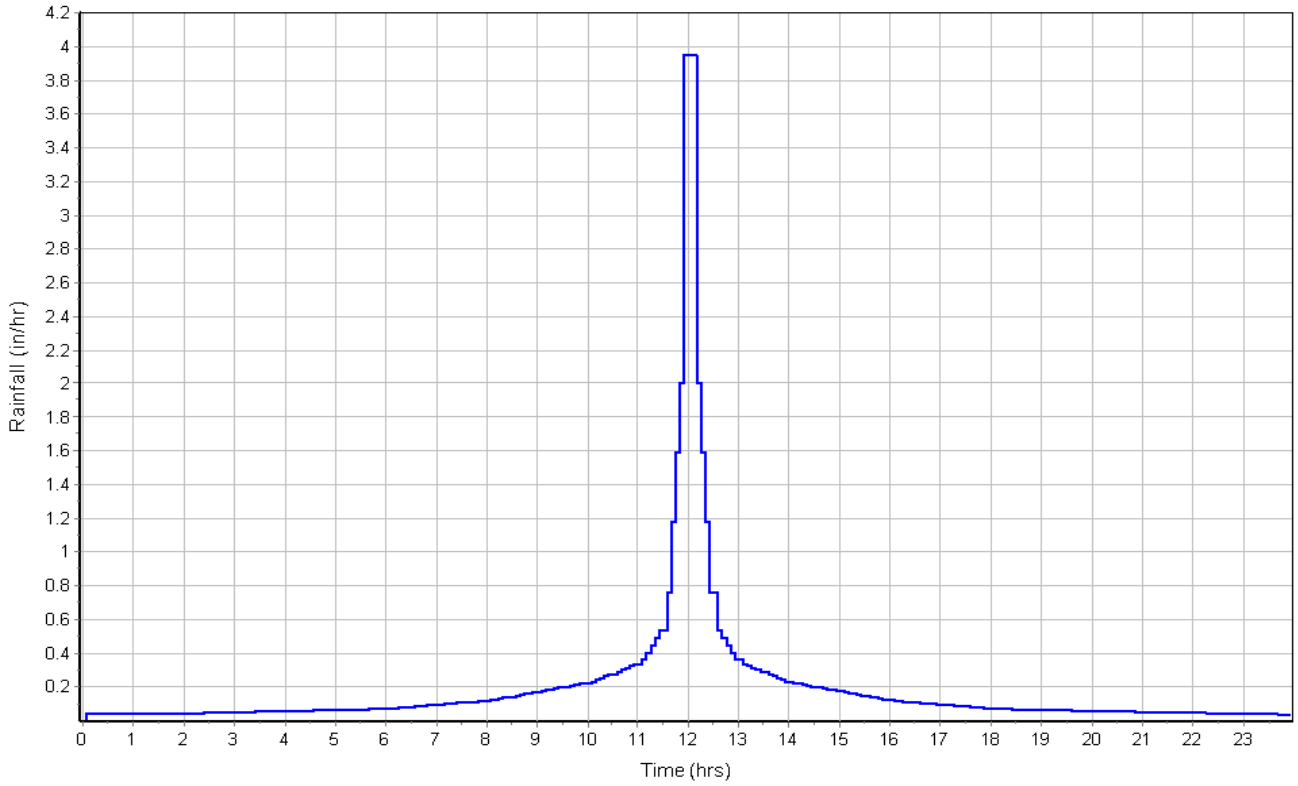
Total TOC (min) 13.41

Subbasin Runoff Results

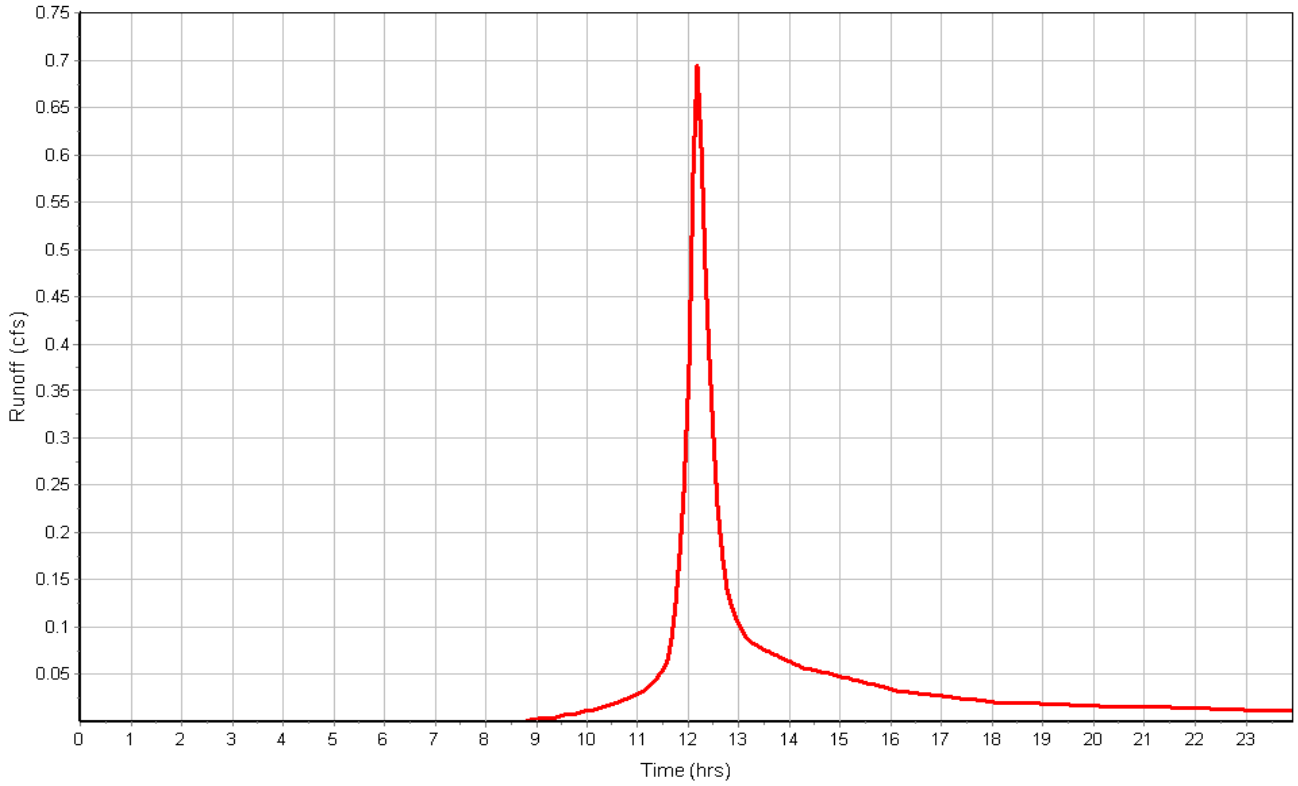
Total Rainfall (in) 4.70
Total Runoff (in) 2.37
Peak Runoff (cfs) 0.70
Weighted Curve Number 77.00
Time of Concentration (days hh:mm:ss) 0 00:13:25

Subbasin : Basin6

Rainfall Intensity Graph



Runoff Hydrograph



Project Description

File Name	Dover_PreDev.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	May 19, 2016	00:00:00
End Analysis On	May 20, 2016	00:00:00
Start Reporting On	May 19, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	6
Nodes	6
Junctions	0
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage	Time Series	100YR-24HR	Intensity	inches	Massachusetts	Norfolk	100	6.70	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Basin1	2.14	77.94	6.70	4.20	8.99	7.11	0 00:19:54
2	Basin2	3.22	77.68	6.70	4.17	13.44	9.36	0 00:27:39
3	Basin3	2.89	77.38	6.70	4.14	11.95	11.04	0 00:11:42
4	Basin4	1.46	77.34	6.70	4.13	6.04	5.74	0 00:10:16
5	Basin5	0.56	78.02	6.70	4.21	2.35	2.41	0 00:05:00
6	Basin6	0.33	77.00	6.70	4.10	1.33	1.20	0 00:13:24

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	-1.00					0.00	0.00					
2	Out-02	Outfall	-1.00					0.00	0.00					
3	Out-03	Outfall	-1.00					0.00	0.00					
4	Out-04	Outfall	-1.00					0.00	0.00					
5	Out-05	Outfall	-1.00					0.00	0.00					
6	Out-06	Outfall	-1.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Basin1

Input Data

Area (ac) 2.14
Weighted Curve Number 77.94
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.13	D	77.00
Meadow, non-grazed	2.01	D	78.00
Composite Area & Weighted CN	2.14		77.94

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	132	300	0.00
Slope (%) :	10.6	4.5	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.16	0.23	0.00
Computed Flow Time (min) :	13.76	21.47	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	408	0.00
Slope (%) :	0.00	4.5	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	1.48	0.00
Computed Flow Time (min) :	0.00	4.59	0.00

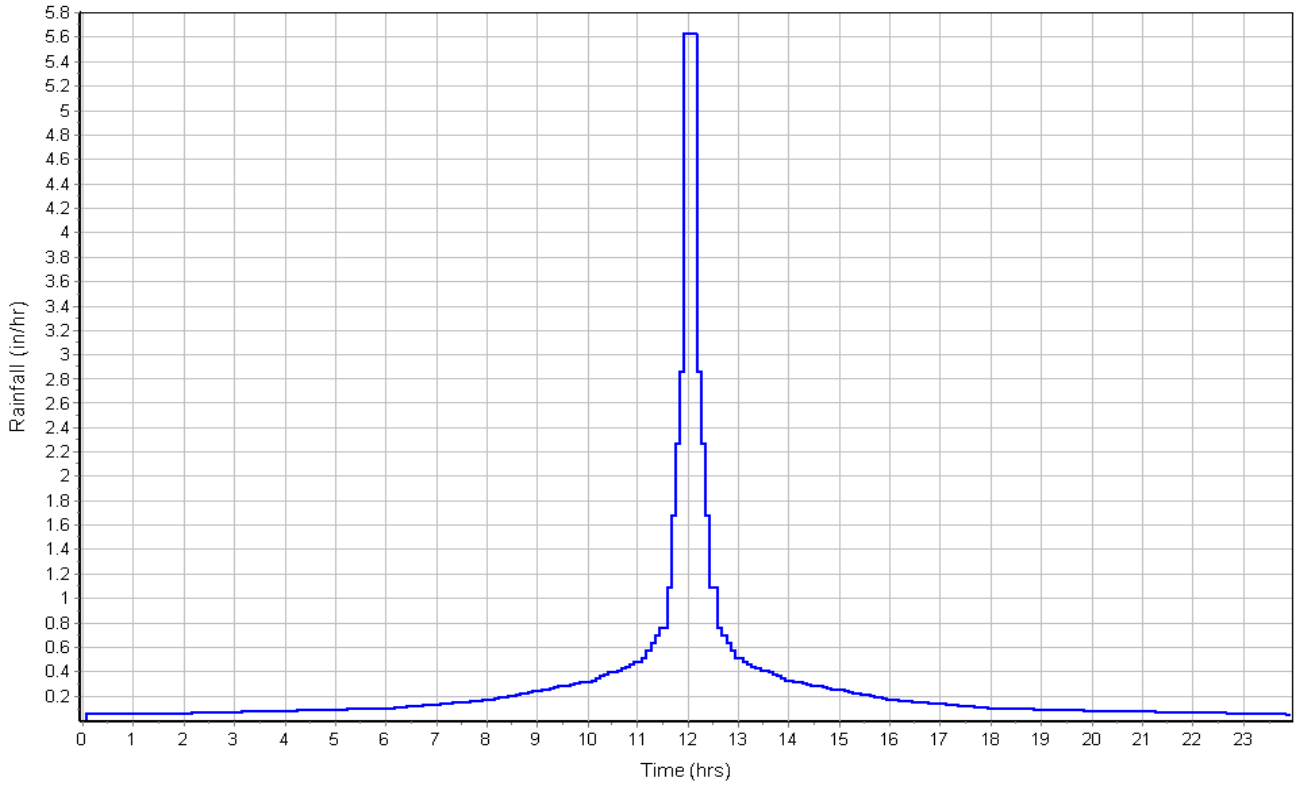
Total TOC (min) 19.91

Subbasin Runoff Results

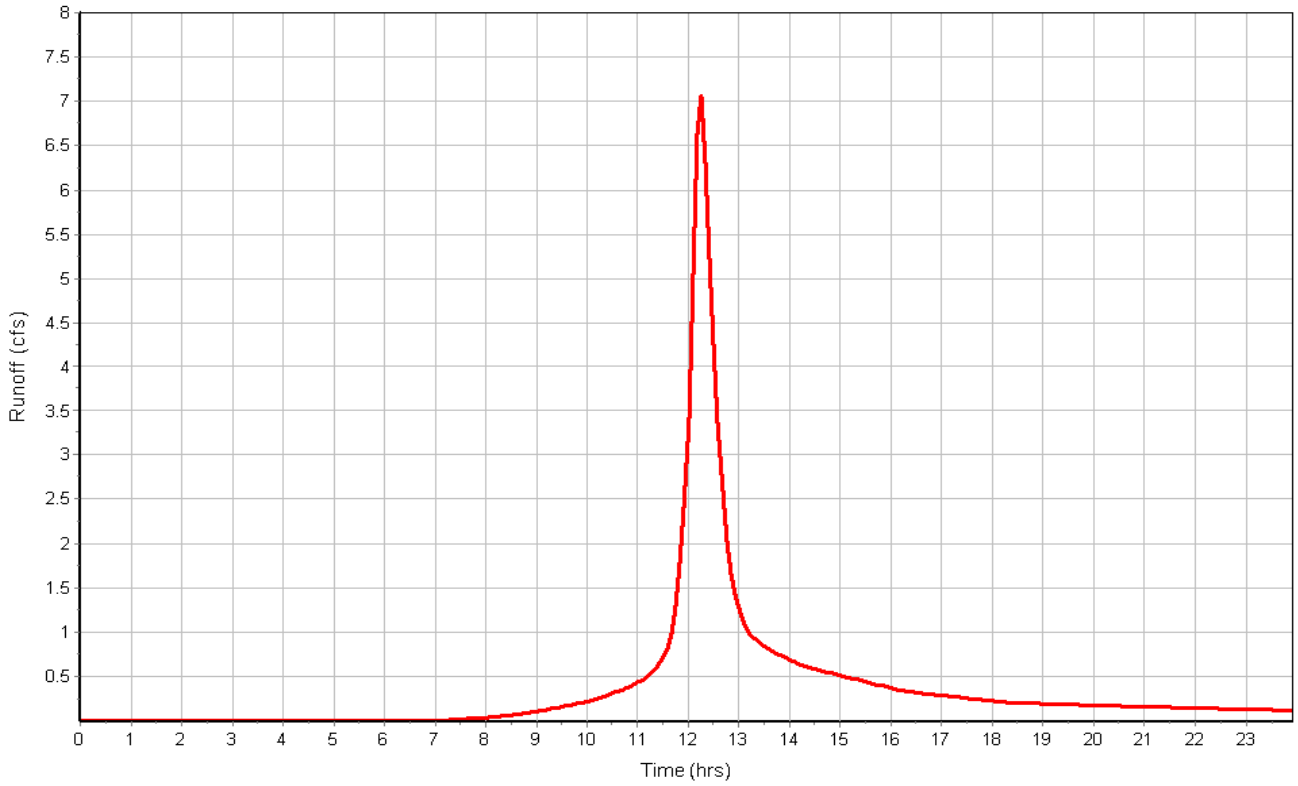
Total Rainfall (in)	6.70
Total Runoff (in)	4.20
Peak Runoff (cfs)	7.11
Weighted Curve Number	77.94
Time of Concentration (days hh:mm:ss)	0 00:19:55

Subbasin : Basin1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin2

Input Data

Area (ac) 3.22
Weighted Curve Number 77.68
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	1.03	D	77.00
Meadow, non-grazed	2.19	D	78.00
Composite Area & Weighted CN	3.22		77.68

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	252	300	0.00
Slope (%) :	6.3	3.4	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.15	0.21	0.00
Computed Flow Time (min) :	28.43	24.02	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	222	0.00
Slope (%) :	0.00	3.4	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	1.29	0.00
Computed Flow Time (min) :	0.00	2.87	0.00

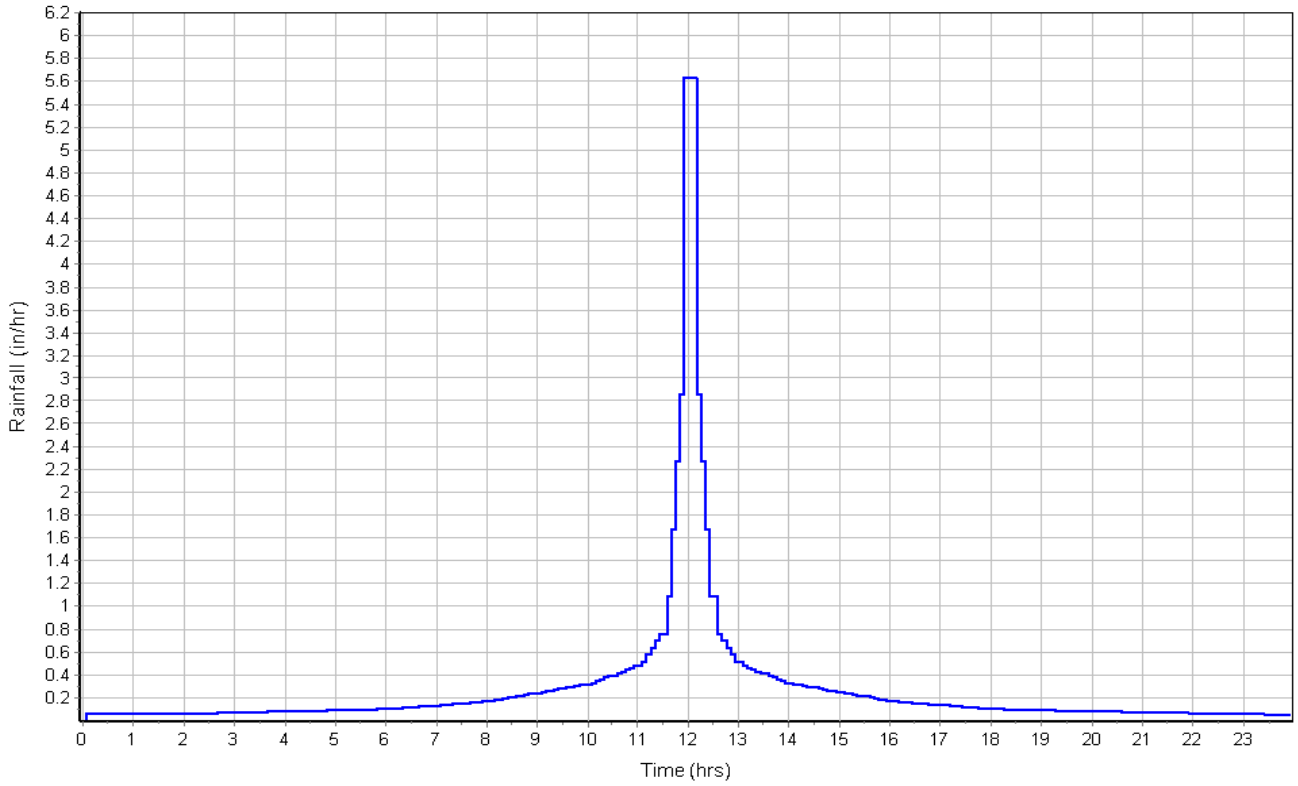
Total TOC (min) 27.66

Subbasin Runoff Results

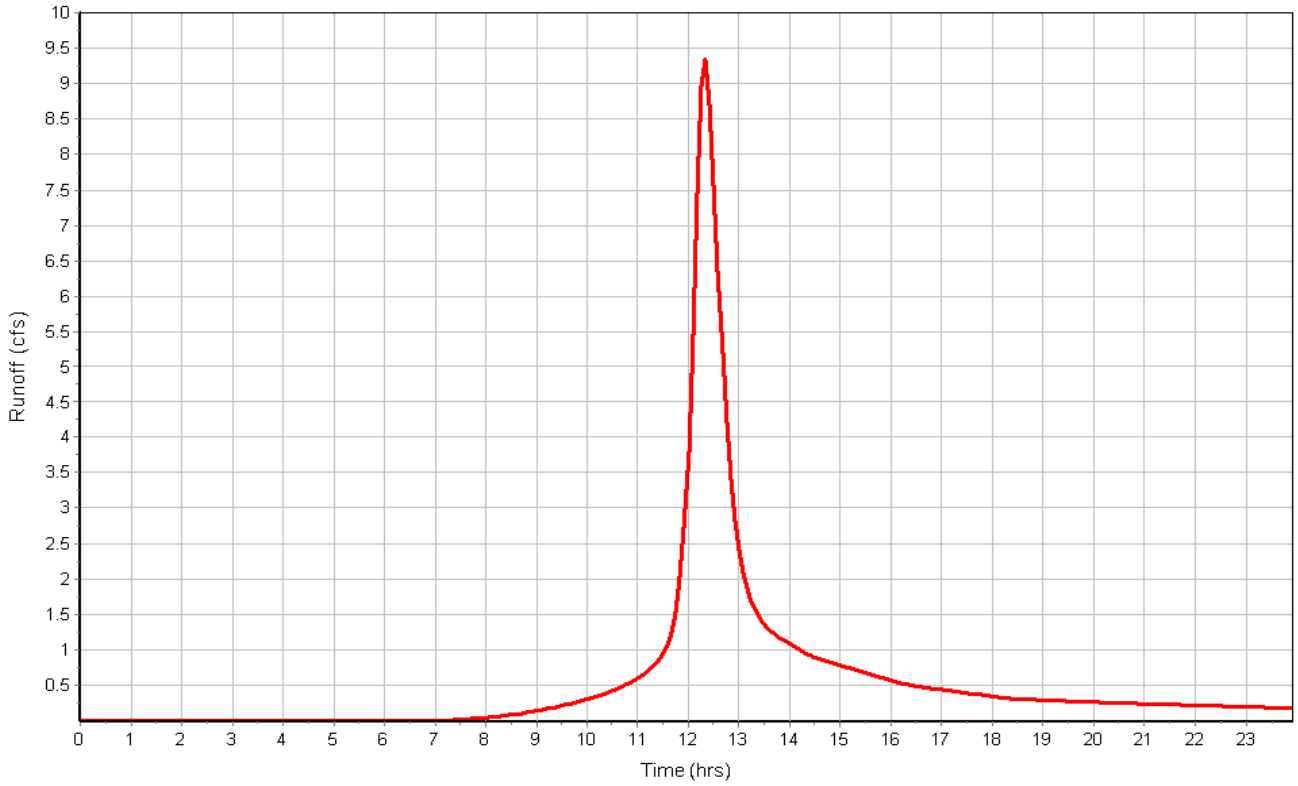
Total Rainfall (in) 6.70
Total Runoff (in) 4.17
Peak Runoff (cfs) 9.36
Weighted Curve Number 77.68
Time of Concentration (days hh:mm:ss) 0 00:27:40

Subbasin : Basin2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin3

Input Data

Area (ac) 2.89
Weighted Curve Number 77.38
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	2.43	D	77.00
Meadow, non-grazed	0.40	D	78.00
Dirt roads	0.06	D	89.00
Composite Area & Weighted CN	2.89		77.38

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	.01
Flow Length (ft) :	300	48	93
Slope (%) :	9.2	12.5	5.4
2 yr, 24 hr Rainfall (in) :	3.20	3.20	3.20
Velocity (ft/sec) :	0.18	0.24	2.18
Computed Flow Time (min) :	28.09	3.29	0.71

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	276	0.00	0.00
Slope (%) :	9.2	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	3.03	0.00	0.00

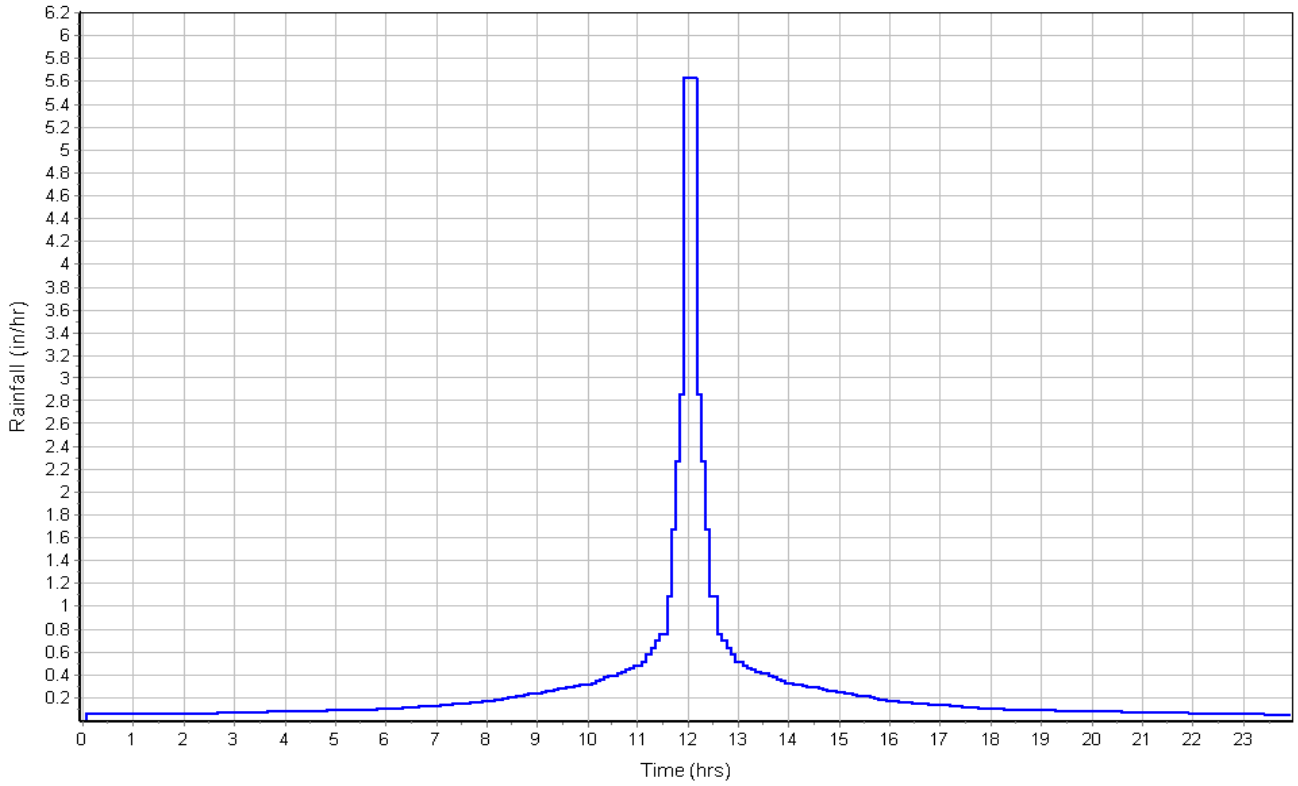
Total TOC (min) 11.71

Subbasin Runoff Results

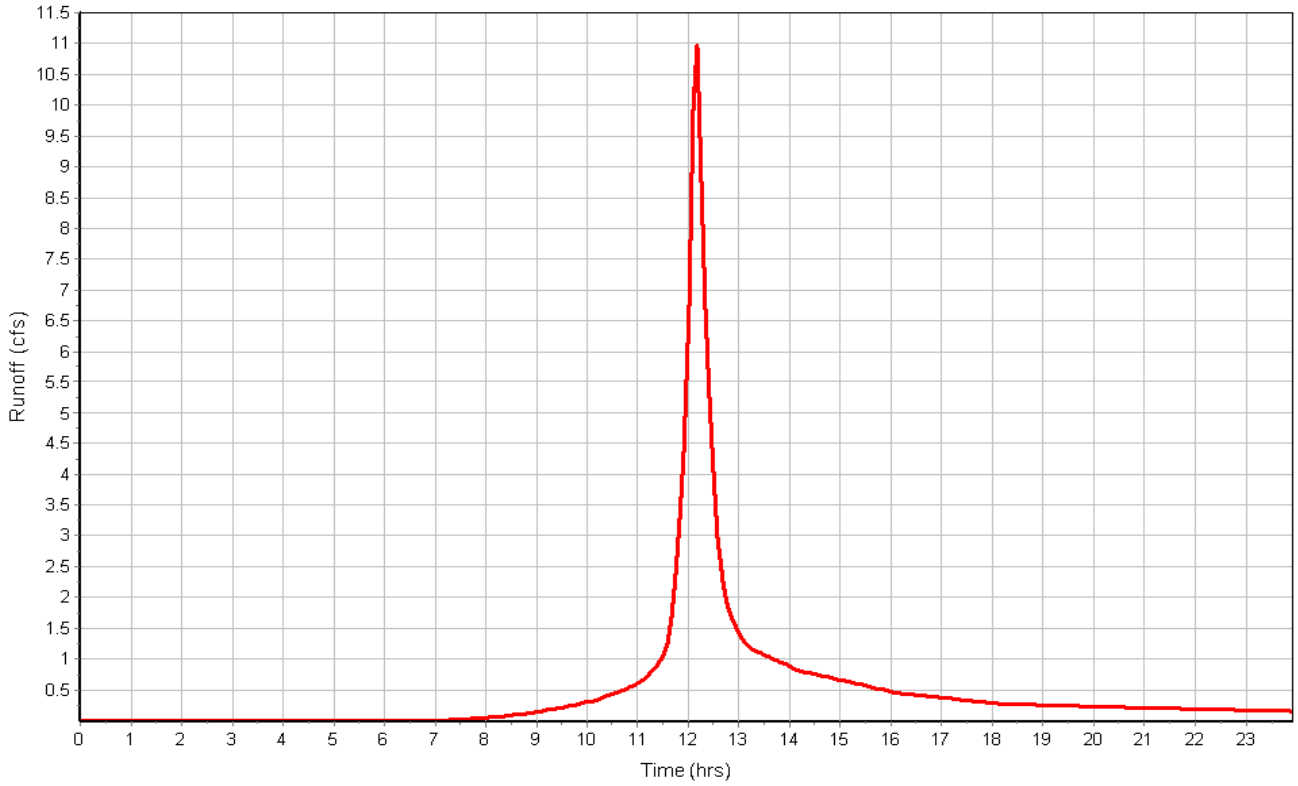
Total Rainfall (in) 6.70
Total Runoff (in) 4.14
Peak Runoff (cfs) 11.04
Weighted Curve Number 77.38
Time of Concentration (days hh:mm:ss) 0 00:11:43

Subbasin : Basin3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin4

Input Data

Area (ac) 1.46
Weighted Curve Number 77.34
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.96	D	77.00
Meadow, non-grazed	0.50	D	78.00
Composite Area & Weighted CN	1.46		77.34

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	144	114	0.00
Slope (%) :	20.8	5.3	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.21	0.20	0.00
Computed Flow Time (min) :	11.27	9.27	0.00

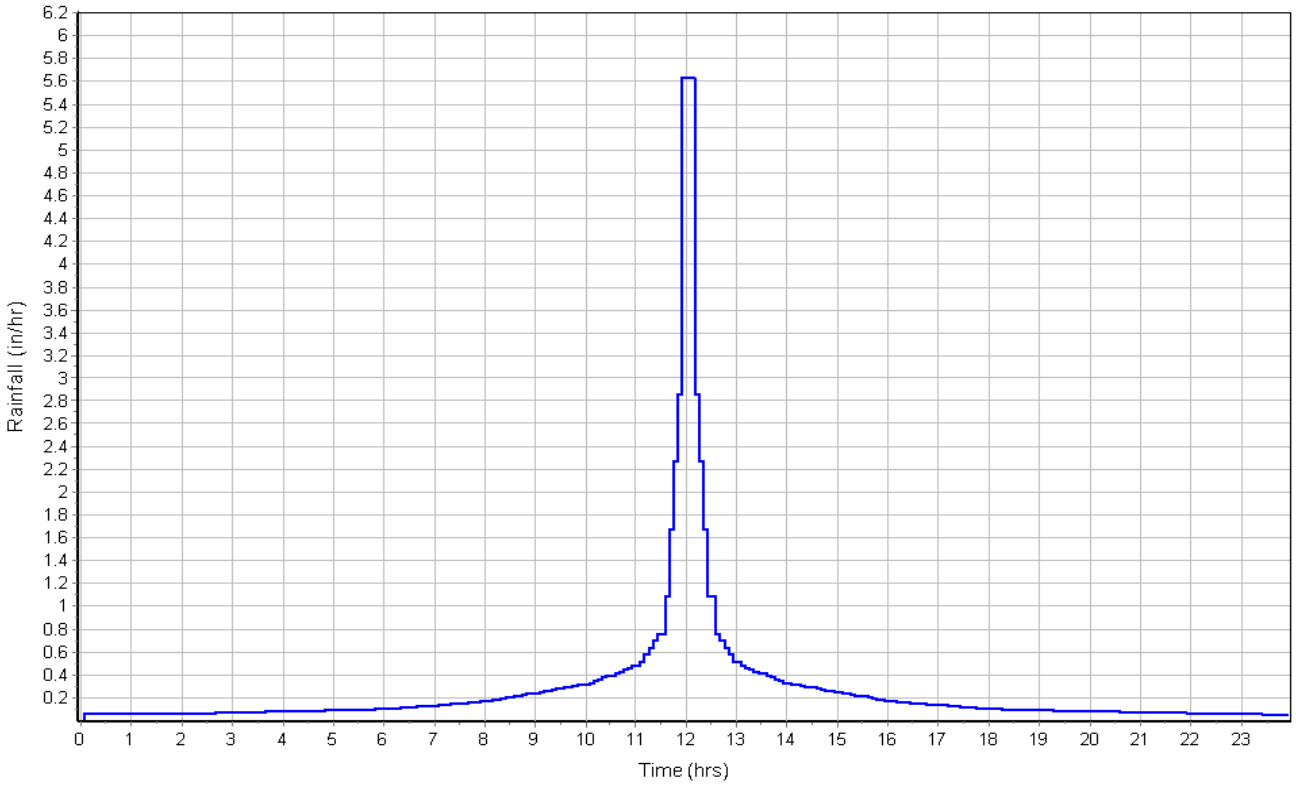
Total TOC (min) 10.27

Subbasin Runoff Results

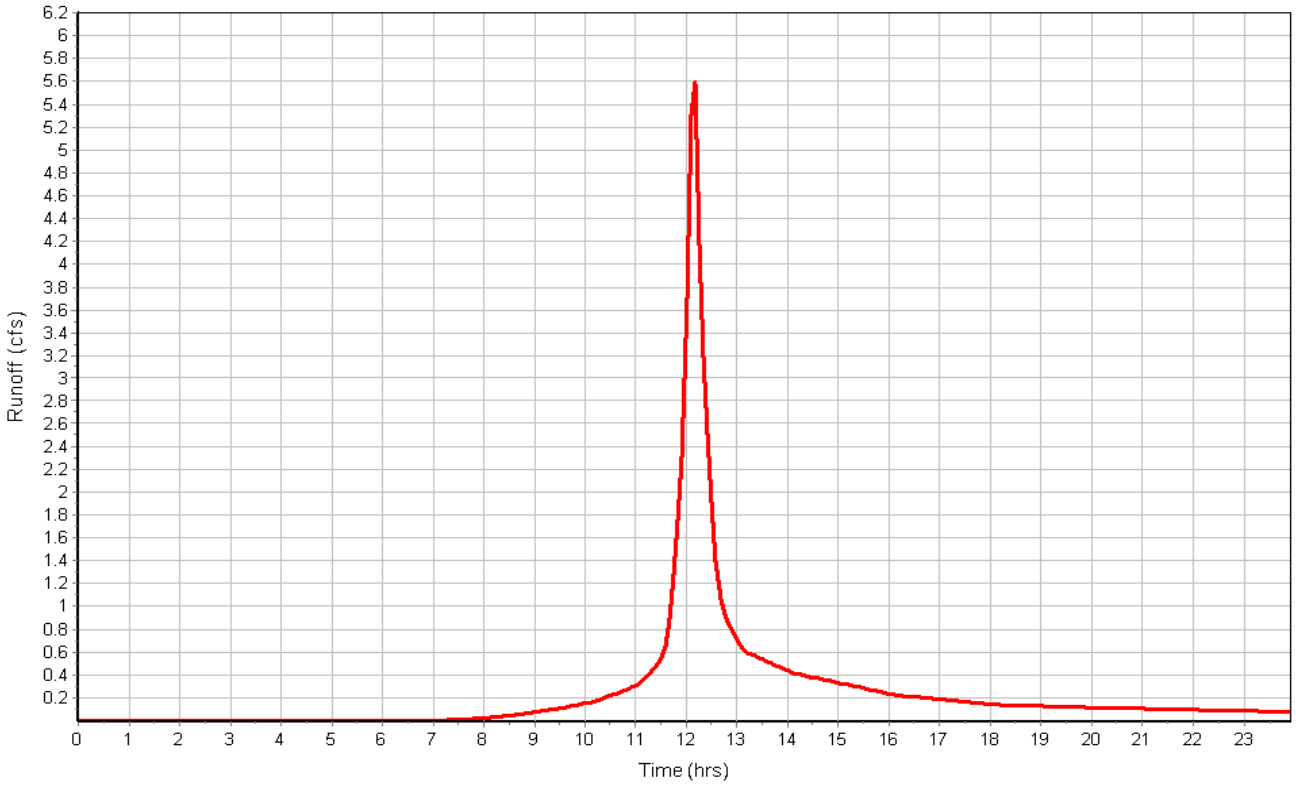
Total Rainfall (in) 6.70
Total Runoff (in) 4.13
Peak Runoff (cfs) 5.74
Weighted Curve Number 77.34
Time of Concentration (days hh:mm:ss) 0 00:10:16

Subbasin : Basin4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin5

Input Data

Area (ac) 0.56
Weighted Curve Number 78.02
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.17	D	77.00
Meadow, non-grazed	0.37	D	78.00
Dirt roads	0.02	D	89.00
Composite Area & Weighted CN	0.56		78.02

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.2	.01	0.00
Flow Length (ft) :	60	90	0.00
Slope (%) :	6.7	2.2	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.20	1.51	0.00
Computed Flow Time (min) :	5.05	0.99	0.00

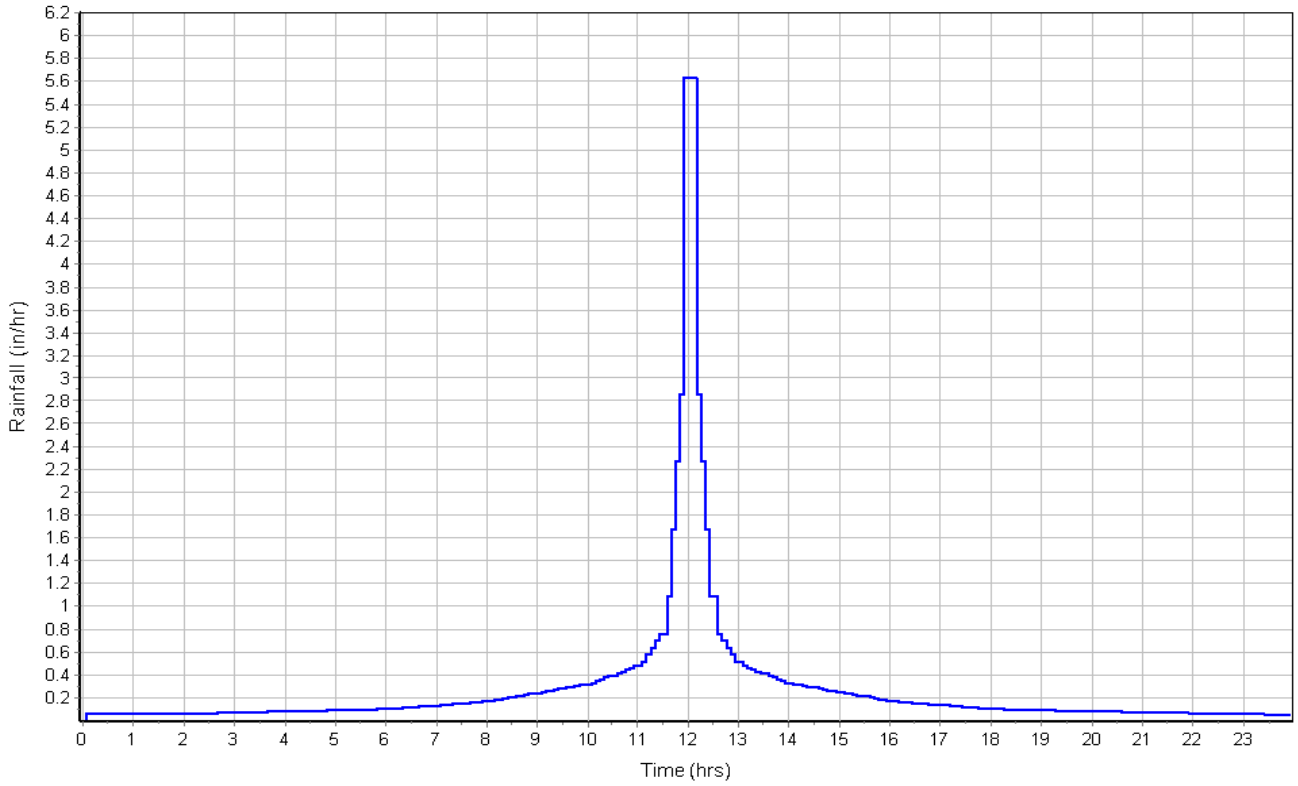
Total TOC (min) 3.02

Subbasin Runoff Results

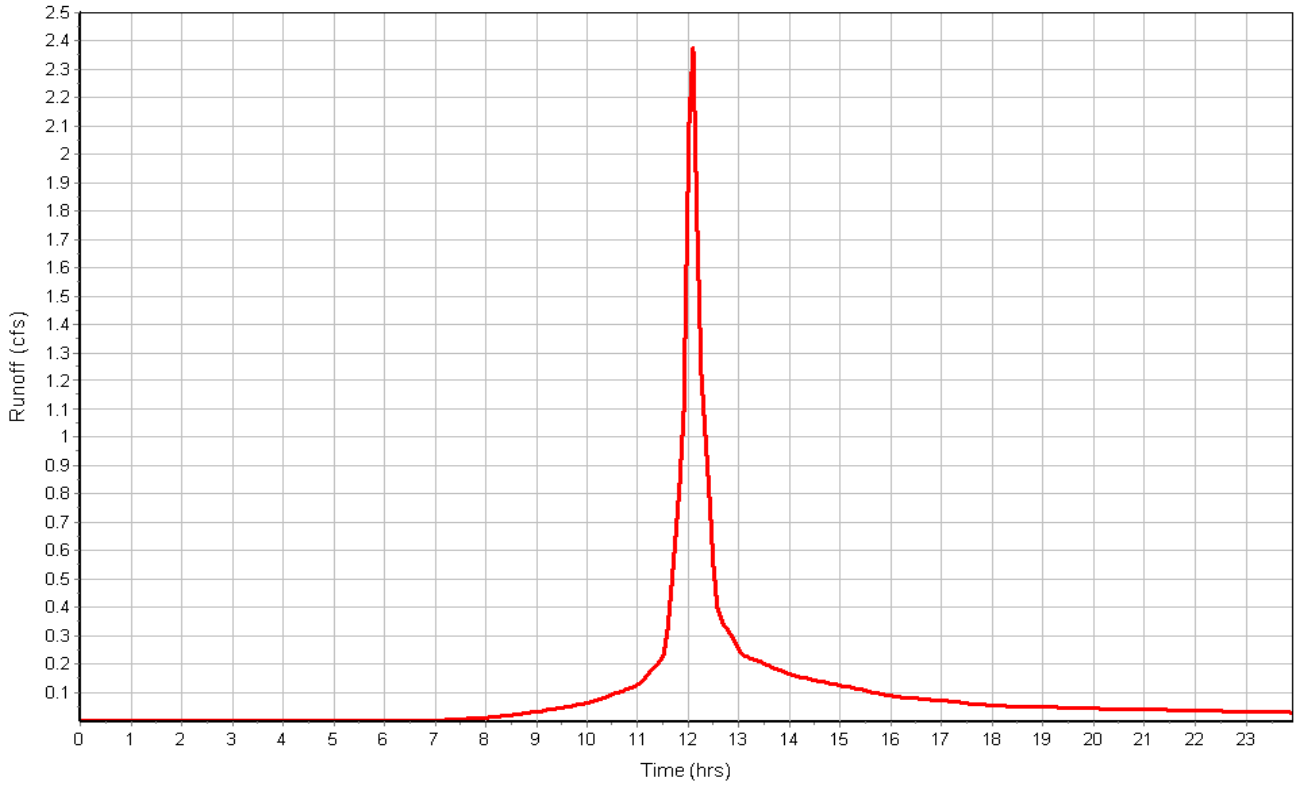
Total Rainfall (in) 6.70
Total Runoff (in) 4.21
Peak Runoff (cfs) 2.41
Weighted Curve Number 78.02
Time of Concentration (days hh:mm:ss) 0 00:03:01

Subbasin : Basin5

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin6

Input Data

Area (ac) 0.33
Weighted Curve Number 77.00
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.33	D	77.00
Composite Area & Weighted CN	0.33		77.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	159	0.00	0.00
Slope (%) :	16.4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.20	0.00	0.00
Velocity (ft/sec) :	0.20	0.00	0.00
Computed Flow Time (min) :	13.41	0.00	0.00

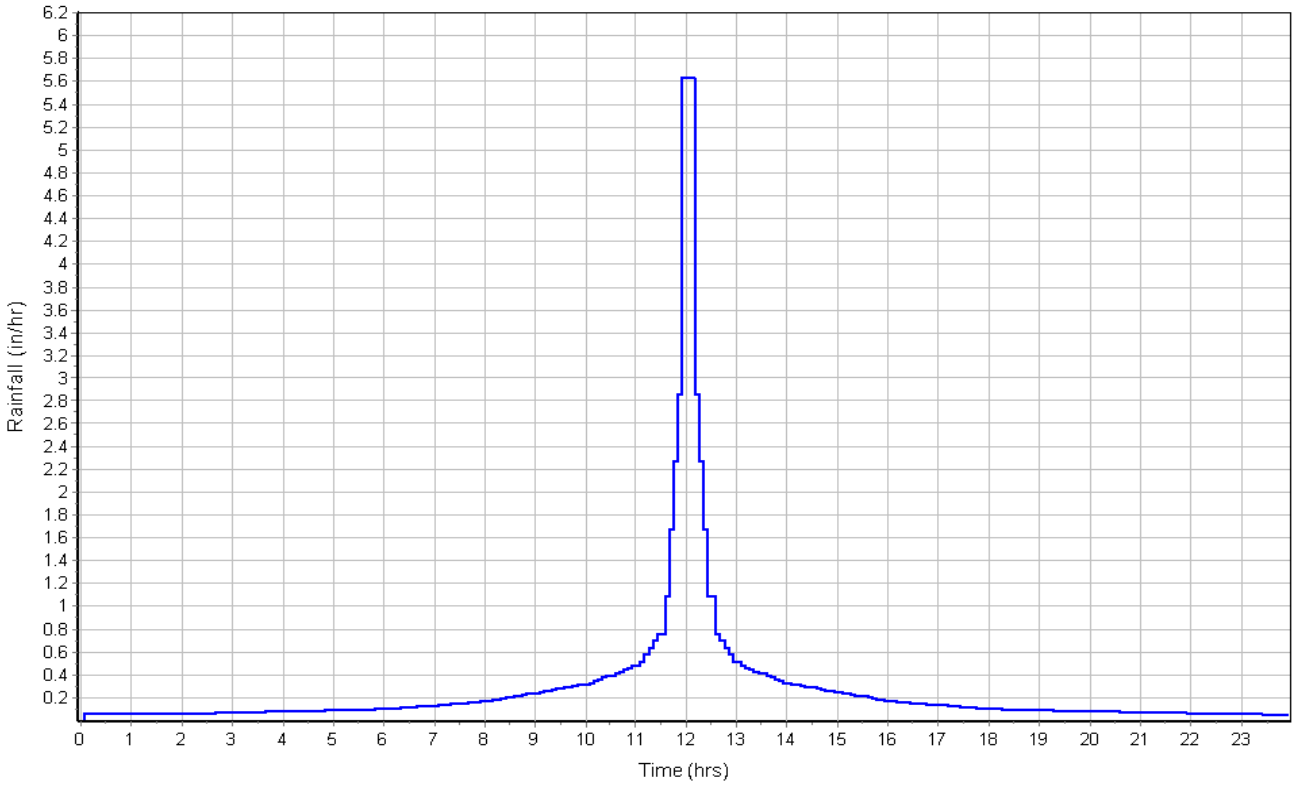
Total TOC (min) 13.41

Subbasin Runoff Results

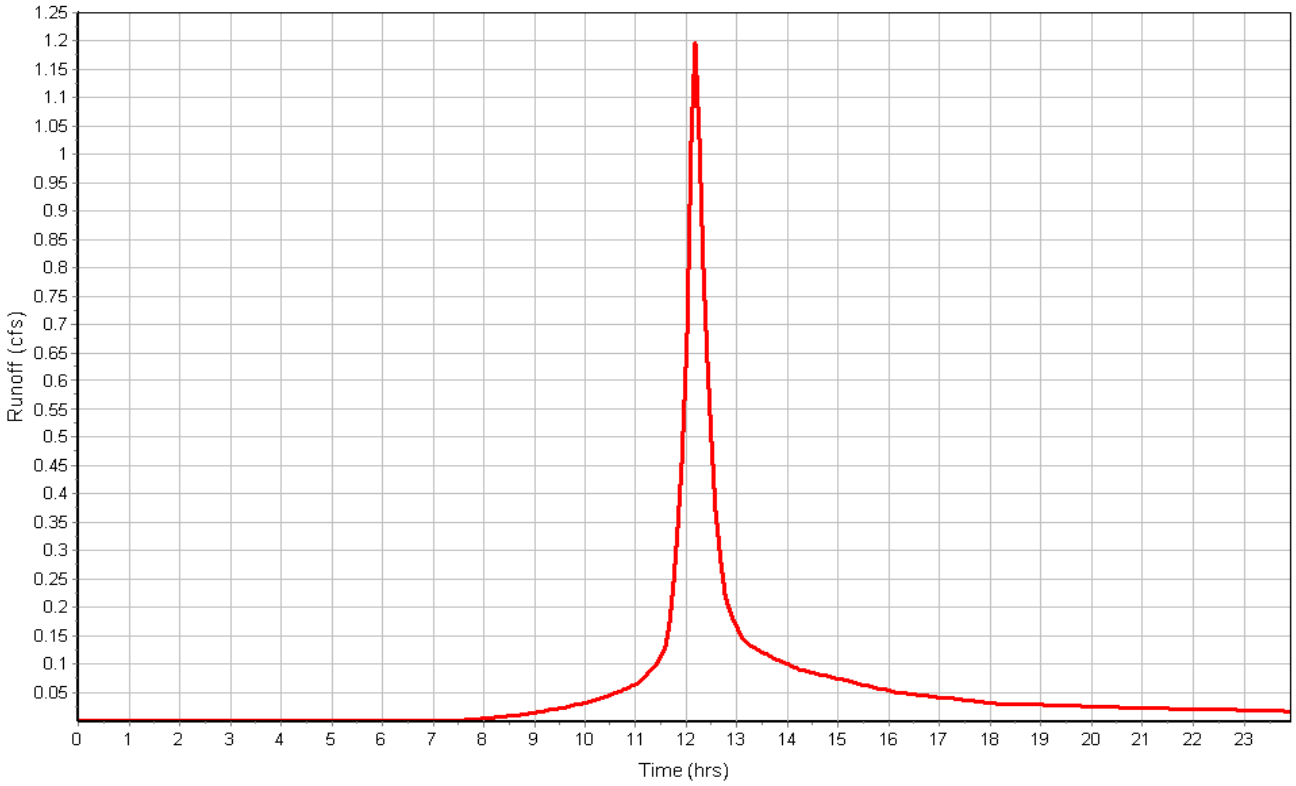
Total Rainfall (in) 6.70
Total Runoff (in) 4.10
Peak Runoff (cfs) 1.20
Weighted Curve Number 77.00
Time of Concentration (days hh:mm:ss) 0 00:13:25

Subbasin : Basin6

Rainfall Intensity Graph



Runoff Hydrograph



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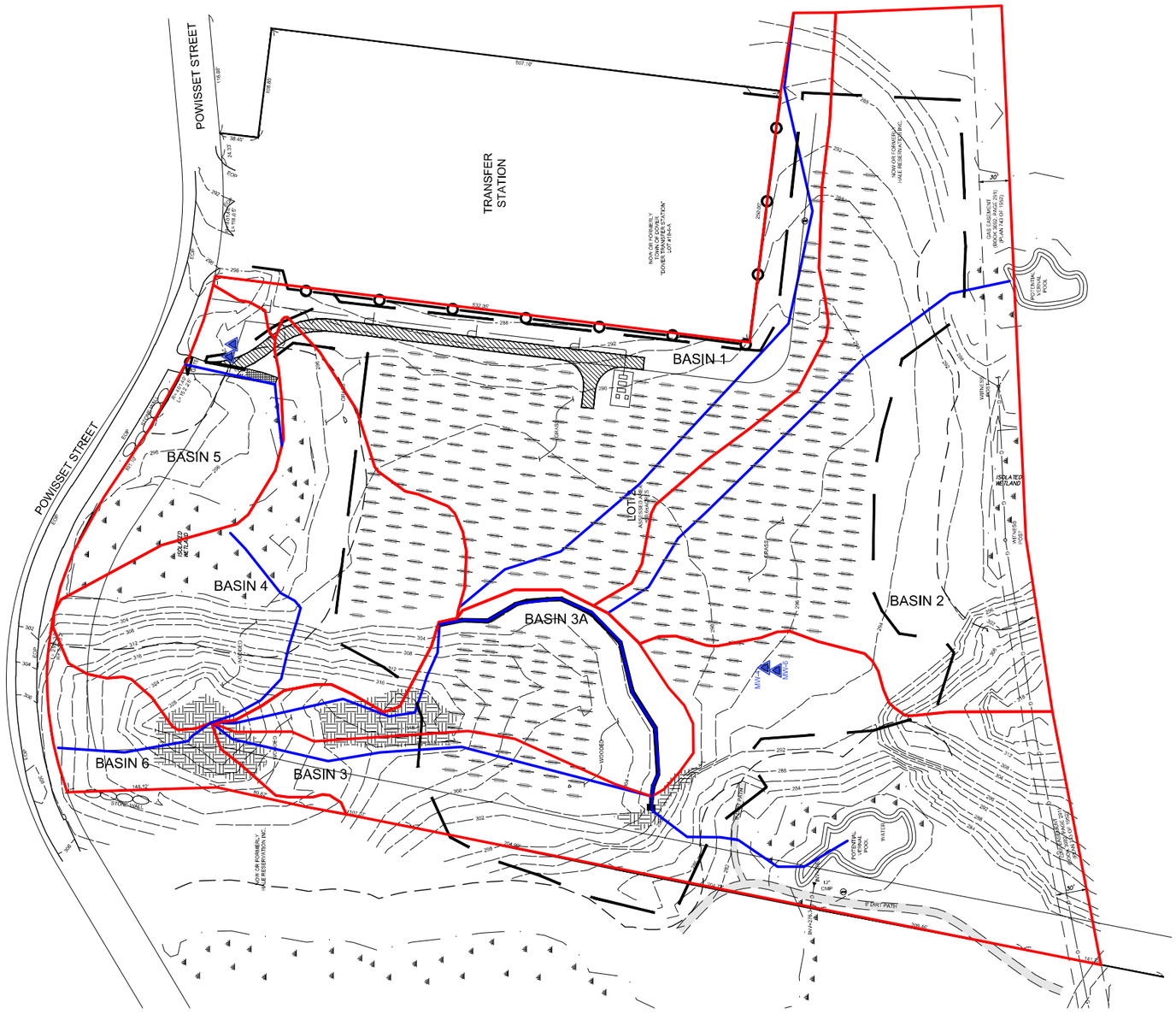


NOTE:
1. DRAINAGE BASIN DELINEATION BASED ON SURVEY COMPLETED BY MERIDIAN ASSOCIATES IN MAY 2016.

N

0 60 120
APPROXIMATE SCALE IN FEET

Kennedy/Jenks Consultants

BLUE WAVE CAPITAL
DOVER LANDFILL, MA

DEVELOPED CONDITION STORMWATER DRAINAGE BASINS

1642009*00
AUGUST 2016

FIGURE 2

Project Description

File Name ..... Dover_PostDev_rev.SPF

Project Options

Flow Units ..... CFS
Elevation Type ..... Elevation
Hydrology Method ..... SCS TR-20
Time of Concentration (TOC) Method ..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Enable Overflow Ponding at Nodes ..... YES
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On ..... May 19, 2016 00:00:00
End Analysis On ..... May 20, 2016 00:00:00
Start Reporting On ..... May 19, 2016 00:00:00
Antecedent Dry Days ..... 0 days
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss
Reporting Time Step ..... 0 00:05:00 days hh:mm:ss
Routing Time Step ..... 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	7
Nodes	7
Junctions	0
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	1
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage	Time Series	2YR-24HR	Intensity	inches	Massachusetts	Norfolk	2	3.20	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Basin1	2.02	79.17	3.20	1.35	2.72	1.44	0 00:48:00
2	Basin2	3.06	77.98	3.20	1.27	3.89	2.73	0 00:25:46
3	Basin3	2.42	77.52	3.20	1.24	3.01	2.44	0 00:17:17
4	Basin3A	0.75	78.23	3.20	1.29	0.97	0.50	0 00:48:46
5	Basin4	1.46	77.50	3.20	1.24	1.82	1.71	0 00:10:16
6	Basin5	0.56	78.34	3.20	1.30	0.72	0.76	0 00:05:00
7	Basin6	0.33	77.00	3.20	1.21	0.39	0.35	0 00:13:24

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	-1.00					1.44	-1.00					
2	Out-02	Outfall	-1.00					2.72	-1.00					
3	Out-03	Outfall	-1.00					2.68	-1.00					
4	Out-04	Outfall	-1.00					1.69	-1.00					
5	Out-05	Outfall	-1.00					0.73	-1.00					
6	Out-06	Outfall	-1.00					0.35	-1.00					
7	Swale	Storage Node	-0.50	1.00	-0.50		0.00	0.50	0.09				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Level Spreader	Weir	Swale	Out-03		-0.50	-1.00				0.50							

Subbasin Hydrology

Subbasin : Basin1

Input Data

Area (ac) 2.02
Weighted Curve Number 79.17
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.18	D	91.00
Meadow, non-grazed	1.84	D	78.00
Composite Area & Weighted CN	2.02		79.17

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.00	0.2	0.00
Flow Length (ft) :	0.00	300	0.00
Slope (%) :	0.00	1.1	0.00
2 yr, 24 hr Rainfall (in) :	0.00	3.20	0.00
Velocity (ft/sec) :	0.00	0.13	0.00
Computed Flow Time (min) :	0.00	37.73	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	450	0.00
Slope (%) :	0.00	1.1	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	0.73	0.00
Computed Flow Time (min) :	0.00	10.27	0.00

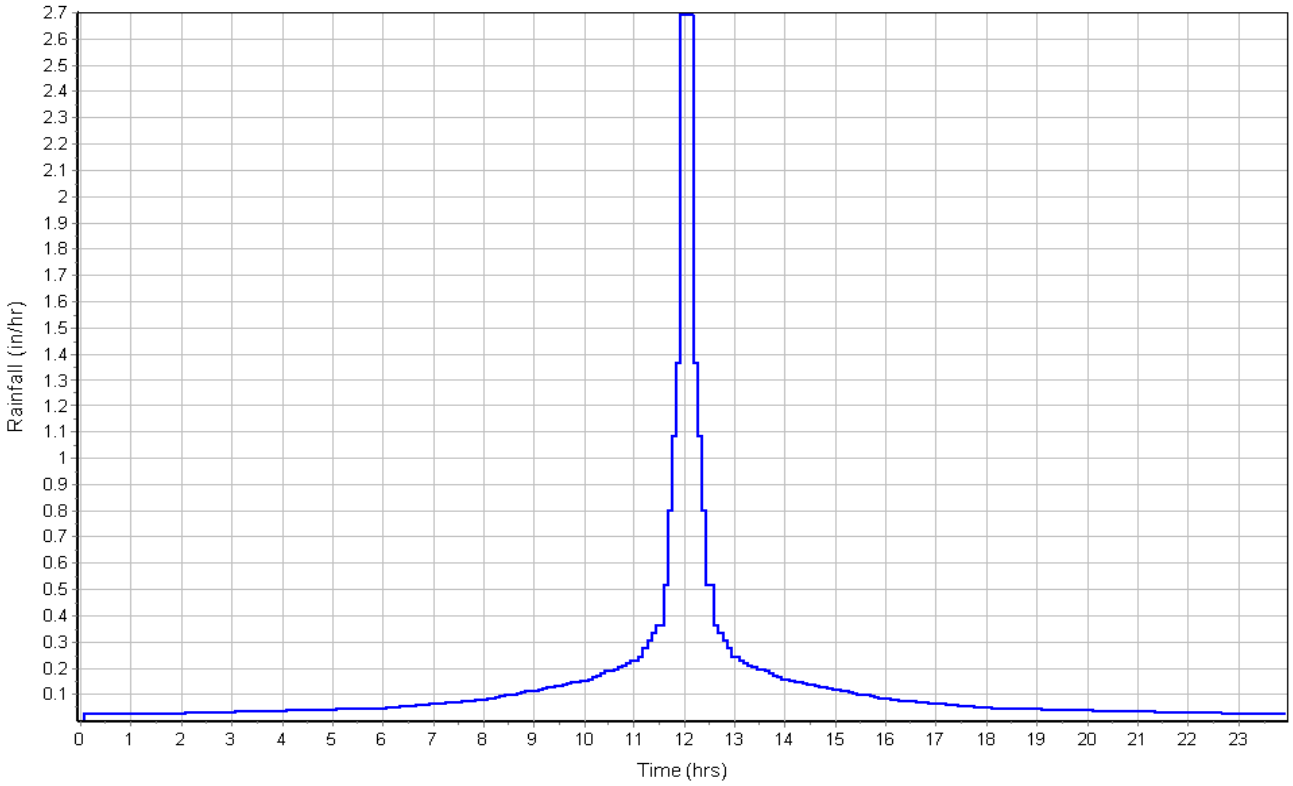
Total TOC (min) 48.00

Subbasin Runoff Results

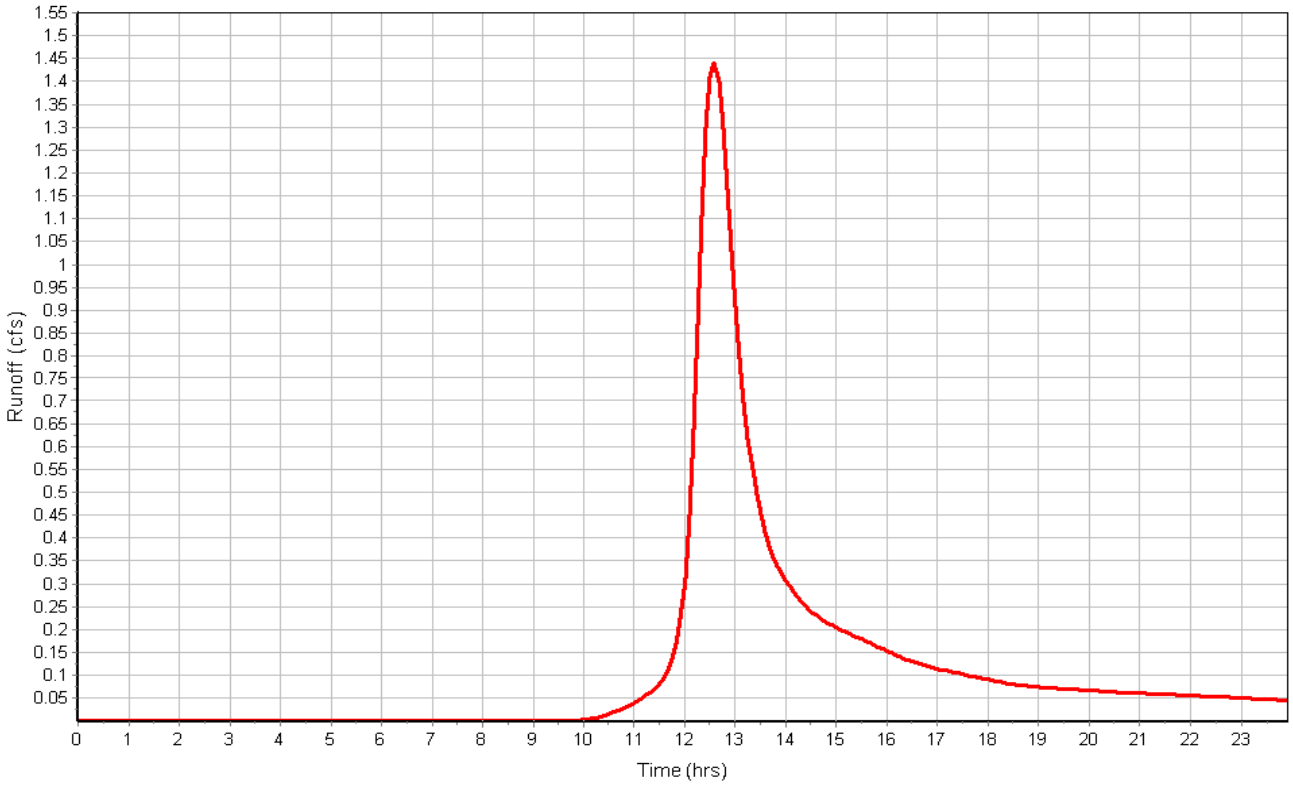
Total Rainfall (in)	3.20
Total Runoff (in)	1.35
Peak Runoff (cfs)	1.44
Weighted Curve Number	79.17
Time of Concentration (days hh:mm:ss)	0 00:48:00

Subbasin : Basin1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin2

Input Data

Area (ac) 3.06
Weighted Curve Number 77.98
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.06	D	91.00
Meadow, non-grazed	2.14	D	78.00
Woods, Good	0.86	D	77.00
Composite Area & Weighted CN	3.06		77.98

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.00	0.2	0.00
Flow Length (ft) :	0.00	300	0.00
Slope (%) :	0.00	3.8	0.00
2 yr, 24 hr Rainfall (in) :	0.00	3.20	0.00
Velocity (ft/sec) :	0.00	0.22	0.00
Computed Flow Time (min) :	0.00	22.98	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	228	0.00
Slope (%) :	0.00	3.8	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	1.36	0.00
Computed Flow Time (min) :	0.00	2.79	0.00

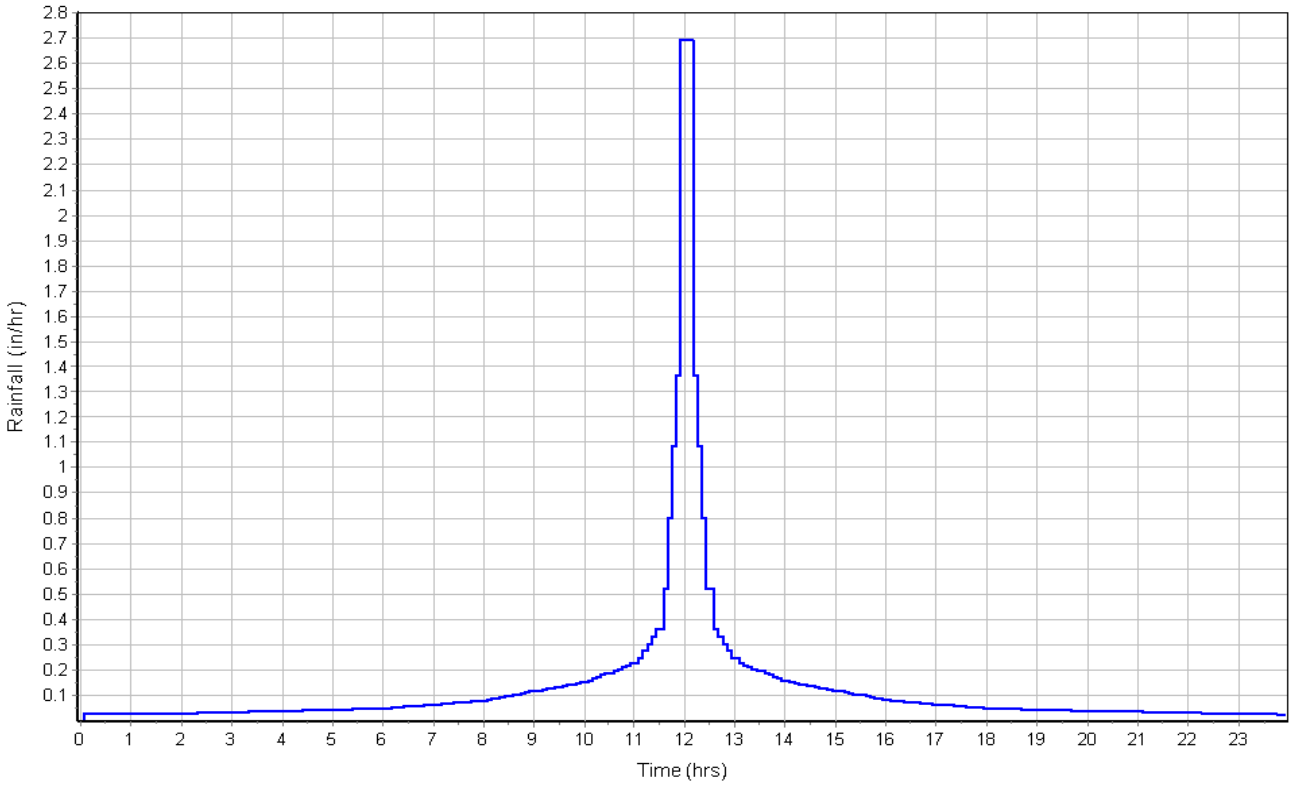
Total TOC (min) 25.77

Subbasin Runoff Results

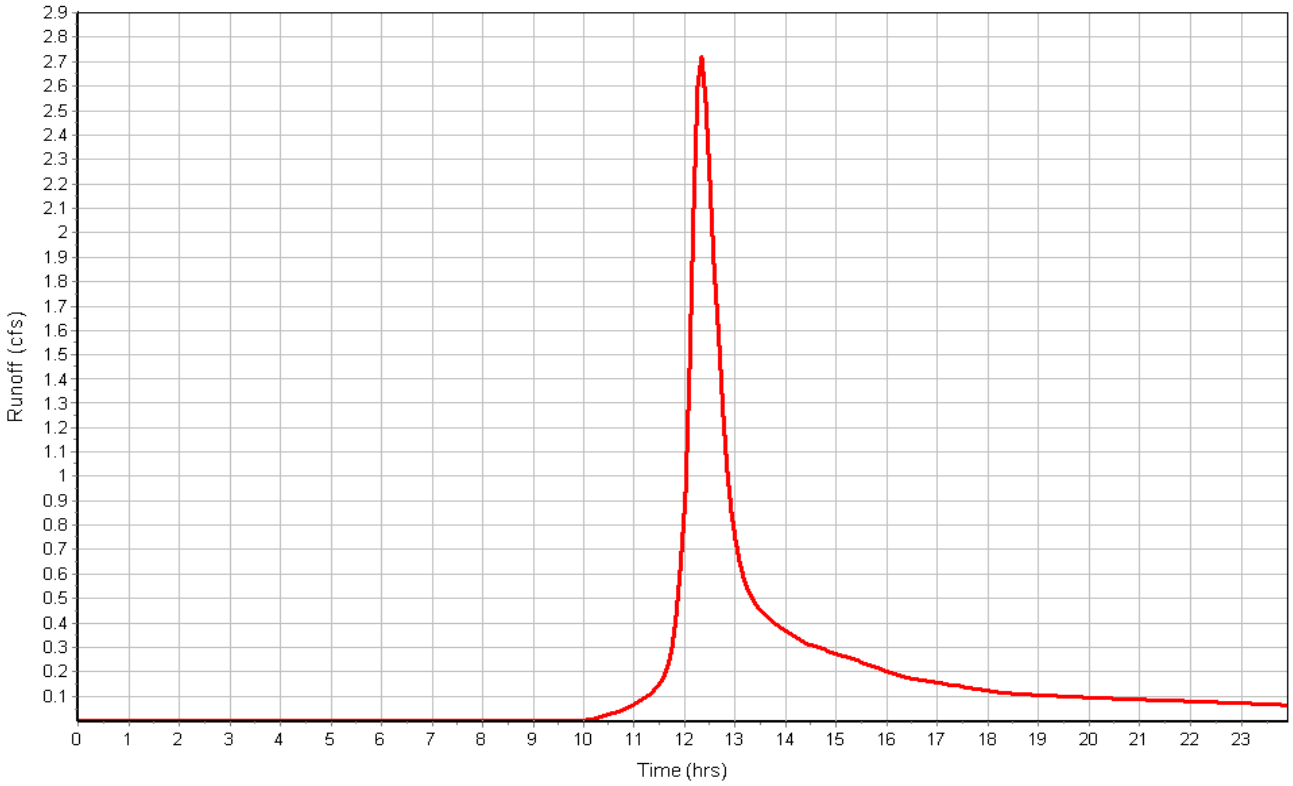
Total Rainfall (in) 3.20
Total Runoff (in) 1.27
Peak Runoff (cfs) 2.73
Weighted Curve Number 77.98
Time of Concentration (days hh:mm:ss) 0 00:25:46

Subbasin : Basin2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin3

Input Data

Area (ac) 2.42
Weighted Curve Number 77.52
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	1.79	D	77.00
Meadow, non-grazed	0.58	D	78.00
Gravel roads	0.05	D	91.00
Composite Area & Weighted CN	2.42		77.52

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	.01	0.00
Flow Length (ft) :	300	12	0.00
Slope (%) :	7.8	4.2	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.17	1.31	0.00
Computed Flow Time (min) :	30.00	0.15	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	372	0.00	0.00
Slope (%) :	7.8	0.00	0.00
Surface Type :	Woodland	Grass pasture	Unpaved
Velocity (ft/sec) :	1.40	0.00	0.00
Computed Flow Time (min) :	4.43	0.00	0.00

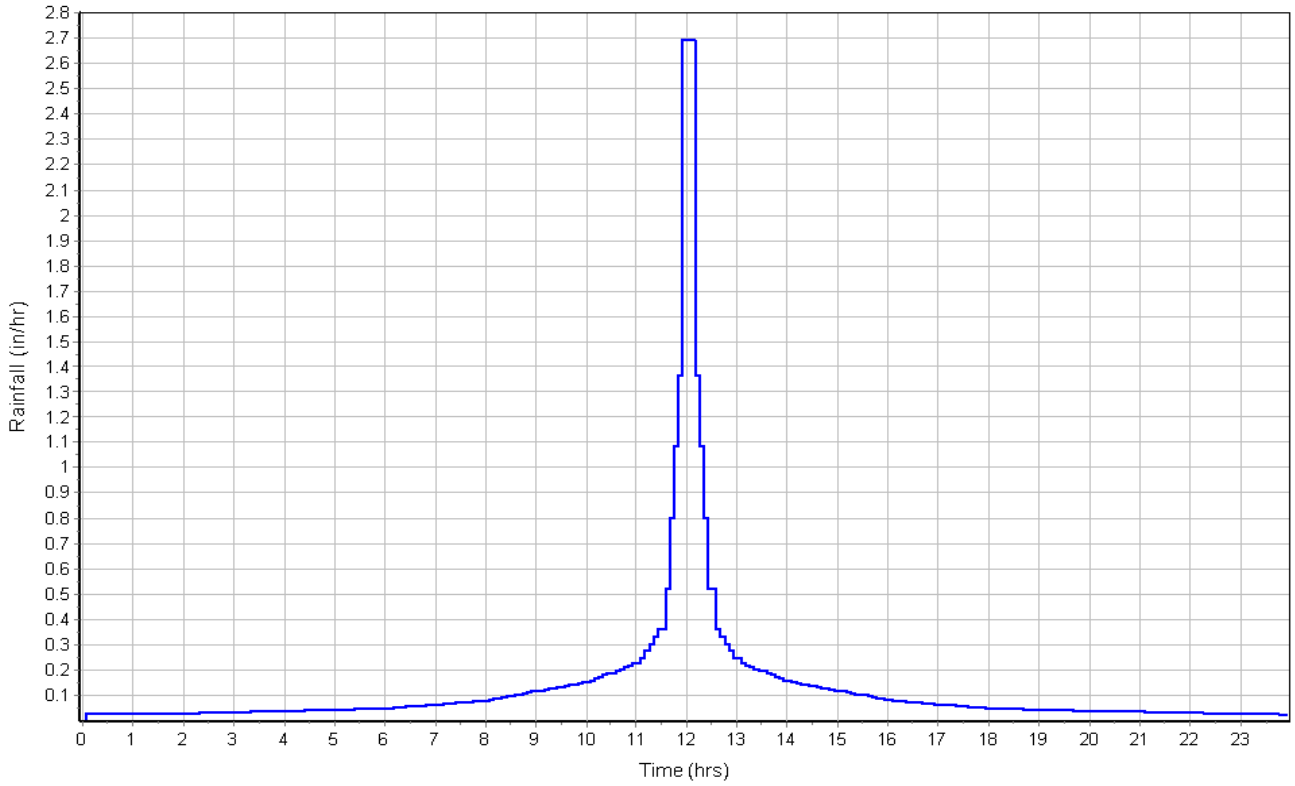
Total TOC (min) 17.29

Subbasin Runoff Results

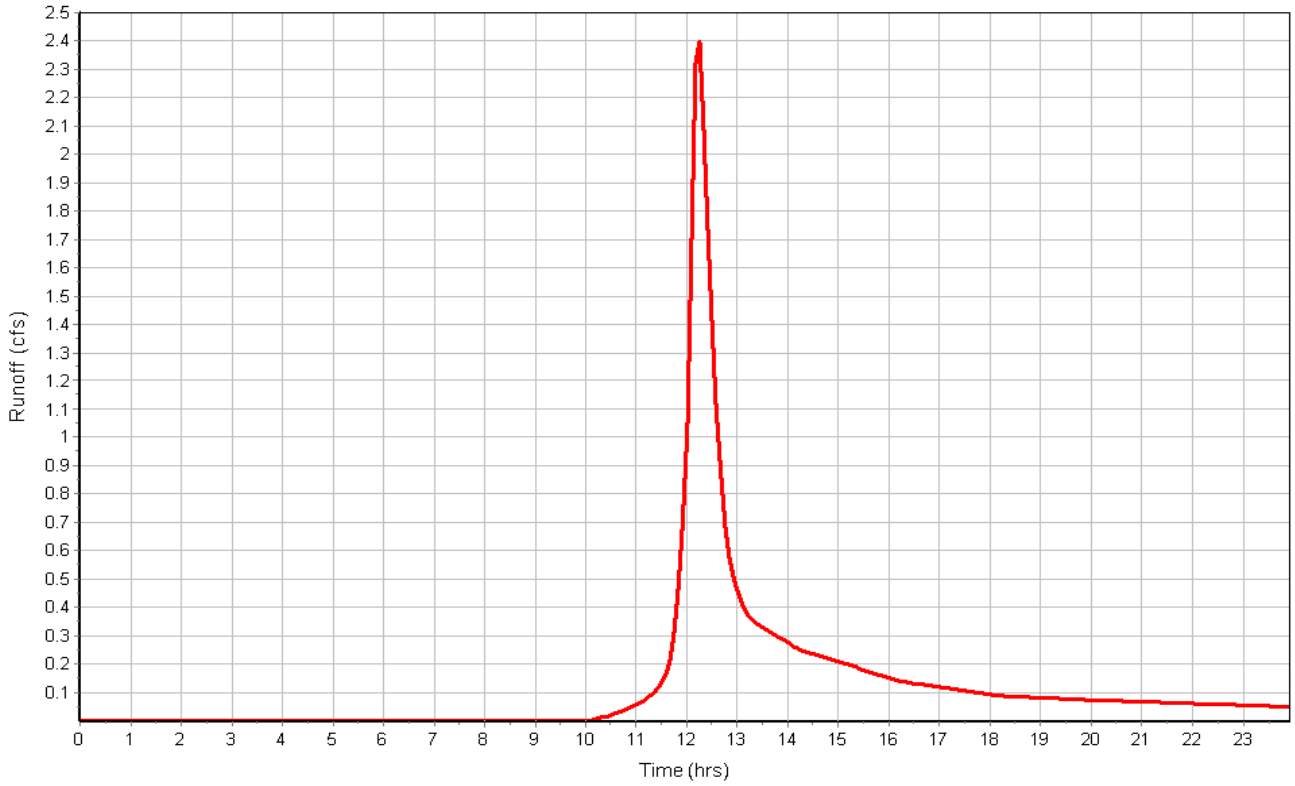
Total Rainfall (in) 3.20
Total Runoff (in) 1.24
Peak Runoff (cfs) 2.44
Weighted Curve Number 77.52
Time of Concentration (days hh:mm:ss) 0 00:17:17

Subbasin : Basin3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin3A

Input Data

Area (ac) 0.75
Weighted Curve Number 78.23
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.12	D	77.00
Meadow, non-grazed	0.61	D	78.00
Gravel roads	0.02	D	91.00
Composite Area & Weighted CN	0.75		78.23

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	300	374	0.00
Slope (%) :	6	0.5	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.15	0.10	0.00
Computed Flow Time (min) :	33.32	61.69	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	74	0.00	0.00
Slope (%) :	0.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.49	0.00	0.00
Computed Flow Time (min) :	2.52	0.00	0.00

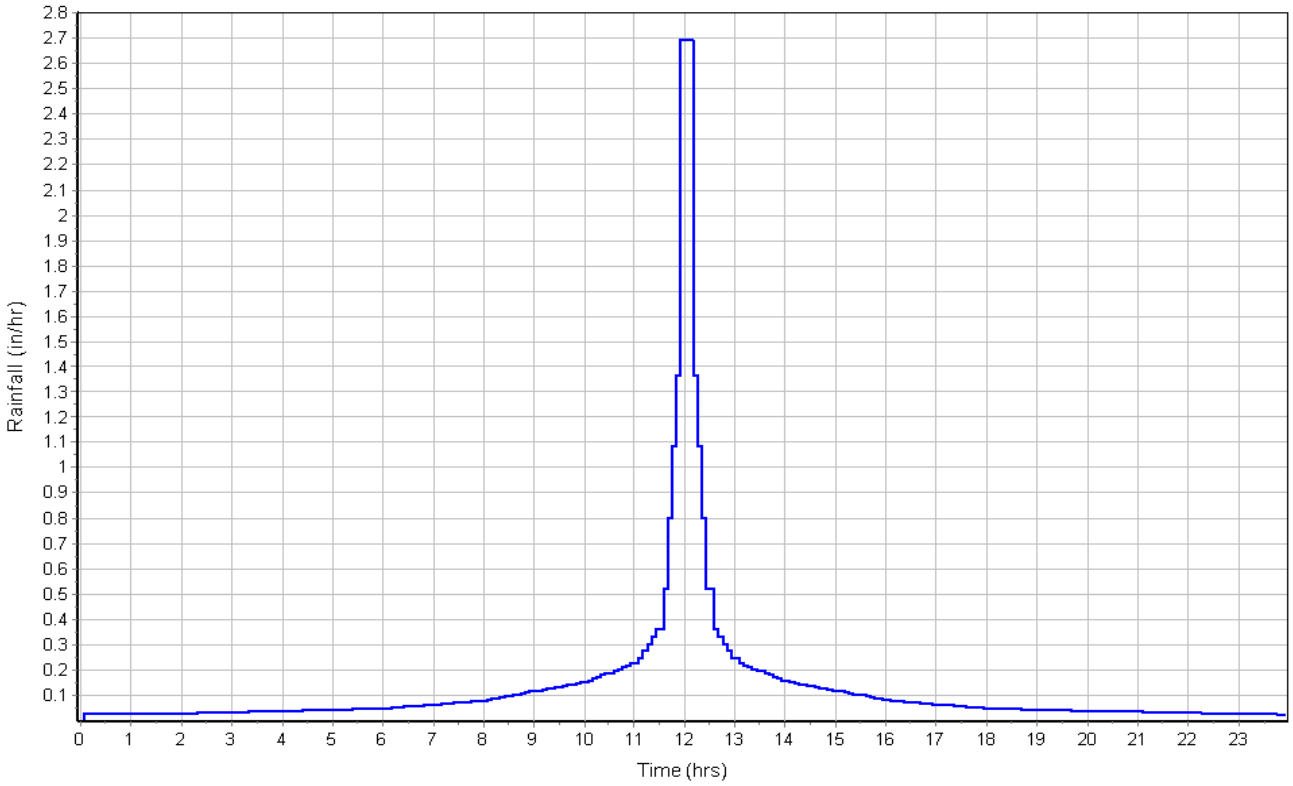
Total TOC (min) 48.77

Subbasin Runoff Results

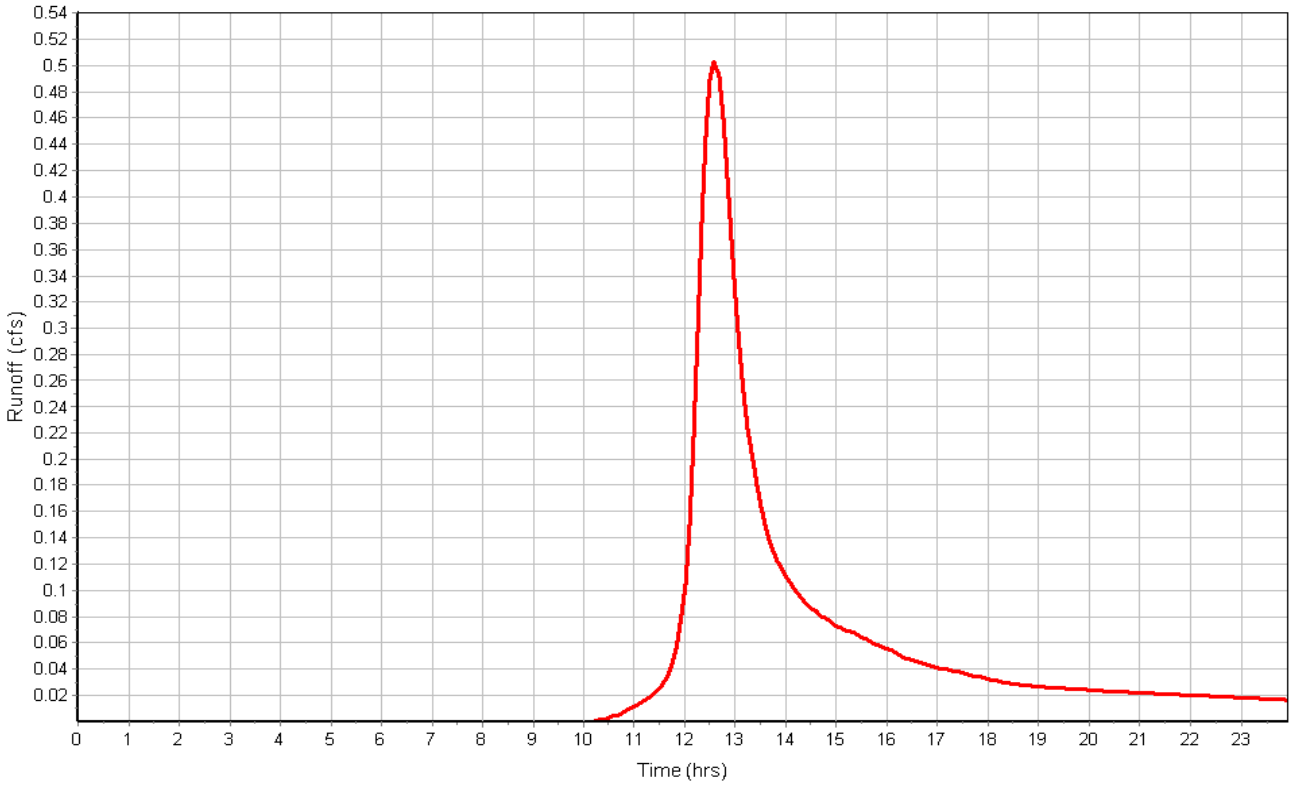
Total Rainfall (in) 3.20
Total Runoff (in) 1.29
Peak Runoff (cfs) 0.50
Weighted Curve Number 78.23
Time of Concentration (days hh:mm:ss) 0 00:48:46

Subbasin : Basin3A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin4

Input Data

Area (ac) 1.46
Weighted Curve Number 77.50
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.92	D	77.00
Meadow, non-grazed	0.53	D	78.00
Gravel roads	0.01	D	91.00
Composite Area & Weighted CN	1.46		77.50

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	144	114	0.00
Slope (%) :	20.8	5.3	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.21	0.20	0.00
Computed Flow Time (min) :	11.27	9.27	0.00

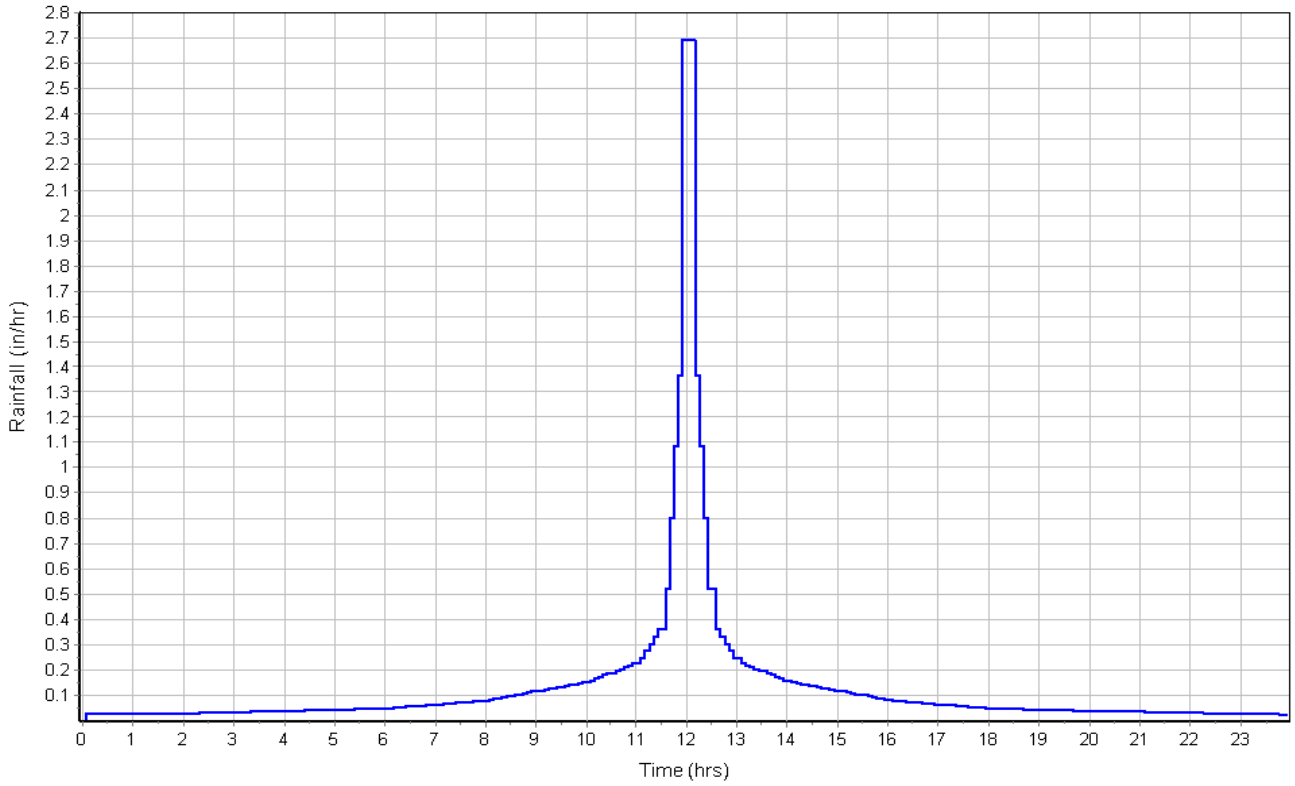
Total TOC (min) 10.27

Subbasin Runoff Results

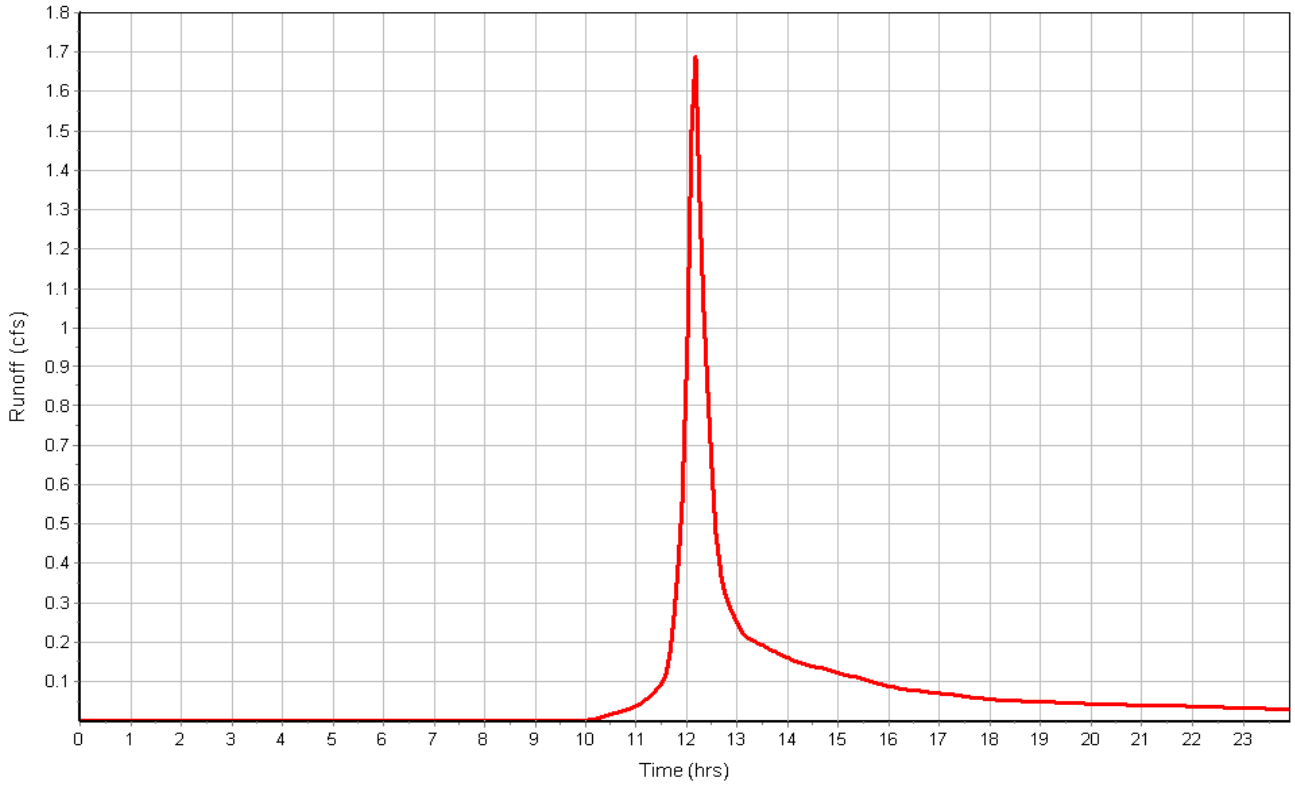
Total Rainfall (in) 3.20
Total Runoff (in) 1.24
Peak Runoff (cfs) 1.71
Weighted Curve Number 77.50
Time of Concentration (days hh:mm:ss) 0 00:10:16

Subbasin : Basin4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin5

Input Data

Area (ac) 0.56
Weighted Curve Number 78.34
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.17	D	77.00
Meadow, non-grazed	0.36	D	78.00
Gravel roads	0.03	D	91.00
Composite Area & Weighted CN	0.56		78.34

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.2	.01	0.00
Flow Length (ft) :	60	90	0.00
Slope (%) :	6.7	2.2	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.20	1.51	0.00
Computed Flow Time (min) :	5.05	0.99	0.00

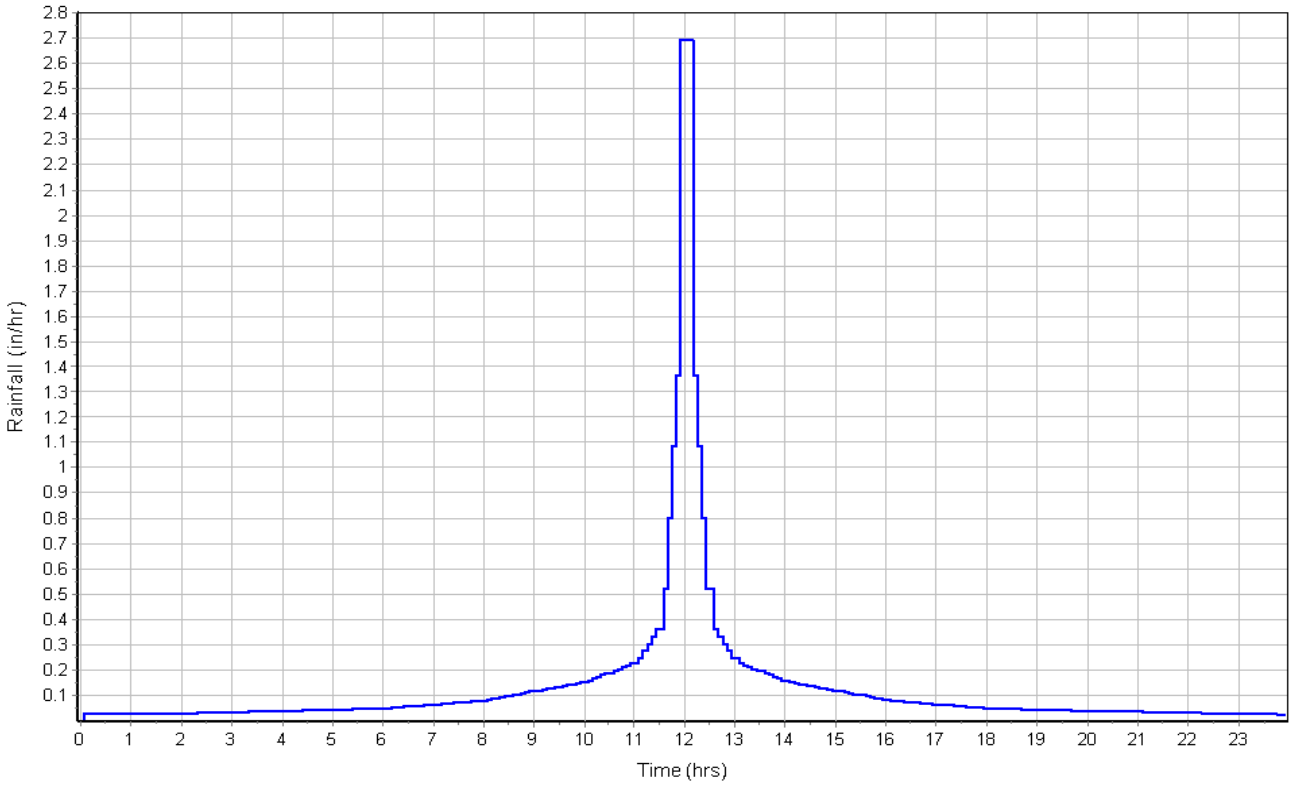
Total TOC (min) 3.02

Subbasin Runoff Results

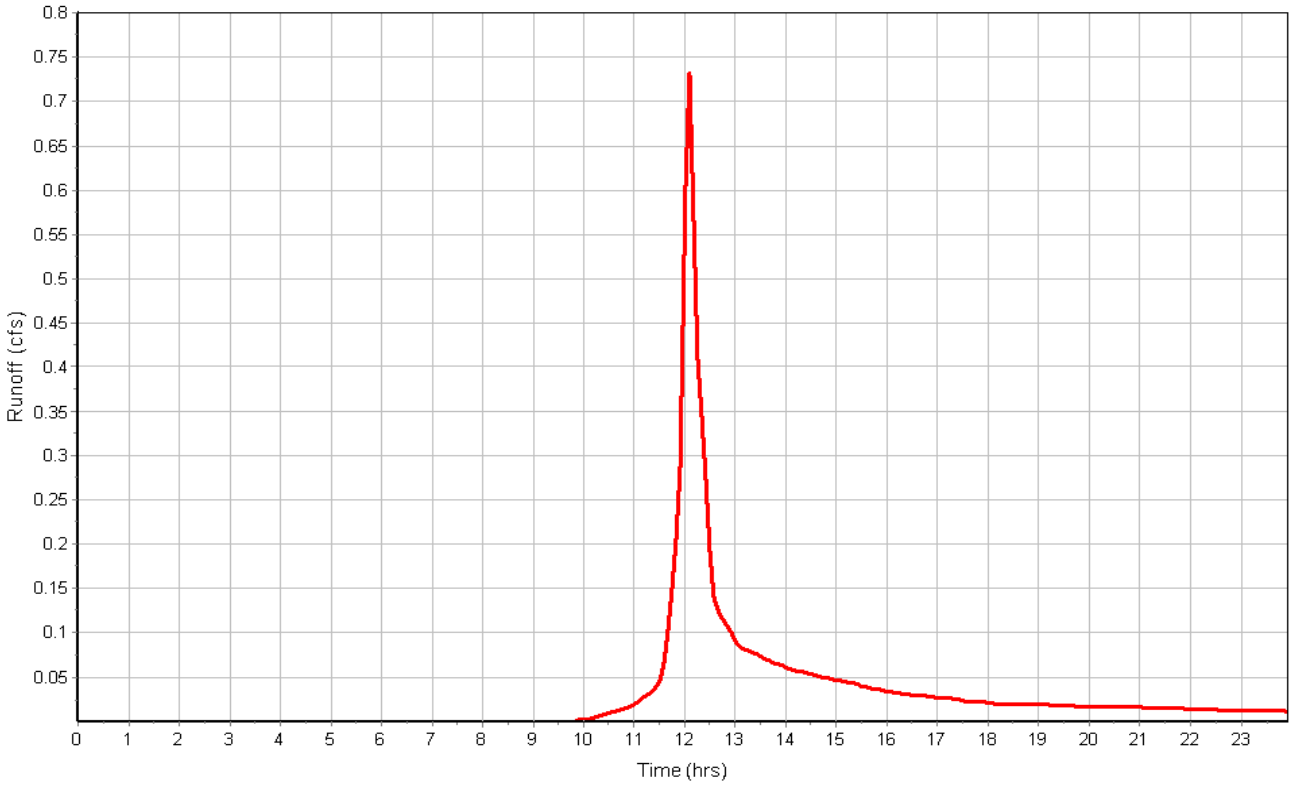
Total Rainfall (in) 3.20
Total Runoff (in) 1.30
Peak Runoff (cfs) 0.76
Weighted Curve Number 78.34
Time of Concentration (days hh:mm:ss) 0 00:03:01

Subbasin : Basin5

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin6

Input Data

Area (ac) 0.33
Weighted Curve Number 77.00
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.33	D	77.00
Composite Area & Weighted CN	0.33		77.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	159	0.00	0.00
Slope (%) :	16.4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.20	0.00	0.00
Velocity (ft/sec) :	0.20	0.00	0.00
Computed Flow Time (min) :	13.41	0.00	0.00

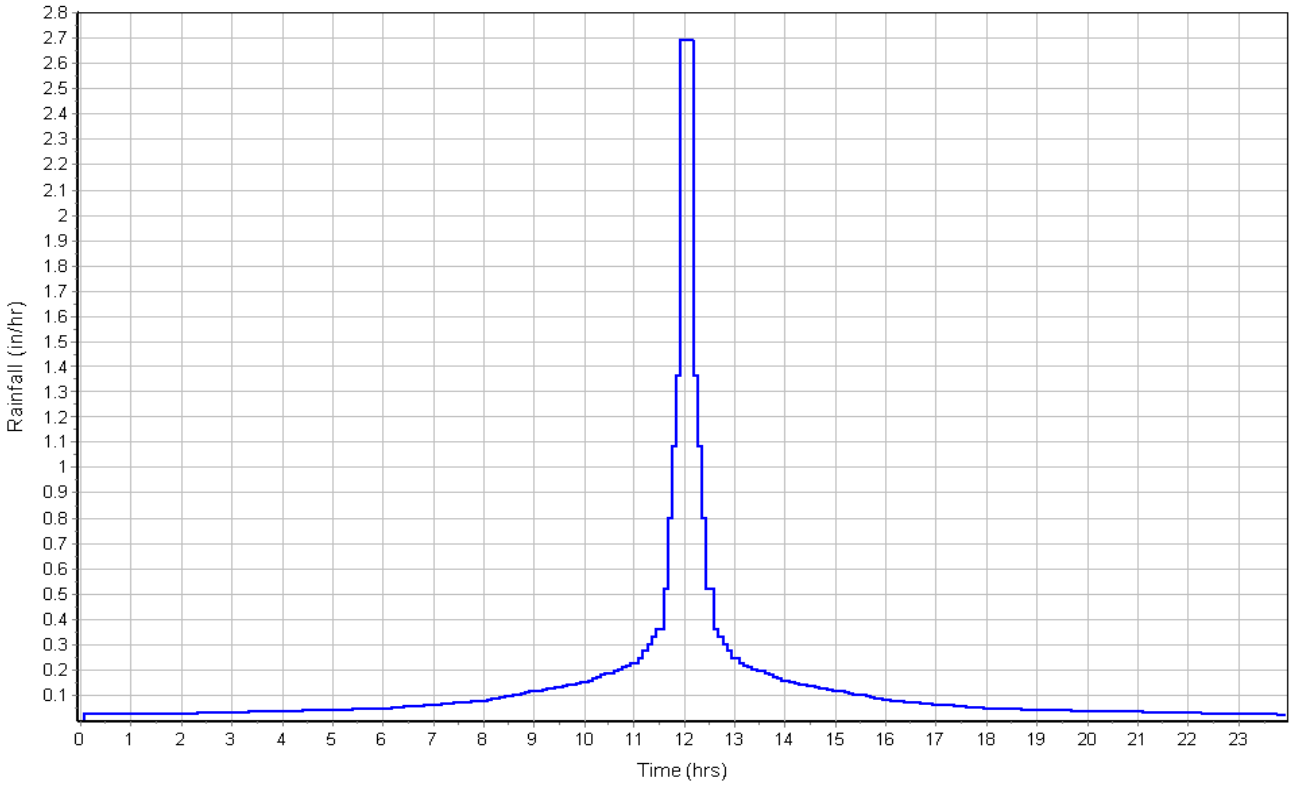
Total TOC (min) 13.41

Subbasin Runoff Results

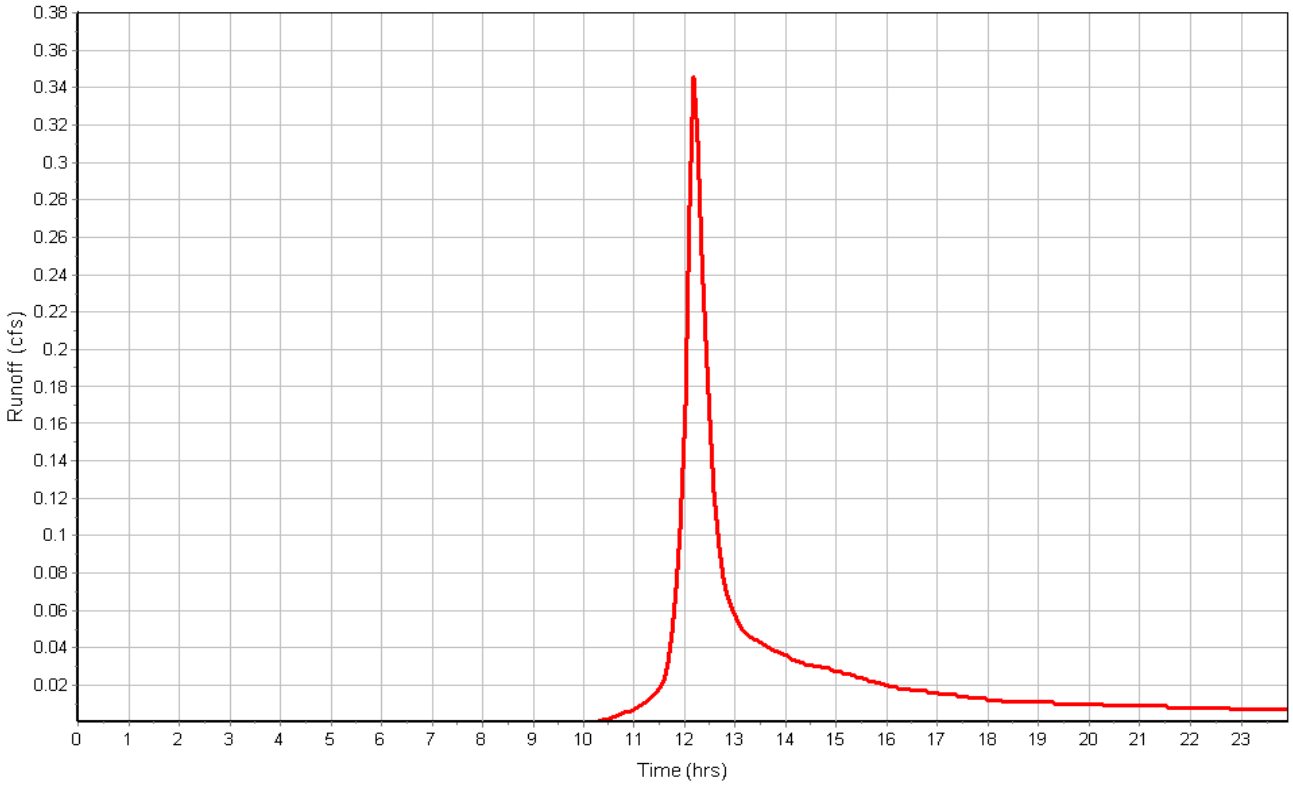
Total Rainfall (in) 3.20
Total Runoff (in) 1.21
Peak Runoff (cfs) 0.35
Weighted Curve Number 77.00
Time of Concentration (days hh:mm:ss) 0 00:13:25

Subbasin : Basin6

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Swale

Input Data

Invert Elevation (ft)	-0.50
Max (Rim) Elevation (ft)	1.00
Max (Rim) Offset (ft)	1.50
Initial Water Elevation (ft)	-0.50
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Level Spreader	Trapezoidal	No	0.00	0.50	6.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	0.50
Peak Lateral Inflow (cfs)	0.50
Peak Outflow (cfs)	0.50
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	0.09
Max HGL Depth Attained (ft)	0.59
Average HGL Elevation Attained (ft)	-0.23
Average HGL Depth Attained (ft)	0.27
Time of Max HGL Occurrence (days hh:mm)	0 12:40
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name ..... Dover_PostDev_rev.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	May 19, 2016	00:00:00
End Analysis On	May 20, 2016	00:00:00
Start Reporting On	May 19, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	7
Nodes	7
Junctions	0
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	1
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage	Time Series	10YR-24HR	Intensity	inches	Massachusetts	Norfolk	10	4.70	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Basin1	2.02	79.17	4.70	2.56	5.17	2.79	0 00:48:00
2	Basin2	3.06	77.98	4.70	2.46	7.51	5.38	0 00:25:46
3	Basin3	2.42	77.52	4.70	2.42	5.85	4.86	0 00:17:17
4	Basin3A	0.75	78.23	4.70	2.48	1.86	0.99	0 00:48:46
5	Basin4	1.46	77.50	4.70	2.42	3.53	3.37	0 00:10:16
6	Basin5	0.56	78.34	4.70	2.49	1.39	1.45	0 00:05:00
7	Basin6	0.33	77.00	4.70	2.37	0.77	0.70	0 00:13:24

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	-1.00					2.78	-1.00					
2	Out-02	Outfall	-1.00					5.34	-1.00					
3	Out-03	Outfall	-1.00					5.34	-1.00					
4	Out-04	Outfall	-1.00					3.31	-1.00					
5	Out-05	Outfall	-1.00					1.42	-1.00					
6	Out-06	Outfall	-1.00					0.69	-1.00					
7	Swale	Storage Node	-0.50	1.00	-0.50		0.00	0.99	0.13				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Level Spreader	Weir	Swale	Out-03		-0.50	-1.00				0.99							

Subbasin Hydrology

Subbasin : Basin1

Input Data

Area (ac) 2.02
Weighted Curve Number 79.17
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.18	D	91.00
Meadow, non-grazed	1.84	D	78.00
Composite Area & Weighted CN	2.02		79.17

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.00	0.2	0.00
Flow Length (ft) :	0.00	300	0.00
Slope (%) :	0.00	1.1	0.00
2 yr, 24 hr Rainfall (in) :	0.00	3.20	0.00
Velocity (ft/sec) :	0.00	0.13	0.00
Computed Flow Time (min) :	0.00	37.73	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	450	0.00
Slope (%) :	0.00	1.1	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	0.73	0.00
Computed Flow Time (min) :	0.00	10.27	0.00

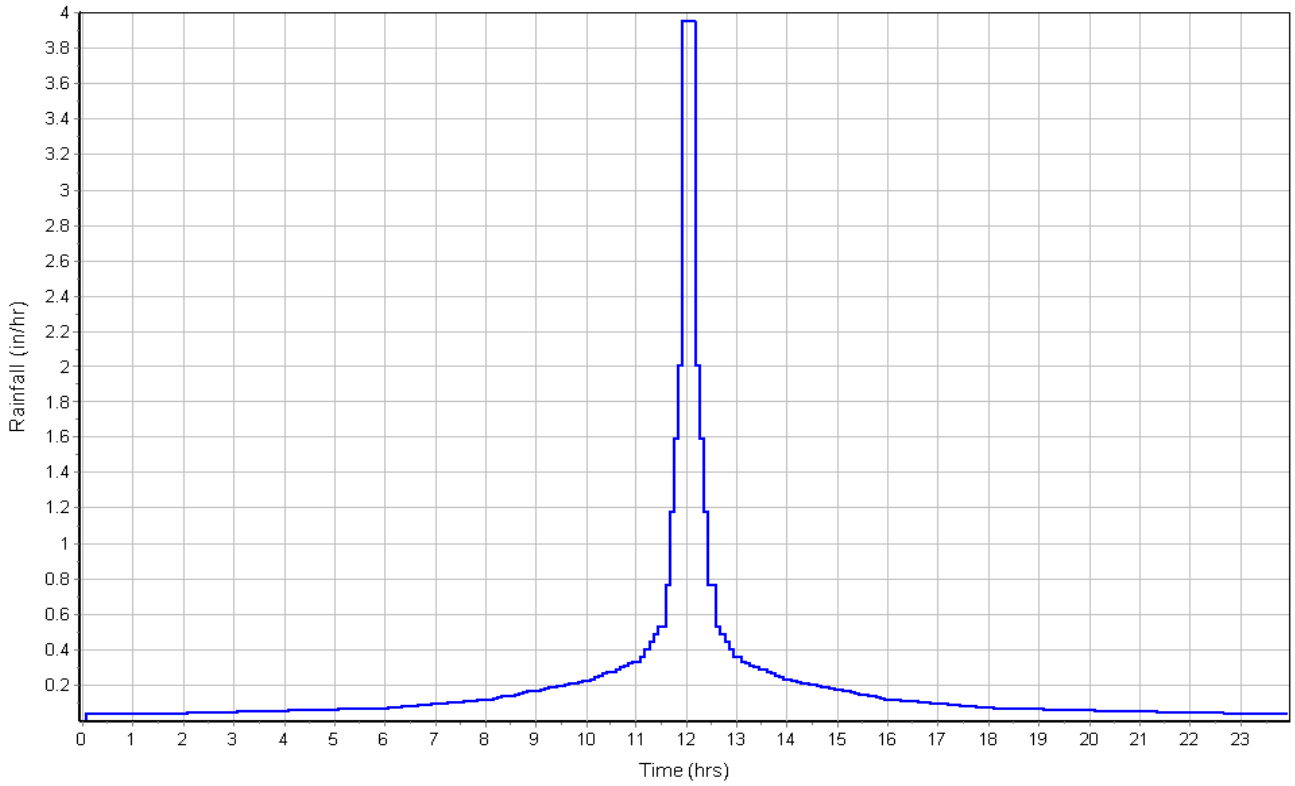
Total TOC (min) 48.00

Subbasin Runoff Results

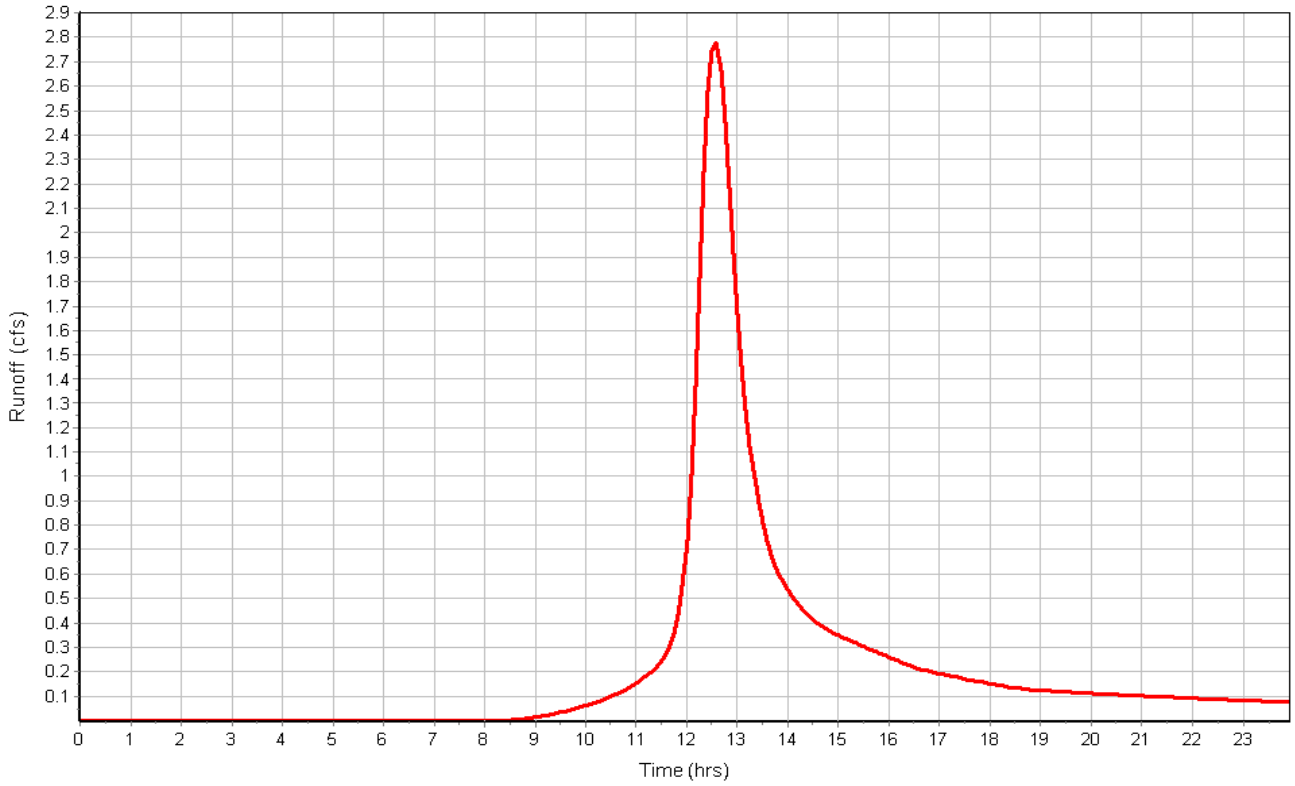
Total Rainfall (in)	4.70
Total Runoff (in)	2.56
Peak Runoff (cfs)	2.79
Weighted Curve Number	79.17
Time of Concentration (days hh:mm:ss)	0 00:48:00

Subbasin : Basin1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin2

Input Data

Area (ac) 3.06
Weighted Curve Number 77.98
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.06	D	91.00
Meadow, non-grazed	2.14	D	78.00
Woods, Good	0.86	D	77.00
Composite Area & Weighted CN	3.06		77.98

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.00	0.2	0.00
Flow Length (ft) :	0.00	300	0.00
Slope (%) :	0.00	3.8	0.00
2 yr, 24 hr Rainfall (in) :	0.00	3.20	0.00
Velocity (ft/sec) :	0.00	0.22	0.00
Computed Flow Time (min) :	0.00	22.98	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	228	0.00
Slope (%) :	0.00	3.8	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	1.36	0.00
Computed Flow Time (min) :	0.00	2.79	0.00

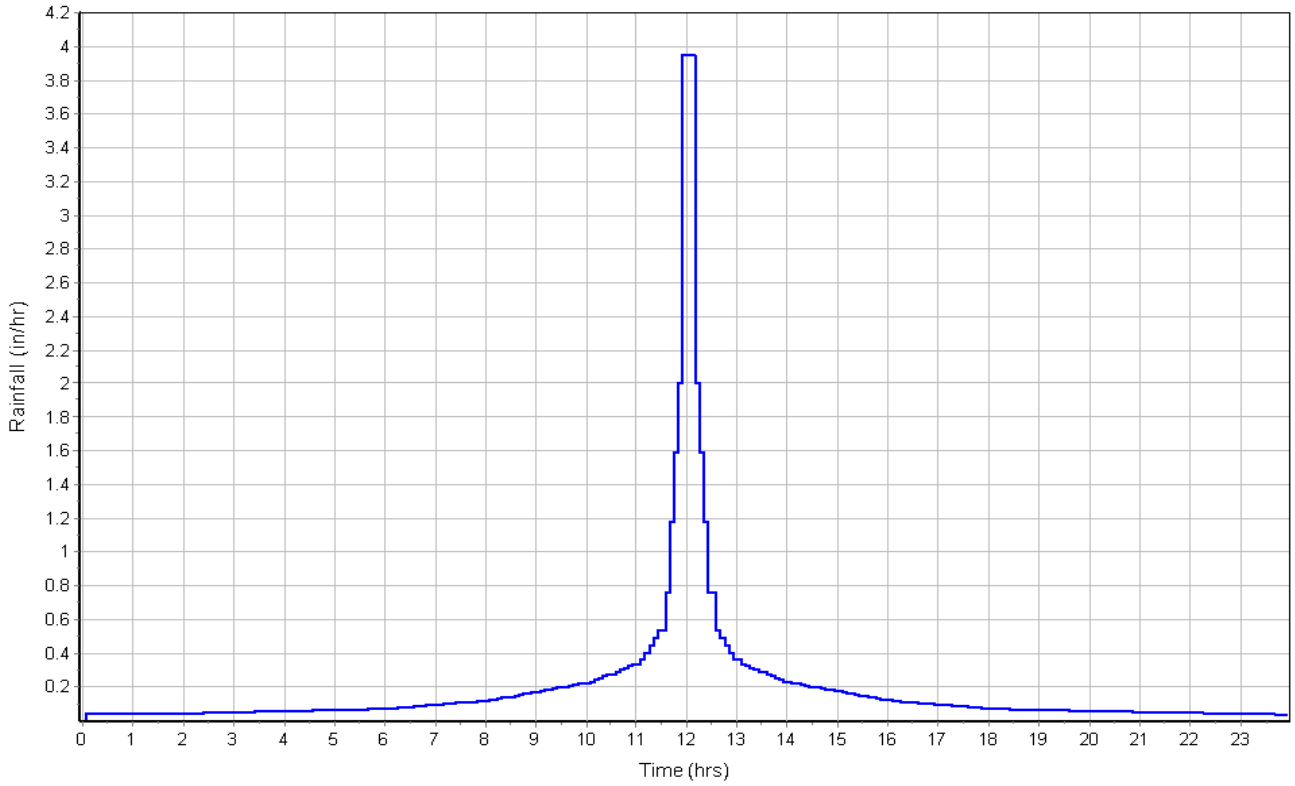
Total TOC (min) 25.77

Subbasin Runoff Results

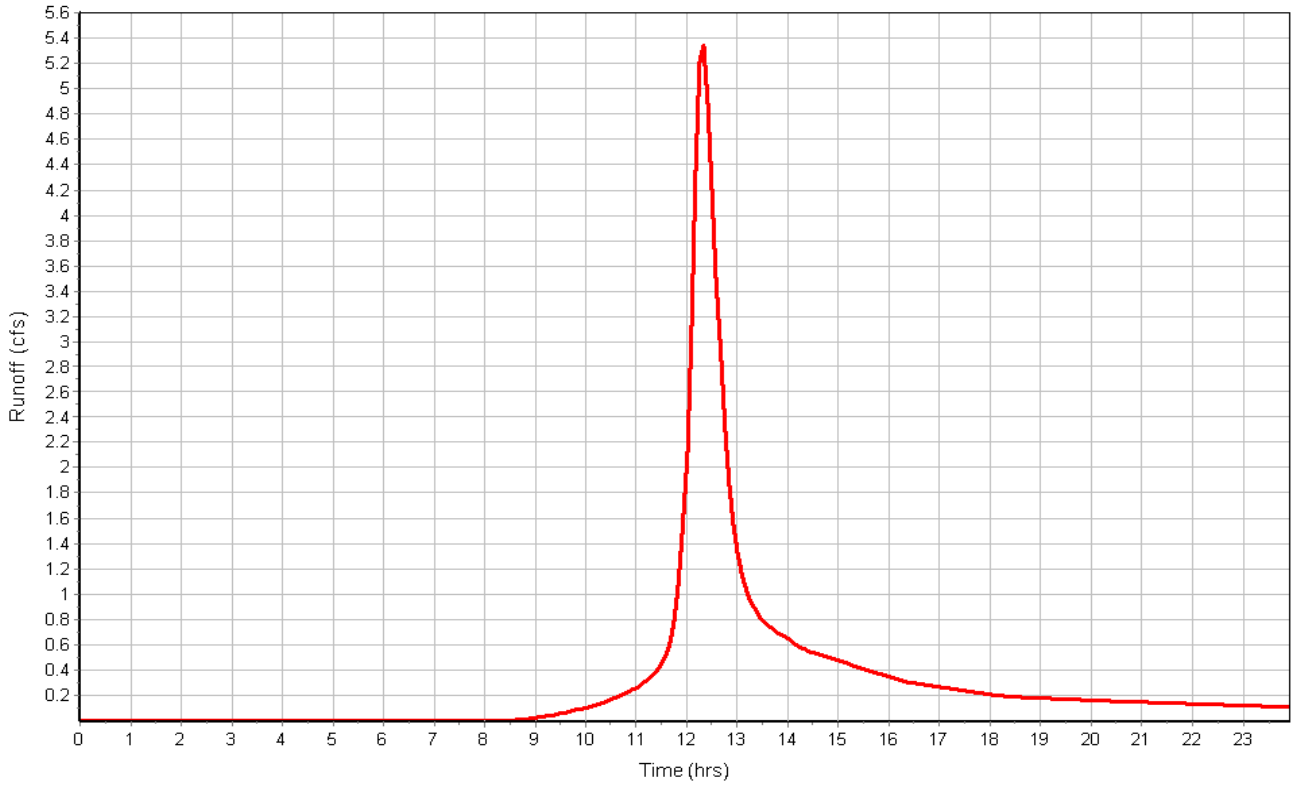
Total Rainfall (in) 4.70
Total Runoff (in) 2.46
Peak Runoff (cfs) 5.38
Weighted Curve Number 77.98
Time of Concentration (days hh:mm:ss) 0 00:25:46

Subbasin : Basin2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin3

Input Data

Area (ac) 2.42
Weighted Curve Number 77.52
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	1.79	D	77.00
Meadow, non-grazed	0.58	D	78.00
Gravel roads	0.05	D	91.00
Composite Area & Weighted CN	2.42		77.52

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	.01	0.00
Flow Length (ft) :	300	12	0.00
Slope (%) :	7.8	4.2	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.17	1.31	0.00
Computed Flow Time (min) :	30.00	0.15	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	372	0.00	0.00
Slope (%) :	7.8	0.00	0.00
Surface Type :	Woodland	Grass pasture	Unpaved
Velocity (ft/sec) :	1.40	0.00	0.00
Computed Flow Time (min) :	4.43	0.00	0.00

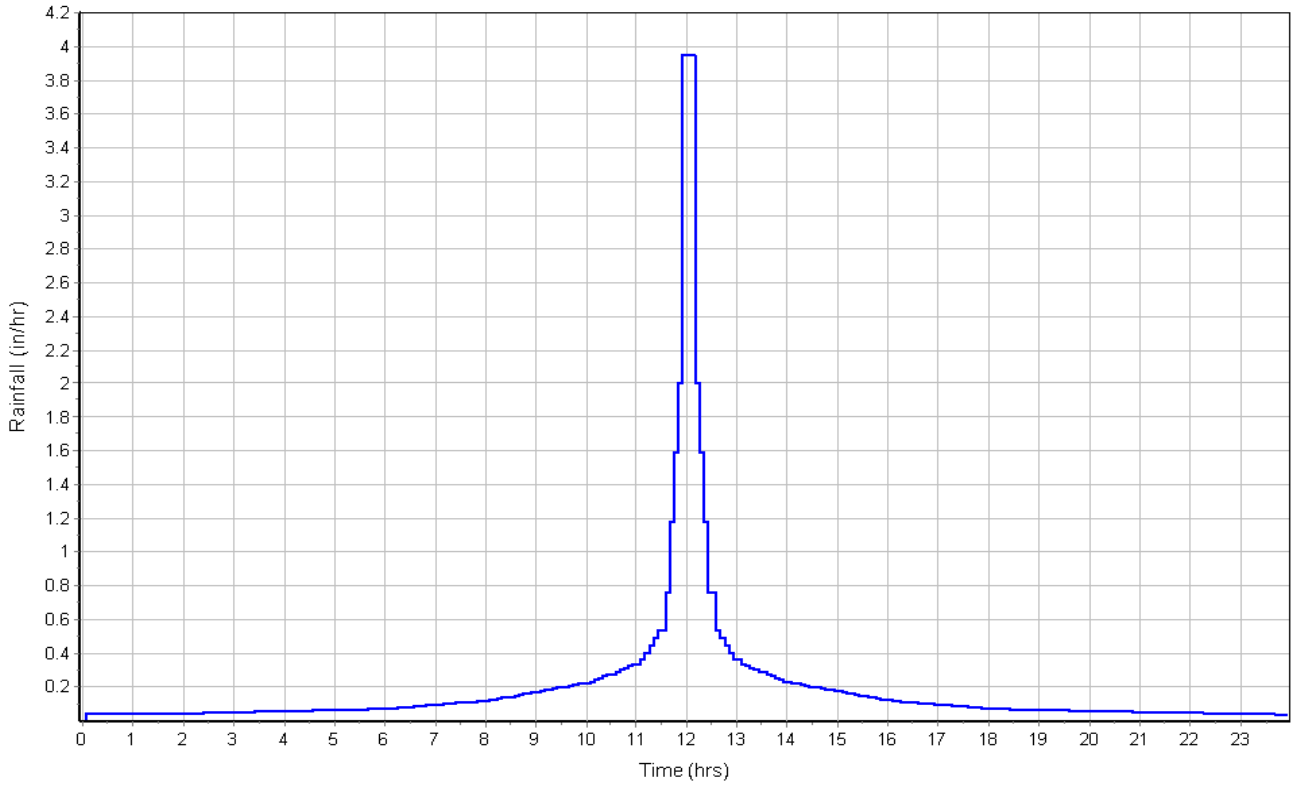
Total TOC (min) 17.29

Subbasin Runoff Results

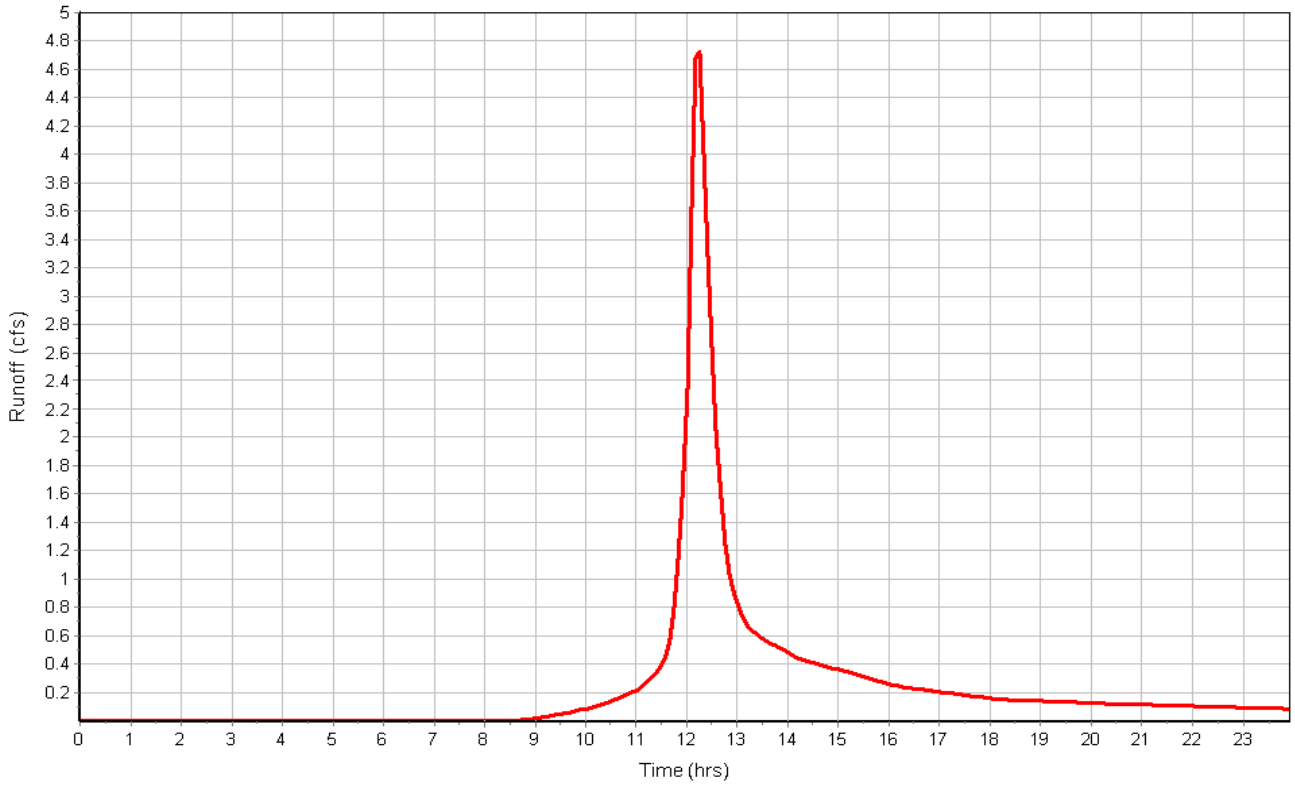
Total Rainfall (in) 4.70
Total Runoff (in) 2.42
Peak Runoff (cfs) 4.86
Weighted Curve Number 77.52
Time of Concentration (days hh:mm:ss) 0 00:17:17

Subbasin : Basin3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin3A

Input Data

Area (ac) 0.75
Weighted Curve Number 78.23
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.12	D	77.00
Meadow, non-grazed	0.61	D	78.00
Gravel roads	0.02	D	91.00
Composite Area & Weighted CN	0.75		78.23

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	300	374	0.00
Slope (%) :	6	0.5	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.15	0.10	0.00
Computed Flow Time (min) :	33.32	61.69	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	74	0.00	0.00
Slope (%) :	0.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.49	0.00	0.00
Computed Flow Time (min) :	2.52	0.00	0.00

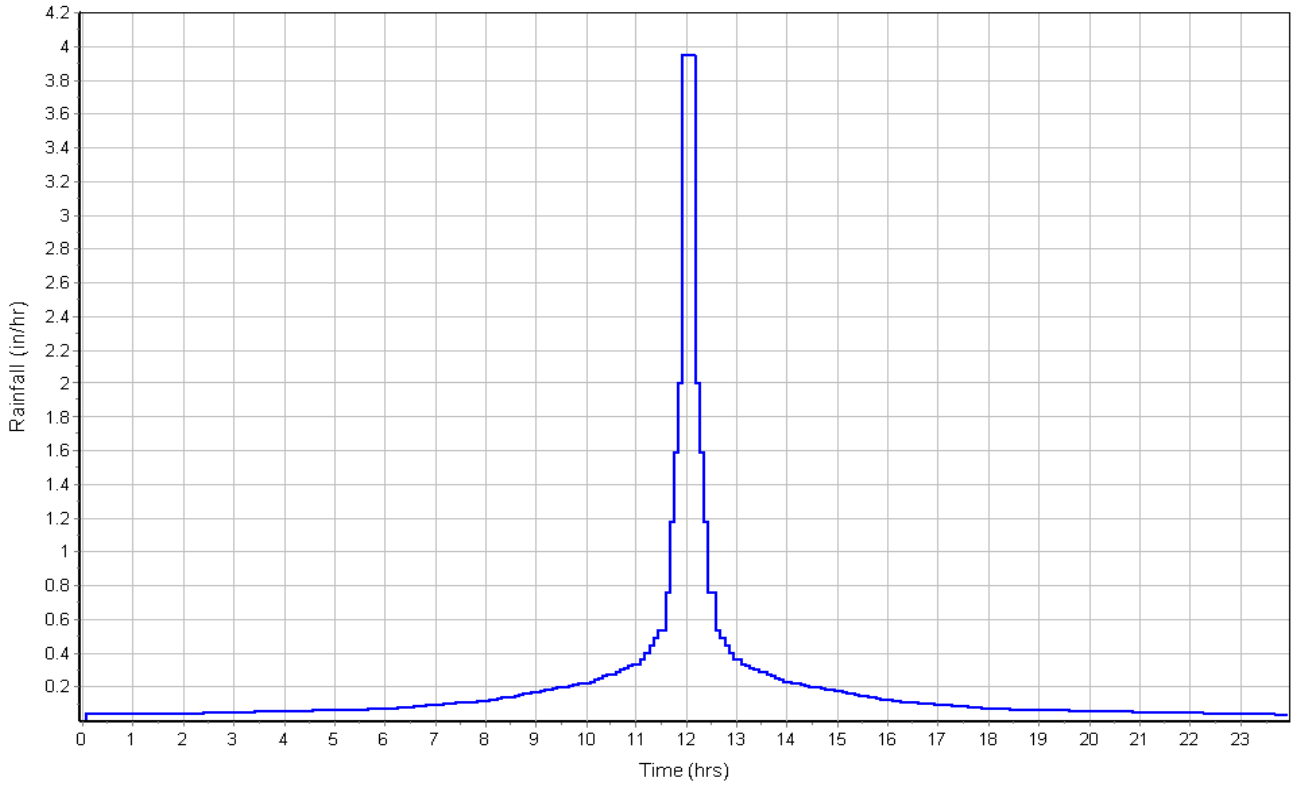
Total TOC (min) 48.77

Subbasin Runoff Results

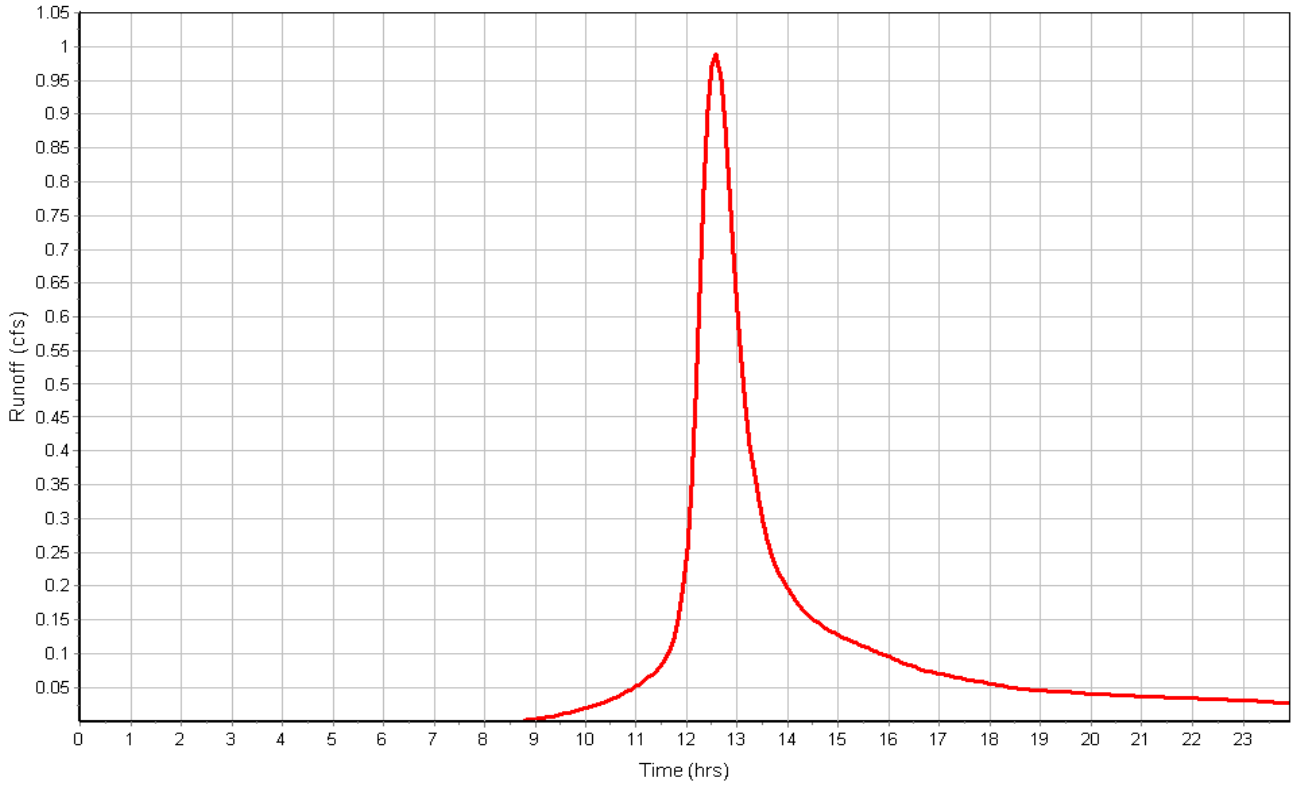
Total Rainfall (in) 4.70
Total Runoff (in) 2.48
Peak Runoff (cfs) 0.99
Weighted Curve Number 78.23
Time of Concentration (days hh:mm:ss) 0 00:48:46

Subbasin : Basin3A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin4

Input Data

Area (ac) 1.46
Weighted Curve Number 77.50
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.92	D	77.00
Meadow, non-grazed	0.53	D	78.00
Gravel roads	0.01	D	91.00
Composite Area & Weighted CN	1.46		77.50

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	144	114	0.00
Slope (%) :	20.8	5.3	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.21	0.20	0.00
Computed Flow Time (min) :	11.27	9.27	0.00

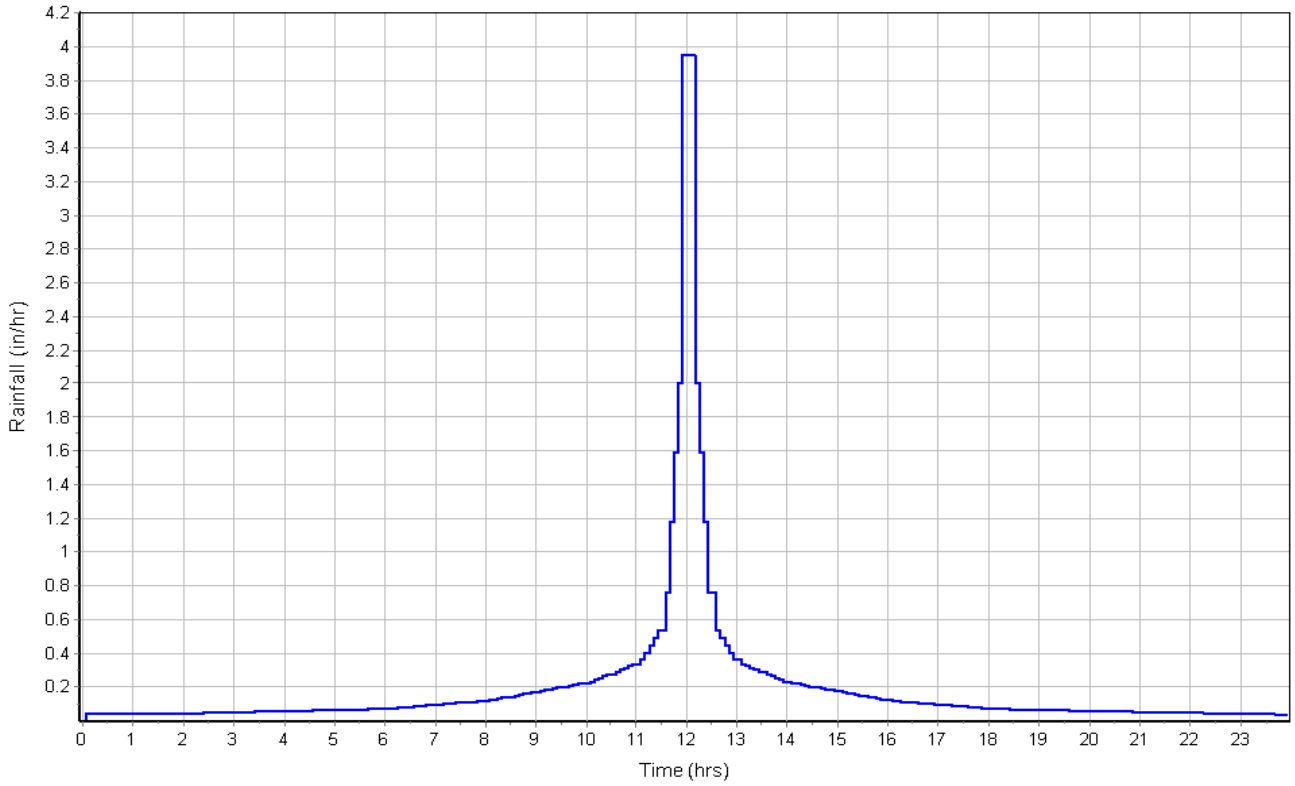
Total TOC (min) 10.27

Subbasin Runoff Results

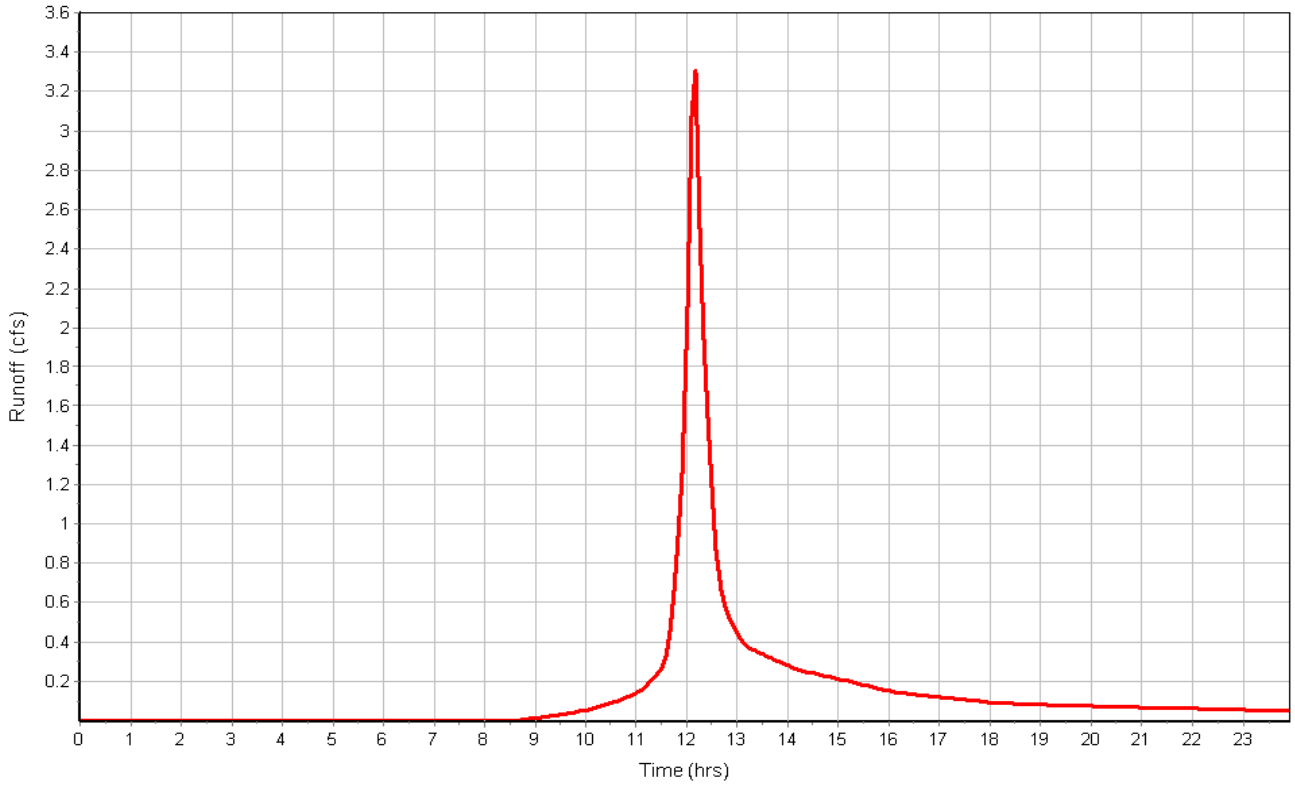
Total Rainfall (in) 4.70
Total Runoff (in) 2.42
Peak Runoff (cfs) 3.37
Weighted Curve Number 77.50
Time of Concentration (days hh:mm:ss) 0 00:10:16

Subbasin : Basin4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin5

Input Data

Area (ac) 0.56
Weighted Curve Number 78.34
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.17	D	77.00
Meadow, non-grazed	0.36	D	78.00
Gravel roads	0.03	D	91.00
Composite Area & Weighted CN	0.56		78.34

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.2	.01	0.00
Flow Length (ft) :	60	90	0.00
Slope (%) :	6.7	2.2	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.20	1.51	0.00
Computed Flow Time (min) :	5.05	0.99	0.00

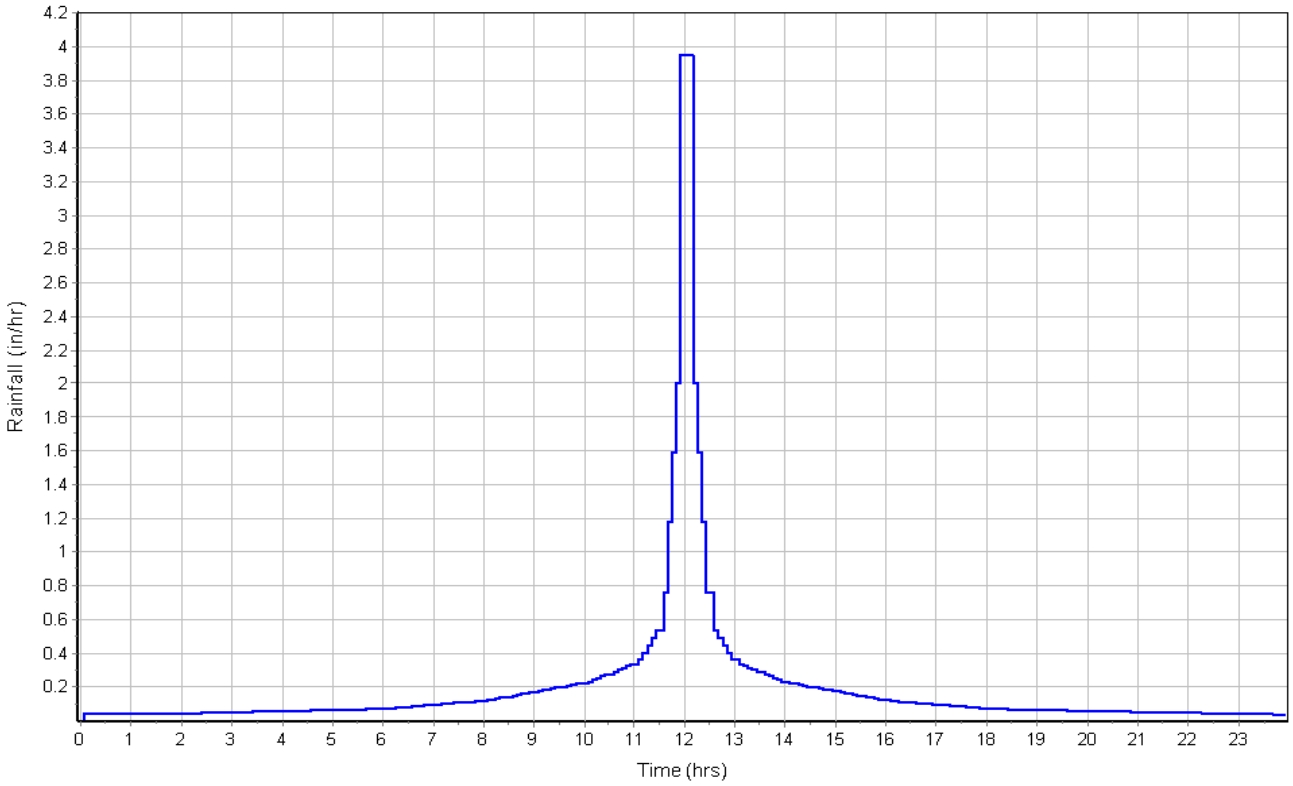
Total TOC (min) 3.02

Subbasin Runoff Results

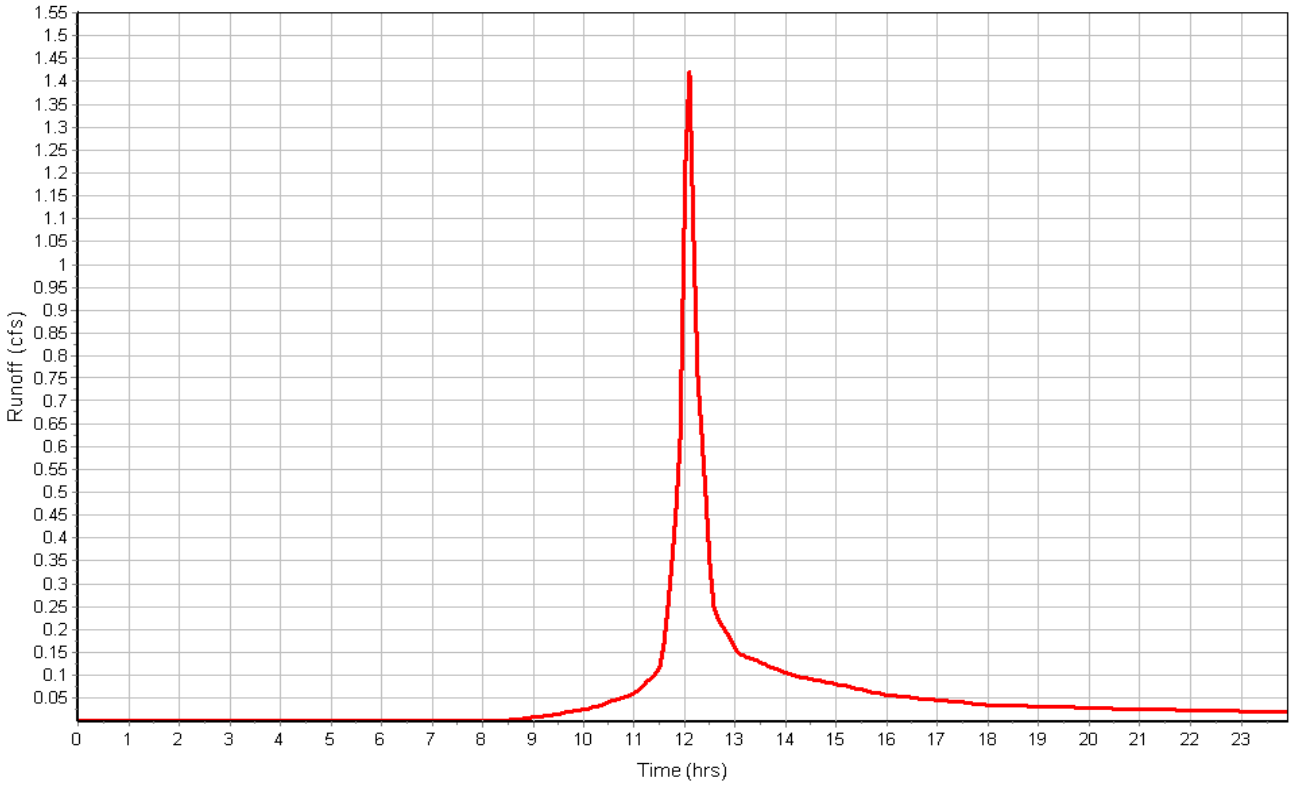
Total Rainfall (in) 4.70
Total Runoff (in) 2.49
Peak Runoff (cfs) 1.45
Weighted Curve Number 78.34
Time of Concentration (days hh:mm:ss) 0 00:03:01

Subbasin : Basin5

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin6

Input Data

Area (ac) 0.33
Weighted Curve Number 77.00
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.33	D	77.00
Composite Area & Weighted CN	0.33		77.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	159	0.00	0.00
Slope (%) :	16.4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.20	0.00	0.00
Velocity (ft/sec) :	0.20	0.00	0.00
Computed Flow Time (min) :	13.41	0.00	0.00

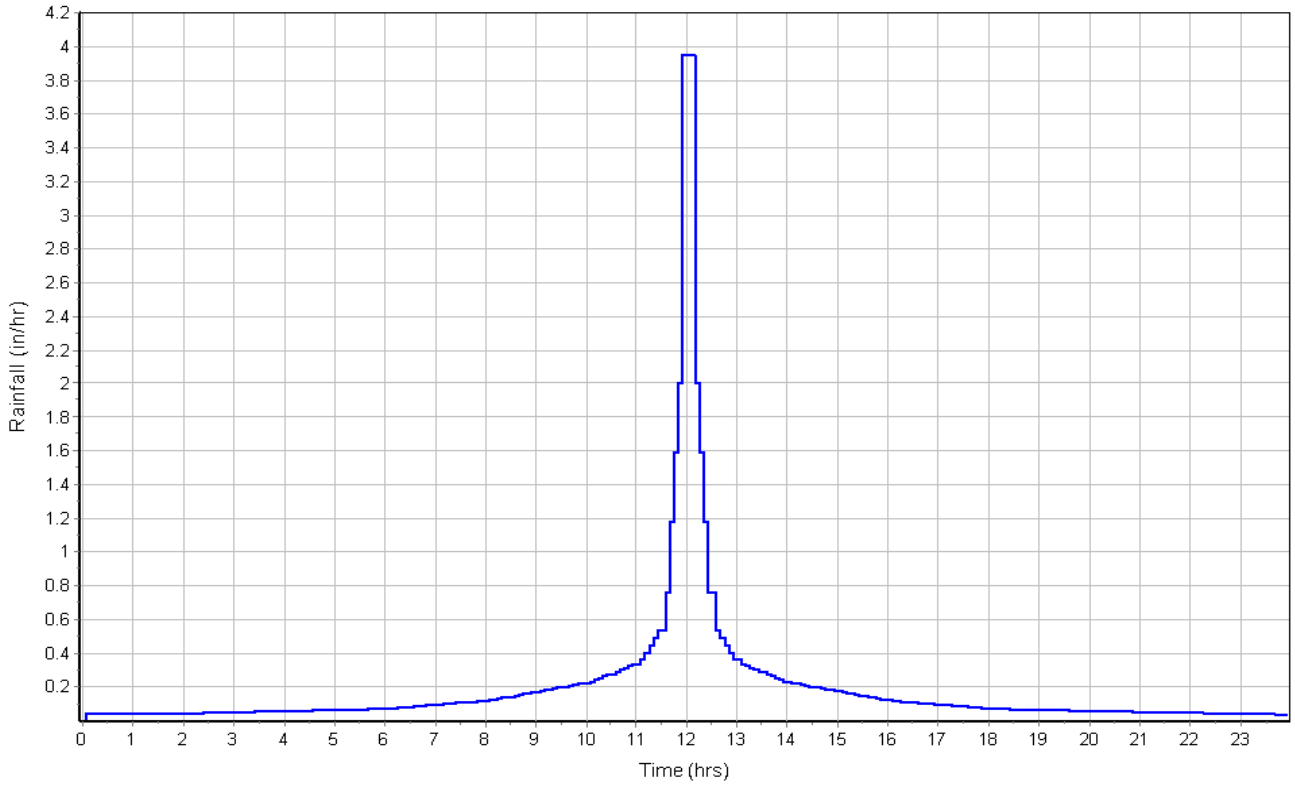
Total TOC (min) 13.41

Subbasin Runoff Results

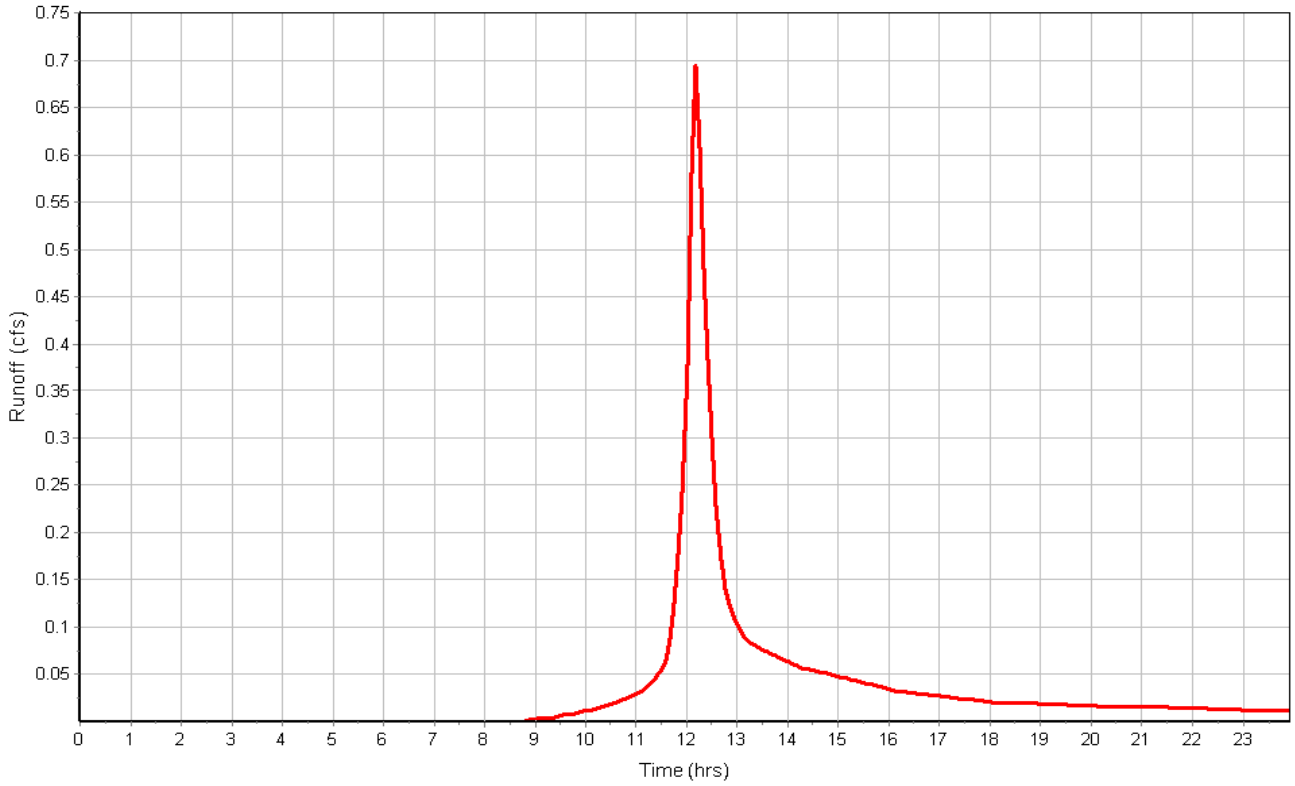
Total Rainfall (in) 4.70
Total Runoff (in) 2.37
Peak Runoff (cfs) 0.70
Weighted Curve Number 77.00
Time of Concentration (days hh:mm:ss) 0 00:13:25

Subbasin : Basin6

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Swale

Input Data

Invert Elevation (ft)	-0.50
Max (Rim) Elevation (ft)	1.00
Max (Rim) Offset (ft)	1.50
Initial Water Elevation (ft)	-0.50
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Level Spreader	Trapezoidal	No	0.00	0.50	6.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	0.99
Peak Lateral Inflow (cfs)	0.99
Peak Outflow (cfs)	0.99
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	0.13
Max HGL Depth Attained (ft)	0.63
Average HGL Elevation Attained (ft)	-0.20
Average HGL Depth Attained (ft)	0.3
Time of Max HGL Occurrence (days hh:mm)	0 12:40
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name	Dover_PostDev_rev.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	May 19, 2016	00:00:00
End Analysis On	May 20, 2016	00:00:00
Start Reporting On	May 19, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	7
Nodes	7
Junctions	0
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	1
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage	Time Series	100YR-24HR	Intensity	inches	Massachusetts	Norfolk	100	6.70	SCS Type III 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Basin1	2.02	79.17	6.70	4.33	8.74	4.70	0 00:48:00
2	Basin2	3.06	77.98	6.70	4.20	12.84	9.20	0 00:25:46
3	Basin3	2.42	77.52	6.70	4.15	10.05	8.33	0 00:17:17
4	Basin3A	0.75	78.23	6.70	4.23	3.17	1.69	0 00:48:46
5	Basin4	1.46	77.50	6.70	4.15	6.07	5.76	0 00:10:16
6	Basin5	0.56	78.34	6.70	4.24	2.37	2.43	0 00:05:00
7	Basin6	0.33	77.00	6.70	4.10	1.33	1.20	0 00:13:24

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	-1.00					4.68	-1.00					
2	Out-02	Outfall	-1.00					9.09	-1.00					
3	Out-03	Outfall	-1.00					9.16	-1.00					
4	Out-04	Outfall	-1.00					5.62	-1.00					
5	Out-05	Outfall	-1.00					2.40	-1.00					
6	Out-06	Outfall	-1.00					1.20	-1.00					
7	Swale	Storage Node	-0.50	1.00	-0.50		0.00	1.68	0.19				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Level Spreader	Weir	Swale	Out-03		-0.50	-1.00				1.68							

Subbasin Hydrology

Subbasin : Basin1

Input Data

Area (ac) 2.02
Weighted Curve Number 79.17
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.18	D	91.00
Meadow, non-grazed	1.84	D	78.00
Composite Area & Weighted CN	2.02		79.17

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.00	0.2	0.00
Flow Length (ft) :	0.00	300	0.00
Slope (%) :	0.00	1.1	0.00
2 yr, 24 hr Rainfall (in) :	0.00	3.20	0.00
Velocity (ft/sec) :	0.00	0.13	0.00
Computed Flow Time (min) :	0.00	37.73	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	450	0.00
Slope (%) :	0.00	1.1	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	0.73	0.00
Computed Flow Time (min) :	0.00	10.27	0.00

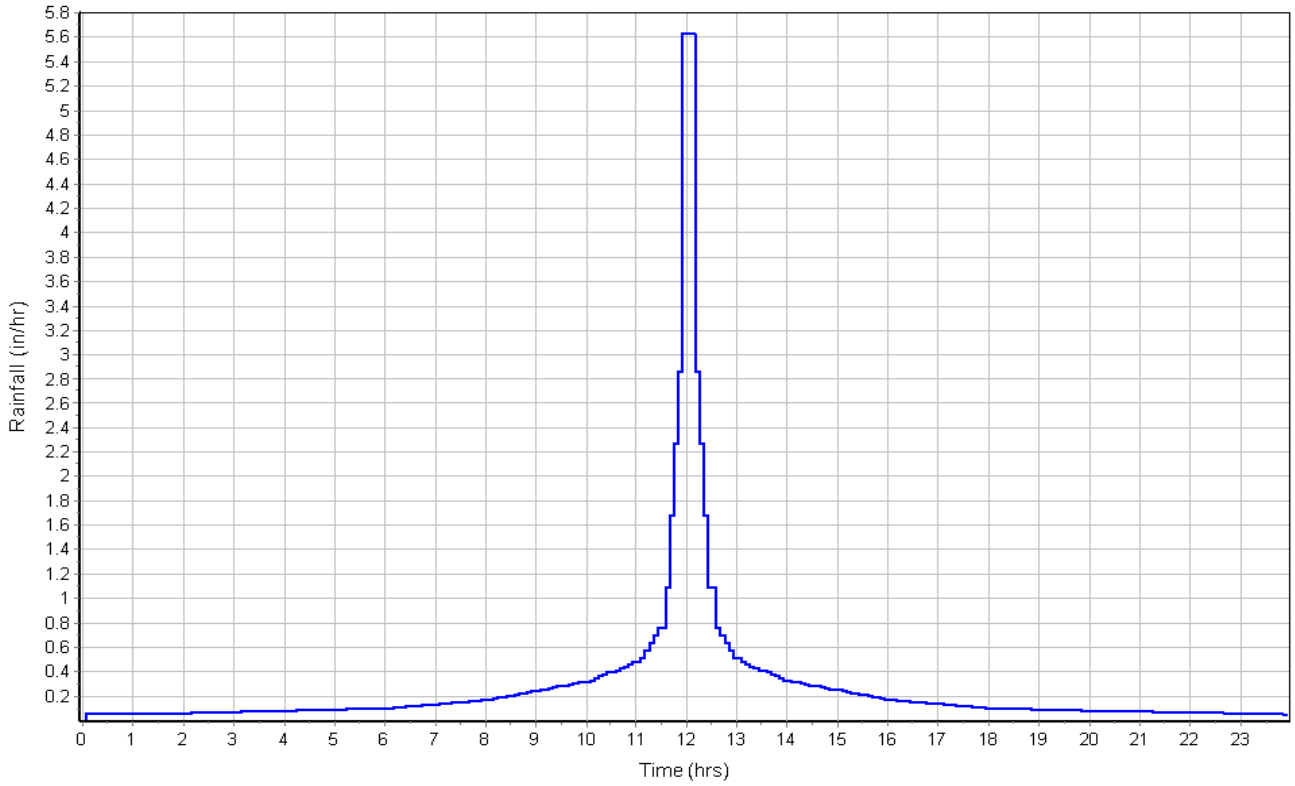
Total TOC (min) 48.00

Subbasin Runoff Results

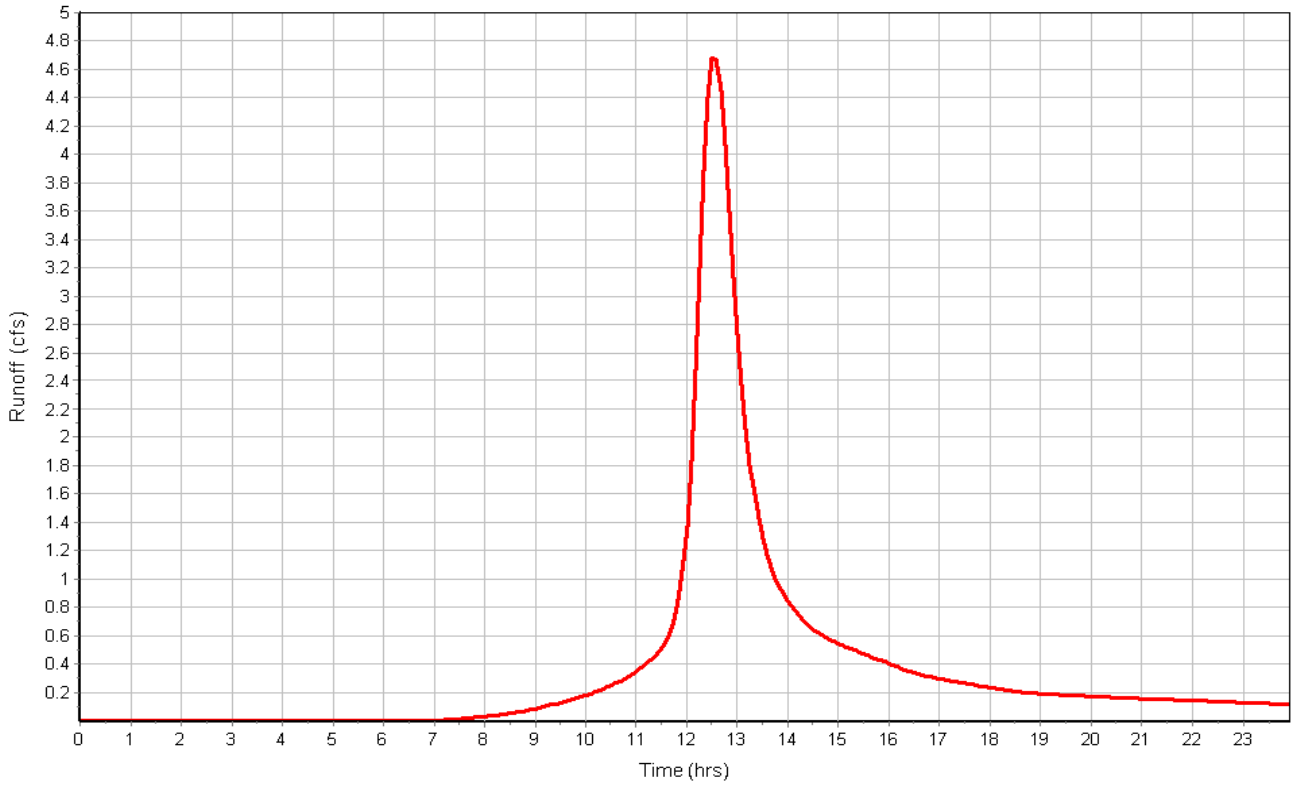
Total Rainfall (in)	6.70
Total Runoff (in)	4.33
Peak Runoff (cfs)	4.70
Weighted Curve Number	79.17
Time of Concentration (days hh:mm:ss)	0 00:48:00

Subbasin : Basin1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin2

Input Data

Area (ac) 3.06
Weighted Curve Number 77.98
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.06	D	91.00
Meadow, non-grazed	2.14	D	78.00
Woods, Good	0.86	D	77.00
Composite Area & Weighted CN	3.06		77.98

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.00	0.2	0.00
Flow Length (ft) :	0.00	300	0.00
Slope (%) :	0.00	3.8	0.00
2 yr, 24 hr Rainfall (in) :	0.00	3.20	0.00
Velocity (ft/sec) :	0.00	0.22	0.00
Computed Flow Time (min) :	0.00	22.98	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	0.00	228	0.00
Slope (%) :	0.00	3.8	0.00
Surface Type :	Unpaved	Grass pasture	Unpaved
Velocity (ft/sec) :	0.00	1.36	0.00
Computed Flow Time (min) :	0.00	2.79	0.00

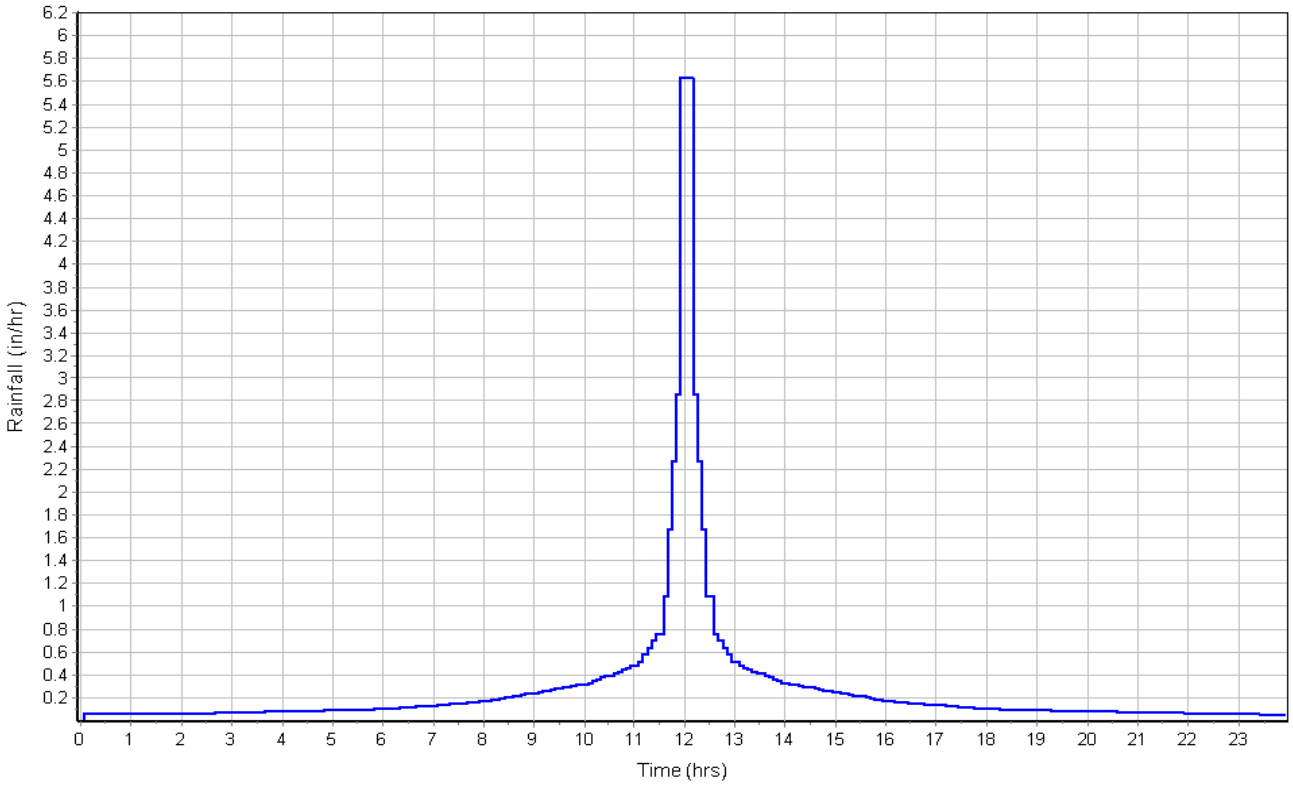
Total TOC (min) 25.77

Subbasin Runoff Results

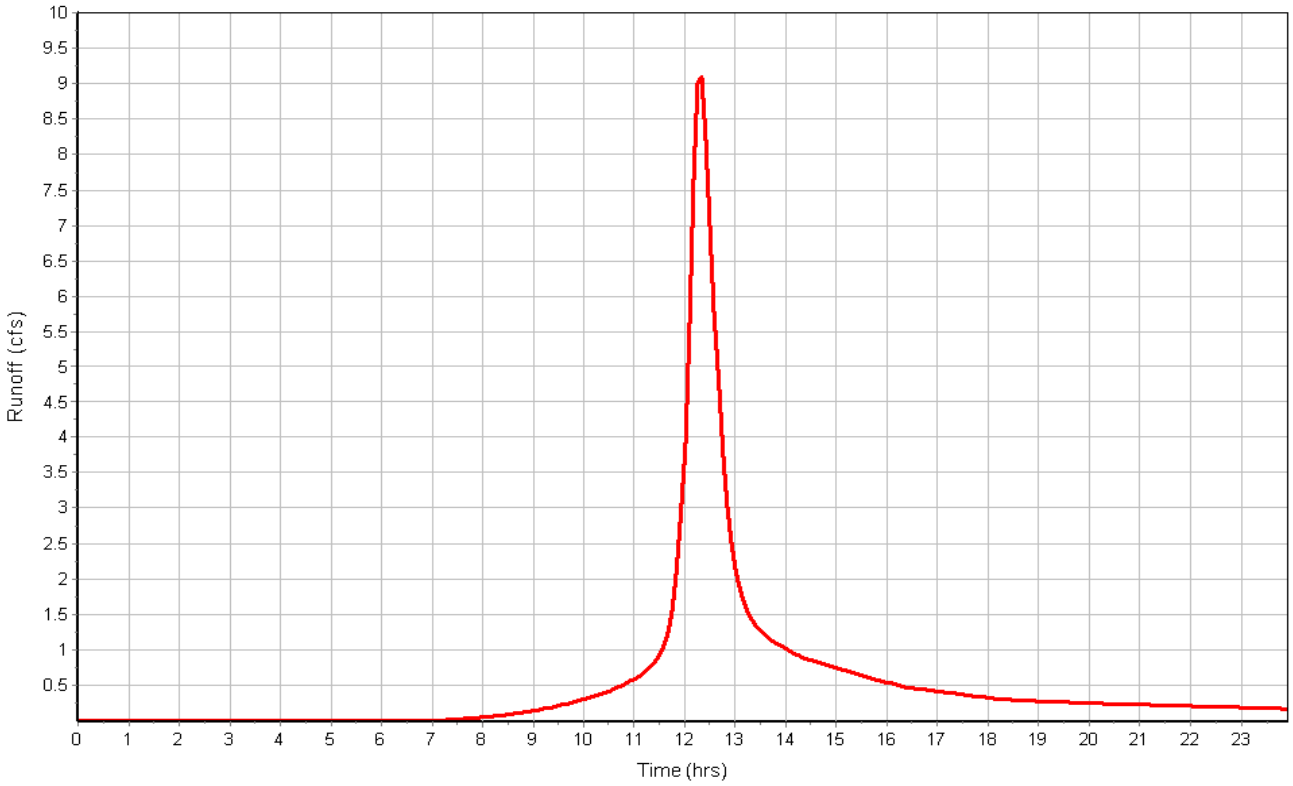
Total Rainfall (in) 6.70
Total Runoff (in) 4.20
Peak Runoff (cfs) 9.20
Weighted Curve Number 77.98
Time of Concentration (days hh:mm:ss) 0 00:25:46

Subbasin : Basin2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin3

Input Data

Area (ac) 2.42
Weighted Curve Number 77.52
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	1.79	D	77.00
Meadow, non-grazed	0.58	D	78.00
Gravel roads	0.05	D	91.00
Composite Area & Weighted CN	2.42		77.52

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	.01	0.00
Flow Length (ft) :	300	12	0.00
Slope (%) :	7.8	4.2	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.17	1.31	0.00
Computed Flow Time (min) :	30.00	0.15	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	372	0.00	0.00
Slope (%) :	7.8	0.00	0.00
Surface Type :	Woodland	Grass pasture	Unpaved
Velocity (ft/sec) :	1.40	0.00	0.00
Computed Flow Time (min) :	4.43	0.00	0.00

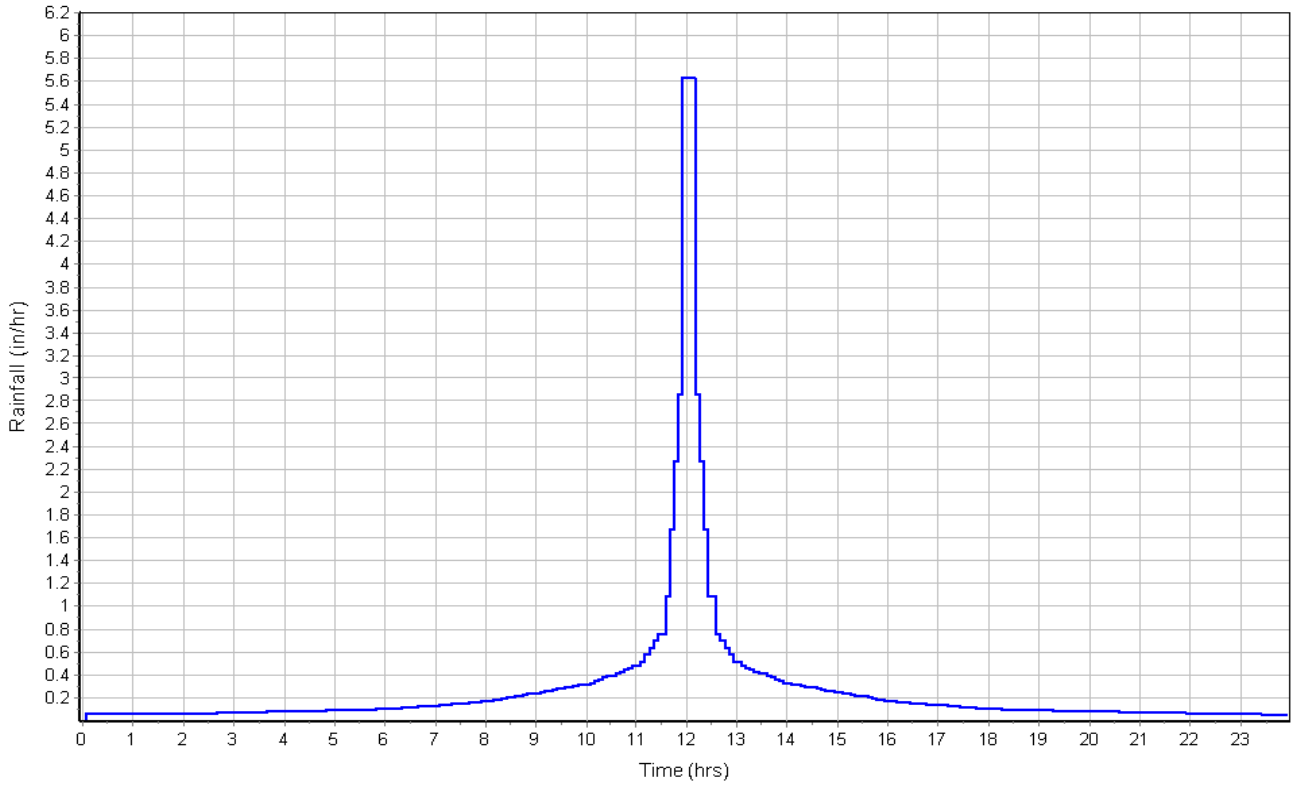
Total TOC (min) 17.29

Subbasin Runoff Results

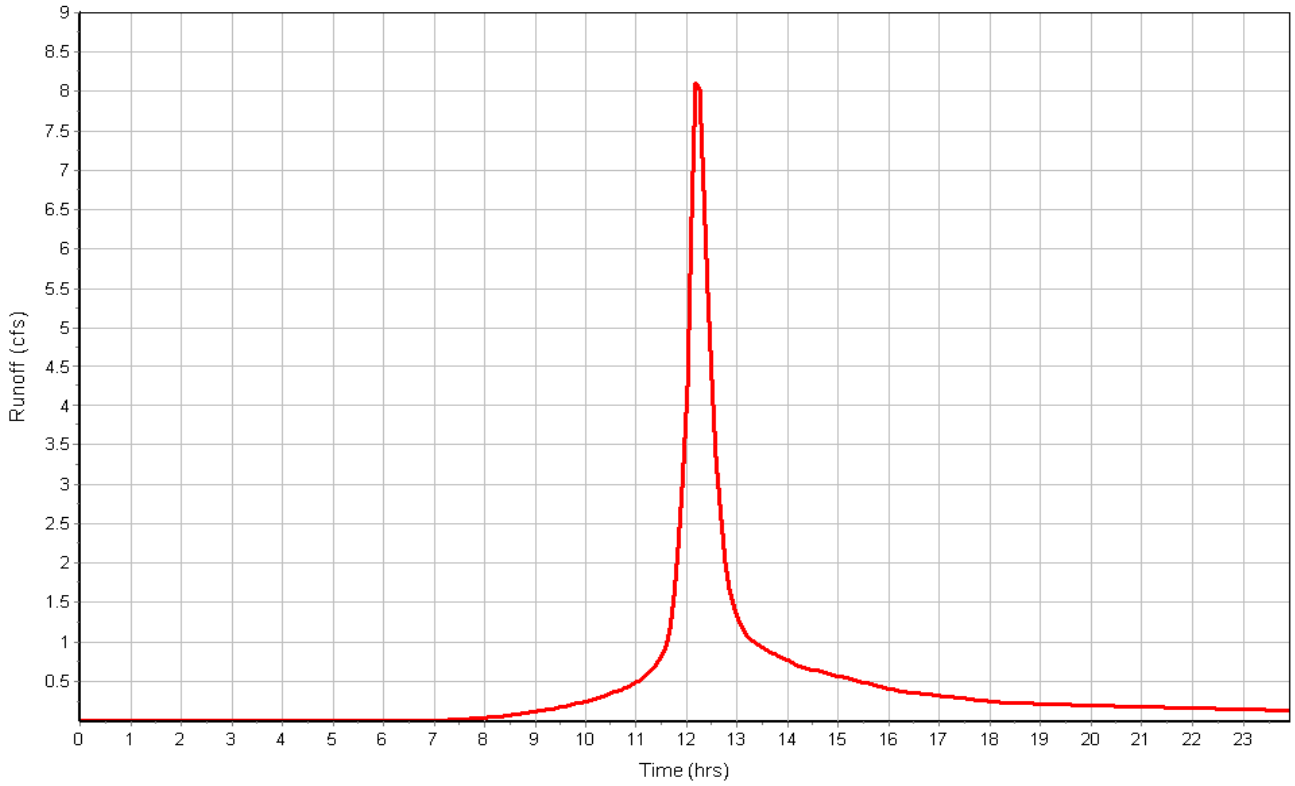
Total Rainfall (in) 6.70
Total Runoff (in) 4.15
Peak Runoff (cfs) 8.33
Weighted Curve Number 77.52
Time of Concentration (days hh:mm:ss) 0 00:17:17

Subbasin : Basin3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin3A

Input Data

Area (ac) 0.75
Weighted Curve Number 78.23
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.12	D	77.00
Meadow, non-grazed	0.61	D	78.00
Gravel roads	0.02	D	91.00
Composite Area & Weighted CN	0.75		78.23

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	300	374	0.00
Slope (%) :	6	0.5	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.15	0.10	0.00
Computed Flow Time (min) :	33.32	61.69	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	74	0.00	0.00
Slope (%) :	0.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.49	0.00	0.00
Computed Flow Time (min) :	2.52	0.00	0.00

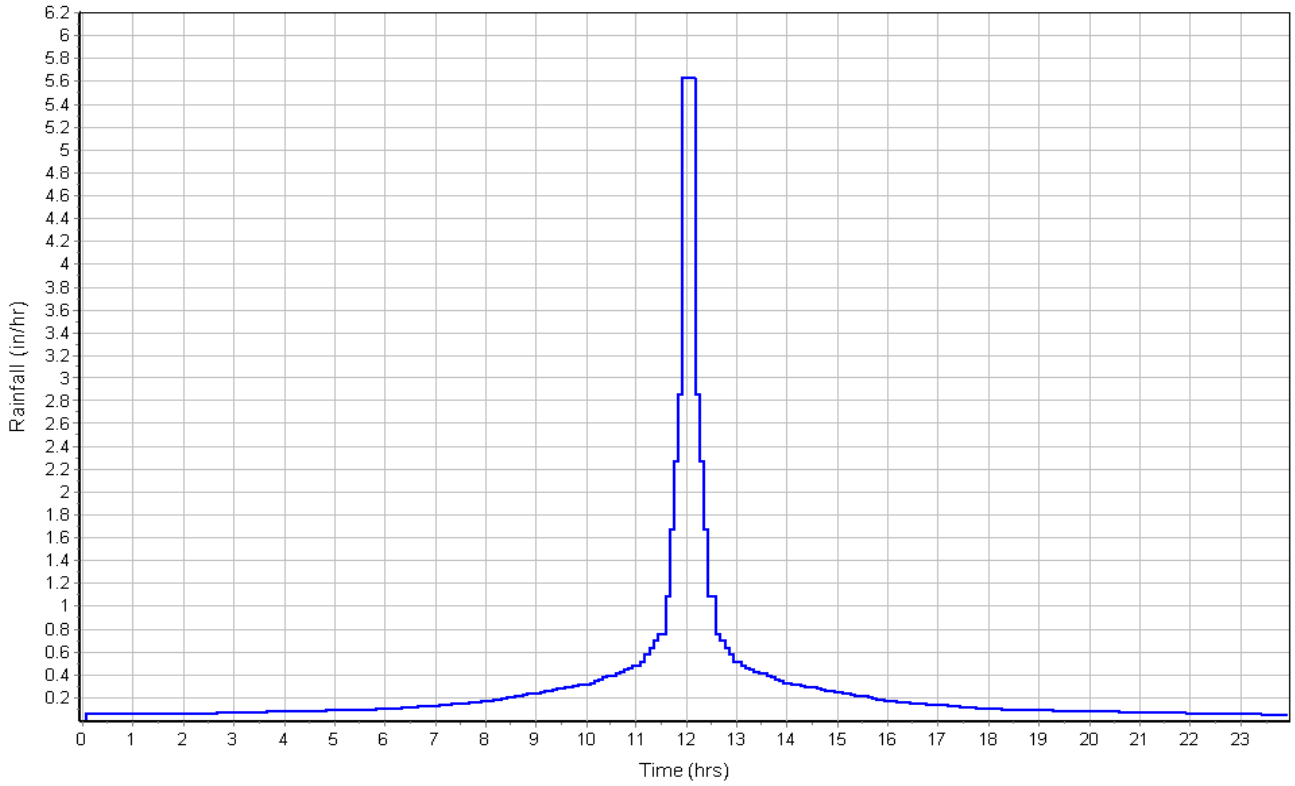
Total TOC (min) 48.77

Subbasin Runoff Results

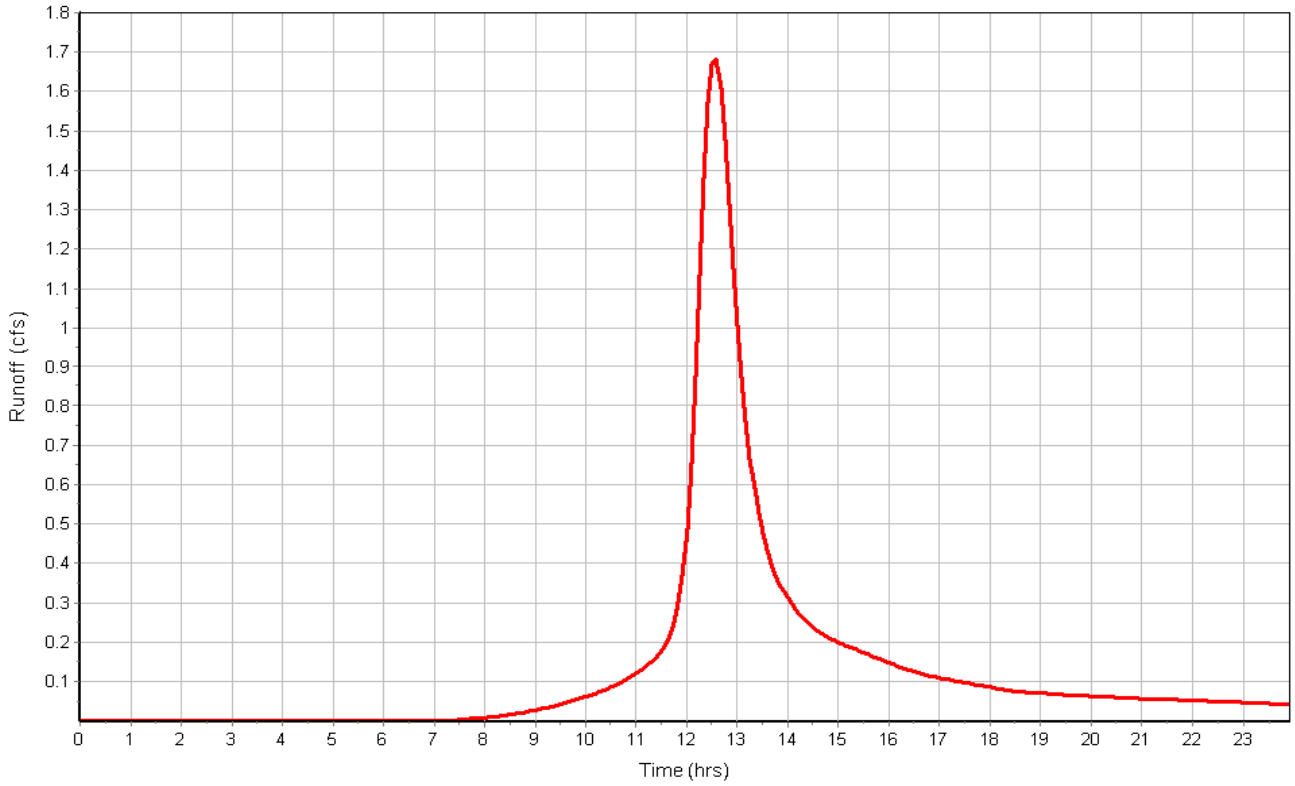
Total Rainfall (in) 6.70
Total Runoff (in) 4.23
Peak Runoff (cfs) 1.69
Weighted Curve Number 78.23
Time of Concentration (days hh:mm:ss) 0 00:48:46

Subbasin : Basin3A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin4

Input Data

Area (ac) 1.46
Weighted Curve Number 77.50
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.92	D	77.00
Meadow, non-grazed	0.53	D	78.00
Gravel roads	0.01	D	91.00
Composite Area & Weighted CN	1.46		77.50

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.2	0.00
Flow Length (ft) :	144	114	0.00
Slope (%) :	20.8	5.3	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.21	0.20	0.00
Computed Flow Time (min) :	11.27	9.27	0.00

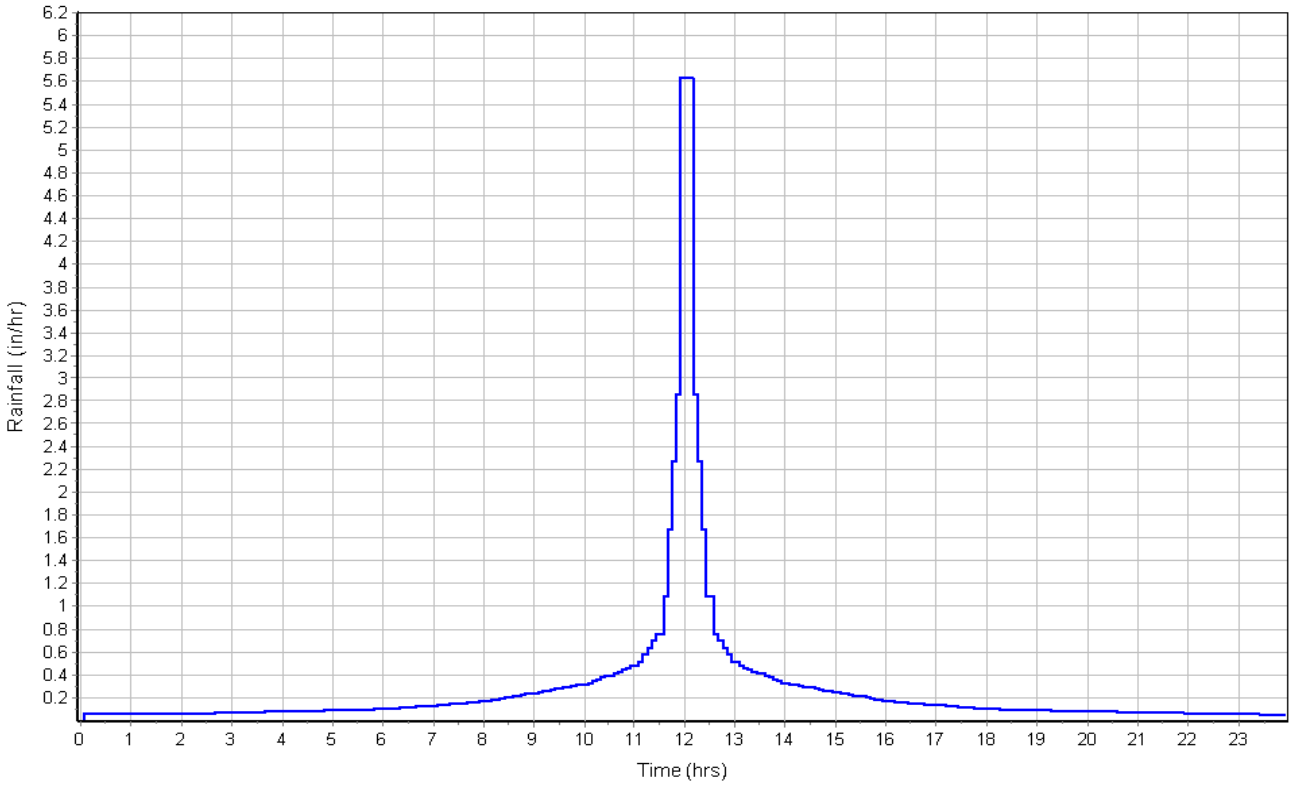
Total TOC (min) 10.27

Subbasin Runoff Results

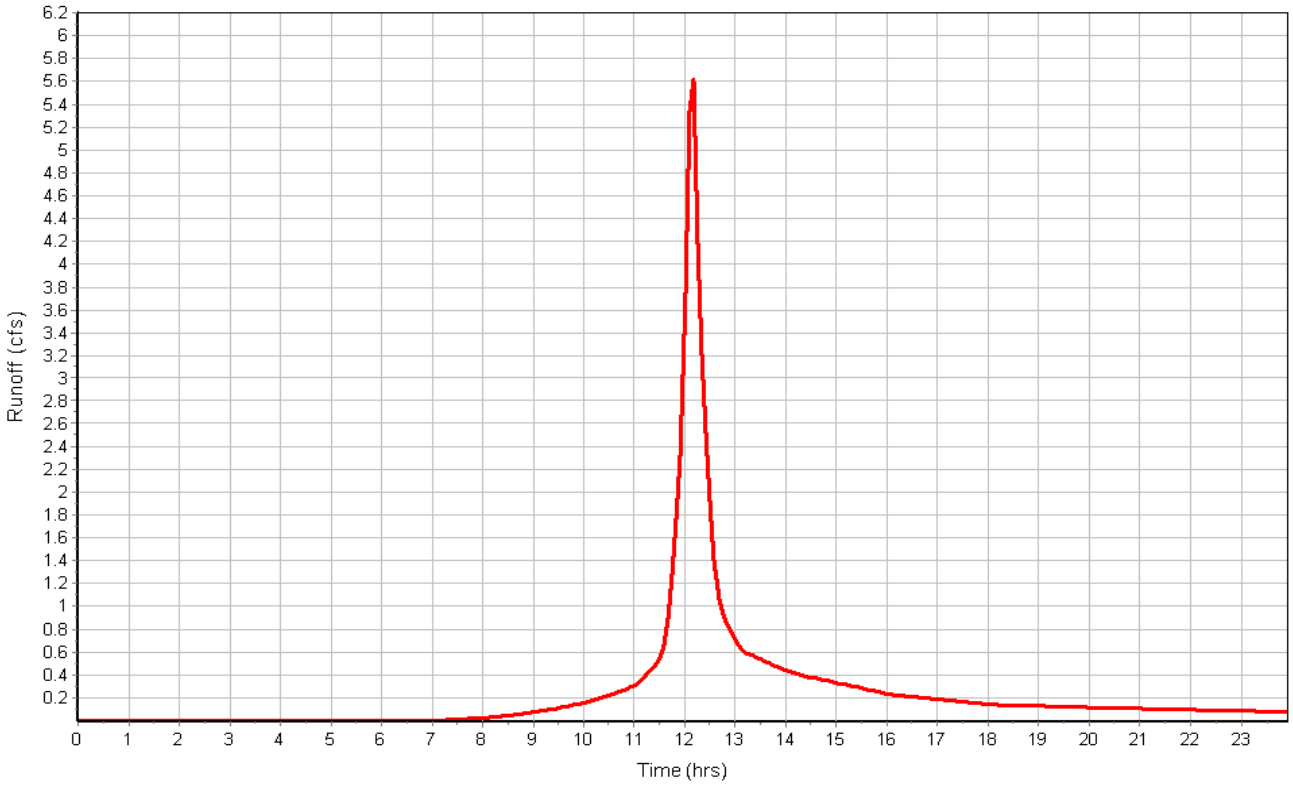
Total Rainfall (in) 6.70
Total Runoff (in) 4.15
Peak Runoff (cfs) 5.76
Weighted Curve Number 77.50
Time of Concentration (days hh:mm:ss) 0 00:10:16

Subbasin : Basin4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin5

Input Data

Area (ac) 0.56
Weighted Curve Number 78.34
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.17	D	77.00
Meadow, non-grazed	0.36	D	78.00
Gravel roads	0.03	D	91.00
Composite Area & Weighted CN	0.56		78.34

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.2	.01	0.00
Flow Length (ft) :	60	90	0.00
Slope (%) :	6.7	2.2	0.00
2 yr, 24 hr Rainfall (in) :	3.20	3.20	0.00
Velocity (ft/sec) :	0.20	1.51	0.00
Computed Flow Time (min) :	5.05	0.99	0.00

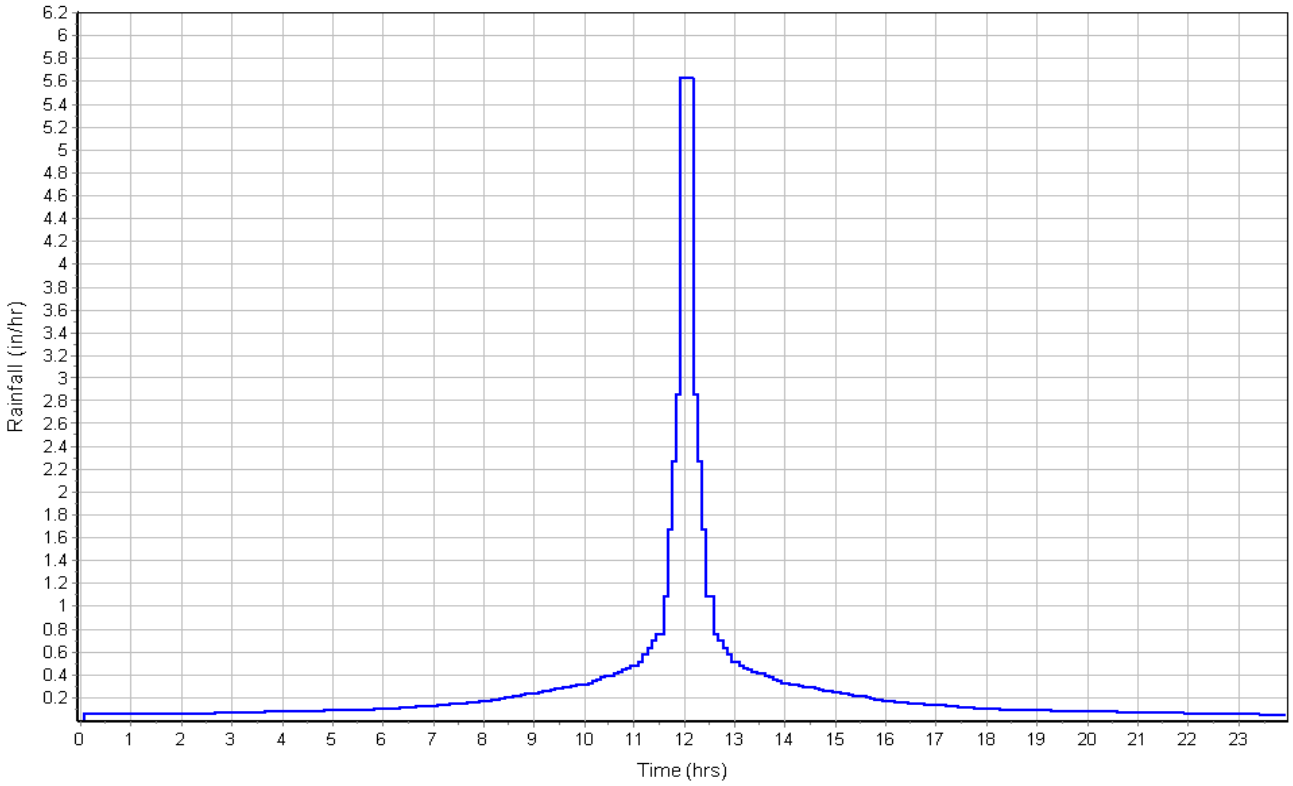
Total TOC (min) 3.02

Subbasin Runoff Results

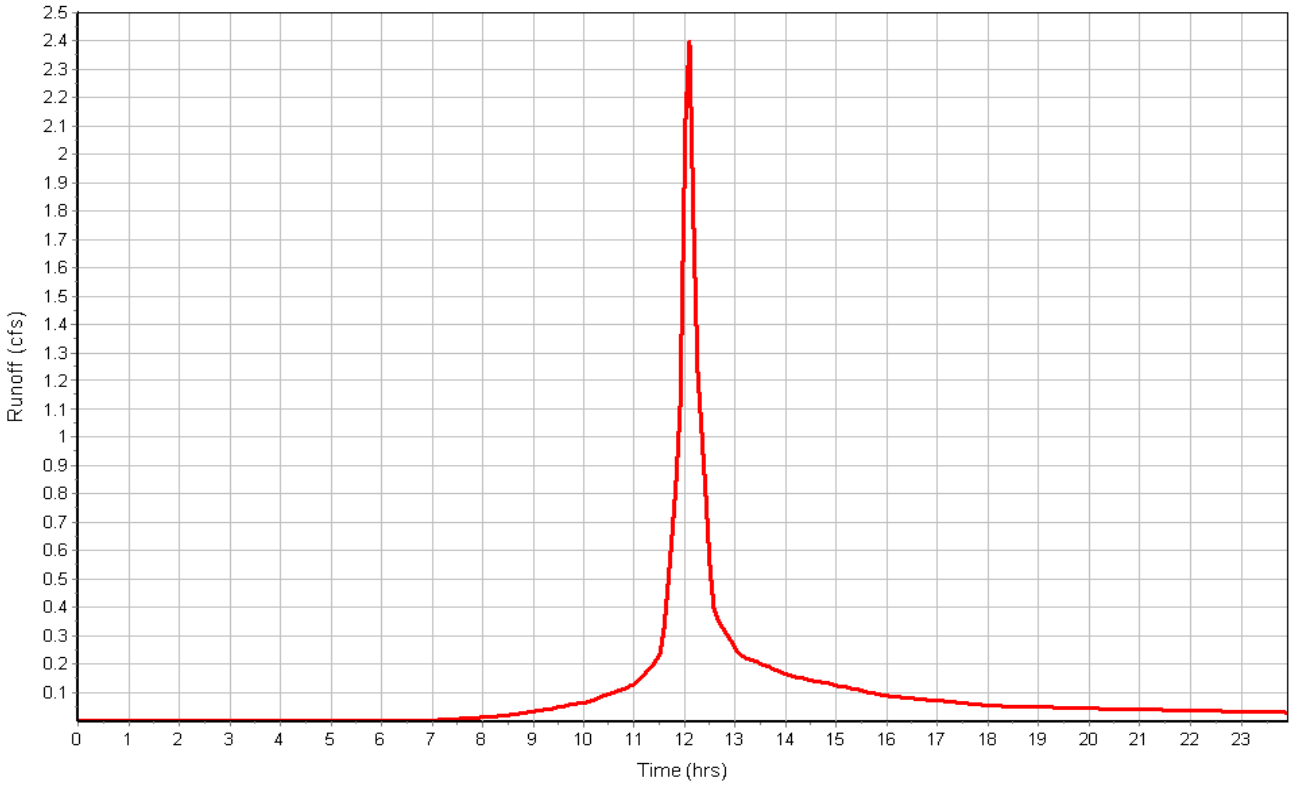
Total Rainfall (in) 6.70
Total Runoff (in) 4.24
Peak Runoff (cfs) 2.43
Weighted Curve Number 78.34
Time of Concentration (days hh:mm:ss) 0 00:03:01

Subbasin : Basin5

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Basin6

Input Data

Area (ac) 0.33
Weighted Curve Number 77.00
Rain Gage ID ..... Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	0.33	D	77.00
Composite Area & Weighted CN	0.33		77.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	159	0.00	0.00
Slope (%) :	16.4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.20	0.00	0.00
Velocity (ft/sec) :	0.20	0.00	0.00
Computed Flow Time (min) :	13.41	0.00	0.00

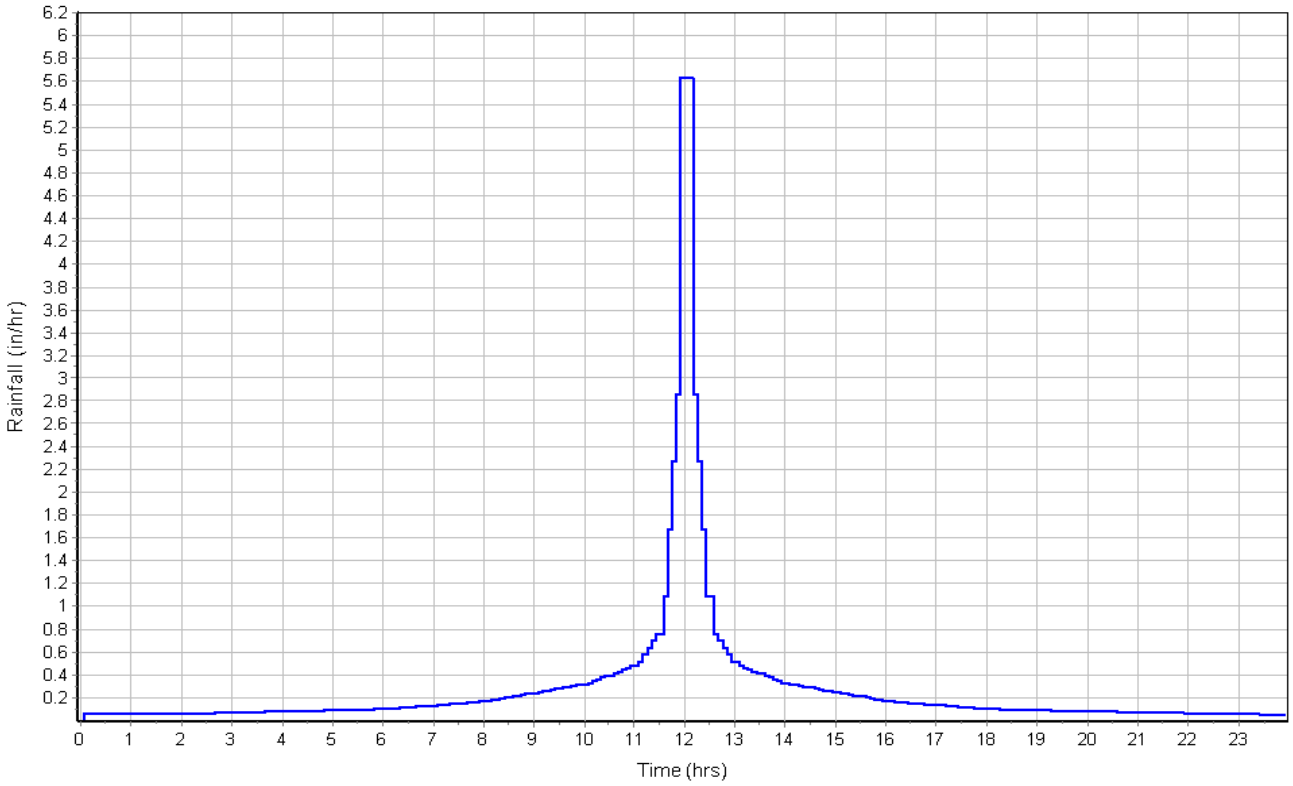
Total TOC (min) 13.41

Subbasin Runoff Results

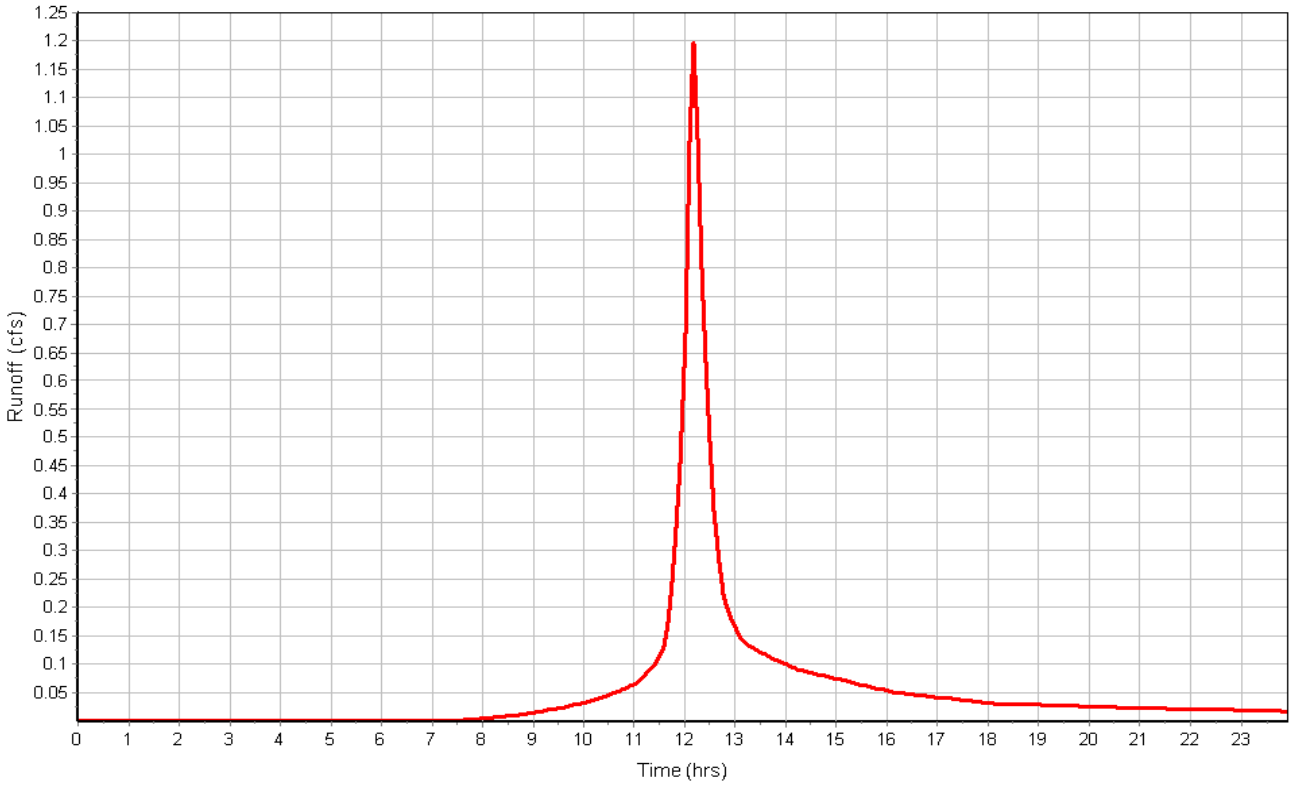
Total Rainfall (in) 6.70
Total Runoff (in) 4.10
Peak Runoff (cfs) 1.20
Weighted Curve Number 77.00
Time of Concentration (days hh:mm:ss) 0 00:13:25

Subbasin : Basin6

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Swale

Input Data

Invert Elevation (ft)	-0.50
Max (Rim) Elevation (ft)	1.00
Max (Rim) Offset (ft)	1.50
Initial Water Elevation (ft)	-0.50
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Level Spreader	Trapezoidal	No	0.00	0.50	6.00	1.00	3.33

Output Summary Results

Peak Inflow (cfs)	1.68
Peak Lateral Inflow (cfs)	1.68
Peak Outflow (cfs)	1.68
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	0.19
Max HGL Depth Attained (ft)	0.69
Average HGL Elevation Attained (ft)	-0.17
Average HGL Depth Attained (ft)	0.33
Time of Max HGL Occurrence (days hh:mm)	0 12:40
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00