

**Junction Village/Christopher Heights of Concord HUD Environmental Review Documentation**

1. Notice of Intent and Stormwater Management Report, Fuss and O'Neill, November 28, 2016
2. Junction Village Open Space Planning Study, JM Goldson community preservation + planning, 7/12/2016
3. Conservation Restriction and Open Space Plan, Fuss and O'Neill
4. Traffic Impacts Memorandum, Bayside Engineering, 11/2013

# Notice of Intent and Stormwater Management Report

Christopher Heights Assisted Living Facility  
Concord, MA

**The Grantham Group, LLC**  
99 Pleasant Street  
Marlborough, MA

November 28, 2016



78 Interstate Drive  
West Springfield, MA

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## Notice of Intent and Stormwater Management Report The Grantham Group, Inc.

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## Notice of Intent and Stormwater Management Report The Grantham Group, Inc.

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# 1 Executive Summary

Pursuant to the Massachusetts Wetlands Protection Act, M.G.L. c. 131 40, 310 CMR §10.00, the Massachusetts Stormwater Handbook and the Town of Concord Regulations, this Notice of Intent (NOI) and Stormwater Management Report describes proposed work associated with the development of an assisted living facility located on Winthrop Street in Concord, Massachusetts. The development proposed to extend Winthrop Street in the project site. Proposed work includes construction 83-unit, 3 story building, asphalt parking areas, a rain garden, infiltration basins, stormwater drainage system, septic system with leaching field, site utilities and other site improvements. The location of the site is shown on the USGS Site Location Map, Figure 1, and the proposed work is shown on the Site Plans provided as Appendix M.

Pursuant to 310 CMR 10.02 (2), filing of a WPA Form 3 Notice of Intent permit application in accordance with the Massachusetts Wetlands Protection Act is required because of proposed alterations work within the buffer of a Bordering Vegetated Wetlands (BVW), Bordering, and Land Subject to Flooding.

## 2 Project Description

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### 2.1 Existing Conditions

The approximate 12.8 acre site is located off Winthrop Street in Concord, Massachusetts. The site is currently vacant, only a portion of the northern corner is used as a material storage area for the Massachusetts Correctional Institute. The eastern and southern portion of the site is mostly wooded with some areas of brush. To the west of the property is railroad. A bike path, designed by others, is proposed to be developed along the existing railroad.

The east property line of the site abuts the Assabet River, the southern property line abuts Nashoba Brook, and there is a small bordering vegetated wetland (BVW) located in the southern portion of the site. The mean high annual water associated the river and the BVW have both been delineated and are shown on the Site Plans located in Appendix M.

The existing site does not contain any stormwater. Rainfall current sheet flows to the to the northern property line, to the east to Assabet River and to the south to a small BVW.

### 2.2 Proposed Conditions

The proposed project involves the construction of an approximately 54,000 square foot, 3 story building, 83-unit assisted living facility with associated parking, rain garden, infiltration basins, stormwater management system, site utilities, septic system with leaching, and other amenities. The site will be accessed from the extension of Winthrop Street. The extension of Winthrop Street will be 24 feet wide, extend into the site and dead-end into a circular dropoff loop at the entrance to the building. There will be two paved parking lots with a total of 43 spaces. Site amenities include concrete pedestrian

sidewalks, benches and lighted bollard located around the drive loop, and a flag pole located in the center island of the dropoff loop.

The site stormwater drainage system was designed to utilize LID stormwater management practices as much as possible. Runoff from the parking lots and a majority of the pavement areas will be managed using sheet flow directed to stone filterstrips, infiltration basins and a rain garden. The roof runoff from the proposed building will be collected and directed to one of the infiltration basins. Proposed conditions are depicted on the Site Plans located in Appendix M.

The infiltration basins and rain garden have been sized to attenuate runoff through the 100-year storm event, with overflows to grade, following the existing drainage patterns. Peak flows leaving the still be maintained or reduced in all storm events through the 100-year design storm. Groundwater recharge will be promoted through the proposed infiltration basins and rain garden.

### 3 Soil Erosion and Sedimentation Control

Erosion and sedimentation controls will be installed in accordance with the “Massachusetts Erosion and Sediment Control Guideline for Urban and Suburban Areas. Erosion and sedimentation controls will be installed prior to construction and maintained for the duration of the project until construction is complete and disturbed slopes have been stabilized. Location and details of the erosion and sedimentation controls for the project are shown on the Site Plans located in Appendix M

### 4 Construction Sequence

The following summarizes the sequencing of site construction:

- Install sediment and erosion controls. Additional sediment controls supplies should be kept on site.
- Install construction entrance and temporary chain link construction fence.
- Clear and grub wooded areas.
- Demolition of site pavement, site amenities, and utilities.
- Rough grade project area and road.
- Installation of building foundation.
- Install drainage pipes and structures.
- Construct rain garden and infiltration basins.
- Construction building
- Install site utilities.
- Place subgrade for pavement.
- Place hot mix asphalt binder course for pavement.
- Install curbing.
- Install concrete sidewalks.
- Grade disturbed areas to finish grade, place top soil and seed.
- Place hot mix asphalt top course for pavement.
- Install pavement markings.

- Place loam, seeding, and landscaping.
- Clean the rain garden, infiltration basins, and stormwater structures of any collected sediment or debris, dispose of properly.
- Remove sedimentation controls once all disturbed areas have stabilized.

This construction sequence is subject to change based on construction methods or due to other unforeseen circumstances.

## 5 Inland Resource Area Description and Impacts

On April 19, 2013, an Order of Resource Area Delineation (ORAD) was issued for the site, MassDEP file #:1137-1203. The ORAD is included in Appendix A. The BVW and mean annual high water delineation for Assabet River and Nashaba Brook are shown on the Site Plans provided in Appendix M.

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### 5.1 Bordering Vegetated Wetlands

There is a small BVW located in the southern portion of the site. This wetland appears to be associated with the Assabet River and Nashaba Brook. There is no proposed work within the existing BVW. There is approximately 2,000 square feet of proposed work within the 100 foot buffer associated with the BVW. The proposed work includes slope grading associated with the extension of Winthrop Street and the installation of a 36 inch culvert to convey water under the street.

Per Town of Concord Wetland Bylaw, there is a 25-foot No-Disturb Zone associated with the BVW. There is no proposed work within the 25-foot No-Disturb Zone.

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### 5.2 Bordering Land Subject to Flooding

The Federal Emergency Management Agency (FEMA) Firm, Flood Insurance Rate Map provided in Appendix B, shows a portion of the site located within bordering land subject to flooding (BLSF). Proposed work within this area will disturb approximately 6,420 cubic feet of storage capacity within the 100-year floodplain. Approximately 11,900 cubic feet of storage is proposed to replace the proposed disturbance. Compensatory flood storage calculations are provided in Appendix C.

The FEMA Firm, Flood Insurance Rate Map show the 100-year flood elevation is approximately 124 feet. The Site Plans provided in Appendix M show the 100-year floodplain in relationship to the project site and the proposed work. Proposed site work located within the BLSF is limited to the slope grading associated with the extension on Winthrop Street and the installation of a 36 inch culvert under the street.

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## 5.3 Riverfront

Assabet River follows the east property line and the Nashaba Brook follows the southern property line. The mean annual high water line was determined from the ORAD included in Appendix A. There is no proposed work within the 200-foot and 100-foot Riverfront Areas associated with the River and Brook. Proposed work is shown on the Site Plans provided in Appendix M. Wetland Protection Regulatory Review

## 6 Wetland Protection Regulatory Review

A review of the current Estimated Habitat and Rare and Endangered Species mapping provided by the Massachusetts NHESP indicates that the proposed project is not located within estimated habitat of rare wildlife and priority habitats for state-protected rare species. Refer to Figure 2.

The proposed work is not within an Area of Critical Environmental (ACES) as listed on Massachusetts DEP's website: [www.mass.gov/dep](http://www.mass.gov/dep).

The proposed site is not within an areas designated as an Outstanding Resource Water as designated in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00.

No portion of the site is subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act (M.G.L. c. 131, § 40A).

## 7 Hydrologic Analysis

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### 7.1 Peak Flows and Rainfall Depths

Peak flows for the existing and proposed conditions were determined by using the Natural Resources Conservation Service (NRCS) hydrologic methods. The HydroCAD computer program was used to conduct watershed modeling. Schematic watershed diagrams are provided for existing and proposed conditions in Appendix D and Appendix E respectively. Runoff curve numbers were developed based on a combination of land cover use and existing site soil types acquired from the NRCS website. Time of concentration runs were developed based on the methods in the NRCS TR55 manual.

Peak flows for the 2-, 5-, 10-, 25-, and 100-year frequency storm events were determined by using a 24-hour type III storm, standard for the New England area. Rainfall depths were obtained from published rainfall records for Middlesex County, Massachusetts. Existing and proposed hydrologic models are included in Appendix D and Appendix E, respectively. Table 1 illustrates that the peak rates for the site were reduced or maintained from existing to proposed.

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## 7.2 Site Soils

Soil mapping generated from the NRCS website is provided in Appendix F. The mapping shows site soils are comprised of mainly of urban land with a portion of Deerfield loamy sand, classified with a hydrological soil type of B. Surrounding soils located off-site are comprised Merrimac-Urban land complex with a hydrological soil type classification of A.

Deep hole test pits were performed by Goldsmith, Prest & Ringwall, Inc. on January 1, 2009. Soils were shown to be comprised of medium sands which generally classified with a hydrological soil type of B and are constant with the soil types provided in the NRCS mapping. Estimated seasonal high groundwater depth within the area of the test pits was observed to be within 94 inches to 136 inches below existing site grades. Deep hole information is located in Appendix G.

The following runoff curve numbers were used for the land cover characteristics:

<u>Land Cover</u>	<u>Runoff Curve No.</u>
Water	98
Impervious/Roof	98
Gravel Surface – HSG B	96
50-75% Grass Cover, Fair – HSG B	69
Woods, Fair – HSG B	60
Brush, Fair – HSG B	56
>75% Grass Cover, Good – HSG B	61

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## 7.3 Watershed Areas

For the purposed of assessing pre- verses post-development hydrologic conditions the site was evaluated with three discharge points, described as follows:

- DP #1 discharges to the BVW located in the southern portion of the site
- DP #2 discharge to Assabet River
- DP #3 discharges to the northern property line

The location of the discharge points can be found on the Existing Watershed Map, Figure 3, and the Proposed Watershed Map, Figure 4.

### 7.3.1 Existing Watershed Areas

The existing conditions model was divided into three watershed areas. Figure 3 illustrates the existing conditions, existing conditions watershed areas and shows the Tc paths. A schematic watershed diagram showing discharge points and a breakdown of the ground cover characteristics for each watershed area can be found in the hydrological calculations provided in Appendix D.

### 7.3.2 Proposed Watershed Areas

The proposed project is divided into seven proposed watershed areas. Figure 4 illustrates the proposed conditions, proposed conditions watershed areas and shows the Tc paths. A schematic watershed diagram showing discharge points and a breakdown of the ground cover characteristics for each watershed area can be found in the hydrological calculations provided in Appendix E.

## 8 MassDEP Stormwater Management Guidelines

The stormwater management system has been designed in accordance with the Stormwater Management Standards outlined in the Massachusetts Stormwater Handbook and in accordance with the Town of Concord Storm Water Regulations. Compliance with these standards is outlined below.

### **LID Measures**

As required by the Stormwater Management Standards, Low Impact Development (LID) measures were evaluated to enhance stormwater quality. The project proposed to sheet flow stormwater runoff extensively throughout. The sheet flow will be collect by infiltration basins and a rain garden. In addition parking was limited to meet only what is needed for the proposed use.

### **Standard #1: No Untreated discharge or Erosion to Wetlands**

There are no new untreated conveyances proposed. Conveyances have been designed to ensure no erosion will occur to the existing bordering vegetated wetlands or riverfront area. Untreated stormwater will not discharge into the existing bordering vegetated wetland, river or brook. Stormwater treatment will be provided by way of a stone filterstrips, infiltration basins, and a rain garden.

### **Standard #2: Peak Rate Attenuation**

Post-development discharge rates will not increase as a result of the development. Stormwater Hydrologic Models demonstrating the peak flow discharge rates have been maintained or reduced are provided in Appendix D and Appendix E. A summary of the pre- verses post-development discharge rates are provided in Table 1.

### **Standard #3: Stormwater Recharge**

The groundwater recharge volume is based on the existing soil conditions and the Recharge Target Depth by Hydrologic Soil Group (HSG) values provided in Volume 1 and 2 of the Massachusetts Stormwater Handbook. Total groundwater recharge required for the site is approximately 1,721 cubic feet. Groundwater recharge is provided by the proposed infiltration systems and rain garden. Groundwater recharge provided by the proposed development is approximately 16,513 cubic feet. Groundwater recharge calculations are provided in Appendix H.

Calculations for 72 hour drawdown are provided in Appendix H. As shown each of the stormwater infiltration BMPs will drawdown within the required 72 hours.

#### **Standard #4: Water Quality**

Water quality measures include infiltration basins and a rain garden. Each treatment train will provided the required 80% total suspended solids (TSS) removal rate. Pretreatment of for each of the infiltration basin is provided by a stone filter strip and sedimentation forebay. Pretreatment for the rain garden is provided by a stone filter strip. TSS worksheets for each treatment train are provided in Appendix I.

A water quality depth of 0.5 inches was used. Total Required Water Quality for the site is approximately 2,458 cubic feet. Required Water Quality Volume is provided by the proposed infiltration basins and rain garden. The proposed project provides approximate total of 16,513 cubic feet of Required Water Quality. Required Water Quality calculations are provided in Appendix J. In addition the sedimentation forebays for each of the infiltration basins have been sized to hold 0.1-inch times the contributing impervious; calculations are provided in Appendix J.

#### **Standard #5: Land Uses with Higher Potential Pollutant Loads**

The project does not contain any area of higher pollutant loads as defended by the Massachusetts Stormwater Handbook.

#### **Standard #6: Critical Areas**

This project does not contain any critical areas as defined by the Massachusetts Stormwater Handbook.

#### **Standard #7: Redevelopment**

This project is mix of redevelopment and new development, however the project will comply with the standards set forth by the Massachusetts Stormwater Handbook.

#### **Standard #8: Construction Period Controls**

It is anticipated that there will be no proposed pollution created during the development of the site. General erosion and sedimentation controls will be implemented and maintained during construction and until construction is complete and disturbed areas have been stabilized. This will be done in accordance with local, state, and federal requirements. Details of these erosion and sedimentation control measures are shown on the Site Plans located in Appendix M. The contractor will be responsible to insure the correct implementation of the erosion and sedimentation controls.

#### **Standard #9: Operation and Maintenance Plan**

A Construction Operation and Maintenance (O&M) plan has been developed for the development of the site and is include in Appendix K. The owner shall be responsible for construction operation and maintenance of the site.

A suggested Long-term Operation and Maintenance plan, including required maintenance activities and schedule of maintenance requirements is include in Appendix L. The owner will be responsible for post construction operation and maintenance of the site.

### **Standard #10 Illicit Discharge to Drainage System**

This project does not contain illicit discharges to Stormwater Management Systems as defined in the Massachusetts Stormwater Handbook.

## **9 Summary**

The proposed project is located off Winthrop Street in Concord, Massachusetts. Proposed improvements include the construction of an 83-unit assisted living facility, asphalt parking areas, rain garden, infiltration basins, septic system with leaching field, site utilities and other site improvements. Work will occur within the 100-foot buffer to a BVW and BLSF. There is no proposed work within the riverfront area associated with Assabet River and Nashaba Brook. The project has been designed to accordance with the Massachusetts Wetland Protection Act, Massachusetts Stormwater Handbook, and the Town of Concord Regulations.

## Tables

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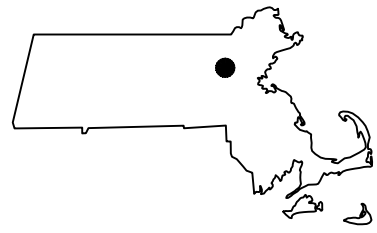
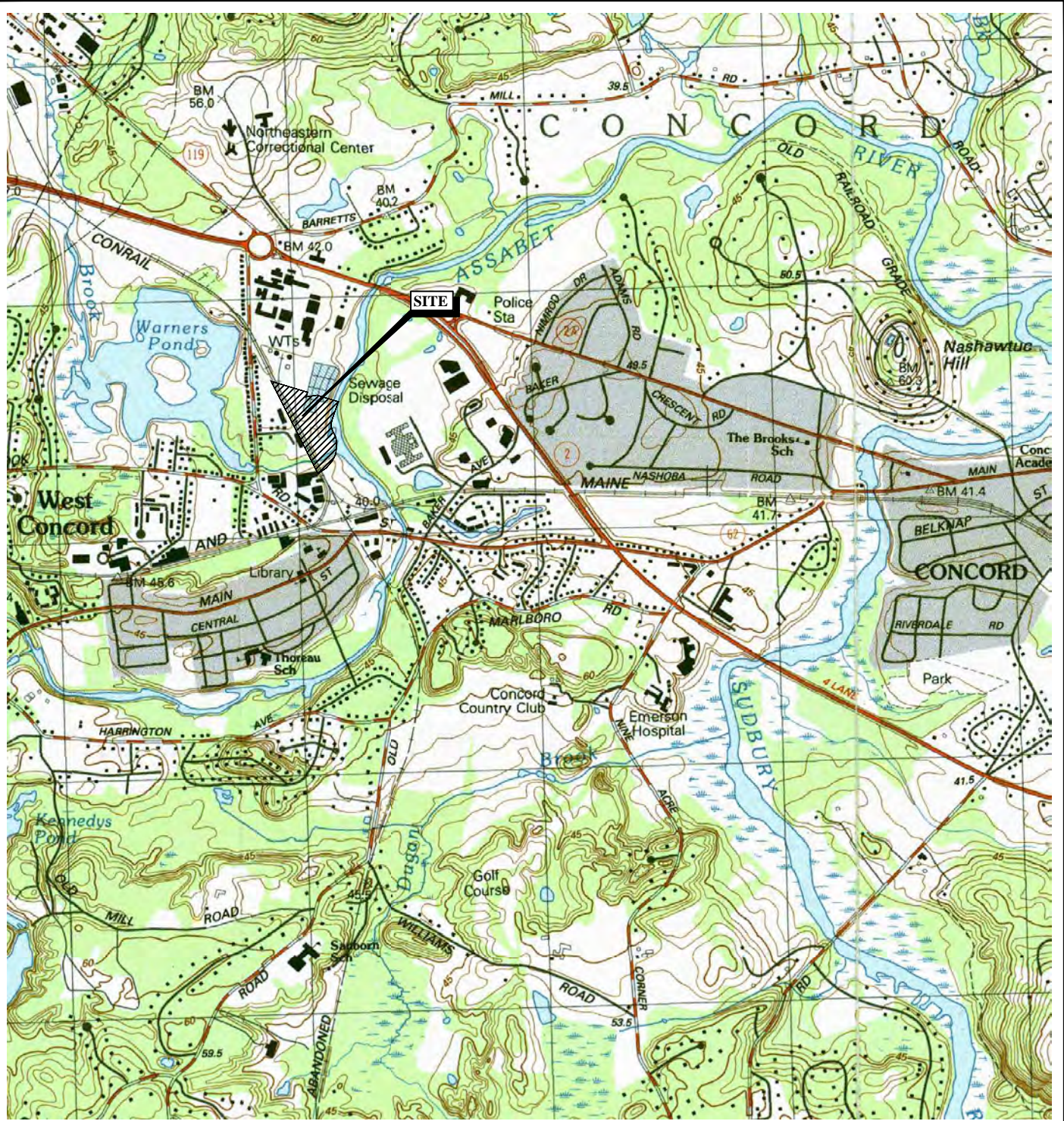
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Peak Discharge Summary			
DP#1			
Yr	Existing	Proposed	Net Change
2	4.20	2.32	-1.88
10	9.69	6.24	-3.45
25	13.21	8.83	-4.38
50	15.97	10.88	-5.09
100	18.80	13.16	-5.64
DP#2			
Yr	Existing	Proposed	Net Change
2	0.30	0.30	0.00
10	1.29	1.29	0.00
25	2.05	2.05	0.00
50	2.68	2.68	0.00
100	3.34	3.34	0.00
DP#3			
Yr	Existing	Proposed	Net Change
2	0.44	0.29	-0.15
10	1.24	0.95	-0.29
25	1.77	1.41	-0.36
50	2.20	1.77	-0.43
100	2.64	2.15	-0.49

## Figures

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**MAP REFERENCE**  
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 NOTE: ORIGINAL MAP UNITS IN METERS.  
 THIS MAP WAS PREPARED FROM THE FOLLOWING SCANNED USGS TOPOGRAPHIC QUAD IMAGES:  
 q209910, q213910, q209906, q213906

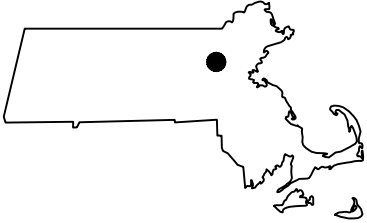
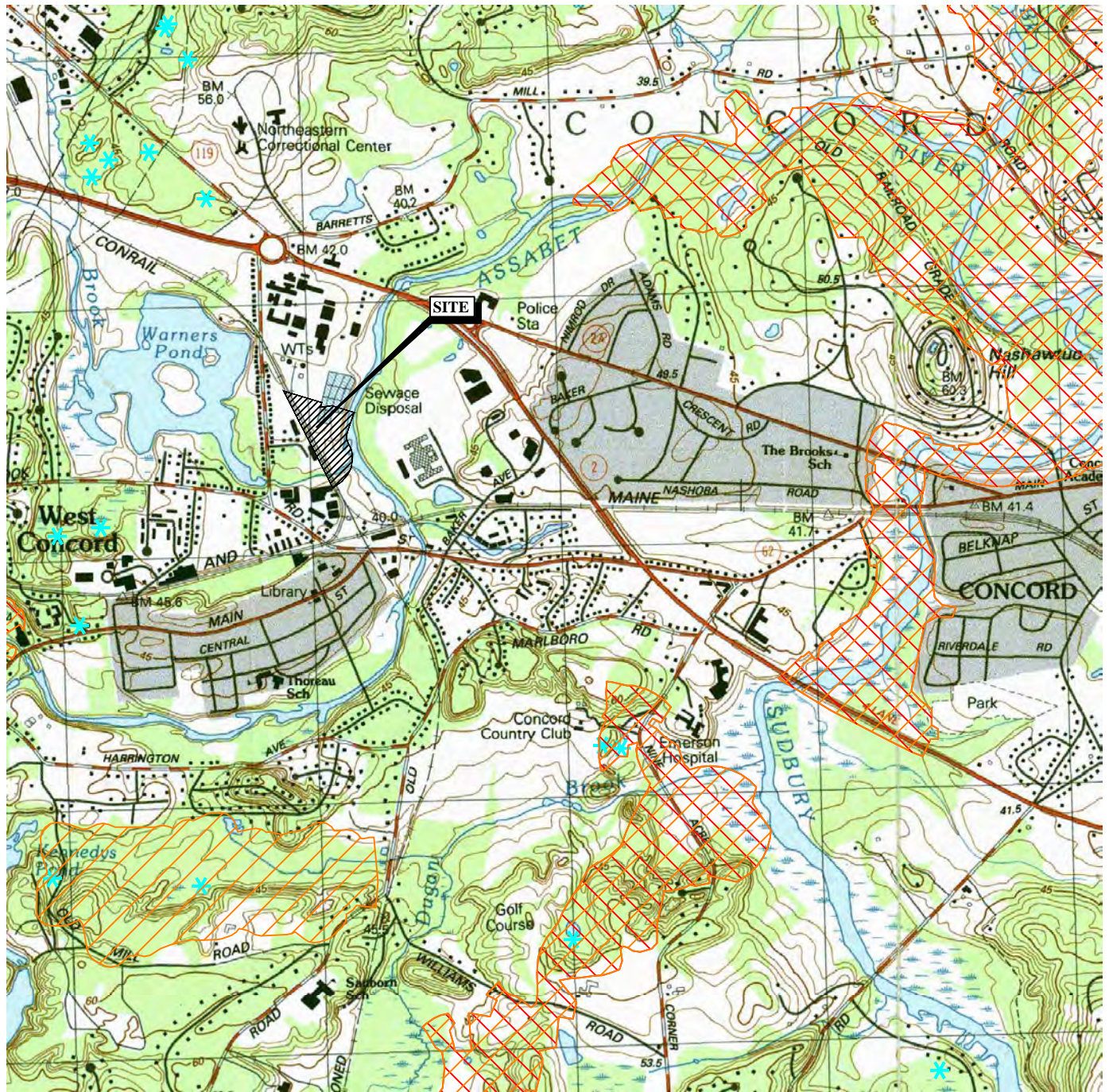
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<b>GRAPHIC SCALE</b>






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 www.fando.com

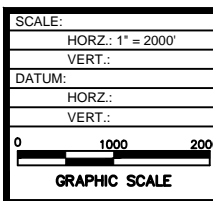
THE GRANTHAM GROUP, LLC.  
 USGS SITE LOCATION MAP  
 CHRISTOPHER HEIGHTS ASSISTED  
 LIVING FACILITY PROJECT  
 CONCORD MASSACHUSETTS

PROJ. No.: 20150485.A10
DATE: 11/28/2016
<b>FIG.1</b>



**MAP REFERENCE**  
 SCANNED USGS TOPOGRAPHIC QUAD IMAGES FROM "OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MassGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS" DATED 1977-79.  
 NOTE: ORIGINAL MAP UNITS IN METERS. THIS MAP WAS PREPARED FROM THE FOLLOWING SCANNED USGS TOPOGRAPHIC QUAD IMAGES: q209910, q213910, q209906 AND q213906.  
 NHPSP INFORMATION WAS PREPARED FROM MASS GIS DATA - 2008 & 2010.

- LEGEND**
-  NHPSP 2008 MA PRIORITY HABITATS FOR STATE-PROTECTED RARE SPECIES
  -  NHPSP 2008 MA ESTIMATED HABITATS OF RARE WILDLIFE
  -  NHPSP 2010 MA CERTIFIED VERNAL POOL

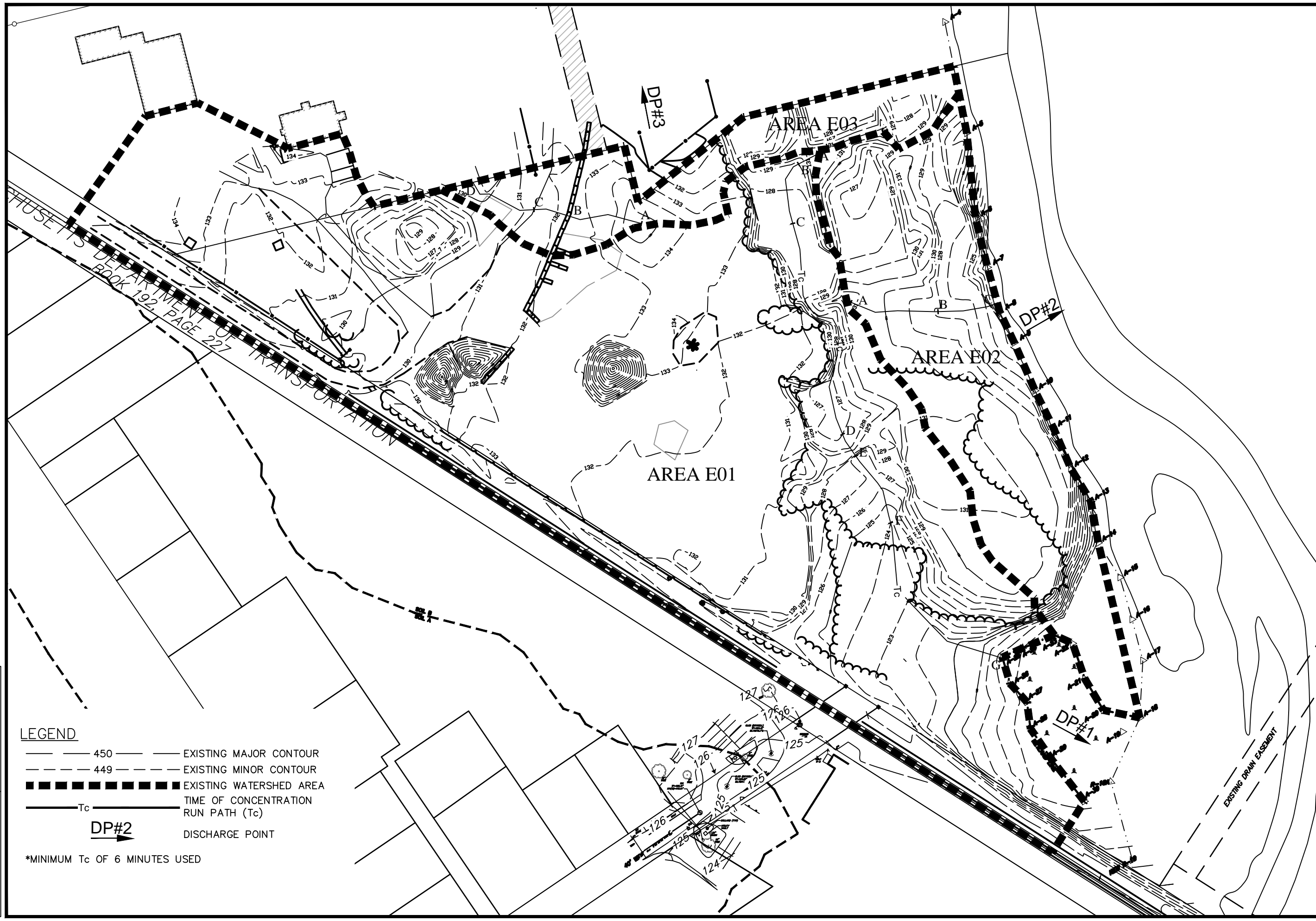



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 NHPSP HABITATS MAP  
 CHRISTOPHER HEIGHTS ASSISTED  
 LIVING FACILITY PROJECT  
 CONCORD MASSACHUSETTS

PROJ. No.:	20150485.A10
DATE:	11/28/2016
<b>FIG.2</b>	

File Path: J:\DWG\20150485A10\ChipPlan\20150485A10\_STM01.dwg Layout: FIG.3 Plotted: Wed, November 16, 2016 - 1:40 PM User: aball  
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 MS VIEW: PLOT



**LEGEND**

- 450 — EXISTING MAJOR CONTOUR
- 449 — EXISTING MINOR CONTOUR
- █ EXISTING WATERSHED AREA
- Tc — TIME OF CONCENTRATION RUN PATH (Tc)
- DP#2 DISCHARGE POINT

\*MINIMUM Tc OF 6 MINUTES USED

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 VERT.: 1"=50'  
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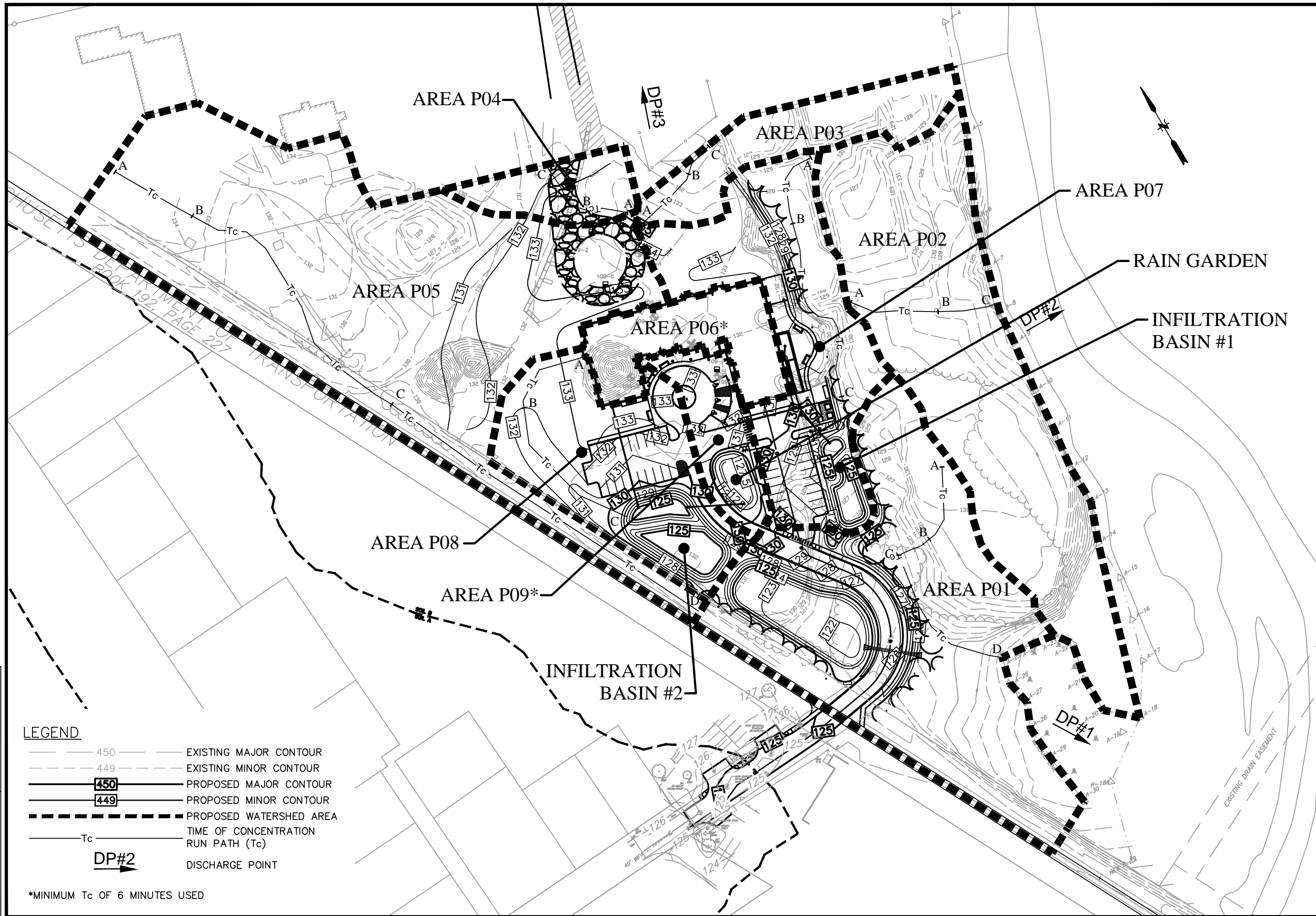
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THE GRANTHAM GROUP, LLC.  
 EXISTING WATERSHED AREA MAP  
 CHRISTOPHER HEIGHTS ASSISTED  
 LIVING FACILITY PROJECTS  
 MASSACHUSETTS

PROJ. No.: 20150485.A10  
 DATE: 11/15/2016

CONCORD  
**FIG. 3**


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**LEGEND**

— 450 —	EXISTING MAJOR CONTOUR
- - - 449 - - -	EXISTING MINOR CONTOUR
— 450 —	PROPOSED MAJOR CONTOUR
- - - 449 - - -	PROPOSED MINOR CONTOUR
- - - - -	PROPOSED WATERSHED AREA
— Tc —	TIME OF CONCENTRATION RUN PATH (Tc)
DP#2	DISCHARGE POINT

\*MINIMUM Tc OF 6 MINUTES USED

SCALE: HORZ.: 1"=100' VERT.: 1"=20' DATUM: HORZ.: NAD 83 VERT.: NAVD 83 GRAPHIC SCALE 0 50 100	 <b>FUSS &amp; O'NEILL</b> 78 INTERSTATE DRIVE WEST SPRINGFIELD, MA 01089 413.452.0445 www.fandob.com	THE GRANTHAM GROUP, LLC. <b>PROPOSED WATERSHED AREA MAP</b> CHRISTOPHER HEIGHTS ASSISTED LIVING FACILITY PROJECTS MASSACHUSETTS
PROJ. No.: 20150485.A10 DATE: 11/15/2016		
<b>FIG. 4</b>		

## Appendix A

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### Order of Resource Area Delineation





**TOWN OF CONCORD**  
**NATURAL RESOURCES COMMISSION**  
141 KEYES ROAD, CONCORD, MASSACHUSETTS 01742  
TEL. (978) 318-3285 FAX (978) 318-3291

April 19, 2013

**CERTIFIED MAIL**

Concord Housing Development Corporation  
c/o David Hale  
Omni Properties LLC  
200 Baker Avenue, Suite 303  
Concord, MA 01742

Dear Mr. Hale:

Enclosed please find one original and one copy of the Order of Resource Area Delineation approved at the April 17, 2013 meeting of the Natural Resources Commission.

Please note that because this is an Order for Resource Area Delineation Only, there is no requirement to record this document at the Registry of Deeds.

Please note there is a ten (10) business-day appeal period that allows the opportunity to appeal the project to the Department of Environmental Protection (DEP).

If you have any questions, please do not hesitate to contact our office.

Sincerely,

*Cynthia L. Gray*

Cynthia L. Gray  
Administrative Assistant



**Massachusetts Department of Environmental Protection**  
 Bureau of Resource Protection - Wetlands  
**WPA Form 4B - Order of Resource Area Delineation**  
 Massachusetts Wetlands Protection Act M.G.L. c. 131 S40

Provided by MassDEP:  
 MassDEP File #:137-1203  
 eDEP Transaction #:555764  
 City/Town:CONCORD

**A. General Information**

1. Conservation Commission CONCORD

2. This Issuance is for (Check one):

- a.  Order of Resource Area Delineation
- b.  Amended Order of Resource Area Delineation

3. Applicant Details

a. First Name		b. Last Name	
c. Organization	CONCORD HOUSING DEVELOPMENT CORPORATION		
d. Mailing Address	C/O DAVID HALE, CHDC - JV LLC, P.O. BOX 195		
e. City/Town	CONCORD	f. State	MA
		g. ZIP	01742

4. Property Owner (if different from applicant):

a. First Name		b. Last Name	
c. Organization	CONCORD HOUSING DEVELOPMENT CORPORATION		
d. Mailing Address	C/O DAVID HALE, CHDC - JV LLC, P.O. BOX 195		
e. City/Town	CONCORD	f. State	MA
		g. ZIP	01742

5. Project Location

a. Street Address	965 ELM STREET		
b. City/Town	CONCORD	c. Zip	01742
d. Assessors Map/Plat#	D 08	e. Parcel/Lot#	2013
f. Latitude	42.46638N	g. Longitude	71.39352W

6. Dates

a. Date ANRAD Filed	2/20/2013	b. Date Public Hearing Closed	4/17/2013	c. Date Of Issuance	4/19/2013
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7. Final Approved Plans and Other Documents

Plan Title	Plan Prepared By	Plan Signed By	Plan Final Date	Plan Scale
JUNCTION VILLAGE ABBREVIATED NOTICE OF RESOURCE AREA DELINEATION, PLAN OF LAND WINTHROP STREET, CONCORD, MASSACHUSETTS	PLACES ASSOCIATES, INC.	SUSAN E. CARTER, PE	April 3, 2013	1" = 50'

**B. Order of Delineation**

1. The Conservation Commission has determined the following (check whichever is applicable)

a.  **Accurate:** The boundaries described on the referenced plan(s) above and in the Abbreviated Notice of Resource Area Delineation are accurately drawn for the following resource area(s):

- 1.  Bordering Vegetated Wetlands
- 2.  Other resource area(s), specifically
  - a. SEE FINDINGS ATTACHED HERETO.

b.  **Modified:** The boundaries described on the plan(s) referenced above, as modified by the Conservation Commission from the plans contained in the Abbreviated Notice of Resource Area Delineation, are accurately drawn from the following resource area(s):

- 1.  Bordering Vegetated Wetlands



**Massachusetts Department of Environmental Protection**  
Bureau of Resource Protection - Wetlands  
**WPA Form 4B - Order of Resource Area Delineation**  
Massachusetts Wetlands Protection Act M.G.L. c. 131 S40

Provided by MassDEP:  
MassDEP File #:137-1203  
eDEP Transaction #:555764  
City/Town:CONCORD

2.  Other resource area(s), specifically  
a.

c.  **Inaccurate**:: The boundaries described on the referenced plan(s) and in the Abbreviated Notice of Resource Area Delineation were found to be inaccurate and cannot be confirmed for the following resource area(s):

1.  Bordering Vegetated Wetlands
2.  Other resource area(s), specifically  
a.
3. The boundaries were determined to be inaccurate because:

### C. Findings

This Order of Resource Area Delineation determines that the boundaries of those resource areas noted above, have been delineated and approved by the Commission and are binding as to all decisions rendered pursuant to the Massachusetts Wetlands Protection Act (M.G.L. c.131, S 40) and its regulations (310 CMR 10.00). This Order does not, however, determine the boundaries of any resource area or Buffer Zone to any resource area not specifically noted above, regardless of whether such boundaries are contained on the plans attached to this Order or to the Abbreviated Notice of Resource Area Delineation. This Order must be signed by a majority of the Conservation Commission. The Order must be sent by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate DEP Regional Office (see <http://www.mass.gov/dep/about/region/findyour.htm>).

### D. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate DEP Regional Office to issue a Superseding Order of Resource Area Delineation. When requested to issue a Superseding Order of Resource Area Delineation, the Department's review is limited to the objections to the resource area delineation(s) stated in the appeal request. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant. Any appellants seeking to appeal the Department's Superseding Order of Resource Area Delineation will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order or Determination, or providing written information to the Department prior to issuance of a Superseding Order or Determination. The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act, (M.G.L. c. 131, S 40) and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal bylaw or ordinance, and not on the Massachusetts Wetlands Protection Act or regulations, the Department of Environmental Protection has no appellate jurisdiction.



**Massachusetts Department of Environmental Protection**  
 Bureau of Resource Protection - Wetlands  
**WPA Form 4B - Order of Resource Area Delineation**  
 Massachusetts Wetlands Protection Act M.G.L. c. 131 S40

Provided by MassDEP:  
 MassDEP File #:137-1203  
 eDEP Transaction #:555764  
 City/Town:CONCORD

**E. Signatures**

*Don S. Banfield*  
 Don S. Banfield  
 \_\_\_\_\_  
*Elissa J. Brown*  
 Elissa J. Brown  
 \_\_\_\_\_  
*Stephen B. Verrill*  
 Stephen B. Verrill  
 \_\_\_\_\_

1. Date of Original Order \_\_\_\_\_  
 2. No. of Signatures required 4  
*Jeffrey W. Adams*  
 Jeffrey W. Adams  
 \_\_\_\_\_  
 \_\_\_\_\_

**This Order is valid for three years from the date of issuance.**

If this Order constitutes an Amended Order of Resource Area Delineation, this Order does not extend the issuance date of the original Final Order, and the Amended Order will expire on the date of the Original Final Order unless extended in writing by the Department.

This Order is issued to the applicant and the property owner (if different) as follows:

3.  By hand delivery on

4.  By certified mail, return receipt requested on

a. Date April 19, 2013

a. Date \_\_\_\_\_

**FINDINGS**  
**965 Elm Street DEP File #137-1203**  
**Applicant: Concord Housing Development Corporation**  
**ORAD Issued April 19, 2013**

**Findings:**

1. The Natural Resources Commission (the Commission) has verified the following resource area boundaries as shown on the Abbreviated Notice of Resource Area Delineation Plan of Land for Winthrop Street, Concord, MA prepared by Places Associates, Inc, and last revised April 3, 2013:
  - Bordering Vegetated Wetland flag numbers:
    - A-13 through A-18;
    - A-20 through A-30
  - Bank flag numbers:
    - A-5 through A-13
  - Mean Annual High Water flag numbers:
    - A-5 through A-18
    - R-18A and R-19
  - Bordering Land Subject to Flooding at elevation 123.8 feet
2. The Federal Emergency Mapping Agency (FEMA) issued Preliminary Mapping on January 10, 2013 showing the 100-year floodplain at elevation 123.8 feet. The Wetlands Protection Act Regulations (310 CMR 10.57(2)(a)(3)) define Bordering Land Subject to Flooding as:

*“The boundary of Bordering Land Subject to Flooding is the estimated maximum lateral extent of flood water which will theoretically result from the statistical 100-year frequency storm. Said boundary shall be that determined by reference to the most recently available flood profile data prepared for the community within which the work is proposed under the National Flood Insurance Program (NFIP, currently administered by the Federal Emergency Management Agency, successor to the U.S. Department of Housing and Urban Development). Said boundary, so determined, shall be presumed accurate.”*

The Commission finds that the January 10, 2013 mapping represents the most recently available flood profile data.

3. The Commission finds that if the FEMA mapping is appealed, and a new 100-year floodplain elevation is accepted by FEMA, then that elevation shall be approved under this ORAD.

Note that there may be other resource areas present on the site which the Commission was not asked to verify. In addition, the Commission was unable to verify resource area boundary flags other than the ones approved in this ORAD. For this reason, the Commission reserves the right to review any future proposal for work on site to determine if there is a resource area or portion thereof not verified in this ORAD that may trigger the Commission's jurisdiction.

THE COMMONWEALTH OF MASSACHUSETTS  
DEPARTMENT OF CORRECTION  
REMAINING LAND

51+ ACRES  
2,716± REMAINING FRONTAGE  
EXECUTIVE ORDER 22EX, PAGE 479

MAP 8D, BLOCK 2163  
KEVIN E. & CATHERINE O.  
NEUJSTROM  
BOOK 54542, PAGE 271

MAP 8D, BLOCK 2164  
DIANE B. STRONACH  
BOOK 28843, PAGE 440

ZONING INFORMATION

INDUSTRIAL PARK  
MINIMUM AREA: 4 ACRES  
MINIMUM LOT FRONTAGE: 50' OR 200'  
MINIMUM FRONT YARD: 20' OR 100'  
CORNER CLEARANCE: 10'  
MAXIMUM HEIGHT: 40'  
MAXIMUM LOT COVERAGE: 50%

LEGEND

MAP, BLOCK - ASSESSORS INFORMATION  
 - STONE OR CONCRETE BOUND  
 - IRON PIPE  
 - DRILL HOLE  
 - PROPERTY LINE  
 - ABUTTER PROPERTY LINE (±)  
 - EASEMENT LINE  
 - STONE WALL  
 - CONTOUR  
 - INDEX CONTOUR  
 - BVW WETLAND LINE  
 - WETLAND FLAG  
 - 100' BUFFER ZONE  
 - TOP OF BANK  
 - RIVER/MEAN ANNUAL HIGH FLOW  
 - 200' RIVERFRONT AREA

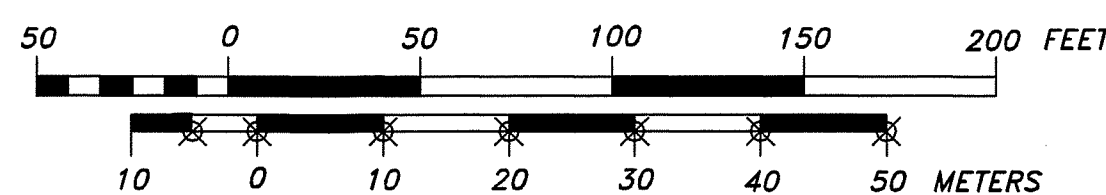
GENERAL NOTES

- THIS PLAN SHOWS A PROPOSED CONVEYANCE AND THE LOT CREATED, PARCEL "A", IS NOT A BUILDING LOT.
- PARCEL "A" IS TO BE CONVEYED TO THE CONCORD HOUSING DEVELOPMENT CORPORATION.
- FIELD SURVEY WAS COMPLETED BY TOTAL STATION/EDM.
- THE HORIZONTAL (NAD 83) AND VERTICAL (NAVD 88) DATUMS WERE DERIVED FROM GPS OBSERVATIONS AND ARE BASED ON THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM.
- ALL UNDERGROUND UTILITY INFORMATION SHOWN HEREON WAS DETERMINED FROM SURFACE EVIDENCE AND PLANS OF RECORD. ALL UNDERGROUND UTILITIES SHOULD BE LOCATED IN THE FIELD PRIOR TO COMMENCEMENT OF ALL SITE WORK. CALL DIGSAFE AT 1-800-322-4844 A MINIMUM OF 72 HOURS PRIOR TO PLANNED ACTIVITY.
- ACCORDING TO FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) MAPS, THE MAJOR IMPROVEMENTS ON THIS SITE ARE DESIGNATED "ZONE X", AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN. COMMUNITY PANEL 359 OF 656, MAP NUMBER 25017C0359E, EFFECTIVE DATE: JUNE 4, 2010. ZONE "AE" FLOOD ELEVATION IS 121'

**NOTE:**  
"PARCEL A", AS SHOWN ON THIS PLAN LIES WHOLLY WITHIN THE LAND ACQUIRED BY THE COMMONWEALTH OF MASSACHUSETTS ON JANUARY 9, 1874 AND RECORDED IN THE MIDDLESEX SOUTH REGISTRY OF DEEDS IN BOOK 1292, PAGE 227. SAID LAND WAS DECLARED SURPLUS TO THE NEEDS OF THE DEPARTMENT OF CORRECTION PER ITS DECLARATION DATED AUGUST 10, 2010 AS REFERENCED IN CHAPTER 117 OF THE ACTS OF 2010.

LOCUS REFERENCE

ASSESSOR'S MAP REFERENCE:  
MAP 8D, BLOCK 2013  
OWNER:  
COMMONWEALTH OF MASSACHUSETTS.  
EXECUTIVE ORDER 22EX, PAGE 479  
BOOK 1292, PAGE 227



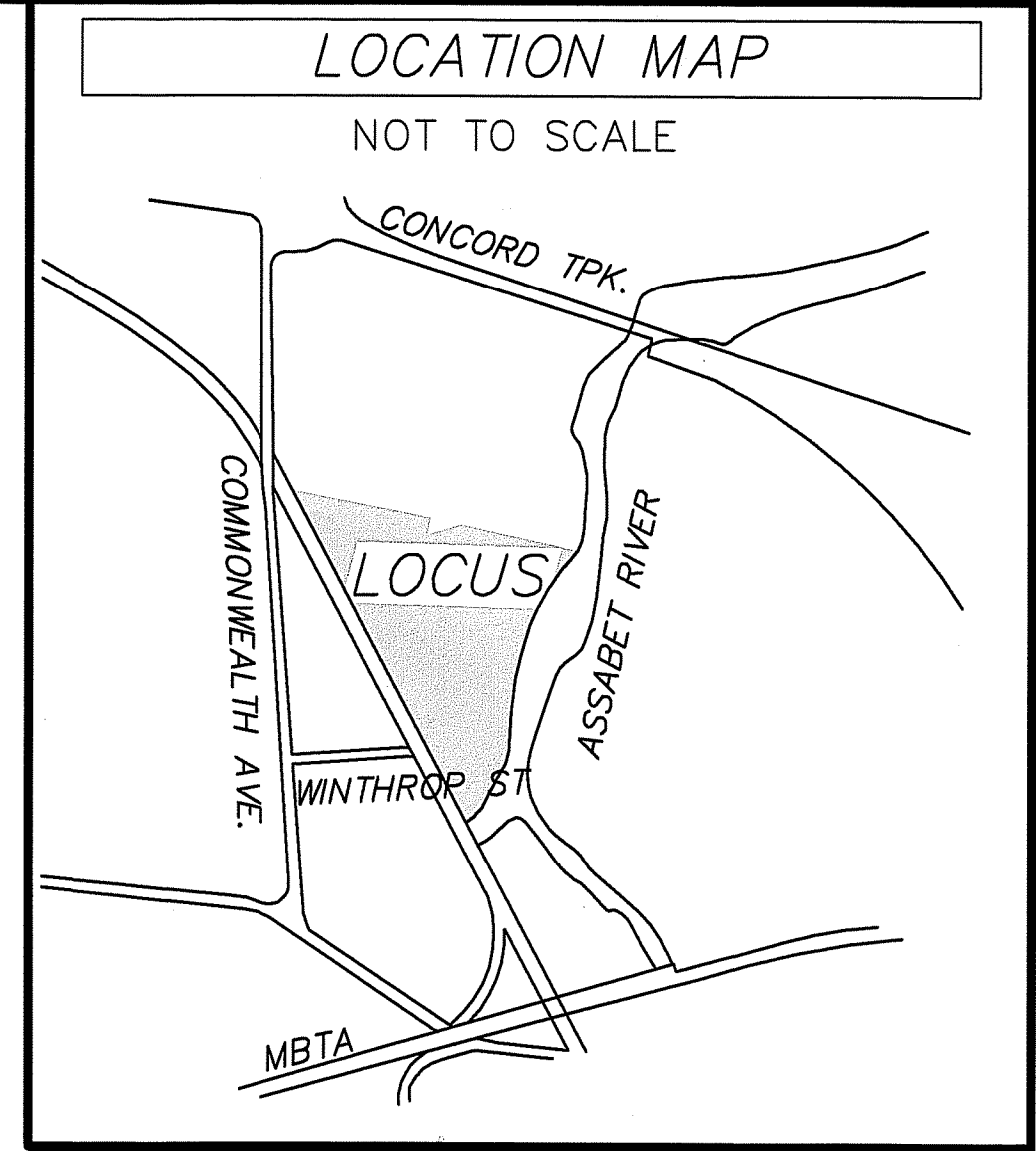
COMMONWEALTH OF MASSACHUSETTS

PARCEL A  
12.8+ ACRES  
EXECUTIVE ORDER 22EX, PAGE 479

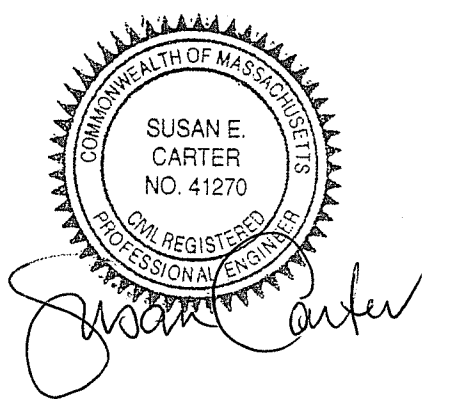
MAP 8D, BLOCK 2168  
WHALE ROCK LLC  
BOOK 46705, PAGE 295

MAP 9D, BLOCK 2177  
GRACE REALTY TRUST TR.  
1/4 BOOK 42300, PAGE 200  
PETER J. & ELLEN M.  
BOOK 14254, PAGE 288 S  
556.85' ±  
TO CONCRETE BOUND  
COMMONWEALTH AVENUE

MAP 9D, BLOCK 2183-CD  
ASSABET RIVER REALTY LLC  
BOOK 32540, PAGE 209



- NOTES:
- FLAGS A-4 THROUGH A-13 ARE BANK AND RIVER.
  - FLAGS A-14 TO A-18 ARE BVW AND RIVER.
  - FLAGS A-18 TO A-30 ARE BVW ONLY.
  - FLAGS A-18, R-18A TO NEW R-19 ARE RIVER/MEAN ANNUAL HIGH FLOW ONLY.
  - FLAGS A-15 TO A-17 AND FLAG A-19 ARE NO LONGER A RESOURCE AREA BUT ARE KEPT ON THIS PLAN FOR REFERENCE PURPOSES ONLY.



"JUNCTION VILLAGE"  
ABBREVIATED NOTICE OF  
RESOURCE AREA DELINEATION

PLAN OF LAND  
LOCATION: WINTHROP STREET  
TOWN: CONCORD, MASSACHUSETTS  
PREPARED FOR:

CONCORD HOUSING  
DEVELOPMENT CORP.

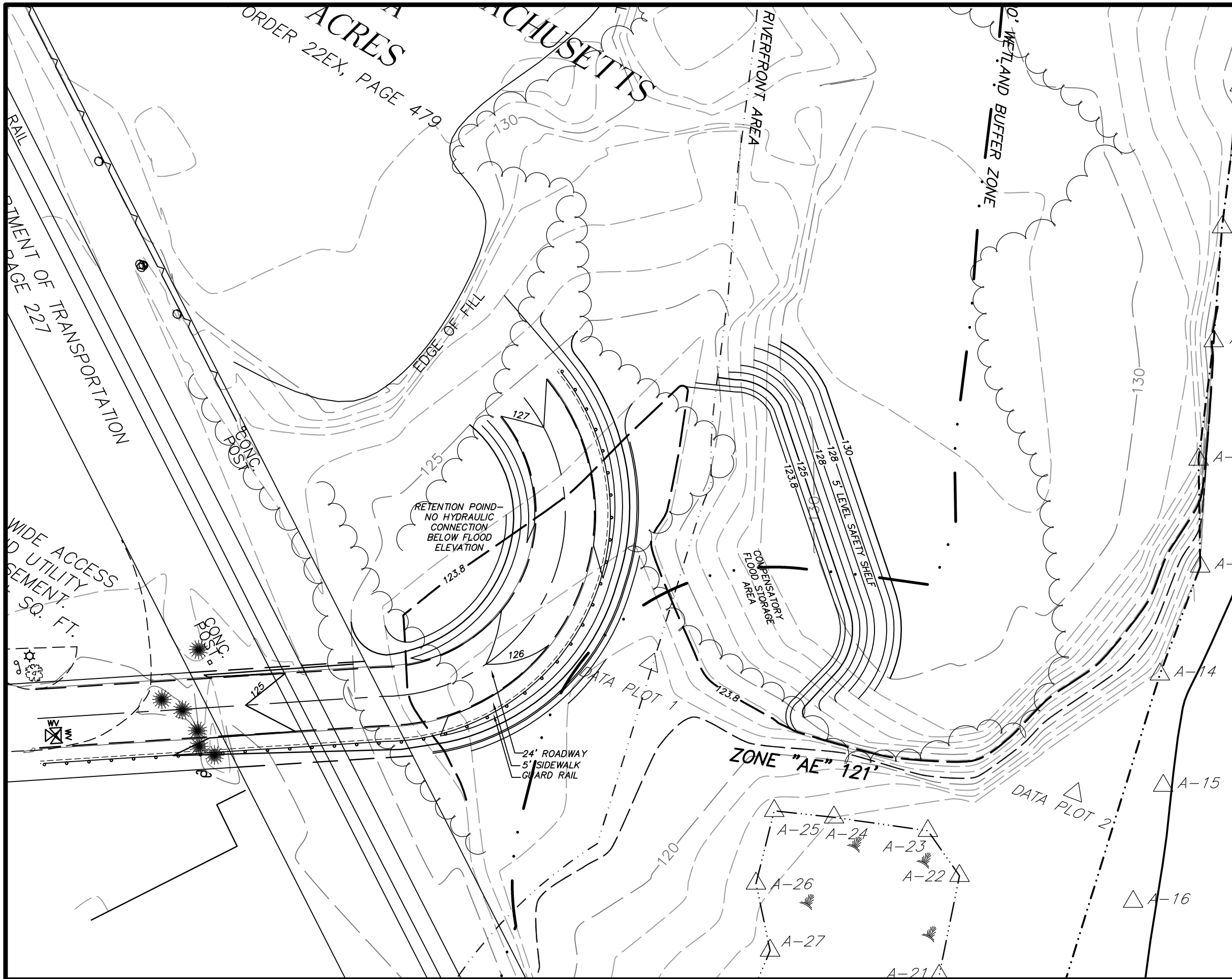
SCALE: 1"=50' DATE: FEB 20, 2013

Places Associates, Inc.

Planning, Landscape Architecture,  
Civil Engineering, Surveying  
510 KING STREET, SUITE 9  
LITTLETON, MA 01460  
978.486.0334 Ph.  
978.486.0447 Fax  
places@placesassociates.com

PROJECT No.: 11-6002 PLAN No.: 6002-ANRAD

REVISIONS:  
2-28-13 BASED ON SITE WALK W/NRC



LEGEND	
MAP, BLOCK	-ASSESSORS INFORMATION
□	-STONE OR CONCRETE BOUND
○	-IRON PIPE
●	-DRILL HOLE
—	-PROPERTY LINE
— ± —	-ABUTTER PROPERTY LINE (±)
— — —	-EASEMENT LINE
— — — —	-STONE WALL
— — — —	-CONTOUR
— 100 —	-INDEX CONTOUR
— · — · —	-BVW WETLAND LINE
△ A-12	-WETLAND FLAG
— — — —	-100' BUFFER ZONE
— · — · —	-TOP OF BANK
— — — —	-RIVER
— · — · —	-200' RIVERFRONT AREA

SUMMARY OF FLOOD STORAGE:

AREA FILLED:  
 ELEV. 122= 55 S.F.  
 ELEV. 123= 2795 S.F.  
 ELEV. 123.8= 6698 S.F.

COMPENSATORY AREA:  
 ELEV. 122= 83 S.F.  
 ELEV. 123= 3244 S.F.  
 ELEV. 123.8= 6790 S.F.

"JUNCTION VILLAGE"  
 SKETCH OF ENTRANCE

PLAN OF LAND  
 LOCATION: WINTHROP STREET  
 TOWN: CONCORD, MASSACHUSETTS  
 PREPARED FOR:  
 CONCORD HOUSING  
 DEVELOPMENT CORP.

SCALE: 1"=40' DATE: MAR. 14, 2013

Places Associates, Inc.

Planning, Landscape Architecture,  
 Civil Engineering, Surveying  
 510 KING STREET, SUITE 9  
 LITTLETON, MA 01460  
 978.486.0334 Ph.  
 978.486.0447 Fax  
 places@placesassociates.com

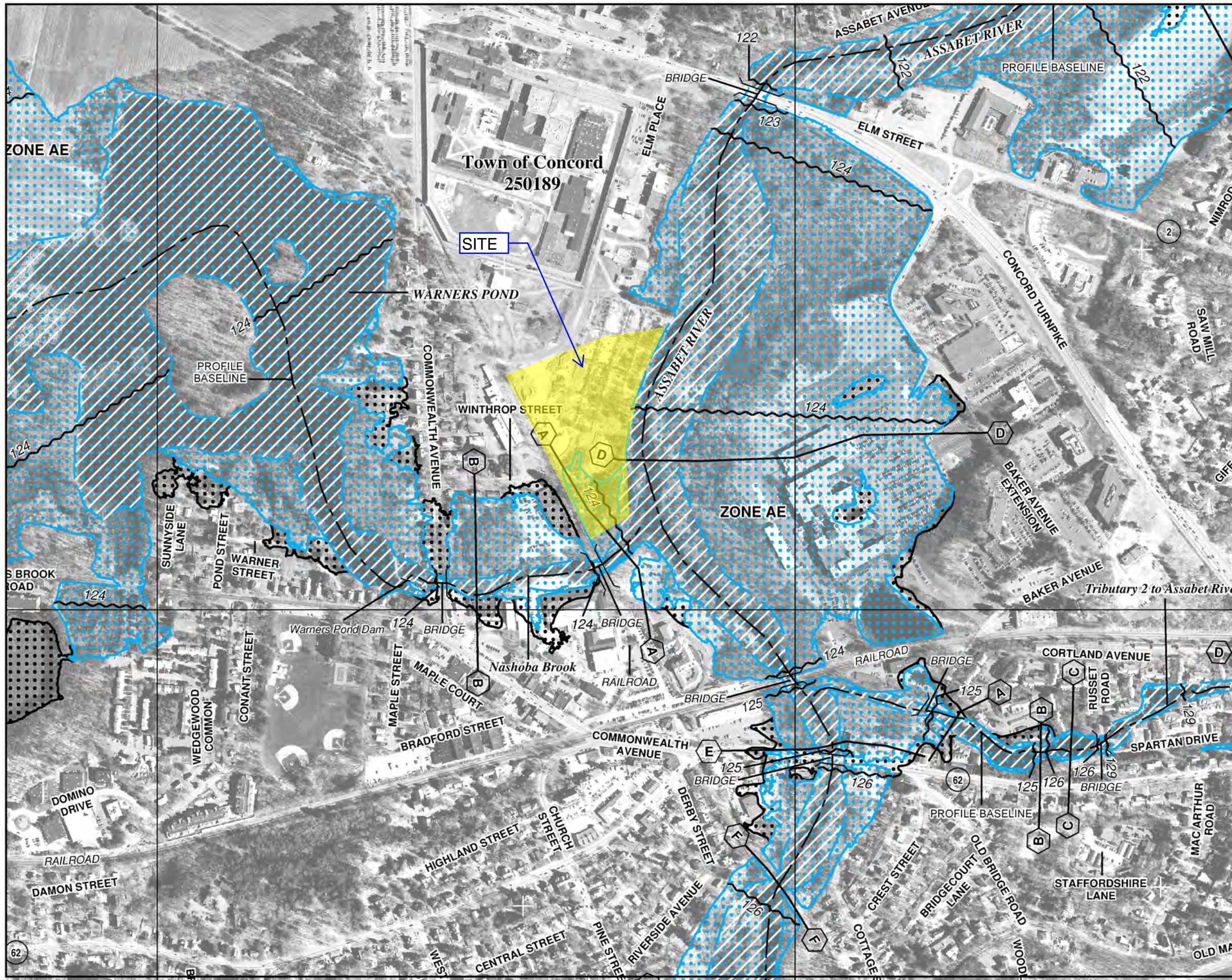
PROJECT No.: 11-6002 PLAN No.: 6002-FPSKETCH

## Appendix B

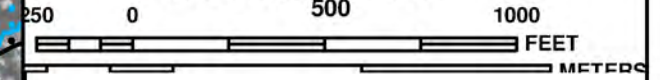
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### Federal Emergency Management Agency Map





MAP SCALE 1" = 500'



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0359F

**FIRM**  
 FLOOD INSURANCE RATE MAP  
 MIDDLESEX COUNTY,  
 MASSACHUSETTS  
 (ALL JURISDICTIONS)

PANEL 359 OF 656  
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONCORD, TOWN OF	250189	0359	F

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER  
 25017C0359F  
 MAP REVISED  
 JULY 7, 2014

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

## Appendix C

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### Compensatory Storage Calculations



Elevation	CUT		FILL	
	Contour Area (SF)	Vol (CF)	Contour Area (SF)	Vol (CF)
121	0	0	0	0
122	1092.57	546.285	46.37	23.185
123	6401.55	3747.06	2858.17	1452.27
124	8814.75	7608.15	7028.28	4943.225
		11901.495		6418.68

### 1:1.5 Comensatory Flood Storage Replication

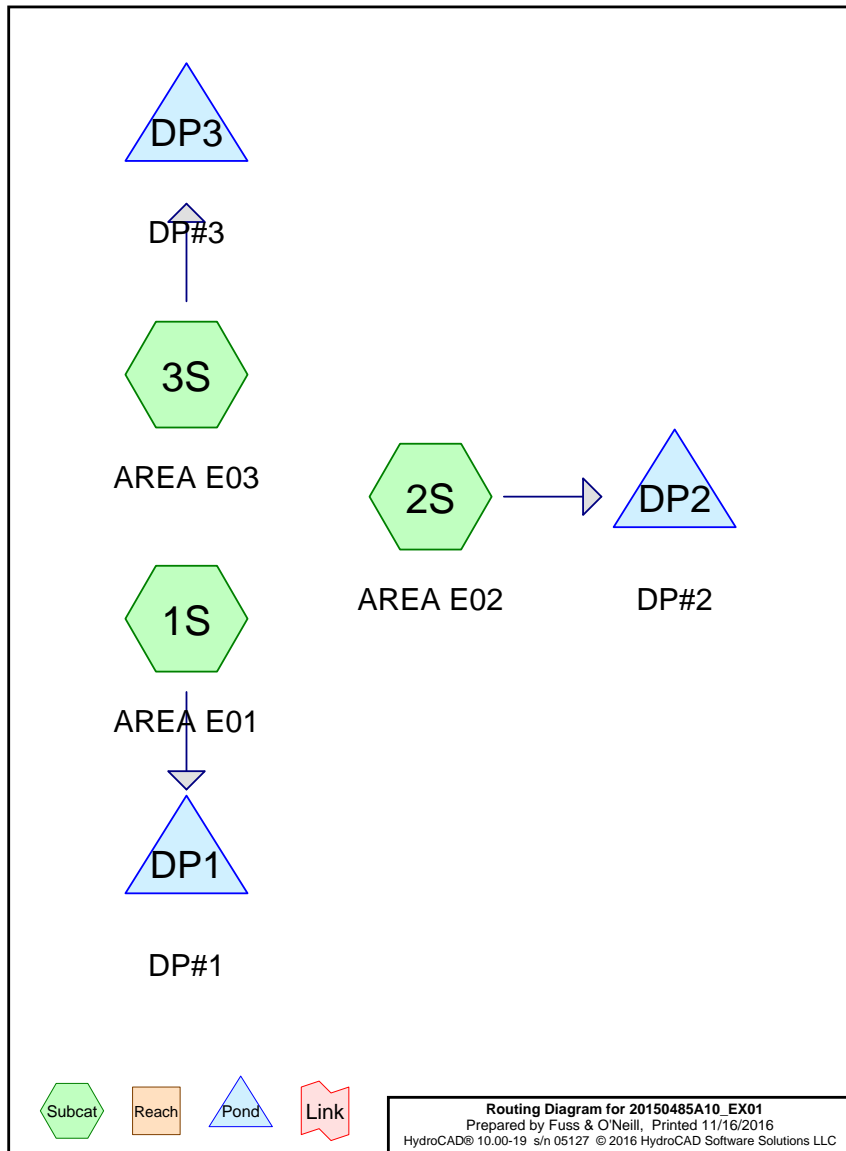
Elevation (FT)	FILL Volume (CF)	Required		Provided	
		CUT Volume (CF)	CUT Volume (CF)	CUT Volume (CF)	CUT Volume (CF)
122	23.185	34.7775	546.285		
123	1452.27	2178.405	3747.06		
124	4943.225	7414.8375	7608.15		

---

## Appendix D

### Existing Stormwater Hydrologic Model





**20150485A10\_EX01**

Prepared by Fuss & O'Neill

HydroCAD® 10.00-19 s/n 05127 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.10"

Printed 11/16/2016

Page 2

**Summary for Subcatchment 1S: AREA E01**

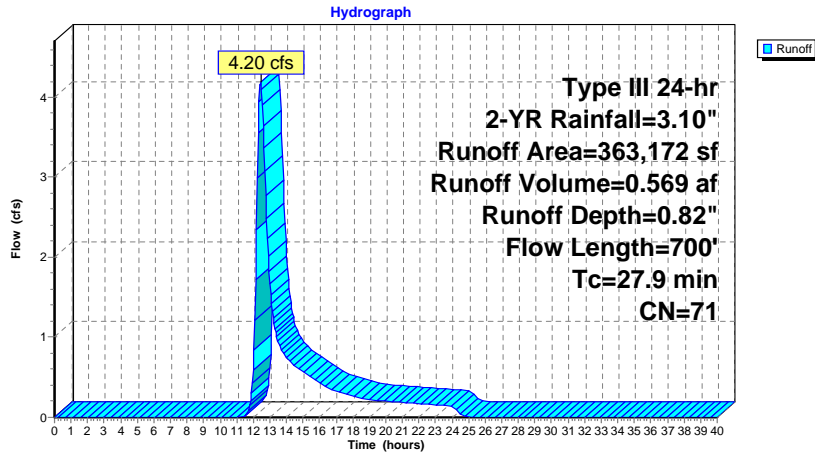
Runoff = 4.20 cfs @ 12.44 hrs, Volume= 0.569 af, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
14,310	98	Unconnected pavement, HSG B
57,050	96	Gravel surface, HSG B
187,666	69	50-75% Grass cover, Fair, HSG B
70,938	60	Woods, Fair, HSG B
33,208	56	Brush, Fair, HSG B
363,172	71	Weighted Average
348,862		96.06% Pervious Area
14,310		3.94% Impervious Area
14,310		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
3.9	264	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b>
					Unpaved Kv= 16.1 fps
0.1	29	0.0800	4.55		<b>Shallow Concentrated Flow, D-E</b>
					Unpaved Kv= 16.1 fps
0.5	87	0.0340	2.97		<b>Shallow Concentrated Flow, E-F</b>
					Unpaved Kv= 16.1 fps
1.0	198	0.0400	3.22		<b>Shallow Concentrated Flow, F-G</b>
					Unpaved Kv= 16.1 fps
0.1	22	0.0900	4.83		<b>Shallow Concentrated Flow, G-F</b>
					Unpaved Kv= 16.1 fps
27.9	700				Total

**Subcatchment 1S: AREA E01**



**Summary for Subcatchment 2S: AREA E02**

Runoff = 0.30 cfs @ 12.43 hrs, Volume= 0.055 af, Depth= 0.34"

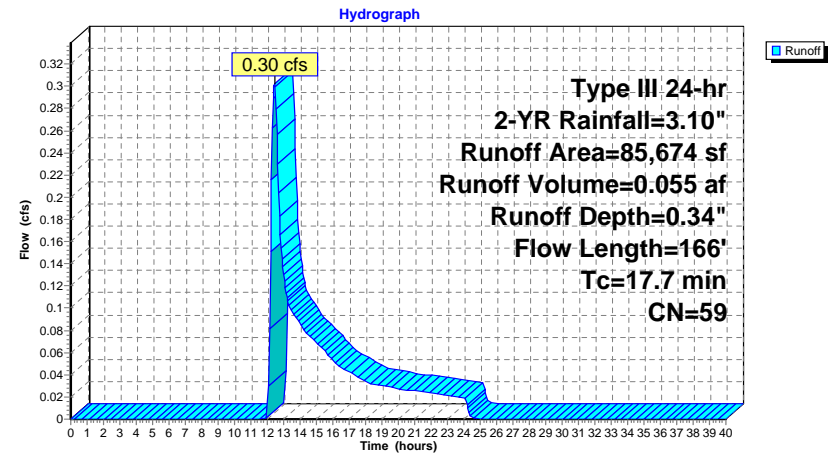
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
0	96	Gravel surface, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,416	60	Woods, Fair, HSG B
22,258	56	Brush, Fair, HSG B
85,674	59	Weighted Average
85,674		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		<b>Sheet Flow, A-B</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		<b>Shallow Concentrated Flow, B-C</b>
					Unpaved Kv= 16.1 fps
17.7	166	Total			

**Subcatchment 2S: AREA E02**



**20150485A10\_EX01**

Prepared by Fuss & O'Neill

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Type III 24-hr 2-YR Rainfall=3.10"

Printed 11/16/2016

Page 5

**Summary for Subcatchment 3S: AREA E03**

Runoff = 0.44 cfs @ 12.14 hrs, Volume= 0.043 af, Depth= 0.59"

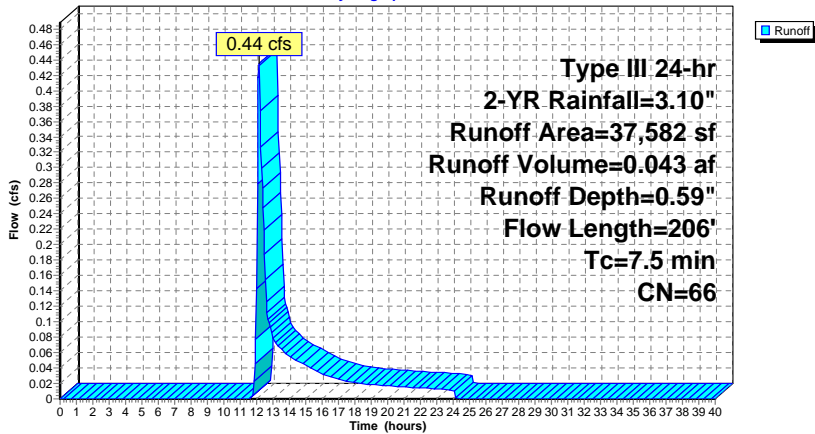
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
3,738	96	Gravel surface, HSG B
15,675	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
8,453	56	Brush, Fair, HSG B
37,582	66	Weighted Average
37,582		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	83	0.0400	0.21		<b>Sheet Flow, A-B</b> Grass: Short n= 0.150 P2= 3.10"
0.3	42	0.0240	2.49		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
0.7	81	0.0150	1.97		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
7.5	206	Total			

**Subcatchment 3S: AREA E03**

Hydrograph



**20150485A10\_EX01**

Prepared by Fuss & O'Neill

HydroCAD® 10.00-19 s/n 05127 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2-YR Rainfall=3.10"

Printed 11/16/2016

Page 6

**Summary for Pond DP1: DP#1**

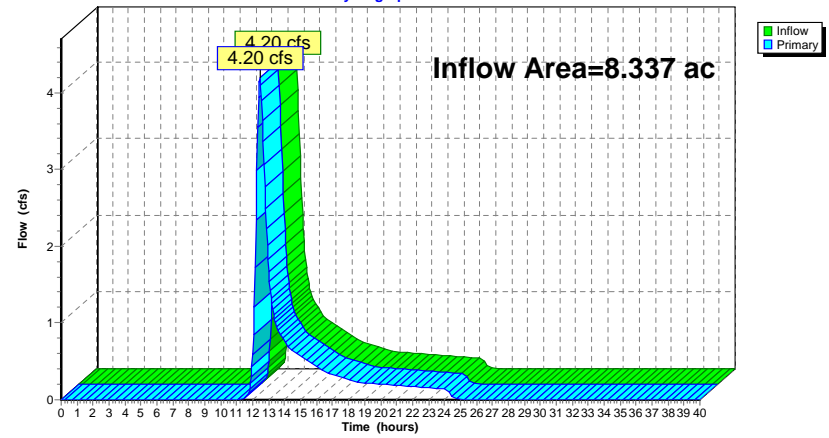
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.337 ac, 3.94% Impervious, Inflow Depth = 0.82" for 2-YR event  
Inflow = 4.20 cfs @ 12.44 hrs, Volume= 0.569 af  
Primary = 4.20 cfs @ 12.44 hrs, Volume= 0.569 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP1: DP#1**

Hydrograph



**Summary for Pond DP2: DP#2**

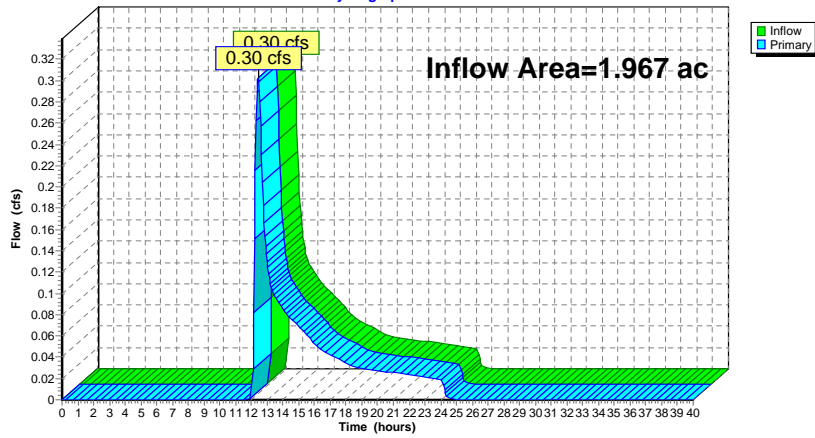
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.967 ac, 0.00% Impervious, Inflow Depth = 0.34" for 2-YR event  
 Inflow = 0.30 cfs @ 12.43 hrs, Volume= 0.055 af  
 Primary = 0.30 cfs @ 12.43 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP2: DP#2**

Hydrograph



**Summary for Pond DP3: DP#3**

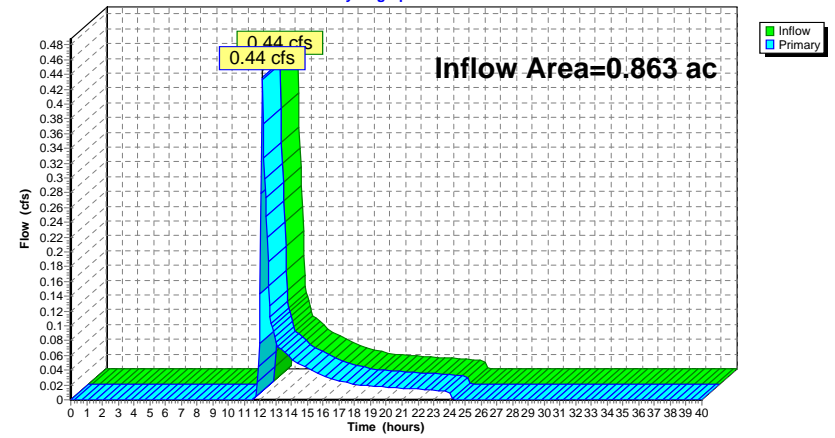
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.863 ac, 0.00% Impervious, Inflow Depth = 0.59" for 2-YR event  
 Inflow = 0.44 cfs @ 12.14 hrs, Volume= 0.043 af  
 Primary = 0.44 cfs @ 12.14 hrs, Volume= 0.043 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP3: DP#3**

Hydrograph



**20150485A10\_EX01**

Prepared by Fuss & O'Neill

HydroCAD® 10.00-19 s/n 05127 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10-YR Rainfall=4.50"

Printed 11/16/2016

Page 9

**Summary for Subcatchment 1S: AREA E01**

Runoff = 9.69 cfs @ 12.41 hrs, Volume= 1.213 af, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
14,310	98	Unconnected pavement, HSG B
57,050	96	Gravel surface, HSG B
187,666	69	50-75% Grass cover, Fair, HSG B
70,938	60	Woods, Fair, HSG B
33,208	56	Brush, Fair, HSG B
363,172	71	Weighted Average
348,862		96.06% Pervious Area
14,310		3.94% Impervious Area
14,310		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
3.9	264	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b>
					Unpaved Kv= 16.1 fps
0.1	29	0.0800	4.55		<b>Shallow Concentrated Flow, D-E</b>
					Unpaved Kv= 16.1 fps
0.5	87	0.0340	2.97		<b>Shallow Concentrated Flow, E-F</b>
					Unpaved Kv= 16.1 fps
1.0	198	0.0400	3.22		<b>Shallow Concentrated Flow, F-G</b>
					Unpaved Kv= 16.1 fps
0.1	22	0.0900	4.83		<b>Shallow Concentrated Flow, G-F</b>
					Unpaved Kv= 16.1 fps
27.9	700				Total

**20150485A10\_EX01**

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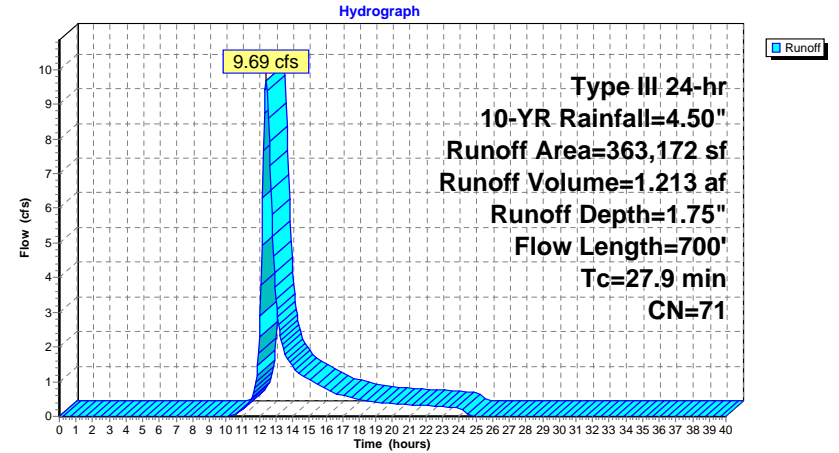
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Type III 24-hr 10-YR Rainfall=4.50"

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**Subcatchment 1S: AREA E01**



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Type III 24-hr 10-YR Rainfall=4.50"

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**Summary for Subcatchment 2S: AREA E02**

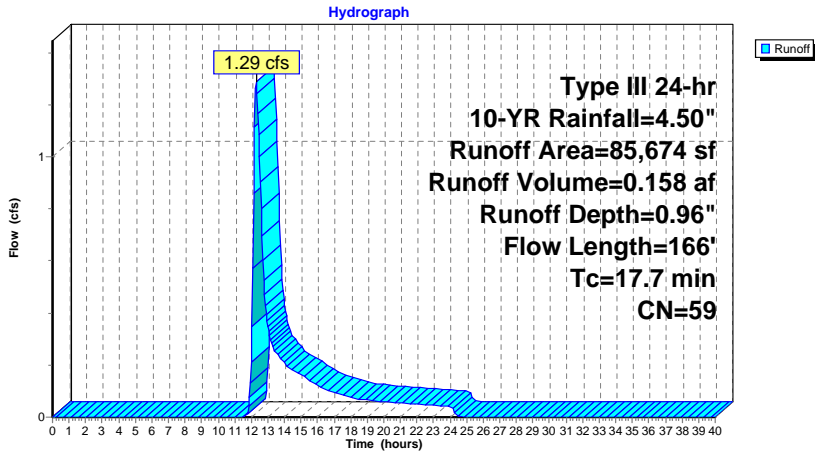
Runoff = 1.29 cfs @ 12.29 hrs, Volume= 0.158 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
0	96	Gravel surface, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,416	60	Woods, Fair, HSG B
22,258	56	Brush, Fair, HSG B
85,674	59	Weighted Average
85,674		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
17.7	166	Total			

**Subcatchment 2S: AREA E02**



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Type III 24-hr 10-YR Rainfall=4.50"

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**Summary for Subcatchment 3S: AREA E03**

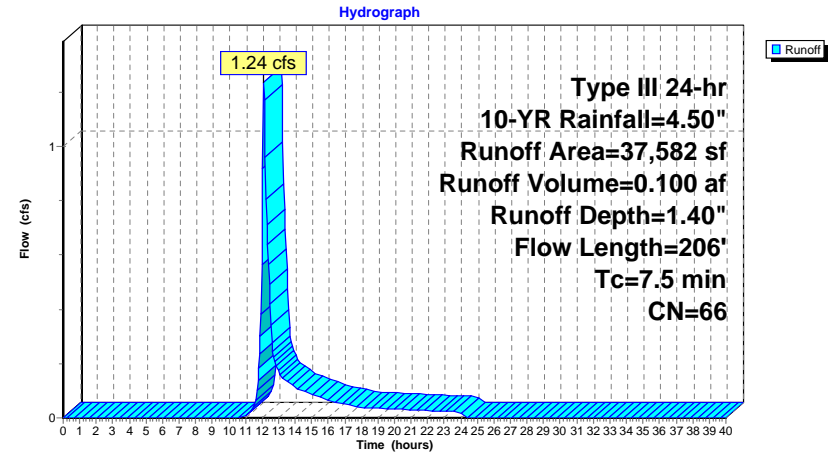
Runoff = 1.24 cfs @ 12.12 hrs, Volume= 0.100 af, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
3,738	96	Gravel surface, HSG B
15,675	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
8,453	56	Brush, Fair, HSG B
37,582	66	Weighted Average
37,582		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	83	0.0400	0.21		<b>Sheet Flow, A-B</b> Grass: Short n= 0.150 P2= 3.10"
0.3	42	0.0240	2.49		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
0.7	81	0.0150	1.97		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
7.5	206	Total			

**Subcatchment 3S: AREA E03**



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Type III 24-hr 10-YR Rainfall=4.50"

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Summary for Pond DP1: DP#1

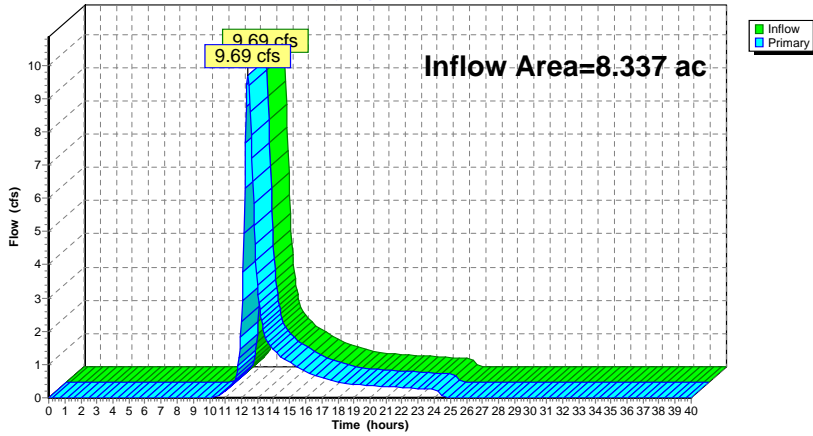
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.337 ac, 3.94% Impervious, Inflow Depth = 1.75" for 10-YR event  
 Inflow = 9.69 cfs @ 12.41 hrs, Volume= 1.213 af  
 Primary = 9.69 cfs @ 12.41 hrs, Volume= 1.213 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP1: DP#1

Hydrograph



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Type III 24-hr 10-YR Rainfall=4.50"

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Summary for Pond DP2: DP#2

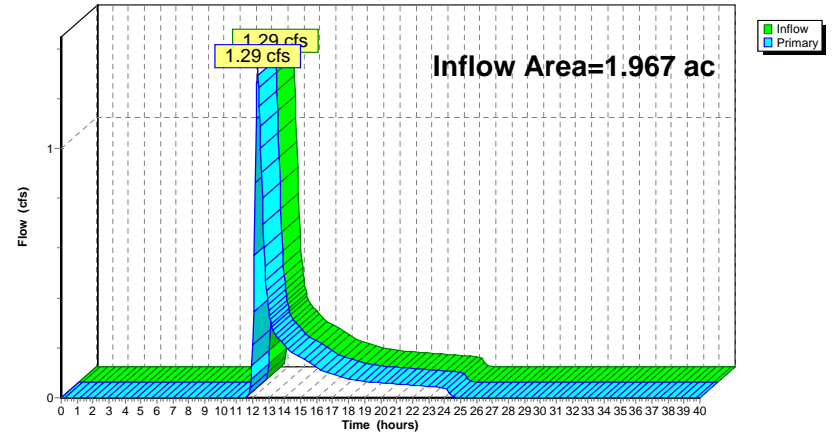
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.967 ac, 0.00% Impervious, Inflow Depth = 0.96" for 10-YR event  
 Inflow = 1.29 cfs @ 12.29 hrs, Volume= 0.158 af  
 Primary = 1.29 cfs @ 12.29 hrs, Volume= 0.158 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP2: DP#2

Hydrograph



**20150485A10\_EX01**

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Type III 24-hr 10-YR Rainfall=4.50"

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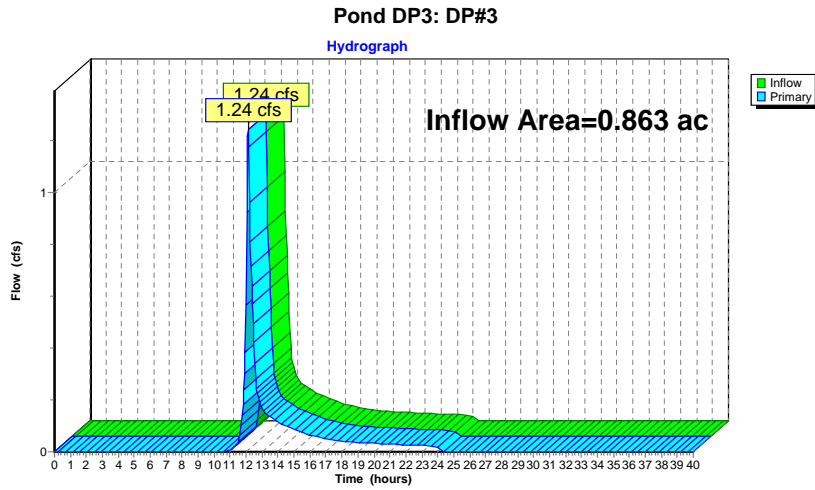
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**Summary for Pond DP3: DP#3**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.863 ac, 0.00% Impervious, Inflow Depth = 1.40" for 10-YR event  
 Inflow = 1.24 cfs @ 12.12 hrs, Volume= 0.100 af  
 Primary = 1.24 cfs @ 12.12 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs



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Type III 24-hr 25-YR Rainfall=5.30"

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**Summary for Subcatchment 1S: AREA E01**

Runoff = 13.21 cfs @ 12.40 hrs, Volume= 1.630 af, Depth= 2.35"

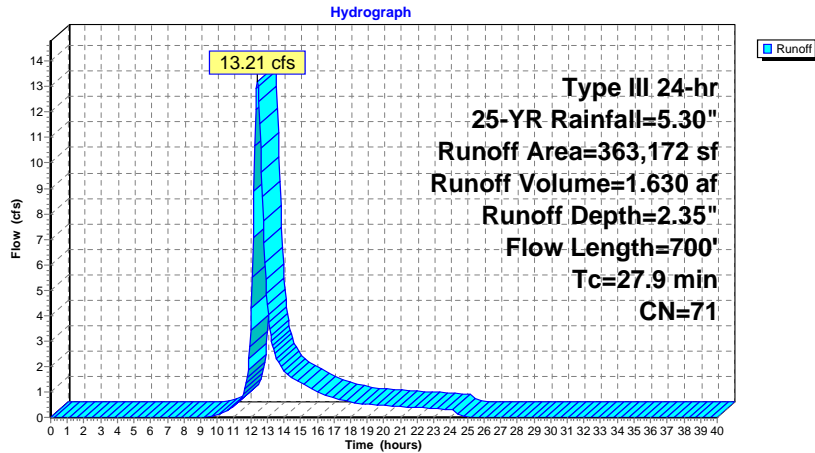
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
14,310	98	Unconnected pavement, HSG B
57,050	96	Gravel surface, HSG B
187,666	69	50-75% Grass cover, Fair, HSG B
70,938	60	Woods, Fair, HSG B
33,208	56	Brush, Fair, HSG B
363,172	71	Weighted Average
348,862		96.06% Pervious Area
14,310		3.94% Impervious Area
14,310		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
3.9	264	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b>
					Unpaved Kv= 16.1 fps
0.1	29	0.0800	4.55		<b>Shallow Concentrated Flow, D-E</b>
					Unpaved Kv= 16.1 fps
0.5	87	0.0340	2.97		<b>Shallow Concentrated Flow, E-F</b>
					Unpaved Kv= 16.1 fps
1.0	198	0.0400	3.22		<b>Shallow Concentrated Flow, F-G</b>
					Unpaved Kv= 16.1 fps
0.1	22	0.0900	4.83		<b>Shallow Concentrated Flow, G-F</b>
					Unpaved Kv= 16.1 fps
27.9	700				Total

**Subcatchment 1S: AREA E01**



**Summary for Subcatchment 2S: AREA E02**

Runoff = 2.05 cfs @ 12.27 hrs, Volume= 0.231 af, Depth= 1.41"

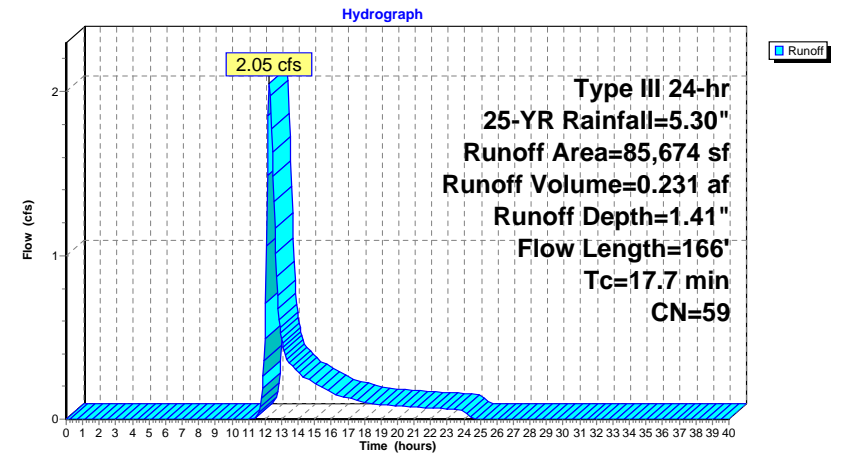
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
0	96	Gravel surface, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,416	60	Woods, Fair, HSG B
22,258	56	Brush, Fair, HSG B
85,674	59	Weighted Average
85,674		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		Sheet Flow, A-B
					Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		Shallow Concentrated Flow, B-C
					Unpaved Kv= 16.1 fps
17.7	166	Total			

**Subcatchment 2S: AREA E02**



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Type III 24-hr 25-YR Rainfall=5.30"

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**Summary for Subcatchment 3S: AREA E03**

Runoff = 1.77 cfs @ 12.12 hrs, Volume= 0.139 af, Depth= 1.94"

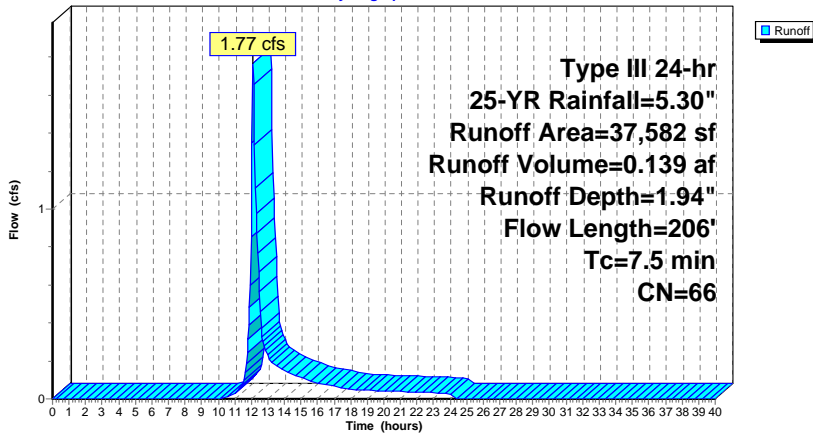
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
3,738	96	Gravel surface, HSG B
15,675	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
8,453	56	Brush, Fair, HSG B
37,582	66	Weighted Average
37,582		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	83	0.0400	0.21		<b>Sheet Flow, A-B</b> Grass: Short n= 0.150 P2= 3.10"
0.3	42	0.0240	2.49		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
0.7	81	0.0150	1.97		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
7.5	206	Total			

**Subcatchment 3S: AREA E03**

Hydrograph



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Type III 24-hr 25-YR Rainfall=5.30"

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**Summary for Pond DP1: DP#1**

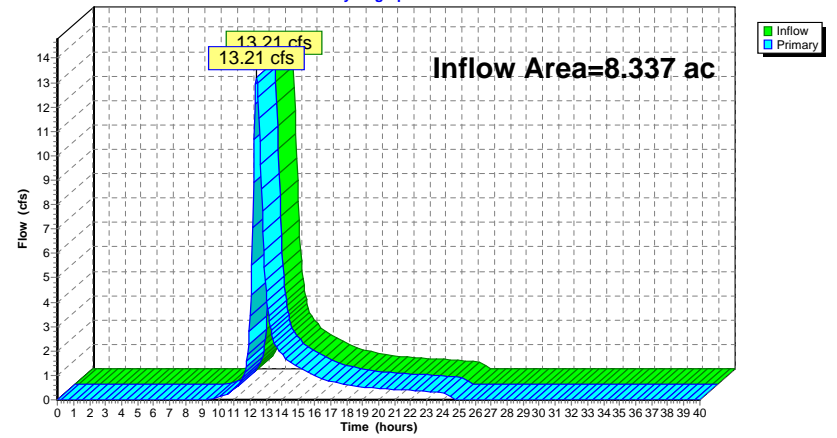
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.337 ac, 3.94% Impervious, Inflow Depth = 2.35" for 25-YR event  
 Inflow = 13.21 cfs @ 12.40 hrs, Volume= 1.630 af  
 Primary = 13.21 cfs @ 12.40 hrs, Volume= 1.630 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP1: DP#1**

Hydrograph



Summary for Pond DP2: DP#2

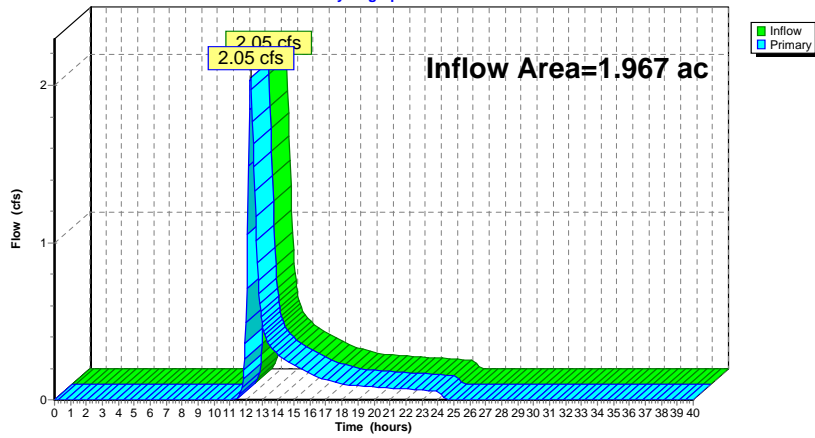
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.967 ac, 0.00% Impervious, Inflow Depth = 1.41" for 25-YR event  
 Inflow = 2.05 cfs @ 12.27 hrs, Volume= 0.231 af  
 Primary = 2.05 cfs @ 12.27 hrs, Volume= 0.231 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP2: DP#2

Hydrograph



Summary for Pond DP3: DP#3

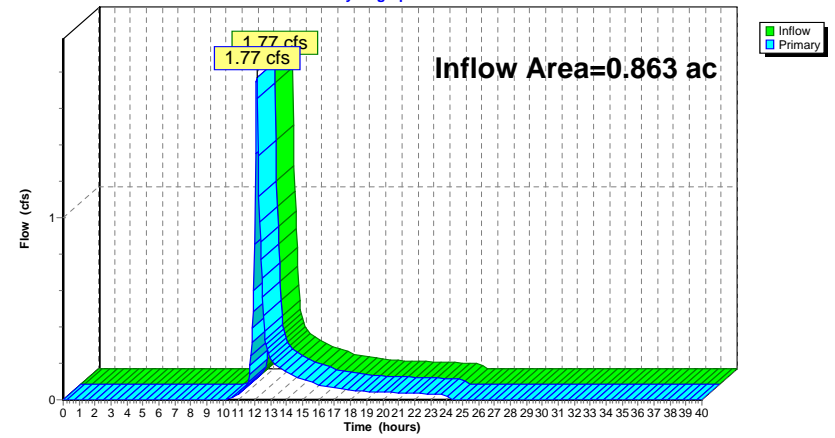
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.863 ac, 0.00% Impervious, Inflow Depth = 1.94" for 25-YR event  
 Inflow = 1.77 cfs @ 12.12 hrs, Volume= 0.139 af  
 Primary = 1.77 cfs @ 12.12 hrs, Volume= 0.139 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP3: DP#3

Hydrograph



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Type III 24-hr 50-YR Rainfall=5.90"

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**Summary for Subcatchment 1S: AREA E01**

Runoff = 15.96 cfs @ 12.40 hrs, Volume= 1.958 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
14,310	98	Unconnected pavement, HSG B
57,050	96	Gravel surface, HSG B
187,666	69	50-75% Grass cover, Fair, HSG B
70,938	60	Woods, Fair, HSG B
33,208	56	Brush, Fair, HSG B
363,172	71	Weighted Average
348,862		96.06% Pervious Area
14,310		3.94% Impervious Area
14,310		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
3.9	264	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b>
					Unpaved Kv= 16.1 fps
0.1	29	0.0800	4.55		<b>Shallow Concentrated Flow, D-E</b>
					Unpaved Kv= 16.1 fps
0.5	87	0.0340	2.97		<b>Shallow Concentrated Flow, E-F</b>
					Unpaved Kv= 16.1 fps
1.0	198	0.0400	3.22		<b>Shallow Concentrated Flow, F-G</b>
					Unpaved Kv= 16.1 fps
0.1	22	0.0900	4.83		<b>Shallow Concentrated Flow, G-F</b>
					Unpaved Kv= 16.1 fps
27.9	700				Total

**20150485A10\_EX01**

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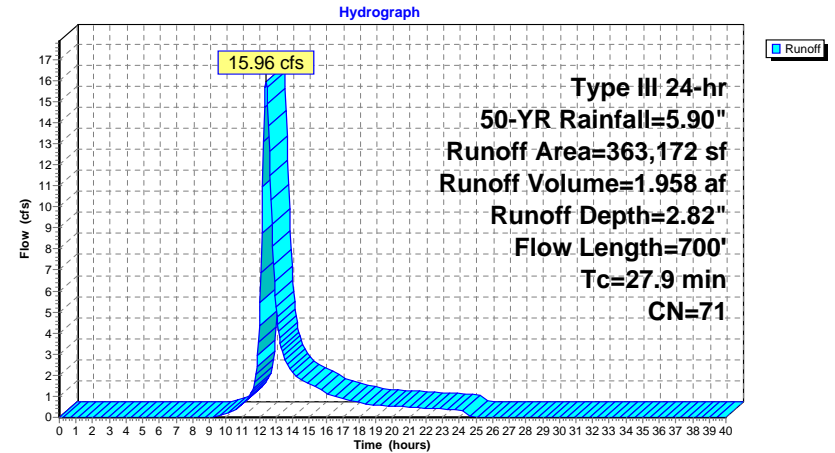
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Type III 24-hr 50-YR Rainfall=5.90"

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**Subcatchment 1S: AREA E01**



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Type III 24-hr 50-YR Rainfall=5.90"

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**Summary for Subcatchment 2S: AREA E02**

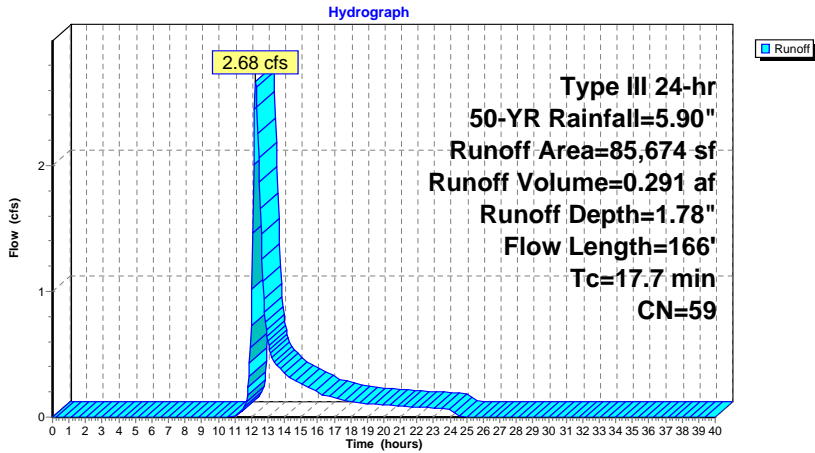
Runoff = 2.68 cfs @ 12.27 hrs, Volume= 0.291 af, Depth= 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
0	96	Gravel surface, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,416	60	Woods, Fair, HSG B
22,258	56	Brush, Fair, HSG B
85,674	59	Weighted Average
85,674		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
17.7	166	Total			

**Subcatchment 2S: AREA E02**



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Type III 24-hr 50-YR Rainfall=5.90"

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**Summary for Subcatchment 3S: AREA E03**

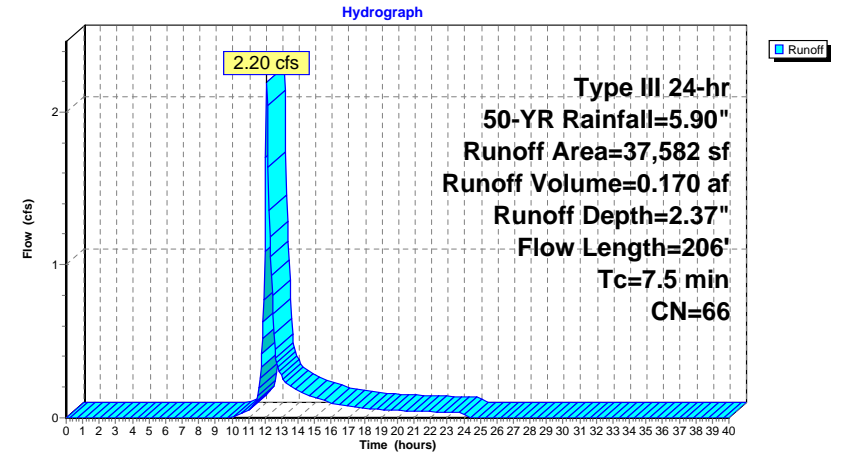
Runoff = 2.20 cfs @ 12.11 hrs, Volume= 0.170 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
3,738	96	Gravel surface, HSG B
15,675	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
8,453	56	Brush, Fair, HSG B
37,582	66	Weighted Average
37,582		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	83	0.0400	0.21		<b>Sheet Flow, A-B</b> Grass: Short n= 0.150 P2= 3.10"
0.3	42	0.0240	2.49		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
0.7	81	0.0150	1.97		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
7.5	206	Total			

**Subcatchment 3S: AREA E03**



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Type III 24-hr 50-YR Rainfall=5.90"

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Summary for Pond DP1: DP#1

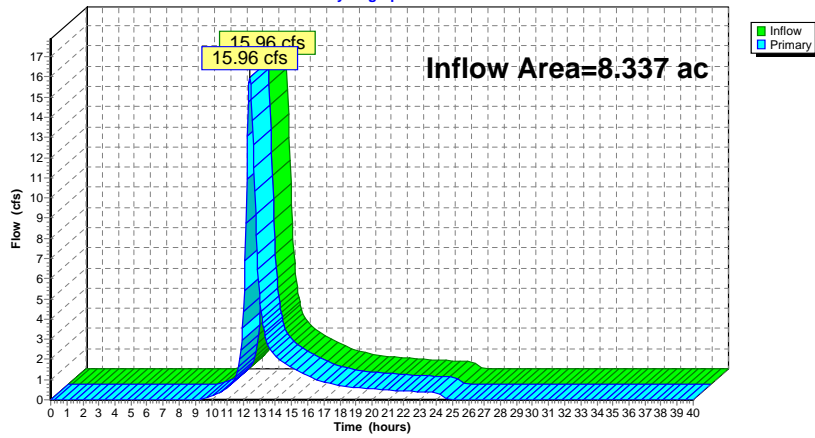
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.337 ac, 3.94% Impervious, Inflow Depth = 2.82" for 50-YR event  
 Inflow = 15.96 cfs @ 12.40 hrs, Volume= 1.958 af  
 Primary = 15.96 cfs @ 12.40 hrs, Volume= 1.958 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP1: DP#1

Hydrograph



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Type III 24-hr 50-YR Rainfall=5.90"

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Summary for Pond DP2: DP#2

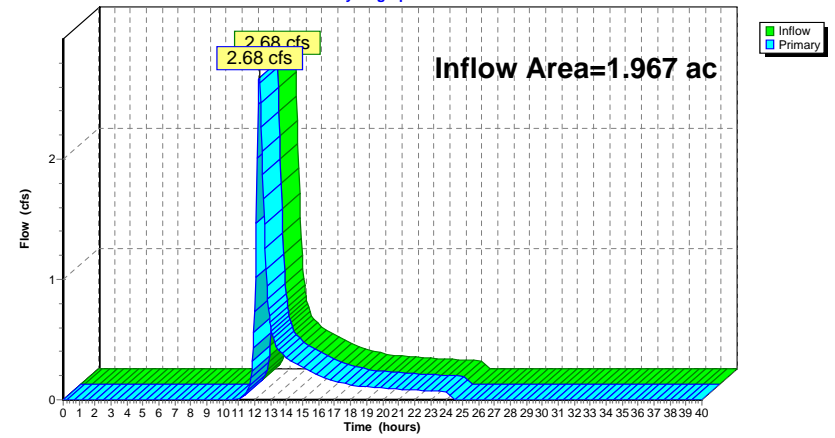
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.967 ac, 0.00% Impervious, Inflow Depth = 1.78" for 50-YR event  
 Inflow = 2.68 cfs @ 12.27 hrs, Volume= 0.291 af  
 Primary = 2.68 cfs @ 12.27 hrs, Volume= 0.291 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP2: DP#2

Hydrograph



**20150485A10\_EX01**

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Type III 24-hr 50-YR Rainfall=5.90"

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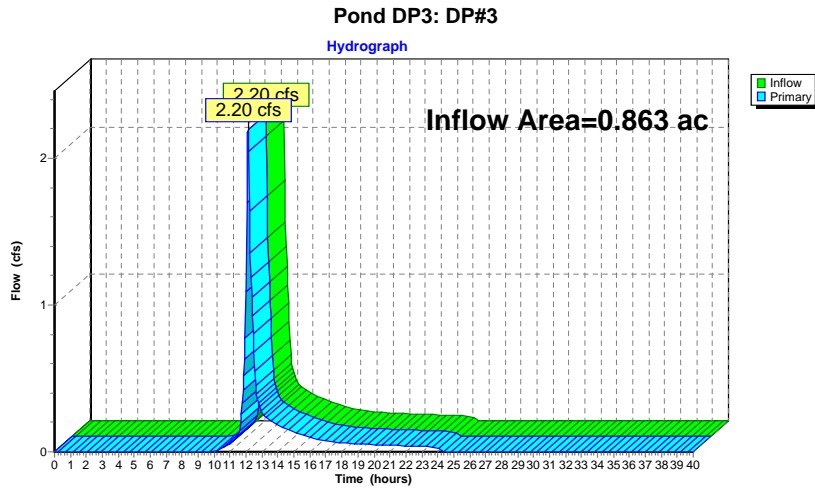
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**Summary for Pond DP3: DP#3**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.863 ac, 0.00% Impervious, Inflow Depth = 2.37" for 50-YR event  
 Inflow = 2.20 cfs @ 12.11 hrs, Volume= 0.170 af  
 Primary = 2.20 cfs @ 12.11 hrs, Volume= 0.170 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs



**20150485A10\_EX01**

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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Subcatchment 1S: AREA E01**

Runoff = 18.80 cfs @ 12.39 hrs, Volume= 2.297 af, Depth= 3.31"

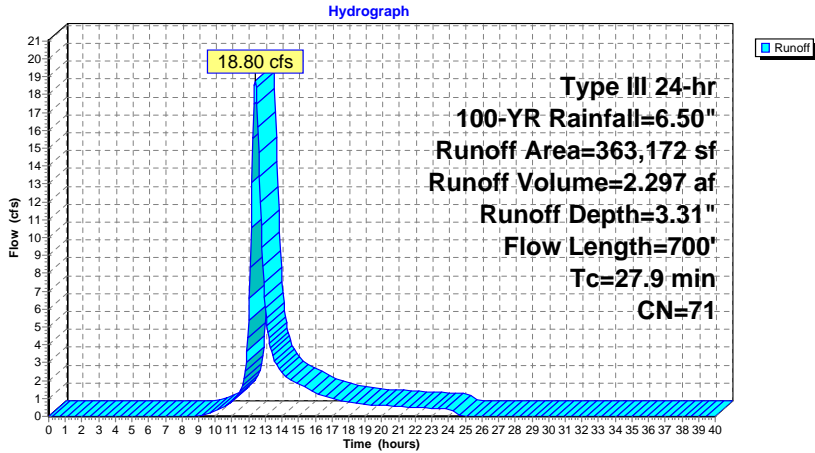
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
14,310	98	Unconnected pavement, HSG B
57,050	96	Gravel surface, HSG B
187,666	69	50-75% Grass cover, Fair, HSG B
70,938	60	Woods, Fair, HSG B
33,208	56	Brush, Fair, HSG B
363,172	71	Weighted Average
348,862		96.06% Pervious Area
14,310		3.94% Impervious Area
14,310		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b>
					Woods: Light underbrush n= 0.400 P2= 3.10"
3.9	264	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b>
					Unpaved Kv= 16.1 fps
0.1	29	0.0800	4.55		<b>Shallow Concentrated Flow, D-E</b>
					Unpaved Kv= 16.1 fps
0.5	87	0.0340	2.97		<b>Shallow Concentrated Flow, E-F</b>
					Unpaved Kv= 16.1 fps
1.0	198	0.0400	3.22		<b>Shallow Concentrated Flow, F-G</b>
					Unpaved Kv= 16.1 fps
0.1	22	0.0900	4.83		<b>Shallow Concentrated Flow, G-F</b>
					Unpaved Kv= 16.1 fps
27.9	700				Total

**Subcatchment 1S: AREA E01**



**Summary for Subcatchment 2S: AREA E02**

Runoff = 3.34 cfs @ 12.26 hrs, Volume= 0.355 af, Depth= 2.17"

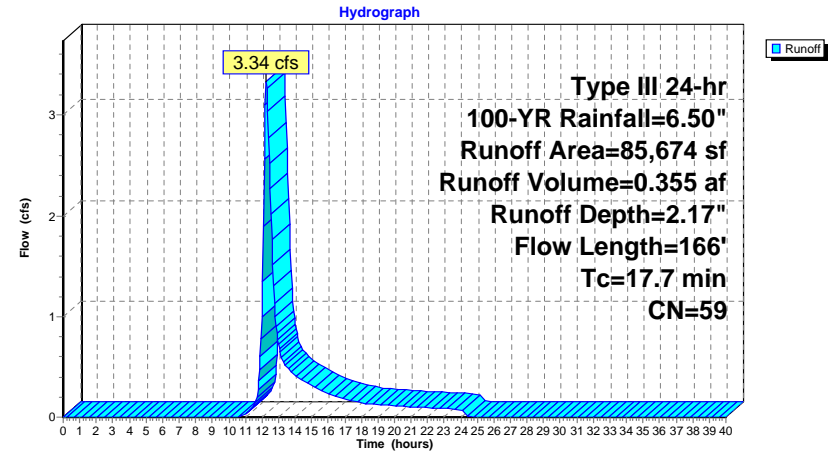
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
0	96	Gravel surface, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,416	60	Woods, Fair, HSG B
22,258	56	Brush, Fair, HSG B
85,674	59	Weighted Average
85,674		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
17.7	166	Total			

**Subcatchment 2S: AREA E02**



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Subcatchment 3S: AREA E03**

Runoff = 2.64 cfs @ 12.11 hrs, Volume= 0.203 af, Depth= 2.82"

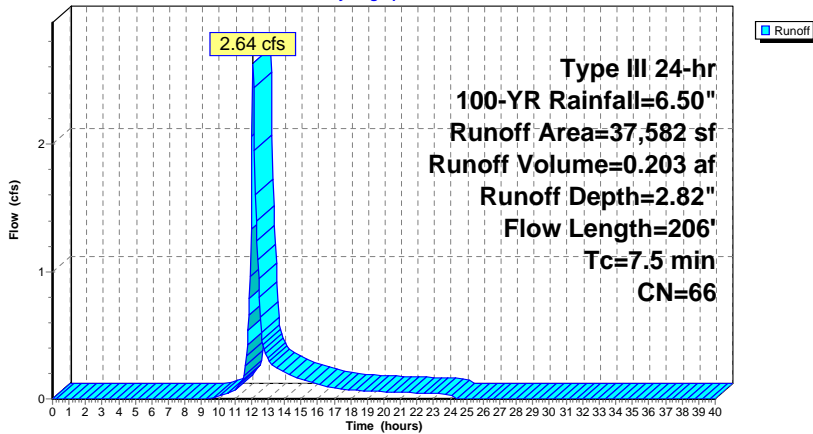
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG B
3,738	96	Gravel surface, HSG B
15,675	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
8,453	56	Brush, Fair, HSG B
37,582	66	Weighted Average
37,582		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	83	0.0400	0.21		<b>Sheet Flow, A-B</b> Grass: Short n= 0.150 P2= 3.10"
0.3	42	0.0240	2.49		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
0.7	81	0.0150	1.97		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
7.5	206	Total			

**Subcatchment 3S: AREA E03**

Hydrograph



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Pond DP1: DP#1**

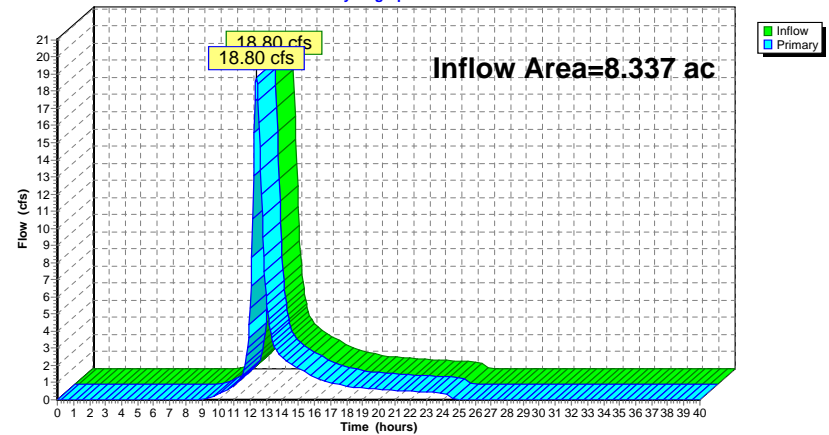
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.337 ac, 3.94% Impervious, Inflow Depth = 3.31" for 100-YR event  
Inflow = 18.80 cfs @ 12.39 hrs, Volume= 2.297 af  
Primary = 18.80 cfs @ 12.39 hrs, Volume= 2.297 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP1: DP#1**

Hydrograph



**Summary for Pond DP2: DP#2**

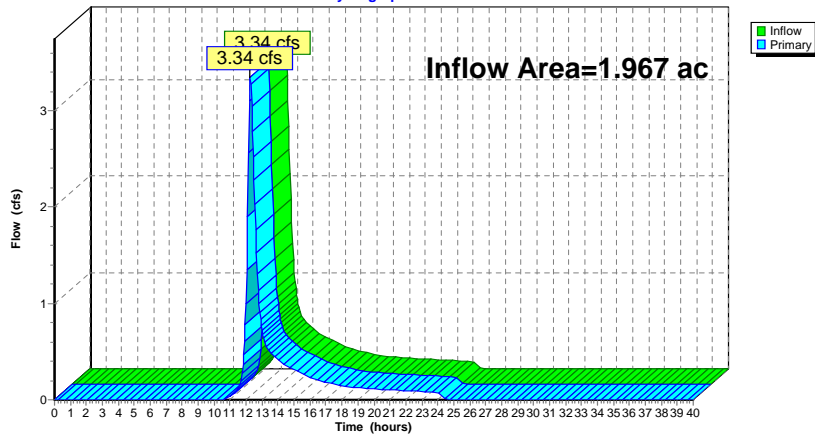
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.967 ac, 0.00% Impervious, Inflow Depth = 2.17" for 100-YR event  
 Inflow = 3.34 cfs @ 12.26 hrs, Volume= 0.355 af  
 Primary = 3.34 cfs @ 12.26 hrs, Volume= 0.355 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP2: DP#2**

Hydrograph



**Summary for Pond DP3: DP#3**

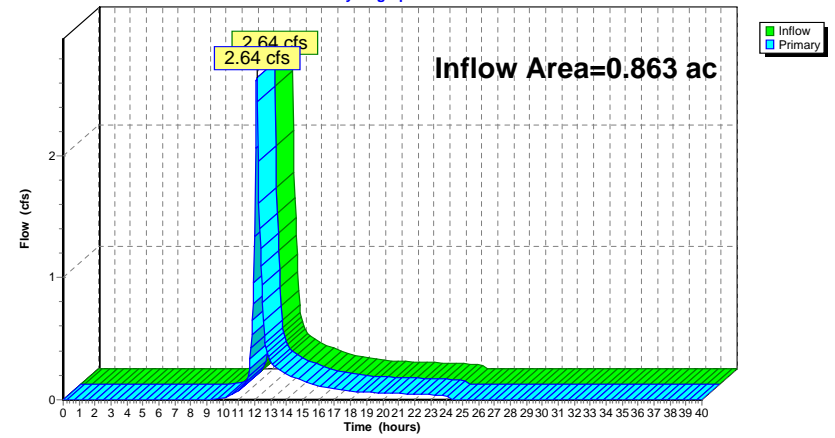
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.863 ac, 0.00% Impervious, Inflow Depth = 2.82" for 100-YR event  
 Inflow = 2.64 cfs @ 12.11 hrs, Volume= 0.203 af  
 Primary = 2.64 cfs @ 12.11 hrs, Volume= 0.203 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP3: DP#3**

Hydrograph

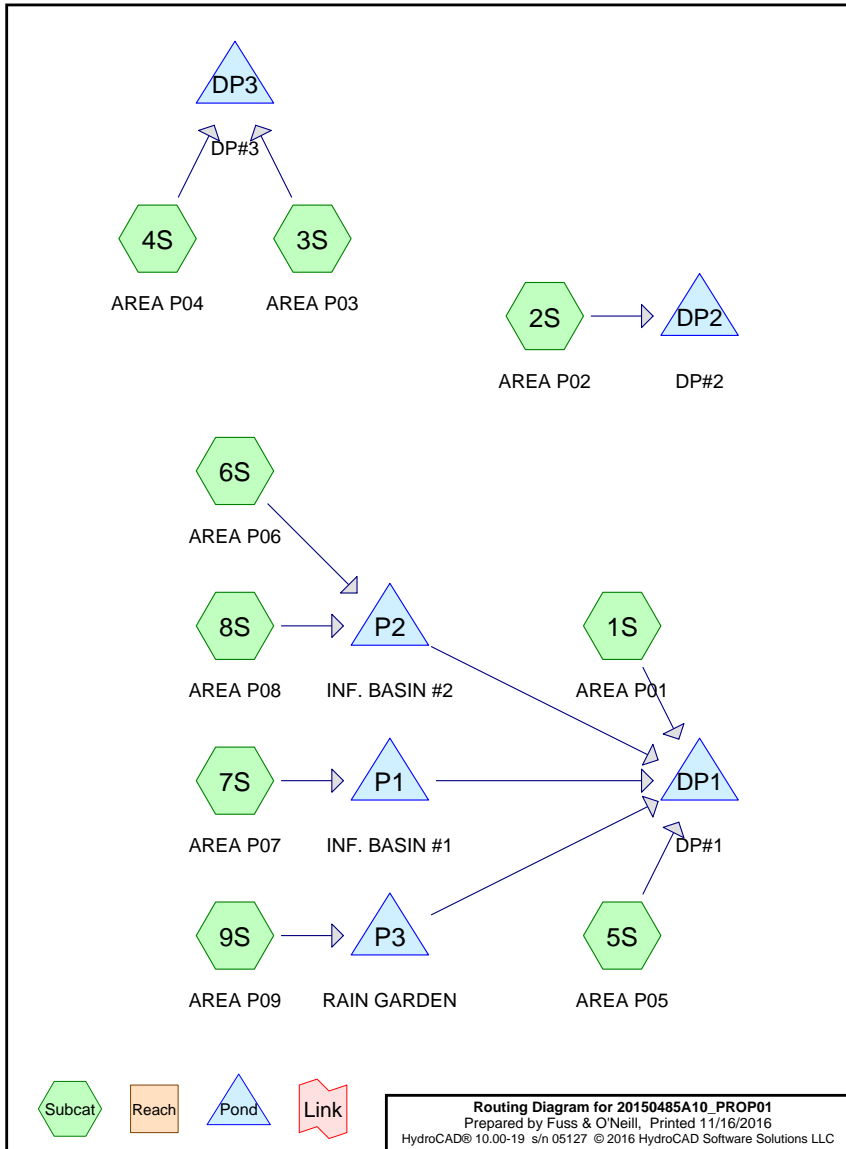


## Appendix E

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### Proposed Stormwater Hydrologic Model





**20150485A10\_PROP01**

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Type III 24-hr 2-YR Rainfall=3.10"

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**Summary for Subcatchment 1S: AREA P01**

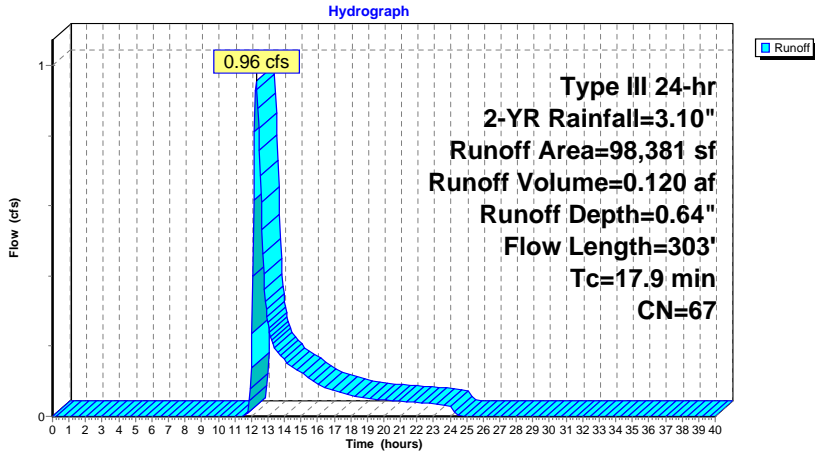
Runoff = 0.96 cfs @ 12.30 hrs, Volume= 0.120 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
10,163	98	Water Surface, 0% imp, HSG B
10,119	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
27,932	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
34,771	60	Woods, Fair, HSG B
15,396	56	Brush, Fair, HSG B
98,381	67	Weighted Average
88,262		89.71% Pervious Area
10,119		10.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	87	0.0290	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.1	39	0.1300	5.80		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.0	177	0.0330	2.92		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
17.9	303	Total			

**Subcatchment 1S: AREA P01**



**Summary for Subcatchment 2S: AREA P02**

Runoff = 0.30 cfs @ 12.43 hrs, Volume= 0.055 af, Depth= 0.34"

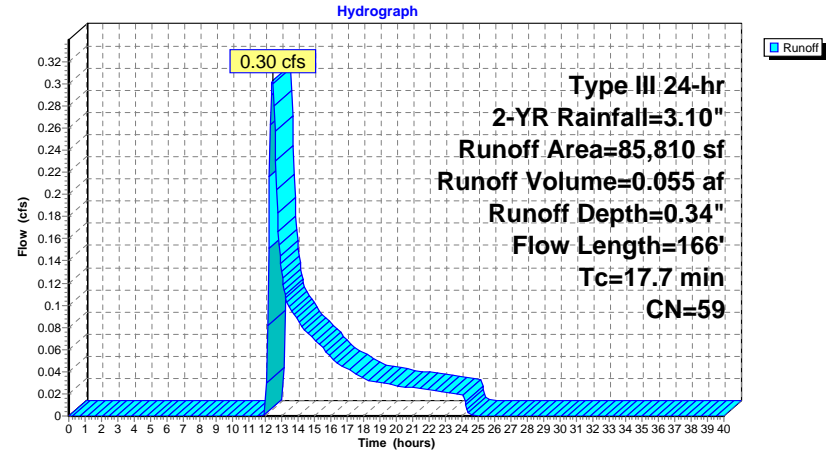
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
0	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,465	60	Woods, Fair, HSG B
22,345	56	Brush, Fair, HSG B
85,810	59	Weighted Average
85,810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
17.7	166	Total			

**Subcatchment 2S: AREA P02**



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Type III 24-hr 2-YR Rainfall=3.10"

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**Summary for Subcatchment 3S: AREA P03**

Runoff = 0.09 cfs @ 12.16 hrs, Volume= 0.014 af, Depth= 0.34"

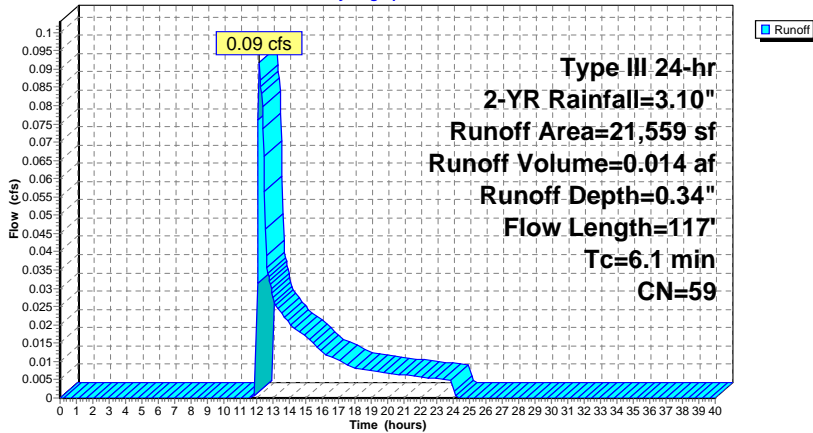
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
6,205	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
5,638	56	Brush, Fair, HSG B
21,559	59	Weighted Average
21,559		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	77	0.0450	0.22		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
0.3	40	0.0200	2.28		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
6.1	117				Total

**Subcatchment 3S: AREA P03**

Hydrograph



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Type III 24-hr 2-YR Rainfall=3.10"

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**Summary for Subcatchment 4S: AREA P04**

Runoff = 0.21 cfs @ 12.11 hrs, Volume= 0.017 af, Depth= 0.77"

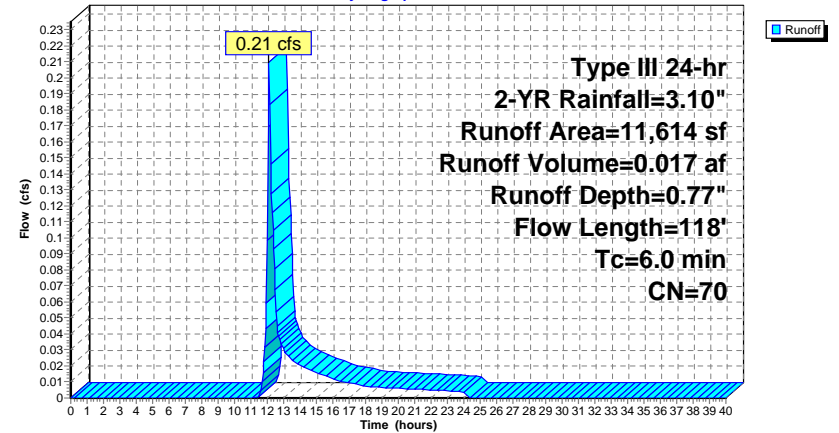
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
2,837	96	Gravel surface, HSG B
8,777	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
11,614	70	Weighted Average
11,614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	47	0.0320	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
0.4	71	0.0280	2.69		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
4.9	118				Total, Increased to minimum Tc = 6.0 min

**Subcatchment 4S: AREA P04**

Hydrograph



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Type III 24-hr 2-YR Rainfall=3.10"

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**Summary for Subcatchment 5S: AREA P05**

Runoff = 1.41 cfs @ 12.28 hrs, Volume= 0.173 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
11,713	98	Paved parking, HSG B
5,680	96	Gravel surface, HSG B
102,021	61	>75% Grass cover, Good, HSG B
22,661	69	50-75% Grass cover, Fair, HSG B
324	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
142,399	67	Weighted Average
130,686		91.77% Pervious Area
11,713		8.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	100	0.0300	0.20		<b>Sheet Flow, A-B</b>
					Grass: Short n= 0.150 P2= 3.10"
3.4	325	0.0100	1.61		<b>Shallow Concentrated Flow, B-C</b>
					Unpaved Kv= 16.1 fps
5.1	416	0.0070	1.35		<b>Shallow Concentrated Flow, C-D</b>
					Unpaved Kv= 16.1 fps
17.0	841				Total

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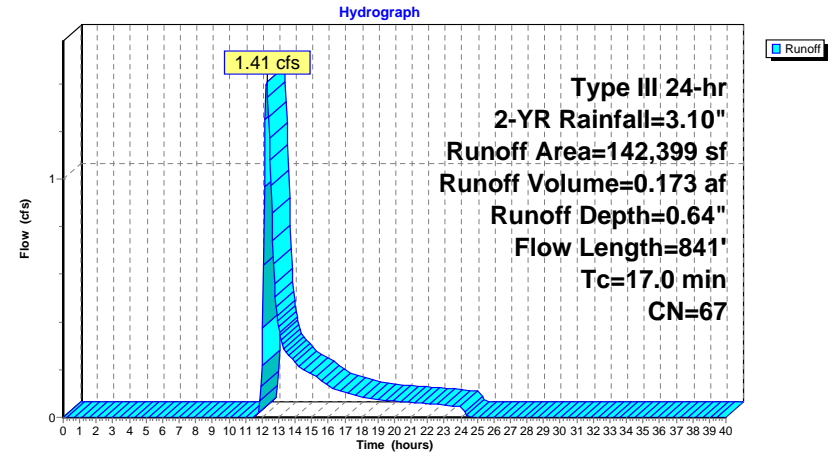
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Type III 24-hr 2-YR Rainfall=3.10"

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**Subcatchment 5S: AREA P05**

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Type III 24-hr 2-YR Rainfall=3.10"

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**Summary for Subcatchment 6S: AREA P06**

Runoff = 1.23 cfs @ 12.09 hrs, Volume= 0.100 af, Depth= 2.87"

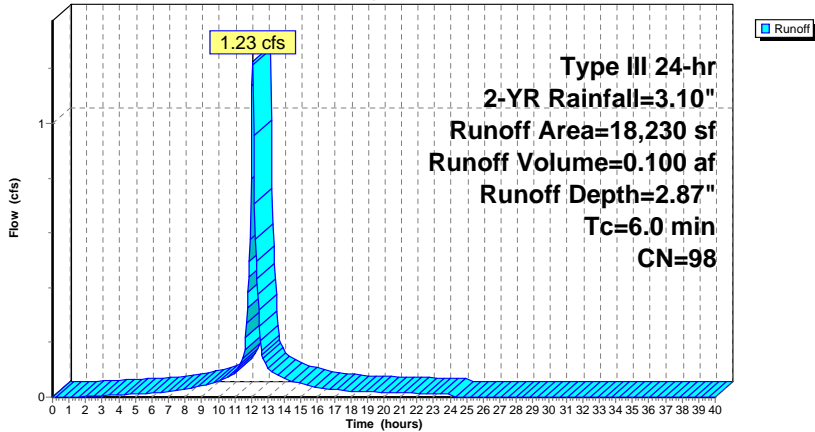
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
18,230	98	Roofs, HSG B
18,230		100.00% Impervious Area

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

**Subcatchment 6S: AREA P06**

Hydrograph



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Type III 24-hr 2-YR Rainfall=3.10"

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**Summary for Subcatchment 7S: AREA P07**

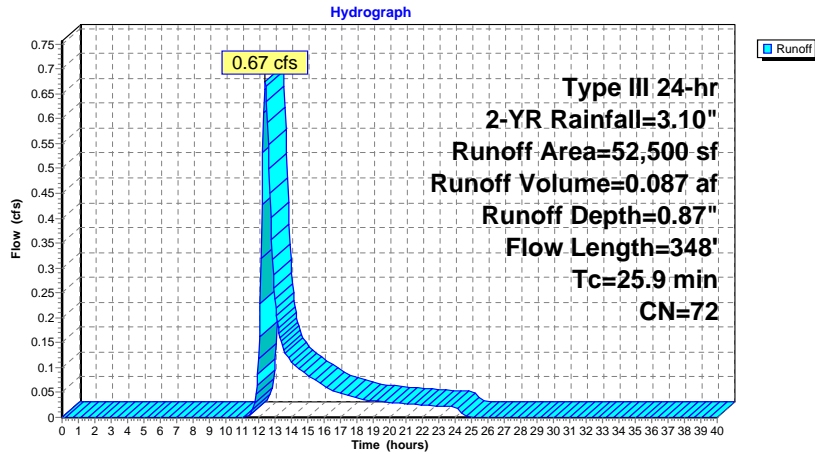
Runoff = 0.67 cfs @ 12.40 hrs, Volume= 0.087 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
3,970	98	Water Surface, HSG B
13,002	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
20,151	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
7,580	60	Woods, Fair, HSG B
7,797	56	Brush, Fair, HSG B
52,500	72	Weighted Average
35,528		67.67% Pervious Area
16,972		32.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b> Woods: Light underbrush n= 0.400 P2= 3.10"
3.2	218	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
0.4	30	0.0050	1.14		<b>Shallow Concentrated Flow, D-E</b> Unpaved Kv= 16.1 fps
25.9	348				Total

**Subcatchment 7S: AREA P07**



**Summary for Subcatchment 8S: AREA P08**

Runoff = 1.04 cfs @ 12.17 hrs, Volume= 0.092 af, Depth= 1.14"

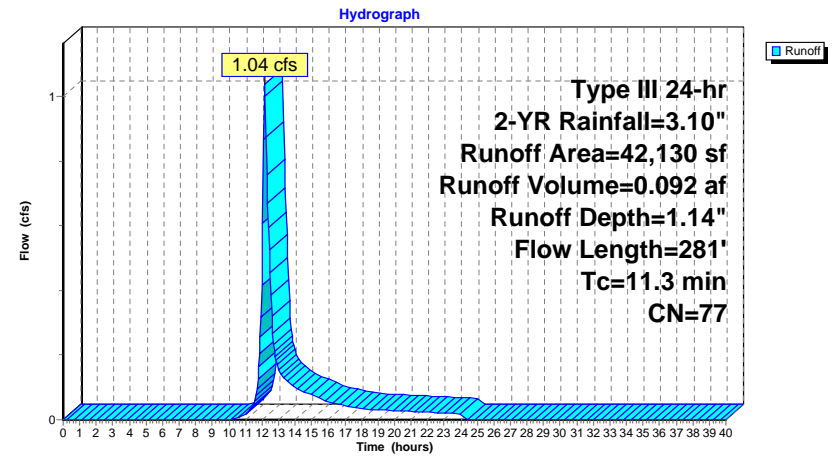
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
7,460	98	Water Surface, HSG B
11,029	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
23,641	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
42,130	77	Weighted Average
23,641		56.11% Pervious Area
18,489		43.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
1.3	181	0.0220	2.39		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
11.3	281				Total

**Subcatchment 8S: AREA P08**



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Type III 24-hr 2-YR Rainfall=3.10"

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**Summary for Subcatchment 9S: AREA P09**

Runoff = 0.84 cfs @ 12.09 hrs, Volume= 0.063 af, Depth= 2.35"

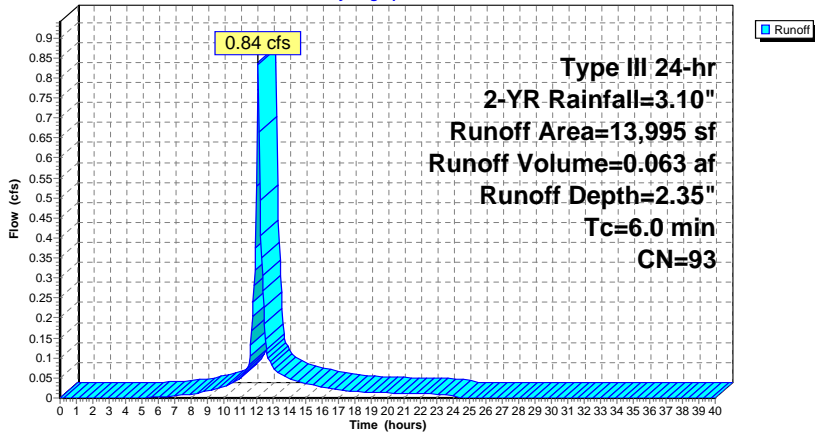
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YR Rainfall=3.10"

Area (sf)	CN	Description
1,986	98	Water Surface, HSG B
10,160	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
1,849	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
13,995	93	Weighted Average
1,849		13.21% Pervious Area
12,146		86.79% Impervious Area

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

**Subcatchment 9S: AREA P09**

Hydrograph



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Type III 24-hr 2-YR Rainfall=3.10"

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**Summary for Pond DP1: DP#1**

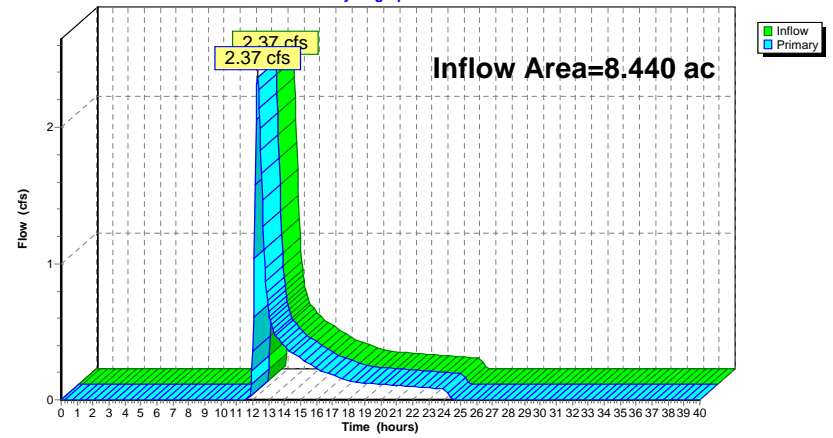
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.440 ac, 23.85% Impervious, Inflow Depth = 0.42" for 2-YR event  
Inflow = 2.37 cfs @ 12.29 hrs, Volume= 0.293 af  
Primary = 2.37 cfs @ 12.29 hrs, Volume= 0.293 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP1: DP#1**

Hydrograph



**Summary for Pond DP2: DP#2**

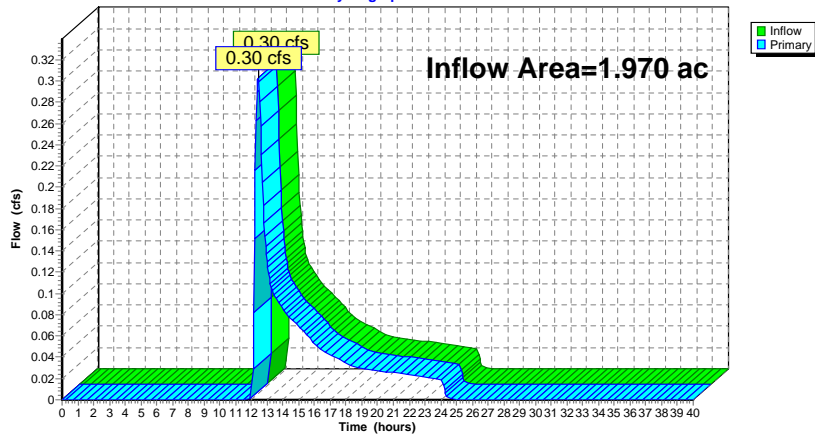
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.970 ac, 0.00% Impervious, Inflow Depth = 0.34" for 2-YR event  
 Inflow = 0.30 cfs @ 12.43 hrs, Volume= 0.055 af  
 Primary = 0.30 cfs @ 12.43 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP2: DP#2**

Hydrograph



**Summary for Pond DP3: DP#3**

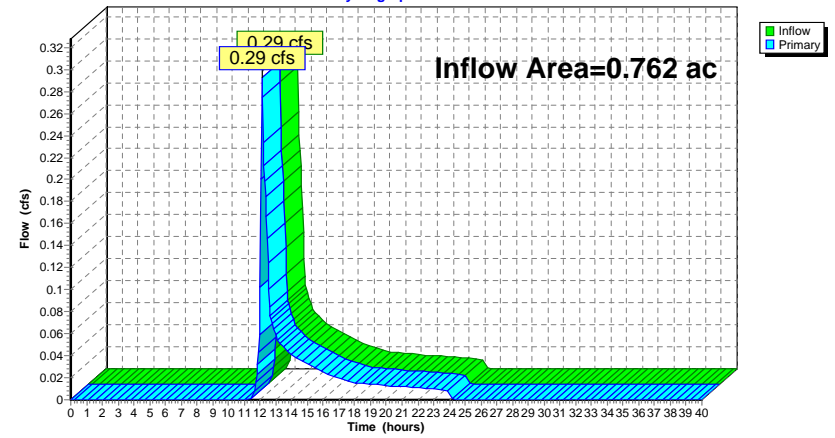
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.762 ac, 0.00% Impervious, Inflow Depth = 0.49" for 2-YR event  
 Inflow = 0.29 cfs @ 12.12 hrs, Volume= 0.031 af  
 Primary = 0.29 cfs @ 12.12 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP3: DP#3**

Hydrograph



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Type III 24-hr 2-YR Rainfall=3.10"

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**Summary for Pond P1: INF. BASIN #1**

Inflow Area = 1.205 ac, 32.33% Impervious, Inflow Depth = 0.87" for 2-YR event  
 Inflow = 0.67 cfs @ 12.40 hrs, Volume= 0.087 af  
 Outflow = 0.05 cfs @ 16.76 hrs, Volume= 0.087 af, Atten= 92%, Lag= 261.5 min  
 Discarded = 0.05 cfs @ 16.76 hrs, Volume= 0.087 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 125.39' @ 16.76 hrs Surf.Area= 2,178 sf Storage= 2,146 cf

Plug-Flow detention time= 514.7 min calculated for 0.087 af (100% of inflow)  
 Center-of-Mass det. time= 514.7 min ( 1,404.1 - 889.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	124.00'	7,021 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
124.00	931	0	0
125.00	1,820	1,376	1,376
126.00	2,750	2,285	3,661
127.00	3,970	3,360	7,021

Device	Routing	Invert	Outlet Devices
#1	Discarded	124.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	126.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b>
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.05 cfs @ 16.76 hrs HW=125.39' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=124.00' (Free Discharge)  
 ↳2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

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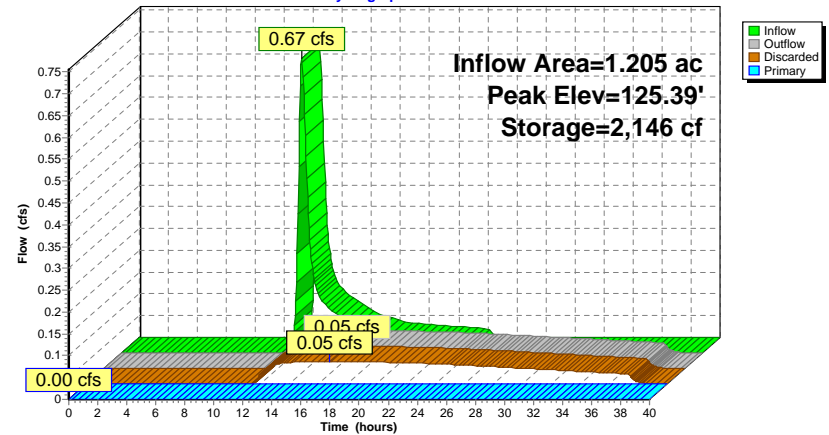
Type III 24-hr 2-YR Rainfall=3.10"

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**Pond P1: INF. BASIN #1**

Hydrograph



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**Summary for Pond P2: INF. BASIN #2**

Inflow Area = 1.386 ac, 60.83% Impervious, Inflow Depth = 1.66" for 2-YR event  
 Inflow = 2.10 cfs @ 12.11 hrs, Volume= 0.192 af  
 Outflow = 0.11 cfs @ 15.43 hrs, Volume= 0.192 af, Atten= 95%, Lag= 198.8 min  
 Discarded = 0.11 cfs @ 15.43 hrs, Volume= 0.192 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 126.05' @ 15.43 hrs Surf.Area= 4,744 sf Storage= 4,322 cf

Plug-Flow detention time= 394.1 min calculated for 0.192 af (100% of inflow)  
 Center-of-Mass det. time= 393.9 min ( 1,199.8 - 805.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	16,167 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	3,480	0	0
126.00	4,673	4,077	4,077
127.00	6,024	5,349	9,425
128.00	7,460	6,742	16,167

Device	Routing	Invert	Outlet Devices
#1	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	127.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b>
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.11 cfs @ 15.43 hrs HW=126.05' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.11 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=125.00' (Free Discharge)  
 ↳2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

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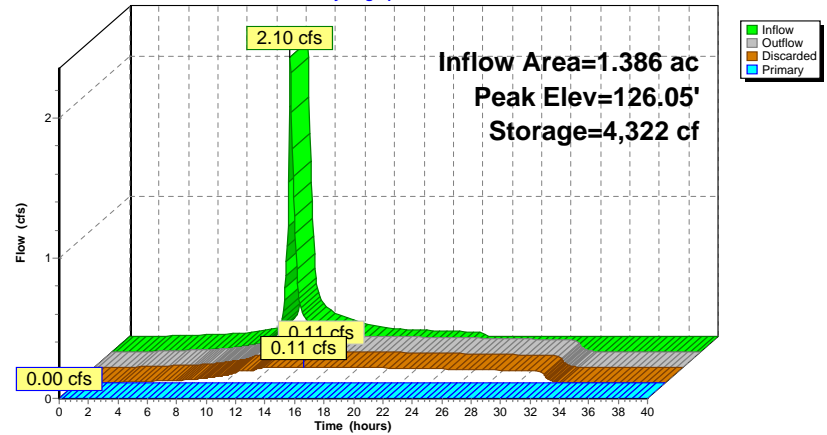
Type III 24-hr 2-YR Rainfall=3.10"

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**Pond P2: INF. BASIN #2**

Hydrograph



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**Summary for Pond P3: RAIN GARDEN**

Inflow Area = 0.321 ac, 86.79% Impervious, Inflow Depth = 2.35" for 2-YR event  
 Inflow = 0.84 cfs @ 12.09 hrs, Volume= 0.063 af  
 Outflow = 0.02 cfs @ 9.85 hrs, Volume= 0.055 af, Atten= 98%, Lag= 0.0 min  
 Discarded = 0.02 cfs @ 9.85 hrs, Volume= 0.055 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 127.00' @ 16.94 hrs Surf.Area= 881 sf Storage= 1,764 cf

Plug-Flow detention time= 710.9 min calculated for 0.055 af (87% of inflow)  
 Center-of-Mass det. time= 652.4 min ( 1,446.1 - 793.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	127.50'	2,121 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	125.00'	2,203 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
		4,323 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
127.50	881	0	0
128.00	1,210	523	523
129.00	1,986	1,598	2,121

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	881	0	0
127.50	881	2,203	2,203

Device	Routing	Invert	Outlet Devices
#1	Device 2	128.50'	<b>12.0" Vert. Grate</b> C= 0.600
#2	Primary	125.50'	<b>12.0" Round Culvert</b> L= 61.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 125.50' / 125.00' S= 0.0082 ' / Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.02 cfs @ 9.85 hrs HW=125.05' (Free Discharge)  
 ↳3=Exfiltration (Exfiltration Controls 0.02 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=125.00' (Free Discharge)  
 ↳2=Culvert ( Controls 0.00 cfs)  
 ↳1=Grate ( Controls 0.00 cfs)

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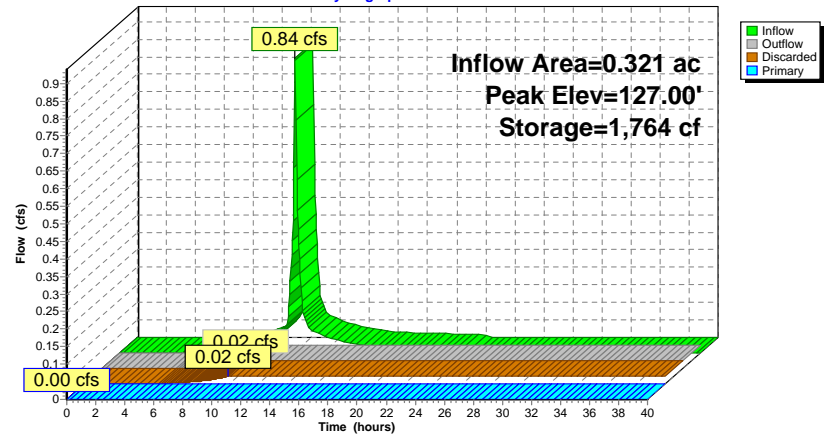
Type III 24-hr 2-YR Rainfall=3.10"

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**Pond P3: RAIN GARDEN**

Hydrograph



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Type III 24-hr 10-YR Rainfall=4.50"

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**Summary for Subcatchment 1S: AREA P01**

Runoff = 2.57 cfs @ 12.27 hrs, Volume= 0.275 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
10,163	98	Water Surface, 0% imp, HSG B
10,119	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
27,932	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
34,771	60	Woods, Fair, HSG B
15,396	56	Brush, Fair, HSG B
98,381	67	Weighted Average
88,262		89.71% Pervious Area
10,119		10.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	87	0.0290	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.1	39	0.1300	5.80		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.0	177	0.0330	2.92		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
17.9	303	Total			

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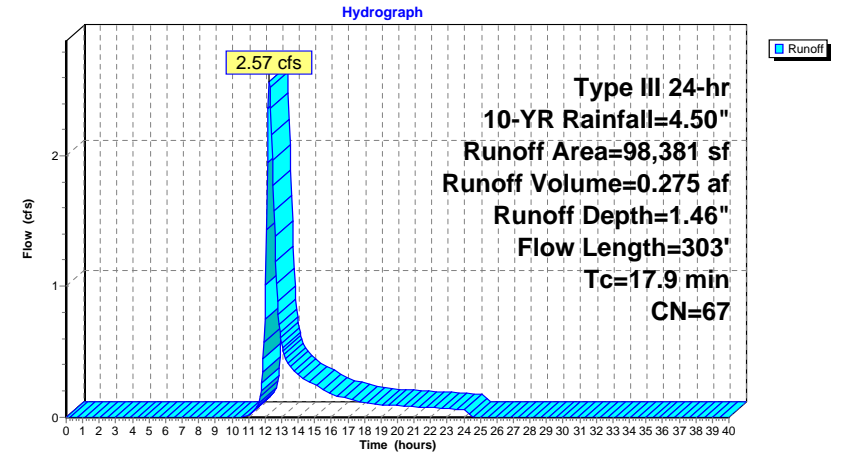
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Type III 24-hr 10-YR Rainfall=4.50"

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**Subcatchment 1S: AREA P01**



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Type III 24-hr 10-YR Rainfall=4.50"

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**Summary for Subcatchment 2S: AREA P02**

Runoff = 1.29 cfs @ 12.29 hrs, Volume= 0.158 af, Depth= 0.96"

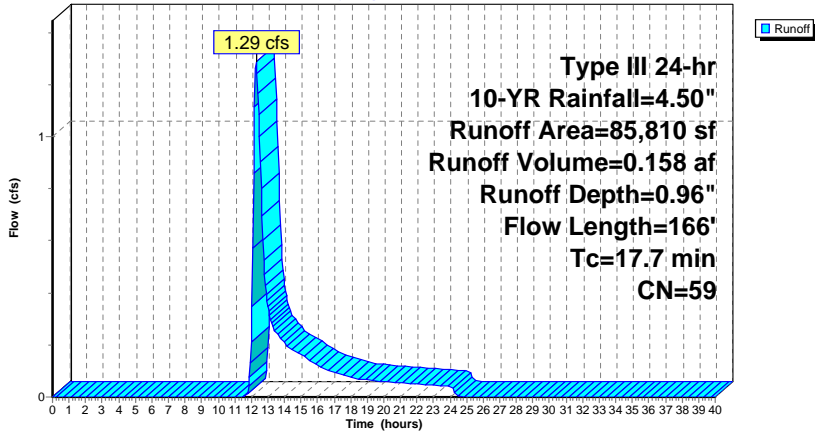
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
0	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,465	60	Woods, Fair, HSG B
22,345	56	Brush, Fair, HSG B
85,810	59	Weighted Average
85,810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
17.7	166	Total			

**Subcatchment 2S: AREA P02**

Hydrograph



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Type III 24-hr 10-YR Rainfall=4.50"

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**Summary for Subcatchment 3S: AREA P03**

Runoff = 0.46 cfs @ 12.11 hrs, Volume= 0.040 af, Depth= 0.96"

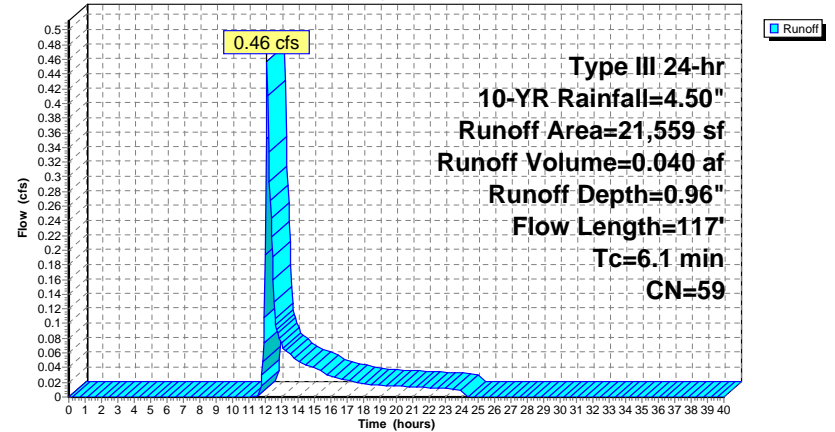
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
6,205	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
5,638	56	Brush, Fair, HSG B
21,559	59	Weighted Average
21,559		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	77	0.0450	0.22		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
0.3	40	0.0200	2.28		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
6.1	117	Total			

**Subcatchment 3S: AREA P03**

Hydrograph



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Type III 24-hr 10-YR Rainfall=4.50"

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**Summary for Subcatchment 4S: AREA P04**

Runoff = 0.50 cfs @ 12.10 hrs, Volume= 0.037 af, Depth= 1.67"

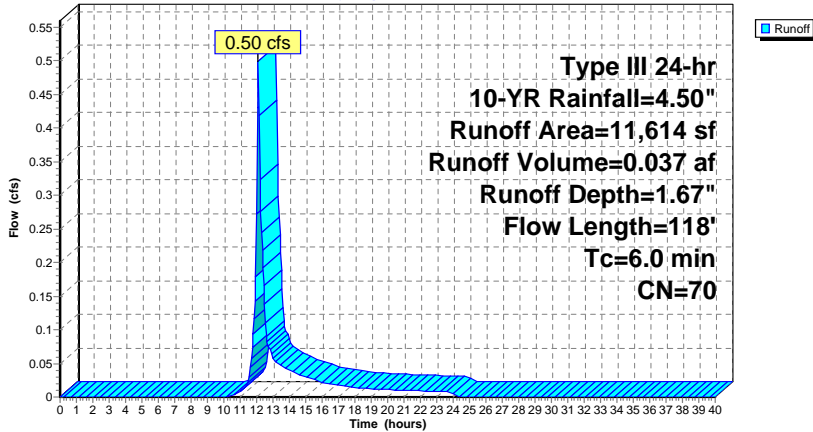
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
2,837	96	Gravel surface, HSG B
8,777	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
11,614	70	Weighted Average
11,614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	47	0.0320	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
0.4	71	0.0280	2.69		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
4.9	118				Total, Increased to minimum Tc = 6.0 min

**Subcatchment 4S: AREA P04**

Hydrograph



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Type III 24-hr 10-YR Rainfall=4.50"

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**Summary for Subcatchment 5S: AREA P05**

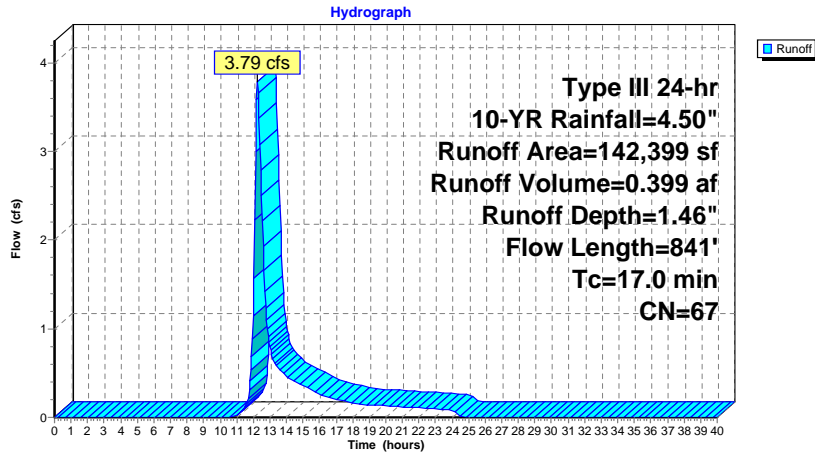
Runoff = 3.79 cfs @ 12.26 hrs, Volume= 0.399 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
11,713	98	Paved parking, HSG B
5,680	96	Gravel surface, HSG B
102,021	61	>75% Grass cover, Good, HSG B
22,661	69	50-75% Grass cover, Fair, HSG B
324	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
142,399	67	Weighted Average
130,686		91.77% Pervious Area
11,713		8.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	100	0.0300	0.20		<b>Sheet Flow, A-B</b> Grass: Short n= 0.150 P2= 3.10"
3.4	325	0.0100	1.61		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
5.1	416	0.0070	1.35		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
17.0	841				Total

**Subcatchment 5S: AREA P05**



**Summary for Subcatchment 6S: AREA P06**

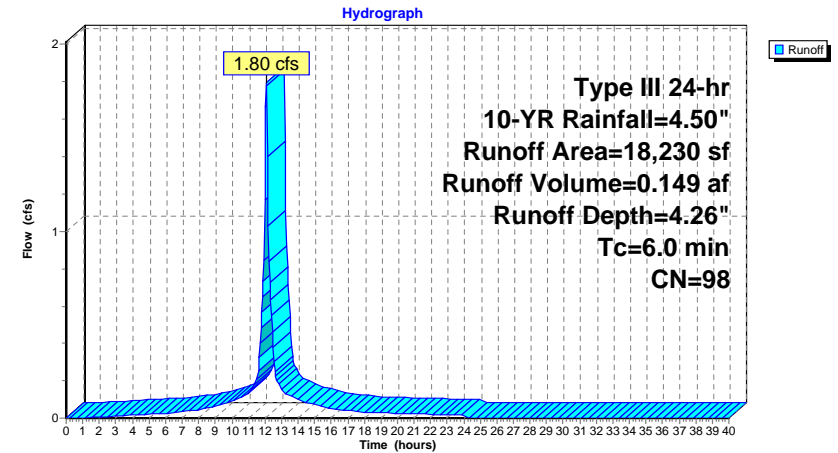
Runoff = 1.80 cfs @ 12.09 hrs, Volume= 0.149 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
18,230	98	Roofs, HSG B
18,230		100.00% Impervious Area

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

**Subcatchment 6S: AREA P06**



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**Summary for Subcatchment 7S: AREA P07**

Runoff = 1.52 cfs @ 12.38 hrs, Volume= 0.183 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
3,970	98	Water Surface, HSG B
13,002	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
20,151	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
7,580	60	Woods, Fair, HSG B
7,797	56	Brush, Fair, HSG B
52,500	72	Weighted Average
35,528		67.67% Pervious Area
16,972		32.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b> Woods: Light underbrush n= 0.400 P2= 3.10"
3.2	218	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
0.4	30	0.0050	1.14		<b>Shallow Concentrated Flow, D-E</b> Unpaved Kv= 16.1 fps
25.9	348	Total			

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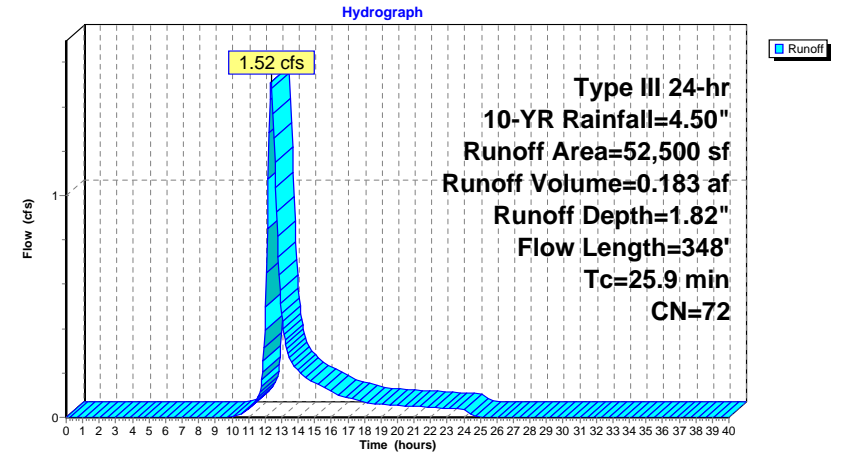
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Type III 24-hr 10-YR Rainfall=4.50"

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**Subcatchment 7S: AREA P07**



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**Summary for Subcatchment 8S: AREA P08**

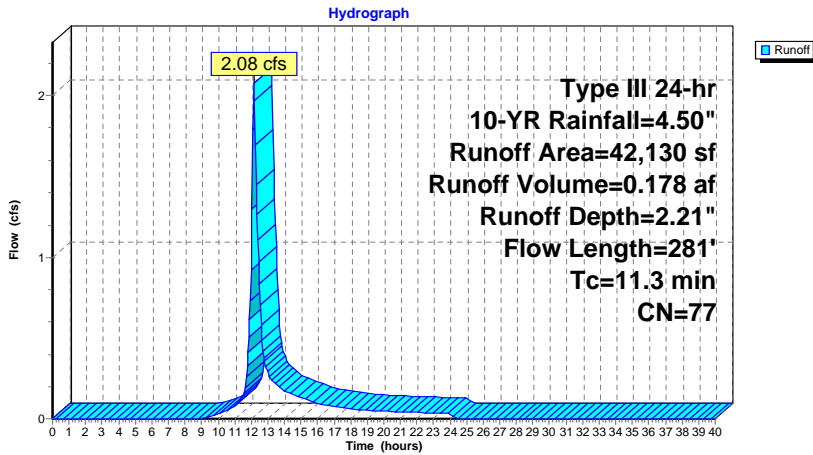
Runoff = 2.08 cfs @ 12.16 hrs, Volume= 0.178 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
7,460	98	Water Surface, HSG B
11,029	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
23,641	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
42,130	77	Weighted Average
23,641		56.11% Pervious Area
18,489		43.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
1.3	181	0.0220	2.39		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
11.3	281	Total			

**Subcatchment 8S: AREA P08**



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Type III 24-hr 10-YR Rainfall=4.50"

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**Summary for Subcatchment 9S: AREA P09**

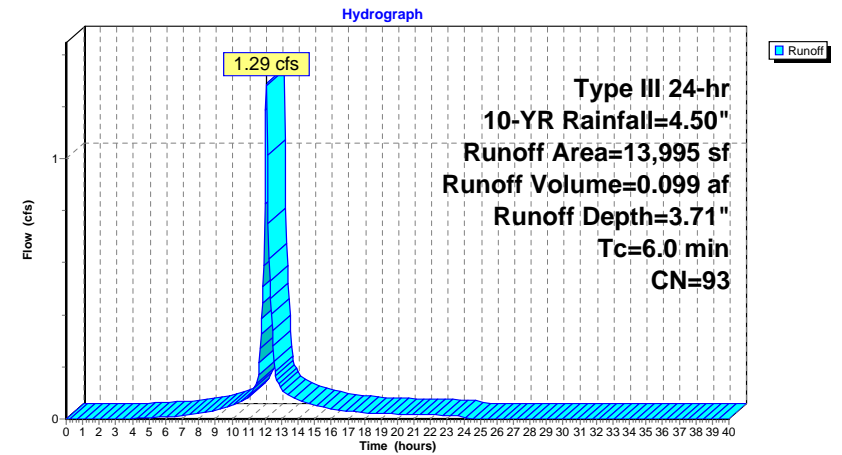
Runoff = 1.29 cfs @ 12.09 hrs, Volume= 0.099 af, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
1,986	98	Water Surface, HSG B
10,160	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
1,849	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
13,995	93	Weighted Average
1,849		13.21% Pervious Area
12,146		86.79% Impervious Area

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

**Subcatchment 9S: AREA P09**



Summary for Pond DP1: DP#1

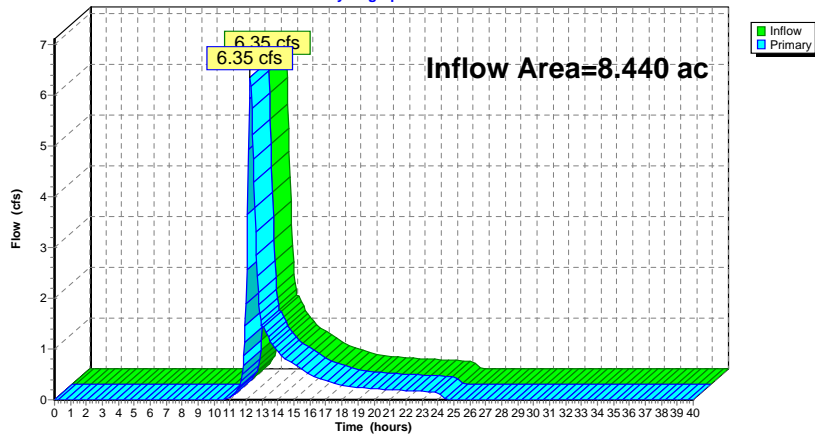
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.440 ac, 23.85% Impervious, Inflow Depth = 1.01" for 10-YR event  
 Inflow = 6.35 cfs @ 12.26 hrs, Volume= 0.713 af  
 Primary = 6.35 cfs @ 12.26 hrs, Volume= 0.713 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP1: DP#1

Hydrograph



Summary for Pond DP2: DP#2

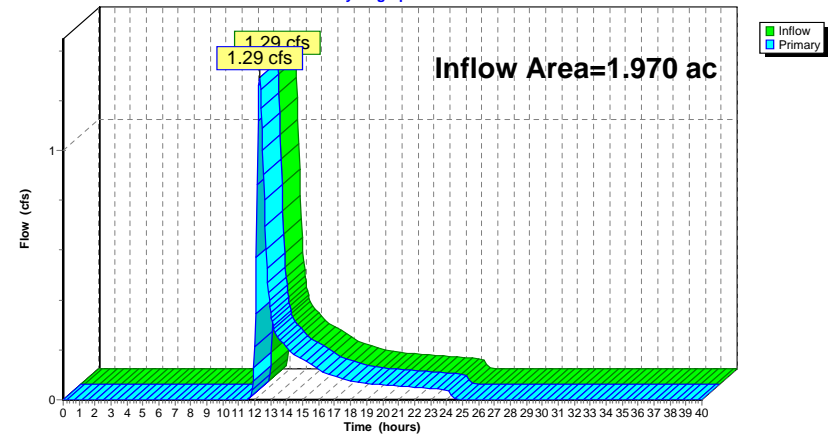
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.970 ac, 0.00% Impervious, Inflow Depth = 0.96" for 10-YR event  
 Inflow = 1.29 cfs @ 12.29 hrs, Volume= 0.158 af  
 Primary = 1.29 cfs @ 12.29 hrs, Volume= 0.158 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP2: DP#2

Hydrograph



**Summary for Pond DP3: DP#3**

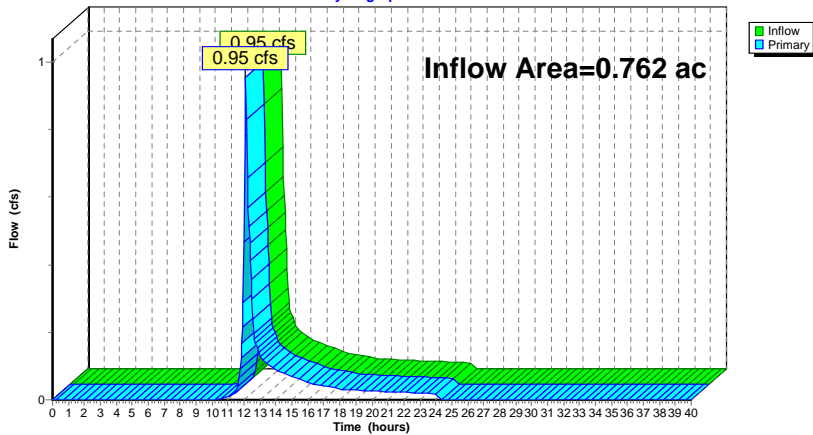
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.762 ac, 0.00% Impervious, Inflow Depth = 1.21" for 10-YR event  
 Inflow = 0.95 cfs @ 12.10 hrs, Volume= 0.077 af  
 Primary = 0.95 cfs @ 12.10 hrs, Volume= 0.077 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP3: DP#3**

Hydrograph



**Summary for Pond P1: INF. BASIN #1**

Inflow Area = 1.205 ac, 32.33% Impervious, Inflow Depth = 1.82" for 10-YR event  
 Inflow = 1.52 cfs @ 12.38 hrs, Volume= 0.183 af  
 Outflow = 0.35 cfs @ 13.20 hrs, Volume= 0.168 af, Atten= 77%, Lag= 49.6 min  
 Discarded = 0.07 cfs @ 13.20 hrs, Volume= 0.129 af  
 Primary = 0.28 cfs @ 13.20 hrs, Volume= 0.039 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 126.05' @ 13.20 hrs Surf.Area= 2,811 sf Storage= 3,798 cf

Plug-Flow detention time= 498.3 min calculated for 0.168 af (92% of inflow)  
 Center-of-Mass det. time= 458.5 min ( 1,325.1 - 866.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	124.00'	7,021 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
124.00	931	0	0
125.00	1,820	1,376	1,376
126.00	2,750	2,285	3,661
127.00	3,970	3,360	7,021

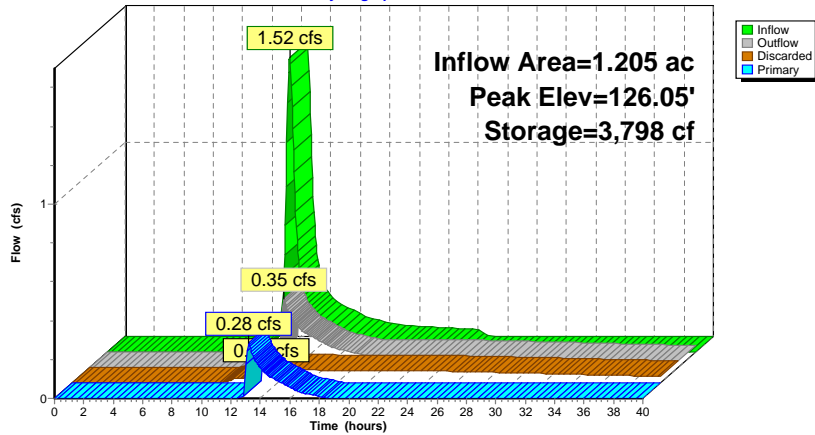
Device	Routing	Invert	Outlet Devices
#1	Discarded	124.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	126.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.07 cfs @ 13.20 hrs HW=126.05' (Free Discharge)  
 1=Exfiltration (Exfiltration Controls 0.07 cfs)

**Primary OutFlow** Max=0.27 cfs @ 13.20 hrs HW=126.05' (Free Discharge)  
 2=Broad-Crested Rectangular Weir (Weir Controls 0.27 cfs @ 0.55 fps)

**Pond P1: INF. BASIN #1**

Hydrograph



**Summary for Pond P2: INF. BASIN #2**

Inflow Area = 1.386 ac, 60.83% Impervious, Inflow Depth = 2.83" for 10-YR event  
 Inflow = 3.62 cfs @ 12.12 hrs, Volume= 0.327 af  
 Outflow = 0.14 cfs @ 16.20 hrs, Volume= 0.309 af, Atten= 96%, Lag= 244.8 min  
 Discarded = 0.14 cfs @ 16.20 hrs, Volume= 0.309 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 126.85' @ 16.20 hrs Surf.Area= 5,827 sf Storage= 8,559 cf

Plug-Flow detention time= 625.5 min calculated for 0.309 af (95% of inflow)  
 Center-of-Mass det. time= 595.3 min ( 1,394.0 - 798.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	16,167 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	3,480	0	0
126.00	4,673	4,077	4,077
127.00	6,024	5,349	9,425
128.00	7,460	6,742	16,167

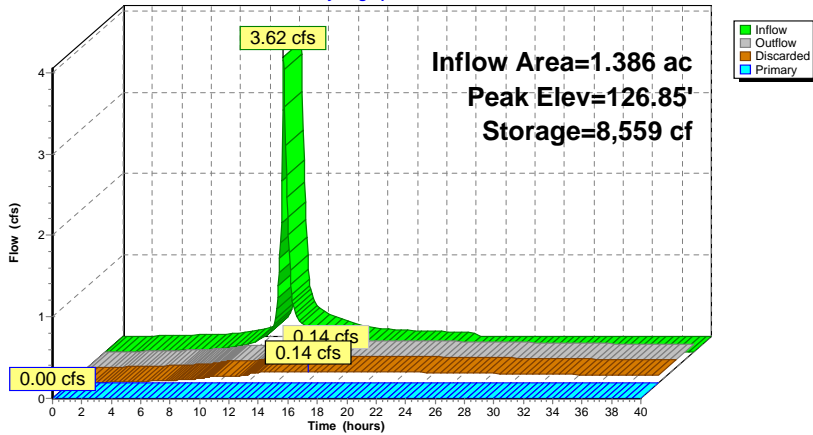
Device	Routing	Invert	Outlet Devices
#1	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	127.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.14 cfs @ 16.20 hrs HW=126.85' (Free Discharge)  
 1=Exfiltration (Exfiltration Controls 0.14 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=125.00' (Free Discharge)  
 2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond P2: INF. BASIN #2**

Hydrograph



**Summary for Pond P3: RAIN GARDEN**

Inflow Area = 0.321 ac, 86.79% Impervious, Inflow Depth = 3.71" for 10-YR event  
 Inflow = 1.29 cfs @ 12.09 hrs, Volume= 0.099 af  
 Outflow = 0.05 cfs @ 15.34 hrs, Volume= 0.078 af, Atten= 96%, Lag= 195.4 min  
 Discarded = 0.05 cfs @ 15.34 hrs, Volume= 0.078 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 127.98' @ 15.34 hrs Surf.Area= 2,077 sf Storage= 2,699 cf

Plug-Flow detention time= 599.4 min calculated for 0.078 af (78% of inflow)  
 Center-of-Mass det. time= 520.5 min ( 1,302.0 - 781.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	127.50'	2,121 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	125.00'	2,203 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
		4,323 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
127.50	881	0	0
128.00	1,210	523	523
129.00	1,986	1,598	2,121

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	881	0	0
127.50	881	2,203	2,203

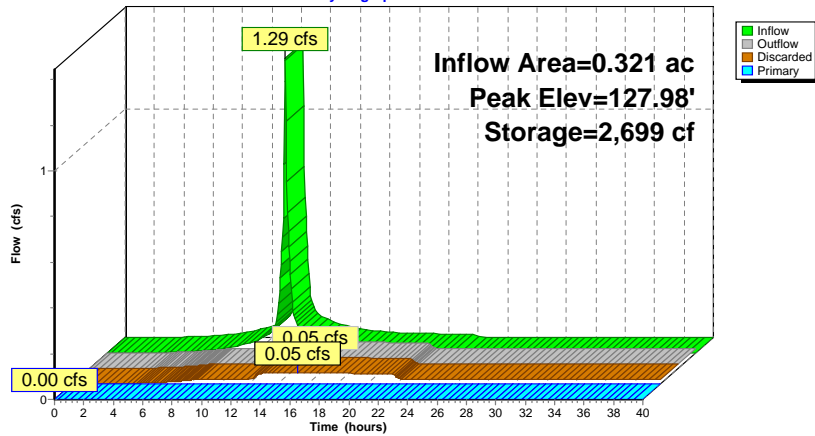
Device	Routing	Invert	Outlet Devices
#1	Device 2	128.50'	<b>12.0" Vert. Grate</b> C= 0.600
#2	Primary	125.50'	<b>12.0" Round Culvert</b> L= 61.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 125.50' / 125.00' S= 0.0082 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.05 cfs @ 15.34 hrs HW=127.98' (Free Discharge)  
 ↳ **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=125.00' (Free Discharge)  
 ↳ **2=Culvert** ( Controls 0.00 cfs)  
 ↳ **1=Grate** ( Controls 0.00 cfs)

**Pond P3: RAIN GARDEN**

Hydrograph



**Summary for Subcatchment 1S: AREA P01**

Runoff = 3.64 cfs @ 12.26 hrs, Volume= 0.379 af, Depth= 2.01"

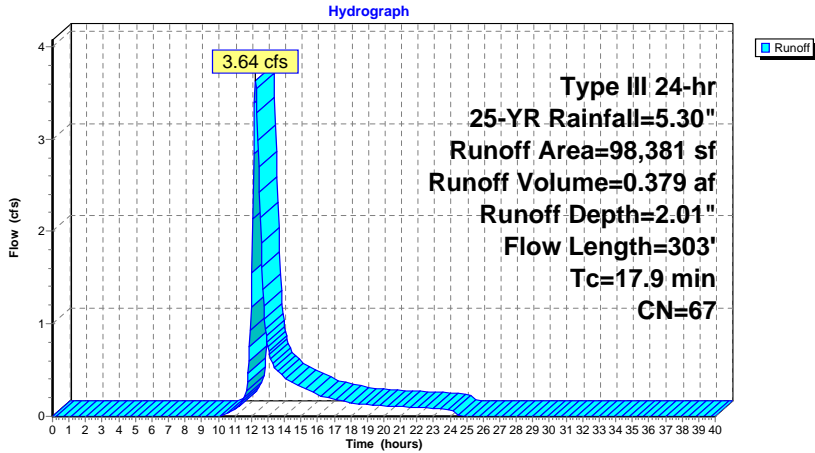
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
10,163	98	Water Surface, 0% imp, HSG B
10,119	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
27,932	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
34,771	60	Woods, Fair, HSG B
15,396	56	Brush, Fair, HSG B
98,381	67	Weighted Average
88,262		89.71% Pervious Area
10,119		10.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	87	0.0290	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.1	39	0.1300	5.80		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.0	177	0.0330	2.92		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
17.9	303	Total			

Subcatchment 1S: AREA P01



Summary for Subcatchment 2S: AREA P02

Runoff = 2.05 cfs @ 12.27 hrs, Volume= 0.231 af, Depth= 1.41"

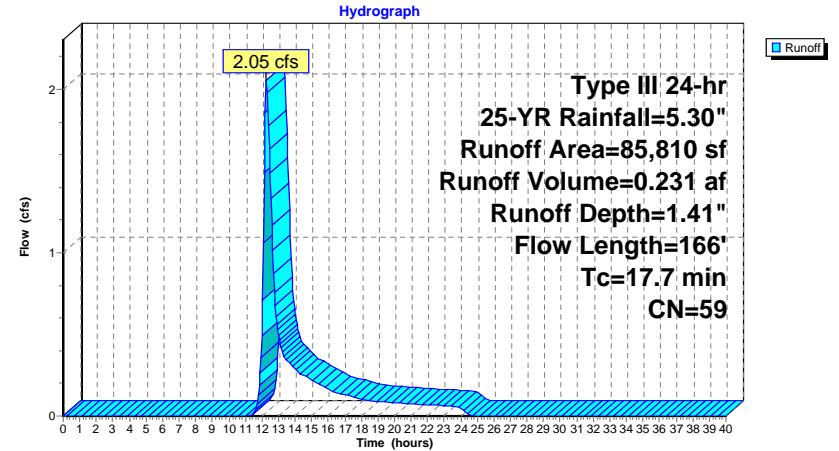
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
0	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,465	60	Woods, Fair, HSG B
22,345	56	Brush, Fair, HSG B
85,810	59	Weighted Average
85,810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
17.7	166	Total			

Subcatchment 2S: AREA P02



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Type III 24-hr 25-YR Rainfall=5.30"

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**Summary for Subcatchment 3S: AREA P03**

Runoff = 0.72 cfs @ 12.10 hrs, Volume= 0.058 af, Depth= 1.41"

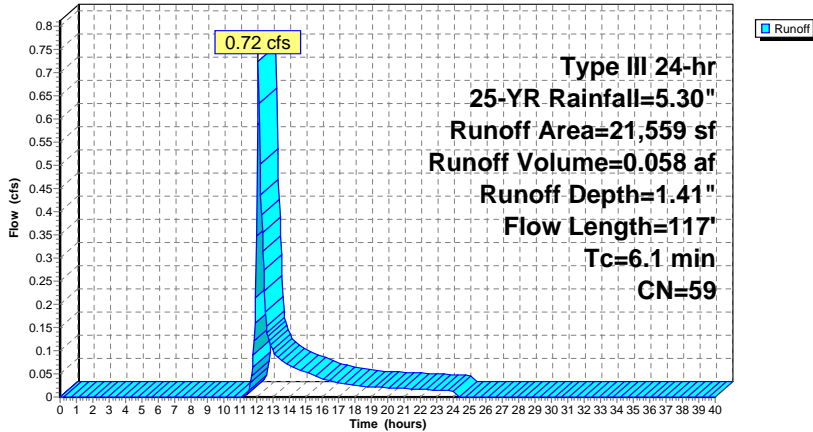
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
6,205	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
5,638	56	Brush, Fair, HSG B
21,559	59	Weighted Average
21,559		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	77	0.0450	0.22		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
0.3	40	0.0200	2.28		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
6.1	117				Total

**Subcatchment 3S: AREA P03**

Hydrograph



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Type III 24-hr 25-YR Rainfall=5.30"

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**Summary for Subcatchment 4S: AREA P04**

Runoff = 0.69 cfs @ 12.10 hrs, Volume= 0.050 af, Depth= 2.26"

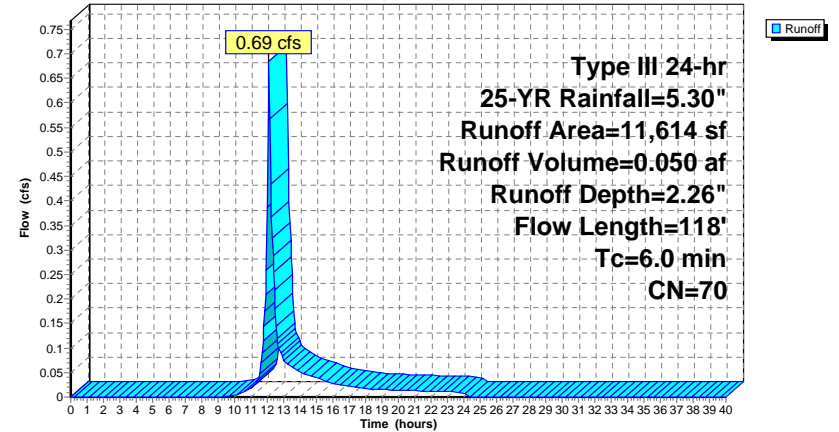
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
2,837	96	Gravel surface, HSG B
8,777	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
11,614	70	Weighted Average
11,614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	47	0.0320	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
0.4	71	0.0280	2.69		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
4.9	118				Total, Increased to minimum Tc = 6.0 min

**Subcatchment 4S: AREA P04**

Hydrograph



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Type III 24-hr 25-YR Rainfall=5.30"

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**Summary for Subcatchment 5S: AREA P05**

Runoff = 5.36 cfs @ 12.25 hrs, Volume= 0.549 af, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
11,713	98	Paved parking, HSG B
5,680	96	Gravel surface, HSG B
102,021	61	>75% Grass cover, Good, HSG B
22,661	69	50-75% Grass cover, Fair, HSG B
324	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
142,399	67	Weighted Average
130,686		91.77% Pervious Area
11,713		8.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	100	0.0300	0.20		<b>Sheet Flow, A-B</b>
					Grass: Short n= 0.150 P2= 3.10"
3.4	325	0.0100	1.61		<b>Shallow Concentrated Flow, B-C</b>
					Unpaved Kv= 16.1 fps
5.1	416	0.0070	1.35		<b>Shallow Concentrated Flow, C-D</b>
					Unpaved Kv= 16.1 fps
17.0	841	Total			

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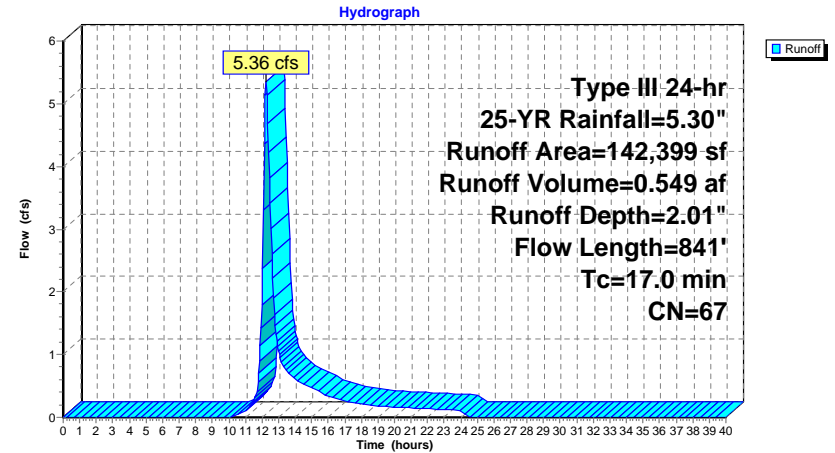
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Type III 24-hr 25-YR Rainfall=5.30"

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**Subcatchment 5S: AREA P05**



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Type III 24-hr 25-YR Rainfall=5.30"

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**Summary for Subcatchment 6S: AREA P06**

Runoff = 2.12 cfs @ 12.09 hrs, Volume= 0.177 af, Depth= 5.06"

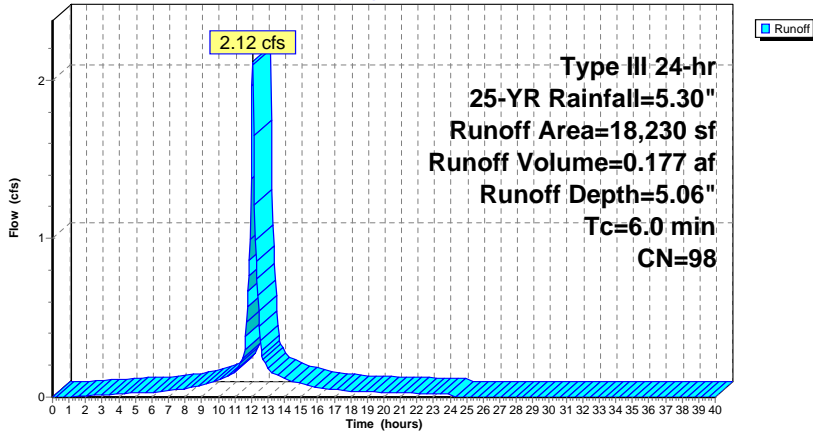
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
18,230	98	Roofs, HSG B
18,230		100.00% Impervious Area

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

**Subcatchment 6S: AREA P06**

Hydrograph



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Type III 24-hr 25-YR Rainfall=5.30"

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**Summary for Subcatchment 7S: AREA P07**

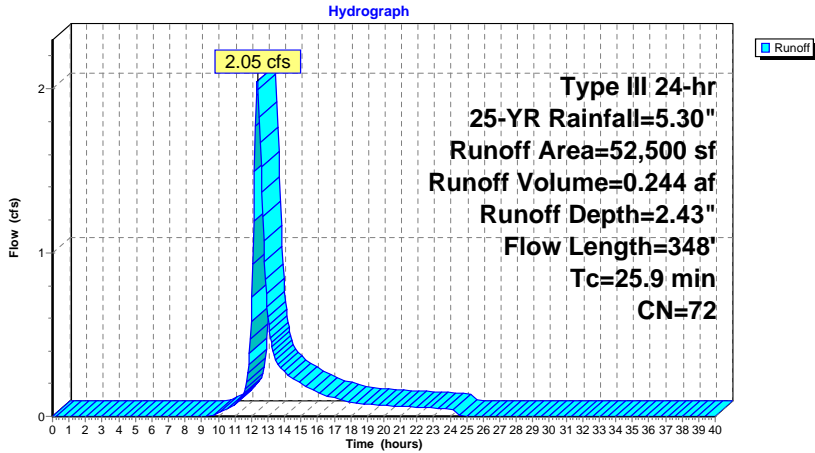
Runoff = 2.05 cfs @ 12.37 hrs, Volume= 0.244 af, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
3,970	98	Water Surface, HSG B
13,002	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
20,151	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
7,580	60	Woods, Fair, HSG B
7,797	56	Brush, Fair, HSG B
52,500	72	Weighted Average
35,528		67.67% Pervious Area
16,972		32.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b> Woods: Light underbrush n= 0.400 P2= 3.10"
3.2	218	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
0.4	30	0.0050	1.14		<b>Shallow Concentrated Flow, D-E</b> Unpaved Kv= 16.1 fps
25.9	348				Total

**Subcatchment 7S: AREA P07**



**Summary for Subcatchment 8S: AREA P08**

Runoff = 2.72 cfs @ 12.16 hrs, Volume= 0.232 af, Depth= 2.88"

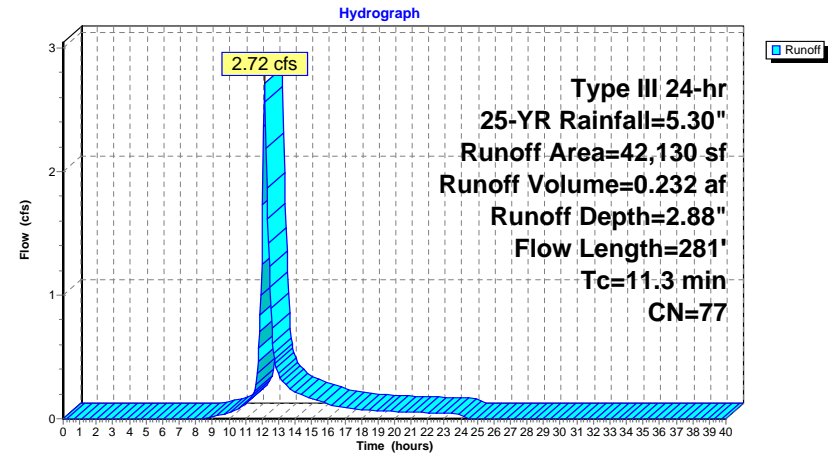
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
7,460	98	Water Surface, HSG B
11,029	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
23,641	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
42,130	77	Weighted Average
23,641		56.11% Pervious Area
18,489		43.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
1.3	181	0.0220	2.39		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
11.3	281				Total

**Subcatchment 8S: AREA P08**



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Type III 24-hr 25-YR Rainfall=5.30"

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**Summary for Subcatchment 9S: AREA P09**

Runoff = 1.55 cfs @ 12.09 hrs, Volume= 0.120 af, Depth= 4.49"

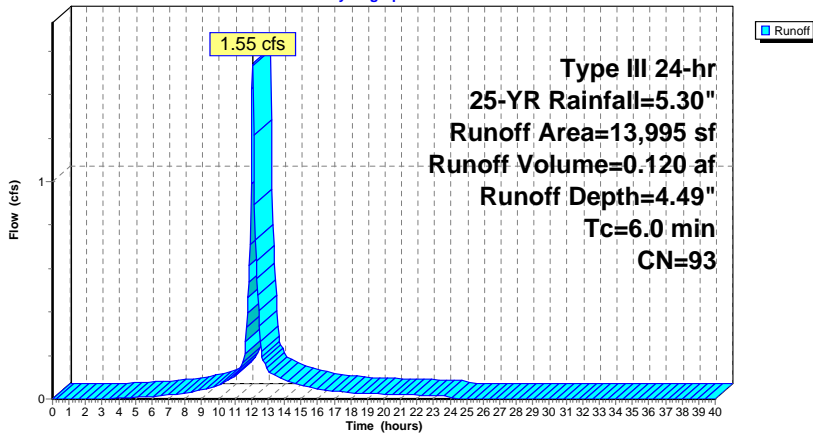
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YR Rainfall=5.30"

Area (sf)	CN	Description
1,986	98	Water Surface, HSG B
10,160	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
1,849	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
13,995	93	Weighted Average
1,849		13.21% Pervious Area
12,146		86.79% Impervious Area

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

**Subcatchment 9S: AREA P09**

Hydrograph



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**Summary for Pond DP1: DP#1**

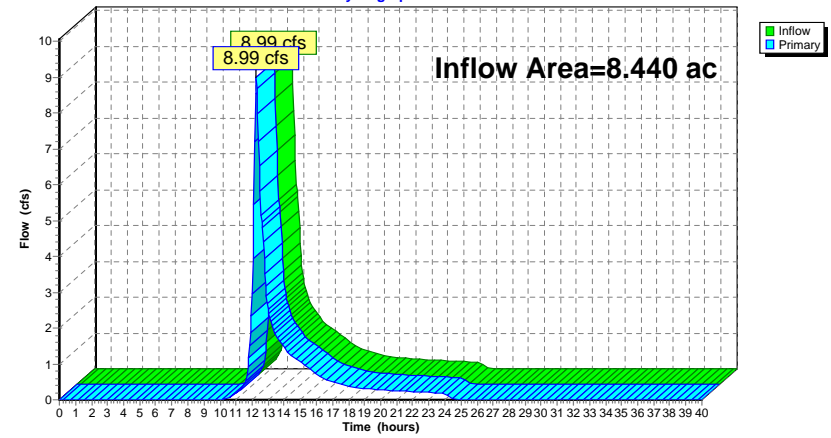
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.440 ac, 23.85% Impervious, Inflow Depth = 1.51" for 25-YR event  
Inflow = 8.99 cfs @ 12.25 hrs, Volume= 1.065 af  
Primary = 8.99 cfs @ 12.25 hrs, Volume= 1.065 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP1: DP#1**

Hydrograph



**Summary for Pond DP2: DP#2**

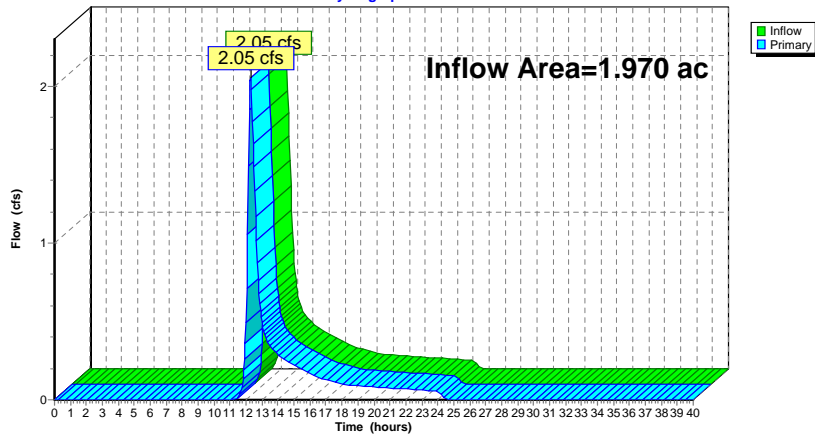
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.970 ac, 0.00% Impervious, Inflow Depth = 1.41" for 25-YR event  
 Inflow = 2.05 cfs @ 12.27 hrs, Volume= 0.231 af  
 Primary = 2.05 cfs @ 12.27 hrs, Volume= 0.231 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP2: DP#2**

Hydrograph



**Summary for Pond DP3: DP#3**

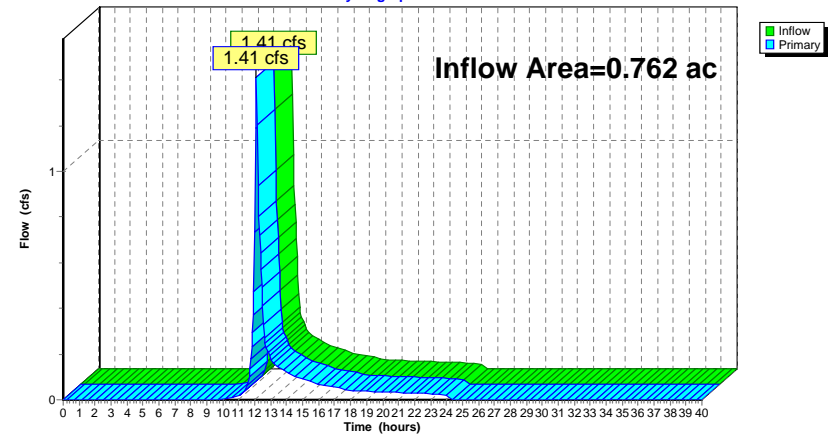
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.762 ac, 0.00% Impervious, Inflow Depth = 1.71" for 25-YR event  
 Inflow = 1.41 cfs @ 12.10 hrs, Volume= 0.108 af  
 Primary = 1.41 cfs @ 12.10 hrs, Volume= 0.108 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP3: DP#3**

Hydrograph



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**Summary for Pond P1: INF. BASIN #1**

Inflow Area = 1.205 ac, 32.33% Impervious, Inflow Depth = 2.43" for 25-YR event  
 Inflow = 2.05 cfs @ 12.37 hrs, Volume= 0.244 af  
 Outflow = 1.19 cfs @ 12.72 hrs, Volume= 0.227 af, Atten= 42%, Lag= 20.9 min  
 Discarded = 0.07 cfs @ 12.72 hrs, Volume= 0.134 af  
 Primary = 1.12 cfs @ 12.72 hrs, Volume= 0.093 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 126.13' @ 12.72 hrs Surf.Area= 2,904 sf Storage= 4,018 cf

Plug-Flow detention time= 381.6 min calculated for 0.227 af (93% of inflow)  
 Center-of-Mass det. time= 346.2 min ( 1,204.3 - 858.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	124.00'	7,021 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
124.00	931	0	0
125.00	1,820	1,376	1,376
126.00	2,750	2,285	3,661
127.00	3,970	3,360	7,021

Device	Routing	Invert	Outlet Devices
#1	Discarded	124.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	126.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b>
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60			
Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64			

**Discarded OutFlow** Max=0.07 cfs @ 12.72 hrs HW=126.13' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.07 cfs)

**Primary OutFlow** Max=1.10 cfs @ 12.72 hrs HW=126.13' (Free Discharge)  
 ↳2=Broad-Crested Rectangular Weir (Weir Controls 1.10 cfs @ 0.88 fps)

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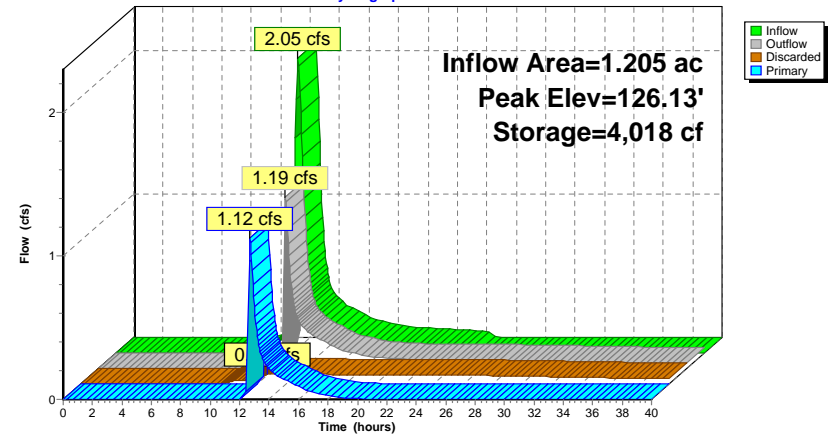
Type III 24-hr 25-YR Rainfall=5.30"

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**Pond P1: INF. BASIN #1**

Hydrograph



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**Summary for Pond P2: INF. BASIN #2**

Inflow Area = 1.386 ac, 60.83% Impervious, Inflow Depth = 3.54" for 25-YR event  
 Inflow = 4.52 cfs @ 12.12 hrs, Volume= 0.408 af  
 Outflow = 0.41 cfs @ 13.50 hrs, Volume= 0.372 af, Atten= 91%, Lag= 82.9 min  
 Discarded = 0.14 cfs @ 13.50 hrs, Volume= 0.329 af  
 Primary = 0.26 cfs @ 13.50 hrs, Volume= 0.043 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 127.05' @ 13.50 hrs Surf.Area= 6,092 sf Storage= 9,712 cf

Plug-Flow detention time= 574.9 min calculated for 0.372 af (91% of inflow)  
 Center-of-Mass det. time= 529.6 min ( 1,324.8 - 795.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	16,167 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	3,480	0	0
126.00	4,673	4,077	4,077
127.00	6,024	5,349	9,425
128.00	7,460	6,742	16,167

Device	Routing	Invert	Outlet Devices
#1	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	127.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b>
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.14 cfs @ 13.50 hrs HW=127.05' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.14 cfs)

**Primary OutFlow** Max=0.26 cfs @ 13.50 hrs HW=127.05' (Free Discharge)  
 ↳2=Broad-Crested Rectangular Weir (Weir Controls 0.26 cfs @ 0.54 fps)

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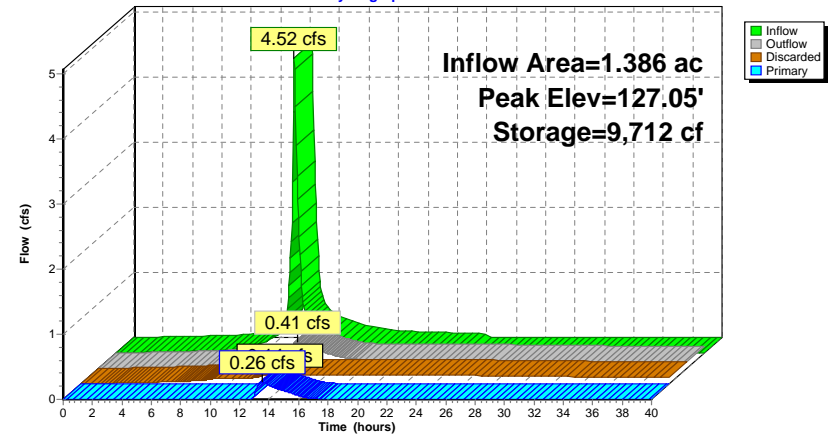
Type III 24-hr 25-YR Rainfall=5.30"

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**Pond P2: INF. BASIN #2**

Hydrograph



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**Summary for Pond P3: RAIN GARDEN**

Inflow Area = 0.321 ac, 86.79% Impervious, Inflow Depth = 4.49" for 25-YR event  
 Inflow = 1.55 cfs @ 12.09 hrs, Volume= 0.120 af  
 Outflow = 0.06 cfs @ 15.39 hrs, Volume= 0.094 af, Atten= 96%, Lag= 198.0 min  
 Discarded = 0.06 cfs @ 15.39 hrs, Volume= 0.094 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 128.43' @ 15.39 hrs Surf.Area= 2,428 sf Storage= 3,323 cf

Plug-Flow detention time= 582.6 min calculated for 0.094 af (78% of inflow)  
 Center-of-Mass det. time= 503.7 min ( 1,280.3 - 776.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	127.50'	2,121 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	125.00'	2,203 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
		4,323 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
127.50	881	0	0
128.00	1,210	523	523
129.00	1,986	1,598	2,121

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	881	0	0
127.50	881	2,203	2,203

Device	Routing	Invert	Outlet Devices
#1	Device 2	128.50'	<b>12.0" Vert. Grate</b> C= 0.600
#2	Primary	125.50'	<b>12.0" Round Culvert</b> L= 61.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 125.50' / 125.00' S= 0.0082 ' / Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.06 cfs @ 15.39 hrs HW=128.43' (Free Discharge)  
 ↳ **3=Exfiltration** (Exfiltration Controls 0.06 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=125.00' (Free Discharge)  
 ↳ **2=Culvert** ( Controls 0.00 cfs)  
 ↳ **1=Grate** ( Controls 0.00 cfs)

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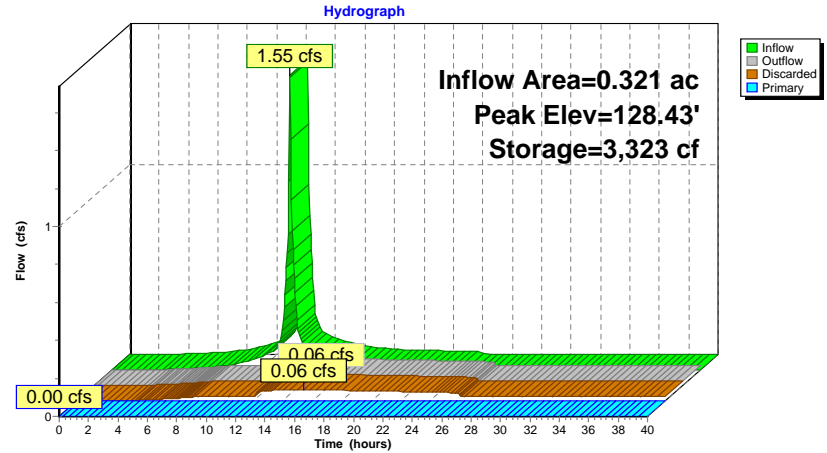
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**Pond P3: RAIN GARDEN**



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**Summary for Subcatchment 1S: AREA P01**

Runoff = 4.48 cfs @ 12.26 hrs, Volume= 0.462 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
10,163	98	Water Surface, 0% imp, HSG B
10,119	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
27,932	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
34,771	60	Woods, Fair, HSG B
15,396	56	Brush, Fair, HSG B
98,381	67	Weighted Average
88,262		89.71% Pervious Area
10,119		10.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	87	0.0290	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.1	39	0.1300	5.80		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.0	177	0.0330	2.92		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
17.9	303	Total			

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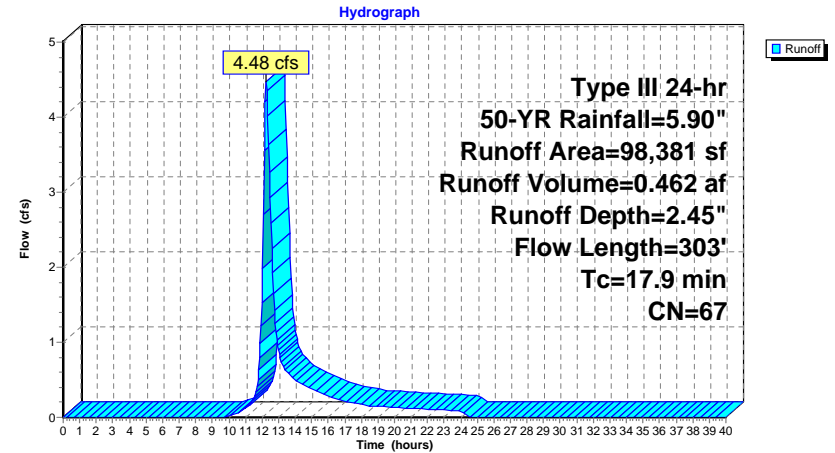
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**Subcatchment 1S: AREA P01**



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**Summary for Subcatchment 2S: AREA P02**

Runoff = 2.68 cfs @ 12.27 hrs, Volume= 0.291 af, Depth= 1.78"

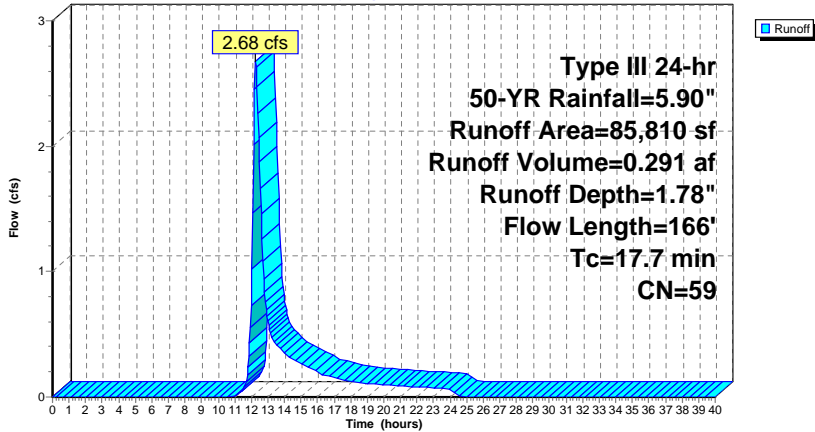
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
0	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,465	60	Woods, Fair, HSG B
22,345	56	Brush, Fair, HSG B
85,810	59	Weighted Average
85,810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
17.7	166				Total

**Subcatchment 2S: AREA P02**

Hydrograph



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**Summary for Subcatchment 3S: AREA P03**

Runoff = 0.94 cfs @ 12.10 hrs, Volume= 0.073 af, Depth= 1.78"

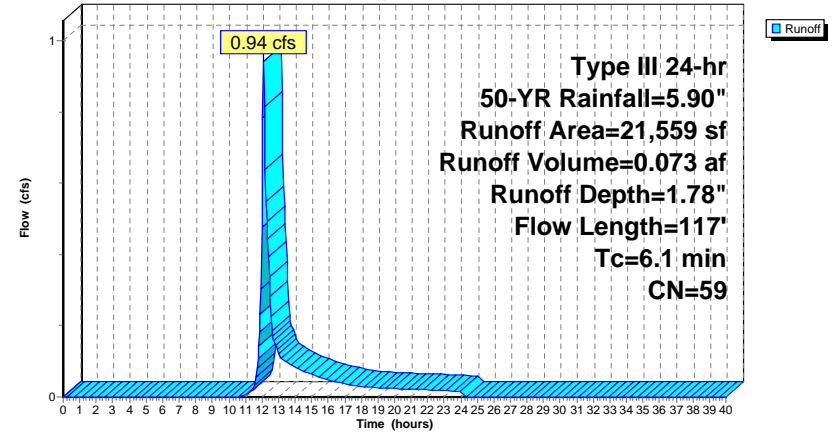
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
6,205	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
5,638	56	Brush, Fair, HSG B
21,559	59	Weighted Average
21,559		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	77	0.0450	0.22		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
0.3	40	0.0200	2.28		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
6.1	117				Total

**Subcatchment 3S: AREA P03**

Hydrograph



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**Summary for Subcatchment 4S: AREA P04**

Runoff = 0.83 cfs @ 12.10 hrs, Volume= 0.061 af, Depth= 2.73"

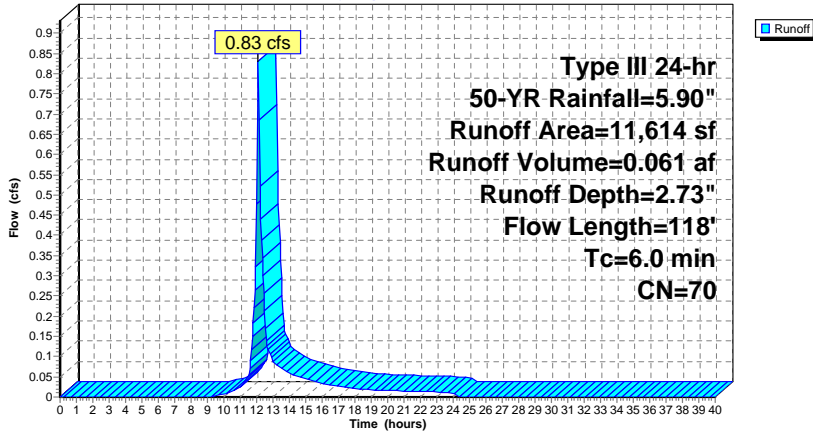
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
2,837	96	Gravel surface, HSG B
8,777	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
11,614	70	Weighted Average
11,614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	47	0.0320	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
0.4	71	0.0280	2.69		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
4.9	118				Total, Increased to minimum Tc = 6.0 min

**Subcatchment 4S: AREA P04**

Hydrograph



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**Summary for Subcatchment 5S: AREA P05**

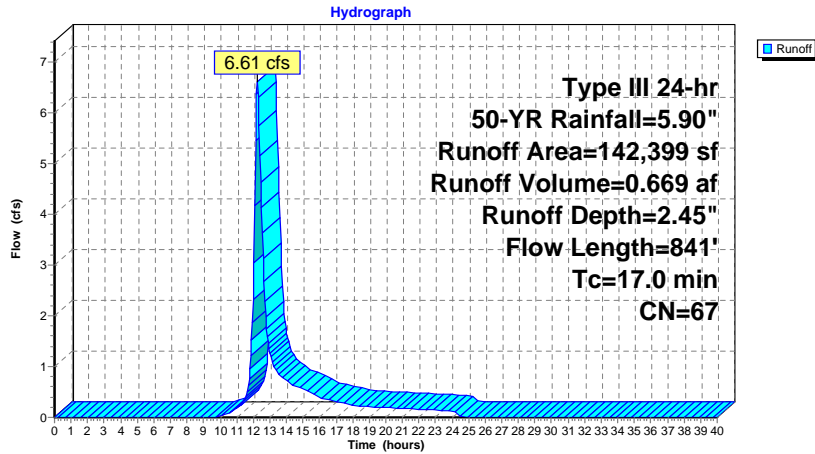
Runoff = 6.61 cfs @ 12.25 hrs, Volume= 0.669 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
11,713	98	Paved parking, HSG B
5,680	96	Gravel surface, HSG B
102,021	61	>75% Grass cover, Good, HSG B
22,661	69	50-75% Grass cover, Fair, HSG B
324	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
142,399	67	Weighted Average
130,686		91.77% Pervious Area
11,713		8.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	100	0.0300	0.20		<b>Sheet Flow, A-B</b> Grass: Short n= 0.150 P2= 3.10"
3.4	325	0.0100	1.61		<b>Shallow Concentrated Flow, B-C</b> Unpaved Kv= 16.1 fps
5.1	416	0.0070	1.35		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
17.0	841				Total

**Subcatchment 5S: AREA P05**



**Summary for Subcatchment 6S: AREA P06**

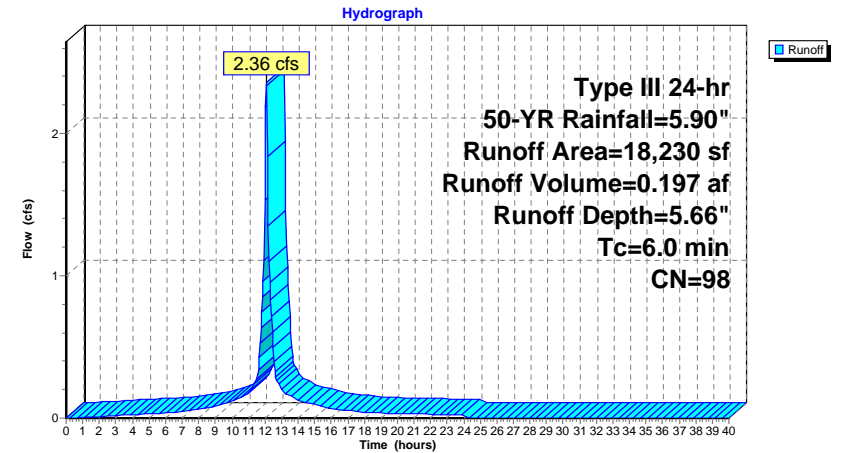
Runoff = 2.36 cfs @ 12.09 hrs, Volume= 0.197 af, Depth= 5.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
18,230	98	Roofs, HSG B
18,230		100.00% Impervious Area

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

**Subcatchment 6S: AREA P06**



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**Summary for Subcatchment 7S: AREA P07**

Runoff = 2.47 cfs @ 12.37 hrs, Volume= 0.292 af, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
3,970	98	Water Surface, HSG B
13,002	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
20,151	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
7,580	60	Woods, Fair, HSG B
7,797	56	Brush, Fair, HSG B
52,500	72	Weighted Average
35,528		67.67% Pervious Area
16,972		32.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b> Woods: Light underbrush n= 0.400 P2= 3.10"
3.2	218	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
0.4	30	0.0050	1.14		<b>Shallow Concentrated Flow, D-E</b> Unpaved Kv= 16.1 fps
25.9	348	Total			

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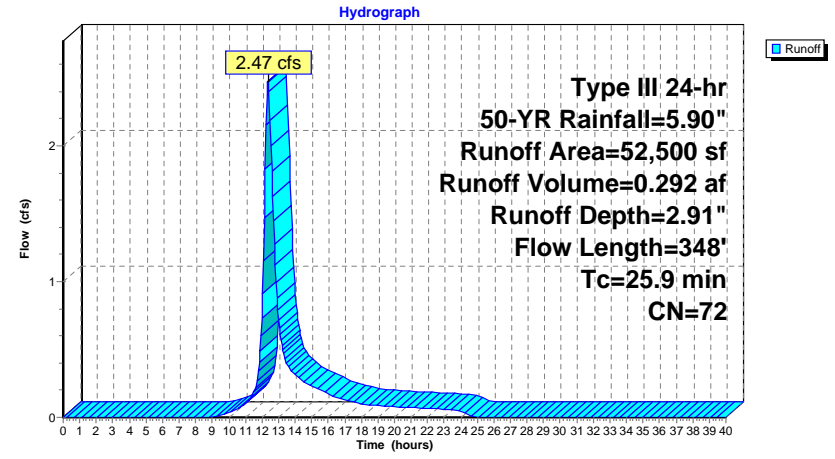
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Type III 24-hr 50-YR Rainfall=5.90"

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**Subcatchment 7S: AREA P07**



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Type III 24-hr 50-YR Rainfall=5.90"

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**Summary for Subcatchment 8S: AREA P08**

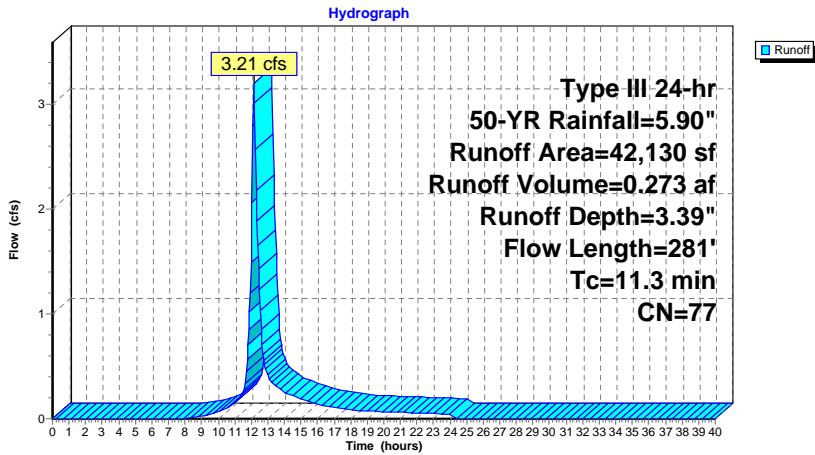
Runoff = 3.21 cfs @ 12.16 hrs, Volume= 0.273 af, Depth= 3.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
7,460	98	Water Surface, HSG B
11,029	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
23,641	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
42,130	77	Weighted Average
23,641		56.11% Pervious Area
18,489		43.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
1.3	181	0.0220	2.39		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
11.3	281	Total			

**Subcatchment 8S: AREA P08**



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Type III 24-hr 50-YR Rainfall=5.90"

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**Summary for Subcatchment 9S: AREA P09**

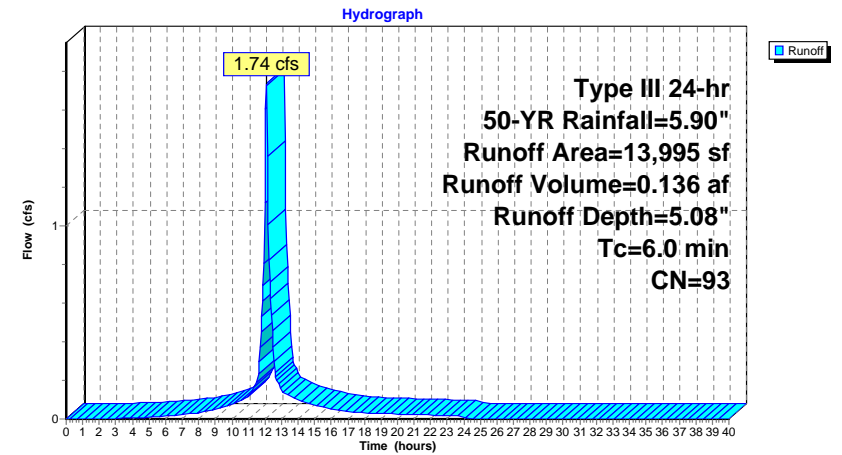
Runoff = 1.74 cfs @ 12.09 hrs, Volume= 0.136 af, Depth= 5.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 50-YR Rainfall=5.90"

Area (sf)	CN	Description
1,986	98	Water Surface, HSG B
10,160	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
1,849	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
13,995	93	Weighted Average
1,849		13.21% Pervious Area
12,146		86.79% Impervious Area

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

**Subcatchment 9S: AREA P09**



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**Summary for Pond DP1: DP#1**

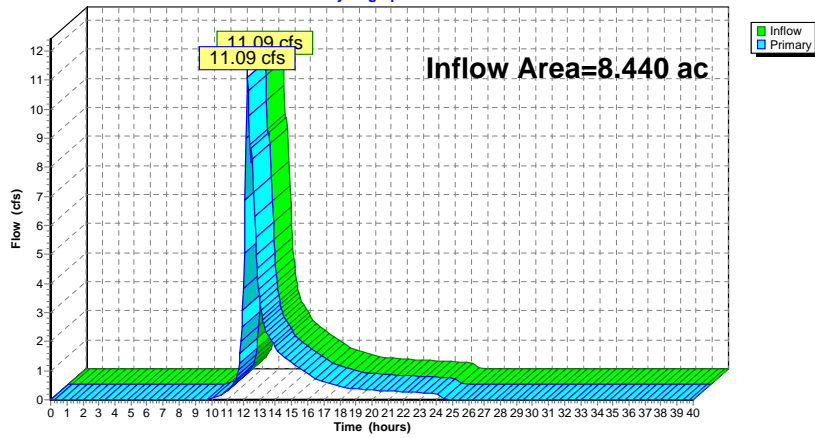
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.440 ac, 23.85% Impervious, Inflow Depth = 1.95" for 50-YR event  
Inflow = 11.09 cfs @ 12.25 hrs, Volume= 1.372 af  
Primary = 11.09 cfs @ 12.25 hrs, Volume= 1.372 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP1: DP#1**

Hydrograph



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Type III 24-hr 50-YR Rainfall=5.90"

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**Summary for Pond DP2: DP#2**

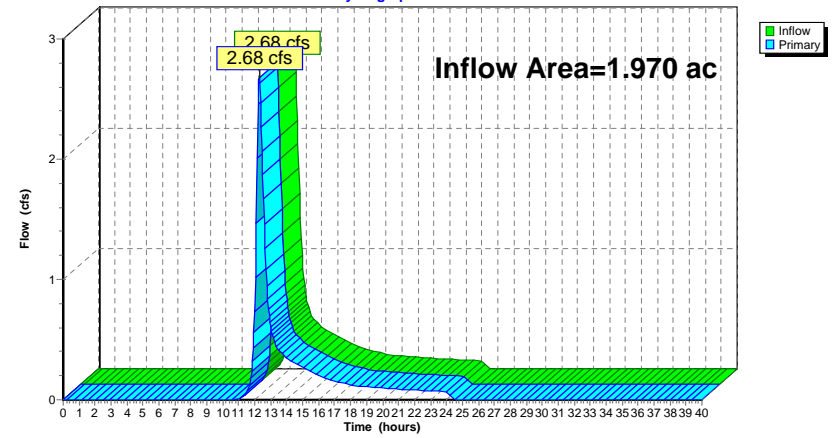
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.970 ac, 0.00% Impervious, Inflow Depth = 1.78" for 50-YR event  
Inflow = 2.68 cfs @ 12.27 hrs, Volume= 0.291 af  
Primary = 2.68 cfs @ 12.27 hrs, Volume= 0.291 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP2: DP#2**

Hydrograph



**Summary for Pond DP3: DP#3**

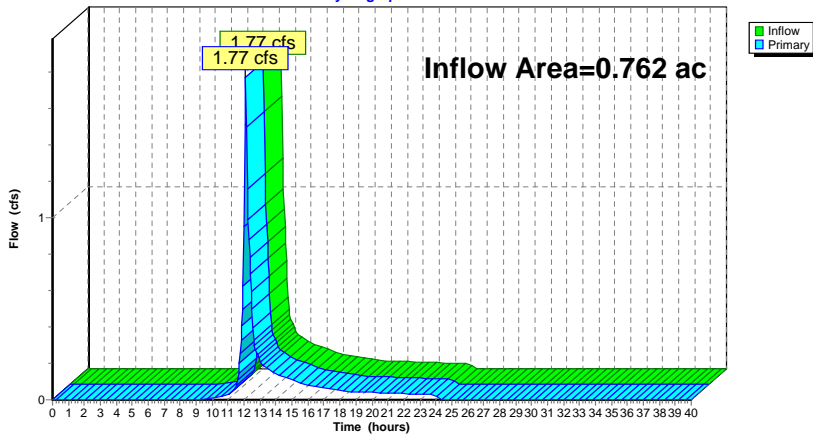
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.762 ac, 0.00% Impervious, Inflow Depth = 2.11" for 50-YR event  
 Inflow = 1.77 cfs @ 12.10 hrs, Volume= 0.134 af  
 Primary = 1.77 cfs @ 12.10 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP3: DP#3**

Hydrograph



**Summary for Pond P1: INF. BASIN #1**

Inflow Area = 1.205 ac, 32.33% Impervious, Inflow Depth = 2.91" for 50-YR event  
 Inflow = 2.47 cfs @ 12.37 hrs, Volume= 0.292 af  
 Outflow = 1.86 cfs @ 12.60 hrs, Volume= 0.274 af, Atten= 25%, Lag= 13.8 min  
 Discarded = 0.07 cfs @ 12.60 hrs, Volume= 0.136 af  
 Primary = 1.79 cfs @ 12.60 hrs, Volume= 0.138 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 126.17' @ 12.60 hrs Surf.Area= 2,961 sf Storage= 4,153 cf

Plug-Flow detention time= 321.4 min calculated for 0.274 af (94% of inflow)  
 Center-of-Mass det. time= 289.5 min ( 1,142.3 - 852.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	124.00'	7,021 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
124.00	931	0	0
125.00	1,820	1,376	1,376
126.00	2,750	2,285	3,661
127.00	3,970	3,360	7,021

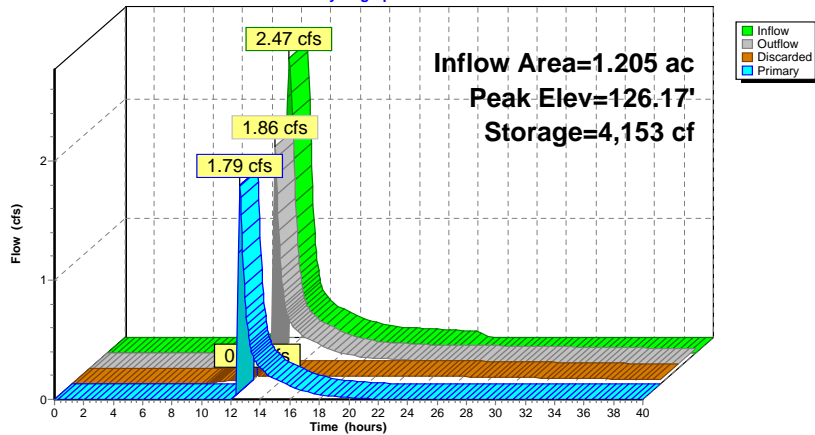
Device	Routing	Invert	Outlet Devices
#1	Discarded	124.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	126.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.07 cfs @ 12.60 hrs HW=126.17' (Free Discharge)  
 1=Exfiltration (Exfiltration Controls 0.07 cfs)

**Primary OutFlow** Max=1.78 cfs @ 12.60 hrs HW=126.17' (Free Discharge)  
 2=Broad-Crested Rectangular Weir (Weir Controls 1.78 cfs @ 1.03 fps)

**Pond P1: INF. BASIN #1**

Hydrograph



**Summary for Pond P2: INF. BASIN #2**

Inflow Area = 1.386 ac, 60.83% Impervious, Inflow Depth = 4.08" for 50-YR event  
 Inflow = 5.22 cfs @ 12.12 hrs, Volume= 0.471 af  
 Outflow = 0.99 cfs @ 12.66 hrs, Volume= 0.431 af, Atten= 81%, Lag= 32.6 min  
 Discarded = 0.15 cfs @ 12.66 hrs, Volume= 0.335 af  
 Primary = 0.85 cfs @ 12.66 hrs, Volume= 0.095 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 127.10' @ 12.66 hrs Surf.Area= 6,174 sf Storage= 10,063 cf

Plug-Flow detention time= 506.1 min calculated for 0.430 af (91% of inflow)  
 Center-of-Mass det. time= 462.9 min ( 1,255.9 - 792.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	16,167 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	3,480	0	0
126.00	4,673	4,077	4,077
127.00	6,024	5,349	9,425
128.00	7,460	6,742	16,167

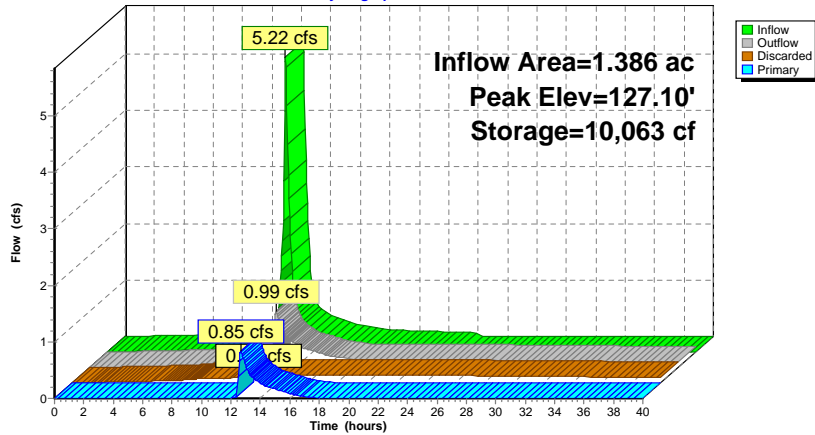
Device	Routing	Invert	Outlet Devices
#1	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	127.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.15 cfs @ 12.66 hrs HW=127.10' (Free Discharge)  
 1=Exfiltration (Exfiltration Controls 0.15 cfs)

**Primary OutFlow** Max=0.84 cfs @ 12.66 hrs HW=127.10' (Free Discharge)  
 2=Broad-Crested Rectangular Weir (Weir Controls 0.84 cfs @ 0.80 fps)

**Pond P2: INF. BASIN #2**

Hydrograph



**Summary for Pond P3: RAIN GARDEN**

Inflow Area = 0.321 ac, 86.79% Impervious, Inflow Depth = 5.08" for 50-YR event  
 Inflow = 1.74 cfs @ 12.09 hrs, Volume= 0.136 af  
 Outflow = 0.11 cfs @ 13.76 hrs, Volume= 0.108 af, Atten= 94%, Lag= 100.5 min  
 Discarded = 0.06 cfs @ 13.76 hrs, Volume= 0.100 af  
 Primary = 0.05 cfs @ 13.76 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 128.60' @ 13.76 hrs Surf.Area= 2,558 sf Storage= 3,595 cf

Plug-Flow detention time= 545.5 min calculated for 0.108 af (79% of inflow)  
 Center-of-Mass det. time= 468.8 min ( 1,242.3 - 773.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	127.50'	2,121 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	125.00'	2,203 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
		4,323 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
127.50	881	0	0
128.00	1,210	523	523
129.00	1,986	1,598	2,121

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	881	0	0
127.50	881	2,203	2,203

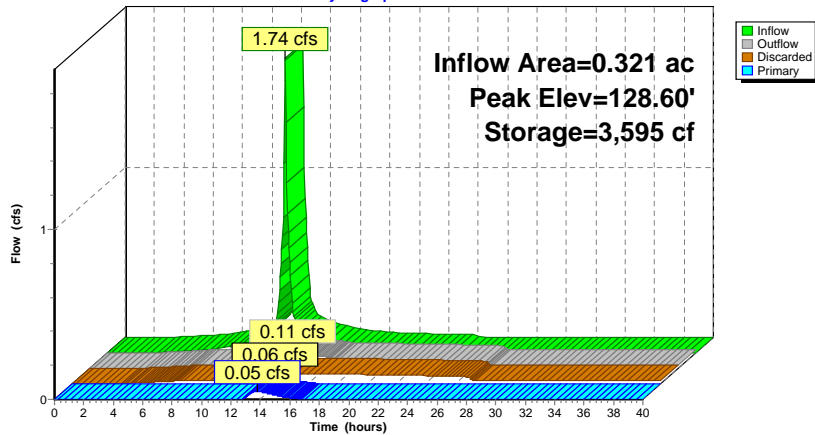
Device	Routing	Invert	Outlet Devices
#1	Device 2	128.50'	<b>12.0" Vert. Grate</b> C= 0.600
#2	Primary	125.50'	<b>12.0" Round Culvert</b> L= 61.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 125.50' / 125.00' S= 0.0082 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.06 cfs @ 13.76 hrs HW=128.60' (Free Discharge)  
 3=Exfiltration (Exfiltration Controls 0.06 cfs)

**Primary OutFlow** Max=0.05 cfs @ 13.76 hrs HW=128.60' (Free Discharge)  
 2=Culvert (Passes 0.05 cfs of 5.76 cfs potential flow)  
 1=Grate (Orifice Controls 0.05 cfs @ 1.09 fps)

**Pond P3: RAIN GARDEN**

Hydrograph



**Summary for Subcatchment 1S: AREA P01**

Runoff = 5.36 cfs @ 12.26 hrs, Volume= 0.548 af, Depth= 2.91"

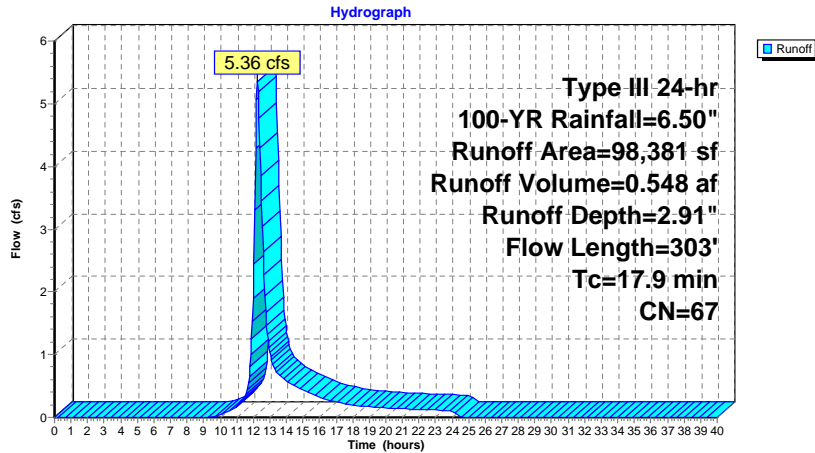
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
10,163	98	Water Surface, 0% imp, HSG B
10,119	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
27,932	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
34,771	60	Woods, Fair, HSG B
15,396	56	Brush, Fair, HSG B
98,381	67	Weighted Average
88,262		89.71% Pervious Area
10,119		10.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	87	0.0290	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.1	39	0.1300	5.80		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.0	177	0.0330	2.92		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
17.9	303	Total			

**Subcatchment 1S: AREA P01**



**Summary for Subcatchment 2S: AREA P02**

Runoff = 3.34 cfs @ 12.26 hrs, Volume= 0.355 af, Depth= 2.17"

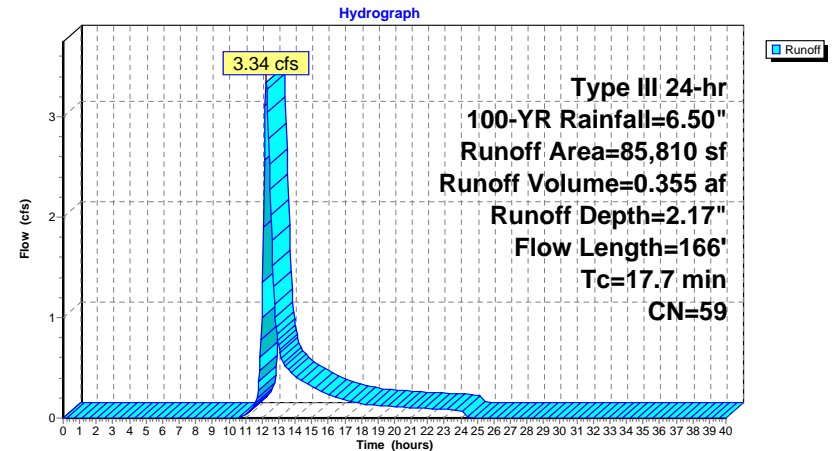
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
0	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
63,465	60	Woods, Fair, HSG B
22,345	56	Brush, Fair, HSG B
85,810	59	Weighted Average
85,810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.4	100	0.0350	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	66	0.0450	3.42		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
17.7	166	Total			

**Subcatchment 2S: AREA P02**



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Subcatchment 3S: AREA P03**

Runoff = 1.17 cfs @ 12.10 hrs, Volume= 0.089 af, Depth= 2.17"

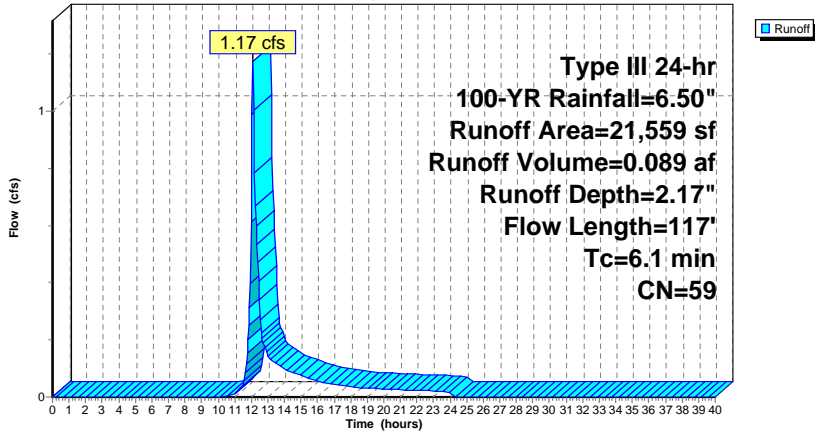
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
6,205	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
9,716	60	Woods, Fair, HSG B
5,638	56	Brush, Fair, HSG B
21,559	59	Weighted Average
21,559		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	77	0.0450	0.22		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
0.3	40	0.0200	2.28		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
6.1	117				Total

**Subcatchment 3S: AREA P03**

Hydrograph



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Subcatchment 4S: AREA P04**

Runoff = 0.98 cfs @ 12.09 hrs, Volume= 0.071 af, Depth= 3.21"

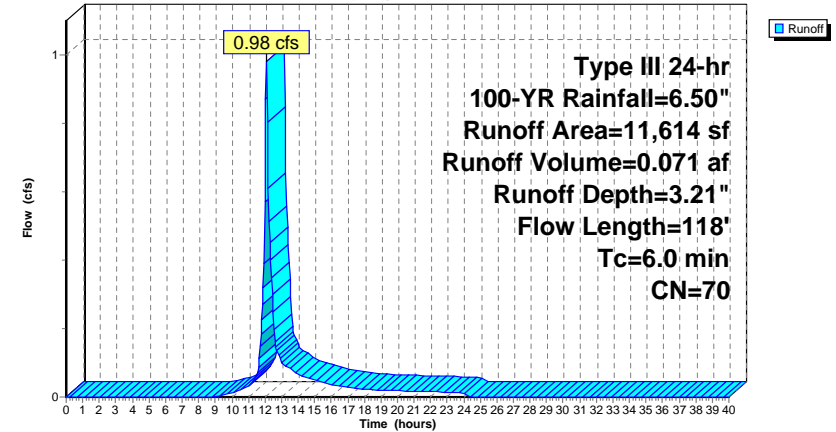
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
0	98	Paved parking, HSG B
2,837	96	Gravel surface, HSG B
8,777	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
11,614	70	Weighted Average
11,614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	47	0.0320	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
0.4	71	0.0280	2.69		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
4.9	118				Total, Increased to minimum Tc = 6.0 min

**Subcatchment 4S: AREA P04**

Hydrograph



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Subcatchment 5S: AREA P05**

Runoff = 7.91 cfs @ 12.24 hrs, Volume= 0.794 af, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
11,713	98	Paved parking, HSG B
5,680	96	Gravel surface, HSG B
102,021	61	>75% Grass cover, Good, HSG B
22,661	69	50-75% Grass cover, Fair, HSG B
324	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
142,399	67	Weighted Average
130,686		91.77% Pervious Area
11,713		8.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	100	0.0300	0.20		<b>Sheet Flow, A-B</b>
					Grass: Short n= 0.150 P2= 3.10"
3.4	325	0.0100	1.61		<b>Shallow Concentrated Flow, B-C</b>
					Unpaved Kv= 16.1 fps
5.1	416	0.0070	1.35		<b>Shallow Concentrated Flow, C-D</b>
					Unpaved Kv= 16.1 fps
17.0	841				<b>Total</b>

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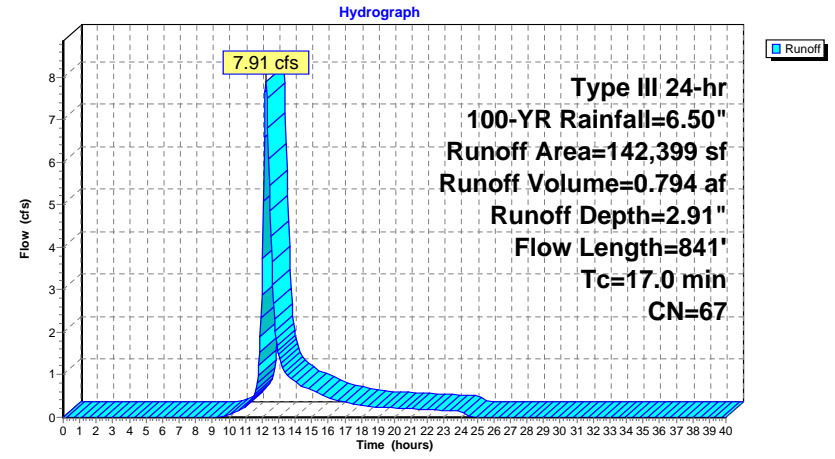
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Type III 24-hr 100-YR Rainfall=6.50"

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**Subcatchment 5S: AREA P05**



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Subcatchment 6S: AREA P06**

Runoff = 2.60 cfs @ 12.09 hrs, Volume= 0.218 af, Depth= 6.26"

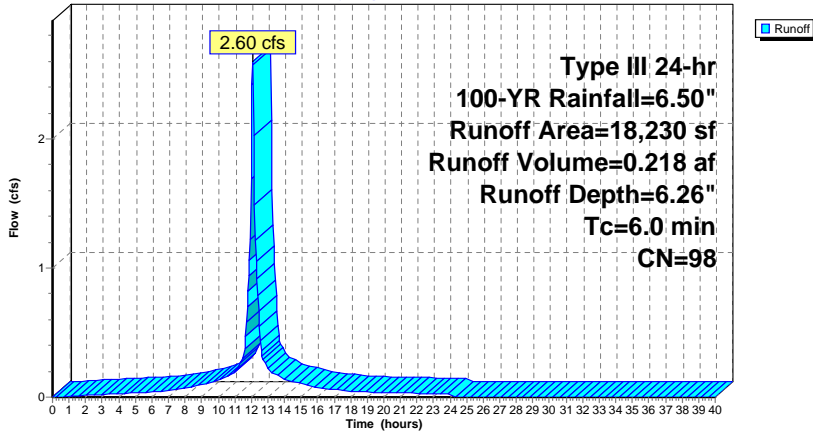
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
18,230	98	Roofs, HSG B
18,230		100.00% Impervious Area

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

**Subcatchment 6S: AREA P06**

Hydrograph



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Subcatchment 7S: AREA P07**

Runoff = 2.90 cfs @ 12.36 hrs, Volume= 0.342 af, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
3,970	98	Water Surface, HSG B
13,002	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
20,151	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
7,580	60	Woods, Fair, HSG B
7,797	56	Brush, Fair, HSG B
52,500	72	Weighted Average
35,528		67.67% Pervious Area
16,972		32.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	26	0.0960	0.11		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.10"
18.3	74	0.0170	0.07		<b>Sheet Flow, B-C</b> Woods: Light underbrush n= 0.400 P2= 3.10"
3.2	218	0.0050	1.14		<b>Shallow Concentrated Flow, C-D</b> Unpaved Kv= 16.1 fps
0.4	30	0.0050	1.14		<b>Shallow Concentrated Flow, D-E</b> Unpaved Kv= 16.1 fps
25.9	348				Total

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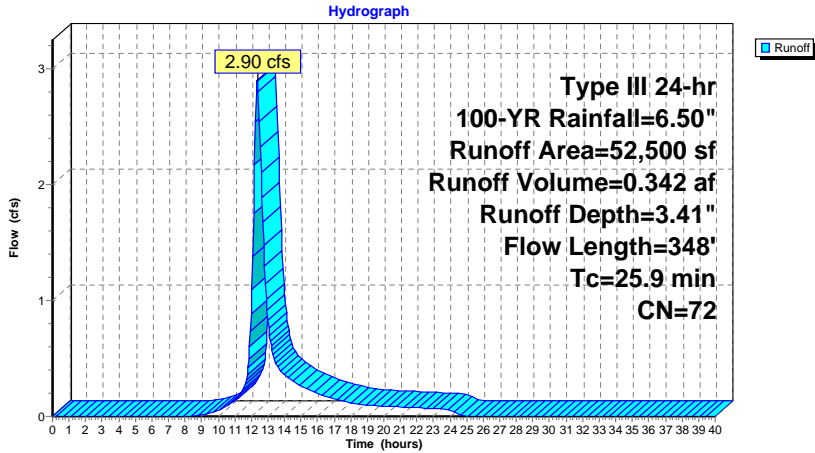
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Type III 24-hr 100-YR Rainfall=6.50"

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**Subcatchment 7S: AREA P07**



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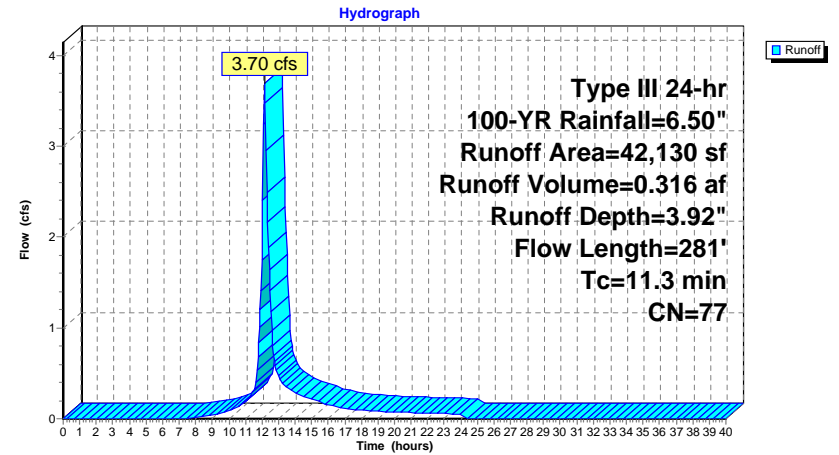
**Summary for Subcatchment 8S: AREA P08**

Runoff = 3.70 cfs @ 12.16 hrs, Volume= 0.316 af, Depth= 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description			
7,460	98	Water Surface, HSG B			
11,029	98	Paved parking, HSG B			
0	96	Gravel surface, HSG B			
23,641	61	>75% Grass cover, Good, HSG B			
0	69	50-75% Grass cover, Fair, HSG B			
0	60	Woods, Fair, HSG B			
0	56	Brush, Fair, HSG B			
42,130	77	Weighted Average			
23,641		56.11% Pervious Area			
18,489		43.89% Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
1.3	181	0.0220	2.39		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
11.3	281				Total

**Subcatchment 8S: AREA P08**



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Subcatchment 9S: AREA P09**

Runoff = 1.93 cfs @ 12.09 hrs, Volume= 0.152 af, Depth= 5.68"

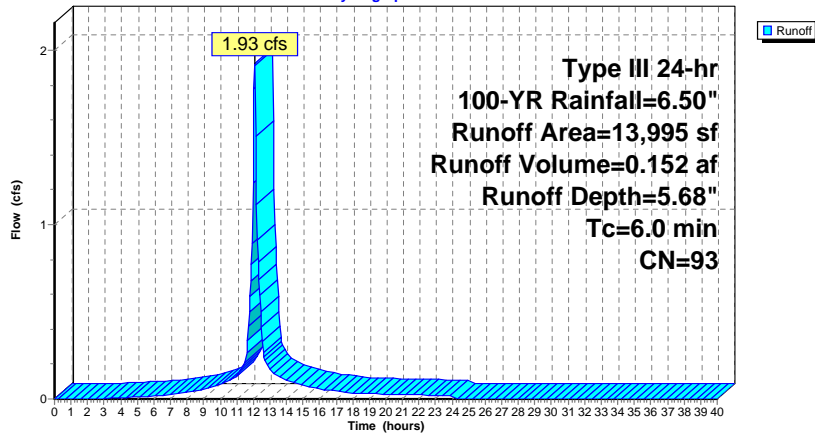
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
1,986	98	Water Surface, HSG B
10,160	98	Paved parking, HSG B
0	96	Gravel surface, HSG B
1,849	61	>75% Grass cover, Good, HSG B
0	69	50-75% Grass cover, Fair, HSG B
0	60	Woods, Fair, HSG B
0	56	Brush, Fair, HSG B
13,995	93	Weighted Average
1,849		13.21% Pervious Area
12,146		86.79% Impervious Area

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

**Subcatchment 9S: AREA P09**

Hydrograph



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Pond DP1: DP#1**

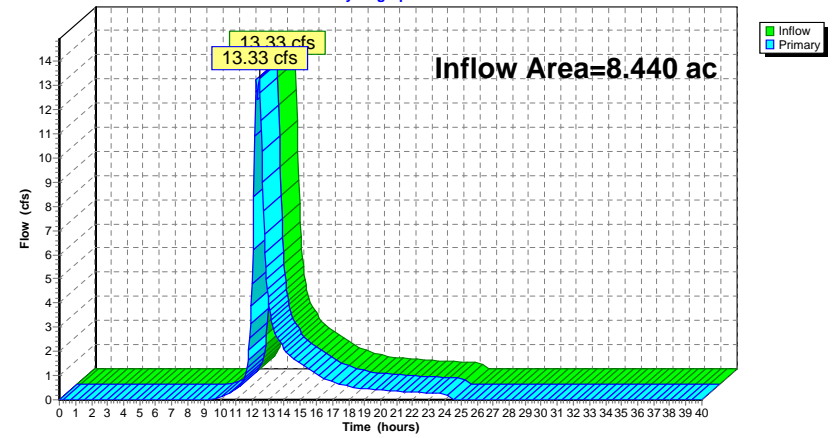
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.440 ac, 23.85% Impervious, Inflow Depth = 2.41" for 100-YR event  
Inflow = 13.33 cfs @ 12.44 hrs, Volume= 1.697 af  
Primary = 13.33 cfs @ 12.44 hrs, Volume= 1.697 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Pond DP1: DP#1**

Hydrograph



Summary for Pond DP2: DP#2

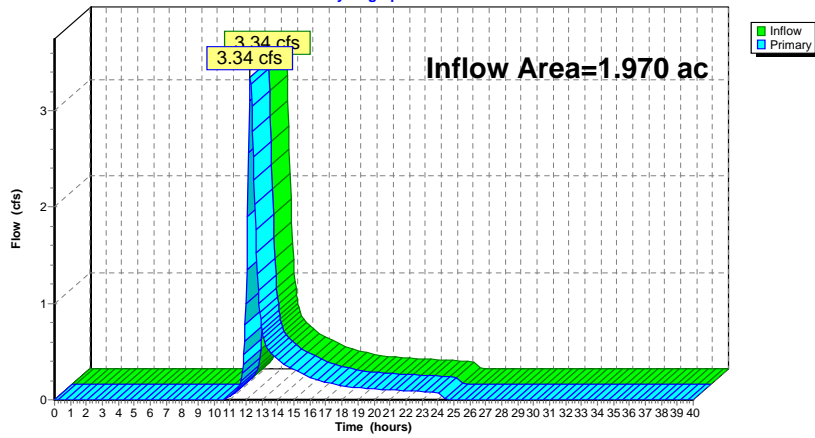
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.970 ac, 0.00% Impervious, Inflow Depth = 2.17" for 100-YR event  
 Inflow = 3.34 cfs @ 12.26 hrs, Volume= 0.355 af  
 Primary = 3.34 cfs @ 12.26 hrs, Volume= 0.355 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP2: DP#2

Hydrograph



Summary for Pond DP3: DP#3

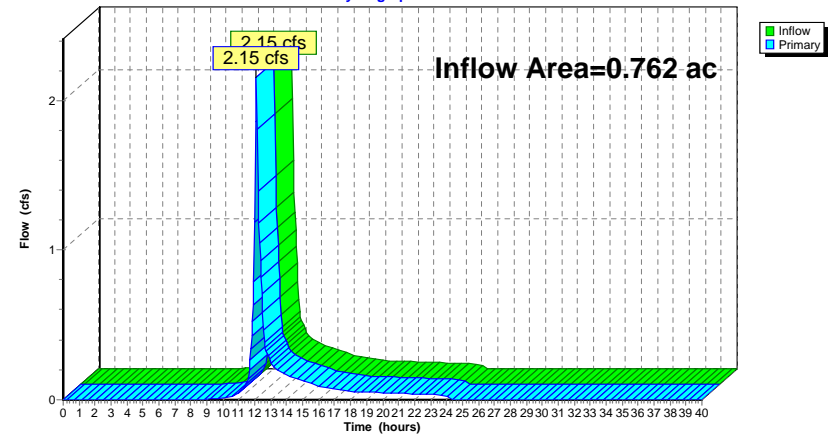
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.762 ac, 0.00% Impervious, Inflow Depth = 2.53" for 100-YR event  
 Inflow = 2.15 cfs @ 12.10 hrs, Volume= 0.161 af  
 Primary = 2.15 cfs @ 12.10 hrs, Volume= 0.161 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Pond DP3: DP#3

Hydrograph



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Pond P1: INF. BASIN #1**

Inflow Area = 1.205 ac, 32.33% Impervious, Inflow Depth = 3.41" for 100-YR event  
 Inflow = 2.90 cfs @ 12.36 hrs, Volume= 0.342 af  
 Outflow = 2.53 cfs @ 12.52 hrs, Volume= 0.323 af, Atten= 13%, Lag= 9.1 min  
 Discarded = 0.07 cfs @ 12.52 hrs, Volume= 0.138 af  
 Primary = 2.46 cfs @ 12.52 hrs, Volume= 0.185 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 126.21' @ 12.52 hrs Surf.Area= 3,010 sf Storage= 4,275 cf

Plug-Flow detention time= 277.4 min calculated for 0.323 af (95% of inflow)  
 Center-of-Mass det. time= 247.8 min ( 1,096.0 - 848.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	124.00'	7,021 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
124.00	931	0	0
125.00	1,820	1,376	1,376
126.00	2,750	2,285	3,661
127.00	3,970	3,360	7,021

Device	Routing	Invert	Outlet Devices
#1	Discarded	124.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	126.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b>
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60			
Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64			

**Discarded OutFlow** Max=0.07 cfs @ 12.52 hrs HW=126.21' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.07 cfs)

**Primary OutFlow** Max=2.46 cfs @ 12.52 hrs HW=126.21' (Free Discharge)  
 ↳2=Broad-Crested Rectangular Weir (Weir Controls 2.42 cfs @ 1.15 fps)

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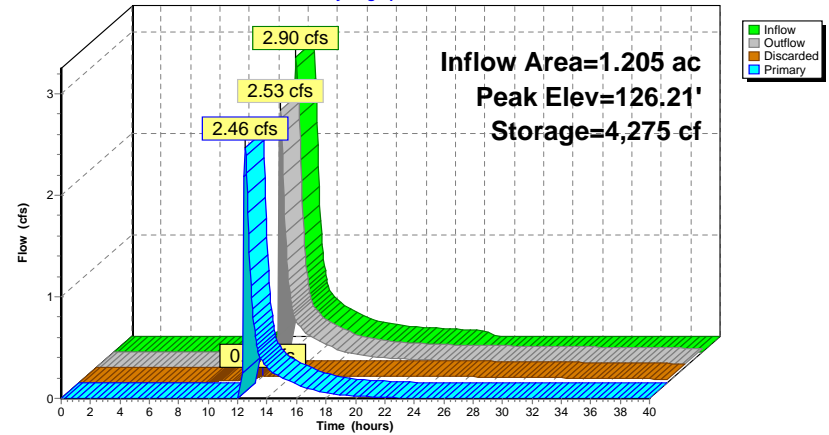
Type III 24-hr 100-YR Rainfall=6.50"

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**Pond P1: INF. BASIN #1**

Hydrograph



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**Summary for Pond P2: INF. BASIN #2**

Inflow Area = 1.386 ac, 60.83% Impervious, Inflow Depth = 4.63" for 100-YR event  
 Inflow = 5.92 cfs @ 12.12 hrs, Volume= 0.534 af  
 Outflow = 1.99 cfs @ 12.50 hrs, Volume= 0.490 af, Atten= 66%, Lag= 22.8 min  
 Discarded = 0.15 cfs @ 12.50 hrs, Volume= 0.341 af  
 Primary = 1.84 cfs @ 12.50 hrs, Volume= 0.149 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 127.18' @ 12.50 hrs Surf.Area= 6,277 sf Storage= 10,508 cf

Plug-Flow detention time= 452.7 min calculated for 0.490 af (92% of inflow)  
 Center-of-Mass det. time= 409.9 min ( 1,200.6 - 790.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	16,167 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	3,480	0	0
126.00	4,673	4,077	4,077
127.00	6,024	5,349	9,425
128.00	7,460	6,742	16,167

Device	Routing	Invert	Outlet Devices
#1	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>
#2	Primary	127.00'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b>
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.15 cfs @ 12.50 hrs HW=127.18' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.15 cfs)

**Primary OutFlow** Max=1.84 cfs @ 12.50 hrs HW=127.18' (Free Discharge)  
 ↳2=Broad-Crested Rectangular Weir (Weir Controls 1.84 cfs @ 1.04 fps)

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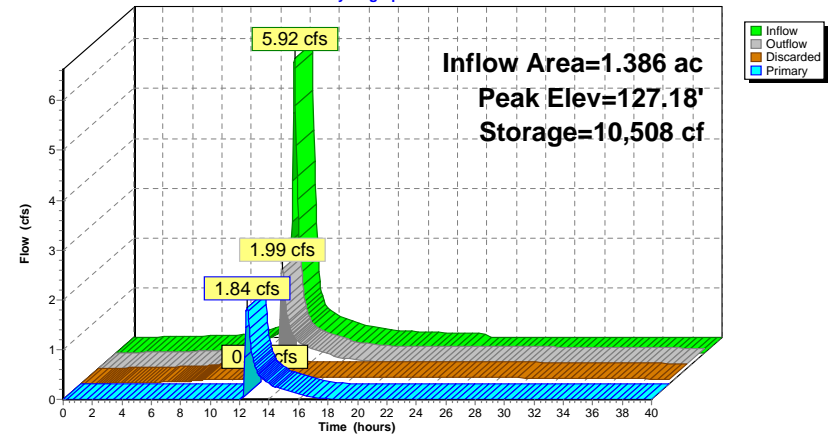
Type III 24-hr 100-YR Rainfall=6.50"

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**Pond P2: INF. BASIN #2**

Hydrograph



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Type III 24-hr 100-YR Rainfall=6.50"

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**Summary for Pond P3: RAIN GARDEN**

Inflow Area = 0.321 ac, 86.79% Impervious, Inflow Depth = 5.68" for 100-YR event  
 Inflow = 1.93 cfs @ 12.09 hrs, Volume= 0.152 af  
 Outflow = 0.21 cfs @ 12.80 hrs, Volume= 0.123 af, Atten= 89%, Lag= 42.5 min  
 Discarded = 0.06 cfs @ 12.80 hrs, Volume= 0.103 af  
 Primary = 0.15 cfs @ 12.80 hrs, Volume= 0.021 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
 Peak Elev= 128.68' @ 12.80 hrs Surf.Area= 2,622 sf Storage= 3,734 cf

Plug-Flow detention time= 493.6 min calculated for 0.123 af (81% of inflow)  
 Center-of-Mass det. time= 421.8 min ( 1,192.5 - 770.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	127.50'	2,121 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	125.00'	2,203 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
		4,323 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
127.50	881	0	0
128.00	1,210	523	523
129.00	1,986	1,598	2,121

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
125.00	881	0	0
127.50	881	2,203	2,203

Device	Routing	Invert	Outlet Devices
#1	Device 2	128.50'	<b>12.0" Vert. Grate</b> C= 0.600
#2	Primary	125.50'	<b>12.0" Round Culvert</b> L= 61.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 125.50' / 125.00' S= 0.0082 /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Discarded	125.00'	<b>1.020 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.06 cfs @ 12.80 hrs HW=128.68' (Free Discharge)  
 ↳ **3=Exfiltration** (Exfiltration Controls 0.06 cfs)

**Primary OutFlow** Max=0.14 cfs @ 12.80 hrs HW=128.68' (Free Discharge)  
 ↳ **2=Culvert** (Passes 0.14 cfs of 5.85 cfs potential flow)  
 ↳ **1=Grate** (Orifice Controls 0.14 cfs @ 1.46 fps)

**20150485A10\_PROP01**

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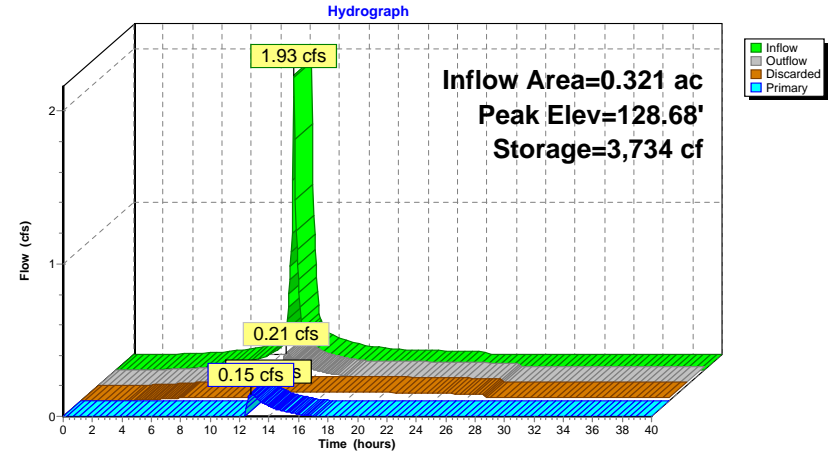
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Type III 24-hr 100-YR Rainfall=6.50"

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**Pond P3: RAIN GARDEN**



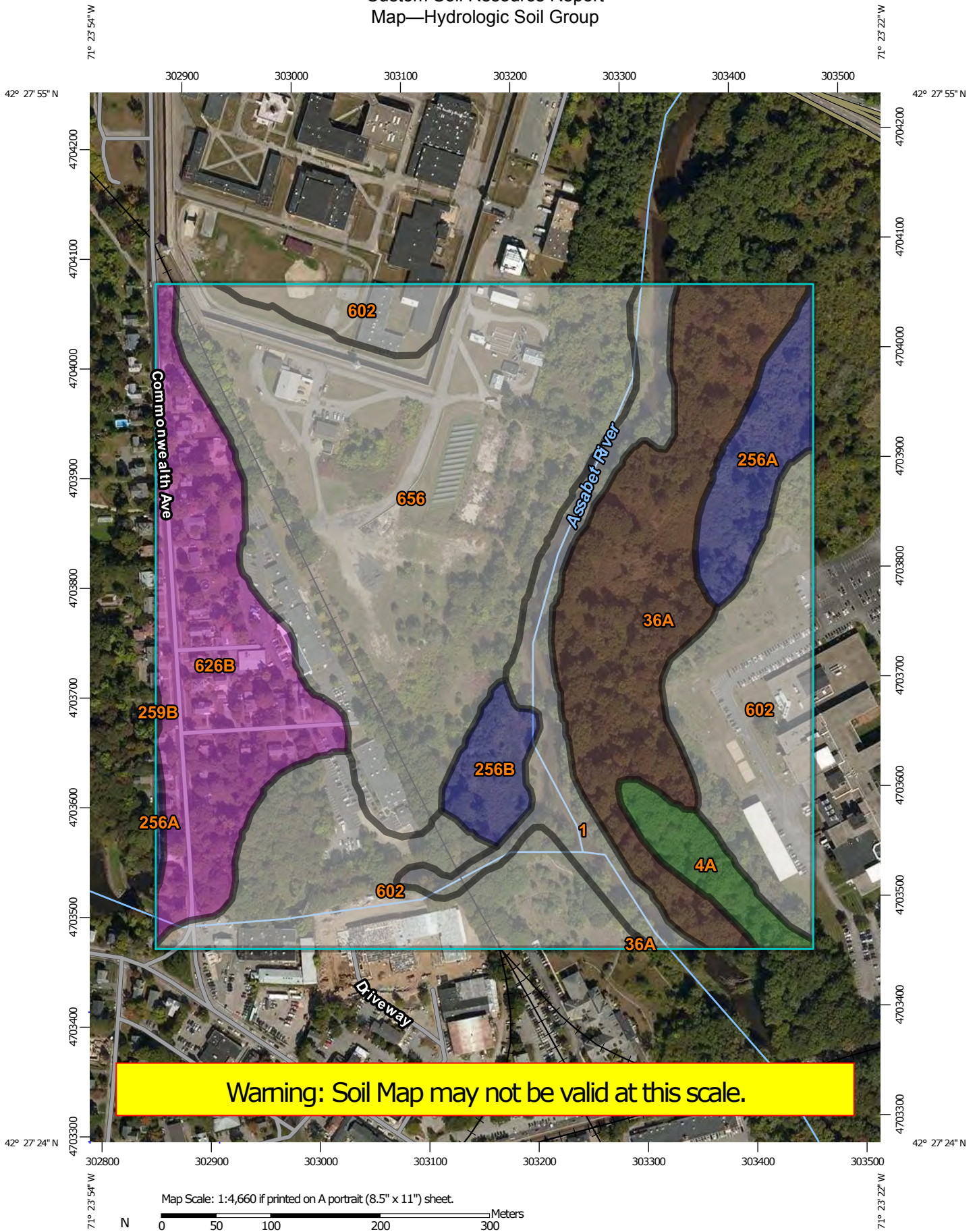
## Appendix F

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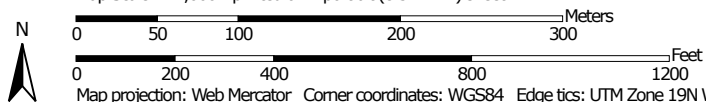
### Natural Resources Conservation Service Soils Mapping



Custom Soil Resource Report  
Map—Hydrologic Soil Group



































Map Scale: 1:4,660 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

### 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
- Water Features**
  -  Streams and Canals
- Transportation**
  -  Rails
  -  Interstate Highways
  -  US Routes
  -  Major Roads
  -  Local Roads
- Background**
  -  Aerial Photography
- Other**
  -  C
  -  C/D
  -  D
  -  Not rated or not available

### 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: Middlesex County, Massachusetts  
 Survey Area Data: Version 15, 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: Sep 12, 2014—Sep 28, 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**

Hydrologic Soil Group— Summary by Map Unit — Middlesex County, Massachusetts (MA017)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		6.2	6.9%
4A	Rippowam fine sandy loam, 0 to 3 percent slopes	A/D	2.1	2.3%
36A	Saco mucky silt loam, 0 to 1 percent slopes	B/D	13.2	14.6%
256A	Deerfield loamy sand, 0 to 3 percent slopes	B	3.7	4.1%
256B	Deerfield loamy sand, 3 to 8 percent slopes	B	2.0	2.2%
259B	Carver loamy coarse sand, 3 to 8 percent slopes	A	0.0	0.0%
602	Urban land		21.2	23.4%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	12.1	13.4%
656	Udorthents-Urban land complex		29.8	33.0%
<b>Totals for Area of Interest</b>			<b>90.5</b>	<b>100.0%</b>

**Rating Options—Hydrologic Soil Group**

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

## Appendix G

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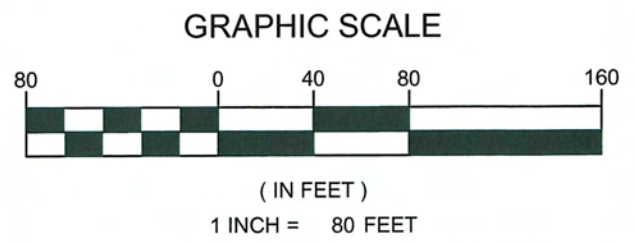
### Deep Hole Observation and Percolation Testing





**LEGEND**

	109-6	DEEP SOIL OBSERVATION HOLE
	109-F	PERCOLATION TEST
	OSP 3	ENVIRONMENTAL SOIL SAMPLE



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DES'D BY: EMR	CHK'D BY: DEM
DATE: JANUARY, 2009	

<b>SOIL TEST LOCATIONS</b>	
965 ELM STREET CONCORD MA, 01742	
PROJECT: 081037	1 of 1

FORM 11 - SOIL EVALUATOR FORM

No. 081037

Date: 1/8/09

Commonwealth of Massachusetts
Concord, Massachusetts

Soil Suitability Assessment for On-Site Sewage Disposal

Performed by: Eric Rudenauer, GPR Inc
Witnessed by: Brent Reagor & Stanley Sosnicki, Concord BOH

Date: 1/8/09

Table with 2 columns: Location Address (965 Elm Street, Concord, MA 01742) and Owner's Name (MA Department of Corrections, 965 Elm Street, Concord, MA 01742, Telephone No. 978-369-8899)

New Construction [checked] Upgrade [ ] Repair [ ]

Office Review

Published Soil Survey Available: No [checked] Yes [ ]
Year Published Internet Publication Scale N/A Soil Map Unit 656
Soil Name Udorthents Soil Limitations urban land complex, excavated and filled area
Surficial Geologic Report Available: No [checked] Yes [ ]
Year Published Publication Scale
Geologic Material(Map Unit)
Landform

Flood Insurance Rate Map: 250189 0010 B
Above 500 Year Flood Boundary No [ ] Yes [checked]
Within 500 Year Flood Boundary No [checked] Yes [ ]
Within 100 Year Flood Boundary No [checked] Yes [ ]
Within Velocity Zone No [checked] Yes [ ]

Wetland Area:

National Wetlands Inventory Map (map unit) N/A
Wetlands Conservancy Program Map (map unit) N/A

Current Water Resource Conditions (USGS): Month December

Range: Above Normal [checked] Normal [ ] Below Normal [ ]

Other Reference Reviewed USGS
NCSS Web Soil Survey

# FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 965 Elm Street  
 Concord, MA 01742

## On-Site Review

Deep Hole #: 109-1 Date: 01/08/09 Time: 9:15 AM Weather: Sunny 30°  
 Location (identify on site plan) See Attached Sketch  
 Land Use gravel storage area Slope (%) 2% Surfaces Stones none  
 (eg woodland, agricultural field, vacant lot etc...)  
 Vegetation none  
 Landform Outwash plain  
 Position on landscape See attached Sketch  
 Distances from:  
     Open Water Body >100 feet      Drainage Way >100 feet  
     Possible Wet Area >100 feet      Property Line 50± feet  
     Drinking Water Well >100 feet      Other: \_\_\_\_\_ feet

<b>Deep Observation Hole Log</b>					
Hole # 109-1		NB 15-1/110			
Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-60 60-136	Fill C	Med Sand	2.5Y6/4	None Observed	mixed soil and debris single grain, loose, no stones, cobbles, or boulders, 10% gravel

\*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) glacial outwash Depth to Bedrock: >136"  
 Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None  
 Estimated Seasonal High Groundwater in the Hole 136"  
 Additional Notes sides of hole were sloughing in  
 \_\_\_\_\_  
 \_\_\_\_\_

## FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 965 Elm Street  
 Concord, MA 01742

### On-Site Review

Deep Hole #: 109-2 Date: 01/08/09 Time: 9:30 AM Weather: Sunny 30°

Location (identify on site plan) See Attached Sketch

Land Use gravel storage area Slope (%) 2% Surfaces Stones none

(eg woodland, agricultural field, vacant lot etc...)

Vegetation none

Landform Outwash plain

Position on landscape See attached Sketch

Distances from:

Open Water Body >100 feet	Drainage Way >100 feet
Possible Wet Area >100 feet	Property Line 30± feet
Drinking Water Well >100 feet	Other: _____ feet

Deep Observation Hole Log					
Hole # 109-2		NB 15-1/110			
Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-20	Fill				mixed soil and debris
20-74	C1	Med Sand	2.5Y6/4	None	single grain, loose, no gravel
74-124	C2	Med Sand	2.5Y 5/4	Observed	single grain, loose, 10% gravel

\*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) glacial outwash Depth to Bedrock: >124"

Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None

Estimated Seasonal High Groundwater in the Hole 124"

Additional Notes sides of hole were sloughing in

.....  
 .....  
 .....

## FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 965 Elm Street  
 Concord, MA 01742

### On-Site Review

Deep Hole #: 109-3 Date: 01/08/09 Time: 9:45 AM Weather: Sunny 30°

Location (identify on site plan) See Attached Sketch

Land Use gravel storage area Slope (%) 2% Surfaces Stones none

(eg woodland, agricultural field, vacant lot etc...)

Vegetation none

Landform Outwash plain

Position on landscape See attached Sketch

Distances from:

Open Water Body >100 feet	Drainage Way >100 feet
Possible Wet Area >100 feet	Property Line 100± feet
Drinking Water Well >100 feet	Other: _____ feet

Deep Observation Hole Log					
Hole # 109-3		NB 15-1/110			
Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-28 28-124	Fill C	Med Sand	2.5Y6/4	None Observed	mixed soil and debris single grain, loose, no stones, cobbles, or boulders, 10% gravel

\*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) glacial outwash Depth to Bedrock: >124"

Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None

Estimated Seasonal High Groundwater in the Hole 124"

Additional Notes sides of hole were sloughing in

.....  
 .....

# FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 965 Elm Street  
 Concord, MA 01742

## On-Site Review

Deep Hole #: 109-4 Date: 01/08/09 Time: 10:00 AM Weather: Sunny 30°  
 Location (identify on site plan) See Attached Sketch  
 Land Use gravel storage area Slope (%) 2% Surfaces Stones none  
 (eg woodland, agricultural field, vacant lot etc...)  
 Vegetation none  
 Landform Outwash plain  
 Position on landscape See attached Sketch  
 Distances from:  
     Open Water Body >100 feet      Drainage Way >100 feet  
     Possible Wet Area >100 feet      Property Line 130± feet  
     Drinking Water Well >100 feet      Other: \_\_\_\_\_ feet

<b>Deep Observation Hole Log</b>					
Hole # 109-4		NB 15-1/112			
Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-40 406-130	Fill C	Med Sand	2.5Y6/4	None Observed	mixed soil and debris single grain, loose, no stones, cobbles, or boulders, 10% gravel

\*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) glacial outwash Depth to Bedrock: >130"  
 Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None  
 Estimated Seasonal High Groundwater in the Hole 130"  
 Additional Notes sides of hole were sloughing in  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 965 Elm Street  
 Concord, MA 01742

## On-Site Review

Deep Hole #: 109-5 Date: 01/08/09 Time: 10:15 AM Weather: Sunny 30°  
 Location (identify on site plan) See Attached Sketch  
 Land Use gravel storage area Slope (%) 2% Surfaces Stones none  
 (eg woodland, agricultural field, vacant lot etc...)  
 Vegetation none  
 Landform Outwash plain  
 Position on landscape See attached Sketch  
 Distances from:  
     Open Water Body >100 feet      Drainage Way >100 feet  
     Possible Wet Area >100 feet      Property Line 150± feet  
     Drinking Water Well >100 feet      Other: \_\_\_\_\_ feet

<b>Deep Observation Hole Log</b>					
Hole # 109-5		NB 15-1/112			
Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-36 36-130	Fill C	Med Sand	2.5Y6/4	None Observed	mixed soil and debris single grain, loose, no stones, cobbles, or boulders, 10% gravel

\*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) glacial outwash Depth to Bedrock: >130"  
 Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None  
 Estimated Seasonal High Groundwater in the Hole 130"  
 Additional Notes sides of hole were sloughing in  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 965 Elm Street  
 Concord, MA 01742

## On-Site Review

Deep Hole #: 109-6 Date: 01/08/09 Time: 12:20 PM Weather: Sunny 30°  
 Location (identify on site plan) See Attached Sketch  
 Land Use gravel storage area Slope (%) 2% Surfaces Stones none  
 (eg woodland, agricultural field, vacant lot etc...)  
 Vegetation none  
 Landform Outwash plain  
 Position on landscape See attached Sketch  
 Distances from:  
     Open Water Body >100 feet      Drainage Way >100 feet  
     Possible Wet Area >100 feet      Property Line 200± feet  
     Drinking Water Well >100 feet      Other: \_\_\_\_\_ feet

<b>Deep Observation Hole Log</b>					
Hole # 109-6		NB 15-1/112			
Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-4	A	LS	10YR 5/4		ABK, vfr
4-45	C1	Med Sand	2.5Y6/4		single grain loose, no gravel
45-120	C2	Med Sand	2.5Y 5/4	@ 94" 10YR 6/8	single grain, loose, 10% gravel

\*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) glacial outwash Depth to Bedrock: >120"  
 Depth to Groundwater: Standing Water in the Hole 94" Weeping from Pit Face: 94"  
 Estimated Seasonal High Groundwater in the Hole 94"  
 Additional Notes sides of hole were sloughing in  
 \_\_\_\_\_  
 \_\_\_\_\_

**FORM 11 - SOIL EVALUATOR FORM**

Location Address or Lot#: 965 Elm Street  
Concord, MA 01742

**Determination for Seasonal High Water Table**

**Method Used:**

- Depth observed standing in observation hole \_\_\_\_\_ inches \_\_\_\_\_
- Depth weeping from side of observation hole \_\_\_\_\_ inches \_\_\_\_\_
- Depth to soil mottles \* \_\_\_\_\_ inches See individual Reports
- Ground water adjustment \_\_\_\_\_ feet \_\_\_\_\_

Index Well Number \_\_\_\_\_ Reading Date \_\_\_\_\_ Index Well Level \_\_\_\_\_

Adjustment Factor \_\_\_\_\_ Adjusted Ground Water Level \_\_\_\_\_

**Depth of Naturally Occuring Pervious Material**

Does at least four feet of naturally occuring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? Yes

If not, what is the depth of naturally occuring pervious material? \_\_\_\_\_ Feet

**Certification**

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated, on the attached soil evaluation form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature *Eve Rudin* Date 1/12/2009

Notes: \_\_\_\_\_  
\_\_\_\_\_

## FORM 12 - PERCOLATION TEST

Location Address: or Lot #      965 Elm Street Concord, MA 01742	Owner's Name: MA Department of Corrections Address:        965 Elm Street Concord, MA 01742  Telephone No. 978-369-8899
--	---

	1/8/09	11:35 AM	1/8/09	11:50
	Date	Time	Date	Time
Observation Hole #	109-A		109-B	
Depth of Perc	64"		48"	
Start Pre-Soak	11:35 AM		11:50 AM	
End Pre-Soak	*		**	
Time @ 12"	*		**	
Time @ 9"				
Time @ 6"				
Time (9"-6")				
Rate (Min./Inch)	<2		<2	

Test Passed:   
 Test Failed:

Test Passed:   
 Test Failed:

Test performed By: Eric Rudenauer, GPR Inc.

Witnessed By: Stanley Sosnicki, Concord BOH

Comments:  
Hole # 109-A: 36" depth to limit of fill

\* over 24 gallons applied unable to soak  
 \*\* over 24 gallons applied unable to soak

## FORM 12 - PERCOLATION TEST

Location Address: or Lot #      965 Elm Street Concord, MA 01742	Owner's Name: MA Department of Corrections Address:        965 Elm Street Concord, MA 01742  Telephone No. 978-369-8899
--	---

	1/8/09	12:05 PM	1/8/09	12:35 PM
	Date	Time	Date	Time
Observation Hole #	109-C		109-D	
Depth of Perc	54"		62"	
Start Pre-Soak	12:05 PM		12:35 PM	
End Pre-Soak	*		**	
Time @ 12"	*		**	
Time @ 9"				
Time @ 6"				
Time (9"-6")				
Rate (Min./Inch)	<2		<2	
	Test Passed: <input checked="" type="checkbox"/>		Test Passed: <input checked="" type="checkbox"/>	
	Test Failed: <input type="checkbox"/>		Test Failed: <input type="checkbox"/>	

Test performed By: Eric Rudenauer, GPR Inc.

Witnessed By: Stanley Sosnicki, Concord BOH

Comments:  
 \_\_\_\_\_  
 \_\_\_\_\_

\* over 24 gallons applied unable to soak  
 \*\* over 24 gallons applied unable to soak

## FORM 12 - PERCOLATION TEST

Location Address: or Lot #      965 Elm Street Concord, MA 01742	Owner's Name: MA Department of Corrections Address:        965 Elm Street Concord, MA 01742  Telephone No. 978-369-8899
--	---

	1/8/09	12:50 PM	1/8/09	1:05 PM
	Date	Time	Date	Time
Observation Hole #	109-E		109-F	
Depth of Perc	58"		36"	
Start Pre-Soak	12:50 PM		1:05 PM	
End Pre-Soak	*		**	
Time @ 12"	*		**	
Time @ 9"				
Time @ 6"				
Time (9"-6")				
Rate (Min./Inch)	<2		<2	

Test Passed:   
 Test Failed:

Test Passed:   
 Test Failed:

Test performed By: Eric Rudenauer, GPR Inc.

Witnessed By: Stanley Sosnicki, Concord BOH

Comments:  
 \_\_\_\_\_  
 \_\_\_\_\_

\* over 24 gallons applied unable to soak  
 \*\* over 24 gallons applied unable to soak

## Appendix H

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### Groundwater Recharge & 72 Hour Drawdown Calculations





## REQUIRED RECHARGE VOLUME

$$Rv = F * IMPERVIOUS AREA$$

$$F = 0.35 \text{ INCH}$$

### Total Proposed Site

Impervious= 58,989 SF

Site Rv= 1721 CF

### Contributing to Infiltration Basin #1

Impervious= 13,002 SF

INF Basin #1 Rv= 379 CF

### Infiltration Basin #1 Design

**Provided Storage Volume= 3,661 CF > 379 CF**  
(at weir elevation 126 Per HydroCAD)

### Contributing to Infiltration Basin #2

Impervious= 29,259 SF

INF Basin #2 Rv= 853 CF

### Infiltration Basin #2 Design

**Provided Storage Volume= 9,425 CF > 853 CF**  
(at weir elevation 127 Per HydroCAD)

### Contributing to Rain Garden

Impervious= 10,160 SF

Rain Garden Rv= 296 CF

### Rain Garden Design

**Provided Storage Volume= 3,427 CF > 296 CF**  
(at Elevation 128.5 Per HydroCAD)



### 72 HOUR DRAWDOWN

$$\text{Time drawdown} = \frac{R_v}{(K)(\text{Bottom Area})}$$

$$K = 1.02 \text{ inch/hour}$$

#### Infiltration Basin #1

Bottom Area of System= 1318 SF  
System Storage= 7021 CF  
**T drawdown= 63 hours < 72 hours**

#### Infiltration Basin #2

Bottom Area of System= 3480.32 SF  
System Storage= 16167 CF  
**T drawdown= 55 hours < 72 hours**

#### Rain Garden

Bottom Area of System= 881.38 SF  
System Storage= 2121 CF (above grade)  
**T drawdown= 28 hours < 72 hours**

---

## Appendix I

### Required Total Suspended Solids



**INSTRUCTIONS:**

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location:

	B	C	D	E	F
	BMP <sup>1</sup>	TSS Removal Rate <sup>1</sup>	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
<b>TSS Removal Calculation Worksheet</b>	Infiltration Basin	0.80	1.00	0.80	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20

**Total TSS Removal =**

**Separate Form Needs to be Completed for Each Outlet or BMP Train**

Project:   
 Prepared By:   
 Date:

\*Equals remaining load from previous BMP (E) which enters the BMP

**INSTRUCTIONS:**

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location:

	B	C	D	E	F
	BMP <sup>1</sup>	TSS Removal Rate <sup>1</sup>	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
<b>TSS Removal Calculation Worksheet</b>	Infiltration Basin	0.80	1.00	0.80	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20

**Total TSS Removal =**

**Separate Form Needs to be Completed for Each Outlet or BMP Train**

Project:   
 Prepared By:   
 Date:

\*Equals remaining load from previous BMP (E) which enters the BMP

**INSTRUCTIONS:**

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location:

	B	C	D	E	F
	BMP <sup>1</sup>	TSS Removal Rate <sup>1</sup>	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
<b>TSS Removal Calculation Worksheet</b>	Bioretention Area	0.90	1.00	0.90	0.10
		0.00	0.10	0.00	0.10
		0.00	0.10	0.00	0.10
		0.00	0.10	0.00	0.10
		0.00	0.10	0.00	0.10

**Total TSS Removal =**

**Separate Form Needs to be Completed for Each Outlet or BMP Train**

Project:   
 Prepared By:   
 Date:

\*Equals remaining load from previous BMP (E) which enters the BMP

## Appendix J

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### Water Quality Volume & Sediment Forebay Sizing Calculations



**REQUIRED WATER QUALITY VOLUME**

**(V<sub>wq</sub>)**

$V_{wq} = (Dwq / 12 \text{ inches/foot}) * (\text{Impervious Area})$

Dwq= 0.5

**TOTAL SITE IMPERVIOUS= 58989 SF**

<b>REQUIRED V<sub>wq</sub>=</b>	<b>2,458</b>	<b>CF</b>
---------------------------------	--------------	-----------

**CONTRIBUTNG IMPERVIOUS TO INF #1= 13,002 SF**

<b>REQUIRED V<sub>wq</sub>=</b>	<b>542</b>	<b>CF</b>
---------------------------------	------------	-----------

<b>PROVIDED WQV STORAGE=</b>	<b>3,661</b>	<b>CF</b>
------------------------------	--------------	-----------

**CONTRIBUTNG IMPERVIOUS TO INF #2= 29,259 SF**

<b>REQUIRED V<sub>wq</sub>=</b>	<b>1,219</b>	<b>CF</b>
---------------------------------	--------------	-----------

<b>PROVIDED WQV STORAGE=</b>	<b>9,425</b>	<b>CF</b>
------------------------------	--------------	-----------

**CONTRIBUTING IMPERVIOUS TO RAIN GARDEN= 10,160 SF**

<b>REQUIRED V<sub>wq</sub>=</b>	<b>423</b>	<b>CF</b>
---------------------------------	------------	-----------

<b>PROVIDED WQV STORAGE=</b>	<b>3,427</b>	<b>CF</b>
------------------------------	--------------	-----------



**SEDIMENT FOREBAY SIZING**

Forebay=0.1\*(Impervious Area)

**INFILTRATION BASIN #1**

**CONTRIBUTING IMPERVIOUS=** 13,002 SF

**REQUIRED FOREBAY SIZE= 108 CF**

STAGE (FT)	ELEV (FT)	CONTOUR AREA (SF)	INC STORAGE (CF)	TOTAL STORAGE (CF)
0	125	387	0	0
1	126	743	565.06	565.06

**PROVIDED FOREBAY STORAGE= 565 CF > 108 CF**

**INFILTRATION BASIN #2**

**CONTRIBUTING IMPERVIOUS=** 29,259 SF

**REQUIRED FOREBAY SIZE= 244 CF**

STAGE (FT)	ELEV (FT)	CONTOUR AREA (SF)	INC STORAGE (CF)	TOTAL STORAGE (CF)
0	125	915	0	0
1	126	1,398	1156.715	1156.715
2	127	1,963	1680.81	2837.525

**PROVIDED FOREBAY STORAGE= 2838 CF > 244 CF**

## Appendix K

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### Construction Operation and Maintenance Plan



## MEMORANDUM

**TO:** Walter Ohanian  
The Grantham Group

**FROM:** Fuss & O'Neill, Inc.

**DATE:** November 15, 2016

**RE:** Construction Operation and Maintenance Plan  
Christopher Heights Assisted Living Facility  
Concord, MA

---

Property Owner: The Grantham Group  
99 Pleasant Street  
Marlborough, MA 01752

Person responsible for financing maintenance and emergency repairs: Walter Ohanian  
508-281-8001

Property Owner shall be responsible for the operation and maintenance of the site during construction. Construction includes of an 3 story building, asphalt parking areas, a rain garden, infiltration basins, stormwater drainage system, septic system with leaching field, site utilities and other site improvements. A suggested operation and maintenance activities and proposed schedule for during construction is as follows:

1. No earthwork activities shall commence until silt fence has been installed. silt fence shall be installed as shown on the drawings.
2. Areas left exposed to erosion for more than seven days shall be rough graded and temporarily stabilized. Areas disturbed but inactive for more than thirty days shall be temporarily seeded.
3. Erosion and sedimentation controls shall be maintained initial successful establishment of ground cover.
4. No staging of materials or lay down areas shall be located within the resource areas.
5. Paved areas shall be kept free of sediment, and shall be cleaned periodically as required by construction activities.
6. Catch basins shall be periodically inspected for the accumulation of sediment. Catch basins within the project shall be cleaned at the end of the project.

7. Temporary soil stockpiles shall be located within areas consisting of formerly paved or developed surfaces, and will be moved as necessary to accommodate ongoing work.
8. Sediment stockpiles shall have a side slope of no greater than 2:1. Stockpiles shall be rough graded or maintain a roughened surface to prevent erosion. Stockpiles that are not to be used within 7 days shall be seeded after formation of stockpile as to prevent erosion. Straw bale barrier and silt fence shall be installed around stockpile area approximately 10 feet from toe of slope.
9. The contractor is responsible to inspect and repair erosion and sedimentation control measures as required to prevent damage or sedimentation.
10. Upon completion of construction and establishment of permanent ground cover, remove and dispose of temporary erosion control measures. Clean sediment and debris from temporary measures and from permanent storm drain and sanitary sewer systems.
11. Catch basin protection to be installed in all catch basins located on site.

Inspections shall be completed a minimum of every seven (7) calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater. Attached is an example Inspection and Maintenance Report Form.

## INSPECTION AND MAINTENANCE REPORT FORM

### Christopher Heights Assisted Living Facility – Concord Massachusetts

*To be completed every 7 calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater*

Inspector: \_\_\_\_\_ Date: \_\_\_\_\_

Inspector's Title and Qualifications: \_\_\_\_\_  
 \_\_\_\_\_

#### Summary of Previous 7-day Rainfall:

Date	Friday Date	Saturday Date	Sunday Date	Monday Date	Tuesday Date	Wednesday Date	Thursday Date
Total Daily Rainfall (in.)							

#### Stabilization Measures:

Area	Disturbed (Yes/No)	Stabilized (Yes/No)	Stabilized With	Condition
<b>Paved Parking Area</b>				
<b>Infiltration Basin #1</b>				
<b>Infiltration Basin #2</b>				
<b>Rain Garden</b>				

#### Infiltration Basin #1

Depth of Infiltration Basin	Condition of Side Slopes	Evidence of Overtopping of Embankments	Condition of Outfall

#### Infiltration Basin #2

Depth of Infiltration Basin	Condition of Side Slopes	Evidence of Overtopping of Embankments	Condition of Outfall

**INSPECTION AND MAINTENANCE REPORT FORM**

**Christopher Heights Assisted Living Facility – Concord Massachusetts**

**Rain Garden**

Depth of Rain Garden	Condition of Side Slopes	Evidence of Overtopping of Embankments	Condition of Outfall

**Construction Site & Adjacent Areas:**

General condition: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Is sediment being tracked on to road? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Maintenance required? \_\_\_\_\_  
 \_\_\_\_\_

**Changes Required to the Pollution Prevention Plan:**

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Reasons for Changes:**

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**INSPECTION AND MAINTENANCE REPORT FORM****Christopher Heights Assisted Living Facility – Concord, Massachusetts****Certification:**

*I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.*

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## Appendix L

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### Long-term Operation and Maintenance Plan



## MEMORANDUM

**TO:** Walter Ohanian  
The Grantham Group

**FROM:** Fuss & O'Neill, Inc.

**DATE:** Revised March 31, 2015

**RE:** Long Term Operation and Maintenance Plan  
Christopher Heights Assisted Living Facility, Belchertown, MA

---

This Long Term Operation and Maintenance Plan (O&M) is the construction of the Christopher Height Assisted Living Facility located in a Concord, Massachusetts. This O&M has been prepared in accordance the Massachusetts Stormwater Handbook and the Town of Belchertown Conservation Commission Stormwater Management regulations.

**Property Owner:** The Grantham Group  
99 Pleasant Street  
Marlborough, MA 01752

**Responsible Party:** Walter Ohanian  
508-281-8001

It will be the responsibility of the Grantham Group to comply with this Long Term Operation and Maintenance Plan. The owner is responsible for all financing, maintenance and emergency repairs. Should the property or any portion of the property be transferred to another owner, that new owner will be notified of the presence of this Long Term Operation and Maintenance Plan and be held responsible for the implementation of this plan and financing as it pertains to their property.

### Operation and Maintenance Plan

The post construction operation and maintenance plan outlined hereafter provides recommendations for periodic inspection and maintenance activities for the stormwater management system. This Long-Term Operation and Maintenance Plan will ensure that the stormwater management system functions as designed throughout the life of the system.

- The stormwater collection systems will be inspected a minimum of four (4) times per year to maintain proper operation. Sediment and debris shall be removed from structures and pipes. Sedimentation will be removed from each deep sump catch basin a minimum of four (4) times a year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe. Deep sump catch basins shall be cleaned at the end of the foliage and snow removal seasons.

- Paved surfaces will be swept twice annually, April and October, to remove sand and debris following winter months.
- Sediment forebays shall be inspected monthly. This will include checking for signs of rilling and gullyng. Also this will include checking for the accumulation of sediments and pollutants. Sediment forebays shall be cleaned at least four times per year and when sediment depth is between 3 to 6 inches. When mowing grasses, keep the grass height not greater than six (6) inches.
- At least twice per year, during the spring (April) and fall (November), outlet structures will be examined and cleaned, and all floatables and solids trapped will be removed.
- Stormwater structures and pipes will be inspected each spring (April) and fall (November) for accumulation of sediment and debris. Clean as required.
- Rain garden areas and rain gardens shall be maintained monthly. Re-mulch void areas annually in the spring, remove dead vegetation annually in the spring or fall, replace dead vegetation annually in the spring, prune annually in the spring or fall, and replace entire media and all vegetation in late spring or early summer as needed.
- Infiltration basin shall be inspected after every major storm event for the first three months and a minimum twice a year thereafter. Basin shall be inspected for, but not limited to, evidence of differential settlement, cracking, erosion, leakage in the embankments, tree growth on the embankments, condition of riprap, and sediment accumulation and the health of the turf. Upper-stage, side slopes, embankments, and emergency spillways shall be mowed at least twice a year. Trash and debris shall be removed at least twice a year and accumulated sediment shall be removed at least twice a year from the basin.

### **Snow Removal and Storage**

Snow removal and storage shall be performed when needed as follows:

- Snow shall be plowed to snow storage areas as shown on attached Plan Sheet.
- De-icing chemicals may only be used on pedestrian surfaces. All other paved surfaces may have sand applied.
- Excess snow shall be removed from site or stockpiled only within the paved areas on the site.

### **Location and Access of Stormwater Management System**

All components of the stormwater management system are located within project site area. Access to the components will be from Berkshire Avenue. The attached Site Plans provide the location and access for the stormwater management system.

### **Records of Maintenance and Repair Activities**

The responsible parties shall keep records of installation, maintenance and repairs of the stormwater management facilities. These records shall be retained for the most recent five years on site and be



provided to the Conservation Commission annually and upon request. An example Operation and Maintenance Log Form is attached.

Attachments: O&M Log Form

## Operation and Maintenance Log Form

Project/Location: \_\_\_\_\_

“As Built” Plans Available? \_\_\_\_\_

Date/Time: \_\_\_\_\_

Days Since Previous Rainfall and Rainfall Amount: \_\_\_\_\_

Inspector: \_\_\_\_\_

Maintenance Item	Satisfactory	Unsatisfactory	Comments
<b>1. Street Sweeping - Paved Parking Areas</b>			
<ul style="list-style-type: none"> <li>• Evidence of erosion</li> </ul>			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			
<b>2. Deep Sump Catch Basins</b>			
<ul style="list-style-type: none"> <li>• Sump clean of sedimentation</li> </ul>			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			
<b>3. Infiltration Basin #1</b>			
<ul style="list-style-type: none"> <li>• Vegetation coverage adequate</li> <li>• Undesirable vegetative growth</li> <li>• Undesirable woody vegetation</li> <li>• Mowing performed as necessary</li> <li>• Embankment in good repair</li> <li>• No evidence of erosion</li> <li>• Standing water or wet spots</li> <li>• Sediment and/or trash accumulation</li> <li>• Outlet Control Structure Good Condition</li> <li>• Other (specify)</li> </ul>			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			
<b>4. Infiltration Basin #2</b>			
<ul style="list-style-type: none"> <li>• Vegetation coverage adequate</li> <li>• Undesirable vegetative growth</li> <li>• Undesirable woody vegetation</li> <li>• Mowing performed as necessary</li> <li>• Embankment in good repair</li> </ul>			

Maintenance Item	Satisfactory	Unsatisfactory	Comments
• No evidence of erosion			
• Standing water or wet spots			
• Sediment and/or trash accumulation			
• Outlet Control Structure Good Condition			
• Other (specify)			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			
<b>5. Rain Garden</b>			
• Vegetation coverage adequate			
• Undesirable vegetative growth			
• Undesirable woody vegetation			
• Mowing performed as necessary			
• Embankment in good repair			
• No evidence of erosion			
• Standing water or wet spots			
• Sediment and/or trash accumulation			
• Outlet Control Structure Good Condition			
• Other (specify)			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			

Source: Adapted from Watershed Management Institute, Inc. 1997. *Operation, Maintenance, and Management of Stormwater Management Systems*. In cooperation with U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

## Appendix M

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Site Plans (under separate attachment)

**TOWN OF CONCORD**

# JUNCTION VILLAGE OPEN SPACE PLANNING STUDY

**FUNDING PROVIDED BY THE CONCORD  
COMMUNITY PRESERVATION FUND**

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**Prepared for**

Concord Housing Development Corporation  
P.O. Box 195  
Concord, MA 01742

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**Prepared by**

JM Goldson community preservation + planning

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**J M Goldson**

community preservation  
+ planning

**7/12/16**

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# SECTION I

## INTRODUCTION

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### Project Background

Created by a special act of the legislature in 2006, the Concord Housing Development Corporation is a local non-profit group tasked by the Concord Select Board with investigating and implementing alternatives for the provision of affordable housing in Concord. In 2013, the Concord Housing Development Corporation (CHDC) acquired 12.8 acres of land from the Massachusetts State Department of Corrections. The land is located at the end of Winthrop Street in West Concord and set behind the present day Massachusetts Correctional Institute facility on Route 2.

The site is deed restricted to be used exclusively for the development of affordable housing and creation of public open space, approximately 5.5-6.5 acres of the site will be available for open space use with the remainder for affordable housing development. Located along the banks of the Assabet River and the future Bruce Freeman Rail Trail, and within a short walk to West Concord Village, the setting is ideal for a combined use of open space and affordable housing.

After issuing an RFP for affordable housing development proposals for the Junction Village site in 2014, the CHDC selected the Grantham Group of Marlborough, MA to develop an affordable assisted living facility with 83 affordable units. The developer plans to seek a Comprehensive Permit. Grantham Group would own and maintain the facility and the CHDC will retain ownership of the land and any associated management responsibilities not related to the building. CHDC plans to delegate management of the open space to another entity with expertise in open space management.

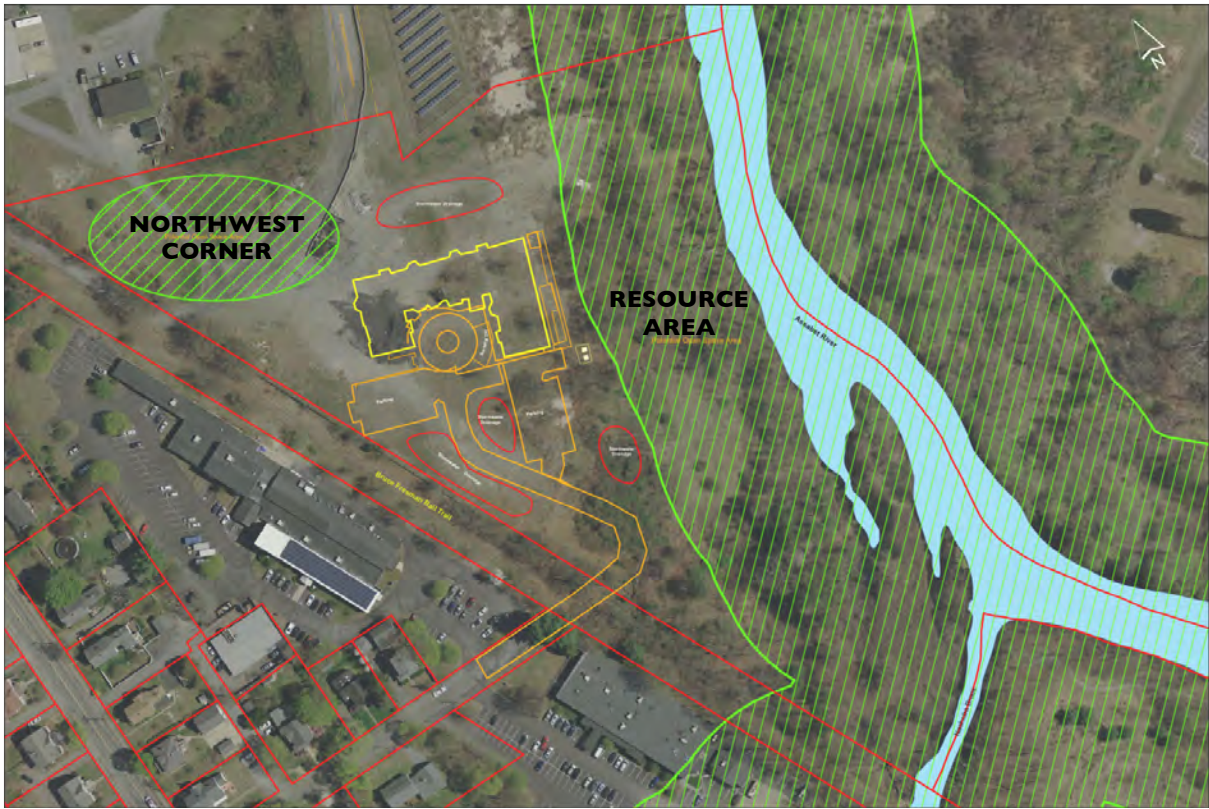
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### Study Purpose & Process

The purpose of Junction Village Open Space Plan is to give insight and guidance to the CHDC as it moves forward with plans to create public open space at the site. Through research across Town planning documents and meetings with stakeholders and community members, this plan intends to identify the most feasible and popular uses of the site. Its proximity to a walkable commercial district, a regional recreation network, and a federally-recognized river, makes it a dynamic site with potential to provide Concord residents and visitors with passive recreational opportunities and to become an asset to the neighborhood.

Over the course of two months, the CHDC worked with consultant JM Goldson community preservation + planning to identify opportunities and obstacles in utilizing the open space portion of the site for public recreational purposes. Through interviews with Town employees, Town committee members, and community advocates for open space and seniors, the consultant identified potential open space uses of the site. The consultant led two community events to inform this study: a site walk for neighbors and abutters and a community site walk and workshop. The purpose of the events was to introduce participants to the site and its possibilities, and to gauge interest in the potential open space uses.

During the workshop, participants used a map of the site (created by the Town of Concord) that identified two possible areas for open space use. See site map on following page.



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## Brief Summary of Study Results

Despite some remaining questions about how the assisted living facility will be sited, connections to public water or on-site sewage management, traffic and parking, participants considered uses for two areas of the site, the Resource Area and the Northwest Corner. Participants were interested in:

**Trails:** Participants prefer trails including connections to the Bruce Freeman Rail Trail and loops of different lengths and materials for users of various abilities over all other uses.

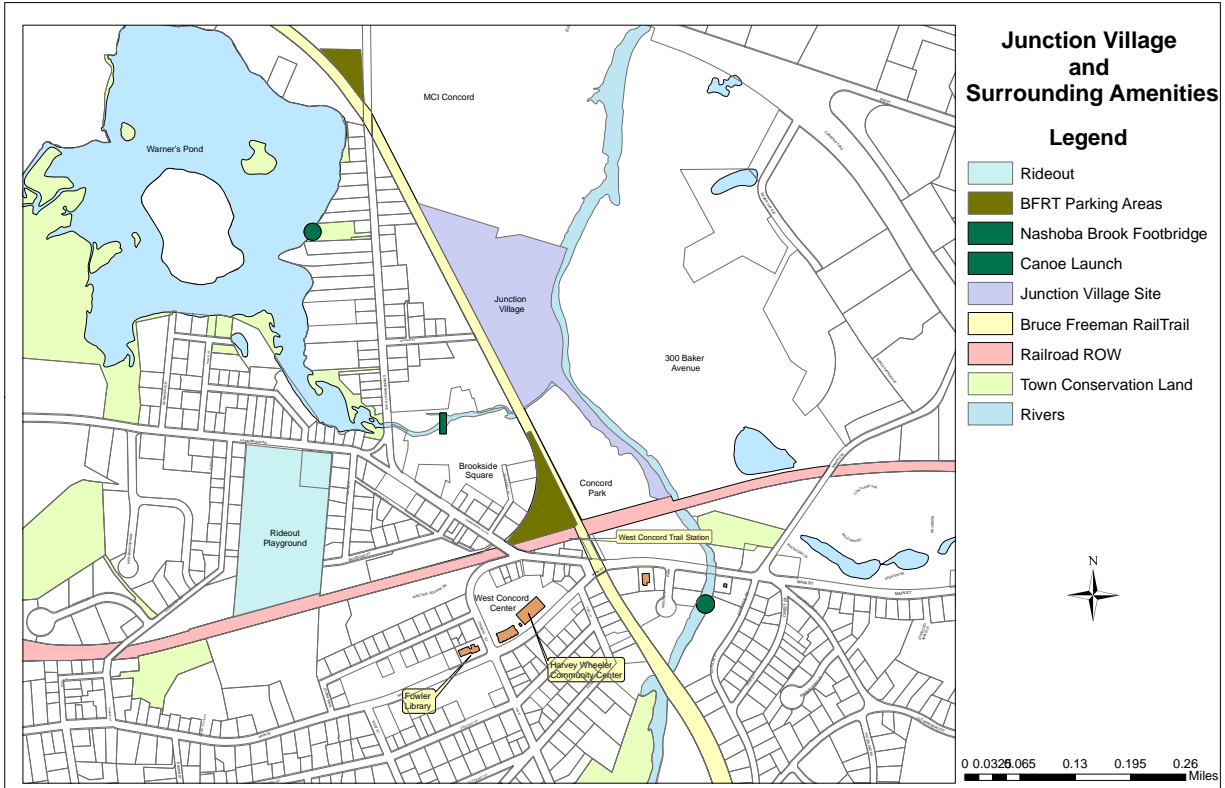
**Habitat protection/enhancement:** Participants favored uses that would have the least impact on wildlife habitat and development that would enhance biodiversity and the natural setting, like a natural meadow and invasive plant removal.

**Access:** Increased traffic and parking demand have already been a big part of the conversation about developing this site. These concerns were fresh in the minds of participants and shaped their attitudes about proposed uses.

# SECTION 2

## SITE DESCRIPTION AND CONTEXT

Located in West Concord on the south side of the Massachusetts Correctional Institute (MCI) at Concord prison, a medium security facility which houses 570 male inmates<sup>1</sup>, the Junction Village site encompasses +/- 12.8 acres of land. The Department of Correction used the site for sewage disposal and the Town also stored aggregate material at the site. The site has many qualities that recommend it as open space—it is bordered by the Assabet River and the future Bruce Freeman Rail Trail, and it is within a quarter mile of the West Concord Village business district.



### Surrounding Neighborhood Context

Access to the site is from Winthrop Street, a short street with mixed residential and light industrial uses. The site is zoned Industrial Park A (IPA), and is bordered by West Concord Industrial (WCI) and Residential C (RC) to the southwest, and Limited Business (LB) to the south<sup>2</sup>.

Village Junction is less than ¼ mile from the center of West Concord Village, a vibrant business district that is serviced by the MBTA commuter rail. It is possible to walk to the Village by crossing through a parking lot

<sup>1</sup> Executive Office of Public Safety and Security. <http://www.mass.gov/eopss/law-enforce-and-cj/prisons/doc-facilities/mci-concord.html>. accessed May 16, 2016.

<sup>2</sup> Town of Concord. Concord MA Public Webmap. <https://www.mapsonline.net/concordma/index.html>. accessed May 16, 2016.

on the southwestern side of the site and then crossing the Nashoba Brook Bakery footbridge over Nashoba Brook.

The Bruce Freeman Rail Trail (BFRT) will connect towns from Lowell to Sudbury along an old B&M railroad right of way. The trail will run the length of the western Junction Village property line and will provide access to the Junction Village open space site. After the Concord BRFT section is completed (construction is projected to begin in 2017), pedestrians and cyclists will be able to travel south from the Junction Village site using the old rail bridge over Nashoba Brook into West Concord, or north towards Acton.

The site is also within walking distance of the Rideout Park which is slated for updates beginning in 2017<sup>3</sup>. Rideout Park has basketball and tennis courts, a playground as well as a walking path and will add adult exercise equipment as part of the 2017 updates. In addition, the park has seasonal restrooms and will have a total of fifty-six parking spaces once renovations are completed in 2017.

---

## Physical Description of Site

The site is a wedge-shaped parcel that is bordered by the Assabet River to the south and east, MCI Concord to the North, and a mixed residential and light industrial neighborhood to the west. In the future, the Bruce Freeman Rail Trail will run the length of the western property border. The property is generally flat but slopes slightly to the east and the river. No bedrock outcrops are present on the site. These characteristics contribute to the site's development feasibility.

Along the southern and eastern portions of the site that border the Assabet River, there is thick vegetation including trees, bushes and vines. Trees include oak and Norway maples. Some of the native trees are quite large and impressive though many are compromised by overgrowth of grape vine. This area is overgrown with invasive species like bittersweet, Japanese knotweed, garlic mustard and honeysuckle. The topography throughout this portion of the site is undulating and rolling due to past storage of aggregate material by the Town. The soil is also mixed heavily with sand. Remnants of the former prison leaching fields are located in this area.

The river sits below a steep bluff that runs from the northeastern section of the site to the southeast. At the southeastern most portion of the riverfront, the grade slopes more gently down to the river and into low wetland scrub vegetation. From the riverbank, one can see the other side of the river which is undeveloped. This portion of the Assabet River has a federal Wild and Scenic designation. Beyond the 200' riverfront buffer, the land is flat and undeveloped.

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<sup>3</sup> Interview. Assistant Town Manager, Kate Hodges. May 6, 2016

# SECTION 3

## DEVELOPMENT CONSTRAINTS AND PLANNING CONTEXT

---

### Physical Constraints

At present, it is unclear whether or not the facility will require its own on-site wastewater treatment or connect to Town sewer. The final siting of the building, parking, and possible waste water treatment may impact the use of the site for open space. Thoughtful siting of the building may enhance the connectivity and seamless use of the site for open space.

#### Setback from Prison Wall

The building is subject to a required 250' setback from the prison wall.

#### Topography

The undulating nature of the woodlands along the river may affect trail development. If trails are to be ADA accessible, they may have to be leveled or routed around these rolling areas. And leveling of the site for trail construction would require approvals from the Natural Resources Commission.

#### Assabet River

The bluff above the river is very steep and quite tall (approximately 15' above the water). This poses a threat of bank erosion with intensive use and safety concerns with visitors approaching the river or walking along these banks.

#### Invasive Plants

The wooded portion of the site is severely overgrown with invasive plants like Japanese knotweed, garlic mustard, and bittersweet among others. Without an inventory to determine the extent of invasive growth and a plan to remove and prevent re-establishment, invasive plants could overwhelm the native plants and trees already there.

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### Regulatory Constraints

The site is subject to a variety of local, state and federal regulatory constraints because of its riverfront location, wetlands, floodplains, and the Assabet's federal Wild and Scenic River designation as well as its proximity to a state prison.

#### Federal Regulations

##### Wild and Scenic River Act

Created by Congress in 1968, the Wild and Scenic Rivers Act protects certain rivers throughout the country that "possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values."<sup>4</sup> The goal of the act is to promote the use of the river in compliance with that river's use plan. Congress designated 29 miles of the Sudbury, Assabet and Concord rivers as Wild and Scenic in 1999, including a 4.4-mile segment of the Assabet River beginning 1,000 feet downstream from the Damonmill Dam in West Concord, to its confluence with the Sudbury River at Egg Rock in Concord.

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<sup>4</sup> The Sudbury, Assabet and Concord Wild and Scenic River Stewardship Council. <http://www.sudbury-assabet-concord.org/the-rivers/ws-rivers>. accessed May 19, 2016.

*“This Act recognizes 29 free-flowing miles of these three rivers for their outstanding ecology, history, scenery, recreation values, and place in American literature. Located about 25 miles west of Boston, the rivers are remarkably undeveloped and provide recreational opportunities in a natural setting to several million people living in the greater Boston metropolitan area.”*

Section 7 of the Wild and Scenic Rivers Act states that no department or agency of the US government shall recommend authorization of a water resources project that would have a direct and adverse effect on the values for which a Wild and Scenic river was designated. This Section provides the authority for the administering agency, in this case the National Park Service, in partnership with the River Stewardship Council (RSC), to review federal projects on and along the designated segment to ensure that they meet this standard. To date, a federal water resources project had been interpreted to mean a project on or along the river that requires a permit (e.g., wastewater discharge permit, dredge and fill permit) and/or has received federal funds to support the project.

Additionally, the National Park Service, in partnership with the RSC, is more broadly responsible for the protection of the outstanding resource values of the river. Section 10 (a) of the Act states: “In such administration primary emphasis shall be given to protecting its aesthetic, scenic, historic, archaeological, and scientific features. Management plans for any such component may establish varying degrees of intensity for its protection and development, based on the special attributes of the area.” Guided by the River Conservation Plan, the National Park Service and the RSC work to advise, educate and advocate for the river with local citizens, in the community and at the state and federal level.

## State Regulations

### Massachusetts Wetlands Protection Act

The purpose of Massachusetts' Wetlands Protection Act (MGL Chapter 131 ~40) is to create a public review and decision-making process for activities that may affect Areas Subject to Protection and therefore require regulation to protect drinking water, wildlife habitat, fisheries, or to prevent pollution and storm water damage, for example. The Wetlands Protection Act provides a uniform process and set of standards to municipalities across the Commonwealth though municipalities may choose to add even greater restriction on wetland development through their own wetlands bylaws.

## Local Regulations

### Concord Wetlands Bylaw

The purpose of the Town of Concord Wetlands Bylaw is to protect the Town of Concord's wetlands, water resources, flood prone areas, and adjoining upland areas including three major rivers, the Assabet, Sudbury, and Concord and their tributaries. The bylaw is subject to and informed by the state's Wetlands Protection Act and also adds additional layers of protection and scrutiny.

Because of the Village Junction property's proximity to the Assabet River, it encompasses a 100' Wetland Buffer zone, a 200' Riverfront Buffer zone, as well as a 25' No Build Zone. These designations require a permit and review by the Town's Natural Resource Commission for any proposed construction or alteration to the resource. The prohibition of activity within these zones is suspended for removal of invasive plant species, removal of dying trees or live trees not more than 6" in diameter, planting of native trees and plants and “vista pruning” which removes plants or trees to create a view to the river at a distance of at least 50' from the high water mark<sup>5</sup>.

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<sup>5</sup> Town of Concord. **Wetlands By-law**. Approved September 23, 2013.

Work proposed through this study (such as construction of trails and installation of benches) will require a Request for Determination of Applicability of proposed work to the Commission which will determine if the work triggers the state's Wetlands Protection Act. Addition or removal of fill, leveling of the ground, and removal of vegetation or any alteration that may impact erosion or drainage will all trigger the permitting or Notice of Intent process. The Commission shall presume that any alteration to the resource will have adverse effects unless the applicant can prove through presentation of credible evidence combined with mitigation measures, that the resource will be protected and/or enhanced.

### Floodplain and Wetlands Conservancy Districts

A small portion of the site lies within both the Floodplain and Wetlands Conservancy Districts. These districts were created to add another layer of regulatory review in areas of environmental importance. The purpose of the Floodplain Conservancy District is to restrict development in areas where there is a high potential for flooding and damage to property or danger to people. Work that may impact the floodplain is subject to a request for a Special Permit. The Wetlands Conservancy District designation alerts the Town to the presence of wetlands and compliance with the State's Wetlands Protection Act. The proposed location of the affordable assisted living facility is outside of these areas.

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## Planning Context

The use of open space at Junction Village should fit into a larger planning context and set of goals as outlined in relevant planning documents including the 2015 Concord Open Space and Recreation Plan, the 2008 West Concord Village Master Plan, and the 1995 Sudbury, Assabet and Concord River Wild and Scenic River Study: River Conservation Plan. These documents provide insight about local open space needs and goals. Themes across the plans include connectivity and access.

**Connectivity and access: Develop a trail network for transportation and nature-based recreation. Increase access to trails and overall walkability of the Town by connecting trails to Town centers and also increase access to natural resources and scenic areas.**

### 2015 Open Space and Recreation Plan

Concord's 2015 Open Space Plan reflects the community's desire to identify, complete, and connect walking and biking trails, including handicapped accessible trails. Residents recognize the positive impact the Bruce Freeman Rail Trail will have on the community and want to expand on the connectivity and access it will engender, seeing it as a central trail with other walking or biking trails connected to it.

When polled regarding their desires for future initiatives, community members encouraged the Town to focus on its already rich resources in trail networks and to make these more accessible through trail maps and guides, but also to consider extending sidewalks and developing rail trails, which provide safe passage without direct conflict with vehicular traffic. Additional goals identified in the Plan pertinent to Village Junction open space include creating more community gardens and a dog park, invasive plant control and improved handicapped accessibility on Town trails.

### West Concord Village Master Plan

The 2009 West Concord Village Master Plan offers a lot of useful ideas about how to integrate Village Junction open space into the West Concord community. One goal identified in the plan is to create opportunities for community engagement by increasing opportunities for all age groups through

development of family friendly meeting places, improved access to natural resources, enhanced active and passive recreation facilities, and places for arts and civic events.

Another goal of the Master Plan is to increase connectivity between open and green spaces within an understandable pedestrian network. In addition, residents expressed a desire to see undeveloped or underused parcels along the old railway developed or improved. Finally, residents approved strategies about how to enhance access to the Village's water resources, Nashoba Brook and the Assabet River:

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**THE VILLAGE GRAPHIC MASTER PLAN ILLUSTRATES AND RECOMMENDS A NEW TRAIL ALONG THE SOUTH SIDE OF NASHOBA BROOK . . . CONNECTING TO THE FUTURE BRUCE FREEMAN RAIL TRAIL. THIS TRAIL WOULD . . . CONNECT WITH A NEW TRAIL SYSTEM PROPOSED ALONG THE WESTERN SIDE OF THE ASSABET RIVER . . . THE EXISTING TRAIL ALONG THE WEST SIDE FROM THE OBSERVATION AREA AT CONCORD PARK WOULD LINK TO A NEW PEDESTRIAN BRIDGE OVER THE RIVER CONNECTING TO THE BAKER AVENUE EXTENSION BUSINESS PARK.**

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### Concord River Wild and Scenic River Study: River Conservation Plan

River Stewardship Council (RSC) developed the River Conservation Plan in 1995 in anticipation of a proposed federal Wild and Scenic designation which was applied in 1999. The purpose of the plan was to outline management standards for the land, watershed and water resources within the waterway with particular emphasis on creating a management framework across public and privately owned resources.

The RSC is tasked with protecting the river's wildlife habitat, recreation and scenic values in cooperation with owners of both public and privately held parcels. As noted in the consultant's interview with a member of the RSC, involving the RSC in any proposed development along the river at the outset will offer the CHDC access to the expertise of the RSC as well as foster a relationship of cooperation and partnership which is the core purpose of the River Conservation Plan.

# SECTION 4

## COMMUNITY ENGAGEMENT

The consultant used a variety of means to solicit public input about the potential uses for the open space portion of the land at Junction Village. These means included a site walk for neighbors, and a community workshop and site walk, plus interviews with key stakeholders.

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### Site Walk with Neighbors

Neighbors and other interested community members were invited to the site walk which took place on May 2, 2016. The consultant along with members of the CHDC met participants at 8:30AM and fourteen people participated. The group walked the site with the consultant stopping along the way to point out property boundaries and unique features of the site. The group observed the river, the mix of vegetation and topography.

The purpose of the walk was to provide neighbors with an opportunity to see the property and gain on-the-ground understanding. With the level of opposition to the affordable housing development within the neighborhood, it was important to show neighbors how the site could become a neighborhood amenity as well as offer them a forum to express their concerns ahead of the community-wide meeting. Participants carried small cards with them on which to keep notes and make comments which were given to the consultant at the conclusion of the walk. Comments included the following:

- A path for walking along the river (keeping the woods)
- I'd like to see if we can blaze a trail south to the BRFT (along the river)
- Walkability connections & walking path to the river
- Parking-this will help persuade voters

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### Stakeholder Interviews

#### Objectives

By interviewing people from across different sectors of Town government, committees and activities, the interviews provided a snap shot of opinions about what uses are best suited to the Village Junction site. In addition, the interviews provided insight and ideas across a broad spectrum of expertise. The purpose of the interviews was to learn more about the site including permitted uses, permitting, and community needs.

#### Methods

The CHDC provided a list of interview contacts that would provide unique insight or perspective on the proposed project. Interviewees included town employees from the Division of Natural Resources, the Council on Aging and the Recreation Department, members of the Planning Board and the West Concord Advisory Committee, as well as a landscape architect, a manager of a local assisted living facility, and a leader in local river stewardship. The interviews took place in person and over the phone between April 27, and May 6, 2016. Questions were not uniform and reflected the areas of knowledge of the interviewees.

## Interview Results

### Possible Uses

Depending on the ultimate size of the site, there are a variety of options for its development. Because the site has riverfront, wetland and flat open space, possible uses are again varied. Interviewees emphasized the need to reduce parking demand and increased traffic in the area to reduce friction with neighbors.

Interviewees also noted that walkability from West Concord to the site would be a positive benefit. How can the site be integrated into existing cycling, walking and water trail networks?

Proposed uses are ranked below according to how much support or interest they received from interviewees.

- 1. Walking trails:** This was the most popular option. It would offer users an opportunity to enjoy the view of Assabet River which has a federal Wild and Scenic designation. The trails could be linked to other proposed trails along the Assabet and would offer a nature experience to neighborhood residents and West Concord Village visitors. In addition, the trails would offer outdoor activities for senior residents of Village Junction and a place for their visitors to spend time with them. Looping trails with options of varying lengths are most accessible to seniors. Frequent benches encourage use by seniors. Picnic areas and enhanced wildlife viewing areas are also important.
- 2. Community garden:** A community garden would provide opportunities for Junction Village residents to garden if the beds were raised to waist height. There are raised beds of this type at Concord Park and they are well used. Additionally, neighbors from Brookside Square or 95 Conant St. who do not have access to garden space might be interested in having a community garden within walking distance. Raised beds may be necessary across the garden as soil remediation of a suspected brownfield site would be an expensive and lengthy process.
- 3. Boat put-in:** There are two possible sites for creating a boat launch or fishing site. The first is in the southeast corner of the site, a flat wetlands section for a boardwalk. The second is at the top of the bluff on the northern portion of the river. The site is almost equidistant to two other boat launch sites, up and down stream. Interviewees thought this would be a good spot for another launch though again the question of parking came up.
- 4. Fishing platform or wildlife viewing deck:** Concord Outfitters in West Concord raises funds to stock the Assabet with fish annually. The river is a popular fishing spot and a platform on the northern bluff or a boardwalk to the river would provide fishing access. A similar structure could be used for wildlife viewing as well.
- 5. Natural meadow:** This would be an excellent use in the open flat area of the site. Once established, it could provide excellent habitat for wildlife and pollinators and would require minimal maintenance, perhaps mowing once or twice a year. It would be expensive to bring in soil and would take 3-5 years to establish.
- 6. Adult exercise equipment:** Exercise equipment that is geared toward adults with both full and limited mobility were supported. As an amenity to the residents of the assisted living facility, this idea received a lot of support. There is equipment that enhances balance and hand-eye coordination and provides gentle therapy for hips, shoulders and knees. These are generally low cost (compared to children's playground equipment).
- 7. Dog park:** There are many places in Concord where people can walk their dogs and it is not clear if there is a demand for a dog park, plus a dog park could trigger a need for parking. It is also unclear what the maintenance demands would be as waste management would certainly be necessary.
- 8. Playground:** Interviewees noted that Rideout playground is very close to the Village Junction site and fulfills this community need.
- 9. Playing fields:** These were seen as positive additions to the community but the need for additional parking triggered by this use limited enthusiasm. In addition, the cost of construction on such a degraded site would be prohibitive, as would cost of maintenance on one or two isolated fields.

The site will require improvements to make any of these uses possible, from trail or dock construction to tree removal to delivery of soil and plant material. There may be significant expense associated with these ideas. It was suggested that a phased approach could help to offset to the outlay of funds.

## Connectivity

With the construction of the Bruce Freeman Rail Trail (BFRT) slated to begin in 2017, and other trails along the Assabet River under development, the Village Junction open space could add another connection point. The Concord Park assisted living facility across the river has a small circuit of trails around its building. These could be linked with Village Junction trails using the bridge at the Nashoba Brook Bakery, or the future BFRT bridge. Pedestrian improvements along Laws Brook Road (to begin spring 2017) will provide safe pedestrian access to the site from the western side of the Village and Rideout playground.

## Parking

As West Concord grows, the demand for parking increases as well. This is already a topic of concern within the Village and interviewees expressed an interest in using the open space in a way that will minimize demand for additional parking.

## Permitting

Recreational improvements to the site may trigger review processes by the Natural Resources Committee (NRC) or the Sudbury-Assabet- Concord Wild and Scenic River Stewardship Council (RSC). Removal of trees requires approval by the NRC as would construction of trails or boat dock or fishing platform. Any project within the 200' riverfront river zone must provide a "net benefit to the environment" meaning removal of trees must be offset by tree replacement. Removal of invasives, which is a problem across town, can substitute for tree replacement. The slope of the wetland is an important consideration for the NRC when reviewing proposals. The benefit to the public of the proposed use is also a consideration. Any construction in this zone would require a Notice of Intent be sent to the NRC.

The Village Junction site abuts the Assabet along a portion that is federally designated Wild and Scenic. The purpose of the Wild and Scenic designation is to "preserve the character" of a river and development along the river is not discouraged but must ensure the river's free flow and protect its "outstanding features." The National Park Service and the RSC have the authority to review federal projects along the river that may impact these standards. These projects include anything that requires a federal permit or uses federal funding. The river steward we interviewed noted that any construction of a dock or boardwalk would involve construction performed by the Army Corps of Engineers and would therefore trigger "Section 7" review (the NPS and RSC review).

In the eastern US, Wild and Scenic rivers are managed using a partnership model, with permitting agencies and private landowners working together to enhance and protect the river. With this in mind, the RSC would like to be kept abreast of proposals on this site that might impact the river. Their knowledge of the river will be a valuable asset as the project moves forward.

## Infrastructure developments

Trails should be accessible and navigable to Junction Village residents. Accessibility includes sloping trails without stairs and minimal grade changes. Stone dust trails with a grade less than 8% can be ADA accessible however stone dust is more expensive than asphalt. Stone dust offers improved permeability which reduces run-off and thermal pollution, a concern along the riverfront.

## Further questions

Interviewees wondered:

- Who will be the managing agency?
- Will there be public restrooms and will any of the uses encourage the use of the site as a “bathroom”?
- How much does each option cost (construction and maintenance)?
- Where will funding come from?

---

## Community Workshop and Site Walk

### Summary

Concord residents and abutters have already engaged in discussions about the future Junction Village assisted living facility development but had not had an opportunity to explore the open space possibilities on the site until the Junction Village Open Space workshop. Hosted by the Concord Housing Development Corporation (CHDC), the workshop was an occasion for participants to see the site as well as to examine the potential uses and options for the site.

Despite some remaining questions about how the assisted living facility will be sited, connections to public water or on-site sewage management, traffic and parking, participants considered uses for two areas of the site, the Resource Area and the Northwest Corner. Participants were interested in:

**Trails:** Participants prefer trails including connections to the Bruce Freeman Rail Trail and loops of different lengths and materials for users of various abilities over all other uses.

**Habitat protection/enhancement:** Participants favored uses that would have the least impact on wildlife habitat and development that would enhance biodiversity and the natural setting, like a natural meadow and invasive plant removal.

**Access:** Increased traffic and parking demand have already been a big part of the conversation about developing this site. These concerns were fresh in the minds of participants and shaped their attitudes about proposed uses.

### Workshop Design

The Village Junction Open Space Community Workshop was held on Tuesday May 17, 2016 from 6:30-9:00PM, with an optional pre-workshop site walk at 4:45pm. The Concord Housing Development Corporation hosted the workshop, which was facilitated by professional planning consultants from JM Goldson community preservation + planning. The purpose of the workshop was to engage participants in a forum that both informs and solicits ideas. The workshop’s primary objectives were the following:

1. Information: Through a site walk and presentation, the consultants provided information to participants about of the site’s resources.
2. Input: To solicit community input about possible open space uses that could be allowed on the site

### Site Walk & Presentation

During the site walk, JM Goldson and members of the CHDC led participants through the site to familiarize them with significant features, the setting, and scale of the site. Representatives from the selected developer, Grantham Group, were also present at the site walk with renderings of the proposed assisted living development and stakes indicating proposed building layout in the field. Participants were able to view the Assabet River and see how the future Bruce Freeman Rail Trail will connect with the site. Senator Michael J. Barrett and Representative Cory Atkins attended the site walk. Seventeen people attended the site walk, thirteen of whom also participated in the workshop.

Upon returning from the site walk, participants joined other attendees and gathered together at tables in groups of five to six. Thirty-eight people participated in the workshop. The first part of the workshop consisted of an introduction by Philip Posner, CHDC co-chair, and a presentation by Jennifer M. Goldson, principal planner at JM Goldson which oriented participants to the location, environmental constraints and current and former uses of the site. The consultant briefly described the proposed assisted living facility and how it will be oriented on the site. Representatives from Grantham Group, future developers of the site, were also on hand at the workshop to answer participant's questions and clarify design and building plans. Finally, the consultant described the uses that have been proposed for the the two open space areas—the Resource Area and the Northwest Corner.

## Digital Group Polling

As part of the presentation, the consultant included digital group polling. Group polling enables workshop organizers to get a picture of who participants are.

- Almost 56 percent of respondents live in West Concord
- 29 percent both live and work in Concord
- 48 percent were members of Town boards or committees
- 32 percent describe themselves as “interested citizens”
- 87 percent of respondents are personally familiar with the site having either attended the site walk or visiting the site on another occasion

The final question asked participants to choose why they were attending the workshop:

- 25 percent of responses were there “to minimize impacts of development on the neighborhood”
- 25 percent indicated they were there “to gather information/learn more about the site”
- 37 percent were there to ensure protection of natural resources or to enhance public enjoyment of the site
- About 10 percent of respondents attended the workshop in order to maximize benefits to West Concord Village

## Small Group Discussion

After the presentation, participants worked for forty-five minutes in small groups, with a member of the CHDC acting as group facilitator. The small groups discussed each proposed use for the two use areas and ranked their opinions about each from Very Appealing to Not Appealing. In addition, a clerk recorded comments and noted areas of consensus or disagreement. An analysis of results is provided below with detailed summaries attached. Finally, the consultant led a discussion of results with facilitators presenting a summary of their group's discussions.

Some participants remain preoccupied by their opposition to the proposed development on the site. In addition to comments and questions made during the workshop, separate comment sheets were available to capture the remarks of these and any other participants who wished to express concerns about the proposed housing development.

Some participants questioned the siting of the assisted living facility as presented by the developers. Participants wondered if the building could be sited in a way that could enhance the open space either by creating one contiguous open space rather than two distinct areas. Also, how can storm water management and parking be sited to enhance the open space use, including adding two or three dedicated parking spaces? How can the the view of the storm water management and the prison be minimized?

## Small Group Discussion Results

For each of the proposed uses participants noted questions about management and expense, habitat protection, parking and access.

### Resource Area

This area includes undisturbed wooded riverfront and wetland along the Assabet River.

#### Trails (walking/hiking): Very Appealing

Groups expressed the most interest in this use. Participants noted that the trails should be as natural as possible while also being ADA accessible. Some groups proposed looped trails with a more accessible loop close to the assisted living facility and more natural loops closer to the river.

One participant wrote at length about the desire to see a plan for this open space fit into a larger trail network to be developed in the future. The town should look to extend walking paths to Route 2 and south to Westvale Meadow. It should also consider future development along the Assabet and how this site can enhance access to the river and promote it as a community resource.

#### Trails with associated amenities (Informational signage, benches and picnic tables): Appealing

Groups expressed varying interest in this use. Some agreed that clustered amenities rather than amenities throughout the site would be more appealing, with amenities closer to the BFRT and away from the river. Some groups noted that picnic tables raise the question of trash removal and increased maintenance needs and cost. Most groups favored amenities that would not impede enjoyment of the natural setting or greatly impact its natural state. One group proposed signs with information about plants and trees and another proposed barcode “signs” that connect with a Smartphone or other device.

#### Natural/Wild area (no maintained trails; perhaps removal of invasive plants): Appealing

Three groups favored this use in combination with trails or as only a component of the whole use of the site. Groups also expressed interest in promoting biodiversity, removing invasive plants, maintaining trees, and improving wildlife habitat. Two groups preferred this use without

#### Car-top boat rest stop with boardwalk: Not Appealing

Only one group favored this use. Other groups were concerned about the expense of construction, the need for parking, and disturbance of the natural area, and wondered if there was a need. One group liked the idea of having a naturalized landing, such as one or more large rocks, where boaters could come to shore to picnic or rest.

#### Fishing platform: Not Appealing

No group approved of this use though one liked the idea of a wildlife viewing platform or blind, a place to observe nature. Other groups didn't see a need or thought the use would raise parking issues.

## Northwest Corner

With the exact location of this area not yet determined, participants considered the proposed uses but some noted that re-orientation of the assisted living facility could enhance the connectivity of the open space so that rather than having two separate areas, the space could be connected though with different uses throughout. However, as it stood at the time of the workshop, the area potentially available for open space use was about one acre in the northwest corner of the site abutting the BFRT.

### Natural meadow: Very appealing

Groups favored this use because it seems more feasible than some of the other possible uses, improves biodiversity and provides important habitat. In addition, a meadow would provide a plant screen and reduce heat created by Route 2 and the rotary.

### Pocket park/Picnic area: Very Appealing

Participants favored this use as an amenity to rail trail users that should include bike racks, a picnic area and benches. One group noted that a pocket park is too groomed and that picnic areas require trash removal. Additionally, the view of the prison should be screened and interpretive signage included.

### Community garden: Somewhat Appealing

Some groups responded positively to this use if it would be for local neighbors only and not trigger parking demand and increase traffic. Others questioned the need to provide water and the lack of direct access to the site. It would be challenging for gardeners to bring tools and supplies to the site, unless some parking was provided as part of the assisted living facility parking lot.

### Dog park: Not Appealing

This use would increase traffic and parking demand. While one group noted that there might be demand in town, the combination of waste management and increased traffic outweigh any possible benefits.

### Playground/Exercise area: Not Appealing

Most groups did not favor this use, particularly because of the increased parking demand. One group proposed a “natural playscape” and another noted that a playground would be a nice amenity for families visiting their loved ones at the assisted living facility.

## SECTION 5

# RECOMMENDATIONS

Through this planning study process, CHDC has learned from community members that the resource area should be minimally disturbed with construction of nature trails with stone dust or gravel surface that is ADA accessible, and possibly some nonintrusive informational signage and benches as well as invasive plant removal. Design of trails should include circuits of varying length to accommodate users of different abilities. Furthermore, the northwest corner site should be considered for a natural meadow with some minimal amenities to tie into the bike path such as bike racks and benches.

Further consideration should be given to these uses, particularly with regard to site planning, design, relationship to the proposed development (particularly as plans progress), funding, and responsibilities of project implementation, and long-term upkeep and management.

In addition, as development plans for the site progress, possible adjustments to the site plan should be considered to maximize connectivity and public enjoyment of the open space areas. As it stands at the time of this writing, the northwest corner and resource areas have minimal opportunities for connectivity due to the placement of the building, circulation, and parking.

In looking ahead, given that the CHDC's mission is to create and preserve affordable housing, it will be critical for a public or private partner to take the lead for further site planning and implementation.

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### Master Plan

After plans for the affordable housing development proposal are finalized, the areas available for open space use should be clearly delineated. CHDC or its designee should engage the services of a landscape architect with specialties in designing in ecologically sensitive areas, as well as trails, meadows, and recreational facilities to prepare a master plan for the open space uses of the site.

The master plan should further the work of this study and include a tree inventory, invasive species remediation plan, location and design of trails, meadow, benches, bike racks, and possibly informational signage. Design of trail circulation patterns should be coordinated with access to nearby amenities and connectivity to nearby trails or other recreation amenities, both existing and proposed.

In addition, the master plan should include specifications, estimated costs, phasing recommendations, as appropriate, and a long-term maintenance plan with associated costs. The master plan could also recommend rules and regulations for public use of the property, which could reflect the existing Concord Conservation Land Regulations.

Upon completion of the master plan, the CHDC (or other entity as designated) would be ready to secure funding for construction and installation, then to contract for the work, likely in phases.

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## Possible Funding/Volunteer Resources

The following is a partial list of possible funding sources and volunteer resources to fund the master plan and development of the open space and recreation amenities. Note, further research should be undertaken to determine additional funding sources.

### Concord Community Preservation Act Funds

Established under M.G.L. c. 44B, the Community Preservation Act (CPA) allows Massachusetts cities and towns to raise monies through a surcharge of up to 3% of the tax levy on real property. These funds can be used to acquire, create and preserve open space; acquire, preserve, rehabilitate or restore historic resources; acquire, create, preserve and support community housing; and acquire and preserve land for recreational use. With its 1.5% local CPA surcharge plus a variable distribution from the state CPA Trust Fund, collected about \$1.33M in FY2015.

The CHDC or its designee could request CPA funds to fund a master plan (as described above) and, subsequently, request CPA funds to fund construction of trails, meadow, and associated amenities. The Concord Community Preservation Committee's deadline in 2015 was on October 5 for consideration at Spring Town Meeting. Funding is available July 1 following Town Meeting.

### Massachusetts Recreational Trails Program

The Massachusetts Recreational Trails Program generally provides grants ranging from \$2,000 to \$50,000, however, grant proposals will be accepted, considered and awarded for larger amounts up to \$100,000, based on need, breadth and reach of the trail project. The 2016 grant application deadline was on February 1, 2016. <http://www.mass.gov/eea/agencies/dcr/services-and-assistance/grants-and-technical-assistance/recreational-trails-grants-program.html>

### Massachusetts AmeriCorps

Members of the SCA Massachusetts AmeriCorps program serve Massachusetts's public lands from Martha's Vineyard to the Berkshires each summer completing Conservation Service projects. Projects include new trail construction, invasive plant management, Universal Access Trail construction, school nature trails, historic site reclamation, and more. <https://www.thesca.org/serve/program/massachusetts-corps>

### Field Pond Foundation

The primary mission of Field Pond Foundation is to provide financial assistance to nature and land conservation organizations that are community-based and that serve to increase environmental awareness by involving local residents in conservation issues. The Foundation hopes to nurture such efforts by making grants under the following priorities:

1. Project grants for trail making and other enhancement of public access to conservation lands, rivers, coastlines and other natural resources;
2. Land acquisition for conservation;
3. Assistance in establishment of endowments as a means of funding stewardship of newly protected conservation areas; and
4. Directly related education programs and publications as components of a land protection project.

Proposals may be submitted at anytime. Grants range from \$500 to \$25,000 and the Foundation is willing to consider multiple-year grants. <http://fieldspond.org/guidelines.htm>

### Eagle Scout Leadership Service Project

The Boy Scouts of America's highest rank is Eagle. Eagle is designed to develop leadership skills and allow Scouts to explore potential careers or hobbies. Scouts must complete a service project to attain the rank of Eagle. The project must benefit an organization and must not be commercial in nature. Service projects, applicable to this endeavor, could include trail construction as well as building benches or kiosks.

### Other Volunteer Resources

The Concord-Carlisle High School and the Minute Man High School may have ability to provide student assistance with projects on this site. For example, as part of the "Rivers and Revolution" program at the Concord-Carlisle High School, students participate in Stewardship Projects with local community organizations.

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## Implementation, Management, and Upkeep

CHDC's primary focus will be on the development of the affordable housing portion of the site, given its mission is to create and preserve affordable housing. It will be critical to the realization of any open space use that the CHDC partner with one or more public or private entities to take leadership and shepherd all aspects of the planning, implementation, and ultimately the oversight and future maintenance of the open space portions of the site. Possible partners for consideration could be the Town of Concord, Concord Natural Resources Commission, Concord Trails Committee, Concord Land Conservation Trust, and/or the Walden Woods Foundation.

# APPENDIX

## COMMUNITY WORKSHOP

### Transcription of Results

#### Potential Uses for the Resource Area

*In groups of 5-6, participants discussed the pros and cons of the sites with their groups. Using a scale of Very Appealing, Somewhat Appealing, Not Appealing, or No Opinion, groups rated the following potential uses for the open space portion of the Concord Junction site.*

<b>Trails (walking/hiking; surface materials?; accessible?)</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Very	Stone dust/gravel; Keep as natural as possible with thought to maintenance
Table B	Very	Surface: inner loop-better surface to serve the old, outer loop-more natural
Table C	Somewhat	Soil path, maintenance?, erosion control?
Table D	Very	Connect and extend the network (trails) Make accessible? (stone dust?) Natural surface along river with more developed near BFRT We see multiple trails-loops/connectors
Table E*	N/A	
Table F	Very	ADA accessible primary (stone dust) and compacted earth secondary trails ADA accessible trail should be a loop

\* Notes from table facilitator: "Three out of the four participants were only interested in making their objections to the whole idea of building on that site. Two of them were from Winthrop Street and objected strenuously to that street being used as access to the site. One insisted that another road in was the only answer. The other was totally against any such use of the site, citing how it was used as a dump for so long, including for cow's carcasses; but that was only one of his reasons for not using the site at all. I am sure he made his other reasons clear to Henry Schwann, who interviewed him at length at our table. The third objector was concerned about never having any input on the need and usefulness of an assisted living facility on the site. Several people at the table pointed out that other such 40B endeavors ended up catering mostly to non-40B recipients. One person at our table said that if there had to be building on the site, she would prefer that the whole open space be given over to meadow and trees, both of which are so important to the environment in Massachusetts (but she was no longer a Concord resident)."

<b>Trails with associated amenities (informational signage, benches, picnic tables)</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Very	All amenities, with sensitivity to the natural and scenic. Clustered together, not spread across the whole site.
Table B	Somewhat	Entrance sign, use technology? (barcodes)
Table C	N/A	
Table D	Somewhat	Provide amenities by the BFRT away from river-keep it more natural by the Assabet
Table E	N/A	
Table F	Very	Plant signs and tree signs to encourage biodiversity; signs should not be visible from the river but overlooking the river Benches on the ADA accessible trail would be helpful (one or two)

		No picnic tables because it encourages trash
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<b>Car-top boat rest stop with boardwalk</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Not	With sensitivity to the natural and scenic and access to amenities
Table B	Somewhat/Not	Very expensive?
Table C	Very	With access to amenities
Table D	Not	Will need car/parking access? Not appealing if to launch boats Potential for erosion from activity Appealing if boaters come to dock and visit-picnic/hike
Table E	N/A	
Table F	Somewhat	A naturalized landing with a couple of big rocks to sit on would be nice No boardwalk, no picnic table

<b>Fishing platform</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Not	
Table B	No Opinion	Expensive
Table C	N/A	
Table D	Somewhat	Bird/wildlife "blind", observatory Would love to have a place to observe nature
Table E	N/A	
Table F	Not	It gets trashy, there's plenty of fishing from shore

<b>Natural/wild area (no maintained trails; perhaps removal of invasive plants)</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Somewhat	But not for entire site, needs to sensitively incorporate previous items
Table B	Somewhat	Wild area in combination with trail
Table C	Somewhat	Keep natural, remove invasives, don't take down any trees
Table D	Very	Minimal trails to an observation blind Support invasives removal
Table E	N/A	
Table F	Very	Invasives removal with native planting-with a sustainable perspective Keep cleared areas as meadow to increase biodiversity

*Are there other potential uses that should be considered for the resource area?*

- Bridge from West Concord to 300 Baker Avenue

## Potential Uses for the Northwest Corner Area

In groups of 5-6, participants discussed the pros and cons of the sites with their groups. Using a scale of Very Appealing, Somewhat Appealing, Not Appealing, or No Opinion, groups rated the following potential uses for the open space portion of the Concord Junction site.

<b>Natural meadow</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Somewhat	A portion could be natural meadow
Table B	Very	Cost feasible; biodiversity; small area; planting screening
Table C	Very	
Table D	Very	Proximity to trail is good but may cause problems with rail trail users Rotary and prison areas need more trees to be heat buffer Access by foot on trail
Table E	N/A	
Table F	Very	Minimize lawns Meadows are a much needed habitat

<b>Dog park</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Not	Extensive traffic potential
Table B	Not	Without parking not appealing
Table C	N/A	
Table D	Not	Intense use needs fenced area Too much activity but might relieve high use in town areas
Table E	N/A	
Table F	Not	Bad access, trash would be hard to manage

<b>Community garden</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Somewhat	If for adjacent residents, otherwise will add parking/traffic issues
Table B	Not	No access
Table C	N/A	
Table D	Somewhat	Water access? Provide buffer from rail trail Good access by foot
Table E	N/A	
Table F	Not	Bad access, vegetables will be stolen

<b>Playground/exercise area</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Not	Too intensive use for the location
Table B	Not/ Very	Without parking
Table C	N/A	
Table D	Not	Too isolated Could be an amenity for families visiting Junction Village No parking could limit participation
Table E	N/A	

Table F	Somewhat	A small children's park adjacent to the trail with bike racks would be good, natural playscape
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<b>Pocket park/picnic area</b>		
<b>Group</b>	<b>Rank</b>	<b>Comments</b>
Table A	Very	But would need to include landscaping screening of prison Informational signage included
Table B	Very	For people on BFRT, maybe closer to WC
Table C	N/A	
Table D	Very	Very accessible Acton Arboretum Place for riders to have lunch?
Table E	N/A	
Table F	Not	No picnic area because of trash issue Pocket park is too groomed

*Are there other potential uses that should be considered for the Northwest Corner area?*

- Creation of a meadow that can serve as performance space?
- Re-foresting of some of the area

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## Housing Development Component Comment Sheet

Although the focus of the community workshop was to discuss the potential uses for the open space portion(s) of the Village Junction site, the consultants provided a comment sheet for participants who wished to share their thoughts and questions about the housing development component of the site. The following eleven comments were submitted.

**Comment #1:**

"This is not a park! Most amenities are not necessary. This site is not meant to service the greater W. Concord community."

**Comment #2:**

"I think an affordable assisted living space is a great use of the property. Low traffic, definite need. I hope to live there someday."

**Comment #3:**

"It would be great to have alternative access (other than Winthrop St.) to the Concord Junction area. It seems that 83 assisted living units is 'pushing the limits' for the area and the limited access. I am concerned with area visitors parking along Winthrop St."

**Comment #4:**

"Unless there is another access road other than Winthrop Street it makes it very difficult for me to be interested in other uses of the area. The traffic on Winthrop Street is more than the neighborhood can handle."

**Comment #5:**

"I have no concerns about usages such as pathways, dog parks, victory gardens or any other passive components. What I do have is a very firm opinion on any additional housing on this site. As a direct abutter to this site (31 Winthrop St), I believe the proposed 83-unit structure is more than enough for this parcel. I would also request the CHDC to explore with BFRT and MCI the viable option to this site from Commonwealth Ave, parallel to the BFRT, into the northwest corner of the parcel."

**Comment #6:**

"Care needs to be taken to ensure that the development doesn't disturb the environment surroundings. Does the town need this assisted living facility, its shape is weird, almost cookie cutter-like? Amenities around the assisted living, walks exercise stops, meadow in the northwest corner."

**Comment #7:**

"I'm at the wrong meeting. I have serious concerns about the project itself, regardless of what is done with the open space. When that is the subject of some of the meeting, I will attend and make my concerns known."

Would this project meet environmental standards if it were not affordable housing? If not, why not? What assurance can you offer that the planned number of affordable units will actually be achieved?"

**Comment #8:**

"I don't want any building or concrete here. Earth's resources are finite, and because of development, pollution, climate change and invasives, they are shrinking. This is a perfect site for a native plant meadow that would serve as an ecosystems area and wildlife habitat."

**Comment #9:**

“Please require builders to create at least net zero energy buildings; the small investment in planning and careful building pays off financially very quickly in lower operating costs of the building, and can be replicated again and again in future projects, multiplying savings of many thousands of \$\$ while help saving the planet from climate change and enhancing the builder’s reputation at the same time.”

**Comment #10:**

“Site plan for building site could potentially be re-worked to make better use of the available open space. Parking configuration and stormwater siting could be better integrated/located.

It would be extremely helpful to have several parking spaces or “entry” point BEFORE the assisted living parking/facility (so that any visitors/traffic would NOT cross thru the Grantham controlled/managed portion). Could this be accommodated within the “elbow” between drive and BFRT? There should be at least 2-3 parking spaces, or people will park on Winthrop or within the private commercial lots at the end of Winthrop. It would also be advantageous to have a trash collection and dog poop bag dispensers. This is the only way to effectively manage dog waste.

Development stormwater management should be visually integrated into the plan/treatment of the open space. The footprint of stormwater BMPs will be significant. This could hugely add to the perception of open space if designed appropriately/adequately. Some planted screening buffer in the NW corner would be beneficial as a screen to the view of the prison.”

**Comment #11:**

“See ‘Boulder Creek Path’ in Boulder, CO as a point of reference and with this in mind:  
Pros: love interpretive signs, kids fishing piers, periodic but not continuous access along banks, fish observatory!

Cons: Concrete path, not natural, many structures.

Challenges: How to balance desire for amenities with access against desire to maintain natural ‘wild/scenic waterway’.

Potential answers: Stone dust paths, natural, native plantings, wild, not manicured landscaping, limited number of amenities consistent with town desires.

Key goal: increased connectivity with existing/planned trail network.

You didn’t really allow for discussion about alternative site layouts. I would push the building toward the “NW Corner” and merge picnic/meadow along the edge of the resource area. However, I will take this up when it comes to the planning board.”

**JM GOLDSON**

**community preservation + planning**

Boston, MA

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## MEMORANDUM

**TO:** Concord Housing Development Corporation  
**FROM:** Kenneth P. Cram, P.E.  
**CC:** David E. Hale  
**DATE:** November 8, 2013  
**RE:** Proposed Residential Development,  
Winthrop Street, Concord, MA

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This memorandum has been prepared to assess the traffic impact associated with the development of a parcel of land at the end of Winthrop Street in Concord, Massachusetts. This assessment has reviewed available traffic volume data, reviewed sight distances, developed trip generation projections and prepared a preliminary assessment of the potential project's impacts at the intersection of Commonwealth Avenue and Winthrop Street.

### Project Description

The 12.8± acre parcel of land to be developed is located at the end of Winthrop Street. Currently the site consists of wooded land and disturbed ground.

The project consists of the development of the site as a residential use. Three development scenarios are under consideration:

1. 60 apartment units,
2. 110 apartment units, or
3. 83 units of assisted living.

Access to the site would be provided by way of Winthrop Street which intersects with Commonwealth Avenue.

### Existing Conditions

#### Roadway Network

Commonwealth Avenue is functionally classified as an Urban Collector that runs in a general north/south direction and is under the jurisdiction of the Town of Concord. In the site vicinity, the roadway provides one travel lane per direction with shoulders. The existing roadway width is approximately 24 feet wide. Travel lanes are separated by a double yellow centerline. The posted speed limit is 30 miles per hour (mph). Illumination is provided by luminaries mounted on poles. Land use along Commonwealth Avenue in the vicinity of Winthrop Street consists primarily of

residential homes.

Winthrop Street will provide the sole access to the site. Winthrop Street is a town owned and controlled local road that runs in a general east/west direction from its western terminus at Commonwealth Avenue to its eastern, dead-end terminus at 56 Winthrop Street, a small office building. The roadway provides one travel lane per direction. There are no pavement markings on Winthrop Street. Land use consists of residential homes and the commercial properties at the east end of Winthrop Street.

### **Intersection**

***Commonwealth Avenue and Winthrop Street*** Winthrop Street intersects Commonwealth Avenue from the east to form this three-legged, unsignalized intersection. The Commonwealth Avenue approaches each consist of single lanes permitting left- or right-turn movements. The Winthrop Street approach consists of a single lane permitting left- or right-turn movements. The Winthrop Street approach currently operates under STOP-like control. A crosswalk exists along the Commonwealth Avenue north leg of the intersection. Land use in the area consists of residential homes.

### **Traffic Volumes**

To establish base traffic conditions within the study area, manual turning movement counts were conducted at the intersection Commonwealth Avenue and Winthrop Street on Tuesday, October 29, 2013 from 7:00 to 9:00 AM and 4:00 to 6:30 PM. Based on the peak period counts, the weekday morning peak hour occurs between 8:00 and 9:00 AM and the weekday evening peak hour occurs between 4:15 and 5:15 PM.

Automatic traffic recorder counts (ATR) were also conducted in October 2013 on Winthrop Street east of Commonwealth Avenue and on Commonwealth Avenue north of Winthrop Street. The traffic count worksheets are provided in the Appendix.

The traffic-volume data gathered as part of this study was collected during the month of October 2013. Data from the Massachusetts Department of Transportation (MassDOT) was reviewed to determine the monthly variations of the traffic volumes. The traffic data showed May volumes to be representative of average month conditions. The 2013 existing daily and peak-hour traffic volumes for average-month conditions are summarized below in Table 1. The existing intersection volumes are shown graphically in the Appendix.

**TABLE 1  
EXISTING TRAFFIC-VOLUME SUMMARY<sup>a</sup>**

Location	Weekday Traffic Volume <sup>b</sup>	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		Traffic Volume <sup>c</sup>	K Factor <sup>d</sup>	Directional Distribution <sup>e</sup>	Traffic Volume	K Factor	Directional Distribution
Winthrop Street east of Commonwealth Avenue	740	62	8.4	87.1% EB	50	6.8	64.0% WB
Commonwealth Avenue north of Winthrop Street	8,850	644	7.3	60.7% NB	894	10.1	72.5% NB

<sup>a</sup>Two-way traffic volume

<sup>b</sup>Daily traffic expressed in vehicles per day.

<sup>c</sup>Expressed in vehicles per hour.

<sup>d</sup>Percent of daily traffic volumes which occurs during the peak hour.

<sup>e</sup>Percent of peak-hour volume in the predominant direction of travel.

NB = northbound; SB = southbound.; EB = eastbound; WB = westbound.

Commonwealth Avenue was recorded to carry approximately 8,850 vehicles per day (vpd) during average month conditions. During the weekday morning peak hour, 644 vehicles per hour (vph) were recorded, and during the weekday evening peak hour, 894 vph were recorded.

Winthrop Street was recorded to carry approximately 740 vpd during average month conditions. During the weekday morning peak hour, 62 vph were recorded, and during the weekday evening peak hour, 50 vph were recorded.

### Vehicle Speeds

Existing speed data for Commonwealth Avenue was also collected using the ATR. The posted speed limit on Commonwealth Avenue is 30 mph. The speed data is summarized in Table 2.

**TABLE 2  
COMMONWEALTH AVENUE VEHICLE SPEEDS**

Direction	Posted Speed Limit (mph)	Average Observed Speed <sup>a</sup> (mph)	85 <sup>th</sup> Percentile Speed (mph)
Commonwealth Avenue Northbound	30	33	37
Commonwealth Avenue Southbound	30	34	40

<sup>a</sup>Based on speed data compiled on October 29 and October 30, 2013.

As shown in Table 2, the average speed of vehicles travelling northbound or southbound was found to be 33 to 34 mph. The 85<sup>th</sup> percentile speed was found to be 37 mph for northbound vehicles and 40 mph for southbound vehicles. The 85<sup>th</sup> percentile speed is the speed at which sight distances are typically evaluated.

### Existing Levels of Service

Level of service (LOS) is a quantitative measure used to describe the operation of an intersection or roadway segment. The level of service definition is described by the quality of traffic flow and is primarily defined in terms of traffic delays. The primary result of capacity analyses<sup>1</sup> is the assignment of a level of service to traffic intersections or roadway segments under various traffic-flow conditions. Six levels of service are defined for traffic intersections and roadway segments. Levels of service range from LOS A to LOS F. LOS A represents very good operating conditions and LOS F represents very poor operating conditions.

Level-of-service analyses were conducted for 2013 Existing conditions for the Commonwealth Avenue intersection with Winthrop Street. The results of the unsignalized results are summarized in Table 3. Detailed analysis sheets are presented in the Appendix.

<sup>1</sup>The capacity analysis methodology is based on procedures presented in the *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010.

**TABLE 3  
COMMONWEALTH AVENUE AND WINTHROP STREET  
UNSIGNALIZED LEVEL-OF-SERVICE ANALYSIS SUMMARY**

Critical Movement/ Peak Hour	2013 Existing			
	Demand <sup>a</sup>	V/C <sup>b</sup>	Delay <sup>c</sup>	LOS <sup>d</sup>
<i>All Movements from Winthrop Street</i>				
Weekday Morning	8	0.03	12.7	B
Weekday Evening	32	0.18	19.3	C

<sup>a</sup>Demand of critical movements in vehicles per hour.

<sup>b</sup>Volume-to-capacity ratio.

<sup>c</sup>Delay in seconds per vehicle.

<sup>d</sup>Level of service.

*Commonwealth Avenue and Winthrop Street* Under 2013 Existing, 2018 No-Build and 2018 Build conditions, the critical movements (all movements from Winthrop Street) at this unsignalized intersection are modeled to operate at LOS B during the weekday morning peak hour and at LOS C during the weekday evening peak hour. These results are confirmed by actual intersection operations during the peak periods.

### **Future Conditions**

Traffic growth on area roadways is a function of the expected land development in the immediate area as well as the surrounding region. Traffic-volume data compiled by MassDOT from historic traffic counts in Concord were reviewed in order to determine traffic growth trends. Based on a review of this data, it was determined that traffic volumes within the study area have generally decreased over the past several years. Accordingly, a 1.0 percent per year compounded annual background traffic growth rate was used in order to account for potential future traffic growth external to the study area and presently unforeseen development. **In addition, traffic from the proposed Beharrell Street Redevelopment Project was included.**

The project consists of one of three possible development scenarios:

1. 60 apartment units,
2. 110 apartment units, or
3. 83 units of assisted living.

### Existing Site Traffic Generation

Trip-generation data published by the ITE *Trip Generation* manual<sup>2</sup> was reviewed. Trip generation data for Land Use Codes (LUC) 220 – Apartments and for LUC 254 – Assisted Living was reviewed to determine the trip generation for the proposed residential development. This data is summarized in Table 4.

**TABLE 4  
TRIP-GENERATION COMPARISON**

	60 Apartment Units <sup>a</sup>	110 Apartment Units <sup>b</sup>	83 Assisted Living Units <sup>c</sup>
<i>Average Weekday Daily Traffic</i>	488	790	228
<i>Weekday Morning Peak Hour:</i>			
Entering	7	12	10
<u>Exiting</u>	<u>26</u>	<u>46</u>	<u>5</u>
Total	33	58	15
<i>Weekday Evening Peak Hour:</i>			
Entering	33	51	12
<u>Exiting</u>	<u>18</u>	<u>27</u>	<u>12</u>
Total	51	78	24

<sup>a</sup>Based on ITE LUC 220, Apartments; 60 units.

<sup>b</sup>Based on ITE LUC 220, Apartments; 110 units.

<sup>c</sup>Based on ITE LUC 254, Assisted Living; 83 Occupied Beds.

Depending on development scenario, the proposed project is expected to generate approximately 228 to 790 vehicle trips on an average weekday. During the weekday morning peak hour, the project is expected to generate approximately 15 to 58 vehicle trips. During the weekday evening peak hour, the project is expected to generate a total of 24 to 78 vehicle trips. The 110 apartment scenario represents the scenario with the largest traffic impact.

### Trip Distribution

The directional distribution of the site-generated traffic was based on existing travel patterns to/from Winthrop Street.

<sup>2</sup>*Trip Generation*, Ninth Edition; Institute of Transportation Engineers; Washington, DC; 2012.

This pattern is summarized in Table 5.

**TABLE 5  
TRIP-DISTRIBUTION SUMMARY**

Route	Direction To or From	Percent of Trips To/From
Commonwealth Avenue	North	38
Commonwealth Avenue	South	<u>62</u>
TOTAL		100

**Future Build Conditions**

Trips for each development scenario were then added and analyzed. The site-generated traffic was distributed within the study area according to the percentages summarized in Table 5. The site generated volumes were superimposed onto the projected No-Build traffic volumes to represent the 2018 Build traffic-volume conditions. These volumes were used as the basis for all analysis as well as to identify potential mitigation measures to ameliorate the project’s impacts. The results are summarized in Table 6.

**TABLE 6  
COMMONWEALTH AVENUE AND WINTHROP STREET  
UNSIGNALIZED LEVEL-OF-SERVICE ANALYSIS SUMMARY**

Critical Movement/ Peak Hour	2018 Build – 60 Apartments			
	Demand <sup>a</sup>	V/C <sup>b</sup>	Delay <sup>c</sup>	LOS <sup>d</sup>
<i>All Movements from Winthrop Street</i>				
Weekday Morning	34	0.12	15.0	C
Weekday Evening	50	0.33	24.8	C

Critical Movement/ Peak Hour	2018 Build – 110 Apartments			
	Demand <sup>a</sup>	V/C <sup>b</sup>	Delay <sup>c</sup>	LOS <sup>d</sup>
<i>All Movements from Winthrop Street</i>				
Weekday Morning	54	0.20	16.3	C
Weekday Evening	59	0.40	27.4	D

Critical Movement/ Peak Hour	2018 Build – 83 Assisted Living Units			
	Demand <sup>a</sup>	V/C <sup>b</sup>	Delay <sup>c</sup>	LOS <sup>d</sup>
<i>All Movements from Winthrop Street</i>				
Weekday Morning	13	0.05	13.8	B
Weekday Evening	44	0.28	22.7	C

<sup>a</sup>Demand of critical movements in vehicles per hour.

<sup>b</sup>Volume-to-capacity ratio.

<sup>c</sup>Delay in seconds per vehicle.

<sup>d</sup>Level of service.

Under 2013 Existing conditions, during the weekday morning peak hour, the critical movements (all movements from Winthrop Street) operate at LOS B and at LOS C during the weekday evening peak hour. Under future 2018 Build conditions, these critical movements are projected to continue to operate at LOS B during the weekday morning peak hour and at LOS C during the weekday evening peak hour for the 60 apartments scenario or the 83 assisted living units scenario. Under future 2018 Build conditions, with the 110 apartments scenario, the critical movements are projected to continue to operate at LOS C during the weekday morning peak hour and at LOS D during the weekday evening peak hour.

Based on the projected traffic flows north and south of Winthrop Street, the additional traffic generated by either development scenario is not expected to significantly impact operations at the intersections to the north



(Concord Rotary) or south (Laws Brook Road). At the intersection of Commonwealth Avenue and Laws Brook Road, using the highest traffic generator of the three potential scenarios (110 apartments), volume through the intersection would marginally increase through the intersection (approximately 3 percent increase). This increase will not significantly impact the level of service at this intersection.

### **Conclusion**

A comparison of the level of service results for future build conditions as shown in Table 6 with those shown in Table 3 shows that only the 110 apartment scenario causes a drop in level of service during the peak hours. The critical movements are projected to operate at level of service D or better under the 110 apartments scenario which are acceptable for the intersection.