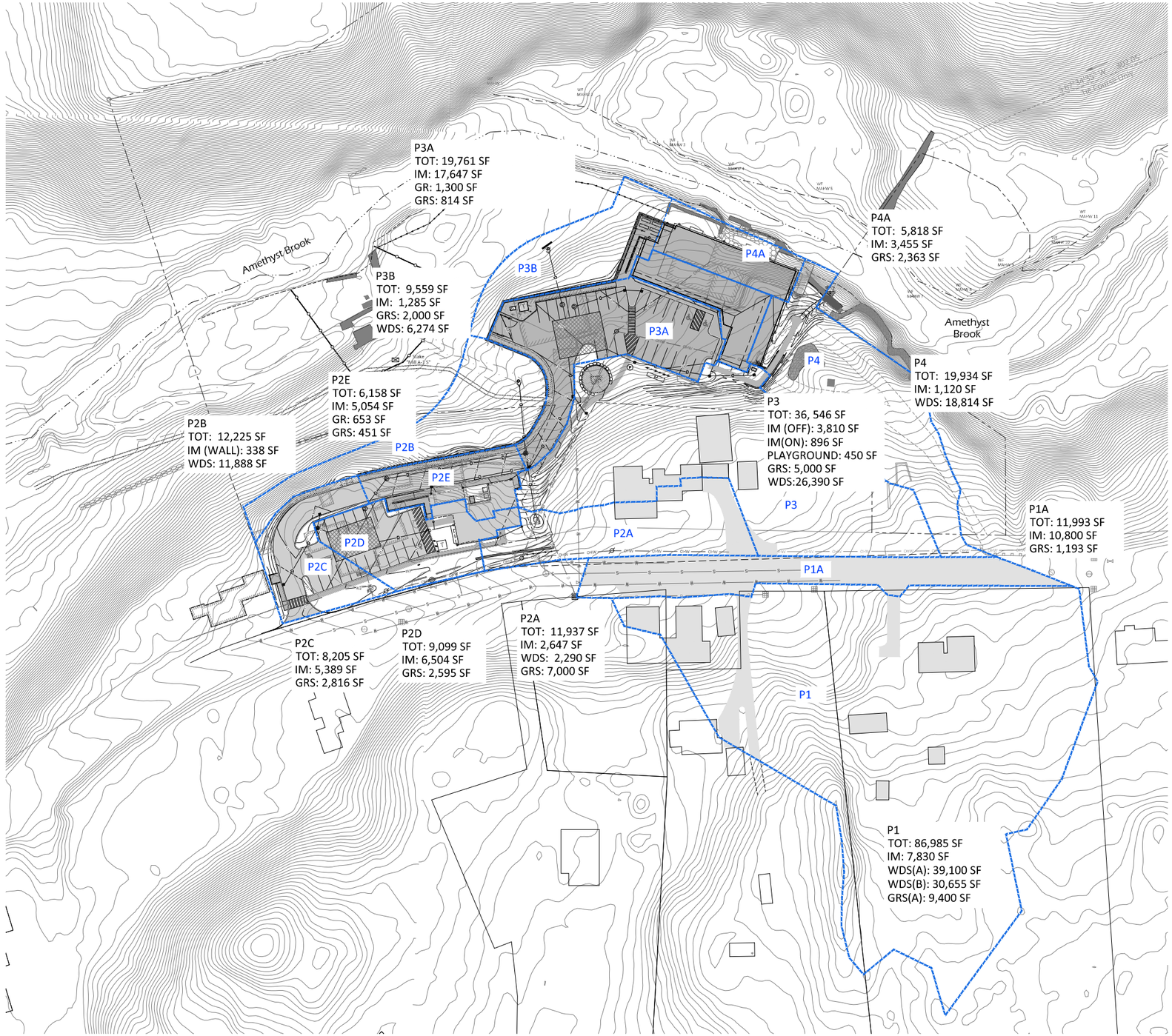


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AMETHYST BROOK
APARTMENTS
20-22 AMHERST ROAD
PELHAM, MA

PROPOSED DRAINAGE

Revisions

Date: December 11, 2020
Scale: 1"=100'
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FIG 6

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# *Stormwater Management Report*

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**For**

## Amethyst Brook Apartments
## 20-22 Amherst Road
## Pelham, MA

**December 21, 2020**

**Prepared by:**

Berkshire Design Group

4 Allen Place, Northampton, Massachusetts 01060

## Table of Contents



## Figures



## Appendix



## Referenced Documents

**Plans:**

**20-22 Amherst Road, Pelham - Permit Set**

Home City Development Inc. is proposing to create new residential housing units at 20-22 Amherst Road, Pelham, Massachusetts. The new units will be created through demolition and replacement of the existing farmhouse at 20 Amherst Street with a similar building and the demolition and replacement of the commercial building at 22 Amherst Road with a new three-story, multi-unit building. The existing driveways and parking areas will be reconfigured as part of the project.

Berkshire Design Group has prepared a Stormwater Management plan for the site in compliance with the Massachusetts Stormwater Handbook. This report summarizes the design of the system and documents how the design complies with those standards.

# I. Introduction

The project includes two properties which will be redeveloped into multi-family housing. The property at 20 Amherst road includes a single-family home and barn as well as a large collapsed wood shed, gravel drive and garage. The 8.73-acre 22 Amherst Road property is comprised of a commercial building, garage buildings, parking and access driveway.

The single-family home at #20 Amherst road will be demolished and replaced with a new building comprised of 6 new residential units. The new building will be located on the eastern side of the lot and a parking area will be constructed at the location of the existing building. The existing barn, sheds and detached garage will be demolished. At 22 Amherst Road, all existing structures will be demolished and replaced with a new 3-story apartment building. A new access drive and parking lots will replace the existing. New utility services and stormwater improvements are also proposed.

The parcels are located on the north side of Amherst Road between Harkness Road and North Valley Road. The project location is shown in Figure 1. The project is situated on a steep hillside between Amherst Road and Amethyst Brook. The existing home at #20 Amherst Road occupies the higher portion of the lot adjacent to Amherst Road while the re-development at #22 Amherst Road is located at the base of the steep hillside above Amethyst Brook.

### Soil Data

NRCS Soil Survey

The NRCS Soil Survey reports that the on-site soils consist of Hinckley loamy sand, hydrologic soil groups (HSG) A. The USGS Surficial Geology survey indicates that the parcel is located in thin till overlaid by alluvial fan deposits near the brook and coarse deposits near Amherst Road. The NRCS Soil Report for the site is attached in **Appendix A**.

Subsurface Exploration

A total of four test pits were completed at the Amherst Road site on December 1, 2020. The soil evaluation report is attached as **Appendix B**. The test pits indicated that the soils included deep gravelly and stony coarse sandy soils. Estimated seasonal high groundwater (ESHG) within test pits 1-3 at #20 Amherst Road was not observed and was therefore estimated as deeper than the test pit depths which varied from 6.7’ to 9’ from the surface. At #22, in Test Pit #4 estimated high groundwater was observed at 4.8 ft below the surface. For purposes of infiltration, A soils with a Rawls rate of 2.41 in/hour were assumed. The design of the underground storage and infiltration systems incorporated two feet of separation from ESHG from the test pit data. Since there was no indication of ESHG at #20, more than 2’ above the deepest test pit elevation was used for design.

### Site Limits

Site limits were based both on the parcel lines and redevelopment areas as well as the contributing drainage area to the south. Since runoff generally flows north towards Amethyst brook as sheet, shallow concentrated and channel flow, a study boundary was established on the north side of the project site to model pre and post peak runoff (see Figures 4 and 6).

# II. Existing Conditions

An Existing Conditions Plan is shown on **Figure 2.** NRCS soils throughout the study area are shown on **Figure 3**. Existing hydrology which includes a significant area off-site is shown on **Figure 4**.

The existing hydrology was analyzed as four major drainage areas, E1 through E4, each including impervious areas, open space and wooded areas.

Drainage area E1 includes the area south of Amherst road which is conveyed through the proposed site. This area is comprised of approximately 400' of roadway, and several driveways, homes, garages and sheds located above the road on the hillside. The roadway area and contiguous impervious areas are modeled as a separate drainage sub-area (E1A) since this area will runoff quickly into the drainage system and create a peak runoff separate from the runoff from the hillside. Area E1 is tributary to an existing on-site swale which drains to a side channel of Amethyst Brook.

Drainage area E2 includes the western portion of the study area, the existing home at #20 Amherst road, barns, sheds and garage as well as a portion of the driveway to #22 Amherst Road access driveway and a portion of the #24 Amherst Road property and impervious area. This area is tributary to an existing drainage swale which drains to a side channel of Amethyst Brook.

Drainage area E3 includes the central portion of the study area. This area is modeled as three sub-areas to reflect existing conditions. Sub-area E3 includes a portion of #24 Amherst Road house, barn and garage roofs and the adjacent property to the north and east which sheet flows north toward the brook. Sub-area E3A is modeled separately because the large impervious area in this area will create an early peak flow. Sub-area E3B is also modeled separately because the garage roof appears to have a separate drainage system which outflows to the terrace below the garage.

Drainage area E4 includes the eastern portion of the study area. Again, this area is modeled as the uphill mostly pervious area (E4) and sub-area E4A, the portion of the factory roof, deck and courtyards which drain directly to the brook.

# III. Proposed Conditions

The proposed conditions plan is provided on **Figure 5** and the proposed hydrology is shown on **Figure 6**. The proposed work maintains existing stormwater flow patterns and includes improvements to the existing drainage system off of Amherst Road, two underground storage systems for peak flow attenuation and recharge and hydrodynamic separators for TSS removal.

The proposed site is modeled with four drainage areas matching the patterns found in existing conditions.

In proposed conditions, off-site drainage areas E1 and E1A are unchanged. These areas are labeled P1 and P1A. As in existing conditions, these areas are tributary to an existing on-site swale which drains to a side channel of Amethyst Brook.

Area P2 includes the western portion of the study area and is modeled as five sub-areas to reflect the proposed development and stormwater improvements. As in existing conditions, most of area P2 is tributary to an existing drainage swale which drains to a side channel of Amethyst Brook. Sub-area P2A includes a portion of the house at #24 Amherst Road which drains west to the existing drainage system and sub-area P2B is the largely unchanged area below the proposed common drive. Sub-area P2C (the first 170 feet of the entrance drive) and sub-area P2D (the parking lot and front #20 roof) are conveyed to a stormwater detention/infiltration facility located under the parking lot. Finally, since sub-area P2E (140 feet of driveway and rear #20 roof) is down gradient of the stormwater facility in the upper parking lot, it is conveyed to the stormwater detention/infiltration facility located in the lower parking lot.

Drainage area P3 includes the central portion of the study area and is modeled as three sub-areas similarly to existing conditions. Sub-area P3 includes a portion of the house at #24 Amherst Road, barn and garage roofs and the adjacent property to the north and east which sheet flows north toward the brook. Sub-area P3A encompasses the driveway to #22, the parking area and the south side of the #22 roof. This area is directed to a stormwater detention/infiltration facility located under the lower parking area. The detention facility outflows to an existing outflow above Amethyst Brook. Sub-area P3B is the lower part of this drainage area and includes undeveloped areas and the western portion of the #22 building improvements. Stormwater runoff sheet flows off his area to Amethyst Brook.

Drainage area P4 includes the eastern portion of the study area. As in existing conditions, this area is modeled as the uphill mostly pervious area (P4) and sub-area P4A, a portion of the new apartment roof. The apartment roof includes several disconnected downspouts which will discharge north towards Amethyst brook.

### Water Quality

Existing impervious areas at the site includes 27,430 sf of roofs, driveways and aprons and 1,201 sf of gravel driveways for a total of 28,640 sf of impervious areas. The proposed redevelopment includes 42,840 sf of building roofs, driveways, parking lots and walkways, an increase of 13,200 sf.

The proposed design provides treatment for impervious area by directing driveways and parking lots to hydrodynamic separators. Runoff from portions of roofs and walkways and other areas which cannot be captured and conveyed to the hydrodynamic separators are conveyed through disconnected downspouts to vegetated buffers or sheet flow through vegetated buffers towards Amethyst brook. Areas treated for water quality exceed new impervious areas created by this re-development project (see Section IV and Appendix E).

Based on the manufacturer's calculations, the hydrodynamic separators will provide greater than 90% removal of TSS.

## IV. Calculations and Design

### Water Quantity

Drainage calculations were performed on HydroCAD Stormwater Modeling System version 10.0 using Soil Conservation Service (SCS) TR-20 methodology. The SCS method is based on rainfall observations, which were used to develop the Intensity-Duration-Frequency relationship, or IDF

curve. The mass curve is a dimensionless distribution of rainfall over time, which indicates the fraction of the rainfall event that occurs at a given time within a 24-hour precipitation event. This synthetic distribution develops peak rates for storms of varying duration and intensities. The SCS distribution provides a cumulative rainfall at any point in time and allows volume-dependent routing runoff calculations to occur. These calculations are included in **Appendix C**. Rainfall values are taken from the latest Northeast Regional Climate Center (NRCC) and are listed in Table 1.

The watershed boundaries for calculation purposes are divided according to the proposed site grading and the parcel boundary. The curve numbers (CNs) for the existing and proposed sub-catchment area are based on the soil type and the existing and proposed cover conditions at the site. The time of concentration (Tc) for large sub-areas with extensive pervious areas is calculated using the lag method. Small sub-area Tcs are set at a minimum of 5 minutes.

Calculations were performed for the 2-, 10-, and 100-year frequency storms under existing and proposed conditions. The results of the calculations are presented in Table 1 below. **Appendix C** presents the HydroCAD output reports.

**Table 1. Runoff Summary Table**

| Point of Analysis | 2-Year Storm 3.07" | 10-Year Storm 4.47" | 100-Year Storm 7.68" |
|---|---|---|---|
| | Peak Flow Rate(cfs) | Peak Flow Rate(cfs) | Peak Flow Rate(cfs) |
| **Existing** | 1.61 | 3.87 | 14.47 |
| **Proposed*** | 1.54 | 3.64 | 14.02 |

*Peak flow after storage/attenuation within underground storage chambers

Runoff from the site shows a decrease in peak flow for all storms between pre and post conditions.

## Water Quality

Water quality at the proposed site is addressed with water quality units (hydrodynamic separators), followed by storage and infiltration. The proposed runoff from driveways, parking areas and a portion of the #20 roof (approximately 29,000 sf) is conveyed to water quality units for treatment prior to storage and infiltration.

Impervious areas (approximately 14,000 sf) which are not conveyed to water quality units include building roofs and some walkways. Runoff from roofs is either directed to storage facilities or discharged through disconnected downspouts to vegetated buffers. Vegetated swales are also included in the design to convey sidewalk runoff.

The Total Suspended Solids removal for the site provided by the water quality units is calculated by the manufacturer at over 90%.

Water quality volume is provided by storage within the underground detention systems below the lowest outlet pipe. Water quality volume is provided for 1" of runoff over the increased impervious area at the site (see cold water fisheries section below). Table 2 provides a summary of the water

quality calculations. The volume provided exceeds the calculated volume for the increased impervious area.

**Table 2. Water Quality Volume**

| Existing Impervious Area (sf) | Proposed Impervious Area (sf) | Increase in Impervious Area (sf) | Water Quality Volume on increase (cf) | Water Quality Volume Provided in all facilities (cf) |
|---|---|---|---|---|
| 28,640 | 41,840 | 13,200 | 1,100 | 1,170 |

Calculations supporting these conclusions are included in **Appendix E**.

### Cold Water Fishery

The proposed redevelopment is within a cold water fishery requiring 80% TSS removal and treatment of the first inch of runoff. The proposed water quality units will provide 90% TSS removal of the runoff from the driveway and parking areas (see Appendix E). The improvements also include infiltration within the underground storage systems which provides temperature mitigation. Storage and detention within the underground storage chambers will also moderate the temperature of the runoff. Walkway areas treated with grass swales and flow through vegetated buffer areas and disconnected downspouts from some of the roofs completes the provided improvements.

### Erosion & Sedimentation Control

The project plan set includes provisions for erosion control during construction. The project will be phased to limit the total land area disturbed at one time.

Erosion control barrier is included below all road and wall construction and around the new apartment construction. to prevent migration of sediment offsite or into resource areas during construction.

Straw wattles combined with silt fence are proposed for down-slope protection.

# V. MADEP Stormwater Standards Compliance

The following section details how the project will meet the DEP Stormwater Management Policy's ten stormwater management standards.

**LID**

The project is the redevelopment of the site of an old factory and associated driveway and parking by Amethyst Brook and a farmhouse off of Amherst Road. The project proposes to build multi-family housing at both sites and improve the driveway access. The possibility for LID is limited due to the steep terrain. Limited disturbance in the riverfront is also considered. Nevertheless, water quality is enhanced from existing conditions by conveying the majority of the impervious surfaces to water quality units which will significantly reduce TSS in the runoff from existing conditions since the existing parking lot and driveway has no water quality treatment. Grass swales, deep sump catch basins and a level spreader are also proposed at the site.

### Standard 1 - Untreated Stormwater Discharge

The proposed project includes water quality units and underground detention/infiltration facilities designed to capture runoff from the impervious surfaces created and provide water quality treatment prior to discharge to the vegetated buffers and the brook. Existing outfalls, including the existing swale to Amethyst Brook and the drainage outlet from the existing garage are re-used.

### Standard 2 - Post-Development Peak Discharge Rates

The proposed detention facilities provide attenuation of discharge rates such that post development discharge rates *are less than* pre-development peak discharge rates leaving the site.

These results are discussed in detail under “Peak Runoff Rate” in **Section IV**, above.

### Standard 3 - Recharge to Groundwater

Recharge of the increased impervious area is provided within the proposed underground storage facilities based on the target depth factor of 0.6”. For the proposed increase in impervious area, the required recharge volume is 660 cf. The design includes capacity to recharge 1,170 cf which exceeds the required volume. Calculations of recharge are included within **Appendix D**.

### Standard 4 – Water Quality

Impervious areas including driveways, parking areas and portions of roofs are captured by BMPs designed to remove 90% TSS.

The water quality volume is calculated based on 1”. For the proposed increase in impervious area, the required water quality volume is 1,100 cu. ft. The proposed facilities provide 1,170 cf thereby providing water quality for the additional impervious areas proposed.

Further discussion of this standard is included under “Water Quality” in Section III and in **Appendix E**.

### Standard 5 - Higher Potential Pollutant Loads

This is not applicable to this project.

### Standard 6 - Protection of Critical Areas

The project is located in a cold water fishery. TSS removal and water quality volume has been increased to meet the requirements of the cold water fishery. Underground storage, detention and infiltration provide runoff temperature moderation.

### Standard 7 - Redevelopment Projects

This project is a redevelopment project and measures have been taken to improve existing conditions. Whereas the existing site has little provision for TSS removal, the proposed project includes water quality units designed to remove over 90% TSS from the majority of the proposed driveway and parking areas. Water quality volume is provided on the increased impervious areas proposed. Recharge volume exceeds the volume calculated for the increased impervious area by over 75%.

### Standard 8 - Erosion/Sediment Control

Proposed erosion and sediment controls are shown on the drainage plan for the site.

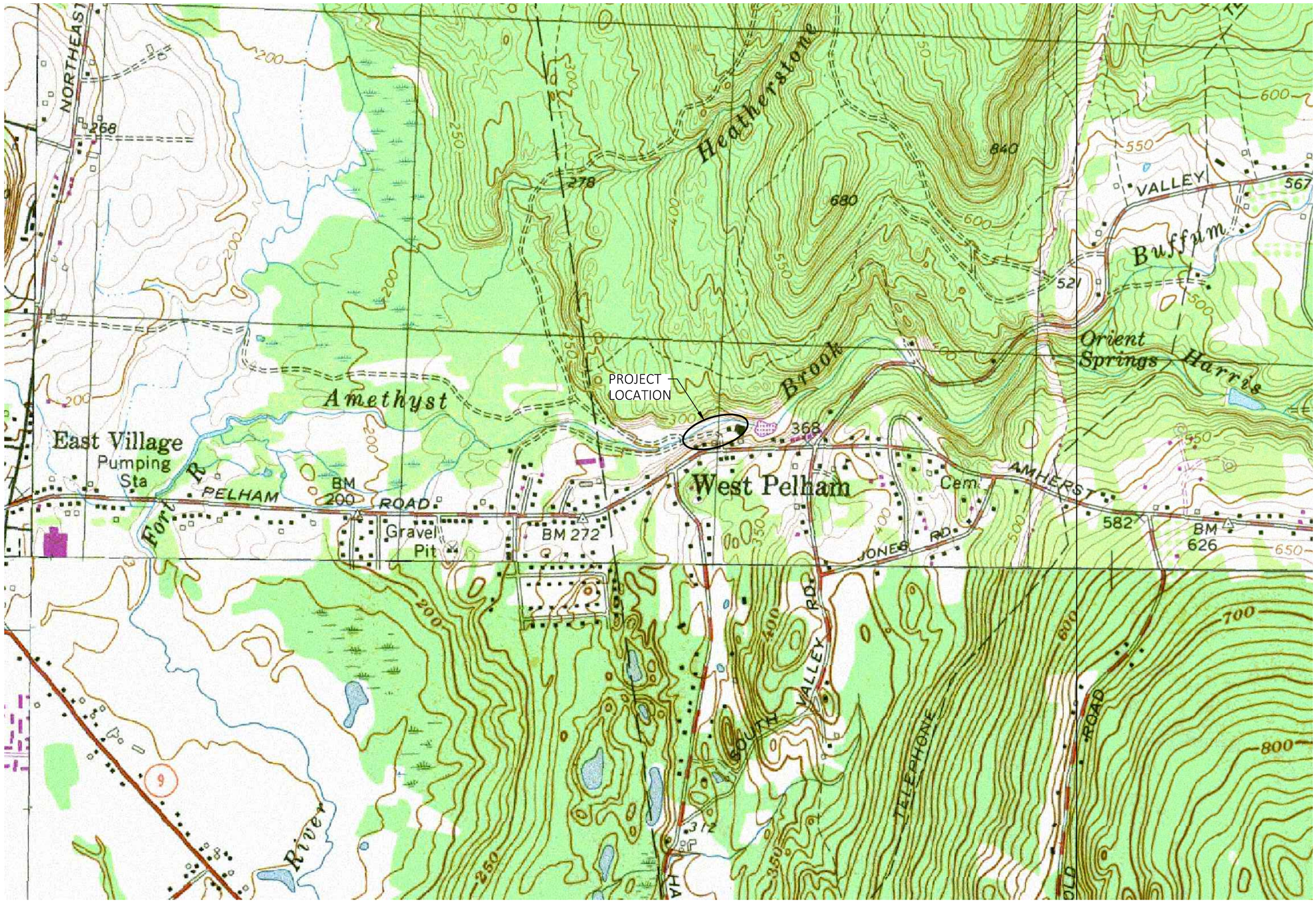
### Standard 9 - Operation/Maintenance Plan

An Operation and Maintenance Plan for the proposed project is included in **Appendix F**. It includes general controls for construction and long term maintenance of the R-Tank systems and Water Quality Units.

### Standard 10 – Prohibition of Illicit Discharges

No Illicit Discharge Compliance Statement is included with this report. It will be the responsibility of the owner to submit a statement prior to the discharge of any stormwater to post-construction BMPs.

# FIGURES

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LOCUS

Revisions

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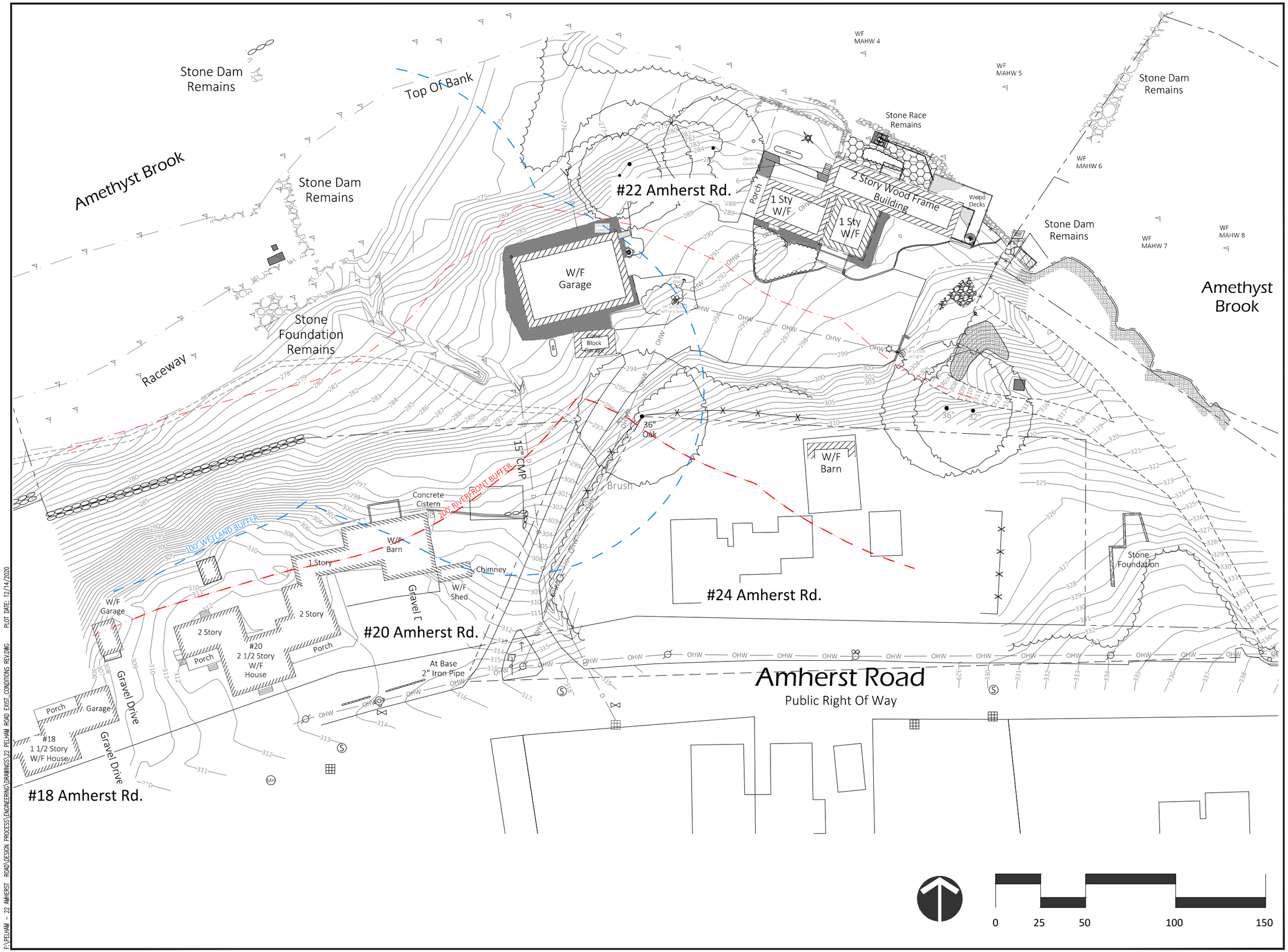


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EXISTING CONDITIONS PLAN

Revisions

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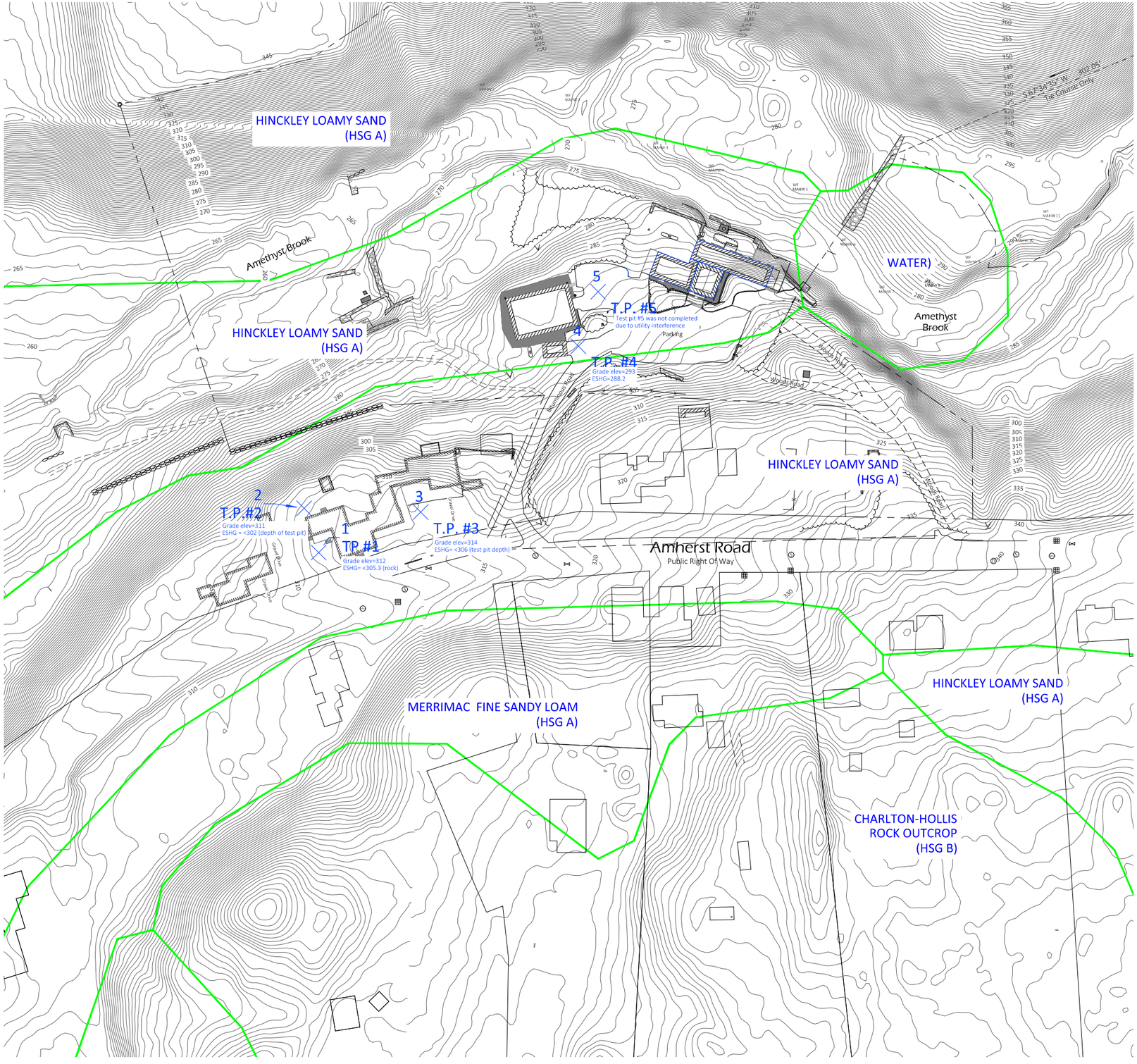


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DRAINAGE AREA SOILS

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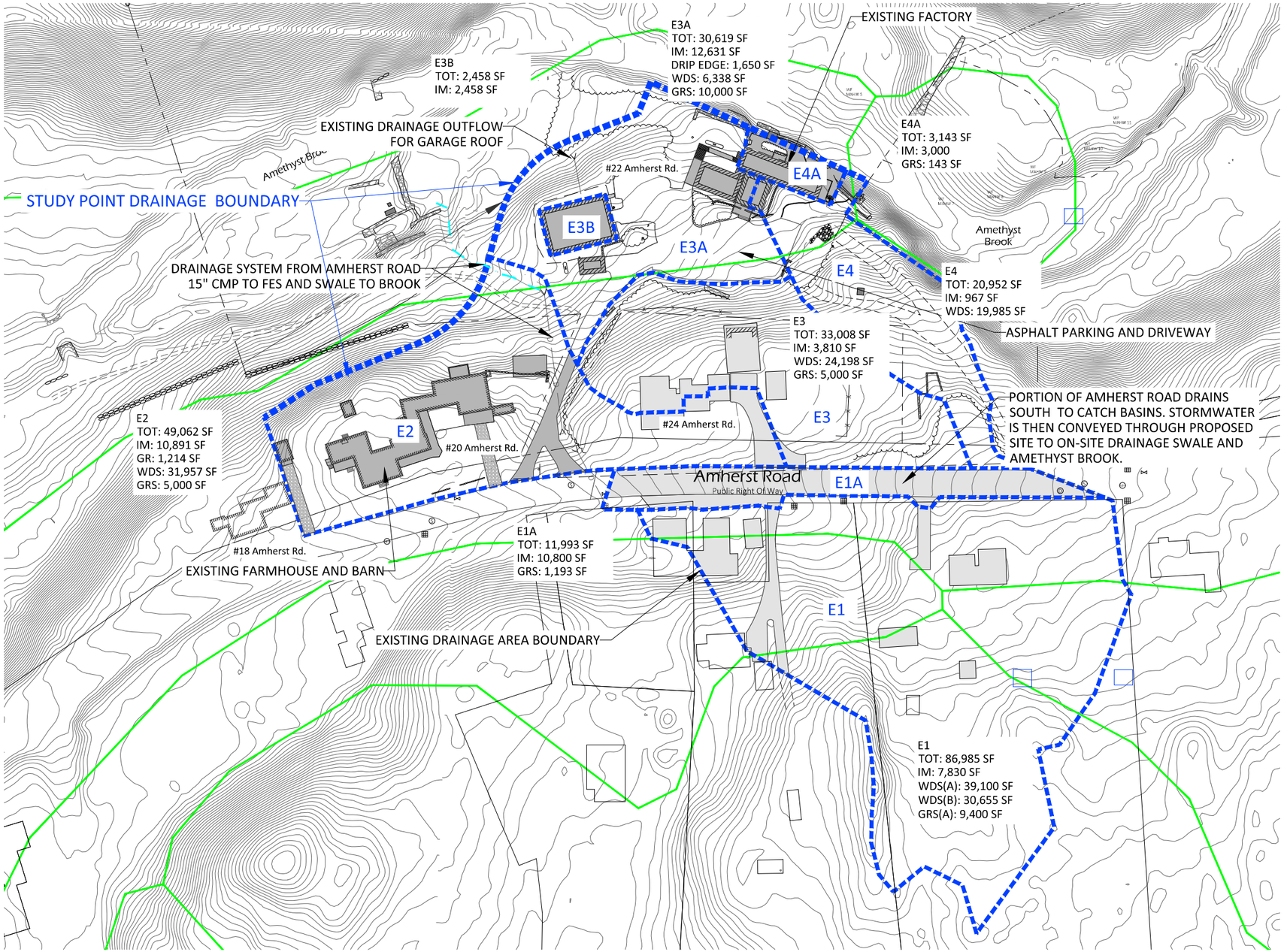


NOTES:

1. LIMITS OF IMPERVIOUS SURFACE LIMITS OFF SITE APPROXIMATED FROM AERIAL PHOTOGRAPHY AND MASS GIS.
2. SOILS ARE HSG A NORTH OF AMHERST ROAD. THE DRAINAGE AREA SOUTH OF AMHERST ROAD IS HSG A AND B.


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AMETHYST BROOK
APARTMENTS
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EXISTING HYDROLOGY

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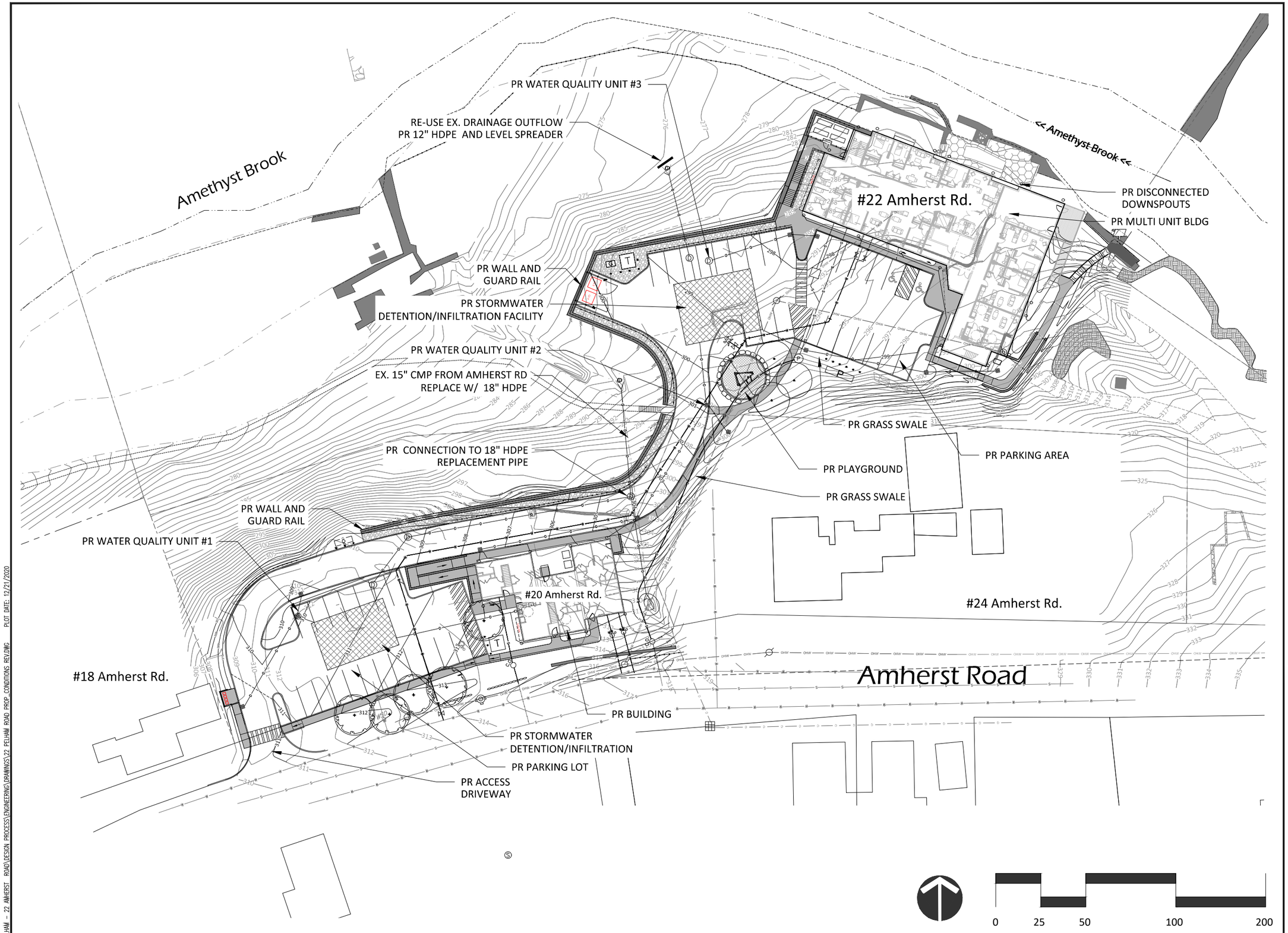


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AMETHYST BROOK
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PROPOSED PLAN

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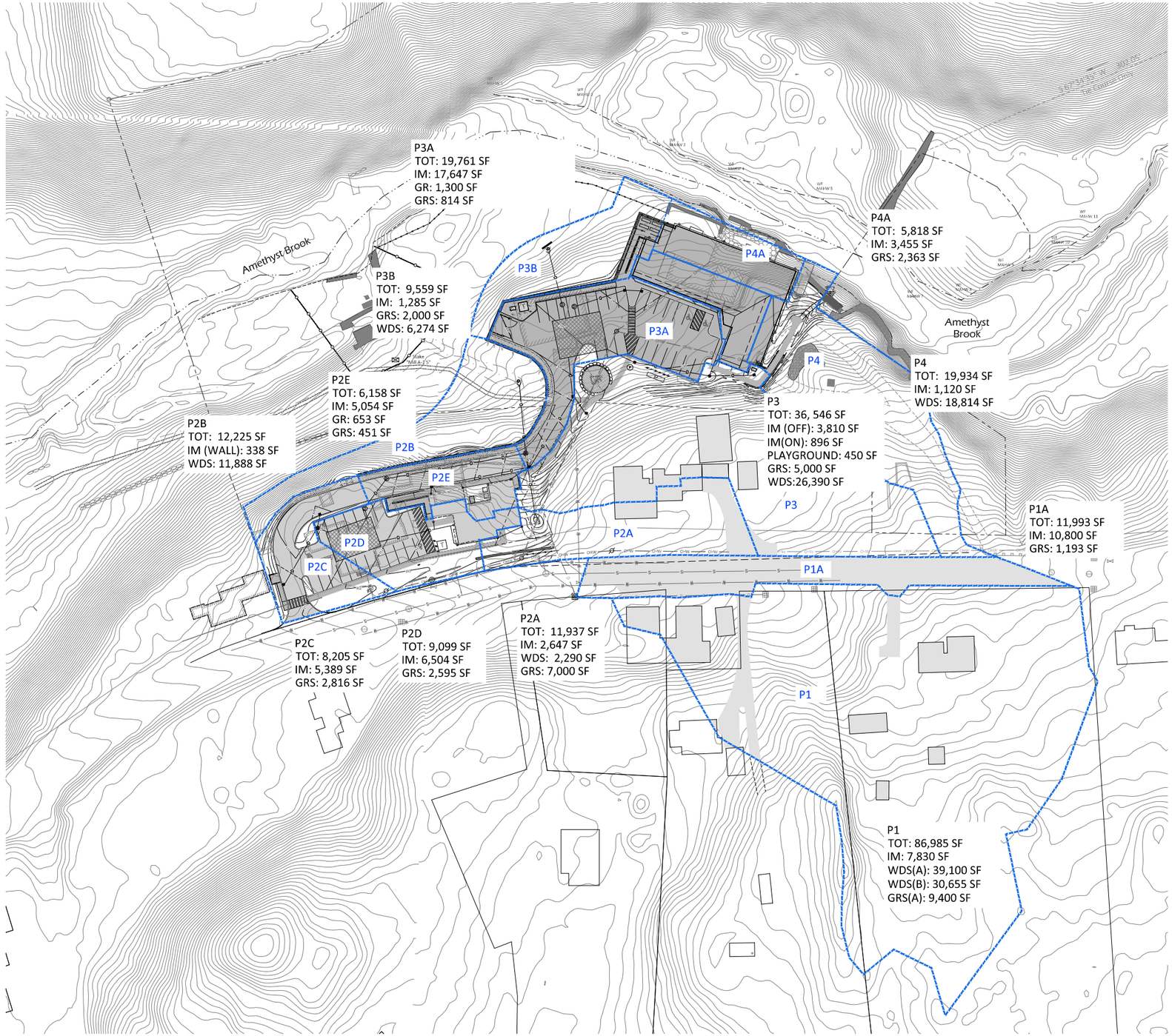


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AMETHYST BROOK
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PROPOSED DRAINAGE

Revisions

Date: December 11, 2020
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FIG 6

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# Appendix A– NRCS Soils Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

# Custom Soil Resource Report for Hampden and Hampshire Counties, Massachusetts, Eastern Part

## 22 Pelham Road


February 19, 2020

# Preface

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

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

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

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

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

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

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# Contents

# How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

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

# Custom Soil Resource Report
## Soil Map


Map Scale: 1:2,470 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

## MAP LEGEND

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

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

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

**Water Features**
- Streams and Canals

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

**Background**
- Aerial Photography

## MAP INFORMATION

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

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:
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: Hampden and Hampshire Counties, Massachusetts, Eastern Part
Survey Area Data: Version 14, Sep 13, 2019

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

Date(s) aerial images were photographed: Sep 29, 2013—Oct 16, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

## MAP LEGEND

## MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 1 | Water | 0.7 | 2.2% |
| 71B | Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony | 0.4 | 1.3% |
| 103C | Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes | 6.8 | 21.9% |
| 253B | Hinckley loamy sand, 3 to 8 percent slopes | 6.9 | 22.2% |
| 253C | Hinckley loamy sand, 8 to 15 percent slopes | 0.1 | 0.3% |
| 253D | Hinckley loamy sand, 15 to 25 percent slopes | 13.5 | 43.3% |
| 254B | Merrimac fine sandy loam, 3 to 8 percent slopes | 2.7 | 8.8% |
| **Totals for Area of Interest** | | **31.2** | **100.0%** |

# Map Unit Descriptions

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

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

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

descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

# Hampden and Hampshire Counties, Massachusetts, Eastern Part

## 1—Water

**Map Unit Setting**

*National map unit symbol:* vhz0
*Mean annual precipitation:* 32 to 50 inches
*Mean annual air temperature:* 45 to 50 degrees F
*Frost-free period:* 110 to 140 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Water:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

## 71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

**Map Unit Setting**

*National map unit symbol:* 2w69c
*Elevation:* 0 to 1,290 feet
*Mean annual precipitation:* 36 to 71 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 140 to 240 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

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

**Description of Ridgebury, Extremely Stony**

**Setting**

*Landform:* Ground moraines, drumlins, drainageways, depressions, hills
*Landform position (two-dimensional):* Toeslope, footslope
*Landform position (three-dimensional):* Head slope, base slope
*Down-slope shape:* Concave
*Across-slope shape:* Concave
*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

**Typical profile**

*Oe - 0 to 1 inches:* moderately decomposed plant material
*A - 1 to 6 inches:* fine sandy loam
*Bw - 6 to 10 inches:* sandy loam
*Bg - 10 to 19 inches:* gravelly sandy loam
*Cd - 19 to 66 inches:* gravelly sandy loam

**Properties and qualities**

*Slope:* 3 to 8 percent
*Percent of area covered with surface fragments:* 9.0 percent
*Depth to restrictive feature:* 15 to 35 inches to densic material

*Natural drainage class:* Poorly drained
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)
*Depth to water table:* About 0 to 6 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Available water storage in profile:* Low (about 3.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* D
*Hydric soil rating:* Yes

**Minor Components**

**Woodbridge, extremely stony**

*Percent of map unit:* 10 percent
*Landform:* Hills, drumlins, ground moraines
*Landform position (two-dimensional):* Footslope, summit, backslope
*Landform position (three-dimensional):* Crest, side slope
*Down-slope shape:* Convex
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Whitman, extremely stony**

*Percent of map unit:* 8 percent
*Landform:* Depressions
*Down-slope shape:* Concave
*Across-slope shape:* Concave
*Hydric soil rating:* Yes

**Paxton, extremely stony**

*Percent of map unit:* 2 percent
*Landform:* Hills, drumlins, ground moraines
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Crest, side slope
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

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

**Map Unit Setting**

*National map unit symbol:* 2wzp1
*Elevation:* 0 to 1,390 feet
*Mean annual precipitation:* 36 to 71 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 140 to 240 days

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Charlton, extremely stony, and similar soils:* 50 percent
*Hollis, extremely stony, and similar soils:* 20 percent
*Rock outcrop:* 10 percent
*Minor components:* 20 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Charlton, Extremely Stony**

**Setting**

*Landform:* Ridges, hills
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Convex
*Parent material:* Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

**Typical profile**

*Oe - 0 to 2 inches:* moderately decomposed plant material
*A - 2 to 4 inches:* fine sandy loam
*Bw - 4 to 27 inches:* gravelly fine sandy loam
*C - 27 to 65 inches:* gravelly fine sandy loam

**Properties and qualities**

*Slope:* 8 to 15 percent
*Percent of area covered with surface fragments:* 9.0 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to high (0.14 to 14.17 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Available water storage in profile:* Moderate (about 8.7 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* B
*Hydric soil rating:* No

**Description of Hollis, Extremely Stony**

**Setting**

*Landform:* Ridges, hills
*Landform position (two-dimensional):* Backslope, shoulder, summit
*Landform position (three-dimensional):* Side slope, nose slope, crest
*Down-slope shape:* Convex
*Across-slope shape:* Linear, convex
*Parent material:* Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

**Typical profile**

*Oi - 0 to 2 inches:* slightly decomposed plant material
*A - 2 to 7 inches:* gravelly fine sandy loam
*Bw - 7 to 16 inches:* gravelly fine sandy loam
*2R - 16 to 26 inches:* bedrock

**Properties and qualities**

*Slope:* 8 to 15 percent
*Percent of area covered with surface fragments:* 9.0 percent
*Depth to restrictive feature:* 8 to 23 inches to lithic bedrock
*Natural drainage class:* Somewhat excessively drained
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Very low (0.00 to 0.00 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Available water storage in profile:* Very low (about 2.7 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* D
*Hydric soil rating:* No

## Description of Rock Outcrop

**Setting**

*Landform:* Hills, ridges
*Parent material:* Igneous and metamorphic rock

**Typical profile**

*R - 0 to 79 inches:* bedrock

**Properties and qualities**

*Slope:* 8 to 15 percent
*Depth to restrictive feature:* 0 inches to lithic bedrock
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Very low (0.00 to 0.00 in/hr)
*Available water storage in profile:* Very low (about 0.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 8
*Hydrologic Soil Group:* D
*Hydric soil rating:* No

## Minor Components

**Woodbridge, extremely stony**

*Percent of map unit:* 8 percent
*Landform:* Hills, drumlins, ground moraines
*Landform position (two-dimensional):* Backslope, footslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Convex

*Across-slope shape:* Linear
*Hydric soil rating:* No

**Canton, extremely stony**
*Percent of map unit:* 5 percent
*Landform:* Hills, ridges, moraines
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Convex
*Hydric soil rating:* No

**Chatfield, extremely stony**
*Percent of map unit:* 5 percent
*Landform:* Hills, ridges
*Landform position (two-dimensional):* Summit, backslope, shoulder
*Landform position (three-dimensional):* Side slope, nose slope, crest
*Down-slope shape:* Convex
*Across-slope shape:* Linear, convex
*Hydric soil rating:* No

**Ridgebury, extremely stony**
*Percent of map unit:* 2 percent
*Landform:* Depressions, hills, drainageways, ground moraines, drumlins
*Landform position (two-dimensional):* Toeslope, footslope
*Landform position (three-dimensional):* Base slope, head slope
*Down-slope shape:* Concave
*Across-slope shape:* Concave
*Hydric soil rating:* Yes

## 253B—Hinckley loamy sand, 3 to 8 percent slopes

**Map Unit Setting**
*National map unit symbol:* 2svm8
*Elevation:* 0 to 1,430 feet
*Mean annual precipitation:* 36 to 53 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 140 to 250 days
*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**
*Hinckley and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Hinckley

#### Setting

*Landform:* Kame terraces, outwash deltas, kames, eskers, outwash terraces, outwash plains, moraines
*Landform position (two-dimensional):* Summit, backslope, footslope, shoulder
*Landform position (three-dimensional):* Nose slope, side slope, base slope, crest, tread, riser
*Down-slope shape:* Linear, convex, concave
*Across-slope shape:* Convex, linear, concave
*Parent material:* Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

#### Typical profile

*Oe - 0 to 1 inches:* moderately decomposed plant material
*A - 1 to 8 inches:* loamy sand
*Bw1 - 8 to 11 inches:* gravelly loamy sand
*Bw2 - 11 to 16 inches:* gravelly loamy sand
*BC - 16 to 19 inches:* very gravelly loamy sand
*C - 19 to 65 inches:* very gravelly sand

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Excessively drained
*Runoff class:* Very low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to very high (1.42 to 99.90 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Available water storage in profile:* Very low (about 3.0 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3s
*Hydrologic Soil Group:* A
*Hydric soil rating:* No

### Minor Components

#### Windsor

*Percent of map unit:* 8 percent
*Landform:* Eskers, outwash terraces, kames, kame terraces, outwash plains, moraines, outwash deltas
*Landform position (two-dimensional):* Summit, shoulder, backslope, footslope
*Landform position (three-dimensional):* Nose slope, side slope, base slope, crest, riser, tread
*Down-slope shape:* Linear, convex, concave
*Across-slope shape:* Convex, linear, concave
*Hydric soil rating:* No

#### Sudbury

*Percent of map unit:* 5 percent

*Landform:* Kame terraces, outwash plains, moraines, outwash deltas, outwash terraces
*Landform position (two-dimensional):* Backslope, footslope
*Landform position (three-dimensional):* Side slope, base slope, head slope, tread
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

**Agawam**

*Percent of map unit:* 2 percent
*Landform:* Kames, kame terraces, outwash plains, moraines, outwash deltas, eskers, outwash terraces
*Landform position (two-dimensional):* Summit, shoulder, backslope, footslope
*Landform position (three-dimensional):* Nose slope, side slope, base slope, crest, tread, riser
*Down-slope shape:* Linear, convex, concave
*Across-slope shape:* Convex, linear, concave
*Hydric soil rating:* No

## 253C—Hinckley loamy sand, 8 to 15 percent slopes

**Map Unit Setting**

*National map unit symbol:* 2svm9
*Elevation:* 0 to 1,480 feet
*Mean annual precipitation:* 36 to 71 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 140 to 240 days
*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

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

**Description of Hinckley**

**Setting**

*Landform:* Kame terraces, outwash plains, moraines, outwash deltas, kames, eskers, outwash terraces
*Landform position (two-dimensional):* Shoulder, toeslope, footslope, backslope
*Landform position (three-dimensional):* Nose slope, side slope, crest, head slope, riser
*Down-slope shape:* Linear, convex, concave
*Across-slope shape:* Convex, linear, concave
*Parent material:* Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

**Typical profile**

*Oe - 0 to 1 inches:* moderately decomposed plant material
*A - 1 to 8 inches:* loamy sand

*Bw1 - 8 to 11 inches:* gravelly loamy sand
*Bw2 - 11 to 16 inches:* gravelly loamy sand
*BC - 16 to 19 inches:* very gravelly loamy sand
*C - 19 to 65 inches:* very gravelly sand

**Properties and qualities**

*Slope:* 8 to 15 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Excessively drained
*Runoff class:* Very low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to very high (1.42 to 99.90 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Available water storage in profile:* Low (about 3.1 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* A
*Hydric soil rating:* No

**Minor Components**

**Merrimac**

*Percent of map unit:* 5 percent
*Landform:* Eskers, outwash terraces, kames, moraines, outwash plains
*Landform position (two-dimensional):* Shoulder, backslope, footslope, toeslope
*Landform position (three-dimensional):* Side slope, head slope, nose slope, crest, riser
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Hydric soil rating:* No

**Windsor**

*Percent of map unit:* 5 percent
*Landform:* Outwash deltas, moraines, outwash terraces, eskers, kame terraces, kames, outwash plains
*Landform position (two-dimensional):* Shoulder, backslope, footslope, toeslope
*Landform position (three-dimensional):* Nose slope, side slope, crest, head slope, riser
*Down-slope shape:* Convex, concave, linear
*Across-slope shape:* Concave, linear, convex
*Hydric soil rating:* No

**Sudbury**

*Percent of map unit:* 5 percent
*Landform:* Moraines, outwash deltas, outwash terraces, kame terraces, outwash plains
*Landform position (two-dimensional):* Backslope, footslope
*Landform position (three-dimensional):* Base slope, tread
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

## 253D—Hinckley loamy sand, 15 to 25 percent slopes

### Map Unit Setting

*National map unit symbol:* 2svmc
*Elevation:* 0 to 1,460 feet
*Mean annual precipitation:* 36 to 71 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 140 to 240 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

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

### Description of Hinckley

#### Setting

*Landform:* Outwash plains, moraines, outwash deltas, kame terraces, kames, eskers, outwash terraces
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Nose slope, side slope, crest, head slope, riser
*Down-slope shape:* Convex, linear, concave
*Across-slope shape:* Linear, convex, concave
*Parent material:* Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

#### Typical profile

*Oe - 0 to 1 inches:* moderately decomposed plant material
*A - 1 to 8 inches:* loamy sand
*Bw1 - 8 to 11 inches:* gravelly loamy sand
*Bw2 - 11 to 16 inches:* gravelly loamy sand
*BC - 16 to 19 inches:* very gravelly loamy sand
*C - 19 to 65 inches:* very gravelly sand

#### Properties and qualities

*Slope:* 15 to 25 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Excessively drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to very high (1.42 to 99.90 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Available water storage in profile:* Low (about 3.1 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 6e
*Hydrologic Soil Group:* A
*Hydric soil rating:* No

**Minor Components**

**Merrimac**

*Percent of map unit:* 8 percent
*Landform:* Outwash terraces, eskers, kames, moraines, outwash plains
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope, crest, head slope, nose slope, riser
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Hydric soil rating:* No

**Windsor**

*Percent of map unit:* 5 percent
*Landform:* Moraines, kame terraces, outwash terraces, eskers, kames, outwash plains, outwash deltas
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Nose slope, side slope, crest, head slope, riser
*Down-slope shape:* Convex, linear, concave
*Across-slope shape:* Linear, convex, concave
*Hydric soil rating:* No

**Sudbury**

*Percent of map unit:* 2 percent
*Landform:* Moraines, outwash deltas, kame terraces, outwash terraces, eskers, outwash plains
*Landform position (two-dimensional):* Backslope, footslope
*Landform position (three-dimensional):* Base slope, tread
*Down-slope shape:* Concave, linear, convex
*Across-slope shape:* Linear, concave, convex
*Hydric soil rating:* No

## 254B—Merrimac fine sandy loam, 3 to 8 percent slopes

**Map Unit Setting**

*National map unit symbol:* 2tyqs
*Elevation:* 0 to 1,290 feet
*Mean annual precipitation:* 36 to 71 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 140 to 240 days
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

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

**Description of Merrimac**

**Setting**

*Landform:* Eskers, outwash terraces, kames, moraines, outwash plains
*Landform position (two-dimensional):* Backslope, footslope, shoulder, summit
*Landform position (three-dimensional):* Side slope, crest, tread, riser
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Parent material:* Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

**Typical profile**

*Ap - 0 to 10 inches:* fine sandy loam
*Bw1 - 10 to 22 inches:* fine sandy loam
*Bw2 - 22 to 26 inches:* stratified gravel to gravelly loamy sand
*2C - 26 to 65 inches:* stratified gravel to very gravelly sand

**Properties and qualities**

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Somewhat excessively drained
*Runoff class:* Very low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to very high (1.42 to 99.90 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 2 percent
*Salinity, maximum in profile:* Nonsaline (0.0 to 1.4 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 1.0
*Available water storage in profile:* Low (about 4.6 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2s
*Hydrologic Soil Group:* A
*Hydric soil rating:* No

**Minor Components**

**Sudbury**

*Percent of map unit:* 5 percent
*Landform:* Outwash plains, terraces, deltas
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Tread, dip
*Down-slope shape:* Concave
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Hinckley**

*Percent of map unit:* 5 percent
*Landform:* Outwash plains, kames, eskers, deltas
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Head slope, crest, side slope, nose slope, rise
*Down-slope shape:* Convex
*Across-slope shape:* Linear, convex
*Hydric soil rating:* No

**Windsor**

*Percent of map unit:* 3 percent
*Landform:* Dunes, deltas, outwash terraces, outwash plains
*Landform position (two-dimensional):* Shoulder
*Landform position (three-dimensional):* Tread, riser
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

**Agawam**

*Percent of map unit:* 2 percent
*Landform:* Moraines, outwash plains, stream terraces, kames, eskers, outwash terraces
*Landform position (three-dimensional):* Rise
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Hydric soil rating:* No

# References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

# Appendix B – Test Pit Results

# COLD SPRING ENVIRONMENTAL CONSULTANTS INC.

- 21E Site Investigations
- Subsurface Investigations
- Pollution Remediation
- LSP on Staff
- Forensic Septic Investigations
- Percolation Tests
- Septic Designs
- Regulatory Compliance
- Recycling and Solid Waste
- Second Opinions


December 14, 2020

**Lucy Conley, P.E.**
**The Berkshire Design Group, Inc,**
**4 Allen Place**
**Northampton, MA 01060**

**RE: Soil Evaluations 18-20 & 22 Amherst Road. Pelham, MA**

Greetings,

The soil evaluations TP-1 through TP-4 were requested by you and performed by us on December 3, 2020 at the abovementioned property. The excavations were conducted at the locations that you provided on the site Plan, Excavation TP-5 was not completed as subsurface utility locations were interpreted as to close.

The soil evaluation attached (and photos) confirmed the existence of deep, Class A & B (Class 1 & 2) gravelly and stoney coarse sandy substrata to a depth of more than 9 feet below grade and shallow Estimated Seasonal High Groundwater conditions ranged from 58" (TP-4) to 108" (TP-2) below grade. Class 1 Coarse sandy stony stream terrace and outwash was observed in TP-1 through TP-4.

These conditions are consistent with the East to West Stream Terrace slopes along Fort Brook in this portion of Pioneer Valley. Form 11 Soil evaluations are attached. Mass Gis notes the Surficial Geology to consist of Stratified Glacial Deposits. NRCS Maps denote Hinkley Loamy Sand (253B) Soils.

Please feel free to contact me with any questions or further evaluation

Sincerely,

**Cold Spring Environmental Consultants, Inc.**

**Alan E. Weiss, M.S., R.S., L.S.P.**
**Licensed Soil Evaluator # 2568, since 1995**
**Principal Hydrogeologist**
**Massachusetts Public Health Sanitarian Lic. #933**

Attachments: Figures, Photos and Soil reports.


350 Old Enfield Road ▪ Belchertown, MA. 01007 ▪ Phone: 413.323.5957 Fax 413.323.4916
email: aeweiss@charter.net

# Cold Spring Environmental Consultants, Inc.

350 Old Enfield Road
Belchertown, MA. 01007
http://www.coldspringenvironmental.com

Ph: 413.323.5957
Fax: 413.323.4916
email: acweiss@charter.net


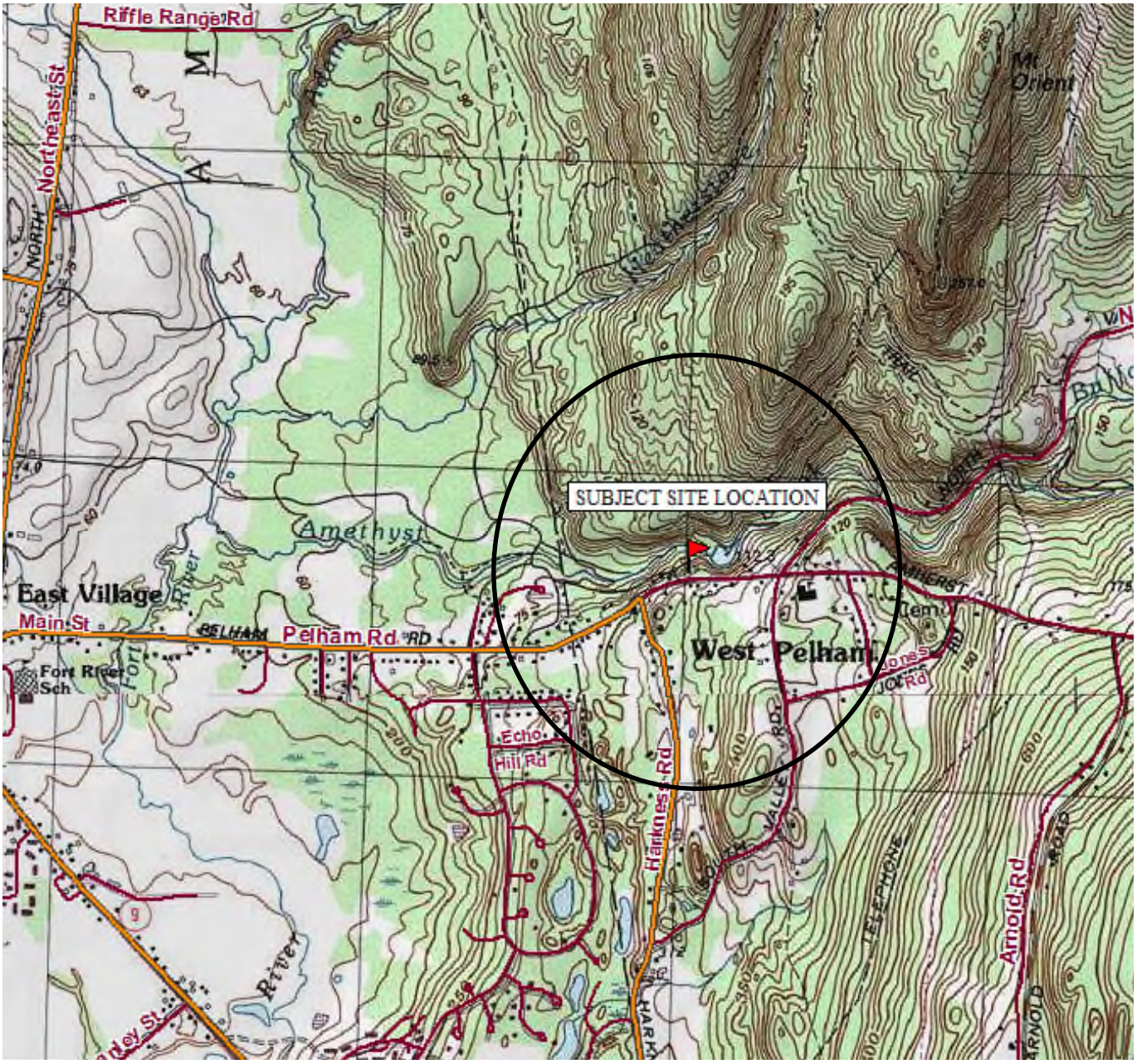


**FIGURE 1—SITE LOCUS**
**18-22 Amherst Road**
**Pelham, MA**

FROM USGS

**December, 2020**

TP-4

Stone Dam Remains

Top Of Bank

Amethyst Brook

Stone Dam Remains

Stone Race Remains

Stone Dam Remains

Amethyst Brook

B-1 GR=289 TILL=273.9 GW=273 REF=267.9

B-9 GR=289 BR=286

1 Sty W/F

1 Sty W/F

2 Story Wood Frame Building

Wood Deck

GR=289 UTILITY=285+

B-8

5 22' T.P. #5

W/F Garage

Bituminous Concrete Parking

GR=298 BR=297.5

B-4

B-3 GR=300 BR=294.9

GR=295 TILL=289 GW=290 REF=283 BRICK

B-5

4 14' T.P. #4

B-7 GR=298 BR=295

Woods Road

Woods Road

Stone Foundation Remains

Raceway

Bituminous Road 19'

36" Oak

36"

W/F Barn

15" CMP

Brush

100' RIVERFRONT BUFFER

100' WETLAND BUFFER

GR=308 TILL=303 REF=301 B-6

Stone Foundation

Woods Road

2 T.P.#2 6' 34'

B-2 GR=311.5 TILL=305 REF=301.5

3 22' 18' T.P. #3

Gravel Drive

1 TP #1 21' 17'

Gravel Drive

At Base 2" Iron Pipe

Gravel Drive

Amherst Road

Public Right Of Way

TP-1,2 -3

0 25 50 100 150

FA:\PELHAM - 22 AMHERST ROAD\DESIGN PROCESS\ENGINEERING\DRAWINGS\22 PELHAM ROAD EXIST CONDITIONS.DWG PLOT DATE: 12/1/2020


Berkshire Design Group

Landscape Architecture
Civil Engineering
Planning
Land Surveying

4 Allen Place, Northampton, Massachusetts 01060
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Web: http://www.berkshiredesign.com




AMETHYST BROOK
APARTMENTS
20-22 AMHERST ROAD
PELHAM, MA

EXISTING CONDITIONS PLAN

Revisions

Date: APRIL 17, 2020
Scale: 1"=50'
Drawn By: LMC
Checked By: MBD

Sheet Number FIG 2

**Commonwealth of Massachusetts**
City/Town of Pelham

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## A. Facility Information

C/O Berkshire Design Group
Owner Name

18-20 Amherst Road — 3-32
Street Address — Map/Lot #

Pelham — MA — 01002
City — State — Zip Code

## B. Site Information

1. (Check one) ☐ New Construction ☐ Upgrade ☒ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Cal web USDA (Source) 253B (Soil Map Unit)

   Hinckley Loamy Sand (Soil Name) — Soil Limitations

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: USGS current (Year Published/Source) gis (Publication Scale) (Map Unit)

   Stoney, Granular Stream Outwash (Geologic/Parent Material) — Stream Terrace (Landform)

4. Flood Rate Insurance Map

   Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☐ Yes ☒ No

   Within the 500-year flood boundary? ☐ Yes ☒ No Within a velocity zone? ☐ Yes ☒ No

5. Wetland Area: Wetlands Conservancy Program Map - (Map Unit) (Name)

6. Current Water Resource Conditions (USGS): (Month/Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

7. Other references reviewed:

**Commonwealth of Massachusetts**
City/Town of Pelham
# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review (*minimum of two holes required at every proposed primary and reserved disposal area)*

**Deep Observation Hole Number:** 1, 2 and 3 | 12.3.2020 (Date) | 1300 (Time) | - (Weather)

1. Location

Ground Elevation at Surface of Hole: shown Location (identify on plan): -

2. Land Use: grassy (e.g., woodland, agricultural field, vacant lot, etc.) | no (Surface Stones) | 2 (Slope (%))
decidous mix (Vegetation) | terrace (Landform) | shown (Position on Landscape (attach sheet))

3. Distances from:

| | | | | | |
|---|---|---|---|---|---|
| Open Water Body | 100'+ feet | Drainage Way | 100'+ feet | Possible Wet Area | 50'+ feet |
| Property Line | 20'+ feet | Drinking Water Well | 100'+ feet | Other | - feet |

4. Parent Material: Outwash Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Not Obs. (Depth Weeping from Pit) | Not Obs. (Depth Standing Water in Hole)

Estimated Depth to High Groundwater: 80-108"+ inches _____ elevation

**Commonwealth of Massachusetts**
City/Town of Pelham
# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review (continued)

Deep Observation Hole Number: 1 & 2

| Depth (in.) | Soil Horizon/ Layer | Soil Matrix: Color-Moist (Munsell) | Redoximorphic Features (mottles) | | | Soil Texture (USDA) | Coarse Fragments % by Volume | | Soil Structure | Soil Consistence (Moist) | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Depth | Color | Percent | | Gravel | Cobbles & Stones | | | |
| 0-10" | A | 10 YR 3.2 | | | | FSL | | | FRIABLE | | mixed |
| 10-28" | Bw | 10 YR 5.6 | | | | FS | | | | Old | System |
| 28-80" | C1 | 2.5 y 5.6 | - | - | - | CS | 10 | 25 | Granular | Bouldery | Outwash |
| Large | Rock | at 80" | | | | | | | | | |
| | | | | | | | | | | | |
| 0-48" | fill | 10 YR 5.8 | | | | FS | | | | | Disturbed |
| 48-108" | C | 2.5 Y 5.6 | - | - | - | CS | 10 | 25 | Granular | Bouldery | Outwash |

Additional Notes:

**Commonwealth of Massachusetts**
City/Town of Pelham
# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review (continued)

Deep Observation Hole Number: 3

| Depth (in.) | Soil Horizon/ Layer | Soil Matrix: Color-Moist (Munsell) | Redoximorphic Features (mottles) | | | Soil Texture (USDA) | Coarse Fragments % by Volume | | Soil Structure | Soil Consistence (Moist) | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Depth | Color | Percent | | Gravel | Cobbles & Stones | | | |
| 0-12" | A | 10 YR 3.2 | | | | FSL | | | | | |
| 12-26" | B | 10 YR 5.6 | | | | FS | | | | | |
| 26-96" | C | 2.5 y 5.6 | - | - | - | CS | 10 | 25 | Granular | Bouldery | Outwash |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Additional Notes:

**Commonwealth of Massachusetts**
City/Town of Pelham
# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## D. Determination of High Groundwater Elevation

1. Method Used:

| | A. | B. |
|---|---|---|
| ☐ Depth observed standing water in observation hole | A. not inches | B. not inches |
| ☐ Depth weeping from side of observation hole | A. not inches | B. not inches |
| ☒ Depth to soil redoximorphic features (mottles) | A. 80-108"+ inches | B. 80-108"+ inches |
| ☐ Groundwater adjustment (USGS methodology) | A. inches | B. inches |

2.

| Index Well Number | Reading Date | Index Well Level |
|---|---|---|
| Adjustment Factor | Adjusted Groundwater Level | |

## E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material
   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?
      ☒ Yes ☐ No
   b. If yes, at what depth was it observed? Upper boundary: 48 inches Lower boundary: 80-108" inches

**Commonwealth of Massachusetts**
City/Town of Pelham
# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## F. 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 required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

| | |
|---|---|
| Signature of Soil Evaluator | 12/01/2020<br>Date |
| ALAN WEISS, RS #933, SE #2568, Cold Spring Env. Inc.<br>Typed or Printed Name of Soil Evaluator / License # | 6/1995<br>Date of Soil Evaluator Exam |
| -<br>Name of Board of Health Witness | Board of Health |

**Note:** In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

**Commonwealth of Massachusetts**
City/Town of Pelham

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## A. Facility Information

C/O Berkshire Design Group
Owner Name

220 Amherst Road | 3-30
Street Address | Map/Lot #

Pelham | MA | 01002
City | State | Zip Code

## B. Site Information

1. (Check one) ☐ New Construction ☐ Upgrade ☒ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Cal web USDA (Source) 253B (Soil Map Unit)

   Hinckley Loamy Sand (Soil Name) | (Soil Limitations)

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: USGS current (Year Published/Source) gis (Publication Scale) (Map Unit)

   Stoney, Granular Stream Outwash (Geologic/Parent Material) | Stream Terrace (Landform)

4. Flood Rate Insurance Map

   Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☐ Yes ☒ No

   Within the 500-year flood boundary? ☐ Yes ☒ No Within a velocity zone? ☐ Yes ☒ No

5. Wetland Area: Wetlands Conservancy Program Map - (Map Unit) (Name)

6. Current Water Resource Conditions (USGS): (Month/Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

7. Other references reviewed:

**Commonwealth of Massachusetts**
City/Town of Pelham
# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review (*minimum of two holes required at every proposed primary and reserved disposal area)*

**Deep Observation Hole Number:** TP-4 | 12.3.2020 (Date) | 1300 (Time) | - (Weather)

1. Location

Ground Elevation at Surface of Hole: shown  Location (identify on plan): -

2. Land Use: grassy (e.g., woodland, agricultural field, vacant lot, etc.) | no (Surface Stones) | 5 (Slope (%))
decidous mix (Vegetation) | terrace (Landform) | shown (Position on Landscape (attach sheet))

3. Distances from:

| | | | | | |
|---|---|---|---|---|---|
| Open Water Body | 100'+ feet | Drainage Way | 100'+ feet | Possible Wet Area | 50'+ feet |
| Property Line | 20'+ feet | Drinking Water Well | 100'+ feet | Other | - feet |

4. Parent Material: Outwash  Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No  If yes: 76" (Depth Weeping from Pit) | - (Depth Standing Water in Hole)

Estimated Depth to High Groundwater: 58"+ inches  elevation

**Commonwealth of Massachusetts**
City/Town of Pelham
# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review (continued)

Deep Observation Hole Number: TP-4

| Depth (in.) | Soil Horizon/ Layer | Soil Matrix: Color-Moist (Munsell) | Redoximorphic Features (mottles) | | | Soil Texture (USDA) | Coarse Fragments % by Volume | | Soil Structure | Soil Consistence (Moist) | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Depth | Color | Percent | | Gravel | Cobbles & Stones | | | |
| 0-36" | Fill | 10 YR 3.2 | | | | FSL | | | | | Disturbed |
| 36-110" | C1 | 2.5 Y5.6 | 58" | 10YR2.2 | 10 | CS | 10 | 10 | Granular | Bouldery | Outwash |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Additional Notes:

**Commonwealth of Massachusetts**
City/Town of Pelham
# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## D. Determination of High Groundwater Elevation

1. Method Used:

| | A | B |
|---|---|---|
| ☐ Depth observed standing water in observation hole | A. not inches | B. not inches |
| ☒ Depth weeping from side of observation hole | A. 76" inches | B. not inches |
| ☒ Depth to soil redoximorphic features (mottles) | A. 58"+ inches | B. not inches |
| ☐ Groundwater adjustment (USGS methodology) | A. inches | B. inches |

2.

| Index Well Number | Reading Date | Index Well Level |
|---|---|---|
| Adjustment Factor | Adjusted Groundwater Level | |

## E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material
   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?
      ☒ Yes ☐ No
   b. If yes, at what depth was it observed? Upper boundary: 36" inches Lower boundary: 110" inches

**Commonwealth of Massachusetts**
City/Town of Pelham
# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

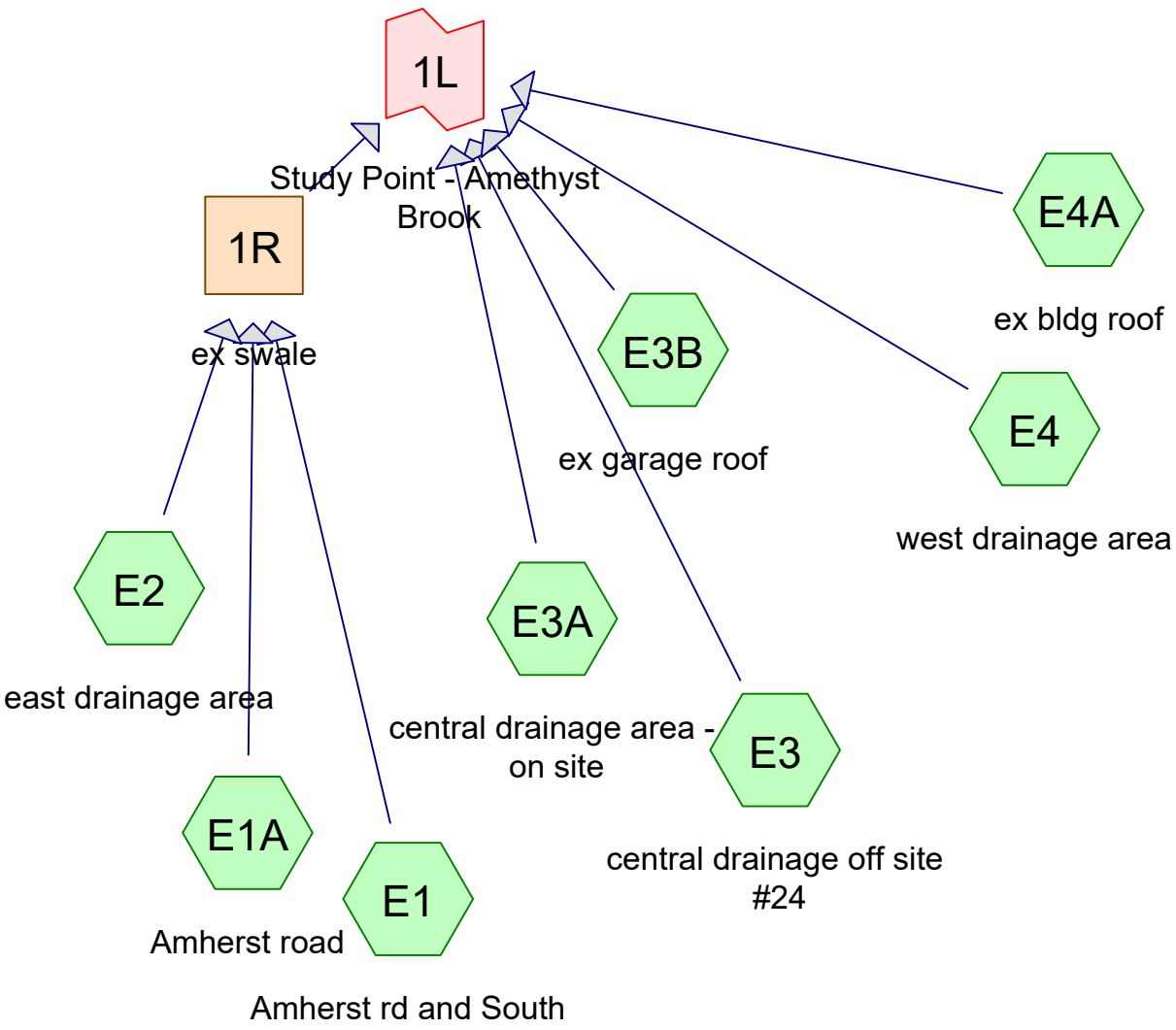
## F. Certification

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 required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

| | |
|---|---|
| Signature of Soil Evaluator | 12/01/2020<br>Date |
| ALAN WEISS, RS #933, SE #2568, Cold Spring Env. Inc.<br>Typed or Printed Name of Soil Evaluator / License # | 6/1995<br>Date of Soil Evaluator Exam |
| -<br>Name of Board of Health Witness | Board of Health |

**Note:** In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

# Appendix C – Stormwater Hydrology Calculations




Subcat Reach Pond Link

**Routing Diagram for 20.024 EXIST REV**
Prepared by Berkshire Design Group, Printed 12/14/2020

## Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 4007 MA Amherst Hampshire County

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.706 | 49 | 50-75% Grass cover, Fair, HSG A (E1, E1A, E2, E3, E3A, E4A) |
| 0.038 | 49 | Drip edge around buildings (E3A) |
| 0.028 | 96 | Gravel surface, HSG A (E2) |
| 1.128 | 98 | Paved parking, HSG A (E1, E1A, E2, E3, E3A, E4, E4A) |
| 0.019 | 98 | Paved parking, HSG B (E1) |
| 0.056 | 98 | Roofs, HSG A (E3B) |
| 2.791 | 36 | Woods, Fair, HSG A (E1, E2, E3, E3A, E4) |
| 0.704 | 60 | Woods, Fair, HSG B (E1) |
| **5.469** | **55** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 4.709 | HSG A | E1, E1A, E2, E3, E3A, E3B, E4, E4A |
| 0.722 | HSG B | E1 |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 0.038 | Other | E3A |
| **5.469** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.706 | 0.000 | 0.000 | 0.000 | 0.000 | 0.706 | 50-75% Grass cover, Fair | E1, E1A, E2, E3, E3A, E4A |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.038 | 0.038 | Drip edge around buildings | E3A |
| 0.028 | 0.000 | 0.000 | 0.000 | 0.000 | 0.028 | Gravel surface | E2 |
| 1.128 | 0.019 | 0.000 | 0.000 | 0.000 | 1.146 | Paved parking | E1, E1A, E2, E3, E3A, E4, E4A |
| 0.056 | 0.000 | 0.000 | 0.000 | 0.000 | 0.056 | Roofs | E3B |
| 2.791 | 0.704 | 0.000 | 0.000 | 0.000 | 3.495 | Woods, Fair | E1, E2, E3, E3A, E4 |
| **4.709** | **0.722** | **0.000** | **0.000** | **0.038** | **5.469** | **TOTAL AREA** | |

## Summary for Subcatchment E1: Amherst rd and South

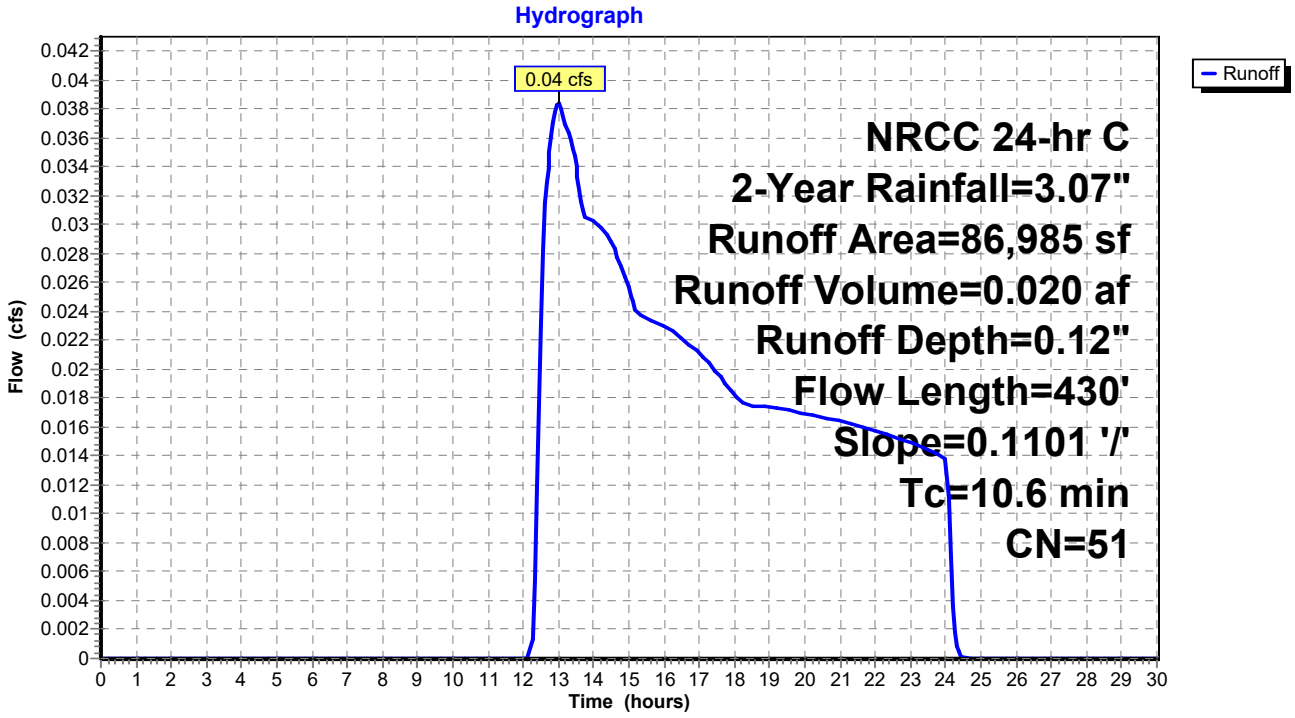
Runoff = 0.04 cfs @ 13.01 hrs, Volume= 0.020 af, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| Area (sf) | CN | Description |
|---|---|---|
| 7,024 | 98 | Paved parking, HSG A |
| 806 | 98 | Paved parking, HSG B |
| 39,100 | 36 | Woods, Fair, HSG A |
| 30,655 | 60 | Woods, Fair, HSG B |
| 9,400 | 49 | 50-75% Grass cover, Fair, HSG A |
| 86,985 | 51 | Weighted Average |
| 79,155 | | 91.00% Pervious Area |
| 7,830 | | 9.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.6 | 430 | 0.1101 | 0.68 | | **Lag/CN Method,** Contour Length= 9,580' Interval= 1' |

### Subcatchment E1: Amherst rd and South



## Summary for Subcatchment E1A: Amherst road

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

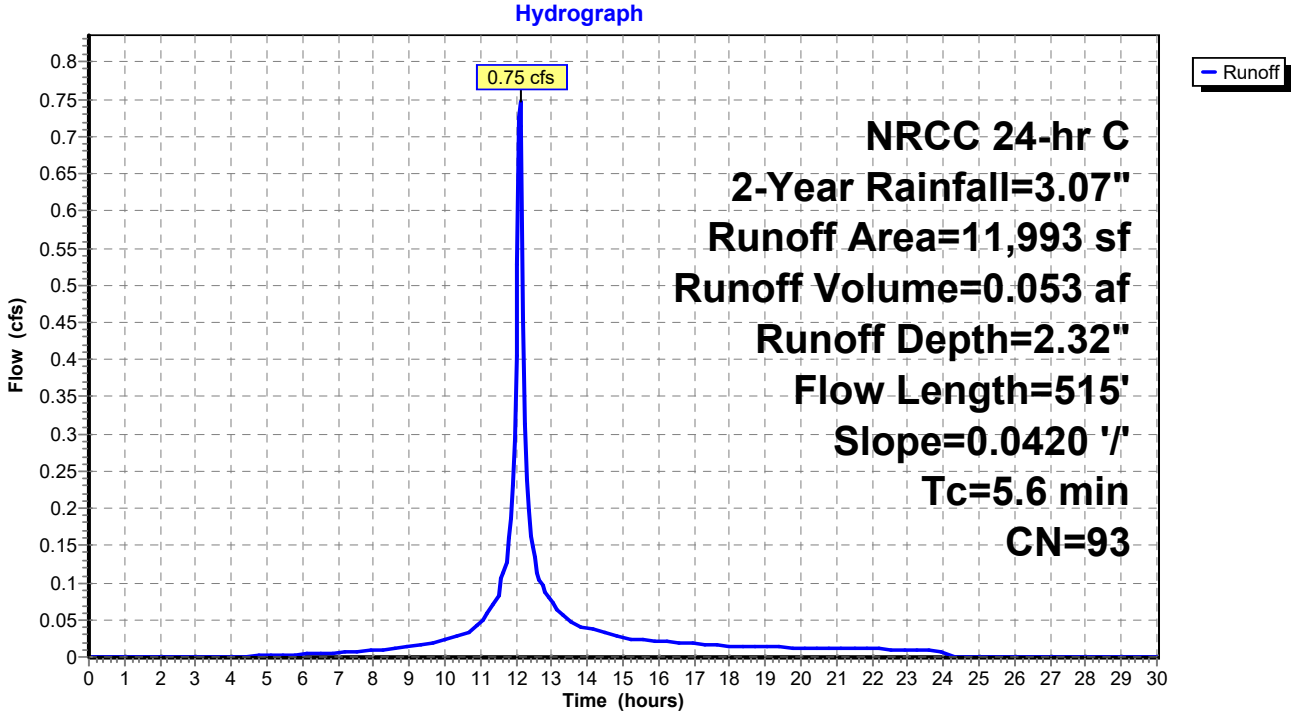
Runoff = 0.75 cfs @ 12.12 hrs, Volume= 0.053 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| Area (sf) | CN | Description |
|---|---|---|
| 10,800 | 98 | Paved parking, HSG A |
| 1,193 | 49 | 50-75% Grass cover, Fair, HSG A |
| 11,993 | 93 | Weighted Average |
| 1,193 | | 9.95% Pervious Area |
| 10,800 | | 90.05% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.6 | 515 | 0.0420 | 1.53 | | **Lag/CN Method,** Contour Length= 504' Interval= 1' |

### Subcatchment E1A: Amherst road



## Summary for Subcatchment E2: east drainage area

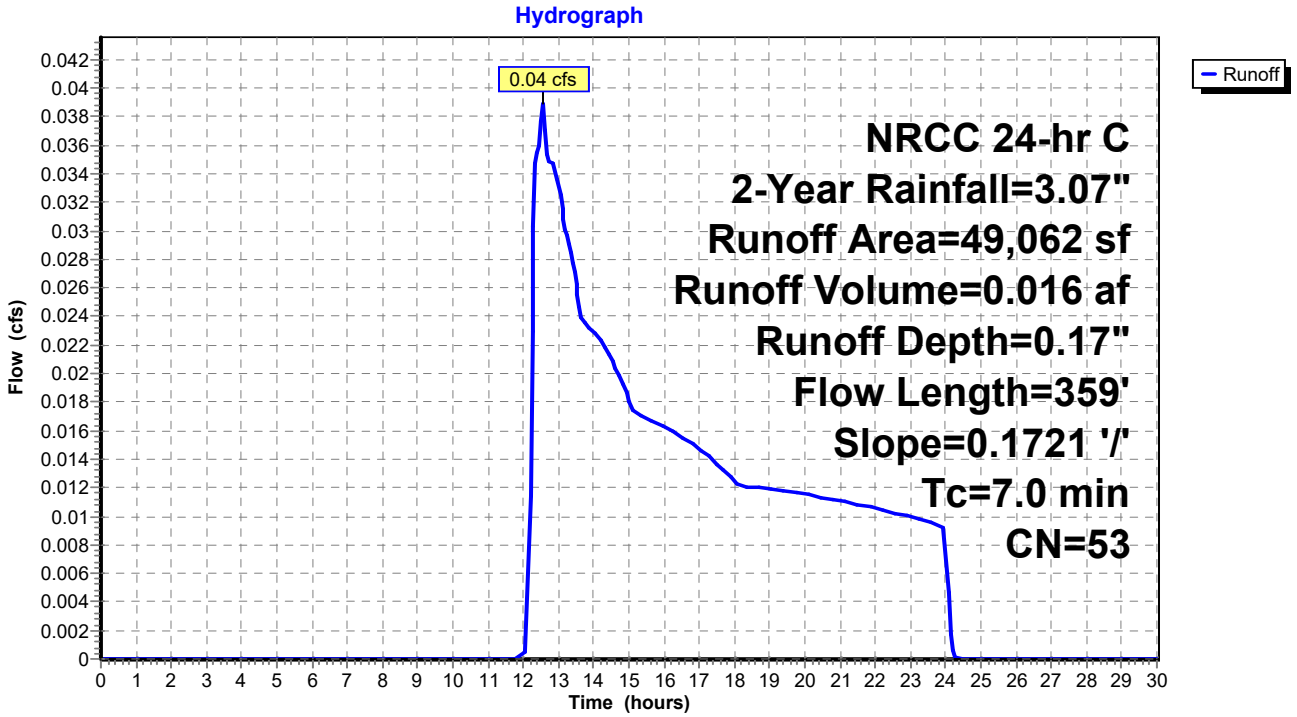
Runoff = 0.04 cfs @ 12.54 hrs, Volume= 0.016 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| Area (sf) | CN | Description |
|---|---|---|
| 10,891 | 98 | Paved parking, HSG A |
| 31,957 | 36 | Woods, Fair, HSG A |
| 5,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| 1,214 | 96 | Gravel surface, HSG A |
| 49,062 | 53 | Weighted Average |
| 38,171 | | 77.80% Pervious Area |
| 10,891 | | 22.20% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.0 | 359 | 0.1721 | 0.86 | | **Lag/CN Method,** Contour Length= 8,443' Interval= 1' |

## Subcatchment E2: east drainage area



## Summary for Subcatchment E3: central drainage off site #24

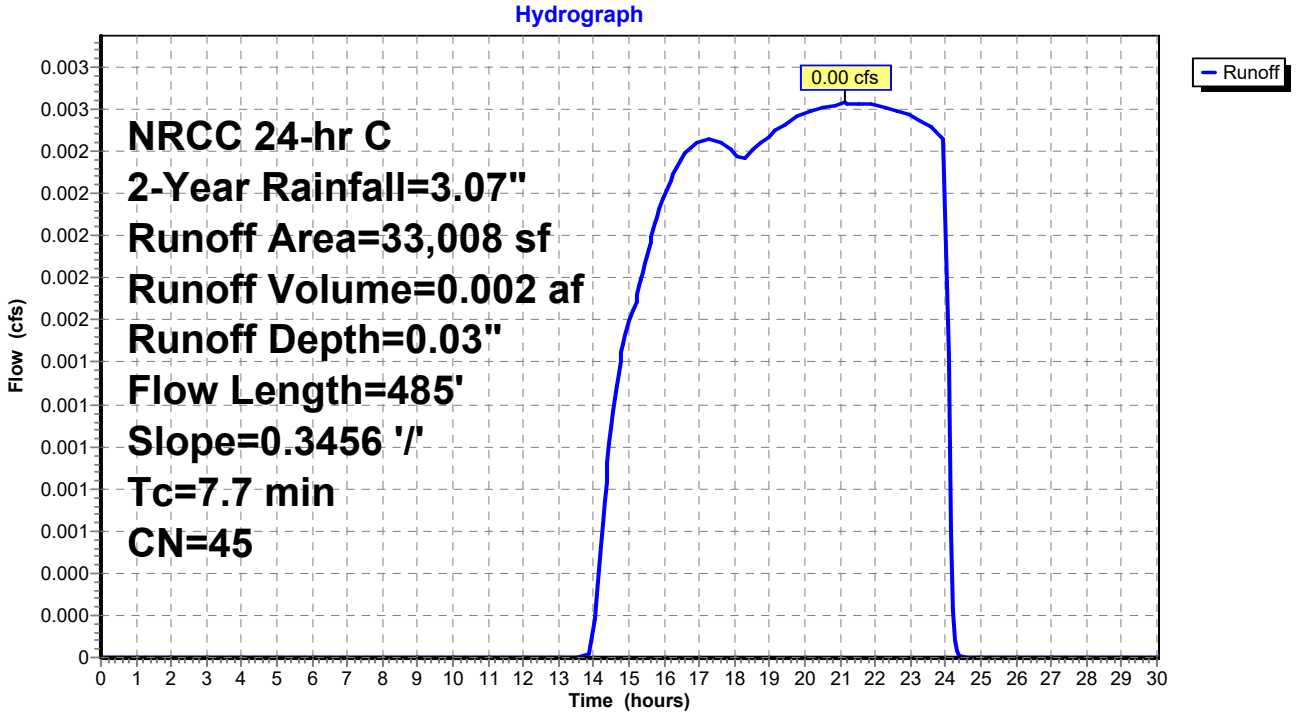
Runoff = 0.00 cfs @ 21.16 hrs, Volume= 0.002 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| Area (sf) | CN | Description |
|---|---|---|
| 3,810 | 98 | Paved parking, HSG A |
| 24,198 | 36 | Woods, Fair, HSG A |
| 5,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| 33,008 | 45 | Weighted Average |
| 29,198 | | 88.46% Pervious Area |
| 3,810 | | 11.54% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.7 | 485 | 0.3456 | 1.05 | | **Lag/CN Method,** Contour Length= 11,408' Interval= 1' |

### Subcatchment E3: central drainage off site #24



## Summary for Subcatchment E3A: central drainage area - on site

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

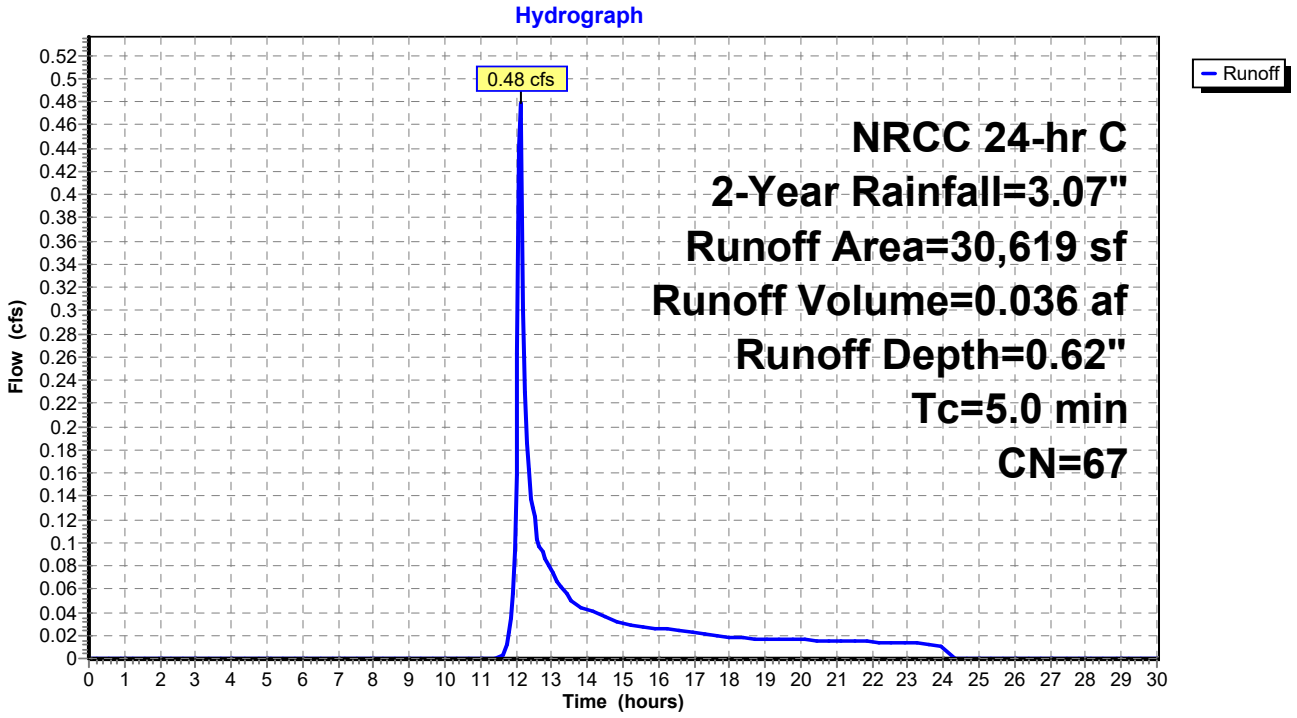
Runoff = 0.48 cfs @ 12.13 hrs, Volume= 0.036 af, Depth= 0.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 12,631 | 98 | Paved parking, HSG A |
| | 10,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 6,338 | 36 | Woods, Fair, HSG A |
| * | 1,650 | 49 | Drip edge around buildings |
| | 30,619 | 67 | Weighted Average |
| | 17,988 | | 58.75% Pervious Area |
| | 12,631 | | 41.25% Impervious Area |

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

## Subcatchment E3A: central drainage area - on site



## Summary for Subcatchment E3B: ex garage roof

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

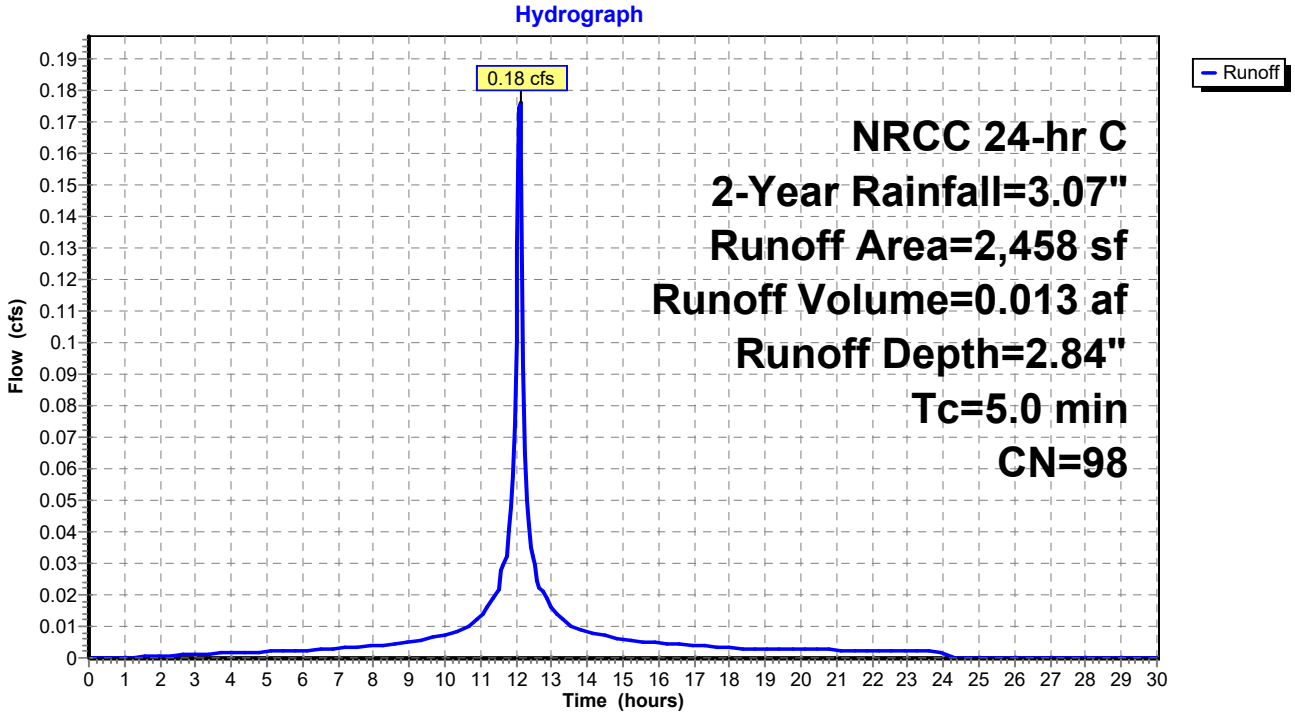
Runoff = 0.18 cfs @ 12.11 hrs, Volume= 0.013 af, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| Area (sf) | CN | Description |
|---|---|---|
| 2,458 | 98 | Roofs, HSG A |
| 2,458 | | 100.00% Impervious Area |

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

### Subcatchment E3B: ex garage roof



## Summary for Subcatchment E4: west drainage area

[45] Hint: Runoff=Zero

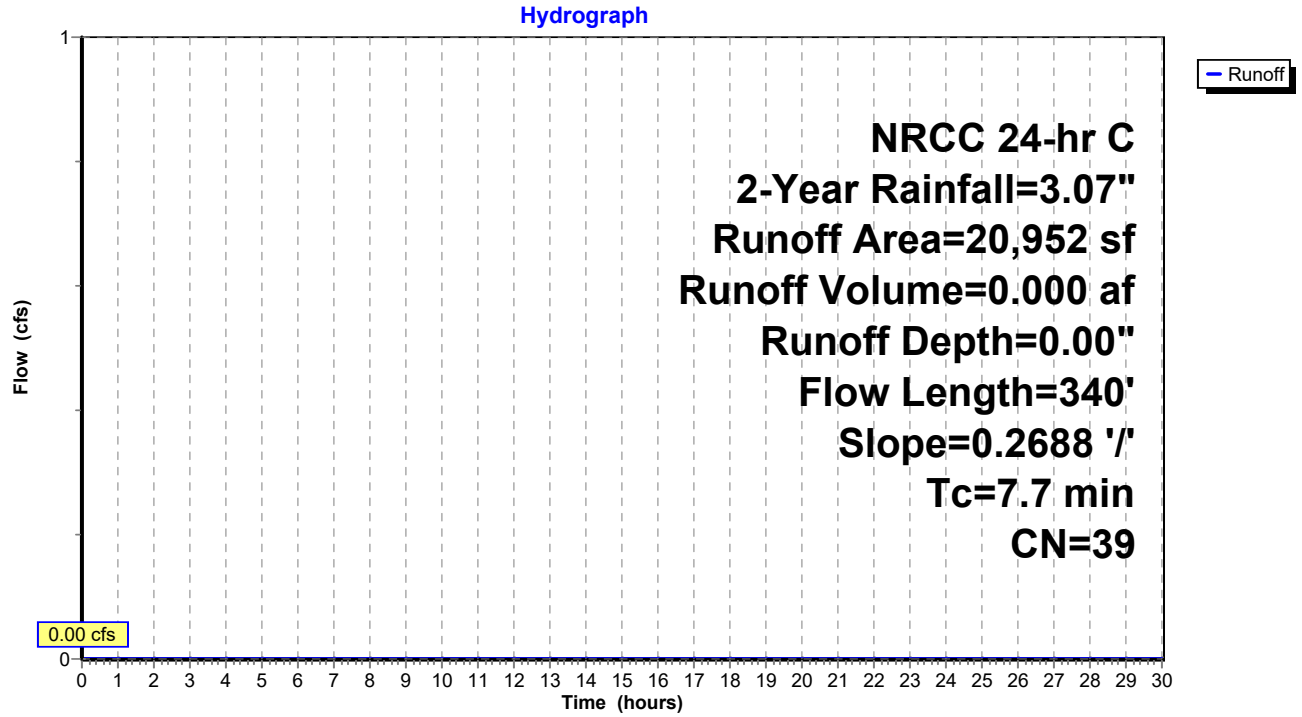
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| Area (sf) | CN | Description |
|---|---|---|
| 967 | 98 | Paved parking, HSG A |
| 19,985 | 36 | Woods, Fair, HSG A |
| 20,952 | 39 | Weighted Average |
| 19,985 | | 95.38% Pervious Area |
| 967 | | 4.62% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.7 | 340 | 0.2688 | 0.74 | | **Lag/CN Method,** Contour Length= 5,632' Interval= 1' |

### Subcatchment E4: west drainage area



## Summary for Subcatchment E4A: ex bldg roof

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

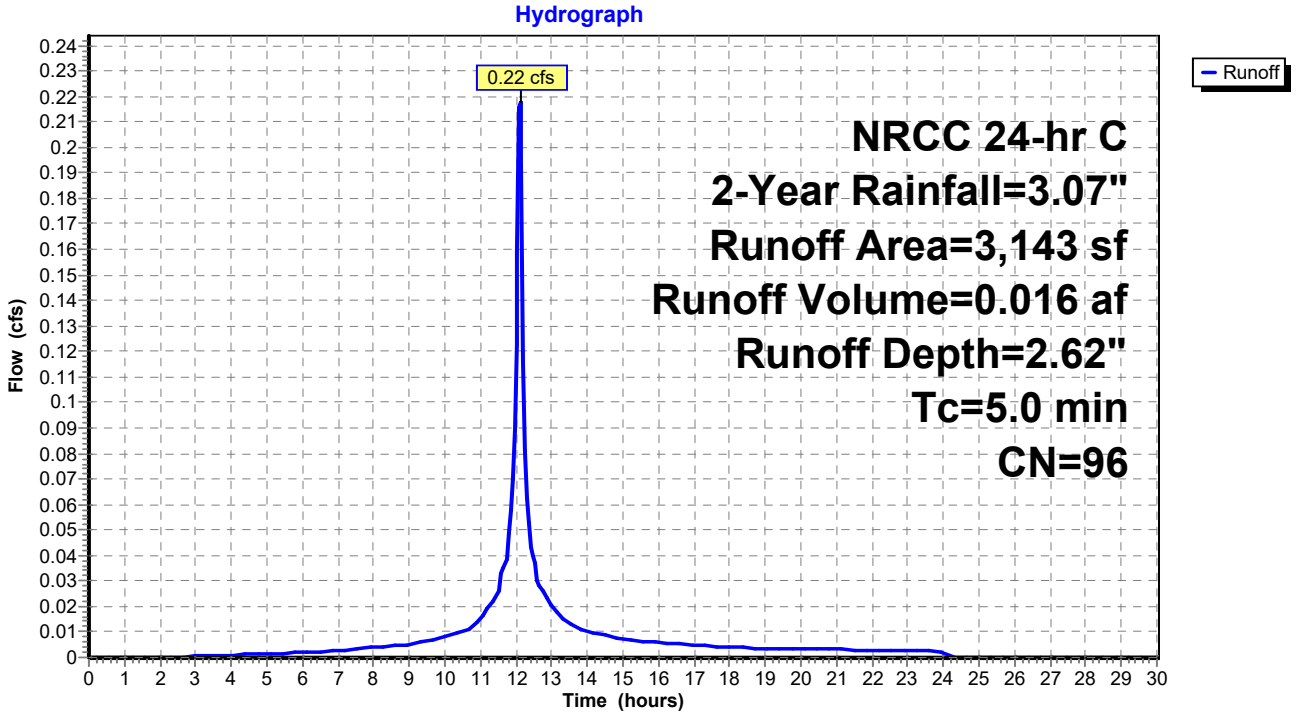
Runoff = 0.22 cfs @ 12.11 hrs, Volume= 0.016 af, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| Area (sf) | CN | Description |
|---|---|---|
| 3,000 | 98 | Paved parking, HSG A |
| 143 | 49 | 50-75% Grass cover, Fair, HSG A |
| 3,143 | 96 | Weighted Average |
| 143 | | 4.55% Pervious Area |
| 3,000 | | 95.45% Impervious Area |

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

## Subcatchment E4A: ex bldg roof



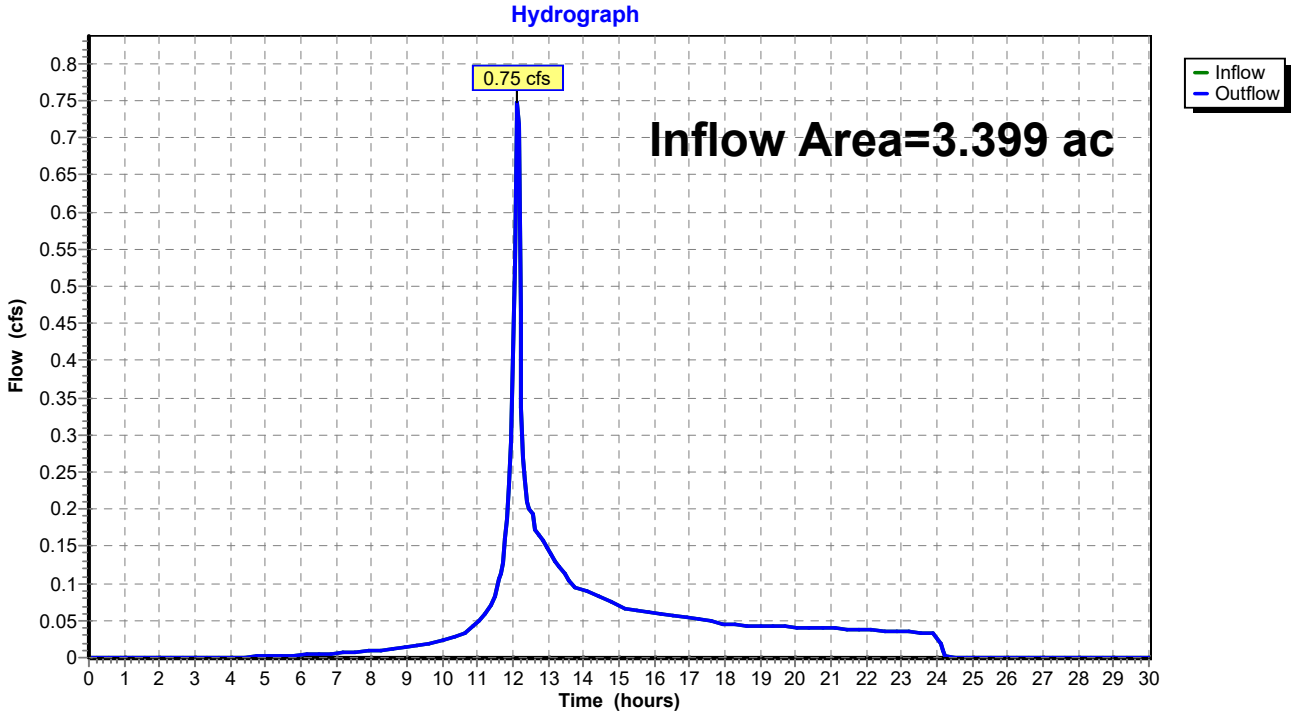
## Summary for Reach 1R: ex swale

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

Inflow Area = 3.399 ac, 19.94% Impervious, Inflow Depth = 0.31" for 2-Year event
Inflow = 0.75 cfs @ 12.12 hrs, Volume= 0.089 af
Outflow = 0.75 cfs @ 12.12 hrs, Volume= 0.089 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 1R: ex swale

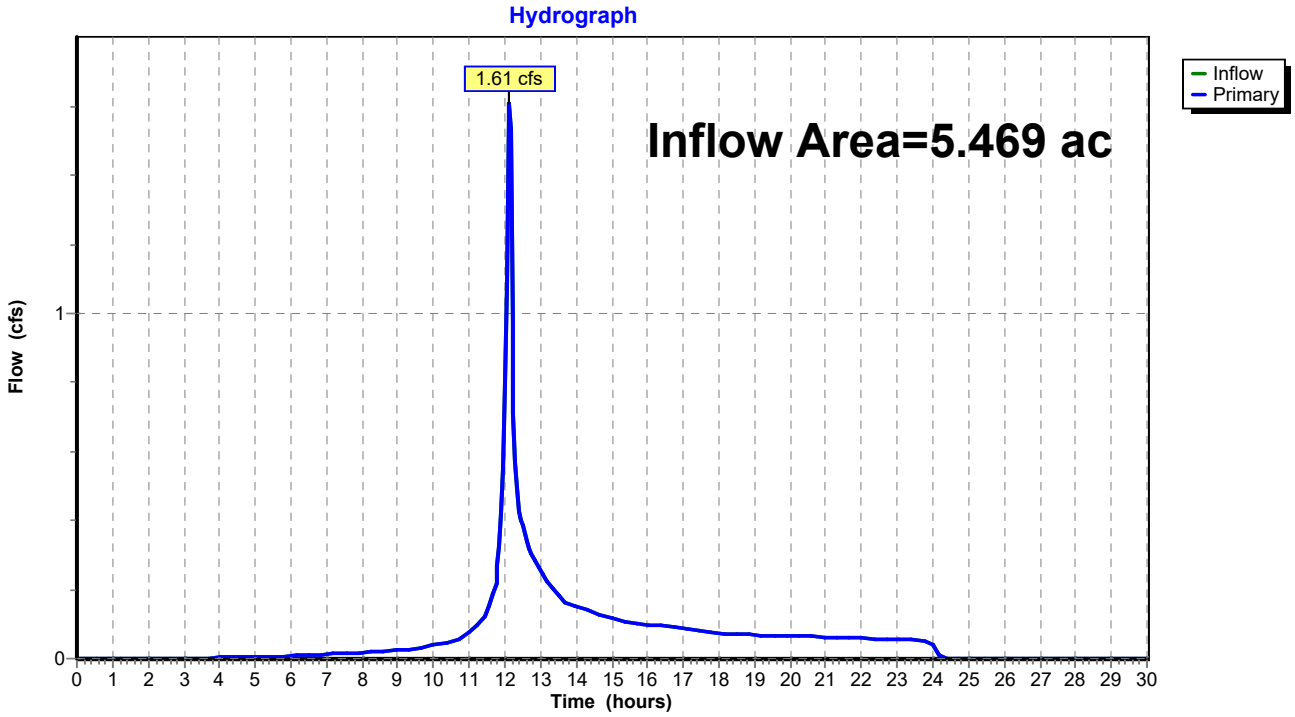


## Summary for Link 1L: Study Point - Amethyst Brook

Inflow Area = 5.469 ac, 21.99% Impervious, Inflow Depth = 0.34" for 2-Year event
Inflow = 1.61 cfs @ 12.12 hrs, Volume= 0.157 af
Primary = 1.61 cfs @ 12.12 hrs, Volume= 0.157 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

## Link 1L: Study Point - Amethyst Brook



## Summary for Subcatchment E1: Amherst rd and South

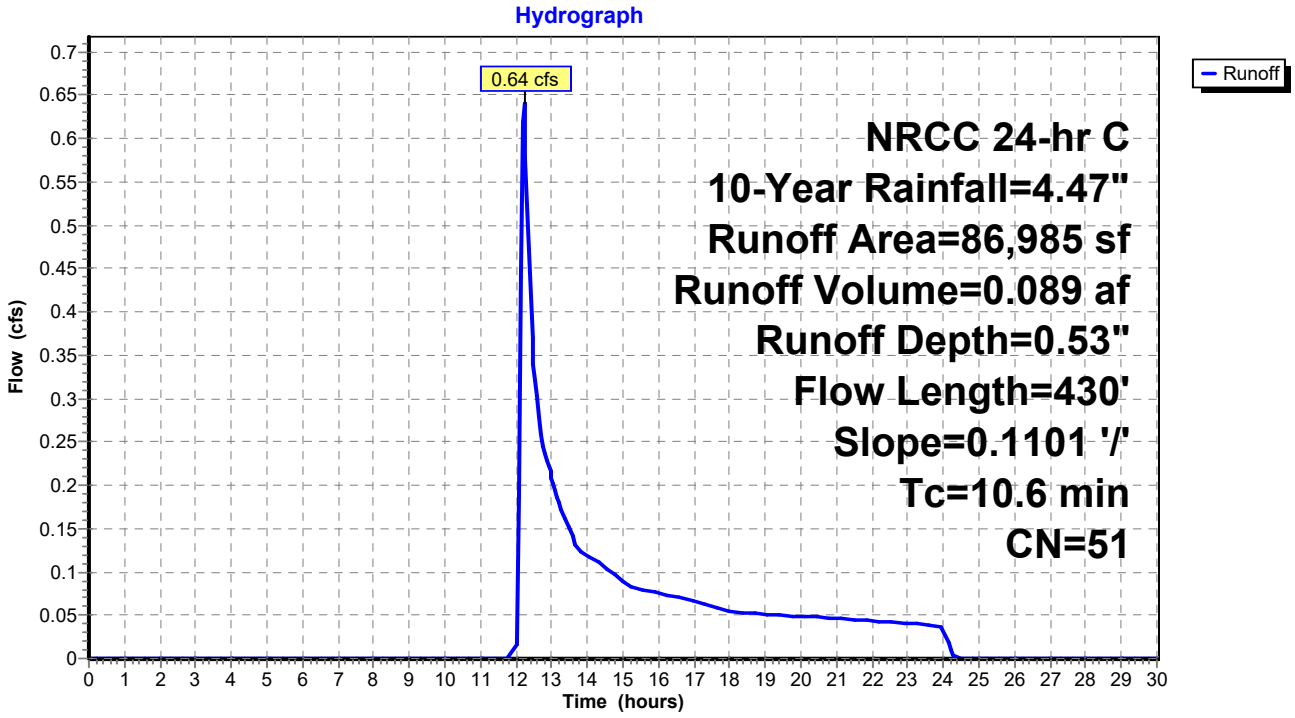
Runoff = 0.64 cfs @ 12.22 hrs, Volume= 0.089 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| Area (sf) | CN | Description |
|---|---|---|
| 7,024 | 98 | Paved parking, HSG A |
| 806 | 98 | Paved parking, HSG B |
| 39,100 | 36 | Woods, Fair, HSG A |
| 30,655 | 60 | Woods, Fair, HSG B |
| 9,400 | 49 | 50-75% Grass cover, Fair, HSG A |
| 86,985 | 51 | Weighted Average |
| 79,155 | | 91.00% Pervious Area |
| 7,830 | | 9.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.6 | 430 | 0.1101 | 0.68 | | **Lag/CN Method,** Contour Length= 9,580' Interval= 1' |

## Subcatchment E1: Amherst rd and South



## Summary for Subcatchment E1A: Amherst road

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

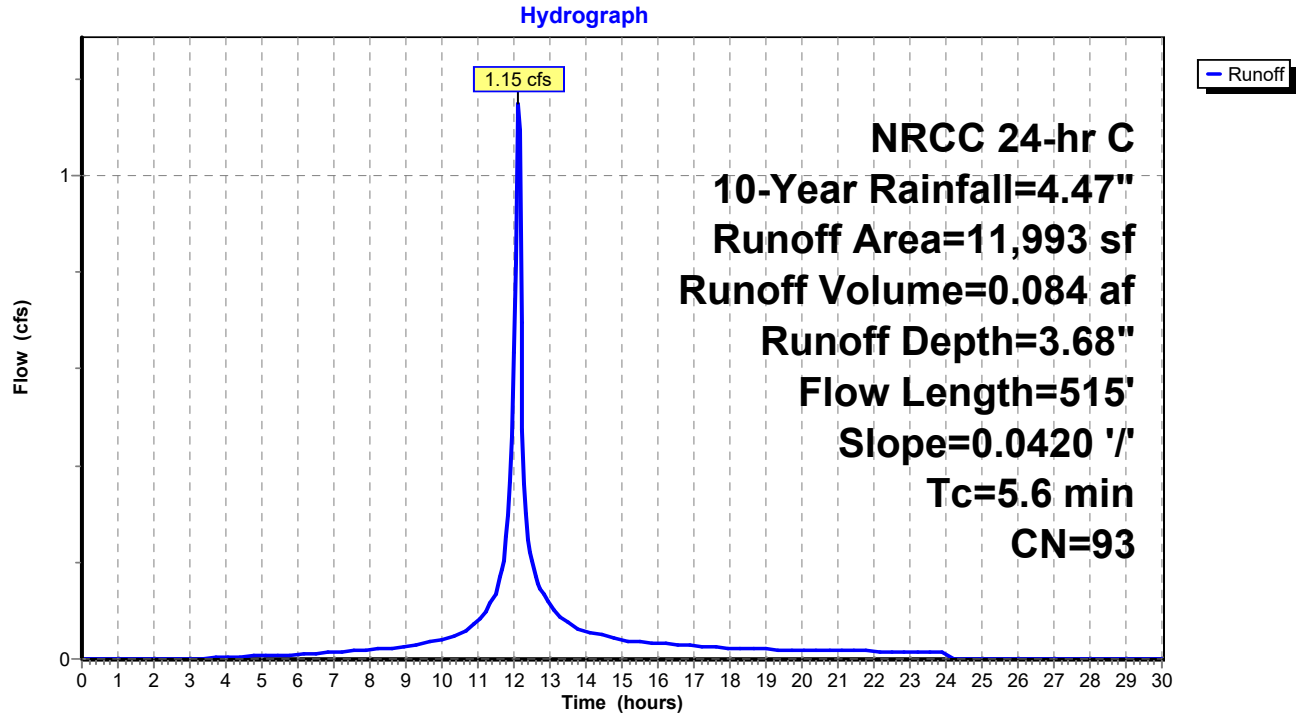
Runoff = 1.15 cfs @ 12.12 hrs, Volume= 0.084 af, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| Area (sf) | CN | Description |
|---|---|---|
| 10,800 | 98 | Paved parking, HSG A |
| 1,193 | 49 | 50-75% Grass cover, Fair, HSG A |
| 11,993 | 93 | Weighted Average |
| 1,193 | | 9.95% Pervious Area |
| 10,800 | | 90.05% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.6 | 515 | 0.0420 | 1.53 | | **Lag/CN Method,** Contour Length= 504' Interval= 1' |

### Subcatchment E1A: Amherst road



## Summary for Subcatchment E2: east drainage area

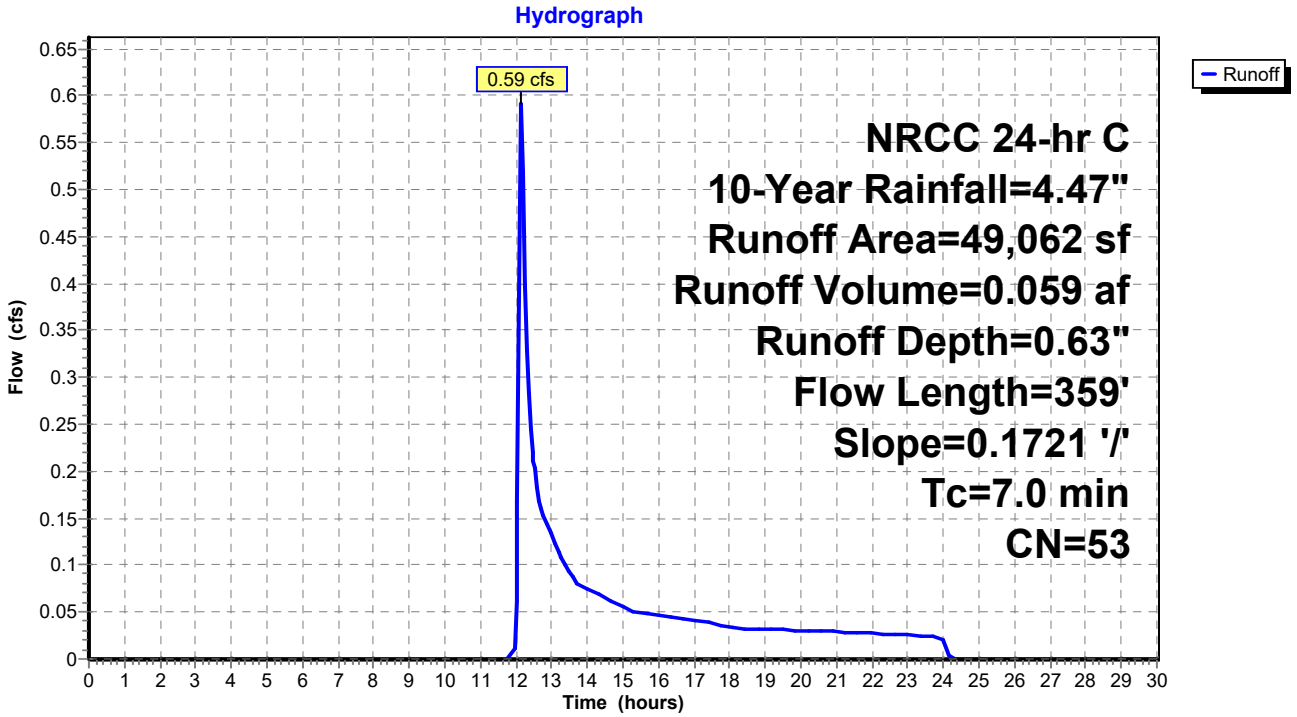
Runoff = 0.59 cfs @ 12.16 hrs, Volume= 0.059 af, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| Area (sf) | CN | Description |
|---|---|---|
| 10,891 | 98 | Paved parking, HSG A |
| 31,957 | 36 | Woods, Fair, HSG A |
| 5,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| 1,214 | 96 | Gravel surface, HSG A |
| 49,062 | 53 | Weighted Average |
| 38,171 | | 77.80% Pervious Area |
| 10,891 | | 22.20% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.0 | 359 | 0.1721 | 0.86 | | **Lag/CN Method,** Contour Length= 8,443' Interval= 1' |

## Subcatchment E2: east drainage area



## Summary for Subcatchment E3: central drainage off site #24

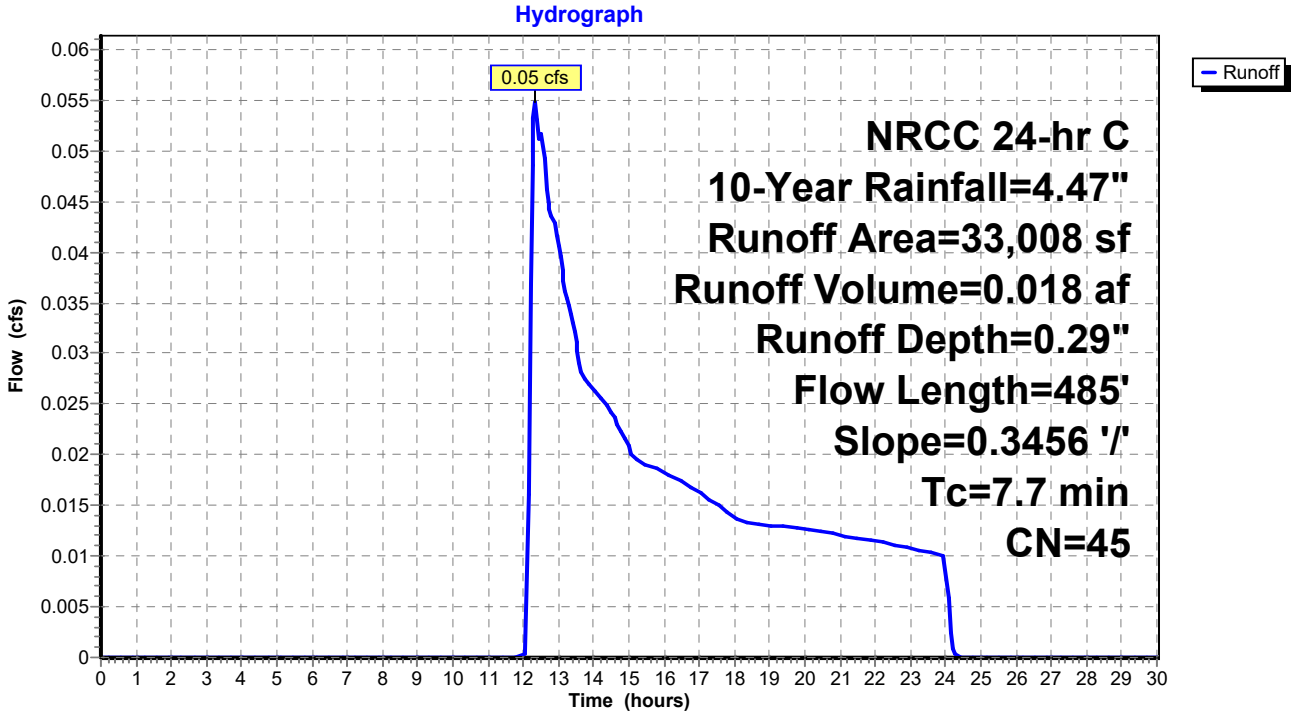
Runoff = 0.05 cfs @ 12.35 hrs, Volume= 0.018 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| Area (sf) | CN | Description |
|---|---|---|
| 3,810 | 98 | Paved parking, HSG A |
| 24,198 | 36 | Woods, Fair, HSG A |
| 5,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| 33,008 | 45 | Weighted Average |
| 29,198 | | 88.46% Pervious Area |
| 3,810 | | 11.54% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.7 | 485 | 0.3456 | 1.05 | | **Lag/CN Method,** Contour Length= 11,408' Interval= 1' |

## Subcatchment E3: central drainage off site #24



## Summary for Subcatchment E3A: central drainage area - on site

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

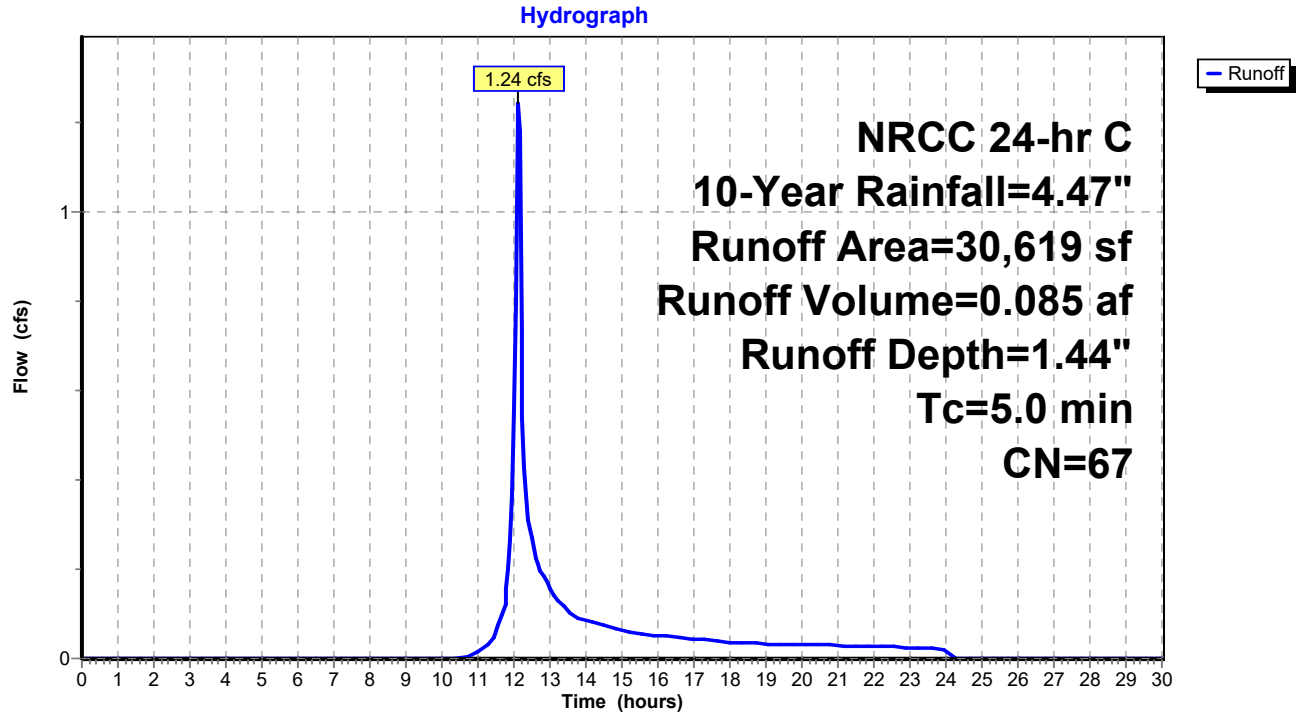
Runoff = 1.24 cfs @ 12.12 hrs, Volume= 0.085 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 12,631 | 98 | Paved parking, HSG A |
| | 10,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 6,338 | 36 | Woods, Fair, HSG A |
| * | 1,650 | 49 | Drip edge around buildings |
| | 30,619 | 67 | Weighted Average |
| | 17,988 | | 58.75% Pervious Area |
| | 12,631 | | 41.25% Impervious Area |

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

### Subcatchment E3A: central drainage area - on site



## Summary for Subcatchment E3B: ex garage roof

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

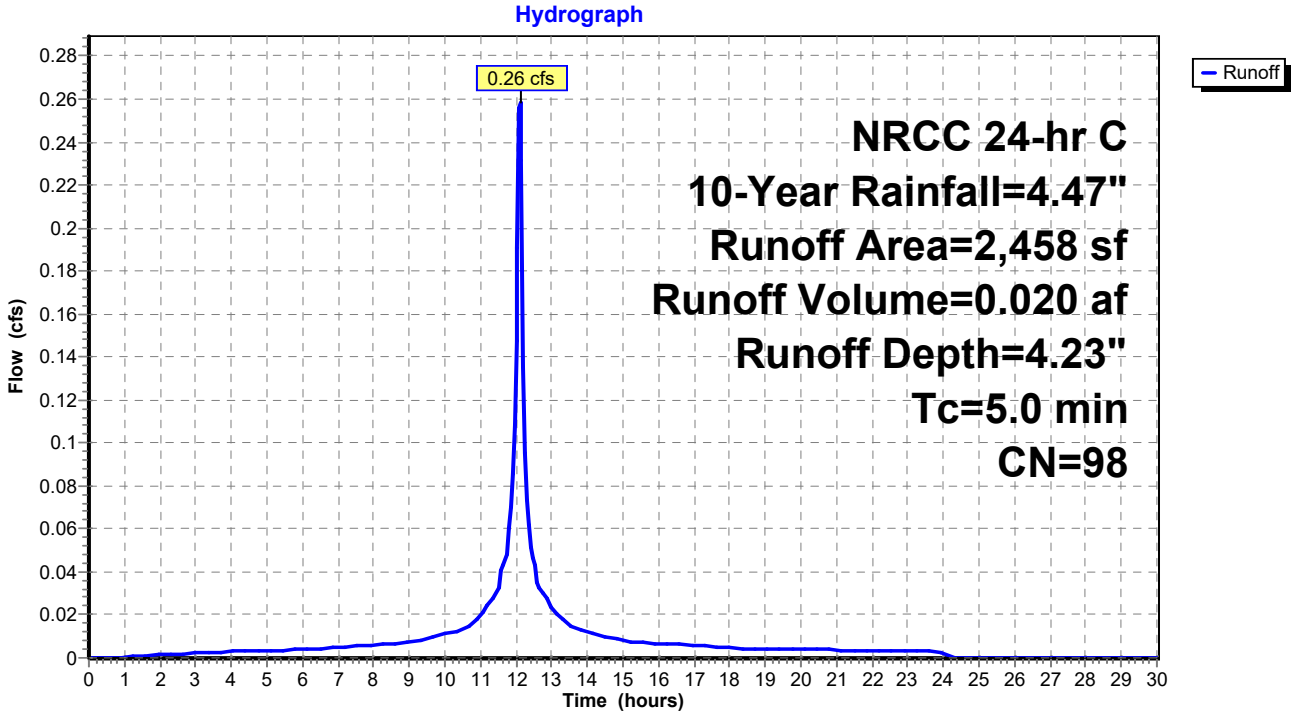
Runoff = 0.26 cfs @ 12.11 hrs, Volume= 0.020 af, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| Area (sf) | CN | Description |
|---|---|---|
| 2,458 | 98 | Roofs, HSG A |
| 2,458 | | 100.00% Impervious Area |

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

### Subcatchment E3B: ex garage roof



## Summary for Subcatchment E4: west drainage area

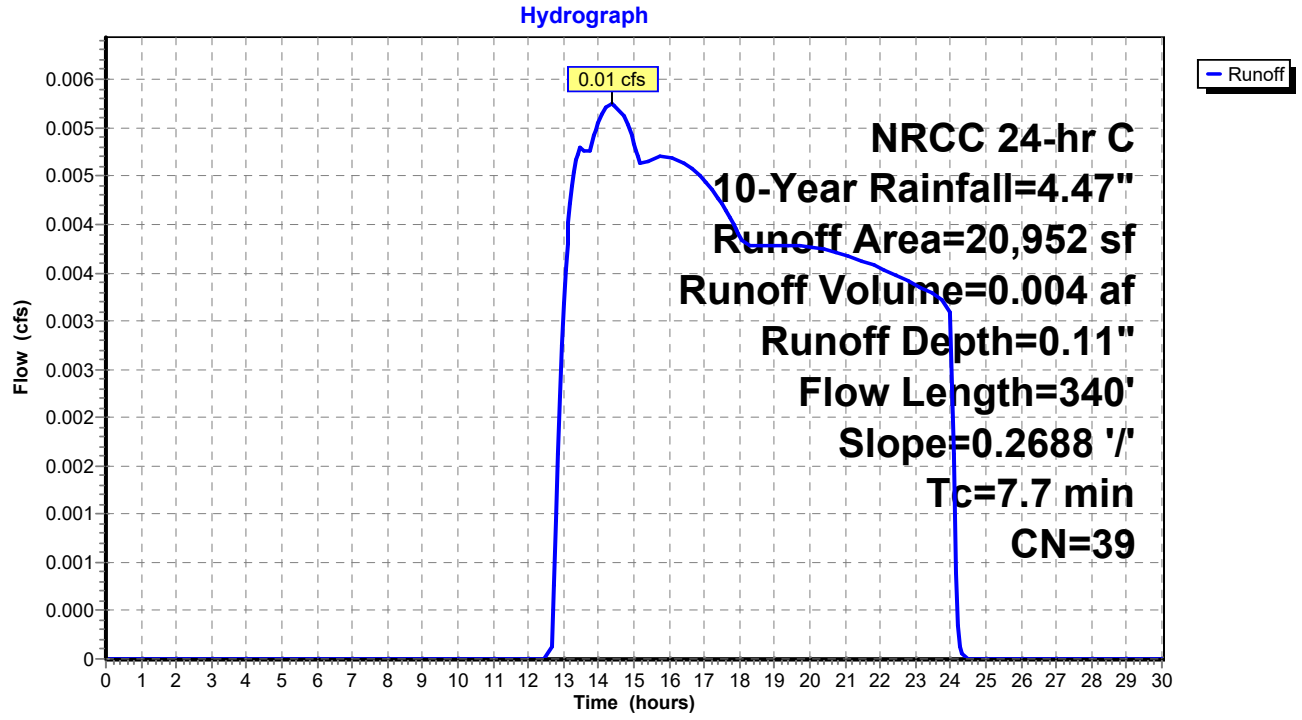
Runoff = 0.01 cfs @ 14.37 hrs, Volume= 0.004 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| Area (sf) | CN | Description |
|---|---|---|
| 967 | 98 | Paved parking, HSG A |
| 19,985 | 36 | Woods, Fair, HSG A |
| 20,952 | 39 | Weighted Average |
| 19,985 | | 95.38% Pervious Area |
| 967 | | 4.62% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.7 | 340 | 0.2688 | 0.74 | | **Lag/CN Method,** Contour Length= 5,632' Interval= 1' |

## Subcatchment E4: west drainage area



## Summary for Subcatchment E4A: ex bldg roof

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

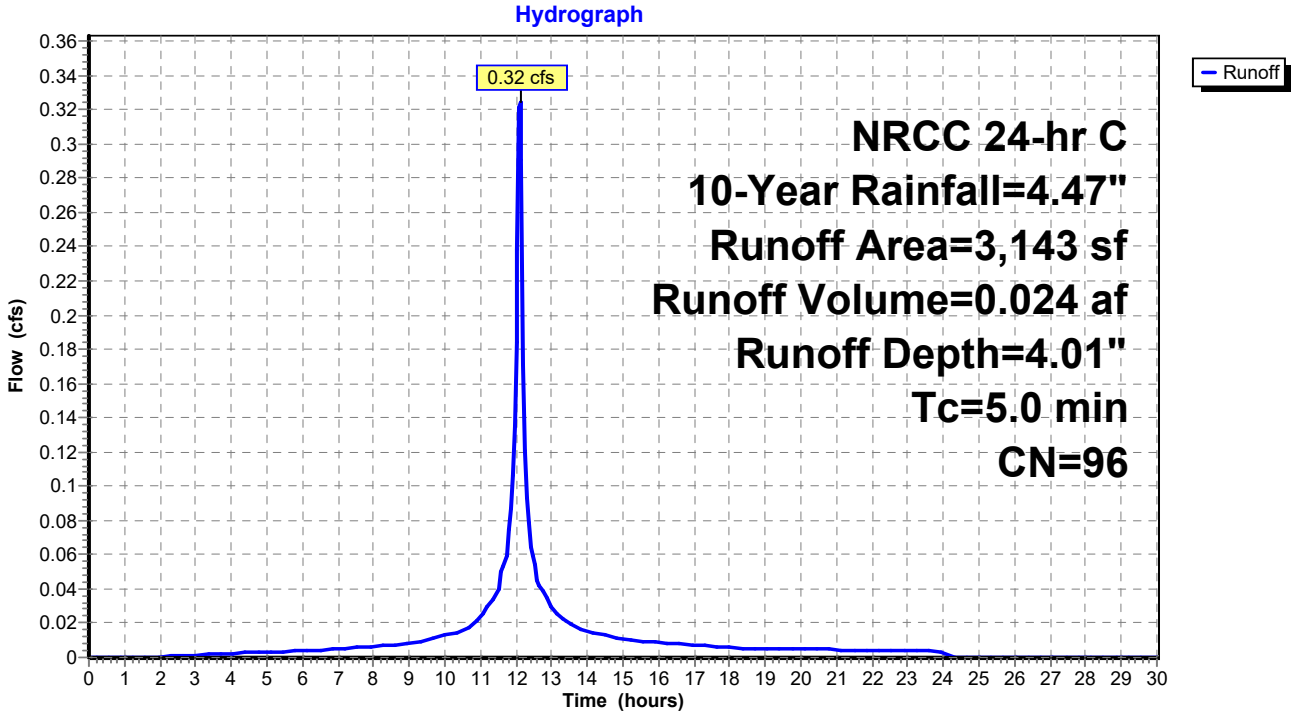
Runoff = 0.32 cfs @ 12.11 hrs, Volume= 0.024 af, Depth= 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| Area (sf) | CN | Description |
|---|---|---|
| 3,000 | 98 | Paved parking, HSG A |
| 143 | 49 | 50-75% Grass cover, Fair, HSG A |
| 3,143 | 96 | Weighted Average |
| 143 | | 4.55% Pervious Area |
| 3,000 | | 95.45% Impervious Area |

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

## Subcatchment E4A: ex bldg roof



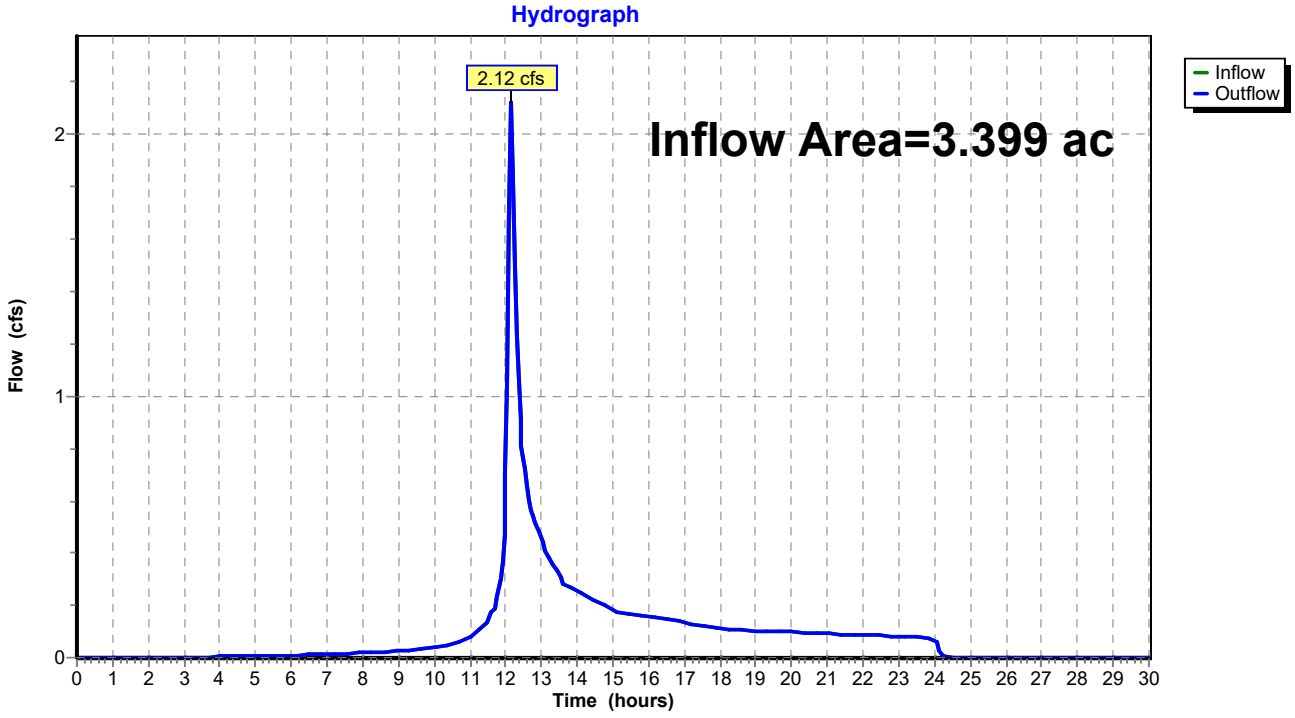
## Summary for Reach 1R: ex swale

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

Inflow Area = 3.399 ac, 19.94% Impervious, Inflow Depth = 0.82" for 10-Year event
Inflow = 2.12 cfs @ 12.15 hrs, Volume= 0.232 af
Outflow = 2.12 cfs @ 12.15 hrs, Volume= 0.232 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 1R: ex swale

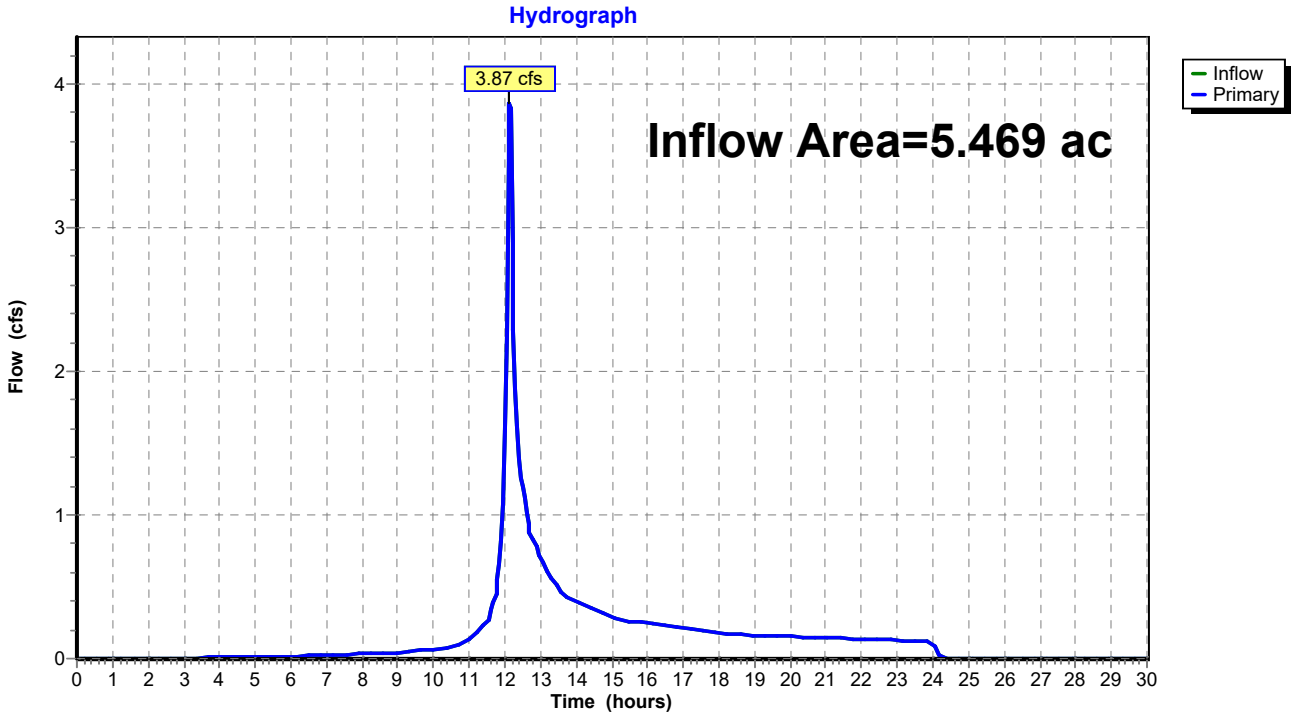


## Summary for Link 1L: Study Point - Amethyst Brook

Inflow Area = 5.469 ac, 21.99% Impervious, Inflow Depth = 0.84" for 10-Year event
Inflow = 3.87 cfs @ 12.14 hrs, Volume= 0.383 af
Primary = 3.87 cfs @ 12.14 hrs, Volume= 0.383 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

## Link 1L: Study Point - Amethyst Brook



## Summary for Subcatchment E1: Amherst rd and South

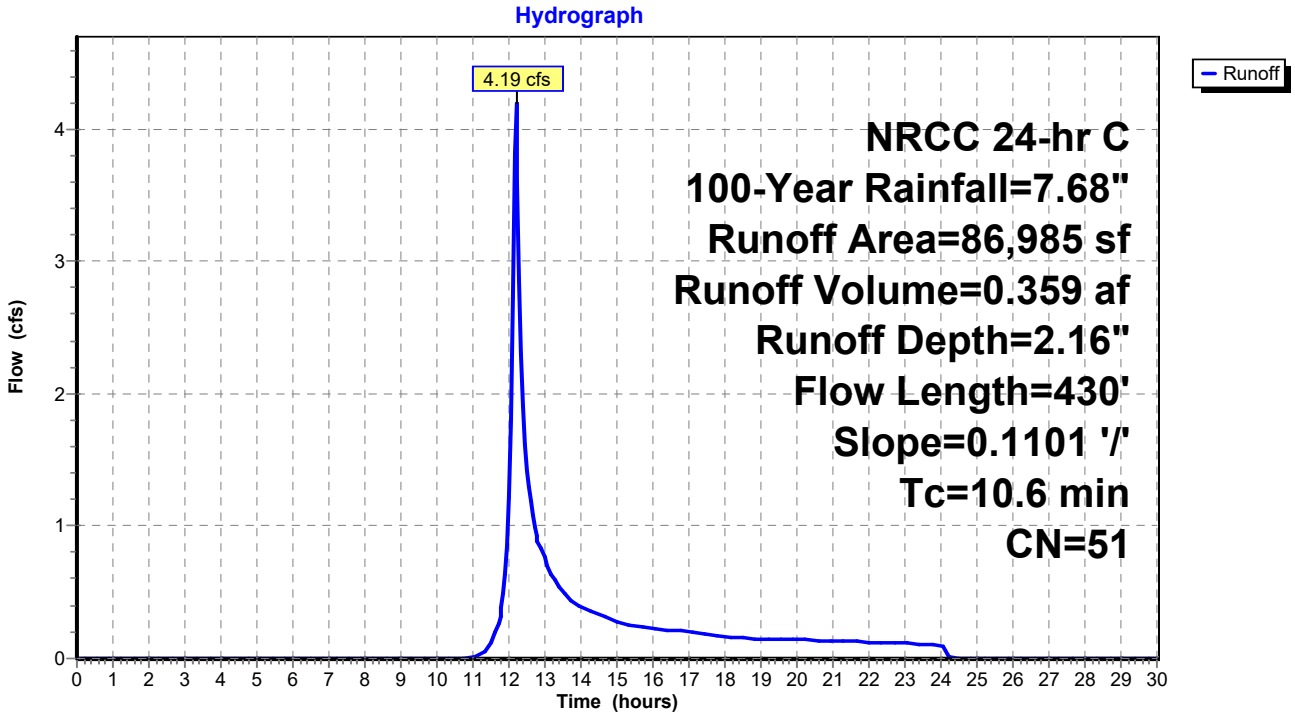
Runoff = 4.19 cfs @ 12.19 hrs, Volume= 0.359 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| Area (sf) | CN | Description |
|---|---|---|
| 7,024 | 98 | Paved parking, HSG A |
| 806 | 98 | Paved parking, HSG B |
| 39,100 | 36 | Woods, Fair, HSG A |
| 30,655 | 60 | Woods, Fair, HSG B |
| 9,400 | 49 | 50-75% Grass cover, Fair, HSG A |
| 86,985 | 51 | Weighted Average |
| 79,155 | | 91.00% Pervious Area |
| 7,830 | | 9.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.6 | 430 | 0.1101 | 0.68 | | **Lag/CN Method,** Contour Length= 9,580' Interval= 1' |

### Subcatchment E1: Amherst rd and South



## Summary for Subcatchment E1A: Amherst road

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

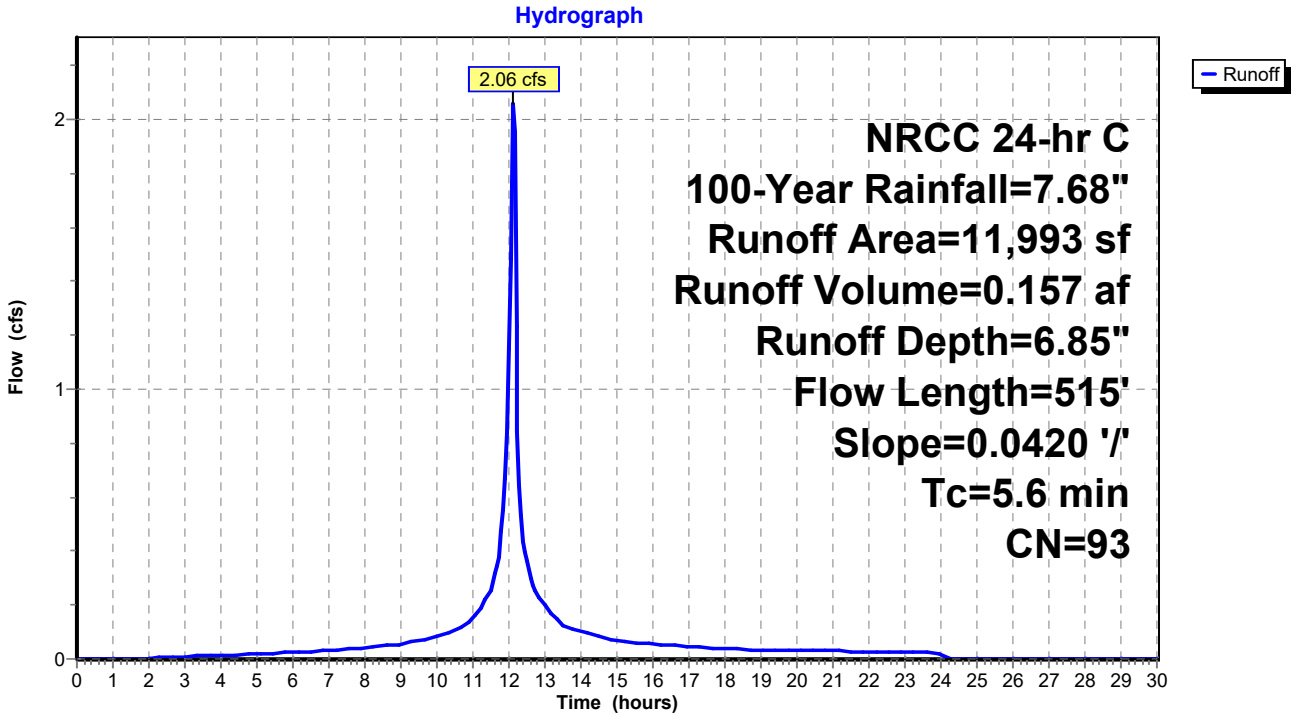
Runoff = 2.06 cfs @ 12.12 hrs, Volume= 0.157 af, Depth= 6.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| Area (sf) | CN | Description |
|---|---|---|
| 10,800 | 98 | Paved parking, HSG A |
| 1,193 | 49 | 50-75% Grass cover, Fair, HSG A |
| 11,993 | 93 | Weighted Average |
| 1,193 | | 9.95% Pervious Area |
| 10,800 | | 90.05% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.6 | 515 | 0.0420 | 1.53 | | **Lag/CN Method,** Contour Length= 504' Interval= 1' |

### Subcatchment E1A: Amherst road



## Summary for Subcatchment E2: east drainage area

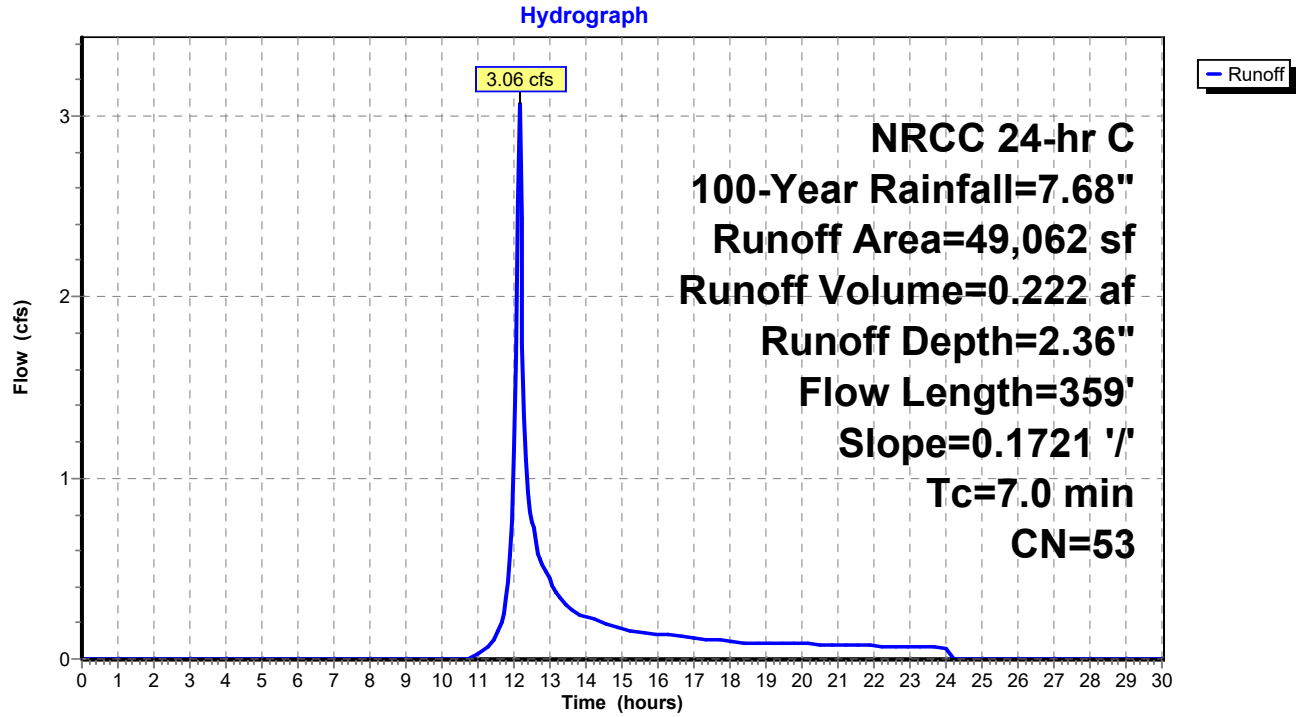
Runoff = 3.06 cfs @ 12.15 hrs, Volume= 0.222 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| Area (sf) | CN | Description |
|---|---|---|
| 10,891 | 98 | Paved parking, HSG A |
| 31,957 | 36 | Woods, Fair, HSG A |
| 5,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| 1,214 | 96 | Gravel surface, HSG A |
| 49,062 | 53 | Weighted Average |
| 38,171 | | 77.80% Pervious Area |
| 10,891 | | 22.20% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.0 | 359 | 0.1721 | 0.86 | | **Lag/CN Method,** Contour Length= 8,443' Interval= 1' |

## Subcatchment E2: east drainage area



## Summary for Subcatchment E3: central drainage off site #24

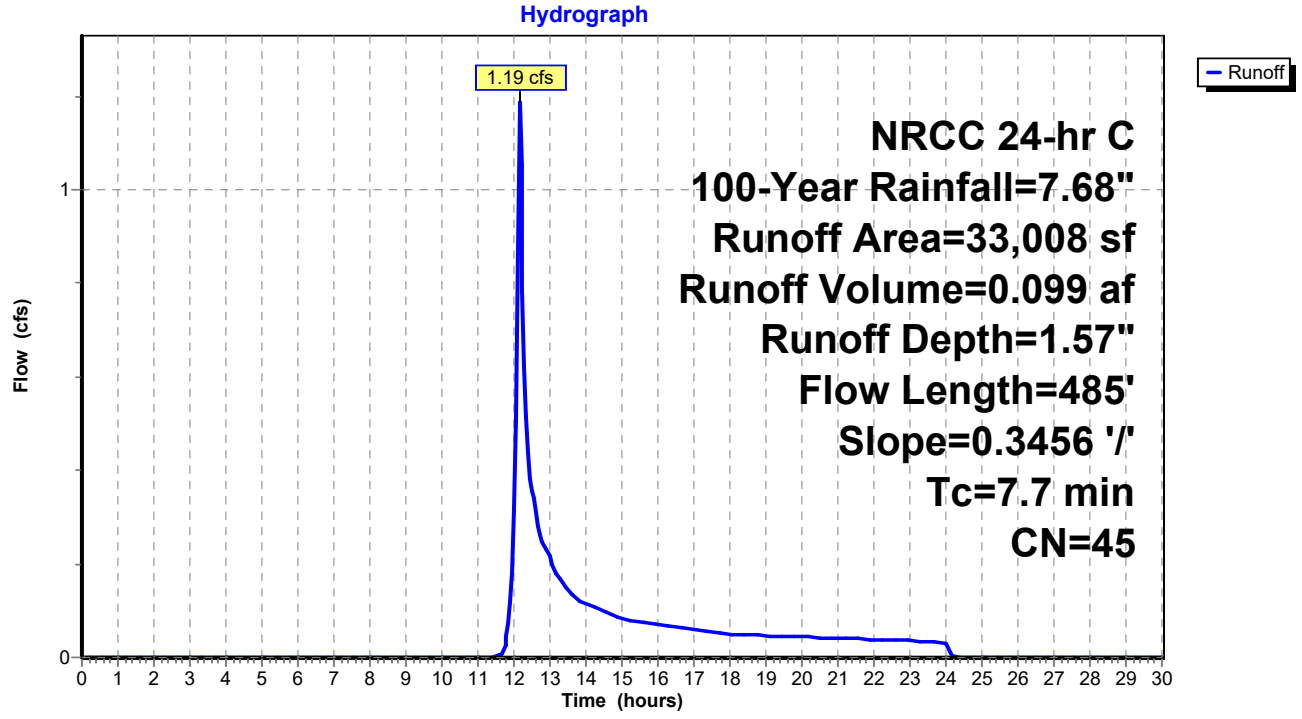
Runoff = 1.19 cfs @ 12.16 hrs, Volume= 0.099 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| Area (sf) | CN | Description |
|---|---|---|
| 3,810 | 98 | Paved parking, HSG A |
| 24,198 | 36 | Woods, Fair, HSG A |
| 5,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| 33,008 | 45 | Weighted Average |
| 29,198 | | 88.46% Pervious Area |
| 3,810 | | 11.54% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.7 | 485 | 0.3456 | 1.05 | | **Lag/CN Method,** Contour Length= 11,408' Interval= 1' |

## Subcatchment E3: central drainage off site #24



## Summary for Subcatchment E3A: central drainage area - on site

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

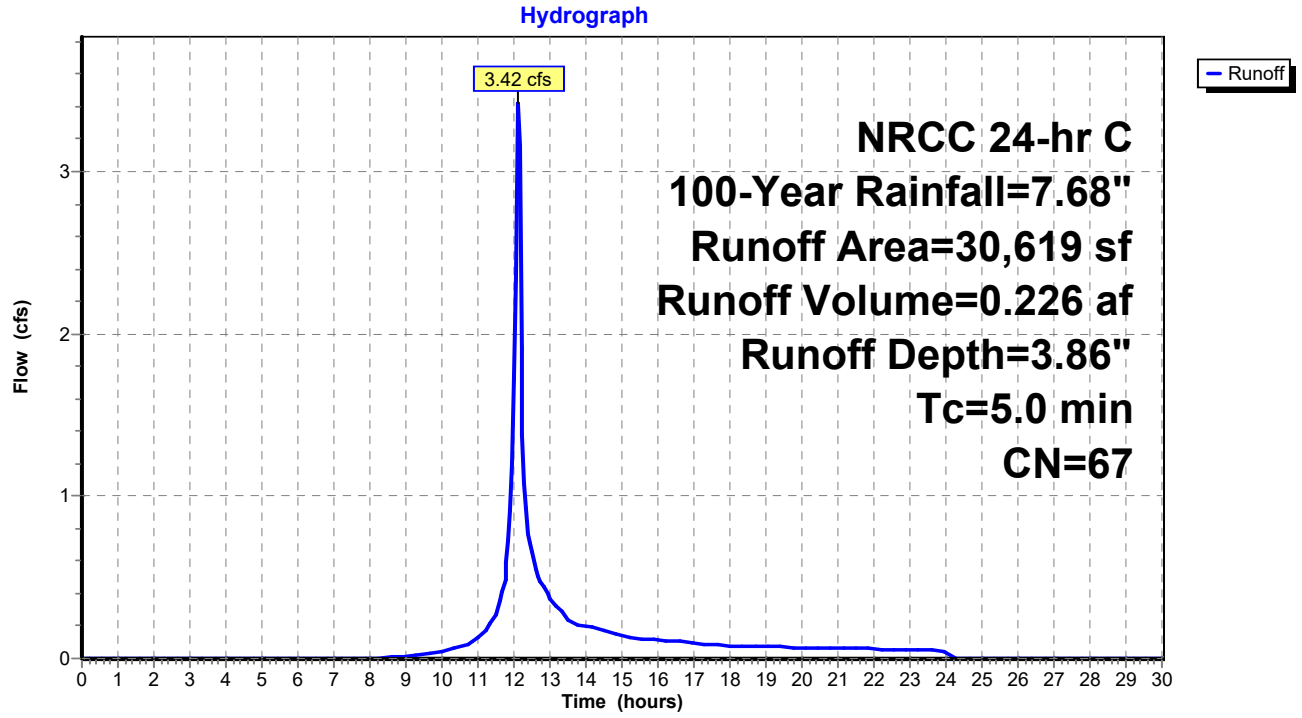
Runoff = 3.42 cfs @ 12.12 hrs, Volume= 0.226 af, Depth= 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 12,631 | 98 | Paved parking, HSG A |
| | 10,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 6,338 | 36 | Woods, Fair, HSG A |
| * | 1,650 | 49 | Drip edge around buildings |
| | 30,619 | 67 | Weighted Average |
| | 17,988 | | 58.75% Pervious Area |
| | 12,631 | | 41.25% Impervious Area |

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

### Subcatchment E3A: central drainage area - on site



## Summary for Subcatchment E3B: ex garage roof

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

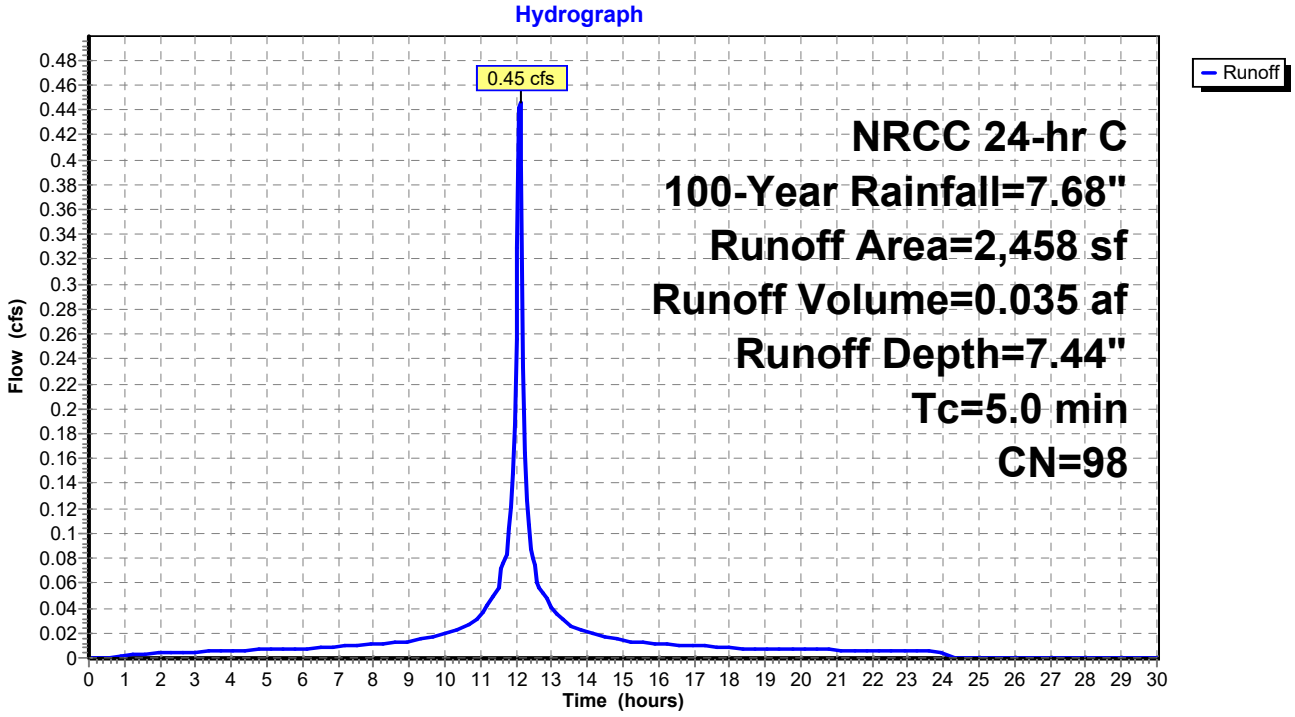
Runoff = 0.45 cfs @ 12.11 hrs, Volume= 0.035 af, Depth= 7.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| Area (sf) | CN | Description |
|---|---|---|
| 2,458 | 98 | Roofs, HSG A |
| 2,458 | | 100.00% Impervious Area |

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

### Subcatchment E3B: ex garage roof



## Summary for Subcatchment E4: west drainage area

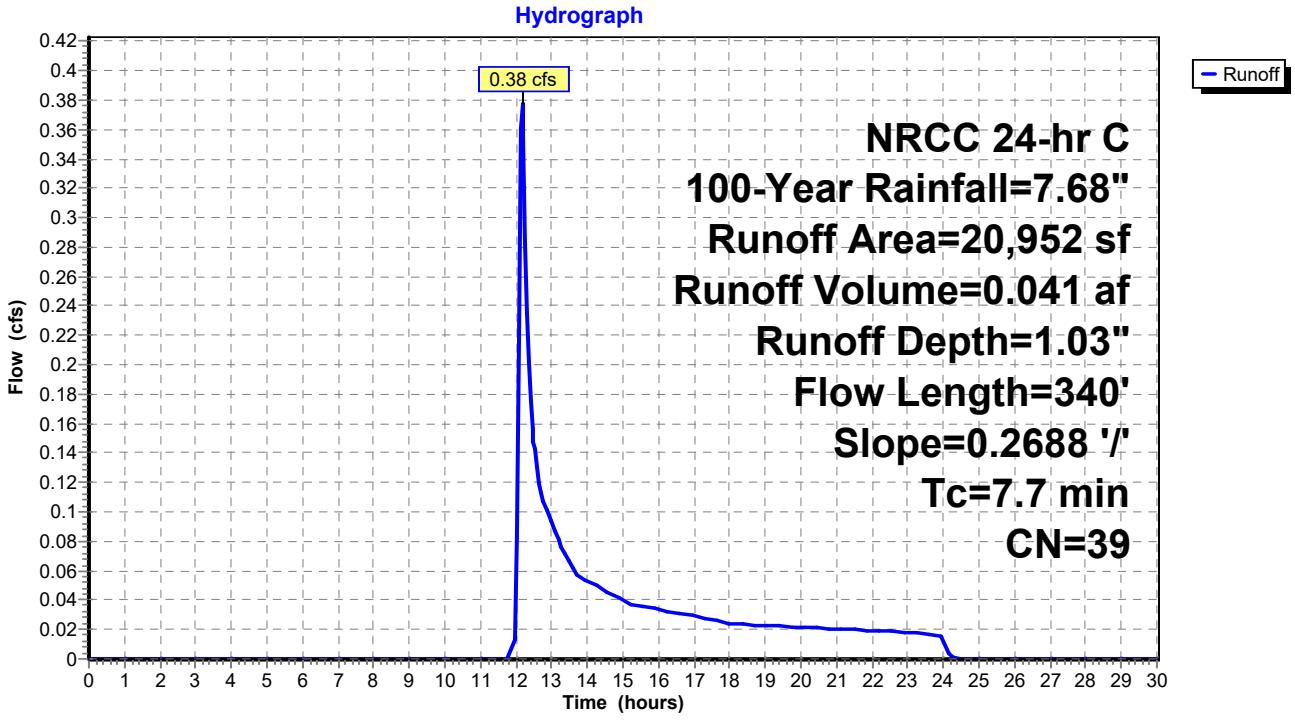
Runoff = 0.38 cfs @ 12.17 hrs, Volume= 0.041 af, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| Area (sf) | CN | Description |
|---|---|---|
| 967 | 98 | Paved parking, HSG A |
| 19,985 | 36 | Woods, Fair, HSG A |
| 20,952 | 39 | Weighted Average |
| 19,985 | | 95.38% Pervious Area |
| 967 | | 4.62% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.7 | 340 | 0.2688 | 0.74 | | **Lag/CN Method,** Contour Length= 5,632' Interval= 1' |

## Subcatchment E4: west drainage area



## Summary for Subcatchment E4A: ex bldg roof

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

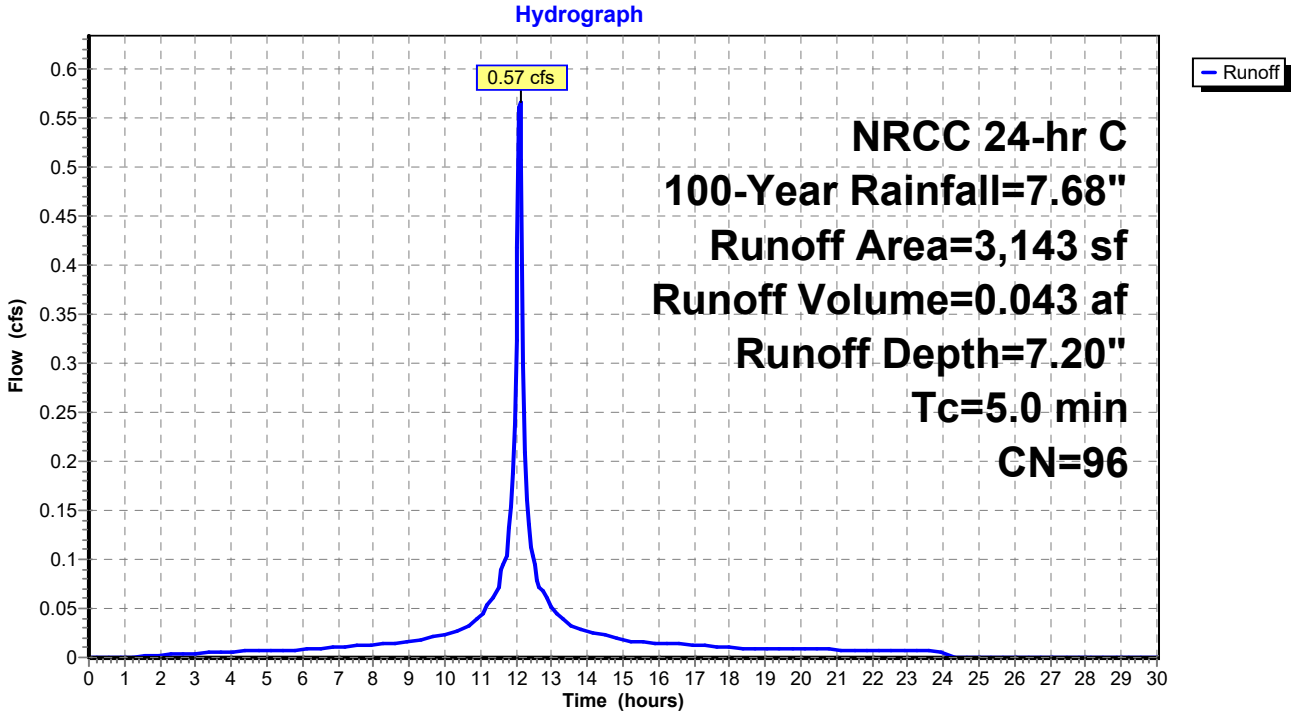
Runoff = 0.57 cfs @ 12.11 hrs, Volume= 0.043 af, Depth= 7.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| Area (sf) | CN | Description |
|---|---|---|
| 3,000 | 98 | Paved parking, HSG A |
| 143 | 49 | 50-75% Grass cover, Fair, HSG A |
| 3,143 | 96 | Weighted Average |
| 143 | | 4.55% Pervious Area |
| 3,000 | | 95.45% Impervious Area |

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

## Subcatchment E4A: ex bldg roof



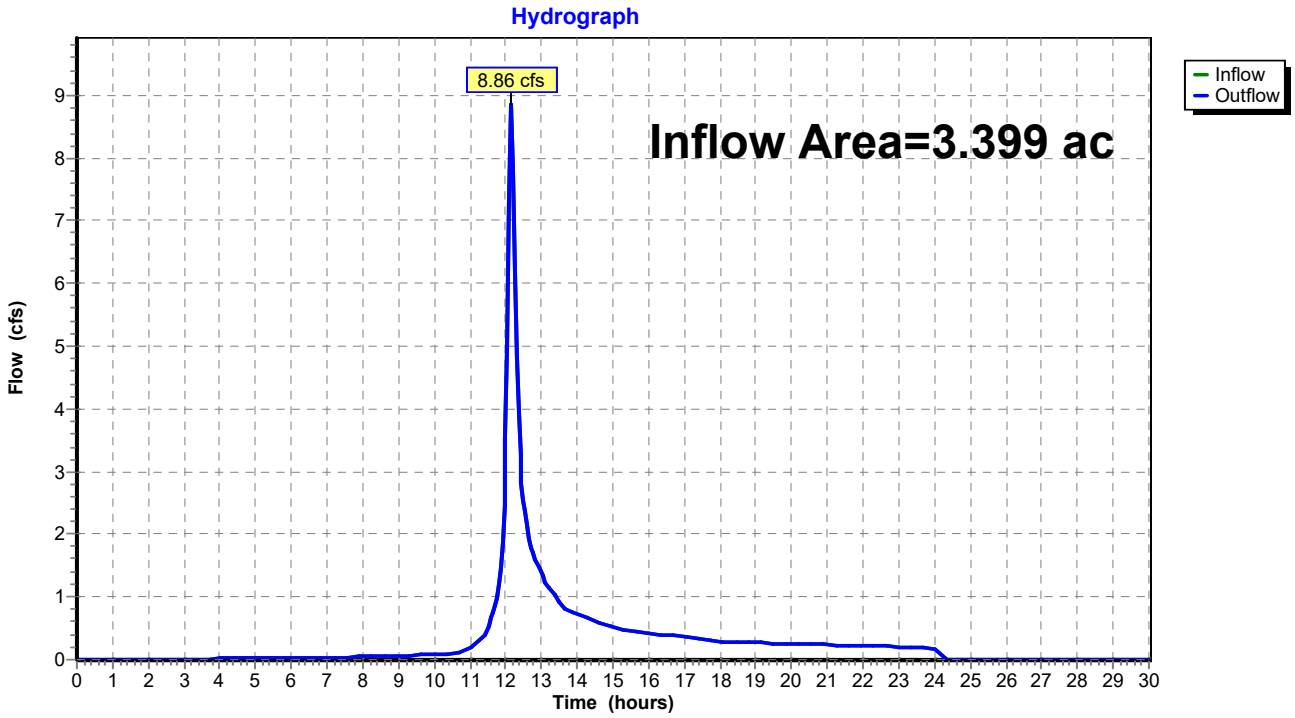
## Summary for Reach 1R: ex swale

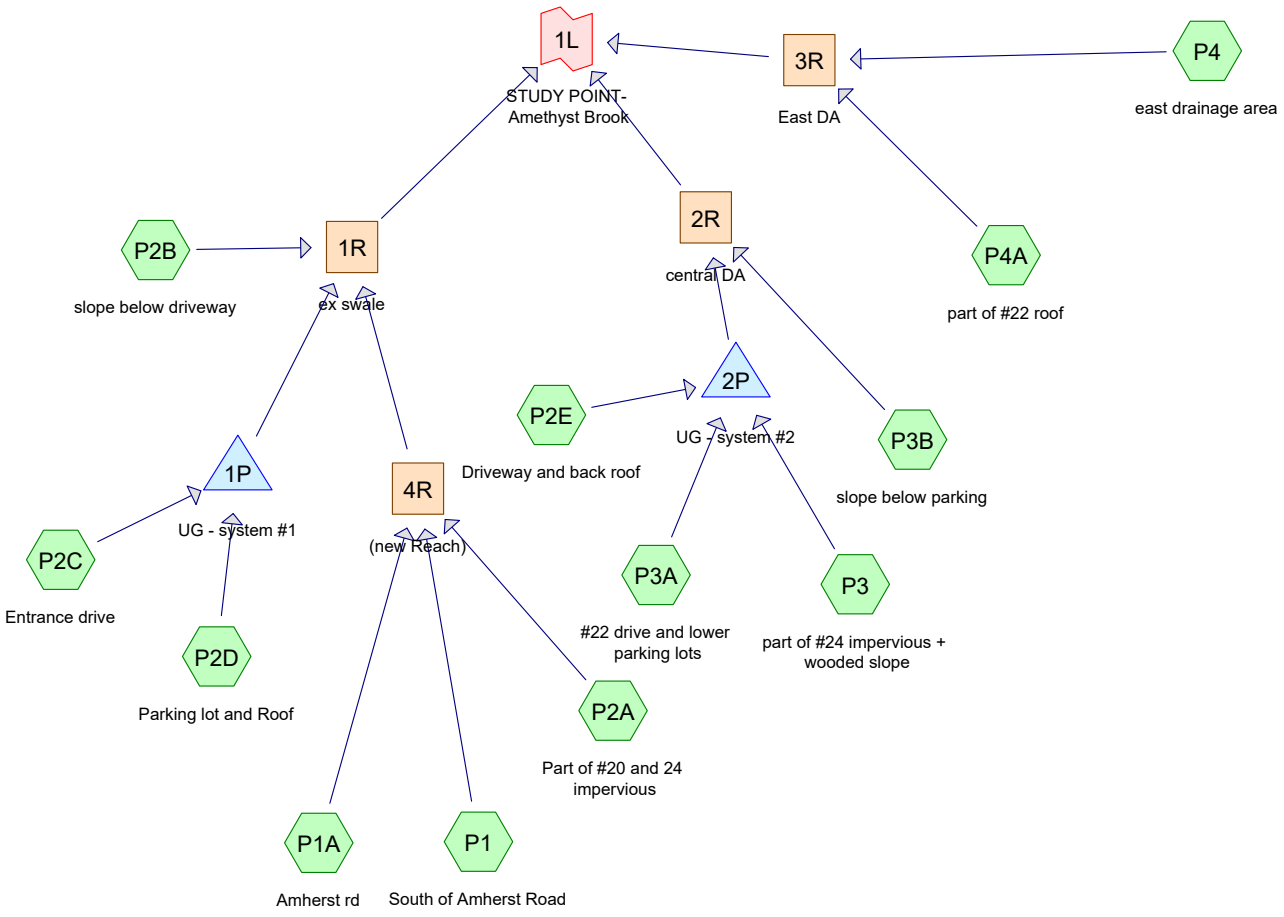
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.399 ac, 19.94% Impervious, Inflow Depth = 2.61" for 100-Year event
Inflow = 8.86 cfs @ 12.16 hrs, Volume= 0.738 af
Outflow = 8.86 cfs @ 12.16 hrs, Volume= 0.738 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 1R: ex swale






Subcat Reach Pond Link

**Routing Diagram for 20.024 PROP REV**
Prepared by Berkshire Design Group, Printed 12/14/2020

## Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 4007 MA Amherst Hampshire County

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.728 | 49 | 50-75% Grass cover, Fair, HSG A (P1, P1A, P2A, P2C, P2D, P2E, P3, P3A, P3B) |
| 0.045 | 96 | Gravel surface, HSG A (P2E, P3A) |
| 0.939 | 98 | Impervious (P2C, P2D, P2E, P3, P3A, P3B, P4) |
| 0.061 | 98 | Impervious HSG A (P2A) |
| 0.018 | 98 | Impervious - roof (P2E) |
| 0.161 | 98 | Impervious HSG A (P1) |
| 0.019 | 98 | Impervious HSG B (P1) |
| 0.248 | 98 | Paved road, HSG A (P1A) |
| 0.079 | 98 | Unconnected roofs, HSG A (P4A) |
| 0.008 | 98 | Wall (P2B) |
| 2.459 | 36 | Woods, Fair, HSG A (P1, P2A, P2B, P3, P3B, P4, P4A) |
| 0.704 | 60 | Woods, Fair, HSG B (P1) |
| **5.469** | **59** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 3.781 | HSG A | P1, P1A, P2A, P2B, P2C, P2D, P2E, P3, P3A, P3B, P4, P4A |
| 0.722 | HSG B | P1 |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 0.965 | Other | P2B, P2C, P2D, P2E, P3, P3A, P3B, P4 |
| **5.469** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.728 | 0.000 | 0.000 | 0.000 | 0.000 | 0.728 | 50-75% Grass cover, Fair | P1, P1A, P2A, P2C, P2D, P2E, P3, P3A, P3B |
| 0.045 | 0.000 | 0.000 | 0.000 | 0.000 | 0.045 | Gravel surface | P2E, P3A |
| 0.222 | 0.019 | 0.000 | 0.000 | 0.939 | 1.180 | Impervious | P1, P2A, P2C, P2D, P2E, P3, P3A, P3B, P4 |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.018 | 0.018 | Impervious - roof | P2E |
| 0.248 | 0.000 | 0.000 | 0.000 | 0.000 | 0.248 | Paved road | P1A |
| 0.079 | 0.000 | 0.000 | 0.000 | 0.000 | 0.079 | Unconnected roofs | P4A |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.008 | 0.008 | Wall | P2B |
| 2.459 | 0.704 | 0.000 | 0.000 | 0.000 | 3.163 | Woods, Fair | P1, P2A, P2B, P3, P3B, P4, P4A |
| **3.781** | **0.722** | **0.000** | **0.000** | **0.965** | **5.469** | **TOTAL AREA** | |

## Summary for Subcatchment P1: South of Amherst Road

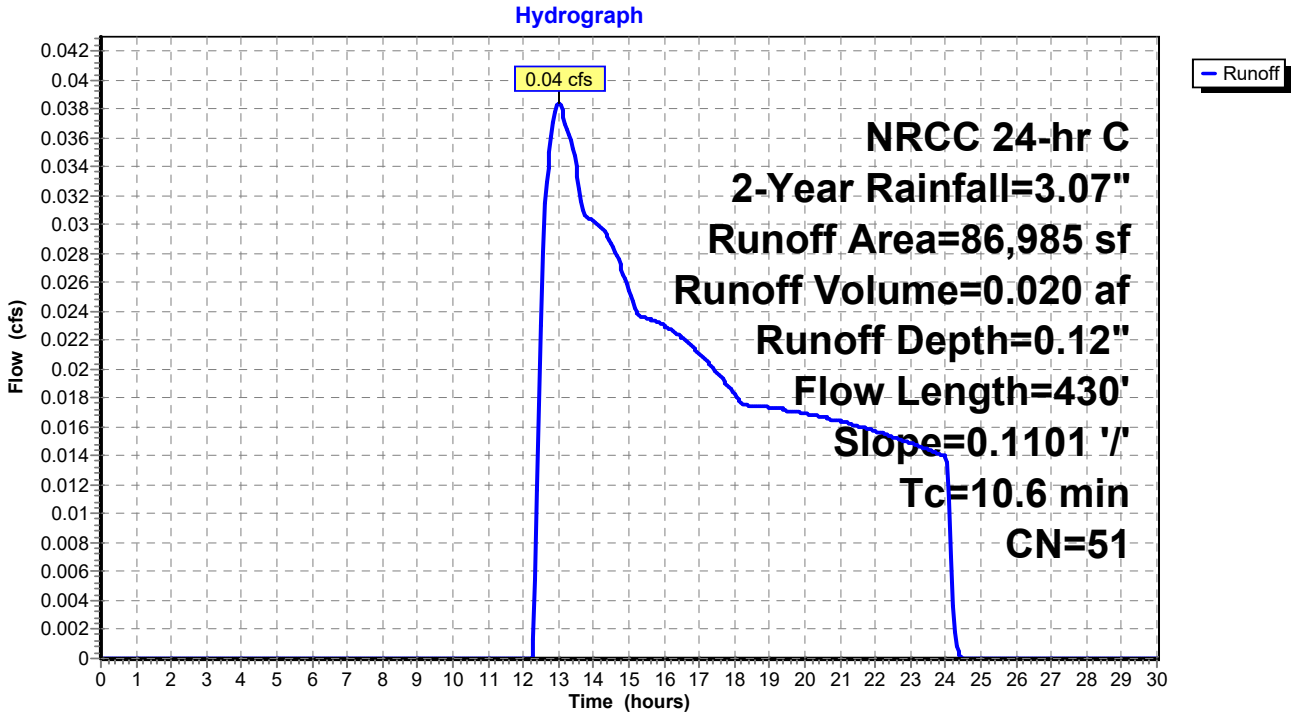
Runoff = 0.04 cfs @ 13.01 hrs, Volume= 0.020 af, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 7,024 | 98 | Impervious HSG A |
| * | 806 | 98 | Impervious HSG B |
| | 39,100 | 36 | Woods, Fair, HSG A |
| | 30,655 | 60 | Woods, Fair, HSG B |
| | 9,400 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 86,985 | 51 | Weighted Average |
| | 79,155 | | 91.00% Pervious Area |
| | 7,830 | | 9.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.6 | 430 | 0.1101 | 0.68 | | **Lag/CN Method,** Contour Length= 9,580' Interval= 1' |

## Subcatchment P1: South of Amherst Road



## Summary for Subcatchment P1A: Amherst rd

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

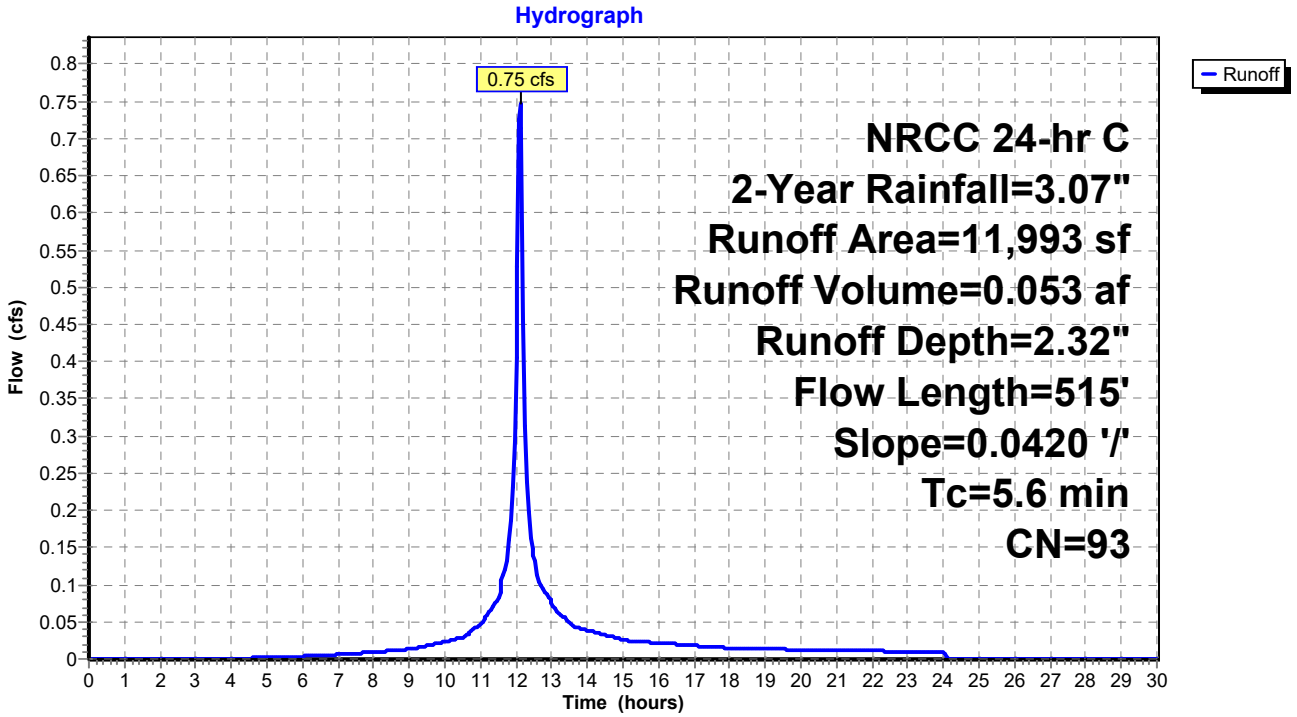
Runoff = 0.75 cfs @ 12.12 hrs, Volume= 0.053 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 10,800 | 98 | Paved road, HSG A |
| | 1,193 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 11,993 | 93 | Weighted Average |
| | 1,193 | | 9.95% Pervious Area |
| | 10,800 | | 90.05% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.6 | 515 | 0.0420 | 1.53 | | **Lag/CN Method,** Contour Length= 504' Interval= 1' |

## Subcatchment P1A: Amherst rd



## Summary for Subcatchment P2A: Part of #20 and 24 impervious

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

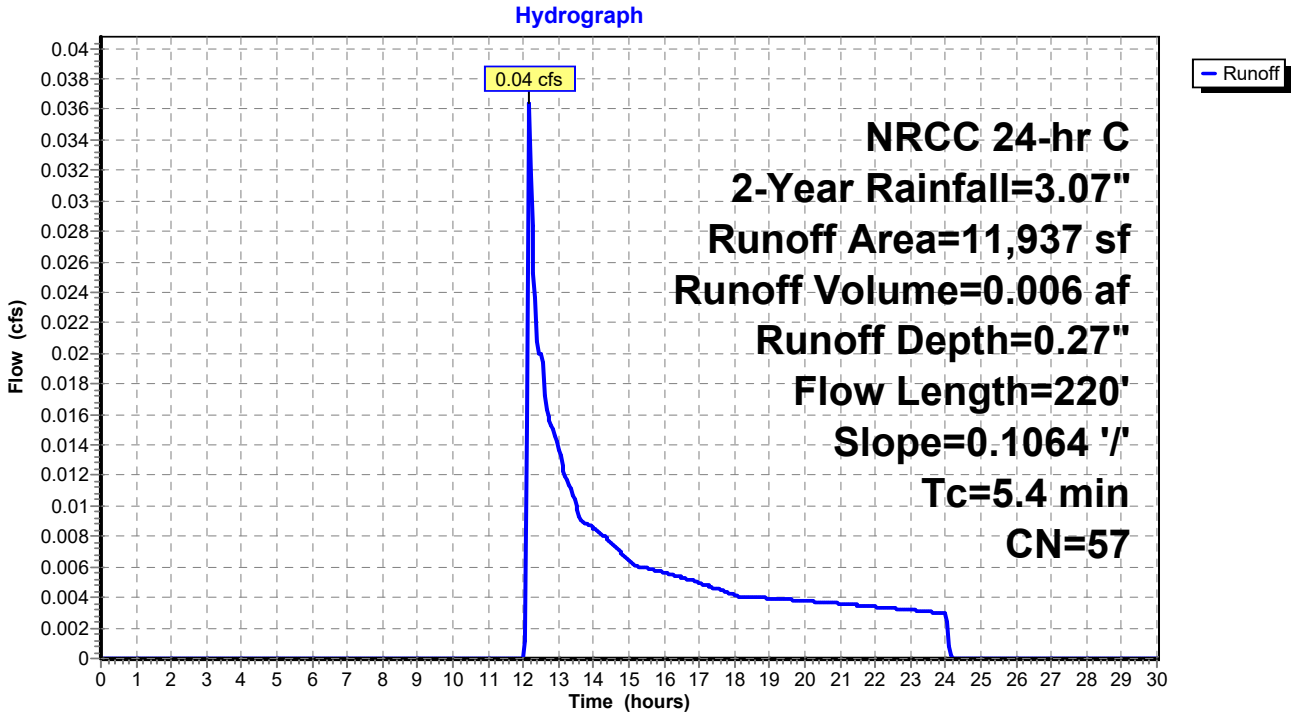
Runoff = 0.04 cfs @ 12.17 hrs, Volume= 0.006 af, Depth= 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 2,647 | 98 | Impervious HSG A |
| | 7,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 2,290 | 36 | Woods, Fair, HSG A |
| | 11,937 | 57 | Weighted Average |
| | 9,290 | | 77.83% Pervious Area |
| | 2,647 | | 22.17% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.4 | 220 | 0.1064 | 0.68 | | **Lag/CN Method,** Contour Length= 1,270' Interval= 1' |

### Subcatchment P2A: Part of #20 and 24 impervious



## Summary for Subcatchment P2B: slope below driveway

[49] Hint: Tc<2dt may require smaller dt
[45] Hint: Runoff=Zero

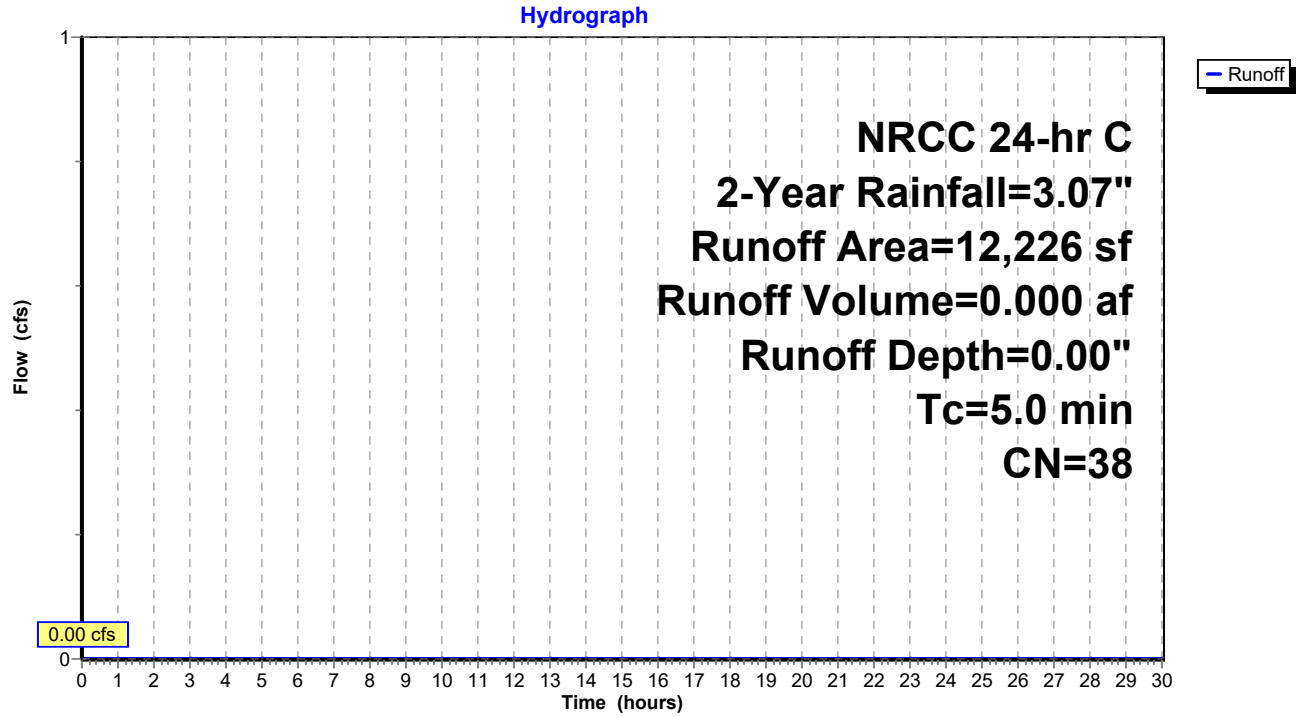
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 11,888 | 36 | Woods, Fair, HSG A |
| * | 338 | 98 | Wall |
| | 12,226 | 38 | Weighted Average |
| | 11,888 | | 97.24% Pervious Area |
| | 338 | | 2.76% Impervious Area |

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

## Subcatchment P2B: slope below driveway



## Summary for Subcatchment P2C: Entrance drive

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

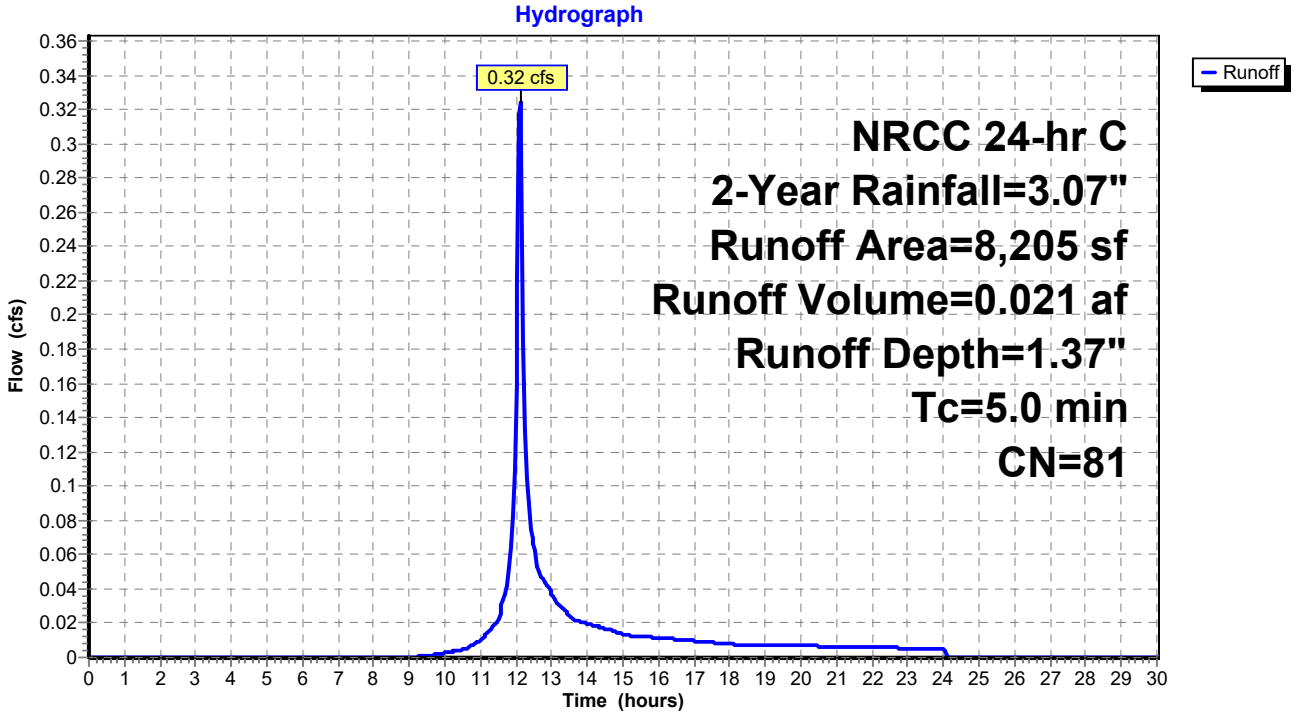
Runoff = 0.32 cfs @ 12.12 hrs, Volume= 0.021 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 5,389 | 98 | Impervious |
| | 2,816 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 8,205 | 81 | Weighted Average |
| | 2,816 | | 34.32% Pervious Area |
| | 5,389 | | 65.68% Impervious Area |

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

## Subcatchment P2C: Entrance drive



## Summary for Subcatchment P2D: Parking lot and Roof

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

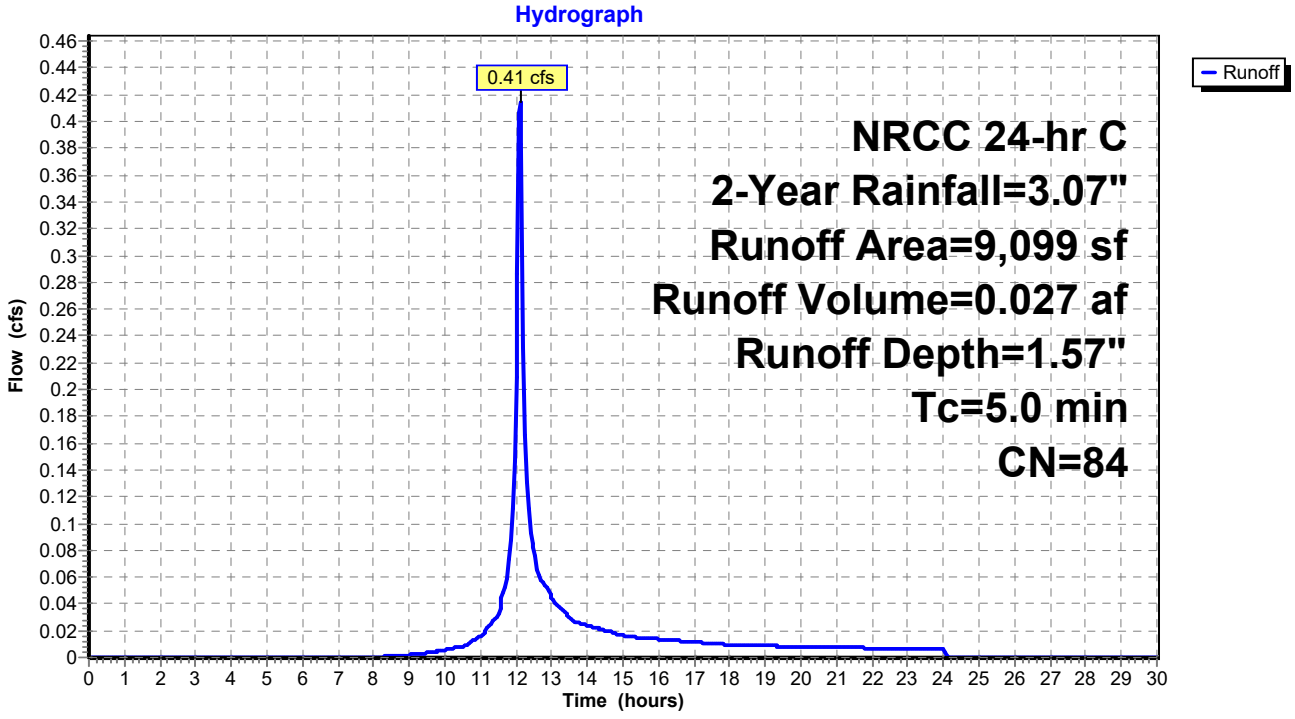
Runoff = 0.41 cfs @ 12.12 hrs, Volume= 0.027 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 6,504 | 98 | Impervious |
| | 2,595 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 9,099 | 84 | Weighted Average |
| | 2,595 | | 28.52% Pervious Area |
| | 6,504 | | 71.48% Impervious Area |

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

## Subcatchment P2D: Parking lot and Roof



## Summary for Subcatchment P2E: Driveway and back roof

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

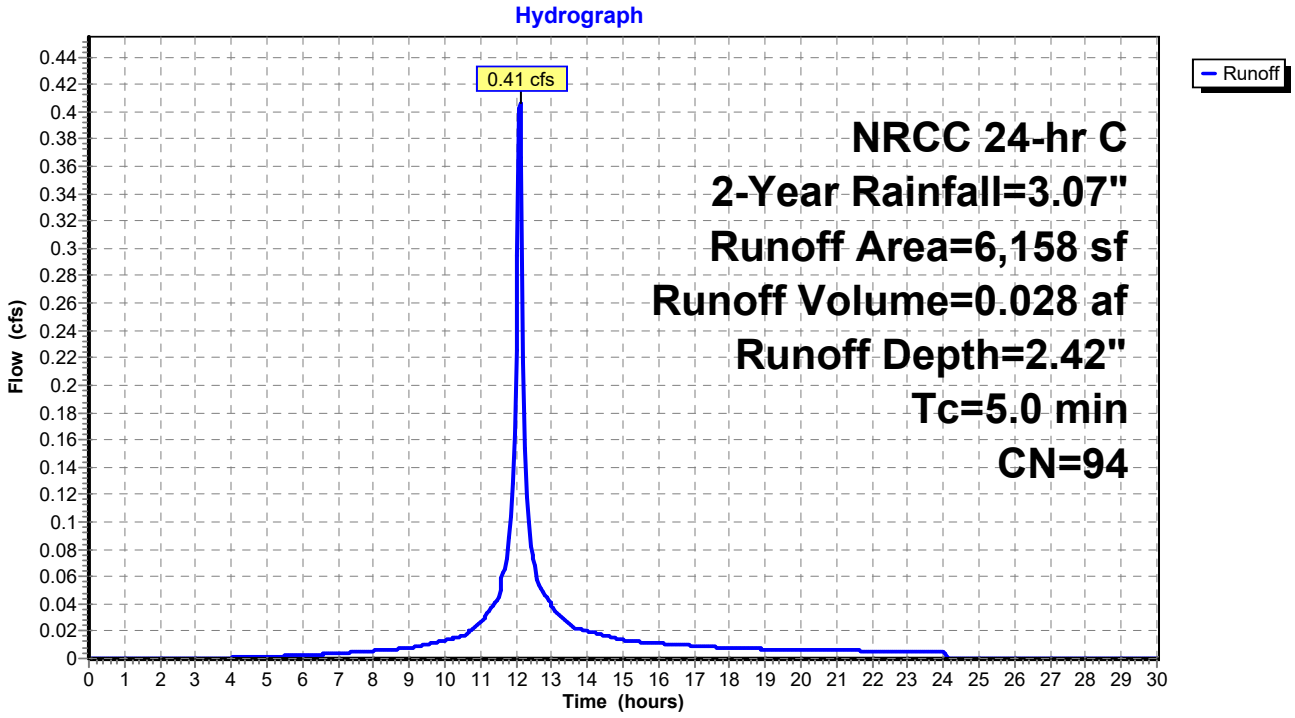
Runoff = 0.41 cfs @ 12.11 hrs, Volume= 0.028 af, Depth= 2.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 4,254 | 98 | Impervious |
| | 653 | 96 | Gravel surface, HSG A |
| | 451 | 49 | 50-75% Grass cover, Fair, HSG A |
| * | 800 | 98 | Impervious - roof |
| | 6,158 | 94 | Weighted Average |
| | 1,104 | | 17.93% Pervious Area |
| | 5,054 | | 82.07% Impervious Area |

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

## Subcatchment P2E: Driveway and back roof



## Summary for Subcatchment P3: part of #24 impervious + wooded slope

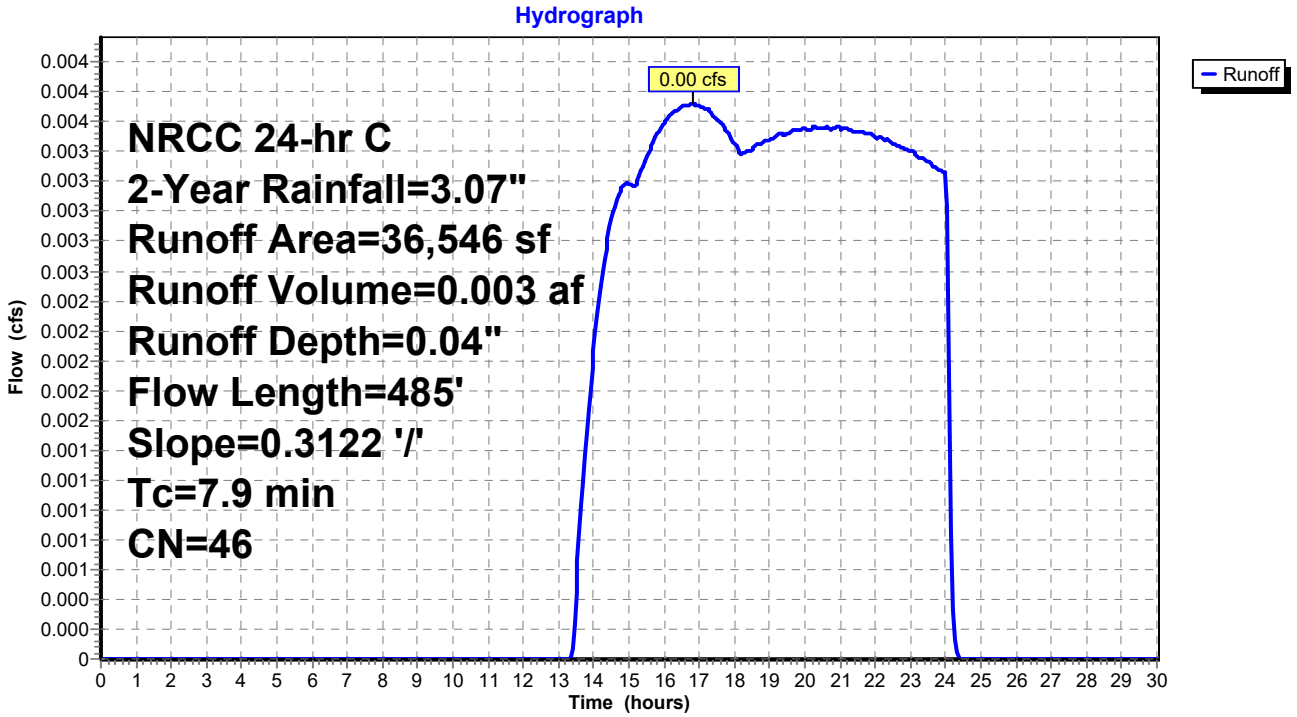
Runoff = 0.00 cfs @ 16.84 hrs, Volume= 0.003 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 4,706 | 98 | Impervious |
| | 26,390 | 36 | Woods, Fair, HSG A |
| | 5,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 450 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 36,546 | 46 | Weighted Average |
| | 31,840 | | 87.12% Pervious Area |
| | 4,706 | | 12.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.9 | 485 | 0.3122 | 1.03 | | **Lag/CN Method,** Contour Length= 11,408' Interval= 1' |

## Subcatchment P3: part of #24 impervious + wooded slope



## Summary for Subcatchment P3A: #22 drive and lower parking lots

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

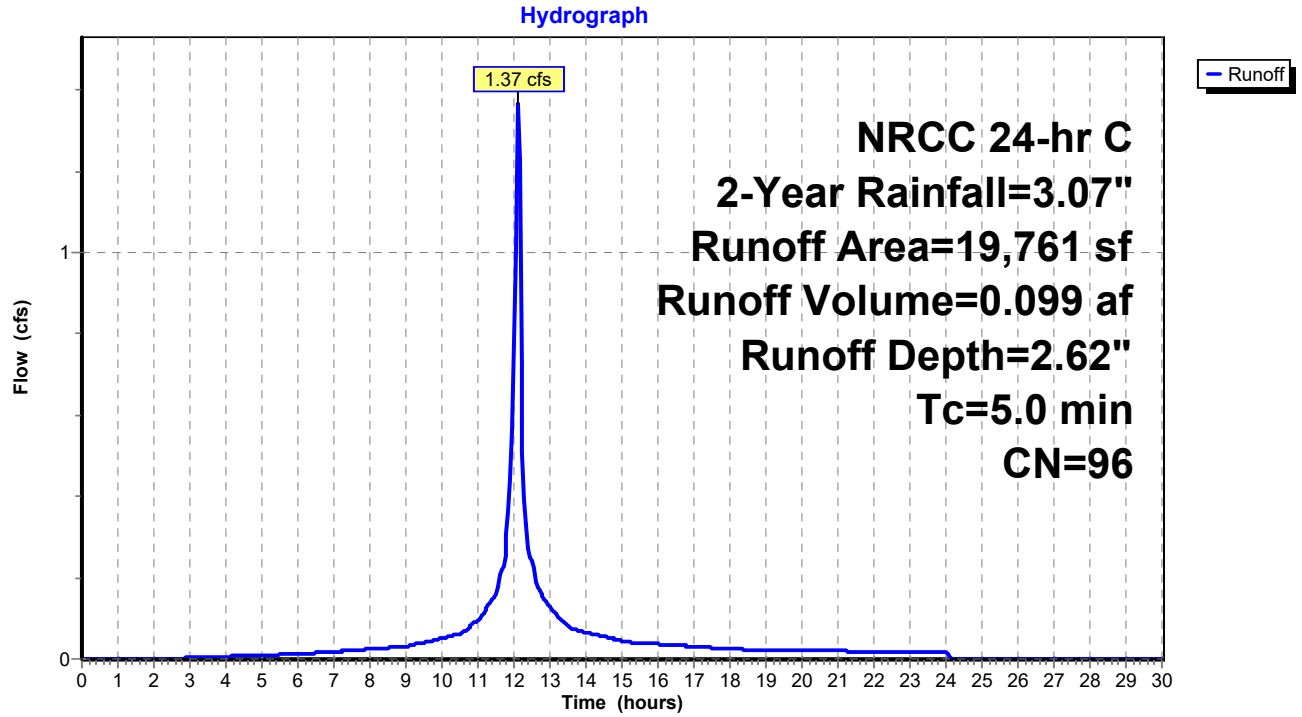
Runoff = 1.37 cfs @ 12.11 hrs, Volume= 0.099 af, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 17,647 | 98 | Impervious |
| | 1,300 | 96 | Gravel surface, HSG A |
| | 814 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 19,761 | 96 | Weighted Average |
| | 2,114 | | 10.70% Pervious Area |
| | 17,647 | | 89.30% Impervious Area |

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

## Subcatchment P3A: #22 drive and lower parking lots



## Summary for Subcatchment P3B: slope below parking

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

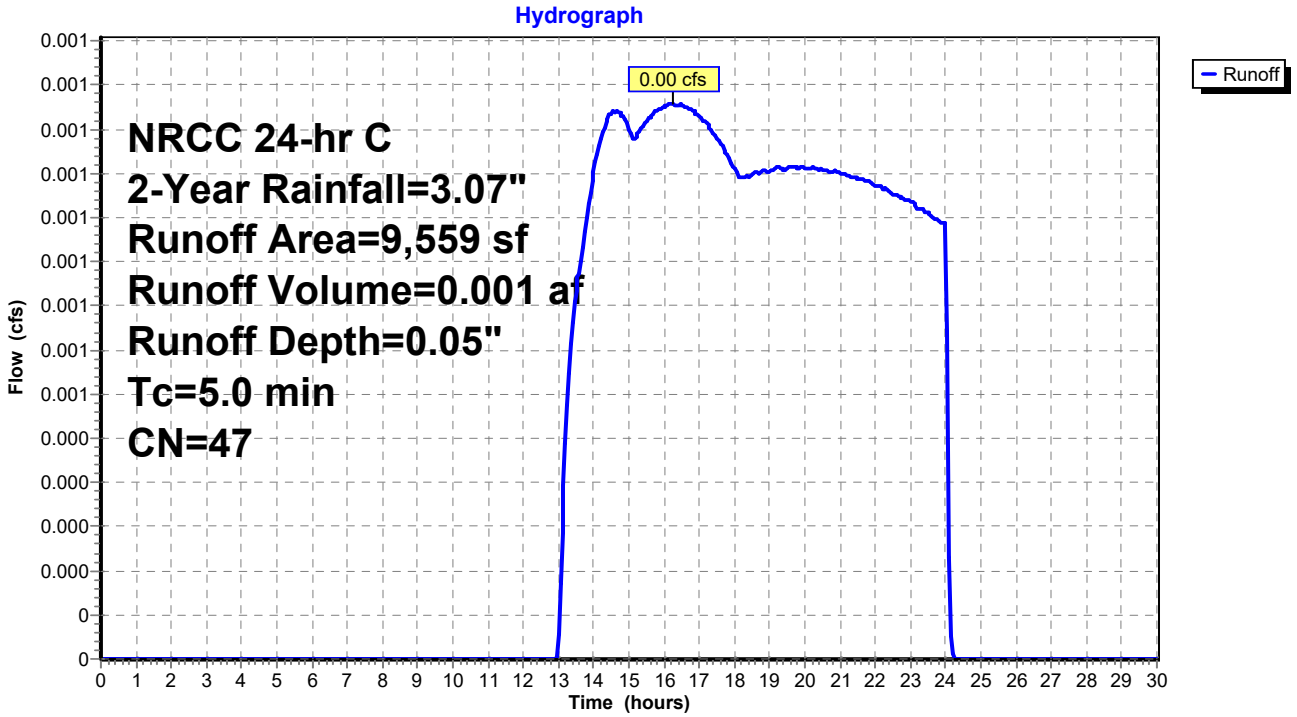
Runoff = 0.00 cfs @ 16.24 hrs, Volume= 0.001 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,285 | 98 | Impervious |
| | 6,274 | 36 | Woods, Fair, HSG A |
| | 2,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 9,559 | 47 | Weighted Average |
| | 8,274 | | 86.56% Pervious Area |
| | 1,285 | | 13.44% Impervious Area |

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

## Subcatchment P3B: slope below parking



## Summary for Subcatchment P4: east drainage area

[45] Hint: Runoff=Zero

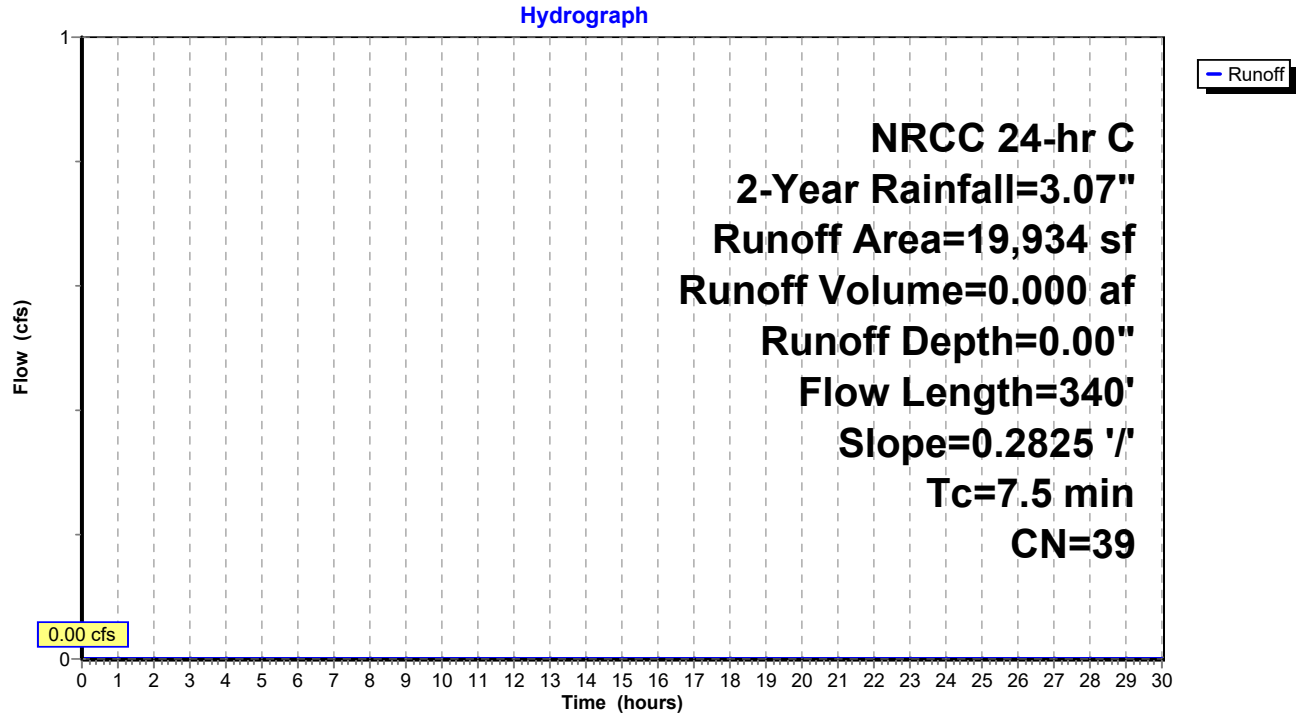
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 18,814 | 36 | Woods, Fair, HSG A |
| * | 1,120 | 98 | Impervious |
| | 19,934 | 39 | Weighted Average |
| | 18,814 | | 94.38% Pervious Area |
| | 1,120 | | 5.62% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.5 | 340 | 0.2825 | 0.75 | | **Lag/CN Method,** Contour Length= 5,632' Interval= 1' |

## Subcatchment P4: east drainage area



## Summary for Subcatchment P4A: part of #22 roof

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

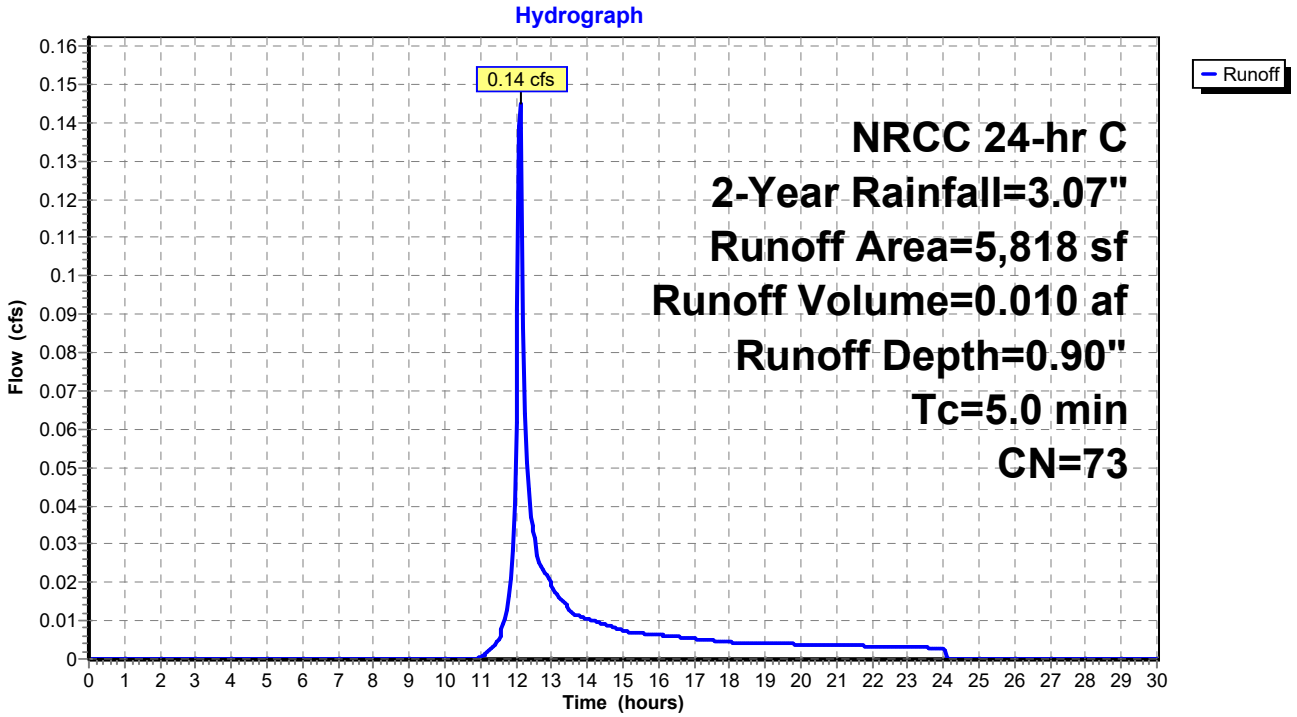
Runoff = 0.14 cfs @ 12.12 hrs, Volume= 0.010 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.07"

| Area (sf) | CN | Description |
|---|---|---|
| 3,455 | 98 | Unconnected roofs, HSG A |
| 2,363 | 36 | Woods, Fair, HSG A |
| 5,818 | 73 | Weighted Average |
| 2,363 | | 40.62% Pervious Area |
| 3,455 | | 59.38% Impervious Area |
| 3,455 | | 100.00% Unconnected |

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

## Subcatchment P4A: part of #22 roof



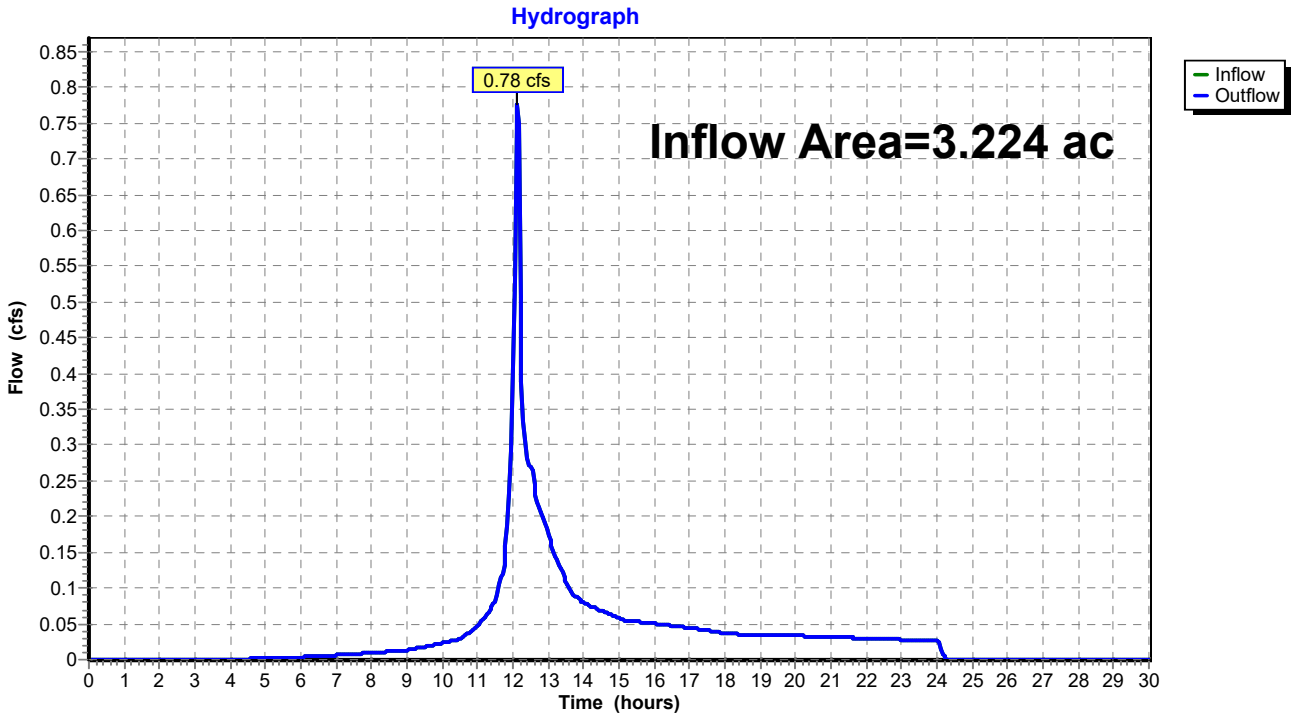
## Summary for Reach 1R: ex swale

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

Inflow Area = 3.224 ac, 23.86% Impervious, Inflow Depth = 0.32" for 2-Year event
Inflow = 0.78 cfs @ 12.13 hrs, Volume= 0.086 af
Outflow = 0.78 cfs @ 12.13 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 1R: ex swale



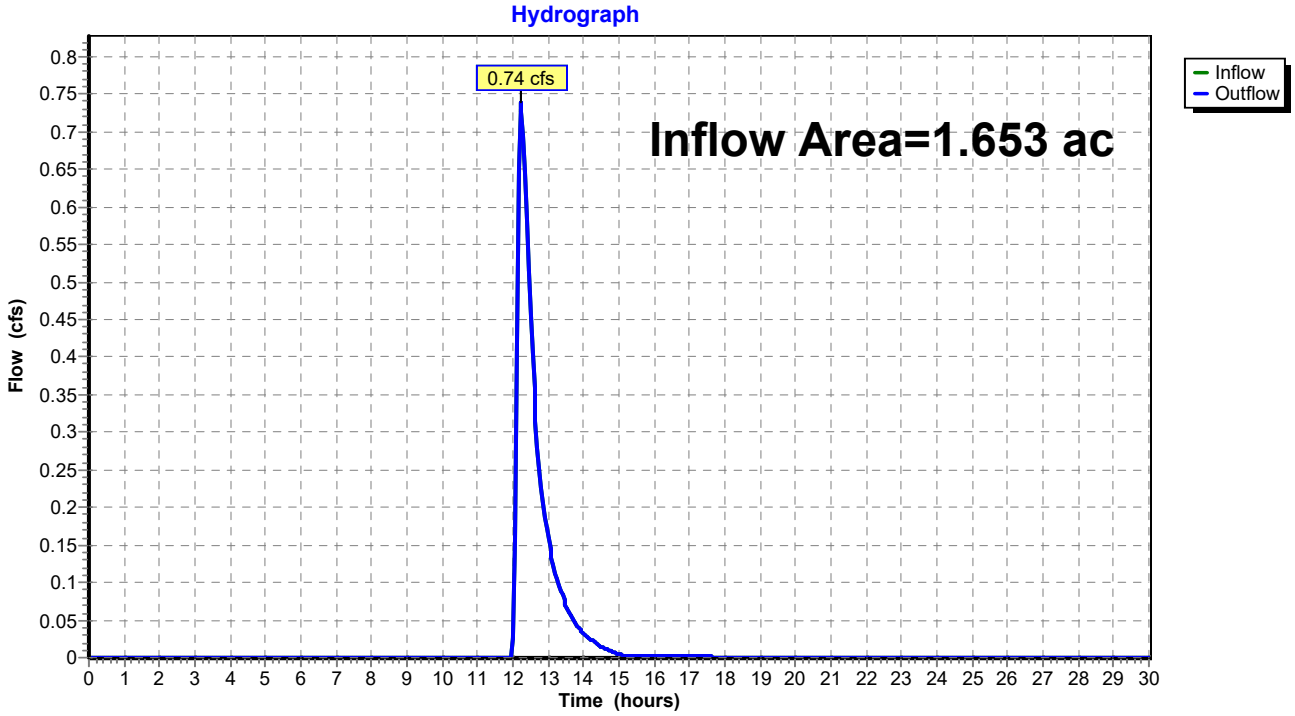
## Summary for Reach 2R: central DA

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

Inflow Area = 1.653 ac, 39.84% Impervious, Inflow Depth = 0.30" for 2-Year event
Inflow = 0.74 cfs @ 12.22 hrs, Volume= 0.042 af
Outflow = 0.74 cfs @ 12.22 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 2R: central DA



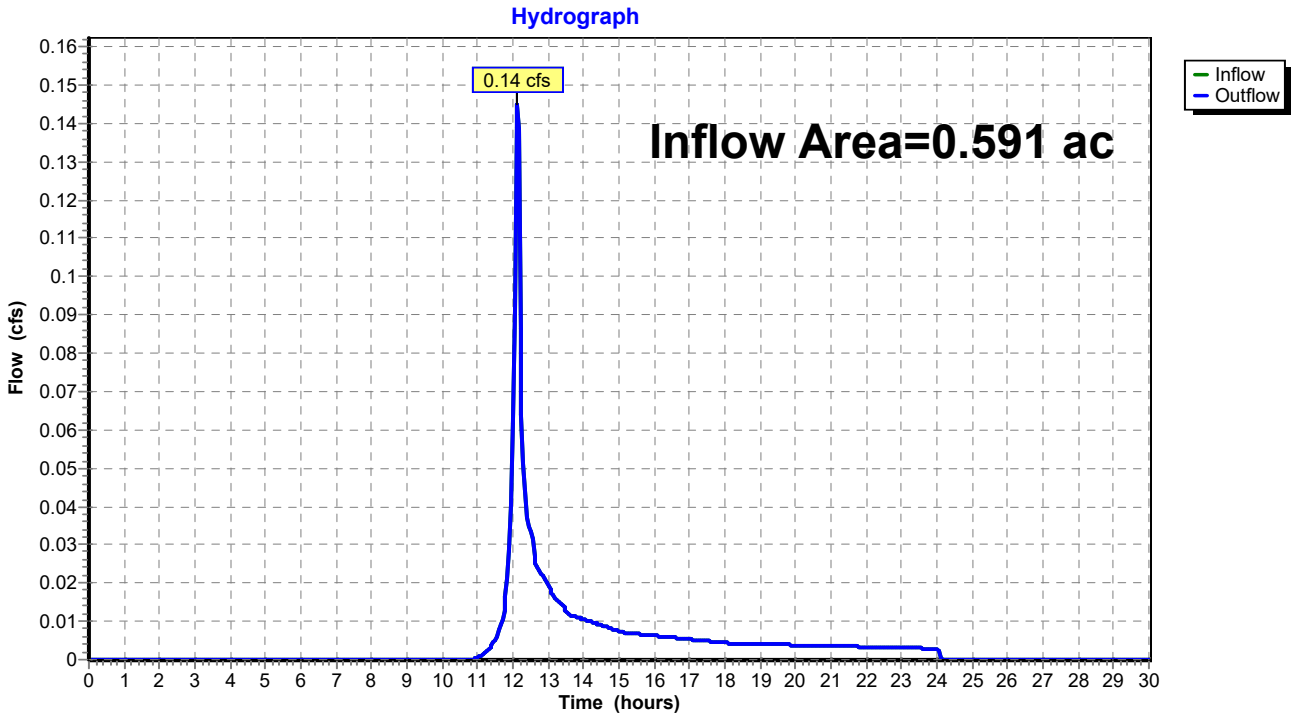
## Summary for Reach 3R: East DA

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

Inflow Area = 0.591 ac, 17.77% Impervious, Inflow Depth = 0.20" for 2-Year event
Inflow = 0.14 cfs @ 12.12 hrs, Volume= 0.010 af
Outflow = 0.14 cfs @ 12.12 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 3R: East DA



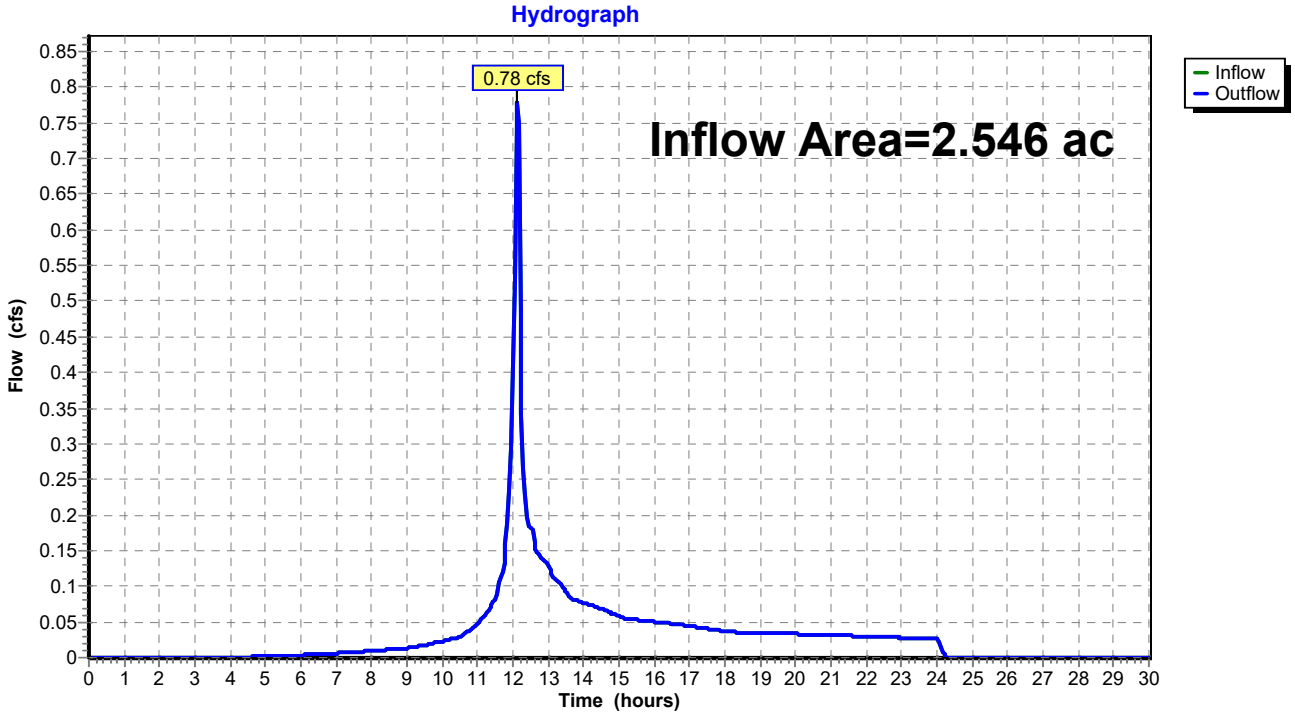
## Summary for Reach 4R: (new Reach)

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

Inflow Area = 2.546 ac, 19.18% Impervious, Inflow Depth = 0.38" for 2-Year event
Inflow = 0.78 cfs @ 12.13 hrs, Volume= 0.080 af
Outflow = 0.78 cfs @ 12.13 hrs, Volume= 0.080 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 4R: (new Reach)



## Summary for Pond 1P: UG - system #1

Inflow Area = 0.397 ac, 68.73% Impervious, Inflow Depth = 1.48" for 2-Year event
Inflow = 0.74 cfs @ 12.12 hrs, Volume= 0.049 af
Outflow = 0.15 cfs @ 12.47 hrs, Volume= 0.049 af, Atten= 79%, Lag= 21.4 min
Discarded = 0.06 cfs @ 11.60 hrs, Volume= 0.043 af
Primary = 0.09 cfs @ 12.47 hrs, Volume= 0.006 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 305.39' @ 12.47 hrs Surf.Area= 0.027 ac Storage= 0.014 af

Plug-Flow detention time= 53.9 min calculated for 0.049 af (100% of inflow)
Center-of-Mass det. time= 53.9 min ( 899.4 - 845.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 304.50' | 0.014 af | **42.06'W x 27.46'L x 2.44'H Field A**<br>0.065 af Overall - 0.030 af Embedded = 0.035 af x 40.0% Voids |
| #2A | 305.00' | 0.028 af | **ACF R-Tank HD 1** x 290 Inside #1<br>Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf<br>Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf<br>290 Chambers in 29 Rows |
| | | 0.042 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 305.20' | **5.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 306.40' | **8.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Discarded | 304.50' | **2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01' |

**Discarded OutFlow** Max=0.06 cfs @ 11.60 hrs HW=304.52' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.06 cfs)

**Primary OutFlow** Max=0.09 cfs @ 12.47 hrs HW=305.39' (Free Discharge)
├**1=Orifice/Grate** (Orifice Controls 0.09 cfs @ 1.47 fps)
└**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond 1P: UG - system #1 - Chamber Wizard Field A

**Chamber Model = ACF R-Tank HD 1 (ACF Environmental R-Tank HD)**
Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf
Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf

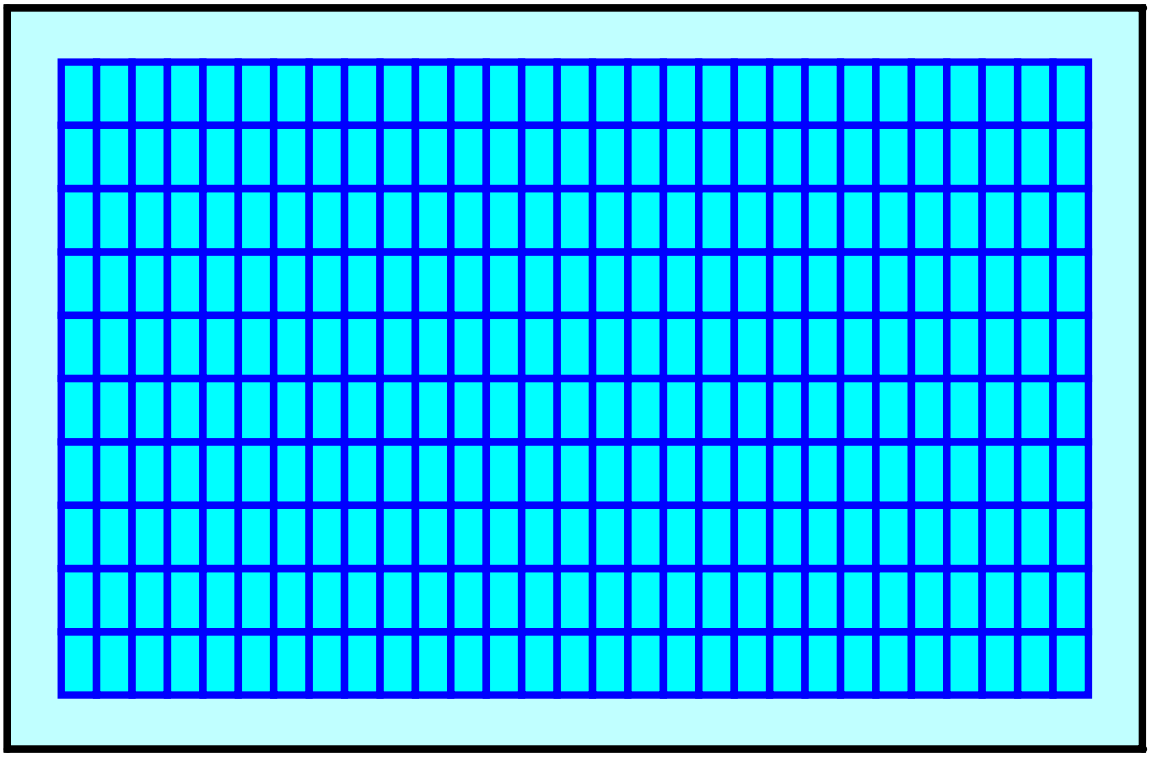
10 Chambers/Row x 2.35' Long = 23.46' Row Length +24.0" End Stone x 2 = 27.46' Base Length
29 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 42.06' Base Width
6.0" Base + 17.3" Chamber Height + 6.0" Cover = 2.44' Field Height

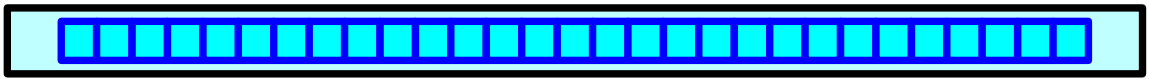
290 Chambers x 4.2 cf = 1,224.3 cf Chamber Storage
290 Chambers x 4.4 cf = 1,288.8 cf Displacement

2,821.9 cf Field - 1,288.8 cf Chambers = 1,533.1 cf Stone x 40.0% Voids = 613.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,837.6 cf = 0.042 af
Overall Storage Efficiency = 65.1%
Overall System Size = 27.46' x 42.06' x 2.44'

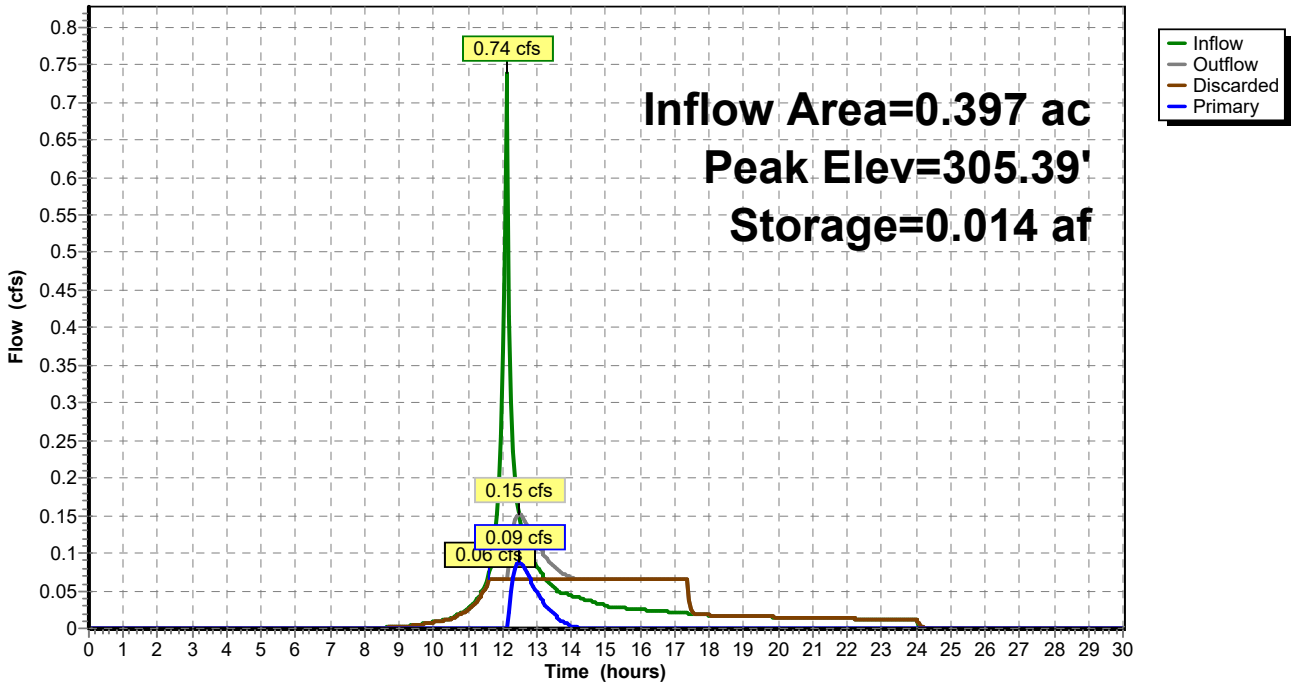
290 Chambers
104.5 cy Field
56.8 cy Stone





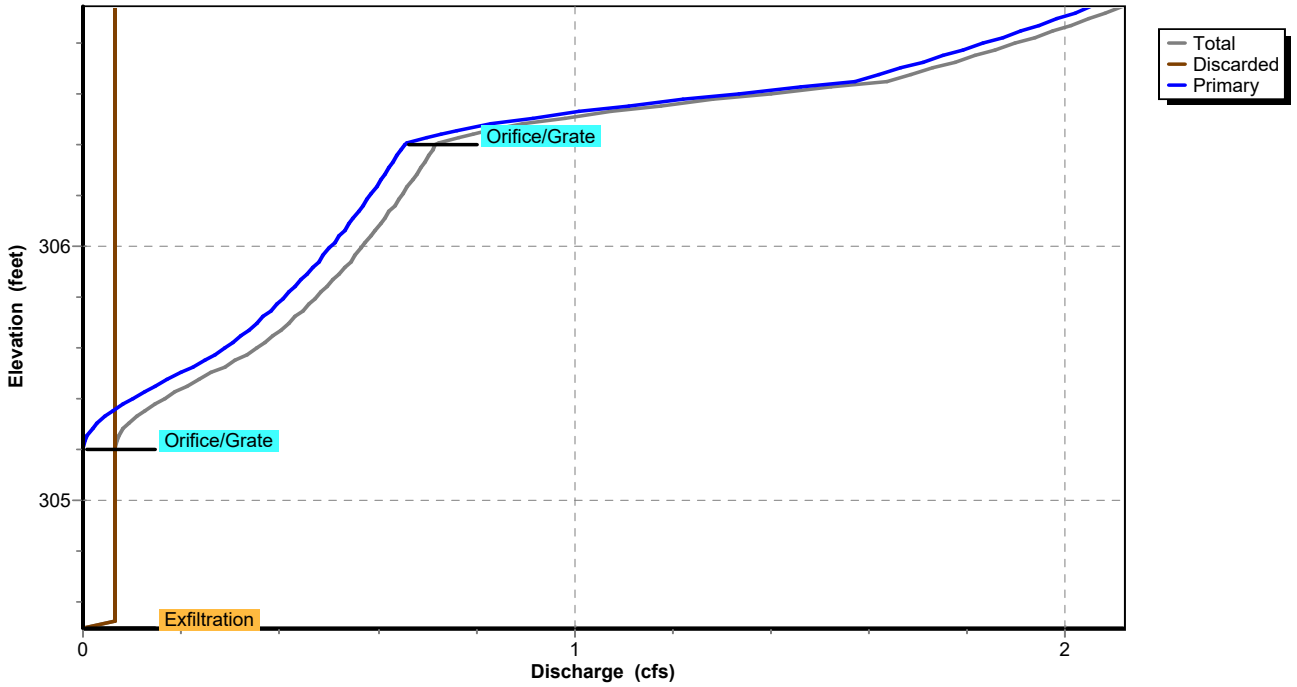
## Pond 1P: UG - system #1

Hydrograph




## Pond 1P: UG - system #1

Stage-Discharge



## Summary for Pond 2P: UG - system #2

Inflow Area = 1.434 ac, 43.88% Impervious, Inflow Depth = 1.09" for 2-Year event
Inflow = 1.77 cfs @ 12.11 hrs, Volume= 0.130 af
Outflow = 0.82 cfs @ 12.22 hrs, Volume= 0.130 af, Atten= 54%, Lag= 6.7 min
Discarded = 0.08 cfs @ 10.65 hrs, Volume= 0.089 af
Primary = 0.74 cfs @ 12.22 hrs, Volume= 0.041 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 294.22' @ 12.22 hrs Surf.Area= 0.034 ac Storage= 0.033 af

Plug-Flow detention time= 53.3 min calculated for 0.130 af (100% of inflow)
Center-of-Mass det. time= 53.2 min ( 842.8 - 789.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 292.80' | 0.020 af | **43.37'W x 34.50'L x 3.17'H Field A**<br>0.109 af Overall - 0.060 af Embedded = 0.049 af x 40.0% Voids |
| #2A | 293.30' | 0.057 af | **ACF R-Tank HD 1.5** x 390 Inside #1<br>Inside= 15.7"W x 26.0"H => 2.70 sf x 2.35'L = 6.3 cf<br>Outside= 15.7"W x 26.0"H => 2.84 sf x 2.35'L = 6.7 cf<br>390 Chambers in 30 Rows |
| | | 0.076 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 293.60' | **7.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 294.50' | **8.0" Vert. Orifice/Grate** C= 0.600 |
| #3 | Primary | 295.80' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Discarded | 292.80' | **2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01' |

**Discarded OutFlow** Max=0.08 cfs @ 10.65 hrs HW=292.83' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.08 cfs)

**Primary OutFlow** Max=0.73 cfs @ 12.22 hrs HW=294.21' (Free Discharge)
├**1=Orifice/Grate** (Orifice Controls 0.73 cfs @ 2.73 fps)
├**2=Orifice/Grate** ( Controls 0.00 cfs)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond 2P: UG - system #2 - Chamber Wizard Field A

**Chamber Model = ACF R-Tank HD 1.5 (ACF Environmental R-Tank HD)**
Inside= 15.7"W x 26.0"H => 2.70 sf x 2.35'L = 6.3 cf
Outside= 15.7"W x 26.0"H => 2.84 sf x 2.35'L = 6.7 cf

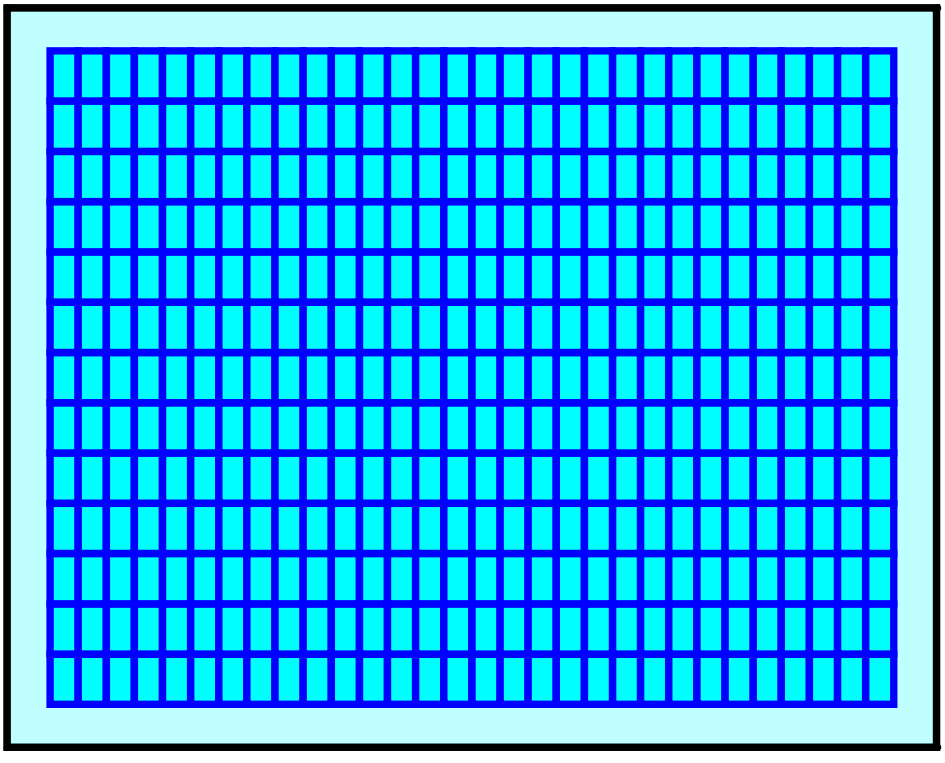
13 Chambers/Row x 2.35' Long = 30.50' Row Length +24.0" End Stone x 2 = 34.50' Base Length
30 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 43.37' Base Width
6.0" Base + 26.0" Chamber Height + 6.0" Cover = 3.17' Field Height

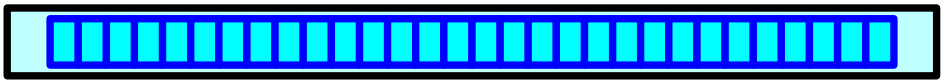
390 Chambers x 6.3 cf = 2,469.8 cf Chamber Storage
390 Chambers x 6.7 cf = 2,599.7 cf Displacement

4,735.6 cf Field - 2,599.7 cf Chambers = 2,135.8 cf Stone x 40.0% Voids = 854.3 cf Stone Storage

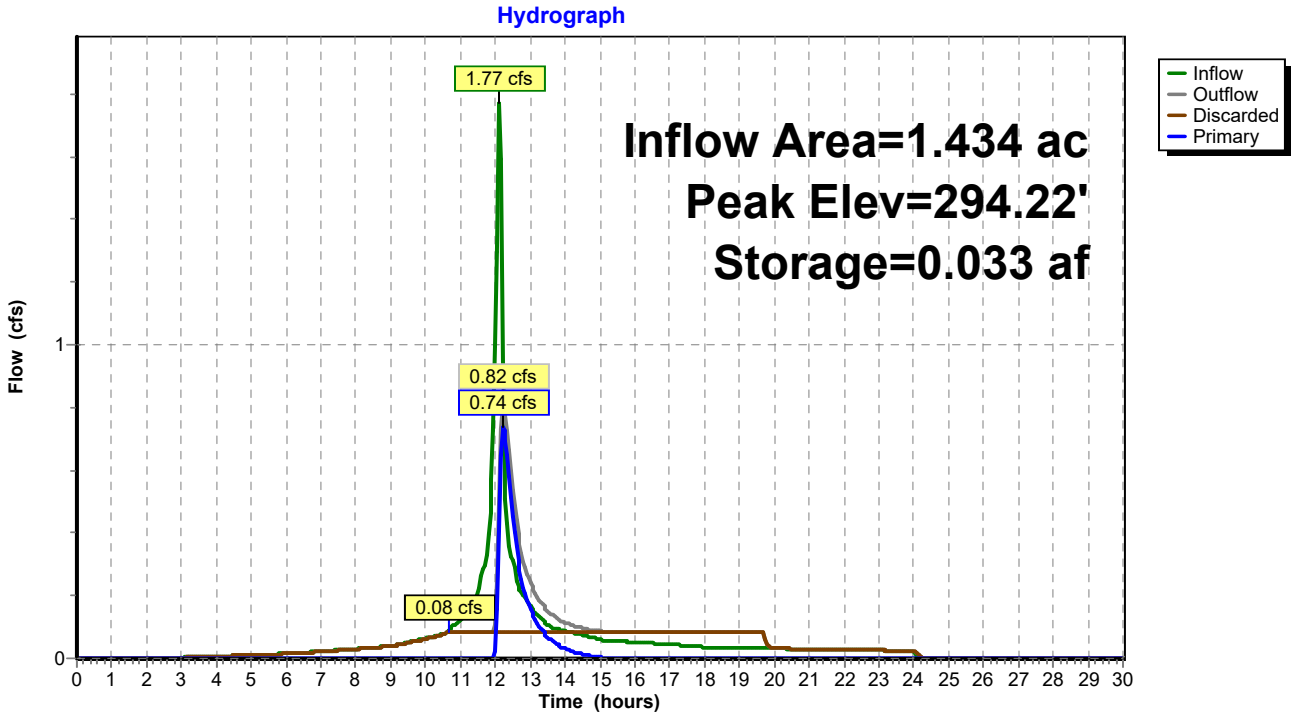
Chamber Storage + Stone Storage = 3,324.1 cf = 0.076 af
Overall Storage Efficiency = 70.2%
Overall System Size = 34.50' x 43.37' x 3.17'

390 Chambers
175.4 cy Field
79.1 cy Stone

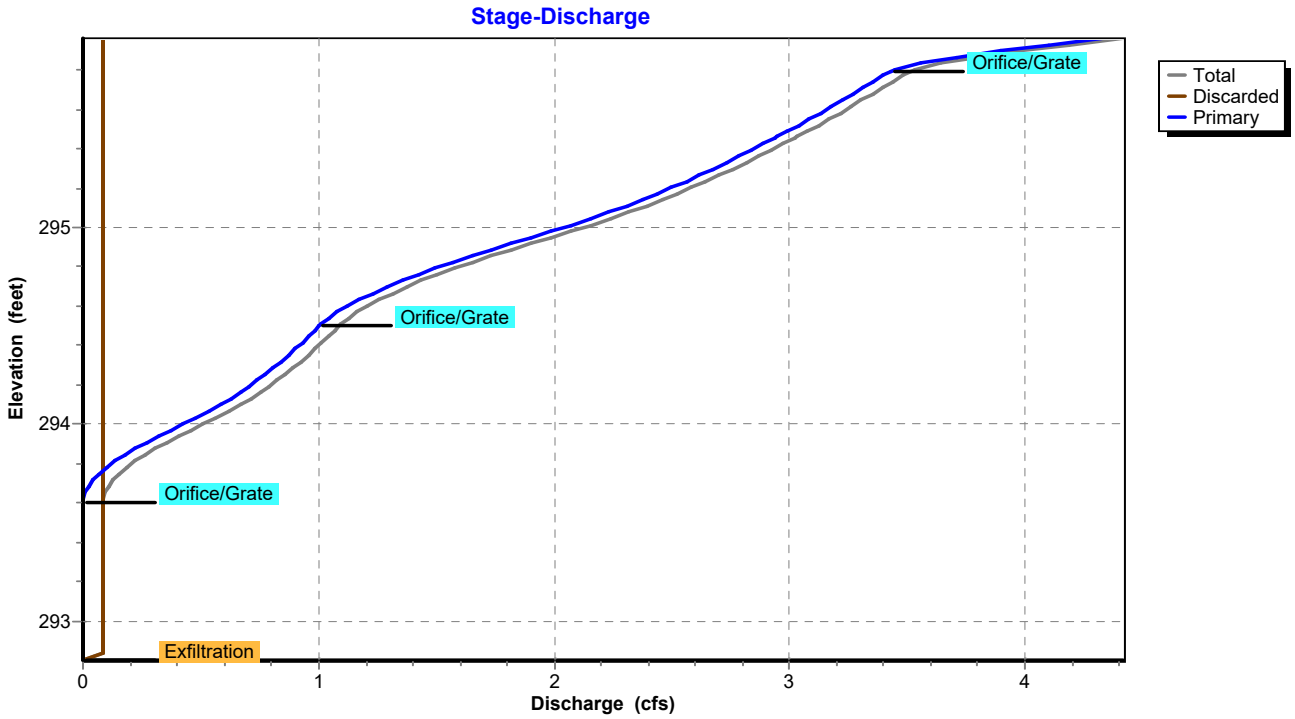




## Pond 2P: UG - system #2




## Pond 2P: UG - system #2

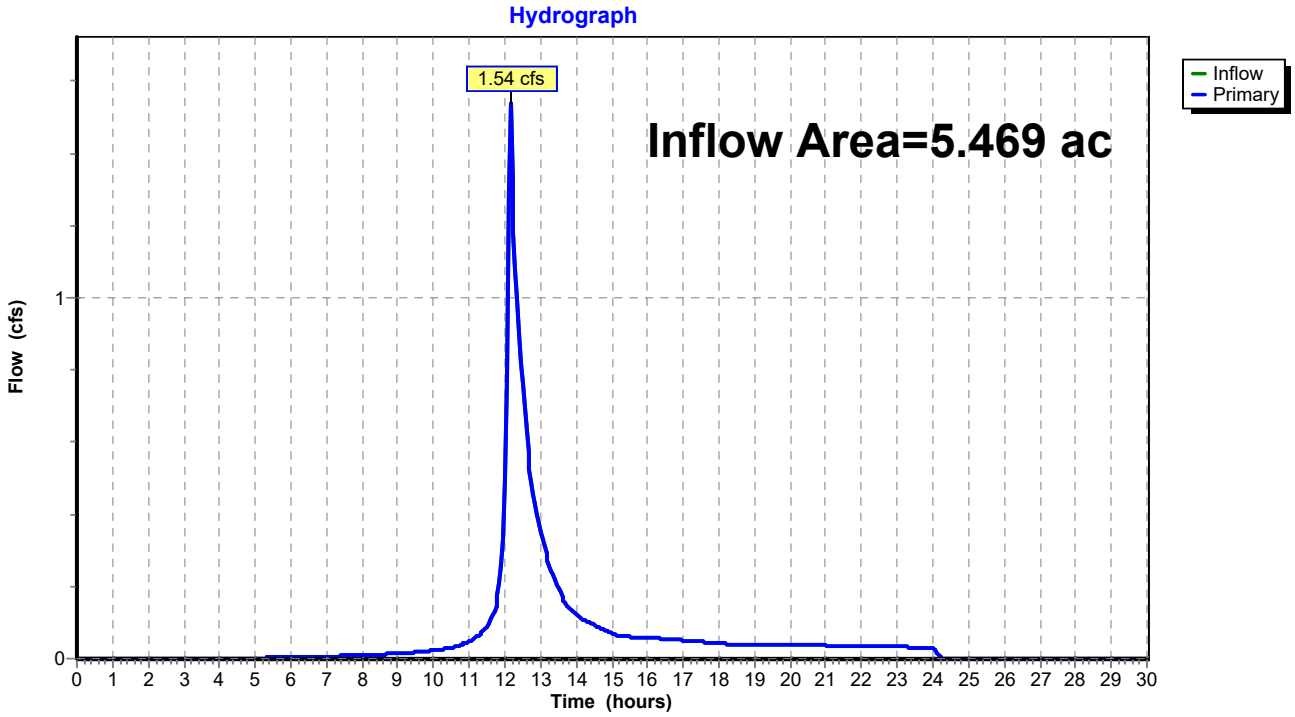


## Summary for Link 1L: STUDY POINT- Amethyst Brook

Inflow Area = 5.469 ac, 28.03% Impervious, Inflow Depth = 0.30" for 2-Year event
Inflow = 1.54 cfs @ 12.15 hrs, Volume= 0.138 af
Primary = 1.54 cfs @ 12.15 hrs, Volume= 0.138 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

## Link 1L: STUDY POINT- Amethyst Brook



## Summary for Subcatchment P1: South of Amherst Road

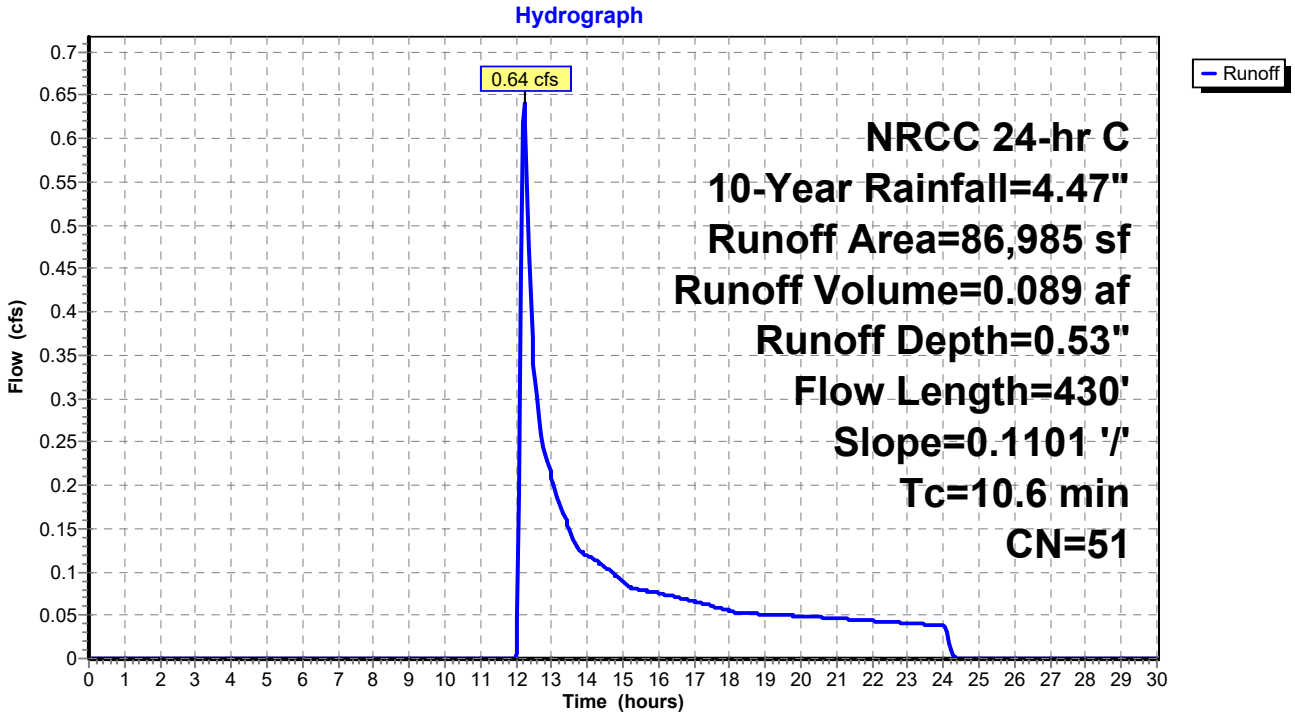
Runoff = 0.64 cfs @ 12.22 hrs, Volume= 0.089 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 7,024 | 98 | Impervious HSG A |
| * | 806 | 98 | Impervious HSG B |
| | 39,100 | 36 | Woods, Fair, HSG A |
| | 30,655 | 60 | Woods, Fair, HSG B |
| | 9,400 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 86,985 | 51 | Weighted Average |
| | 79,155 | | 91.00% Pervious Area |
| | 7,830 | | 9.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.6 | 430 | 0.1101 | 0.68 | | **Lag/CN Method,** Contour Length= 9,580' Interval= 1' |

### Subcatchment P1: South of Amherst Road



## Summary for Subcatchment P1A: Amherst rd

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

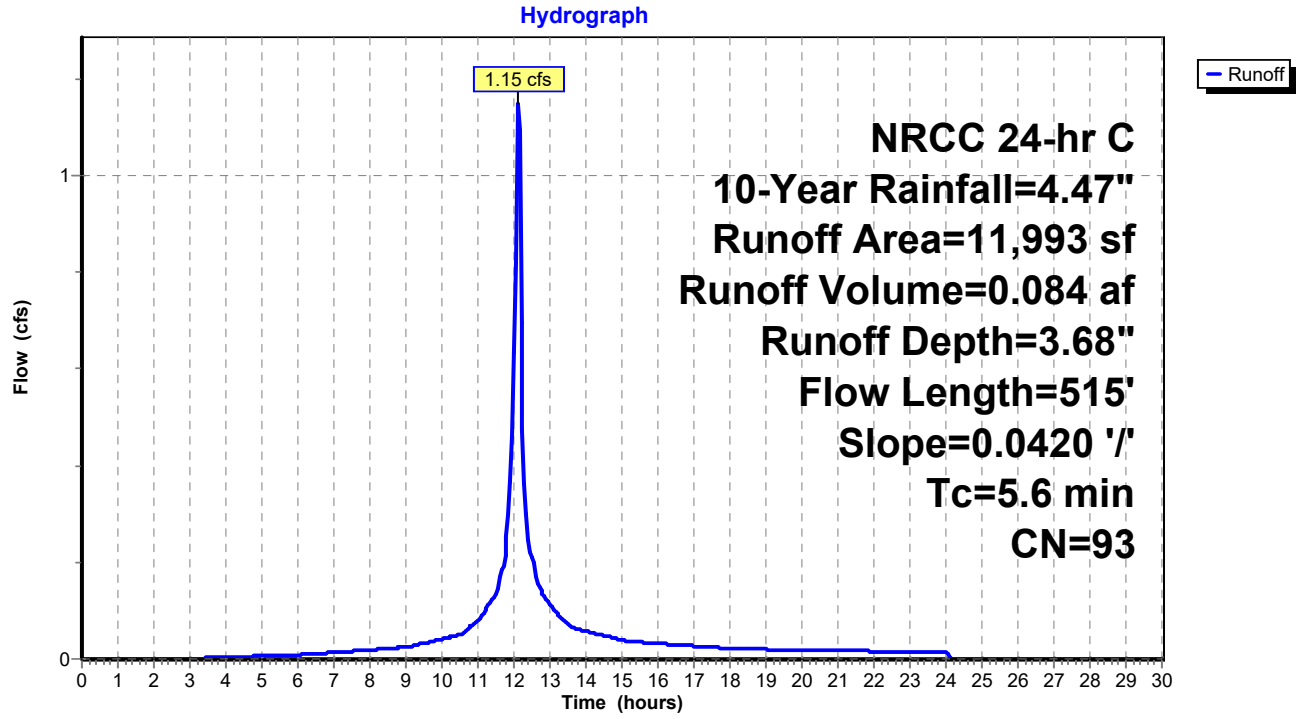
Runoff = 1.15 cfs @ 12.12 hrs, Volume= 0.084 af, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 10,800 | 98 | Paved road, HSG A |
| | 1,193 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 11,993 | 93 | Weighted Average |
| | 1,193 | | 9.95% Pervious Area |
| | 10,800 | | 90.05% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.6 | 515 | 0.0420 | 1.53 | | **Lag/CN Method,** Contour Length= 504' Interval= 1' |

## Subcatchment P1A: Amherst rd



## Summary for Subcatchment P2A: Part of #20 and 24 impervious

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

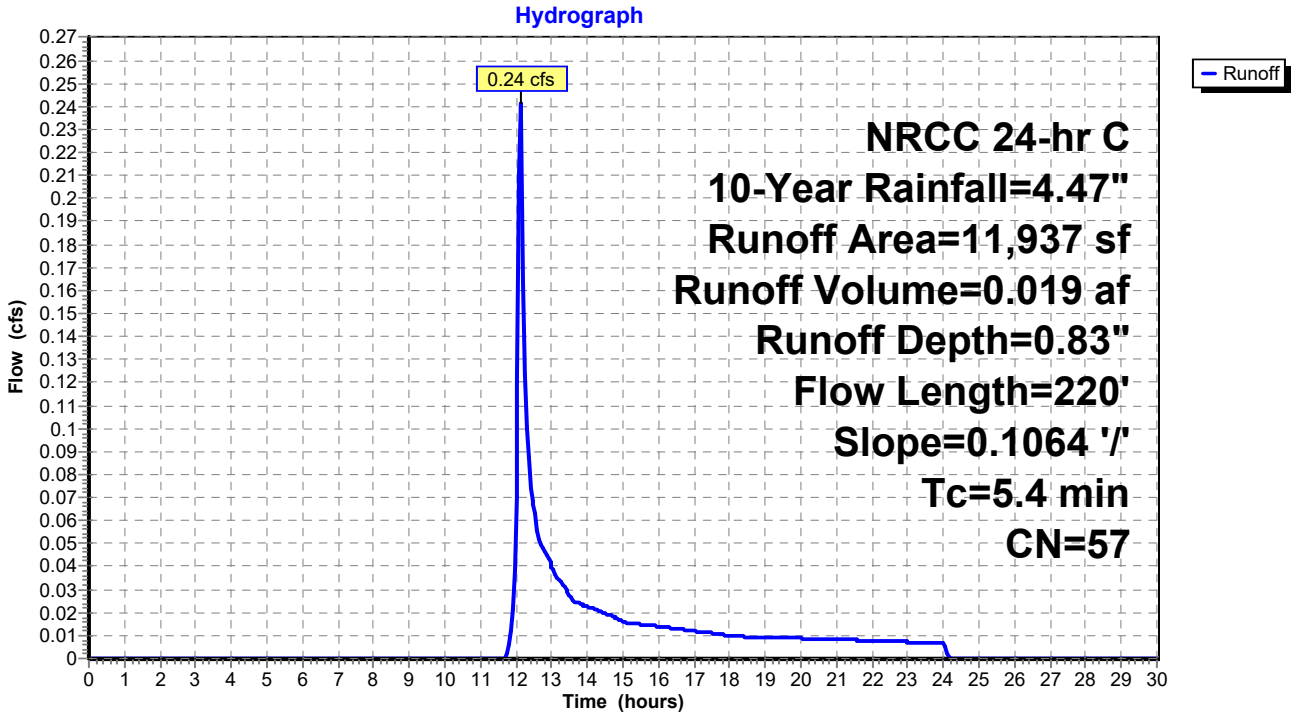
Runoff = 0.24 cfs @ 12.14 hrs, Volume= 0.019 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 2,647 | 98 | Impervious HSG A |
| | 7,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 2,290 | 36 | Woods, Fair, HSG A |
| | 11,937 | 57 | Weighted Average |
| | 9,290 | | 77.83% Pervious Area |
| | 2,647 | | 22.17% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.4 | 220 | 0.1064 | 0.68 | | **Lag/CN Method,** Contour Length= 1,270' Interval= 1' |

## Subcatchment P2A: Part of #20 and 24 impervious



## Summary for Subcatchment P2B: slope below driveway

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

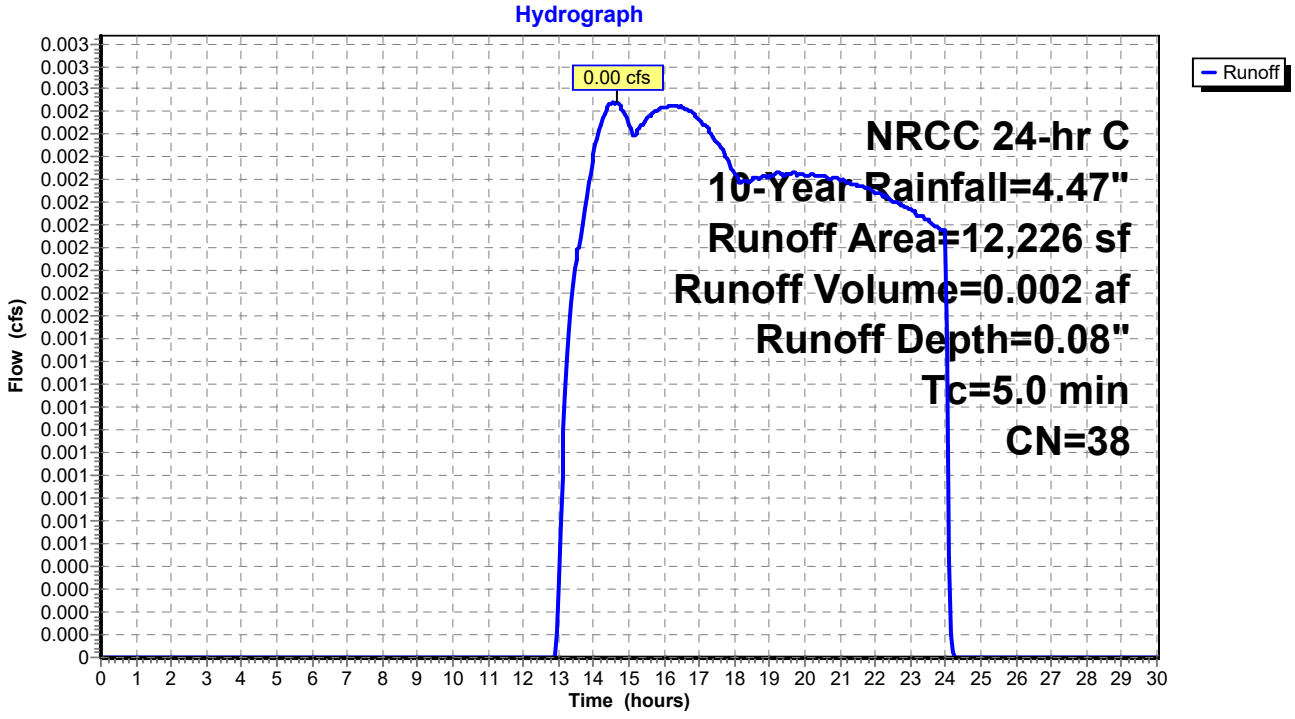
Runoff = 0.00 cfs @ 14.64 hrs, Volume= 0.002 af, Depth= 0.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 11,888 | 36 | Woods, Fair, HSG A |
| * | 338 | 98 | Wall |
| | 12,226 | 38 | Weighted Average |
| | 11,888 | | 97.24% Pervious Area |
| | 338 | | 2.76% Impervious Area |

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

## Subcatchment P2B: slope below driveway



## Summary for Subcatchment P2C: Entrance drive

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

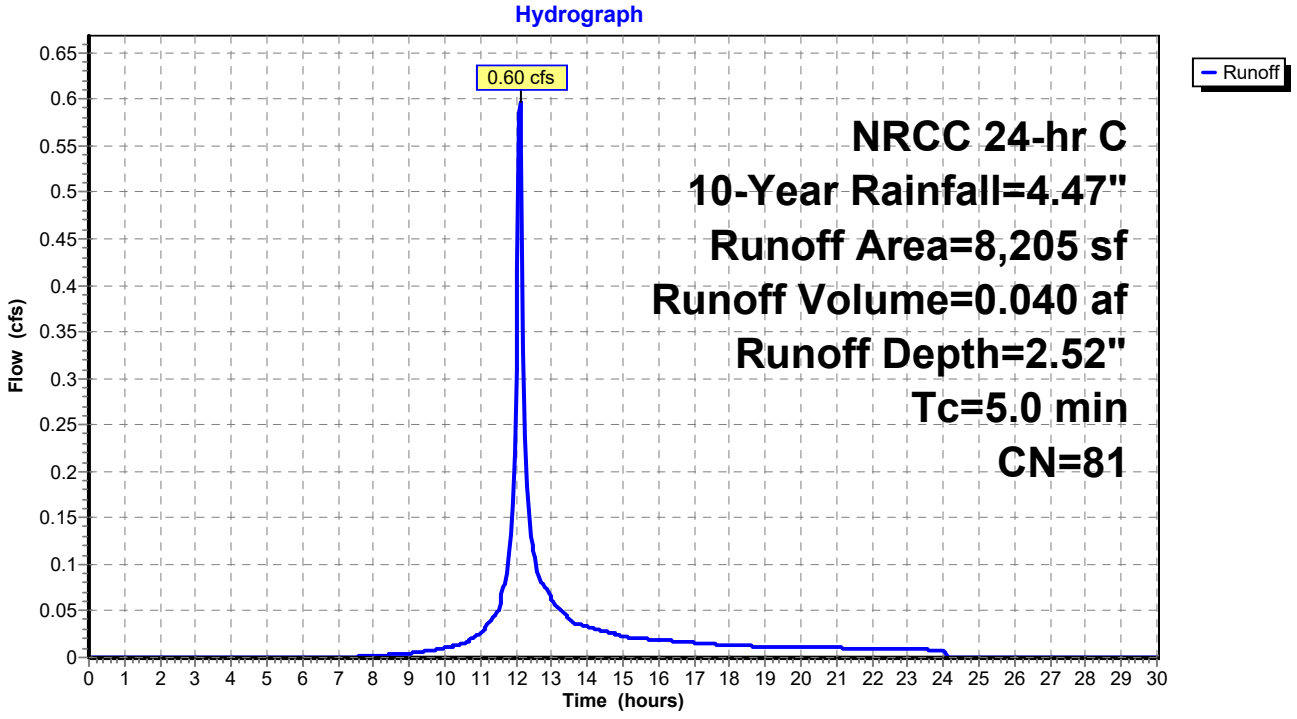
Runoff = 0.60 cfs @ 12.12 hrs, Volume= 0.040 af, Depth= 2.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 5,389 | 98 | Impervious |
| | 2,816 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 8,205 | 81 | Weighted Average |
| | 2,816 | | 34.32% Pervious Area |
| | 5,389 | | 65.68% Impervious Area |

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

## Subcatchment P2C: Entrance drive



## Summary for Subcatchment P2D: Parking lot and Roof

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

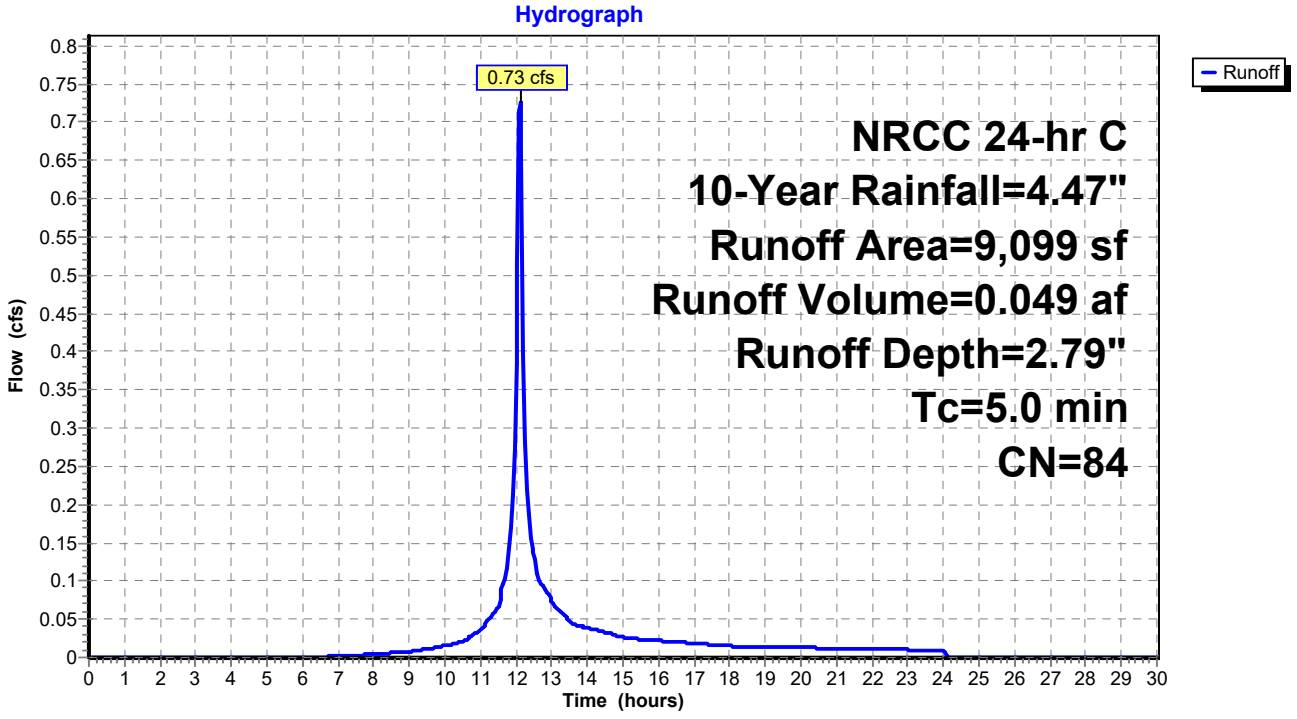
Runoff = 0.73 cfs @ 12.11 hrs, Volume= 0.049 af, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 6,504 | 98 | Impervious |
| | 2,595 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 9,099 | 84 | Weighted Average |
| | 2,595 | | 28.52% Pervious Area |
| | 6,504 | | 71.48% Impervious Area |

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

## Subcatchment P2D: Parking lot and Roof



## Summary for Subcatchment P2E: Driveway and back roof

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

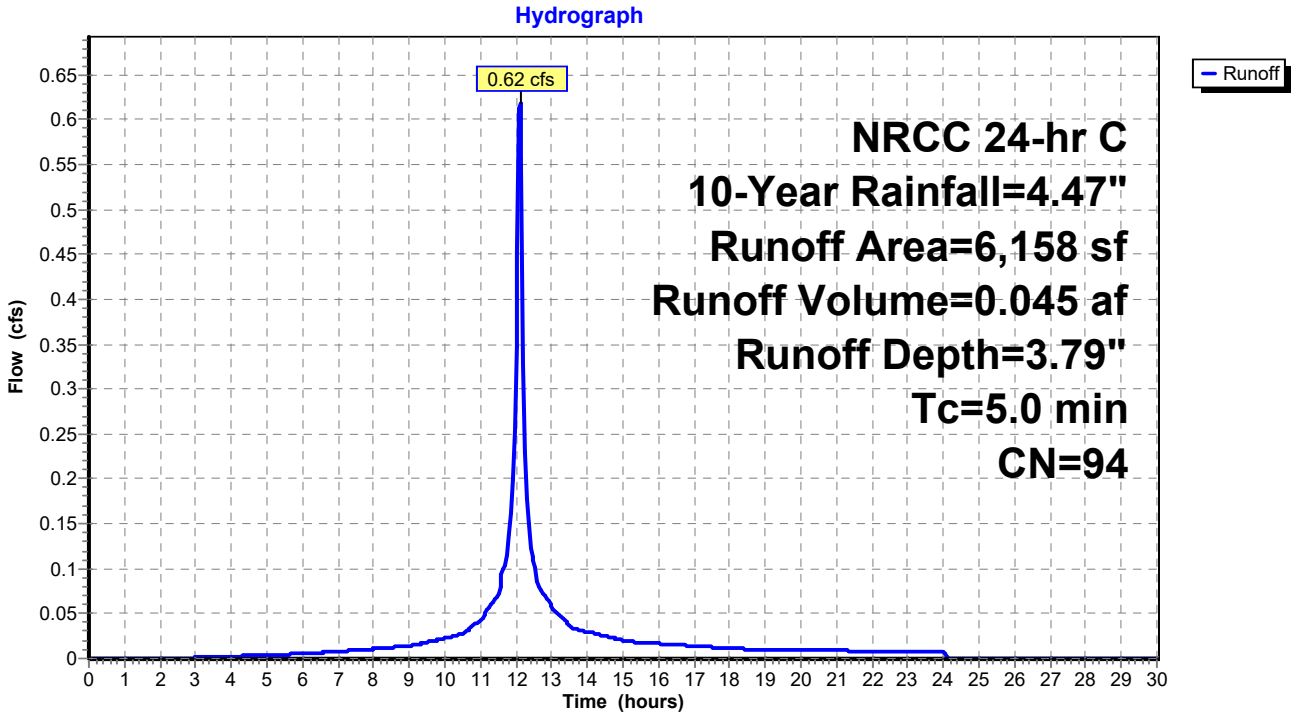
Runoff = 0.62 cfs @ 12.11 hrs, Volume= 0.045 af, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 4,254 | 98 | Impervious |
| | 653 | 96 | Gravel surface, HSG A |
| | 451 | 49 | 50-75% Grass cover, Fair, HSG A |
| * | 800 | 98 | Impervious - roof |
| | 6,158 | 94 | Weighted Average |
| | 1,104 | | 17.93% Pervious Area |
| | 5,054 | | 82.07% Impervious Area |

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

## Subcatchment P2E: Driveway and back roof



## Summary for Subcatchment P3: part of #24 impervious + wooded slope

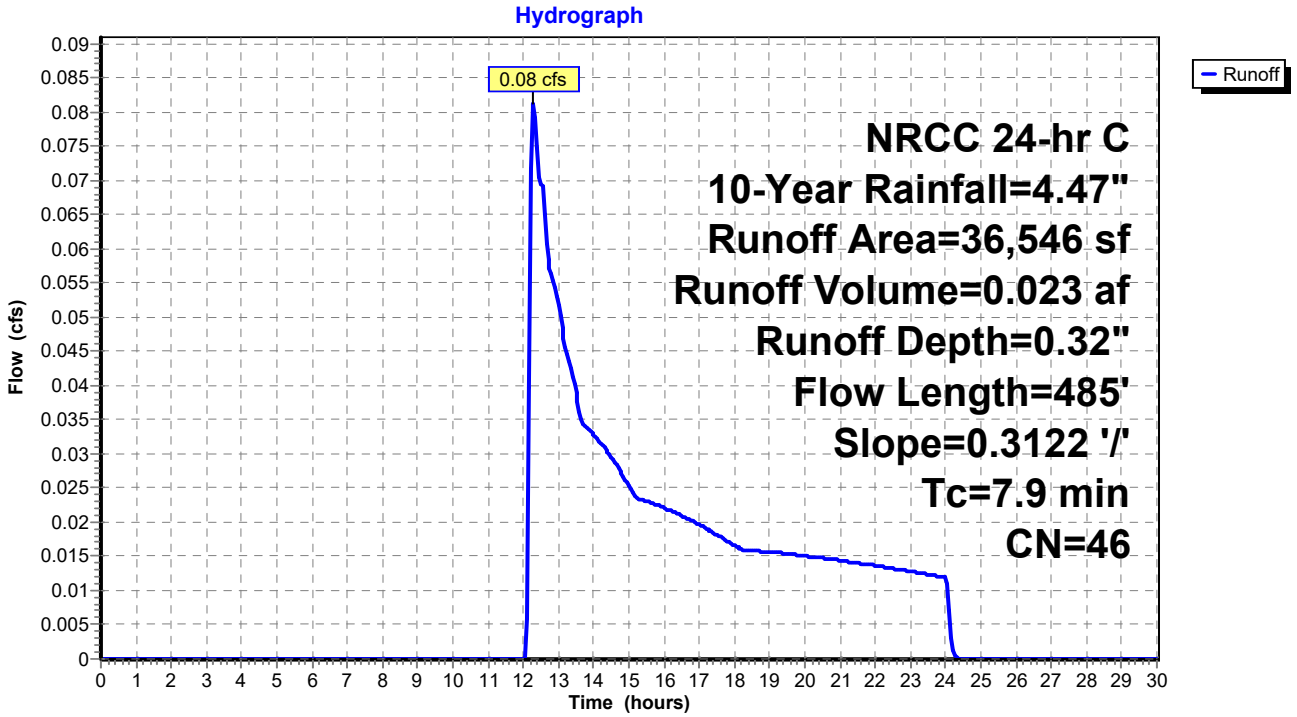
Runoff = 0.08 cfs @ 12.29 hrs, Volume= 0.023 af, Depth= 0.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 4,706 | 98 | Impervious |
| | 26,390 | 36 | Woods, Fair, HSG A |
| | 5,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 450 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 36,546 | 46 | Weighted Average |
| | 31,840 | | 87.12% Pervious Area |
| | 4,706 | | 12.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.9 | 485 | 0.3122 | 1.03 | | **Lag/CN Method,** Contour Length= 11,408' Interval= 1' |

## Subcatchment P3: part of #24 impervious + wooded slope



## Summary for Subcatchment P3A: #22 drive and lower parking lots

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

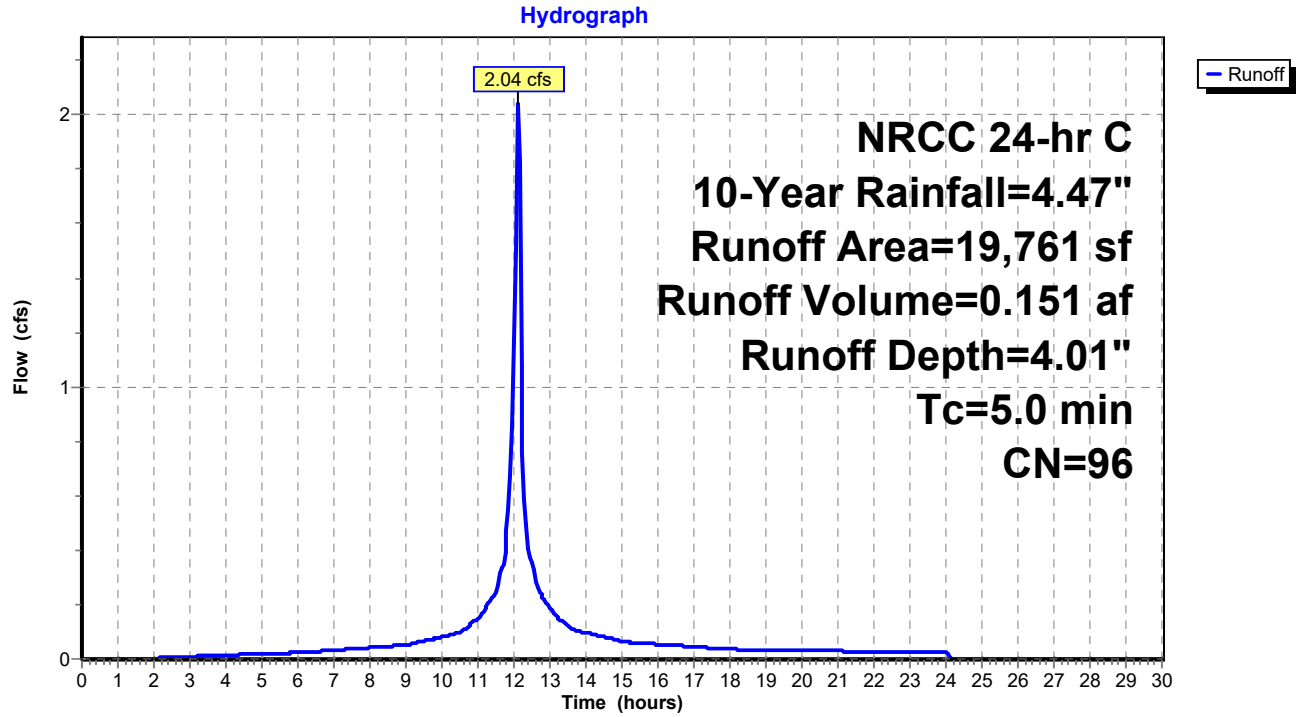
Runoff = 2.04 cfs @ 12.11 hrs, Volume= 0.151 af, Depth= 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 17,647 | 98 | Impervious |
| | 1,300 | 96 | Gravel surface, HSG A |
| | 814 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 19,761 | 96 | Weighted Average |
| | 2,114 | | 10.70% Pervious Area |
| | 17,647 | | 89.30% Impervious Area |

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

## Subcatchment P3A: #22 drive and lower parking lots



## Summary for Subcatchment P3B: slope below parking

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

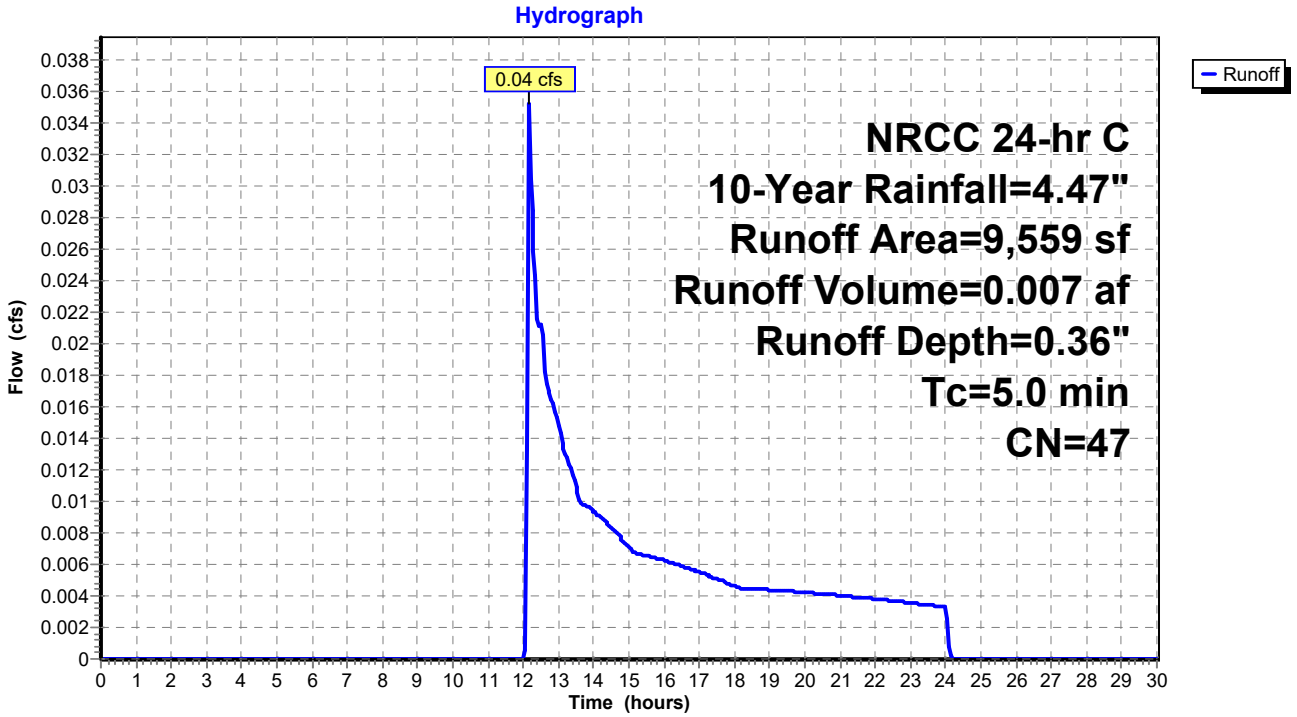
Runoff = 0.04 cfs @ 12.17 hrs, Volume= 0.007 af, Depth= 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,285 | 98 | Impervious |
| | 6,274 | 36 | Woods, Fair, HSG A |
| | 2,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 9,559 | 47 | Weighted Average |
| | 8,274 | | 86.56% Pervious Area |
| | 1,285 | | 13.44% Impervious Area |

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

## Subcatchment P3B: slope below parking



## Summary for Subcatchment P4: east drainage area

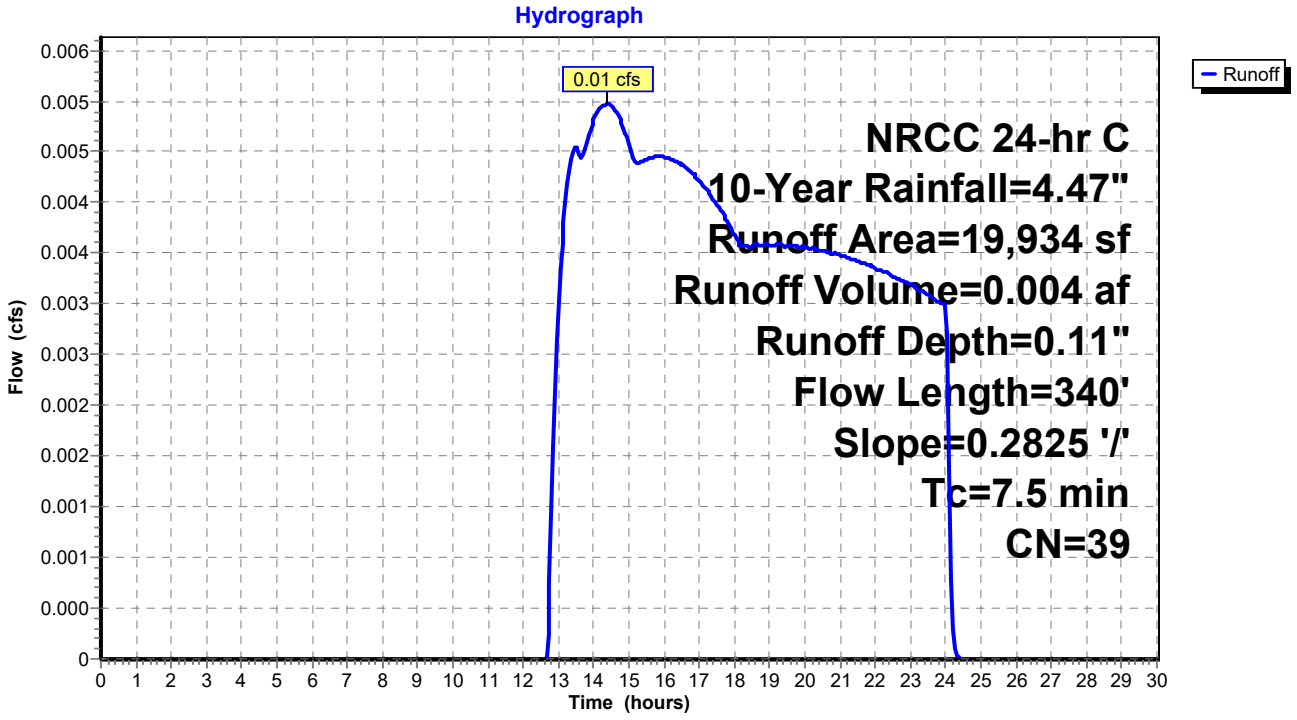
Runoff = 0.01 cfs @ 14.36 hrs, Volume= 0.004 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 18,814 | 36 | Woods, Fair, HSG A |
| * | 1,120 | 98 | Impervious |
| | 19,934 | 39 | Weighted Average |
| | 18,814 | | 94.38% Pervious Area |
| | 1,120 | | 5.62% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.5 | 340 | 0.2825 | 0.75 | | **Lag/CN Method,** Contour Length= 5,632' Interval= 1' |

## Subcatchment P4: east drainage area



## Summary for Subcatchment P4A: part of #22 roof

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

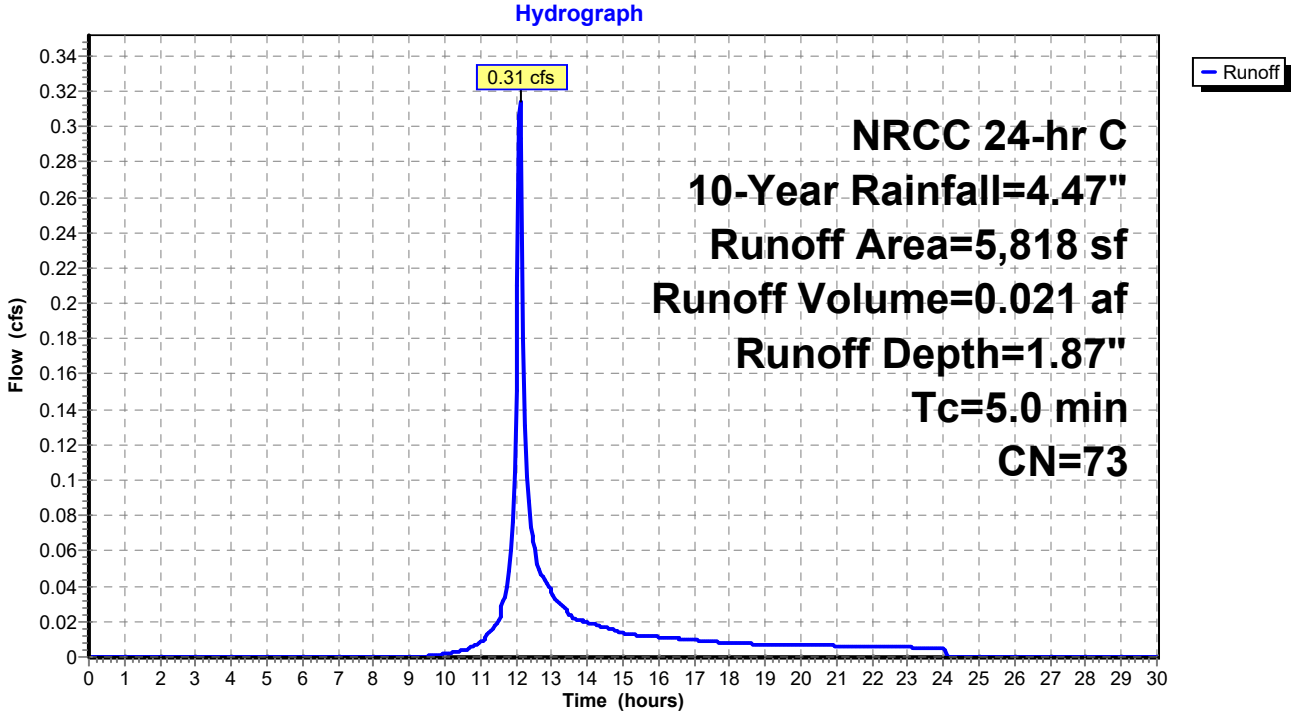
Runoff = 0.31 cfs @ 12.12 hrs, Volume= 0.021 af, Depth= 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.47"

| Area (sf) | CN | Description |
|---|---|---|
| 3,455 | 98 | Unconnected roofs, HSG A |
| 2,363 | 36 | Woods, Fair, HSG A |
| 5,818 | 73 | Weighted Average |
| 2,363 | | 40.62% Pervious Area |
| 3,455 | | 59.38% Impervious Area |
| 3,455 | | 100.00% Unconnected |

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

## Subcatchment P4A: part of #22 roof



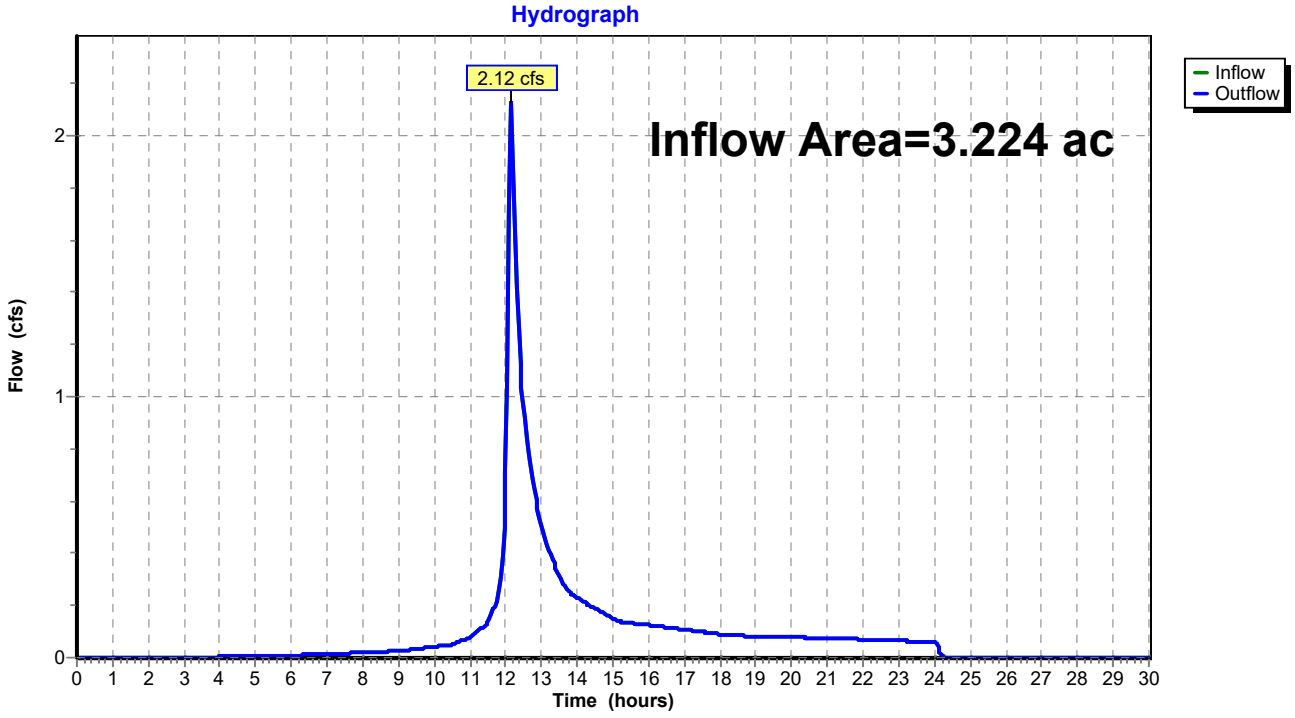
## Summary for Reach 1R: ex swale

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

Inflow Area = 3.224 ac, 23.86% Impervious, Inflow Depth = 0.84" for 10-Year event
Inflow = 2.12 cfs @ 12.16 hrs, Volume= 0.224 af
Outflow = 2.12 cfs @ 12.16 hrs, Volume= 0.224 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 1R: ex swale



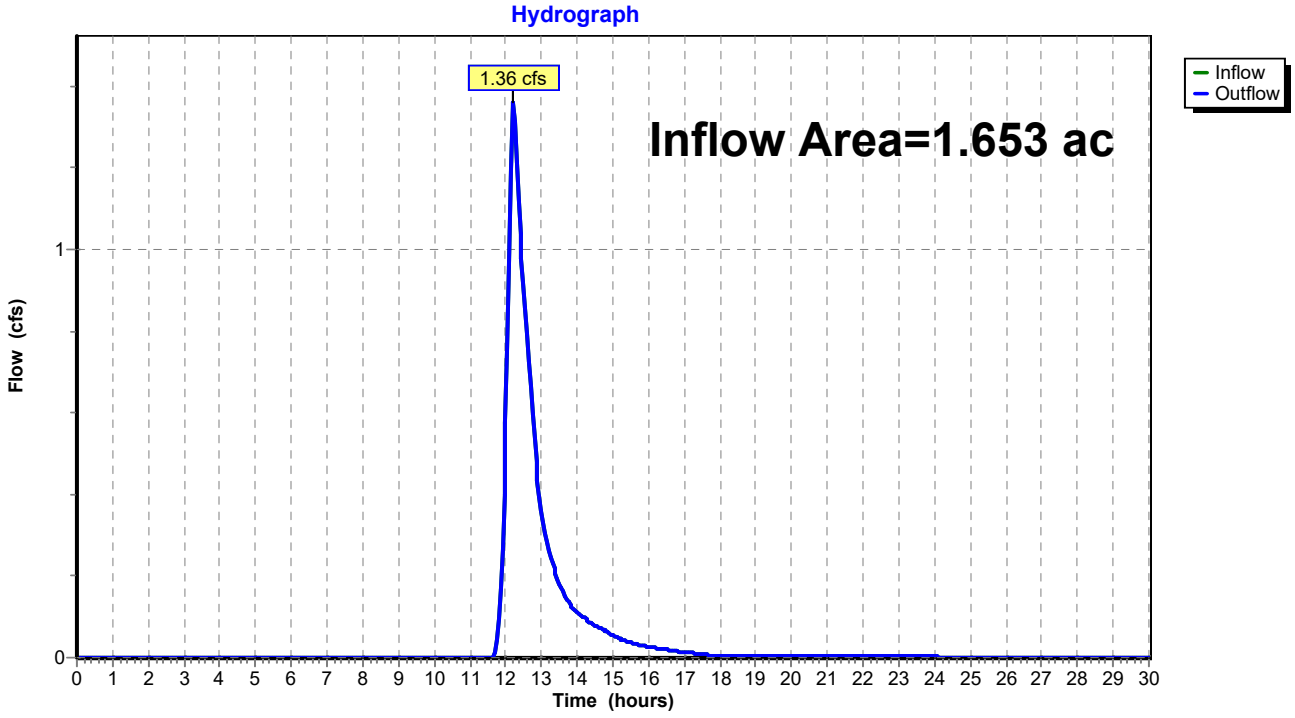
## Summary for Reach 2R: central DA

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

Inflow Area = 1.653 ac, 39.84% Impervious, Inflow Depth = 0.76" for 10-Year event
Inflow = 1.36 cfs @ 12.22 hrs, Volume= 0.105 af
Outflow = 1.36 cfs @ 12.22 hrs, Volume= 0.105 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 2R: central DA



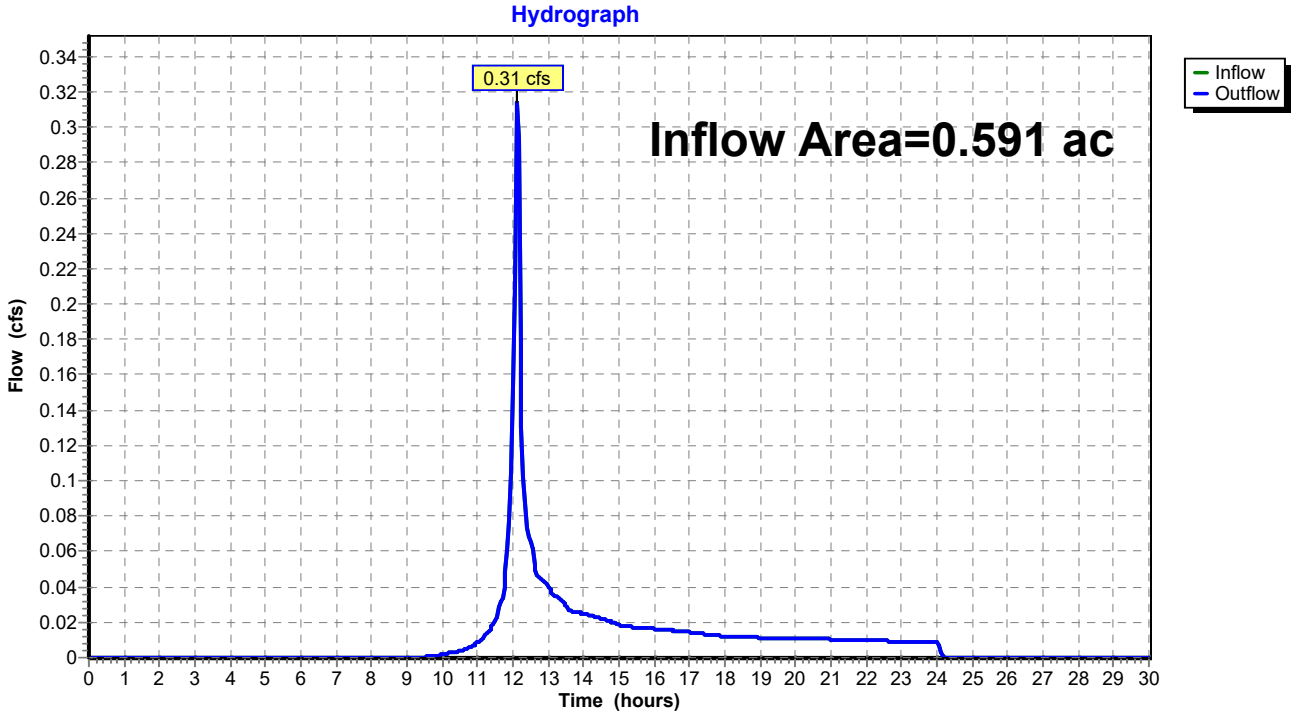
## Summary for Reach 3R: East DA

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

Inflow Area = 0.591 ac, 17.77% Impervious, Inflow Depth = 0.51" for 10-Year event
Inflow = 0.31 cfs @ 12.12 hrs, Volume= 0.025 af
Outflow = 0.31 cfs @ 12.12 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 3R: East DA



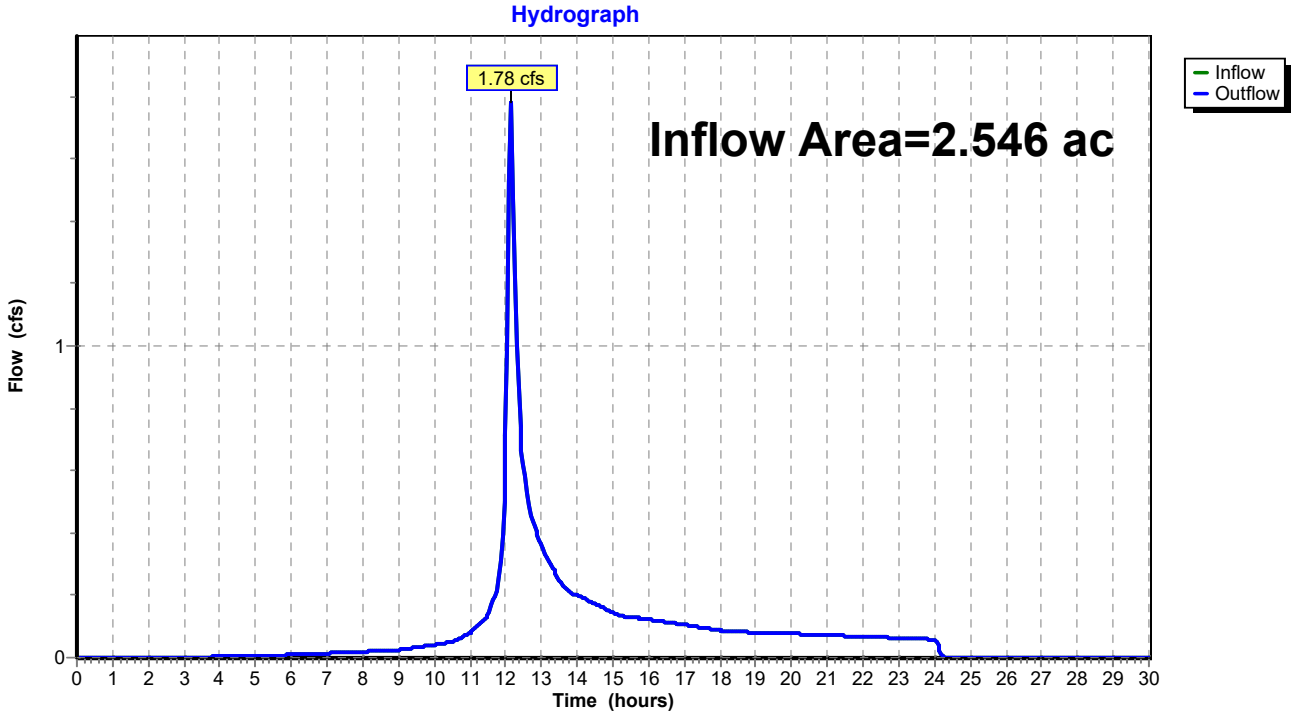
## Summary for Reach 4R: (new Reach)

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

Inflow Area = 2.546 ac, 19.18% Impervious, Inflow Depth = 0.91" for 10-Year event
Inflow = 1.78 cfs @ 12.15 hrs, Volume= 0.192 af
Outflow = 1.78 cfs @ 12.15 hrs, Volume= 0.192 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 4R: (new Reach)



## Summary for Pond 1P: UG - system #1

Inflow Area = 0.397 ac, 68.73% Impervious, Inflow Depth = 2.66" for 10-Year event
Inflow = 1.32 cfs @ 12.12 hrs, Volume= 0.088 af
Outflow = 0.48 cfs @ 12.27 hrs, Volume= 0.088 af, Atten= 64%, Lag= 9.3 min
Discarded = 0.06 cfs @ 11.10 hrs, Volume= 0.058 af
Primary = 0.42 cfs @ 12.27 hrs, Volume= 0.030 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 305.81' @ 12.27 hrs Surf.Area= 0.027 ac Storage= 0.023 af

Plug-Flow detention time= 48.3 min calculated for 0.088 af (100% of inflow)
Center-of-Mass det. time= 48.1 min ( 875.0 - 826.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 304.50' | 0.014 af | **42.06'W x 27.46'L x 2.44'H Field A**<br>0.065 af Overall - 0.030 af Embedded = 0.035 af x 40.0% Voids |
| #2A | 305.00' | 0.028 af | **ACF R-Tank HD 1** x 290 Inside #1<br>Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf<br>Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf<br>290 Chambers in 29 Rows |
| | | 0.042 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 305.20' | **5.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 306.40' | **8.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Discarded | 304.50' | **2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01' |

**Discarded OutFlow** Max=0.06 cfs @ 11.10 hrs HW=304.53' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.06 cfs)

**Primary OutFlow** Max=0.42 cfs @ 12.27 hrs HW=305.81' (Free Discharge)
├**1=Orifice/Grate** (Orifice Controls 0.42 cfs @ 3.05 fps)
└**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond 1P: UG - system #1 - Chamber Wizard Field A

**Chamber Model = ACF R-Tank HD 1 (ACF Environmental R-Tank HD)**
Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf
Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf

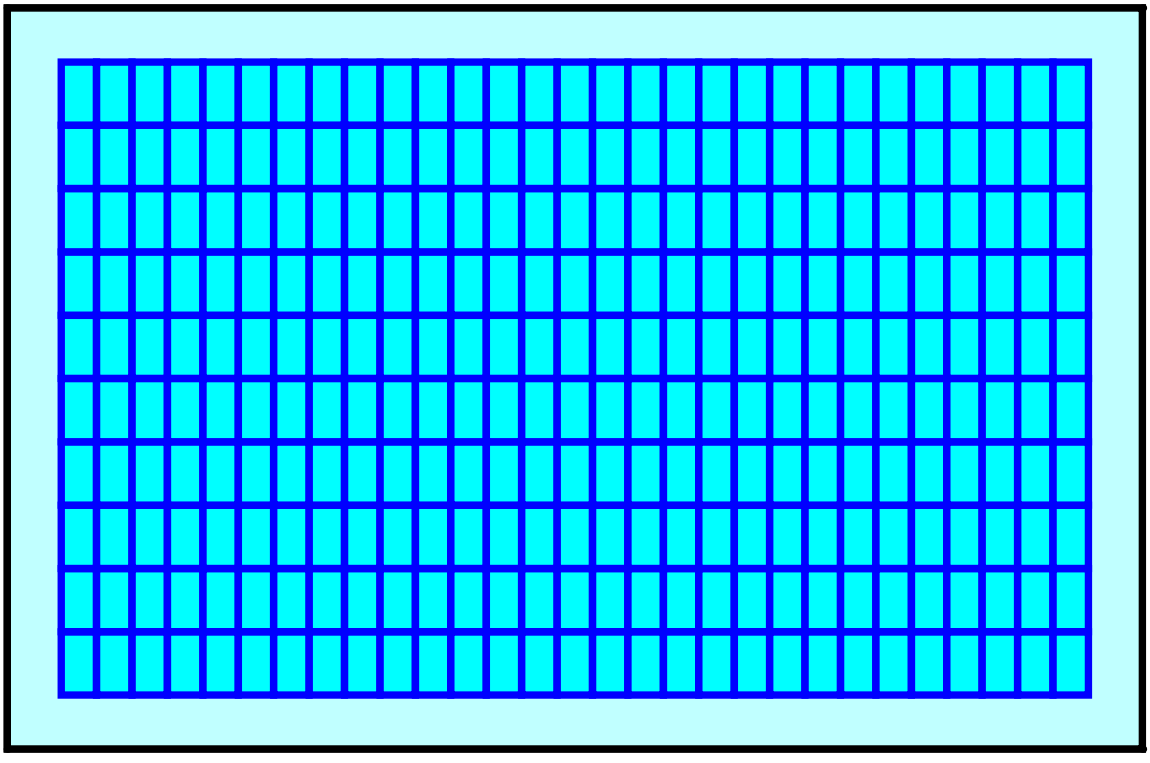
10 Chambers/Row x 2.35' Long = 23.46' Row Length +24.0" End Stone x 2 = 27.46' Base Length
29 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 42.06' Base Width
6.0" Base + 17.3" Chamber Height + 6.0" Cover = 2.44' Field Height

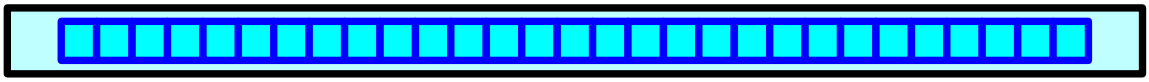
290 Chambers x 4.2 cf = 1,224.3 cf Chamber Storage
290 Chambers x 4.4 cf = 1,288.8 cf Displacement

2,821.9 cf Field - 1,288.8 cf Chambers = 1,533.1 cf Stone x 40.0% Voids = 613.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,837.6 cf = 0.042 af
Overall Storage Efficiency = 65.1%
Overall System Size = 27.46' x 42.06' x 2.44'

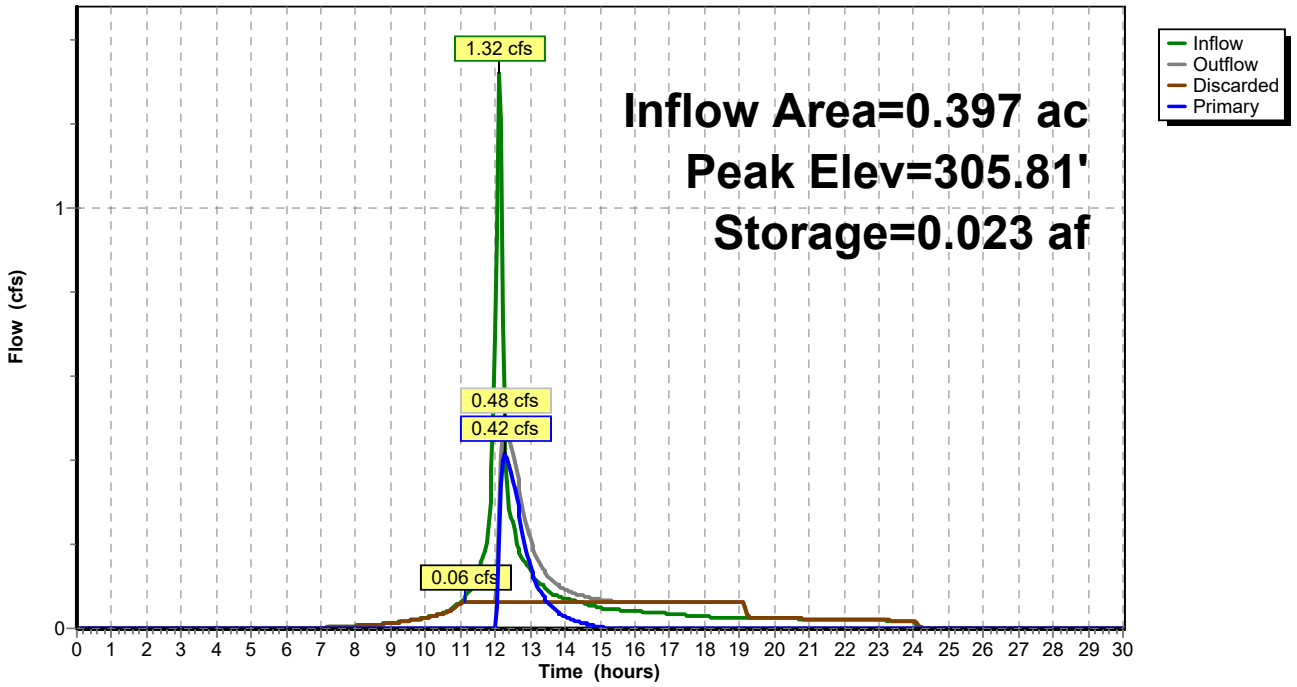
290 Chambers
104.5 cy Field
56.8 cy Stone





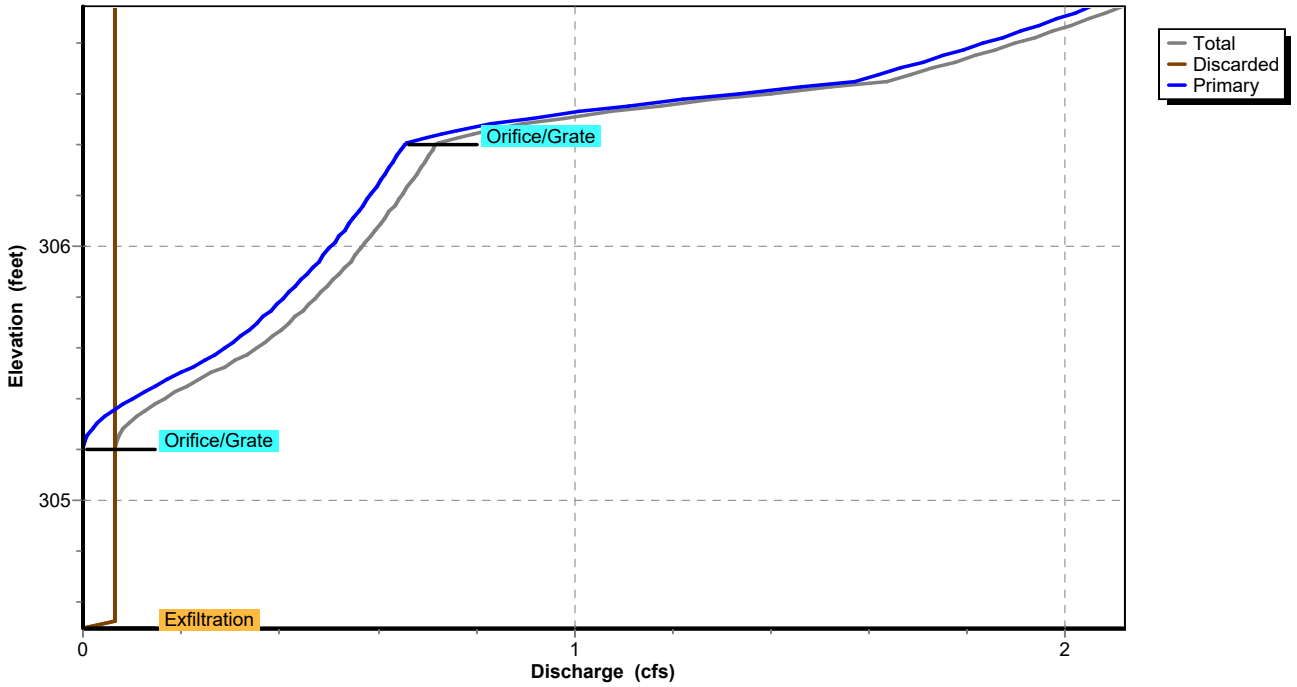
## Pond 1P: UG - system #1

Hydrograph




## Pond 1P: UG - system #1

Stage-Discharge



## Summary for Pond 2P: UG - system #2

Inflow Area = 1.434 ac, 43.88% Impervious, Inflow Depth = 1.83" for 10-Year event
Inflow = 2.67 cfs @ 12.11 hrs, Volume= 0.219 af
Outflow = 1.42 cfs @ 12.22 hrs, Volume= 0.219 af, Atten= 47%, Lag= 6.2 min
Discarded = 0.08 cfs @ 9.55 hrs, Volume= 0.120 af
Primary = 1.33 cfs @ 12.22 hrs, Volume= 0.098 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 294.72' @ 12.22 hrs Surf.Area= 0.034 ac Storage= 0.048 af

Plug-Flow detention time= 55.4 min calculated for 0.218 af (100% of inflow)
Center-of-Mass det. time= 55.3 min ( 847.6 - 792.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 292.80' | 0.020 af | **43.37'W x 34.50'L x 3.17'H Field A**<br>0.109 af Overall - 0.060 af Embedded = 0.049 af x 40.0% Voids |
| #2A | 293.30' | 0.057 af | **ACF R-Tank HD 1.5** x 390 Inside #1<br>Inside= 15.7"W x 26.0"H => 2.70 sf x 2.35'L = 6.3 cf<br>Outside= 15.7"W x 26.0"H => 2.84 sf x 2.35'L = 6.7 cf<br>390 Chambers in 30 Rows |
| | | 0.076 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 293.60' | **7.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 294.50' | **8.0" Vert. Orifice/Grate** C= 0.600 |
| #3 | Primary | 295.80' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Discarded | 292.80' | **2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01' |

**Discarded OutFlow** Max=0.08 cfs @ 9.55 hrs HW=292.83' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.08 cfs)

**Primary OutFlow** Max=1.31 cfs @ 12.22 hrs HW=294.71' (Free Discharge)
├**1=Orifice/Grate** (Orifice Controls 1.16 cfs @ 4.35 fps)
├**2=Orifice/Grate** (Orifice Controls 0.15 cfs @ 1.56 fps)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond 2P: UG - system #2 - Chamber Wizard Field A

**Chamber Model = ACF R-Tank HD 1.5 (ACF Environmental R-Tank HD)**
Inside= 15.7"W x 26.0"H => 2.70 sf x 2.35'L = 6.3 cf
Outside= 15.7"W x 26.0"H => 2.84 sf x 2.35'L = 6.7 cf

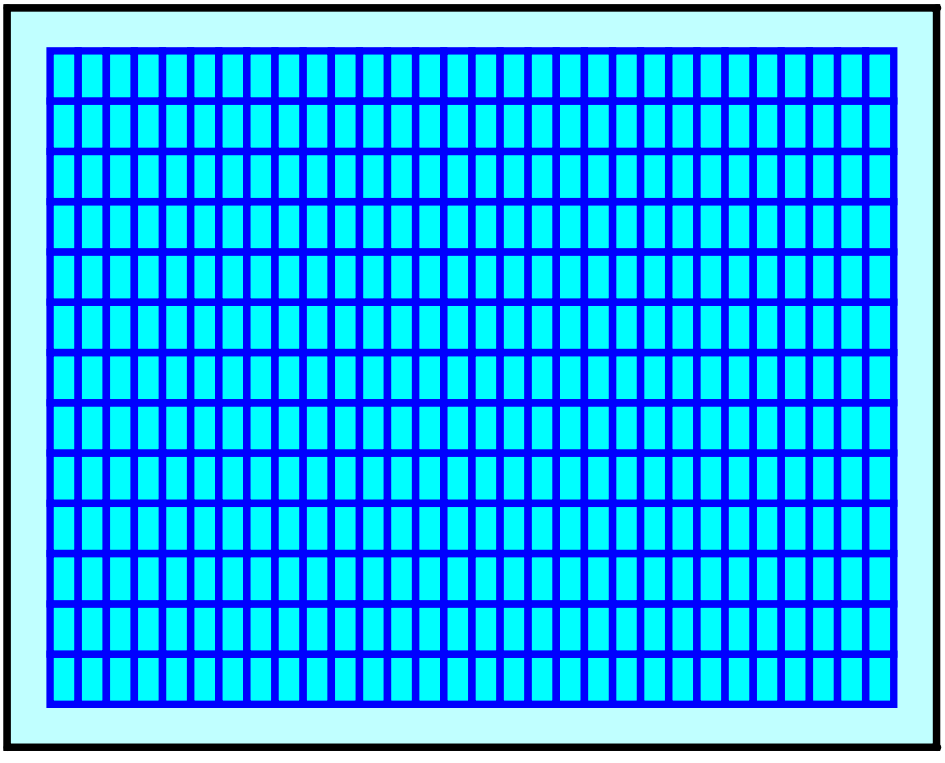
13 Chambers/Row x 2.35' Long = 30.50' Row Length +24.0" End Stone x 2 = 34.50' Base Length
30 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 43.37' Base Width
6.0" Base + 26.0" Chamber Height + 6.0" Cover = 3.17' Field Height

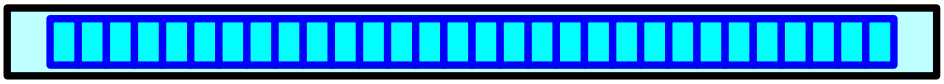
390 Chambers x 6.3 cf = 2,469.8 cf Chamber Storage
390 Chambers x 6.7 cf = 2,599.7 cf Displacement

4,735.6 cf Field - 2,599.7 cf Chambers = 2,135.8 cf Stone x 40.0% Voids = 854.3 cf Stone Storage

Chamber Storage + Stone Storage = 3,324.1 cf = 0.076 af
Overall Storage Efficiency = 70.2%
Overall System Size = 34.50' x 43.37' x 3.17'

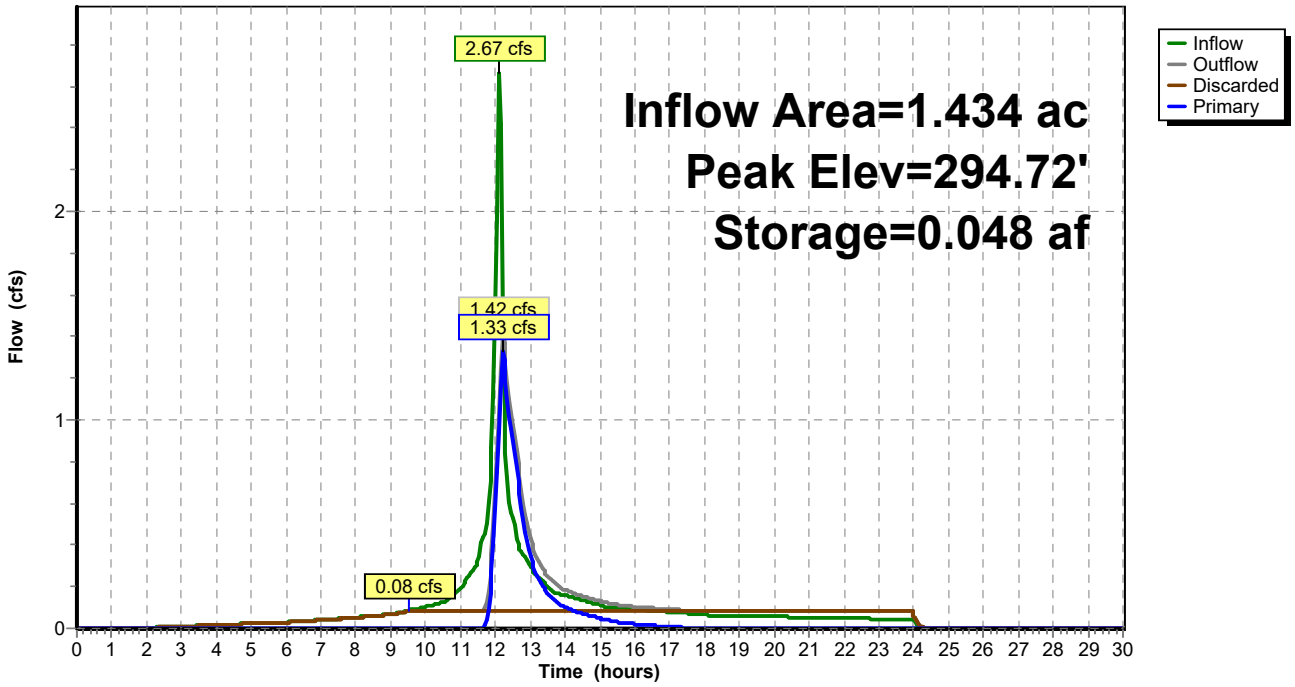
390 Chambers
175.4 cy Field
79.1 cy Stone





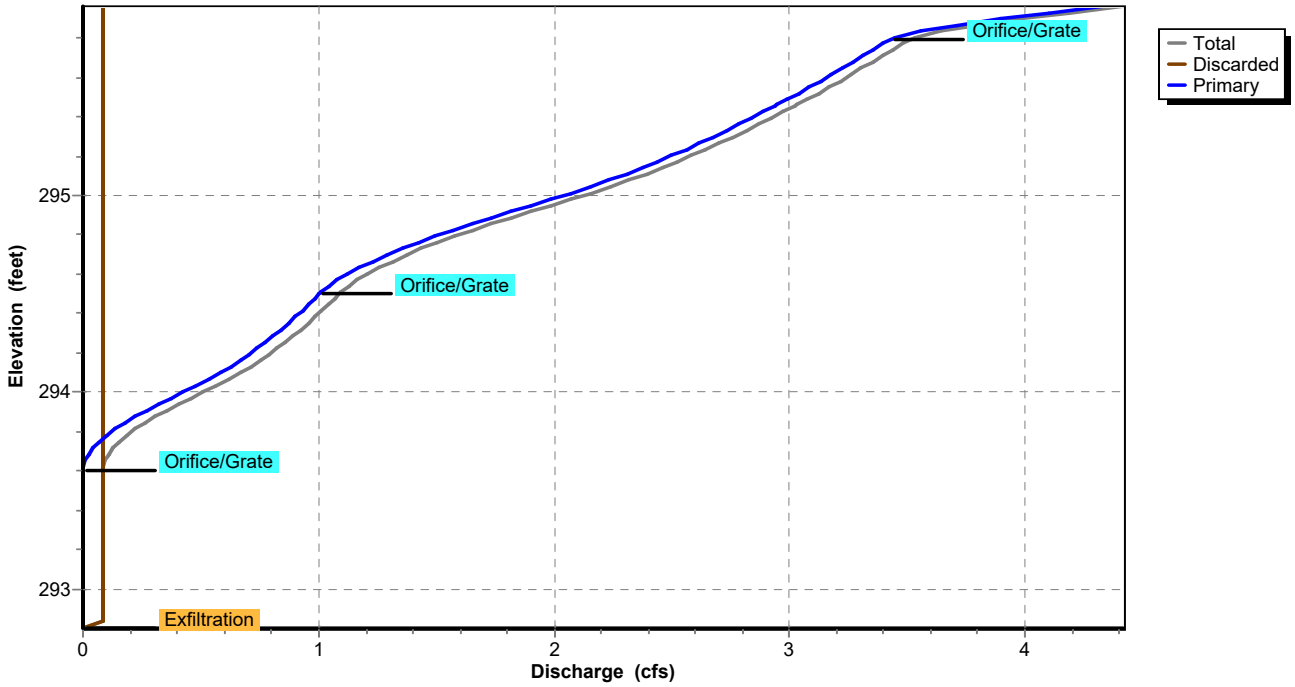
## Pond 2P: UG - system #2

Hydrograph




## Pond 2P: UG - system #2

Stage-Discharge

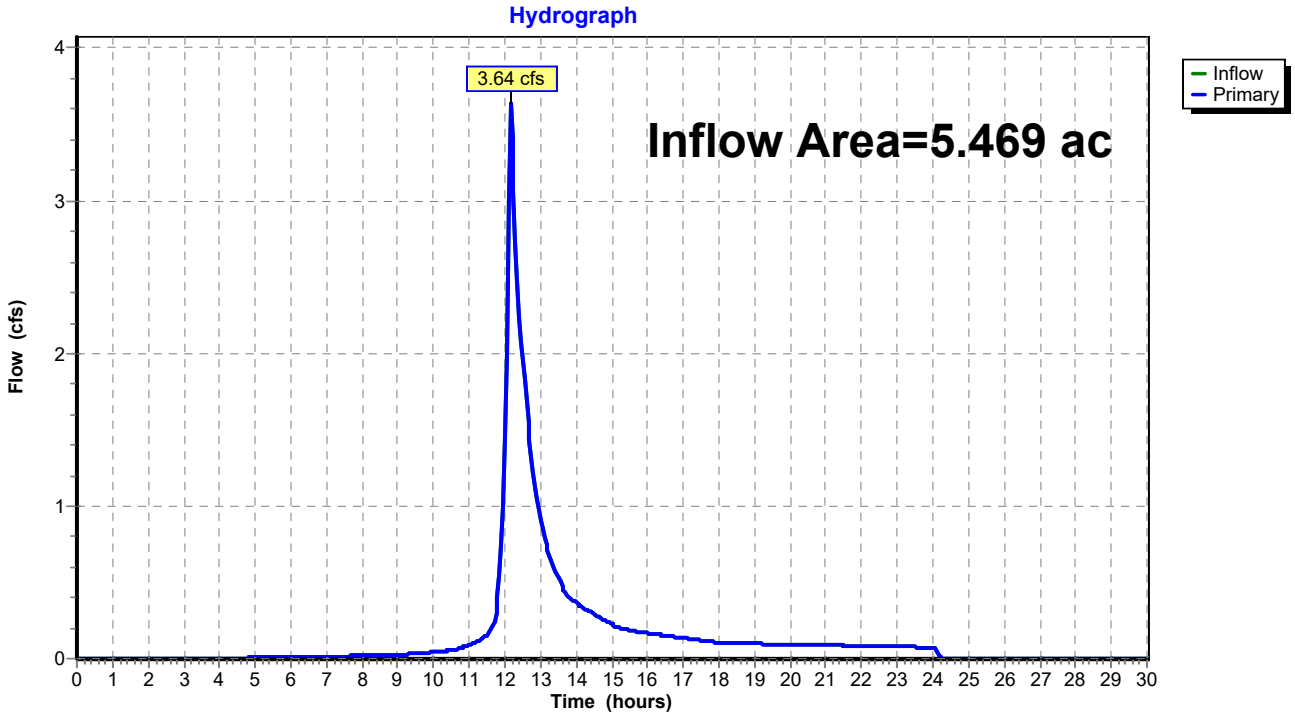


## Summary for Link 1L: STUDY POINT- Amethyst Brook

Inflow Area = 5.469 ac, 28.03% Impervious, Inflow Depth = 0.78" for 10-Year event
Inflow = 3.64 cfs @ 12.16 hrs, Volume= 0.355 af
Primary = 3.64 cfs @ 12.16 hrs, Volume= 0.355 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

## Link 1L: STUDY POINT- Amethyst Brook



## Summary for Subcatchment P1: South of Amherst Road

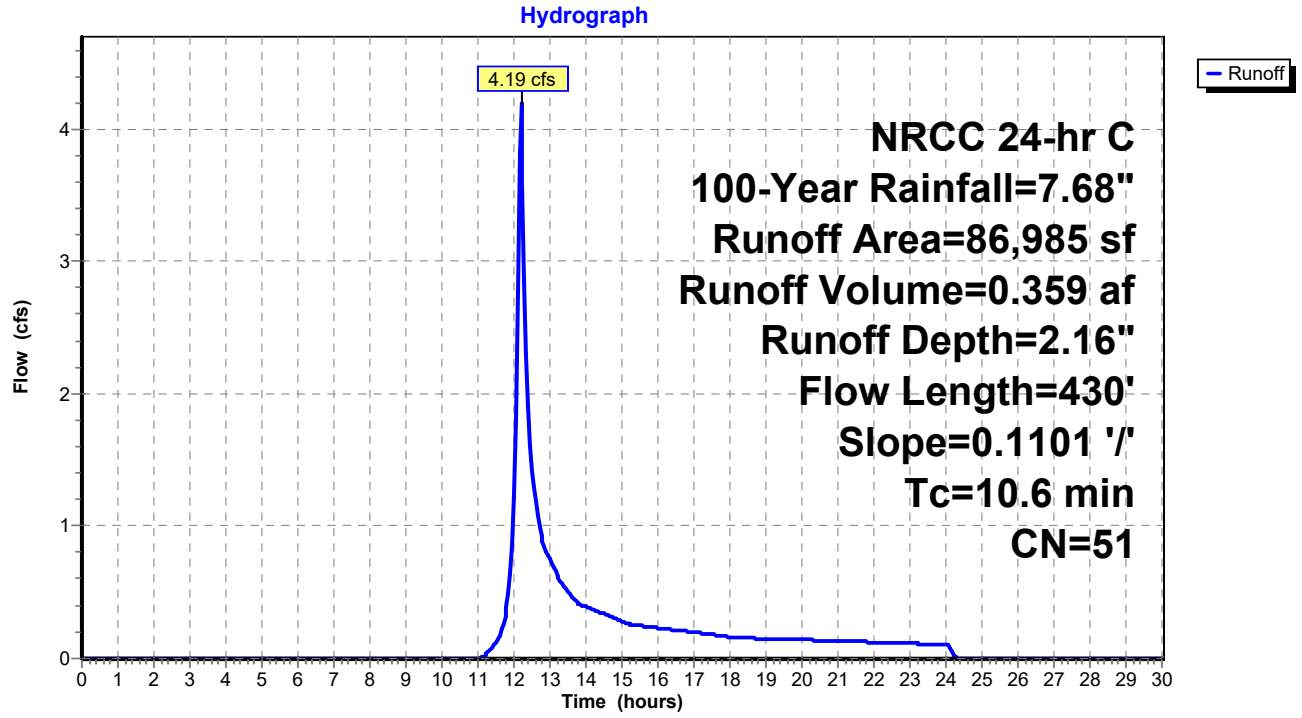
Runoff = 4.19 cfs @ 12.19 hrs, Volume= 0.359 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 7,024 | 98 | Impervious HSG A |
| * | 806 | 98 | Impervious HSG B |
| | 39,100 | 36 | Woods, Fair, HSG A |
| | 30,655 | 60 | Woods, Fair, HSG B |
| | 9,400 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 86,985 | 51 | Weighted Average |
| | 79,155 | | 91.00% Pervious Area |
| | 7,830 | | 9.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.6 | 430 | 0.1101 | 0.68 | | **Lag/CN Method,** Contour Length= 9,580' Interval= 1' |

## Subcatchment P1: South of Amherst Road



## Summary for Subcatchment P1A: Amherst rd

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

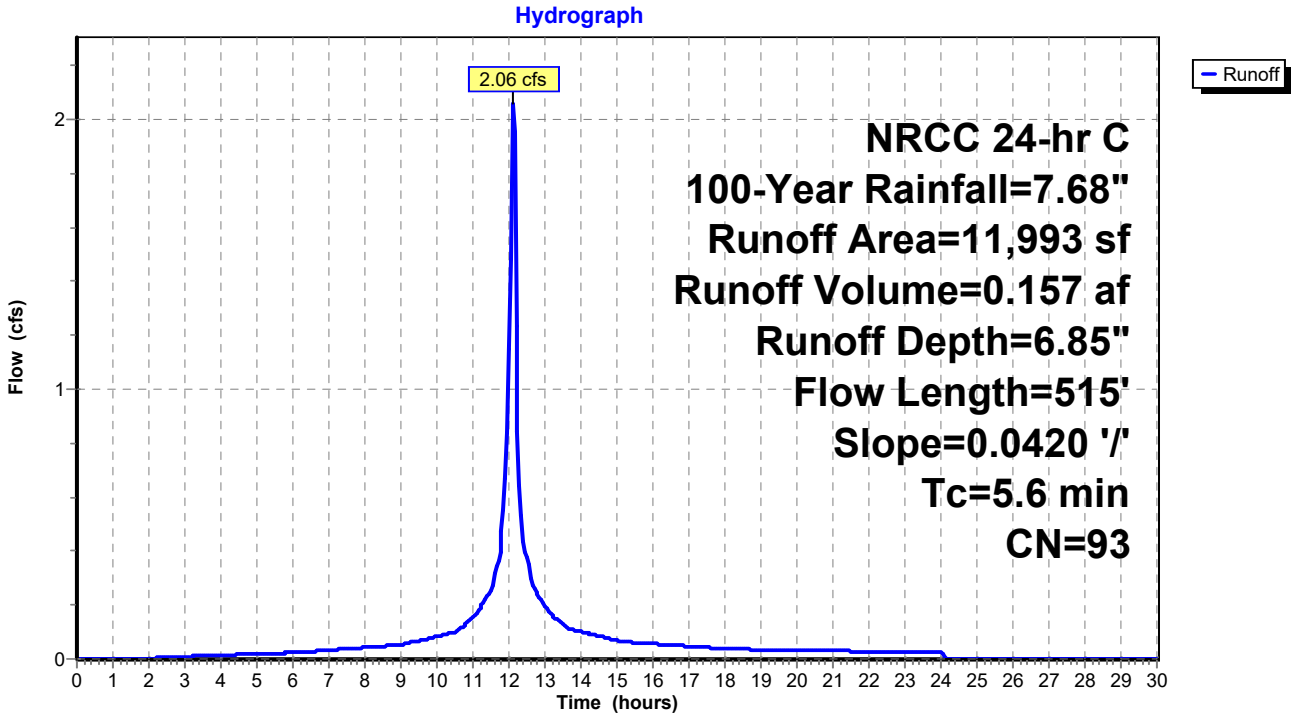
Runoff = 2.06 cfs @ 12.12 hrs, Volume= 0.157 af, Depth= 6.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 10,800 | 98 | Paved road, HSG A |
| | 1,193 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 11,993 | 93 | Weighted Average |
| | 1,193 | | 9.95% Pervious Area |
| | 10,800 | | 90.05% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.6 | 515 | 0.0420 | 1.53 | | **Lag/CN Method,** Contour Length= 504' Interval= 1' |

### Subcatchment P1A: Amherst rd



## Summary for Subcatchment P2A: Part of #20 and 24 impervious

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

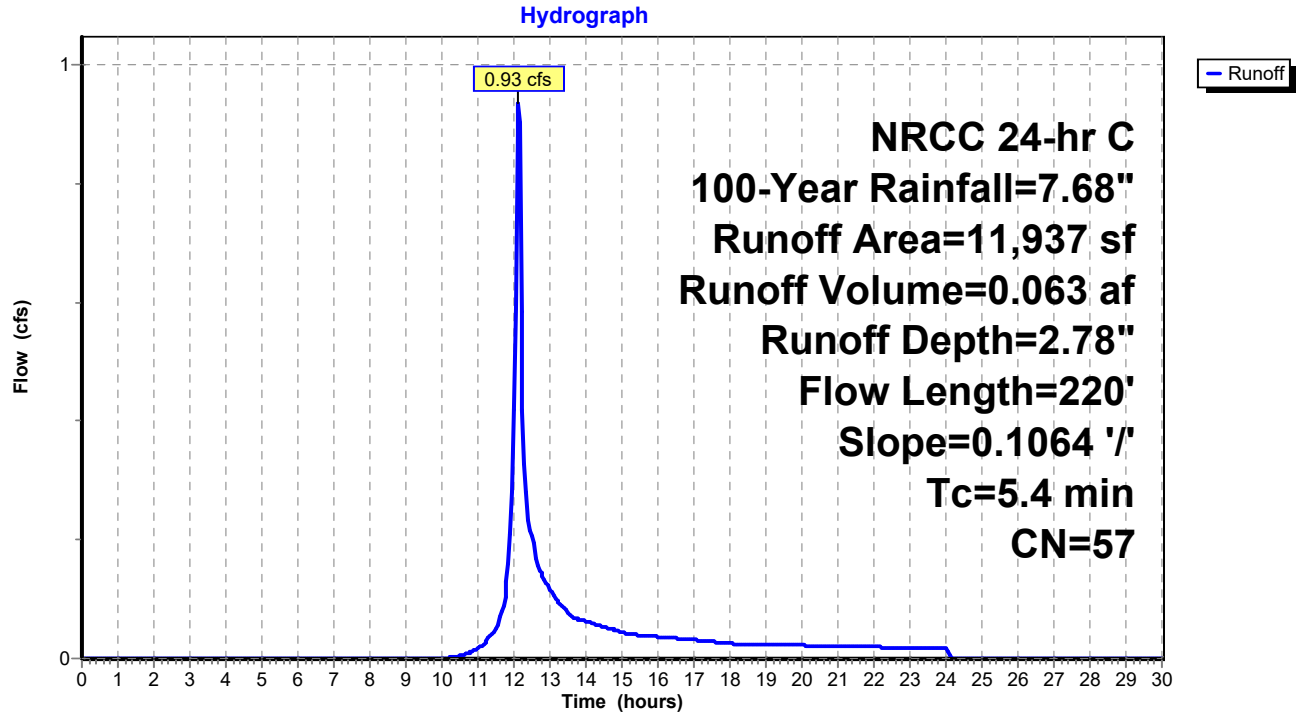
Runoff = 0.93 cfs @ 12.13 hrs, Volume= 0.063 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 2,647 | 98 | Impervious HSG A |
| | 7,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 2,290 | 36 | Woods, Fair, HSG A |
| | 11,937 | 57 | Weighted Average |
| | 9,290 | | 77.83% Pervious Area |
| | 2,647 | | 22.17% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.4 | 220 | 0.1064 | 0.68 | | **Lag/CN Method,** Contour Length= 1,270' Interval= 1' |

### Subcatchment P2A: Part of #20 and 24 impervious



## Summary for Subcatchment P2B: slope below driveway

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

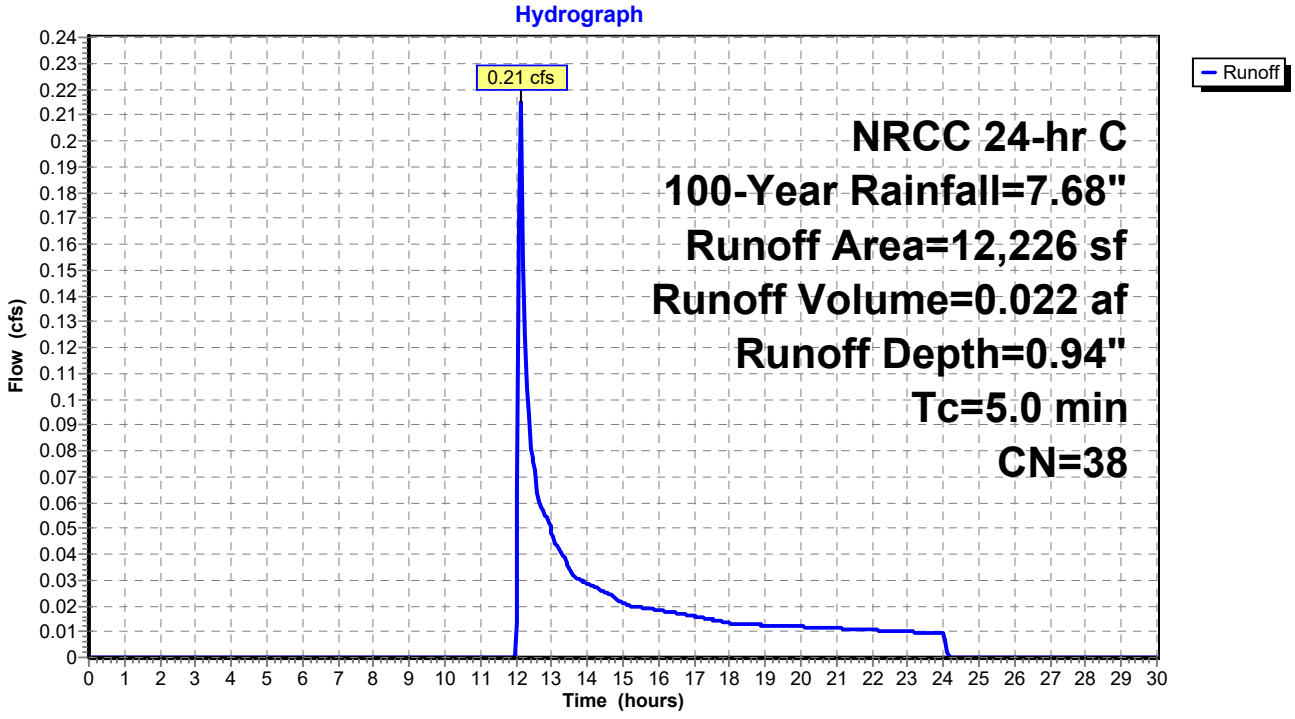
Runoff = 0.21 cfs @ 12.15 hrs, Volume= 0.022 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 11,888 | 36 | Woods, Fair, HSG A |
| * | 338 | 98 | Wall |
| | 12,226 | 38 | Weighted Average |
| | 11,888 | | 97.24% Pervious Area |
| | 338 | | 2.76% Impervious Area |

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

## Subcatchment P2B: slope below driveway



## Summary for Subcatchment P2C: Entrance drive

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

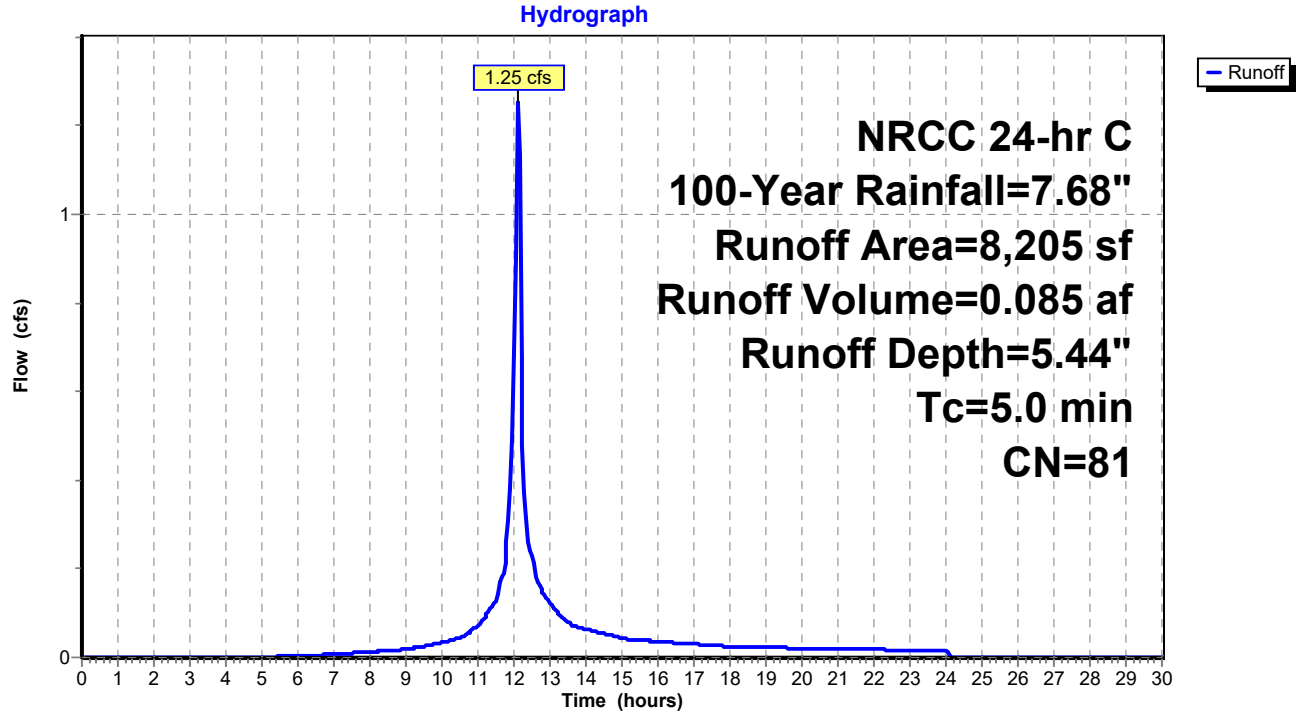
Runoff = 1.25 cfs @ 12.11 hrs, Volume= 0.085 af, Depth= 5.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 5,389 | 98 | Impervious |
| | 2,816 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 8,205 | 81 | Weighted Average |
| | 2,816 | | 34.32% Pervious Area |
| | 5,389 | | 65.68% Impervious Area |

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

## Subcatchment P2C: Entrance drive



## Summary for Subcatchment P2D: Parking lot and Roof

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

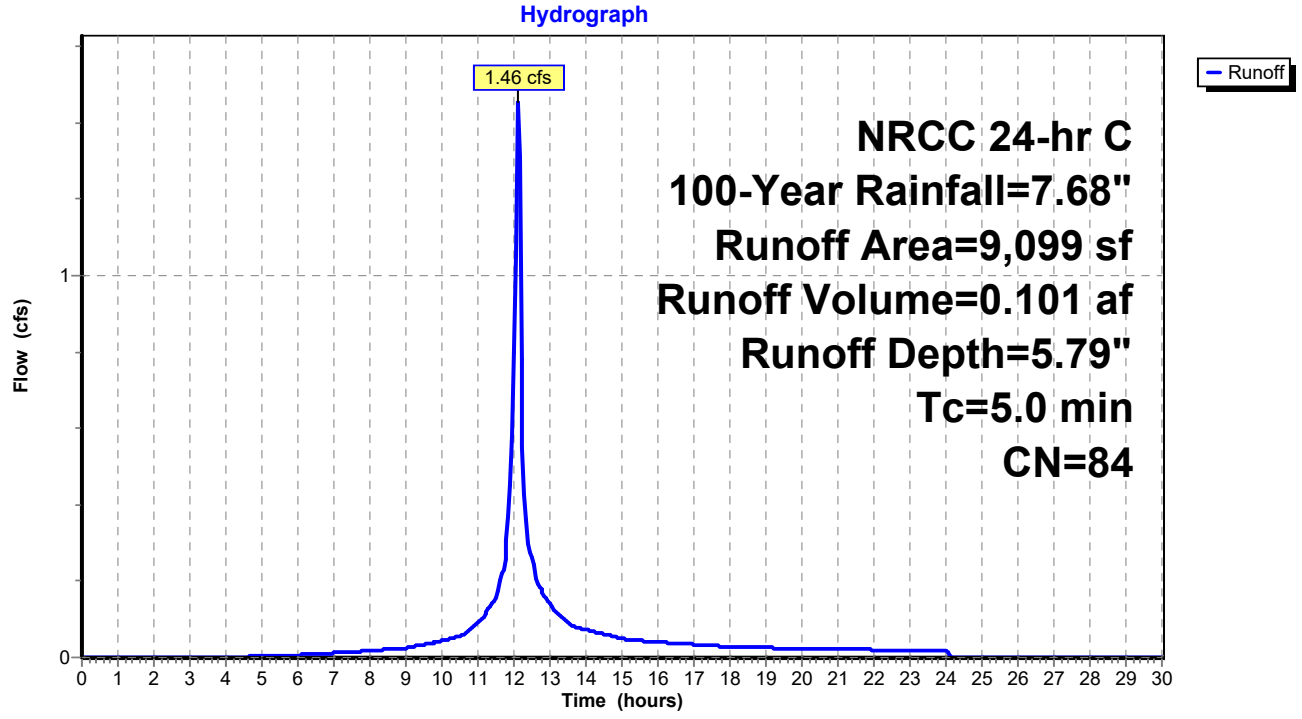
Runoff = 1.46 cfs @ 12.11 hrs, Volume= 0.101 af, Depth= 5.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 6,504 | 98 | Impervious |
| | 2,595 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 9,099 | 84 | Weighted Average |
| | 2,595 | | 28.52% Pervious Area |
| | 6,504 | | 71.48% Impervious Area |

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

### Subcatchment P2D: Parking lot and Roof



## Summary for Subcatchment P2E: Driveway and back roof

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

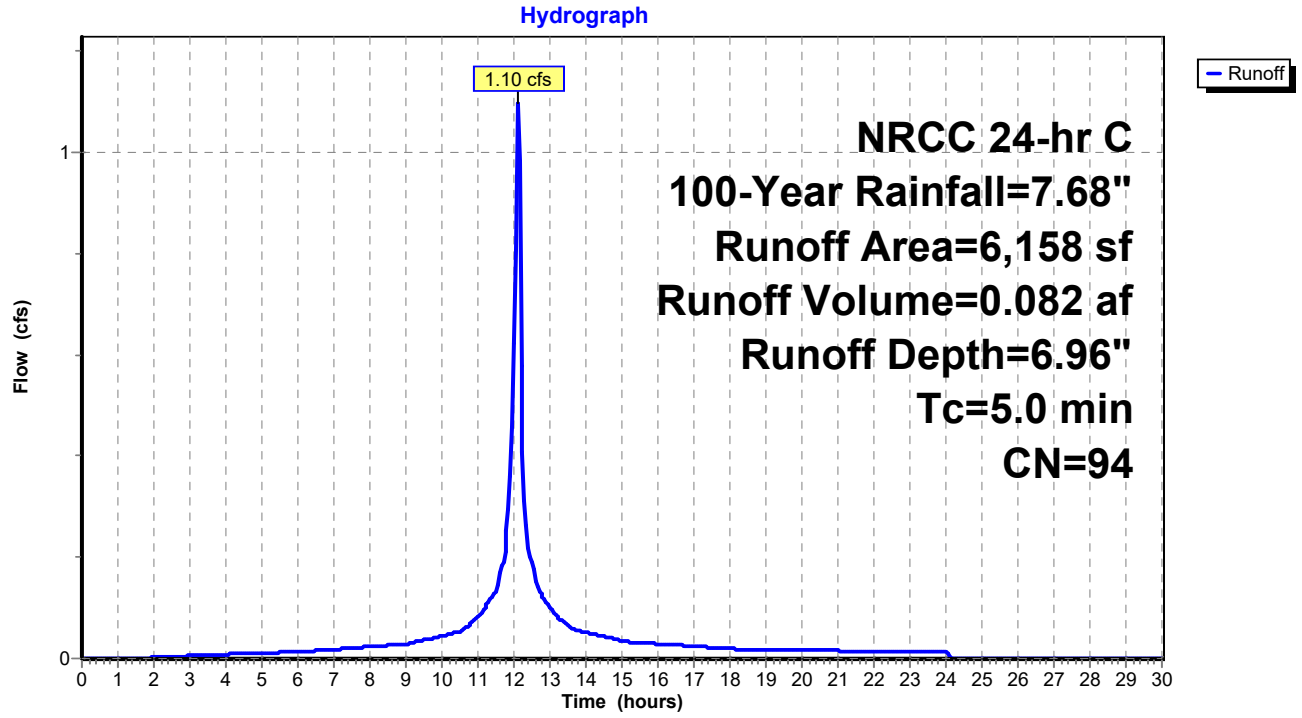
Runoff = 1.10 cfs @ 12.11 hrs, Volume= 0.082 af, Depth= 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 4,254 | 98 | Impervious |
| | 653 | 96 | Gravel surface, HSG A |
| | 451 | 49 | 50-75% Grass cover, Fair, HSG A |
| * | 800 | 98 | Impervious - roof |
| | 6,158 | 94 | Weighted Average |
| | 1,104 | | 17.93% Pervious Area |
| | 5,054 | | 82.07% Impervious Area |

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

## Subcatchment P2E: Driveway and back roof



## Summary for Subcatchment P3: part of #24 impervious + wooded slope

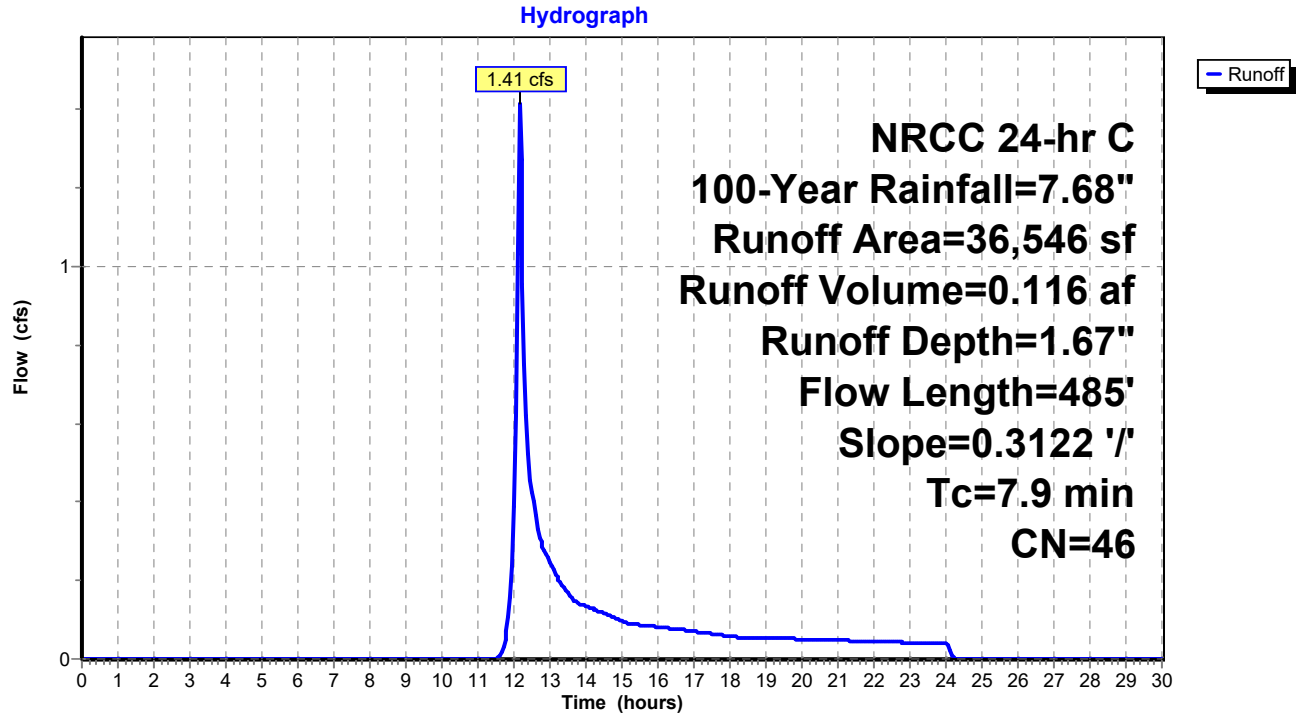
Runoff = 1.41 cfs @ 12.16 hrs, Volume= 0.116 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 4,706 | 98 | Impervious |
| | 26,390 | 36 | Woods, Fair, HSG A |
| | 5,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 450 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 36,546 | 46 | Weighted Average |
| | 31,840 | | 87.12% Pervious Area |
| | 4,706 | | 12.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.9 | 485 | 0.3122 | 1.03 | | **Lag/CN Method,** Contour Length= 11,408' Interval= 1' |

## Subcatchment P3: part of #24 impervious + wooded slope



## Summary for Subcatchment P3A: #22 drive and lower parking lots

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

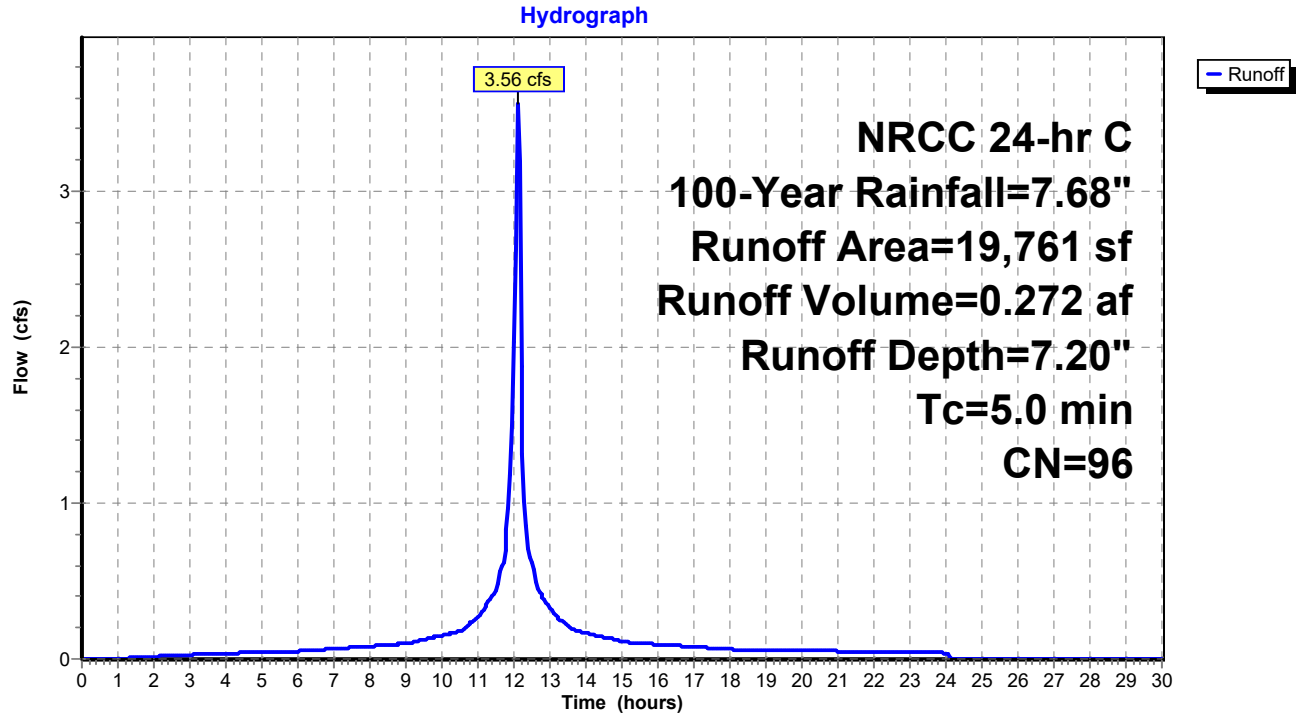
Runoff = 3.56 cfs @ 12.11 hrs, Volume= 0.272 af, Depth= 7.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 17,647 | 98 | Impervious |
| | 1,300 | 96 | Gravel surface, HSG A |
| | 814 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 19,761 | 96 | Weighted Average |
| | 2,114 | | 10.70% Pervious Area |
| | 17,647 | | 89.30% Impervious Area |

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

## Subcatchment P3A: #22 drive and lower parking lots



## Summary for Subcatchment P3B: slope below parking

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

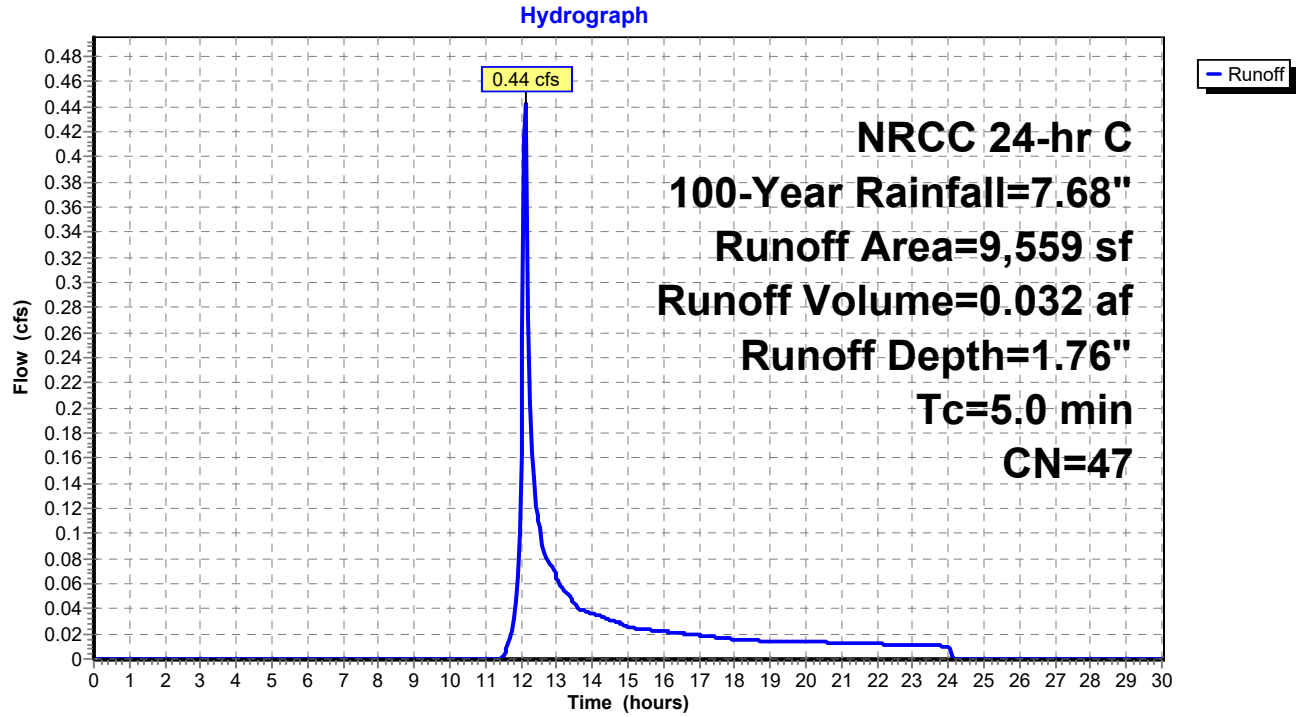
Runoff = 0.44 cfs @ 12.13 hrs, Volume= 0.032 af, Depth= 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,285 | 98 | Impervious |
| | 6,274 | 36 | Woods, Fair, HSG A |
| | 2,000 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 9,559 | 47 | Weighted Average |
| | 8,274 | | 86.56% Pervious Area |
| | 1,285 | | 13.44% Impervious Area |

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

## Subcatchment P3B: slope below parking



## Summary for Subcatchment P4: east drainage area

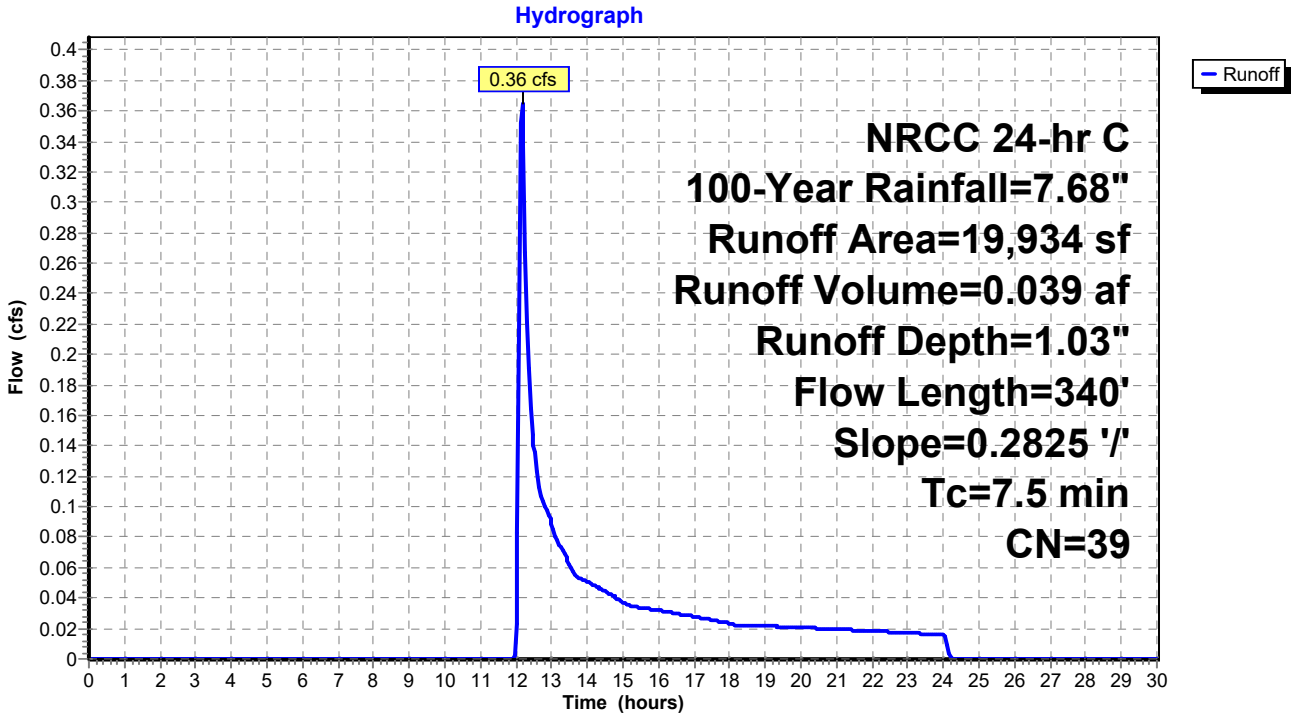
Runoff = 0.36 cfs @ 12.17 hrs, Volume= 0.039 af, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 18,814 | 36 | Woods, Fair, HSG A |
| * | 1,120 | 98 | Impervious |
| | 19,934 | 39 | Weighted Average |
| | 18,814 | | 94.38% Pervious Area |
| | 1,120 | | 5.62% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.5 | 340 | 0.2825 | 0.75 | | **Lag/CN Method,** Contour Length= 5,632' Interval= 1' |

## Subcatchment P4: east drainage area



## Summary for Subcatchment P4A: part of #22 roof

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

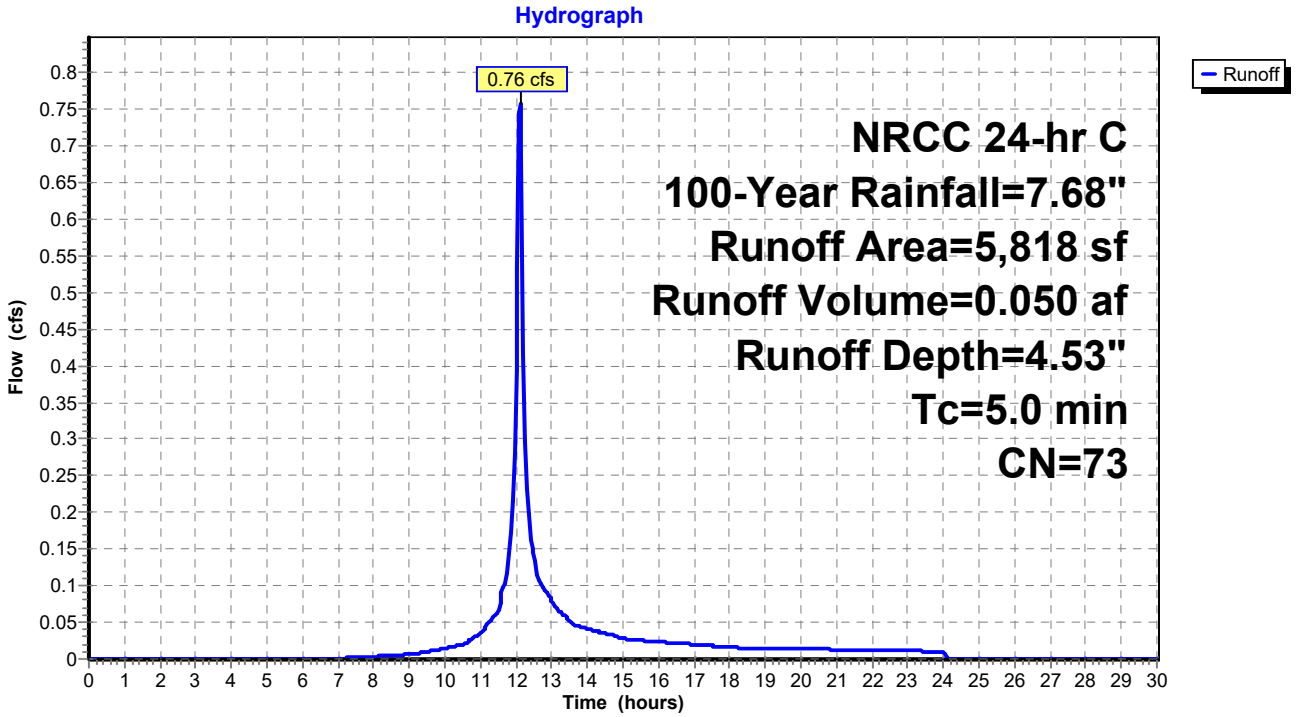
Runoff = 0.76 cfs @ 12.12 hrs, Volume= 0.050 af, Depth= 4.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=7.68"

| Area (sf) | CN | Description |
|---|---|---|
| 3,455 | 98 | Unconnected roofs, HSG A |
| 2,363 | 36 | Woods, Fair, HSG A |
| 5,818 | 73 | Weighted Average |
| 2,363 | | 40.62% Pervious Area |
| 3,455 | | 59.38% Impervious Area |
| 3,455 | | 100.00% Unconnected |

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

### Subcatchment P4A: part of #22 roof



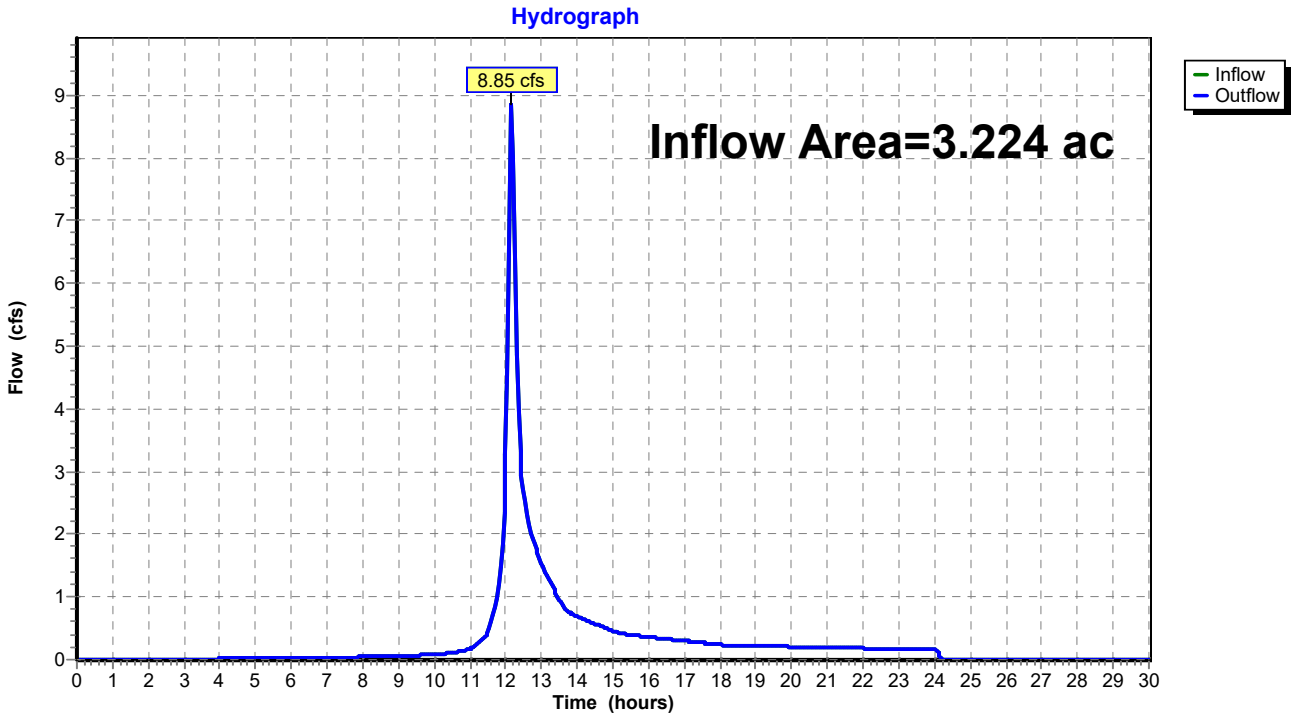
## Summary for Reach 1R: ex swale

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

Inflow Area = 3.224 ac, 23.86% Impervious, Inflow Depth = 2.61" for 100-Year event
Inflow = 8.85 cfs @ 12.16 hrs, Volume= 0.702 af
Outflow = 8.85 cfs @ 12.16 hrs, Volume= 0.702 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 1R: ex swale



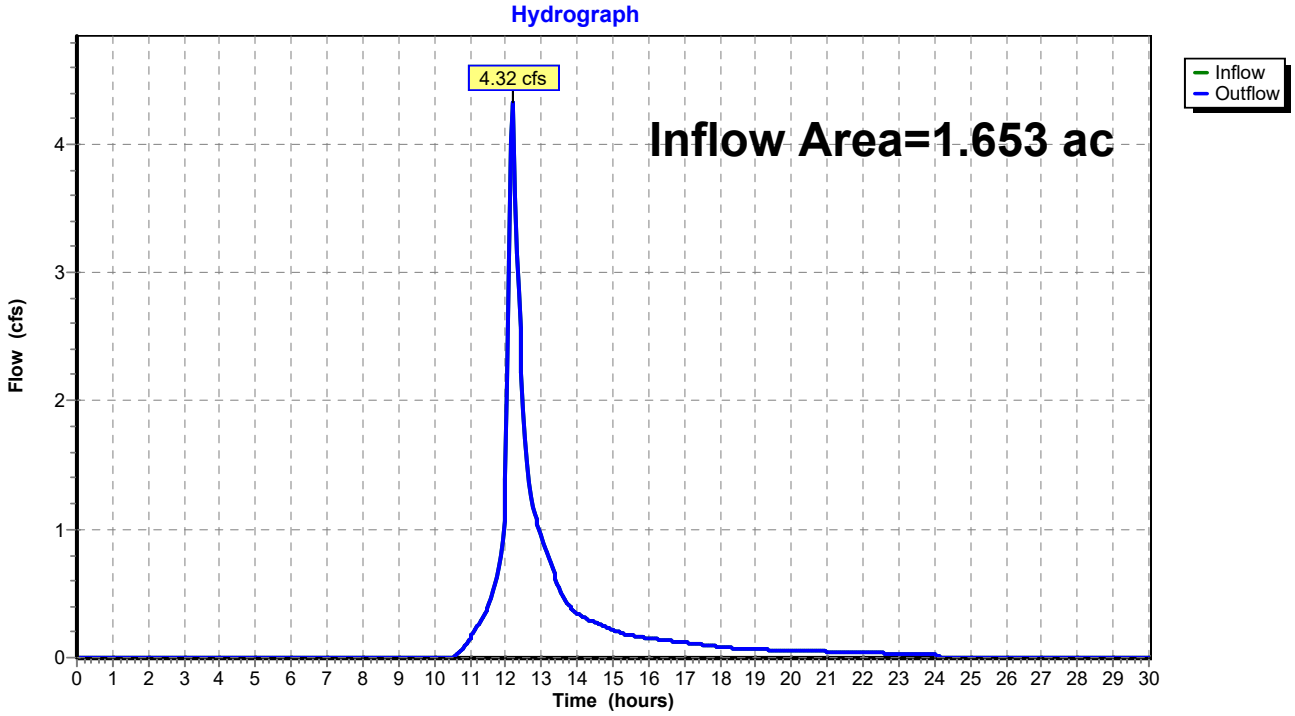
## Summary for Reach 2R: central DA

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

Inflow Area = 1.653 ac, 39.84% Impervious, Inflow Depth = 2.51" for 100-Year event
Inflow = 4.32 cfs @ 12.19 hrs, Volume= 0.346 af
Outflow = 4.32 cfs @ 12.19 hrs, Volume= 0.346 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 2R: central DA



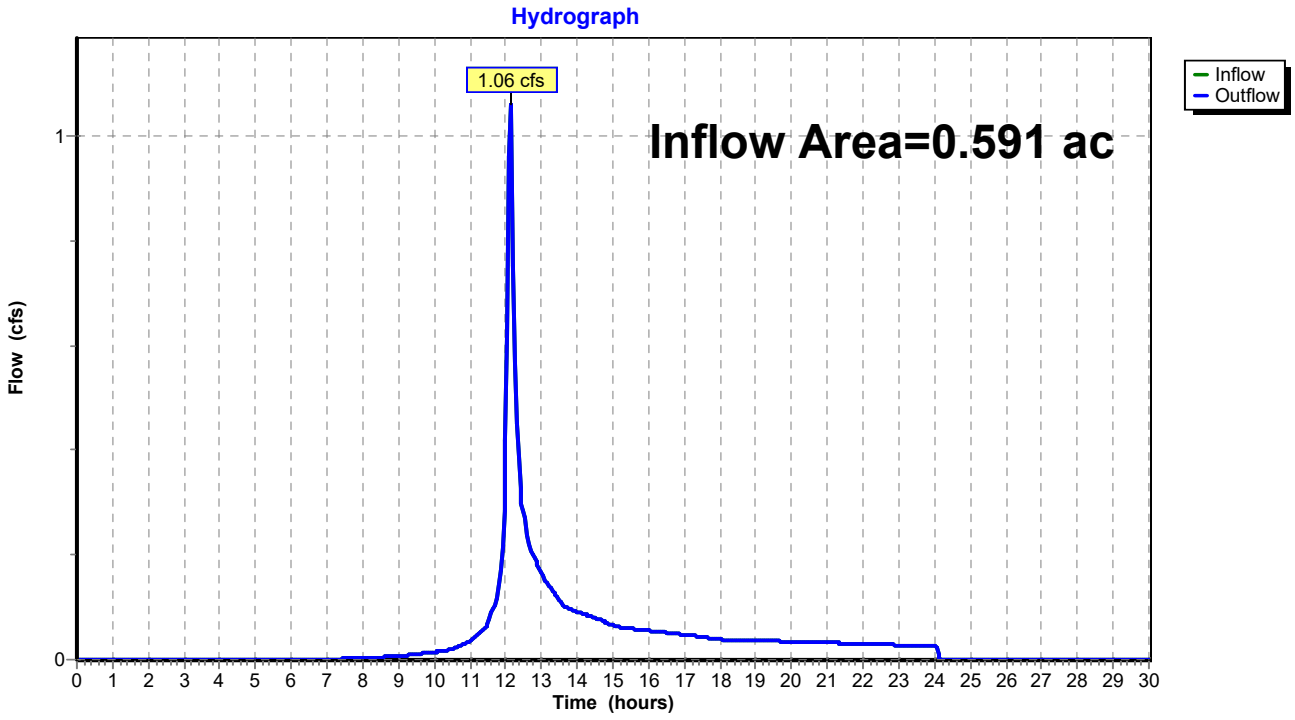
## Summary for Reach 3R: East DA

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

Inflow Area = 0.591 ac, 17.77% Impervious, Inflow Depth = 1.82" for 100-Year event
Inflow = 1.06 cfs @ 12.14 hrs, Volume= 0.090 af
Outflow = 1.06 cfs @ 12.14 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 3R: East DA



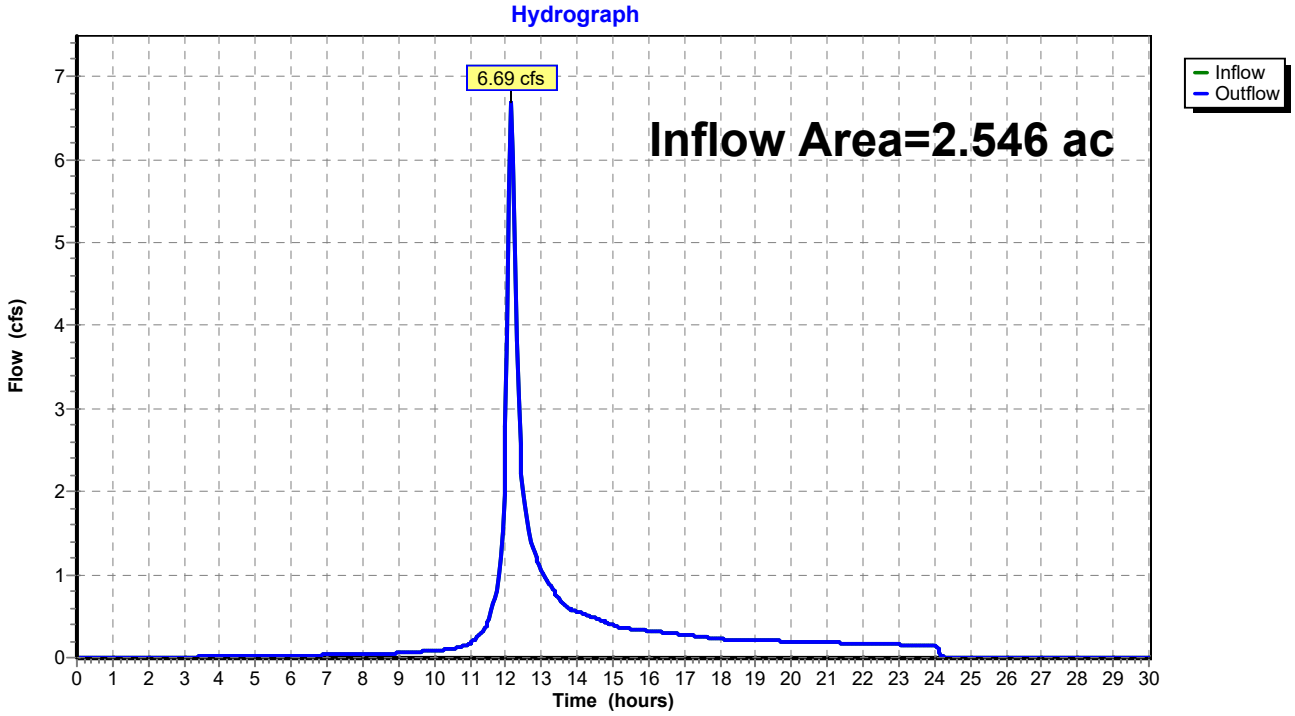
## Summary for Reach 4R: (new Reach)

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

Inflow Area = 2.546 ac, 19.18% Impervious, Inflow Depth = 2.73" for 100-Year event
Inflow = 6.69 cfs @ 12.16 hrs, Volume= 0.580 af
Outflow = 6.69 cfs @ 12.16 hrs, Volume= 0.580 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

### Reach 4R: (new Reach)



## Summary for Pond 1P: UG - system #1

Inflow Area = 0.397 ac, 68.73% Impervious, Inflow Depth = 5.62" for 100-Year event
Inflow = 2.71 cfs @ 12.11 hrs, Volume= 0.186 af
Outflow = 2.07 cfs @ 12.17 hrs, Volume= 0.185 af, Atten= 24%, Lag= 3.7 min
Discarded = 0.06 cfs @ 9.70 hrs, Volume= 0.085 af
Primary = 2.01 cfs @ 12.17 hrs, Volume= 0.100 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 306.86' @ 12.17 hrs Surf.Area= 0.027 ac Storage= 0.041 af

Plug-Flow detention time= 48.8 min calculated for 0.185 af (99% of inflow)
Center-of-Mass det. time= 46.4 min ( 849.9 - 803.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 304.50' | 0.014 af | **42.06'W x 27.46'L x 2.44'H Field A**<br>0.065 af Overall - 0.030 af Embedded = 0.035 af x 40.0% Voids |
| #2A | 305.00' | 0.028 af | **ACF R-Tank HD 1** x 290 Inside #1<br>Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf<br>Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf<br>290 Chambers in 29 Rows |
| | | 0.042 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 305.20' | **5.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 306.40' | **8.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Discarded | 304.50' | **2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01' |

**Discarded OutFlow** Max=0.06 cfs @ 9.70 hrs HW=304.52' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.06 cfs)

**Primary OutFlow** Max=1.86 cfs @ 12.17 hrs HW=306.81' (Free Discharge)
├**1=Orifice/Grate** (Orifice Controls 0.78 cfs @ 5.71 fps)
└**2=Orifice/Grate** (Orifice Controls 1.08 cfs @ 3.10 fps)

## Pond 1P: UG - system #1 - Chamber Wizard Field A

**Chamber Model = ACF R-Tank HD 1 (ACF Environmental R-Tank HD)**
Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf
Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf

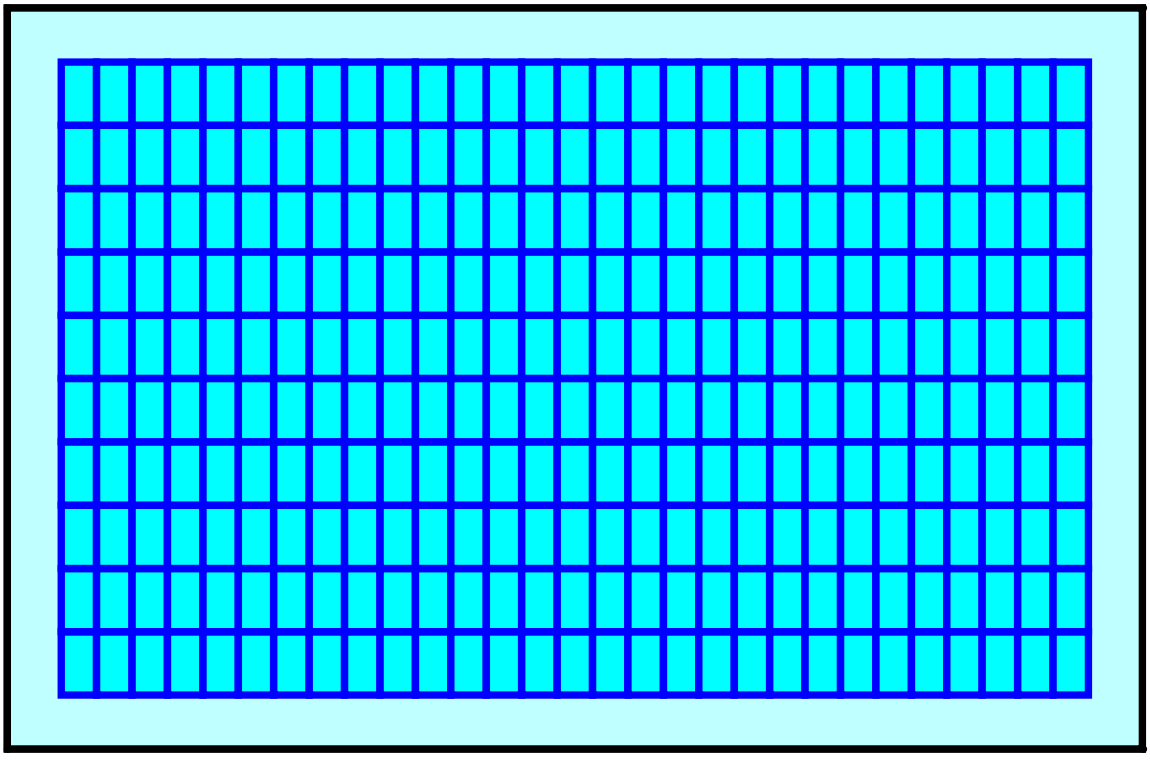
10 Chambers/Row x 2.35' Long = 23.46' Row Length +24.0" End Stone x 2 = 27.46' Base Length
29 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 42.06' Base Width
6.0" Base + 17.3" Chamber Height + 6.0" Cover = 2.44' Field Height

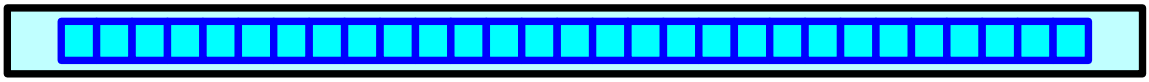
290 Chambers x 4.2 cf = 1,224.3 cf Chamber Storage
290 Chambers x 4.4 cf = 1,288.8 cf Displacement

2,821.9 cf Field - 1,288.8 cf Chambers = 1,533.1 cf Stone x 40.0% Voids = 613.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,837.6 cf = 0.042 af
Overall Storage Efficiency = 65.1%
Overall System Size = 27.46' x 42.06' x 2.44'

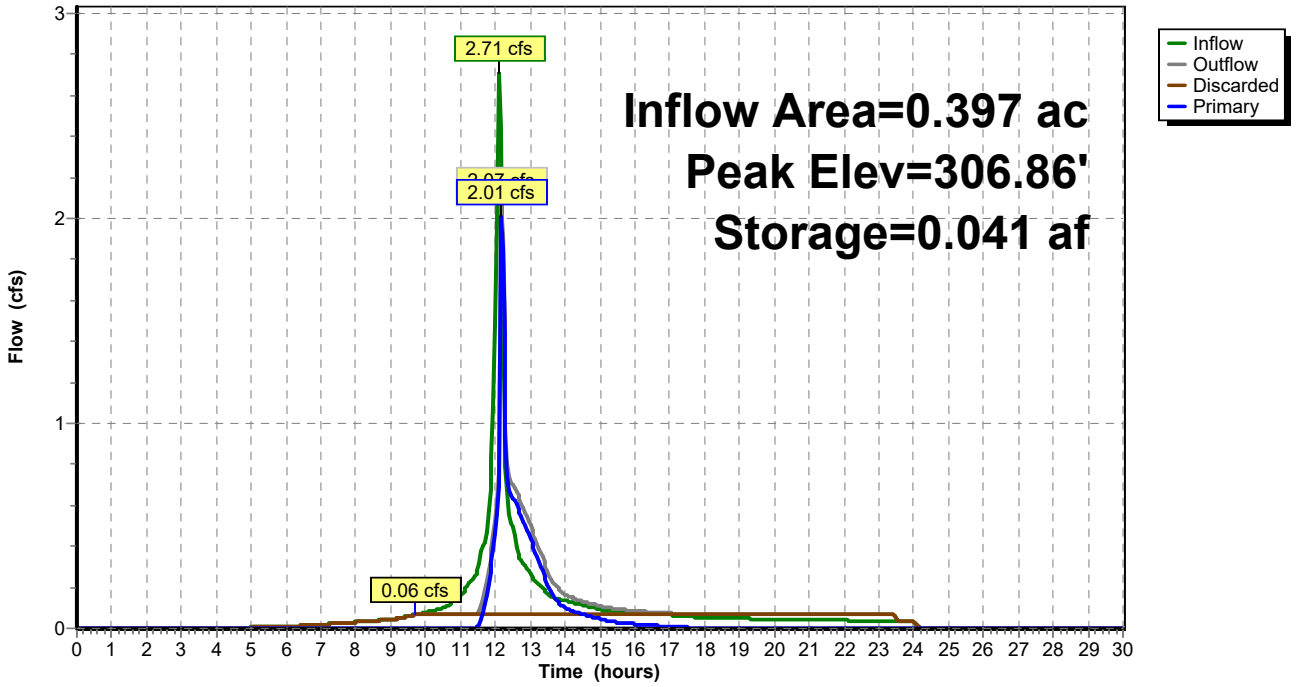
290 Chambers
104.5 cy Field
56.8 cy Stone





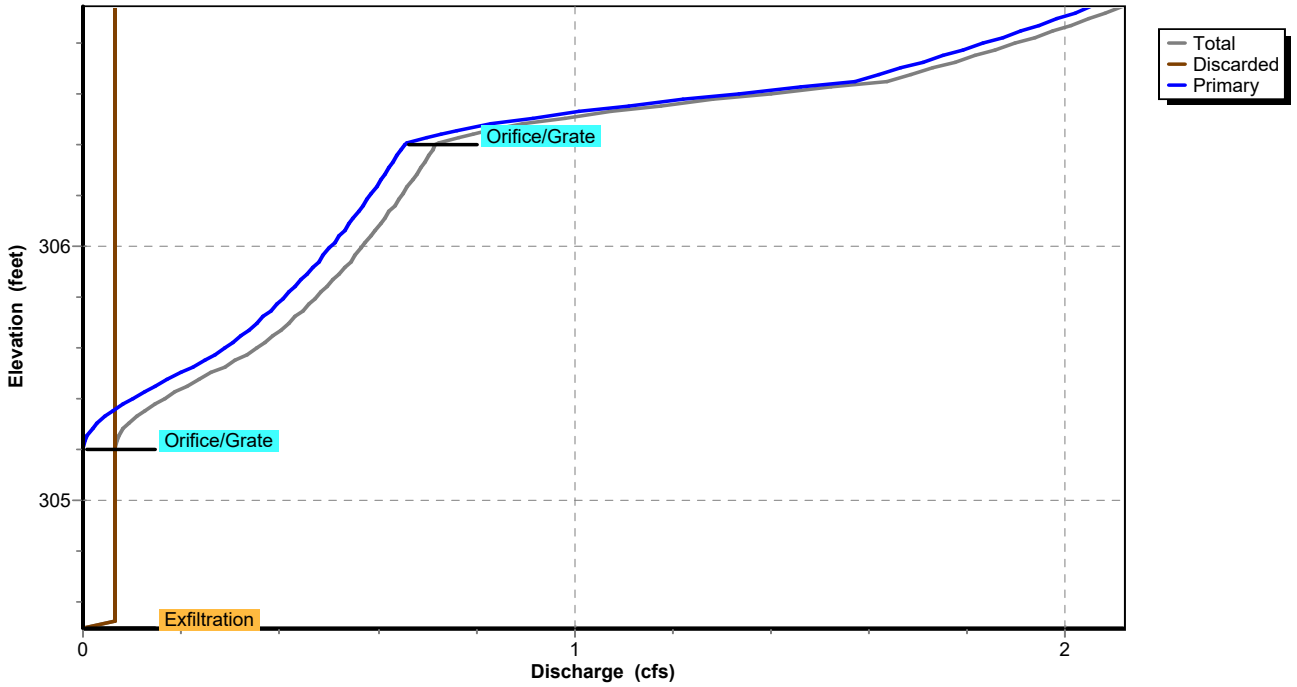
## Pond 1P: UG - system #1

Hydrograph




## Pond 1P: UG - system #1

Stage-Discharge



## Summary for Pond 2P: UG - system #2

Inflow Area = 1.434 ac, 43.88% Impervious, Inflow Depth = 3.94" for 100-Year event
Inflow = 5.81 cfs @ 12.12 hrs, Volume= 0.471 af
Outflow = 4.11 cfs @ 12.19 hrs, Volume= 0.469 af, Atten= 29%, Lag= 4.3 min
Discarded = 0.08 cfs @ 7.05 hrs, Volume= 0.156 af
Primary = 4.03 cfs @ 12.19 hrs, Volume= 0.314 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 295.93' @ 12.19 hrs Surf.Area= 0.034 ac Storage= 0.076 af

Plug-Flow detention time= 48.0 min calculated for 0.469 af (100% of inflow)
Center-of-Mass det. time= 46.3 min ( 838.9 - 792.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 292.80' | 0.020 af | **43.37'W x 34.50'L x 3.17'H Field A**<br>0.109 af Overall - 0.060 af Embedded = 0.049 af x 40.0% Voids |
| #2A | 293.30' | 0.057 af | **ACF R-Tank HD 1.5** x 390 Inside #1<br>Inside= 15.7"W x 26.0"H => 2.70 sf x 2.35'L = 6.3 cf<br>Outside= 15.7"W x 26.0"H => 2.84 sf x 2.35'L = 6.7 cf<br>390 Chambers in 30 Rows |
| | | 0.076 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 293.60' | **7.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 294.50' | **8.0" Vert. Orifice/Grate** C= 0.600 |
| #3 | Primary | 295.80' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Discarded | 292.80' | **2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01' |

**Discarded OutFlow** Max=0.08 cfs @ 7.05 hrs HW=292.83' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.08 cfs)

**Primary OutFlow** Max=3.97 cfs @ 12.19 hrs HW=295.91' (Free Discharge)
├**1=Orifice/Grate** (Orifice Controls 1.83 cfs @ 6.85 fps)
├**2=Orifice/Grate** (Orifice Controls 1.75 cfs @ 5.00 fps)
└**3=Orifice/Grate** (Weir Controls 0.39 cfs @ 1.10 fps)

## Pond 2P: UG - system #2 - Chamber Wizard Field A

**Chamber Model = ACF R-Tank HD 1.5 (ACF Environmental R-Tank HD)**
Inside= 15.7"W x 26.0"H => 2.70 sf x 2.35'L = 6.3 cf
Outside= 15.7"W x 26.0"H => 2.84 sf x 2.35'L = 6.7 cf

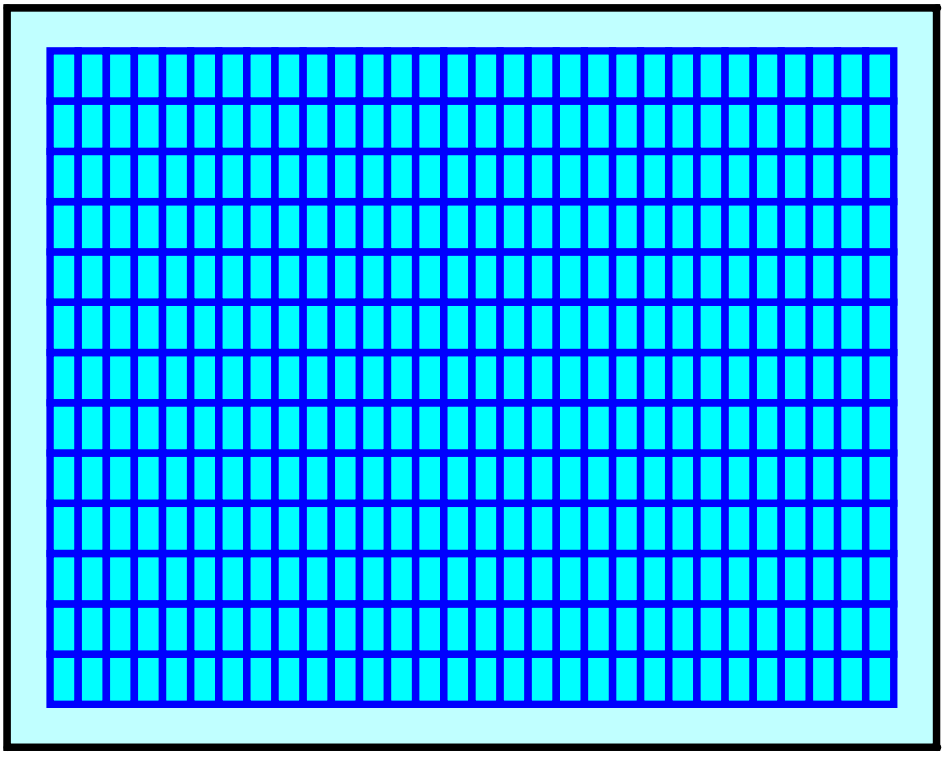
13 Chambers/Row x 2.35' Long = 30.50' Row Length +24.0" End Stone x 2 = 34.50' Base Length
30 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 43.37' Base Width
6.0" Base + 26.0" Chamber Height + 6.0" Cover = 3.17' Field Height

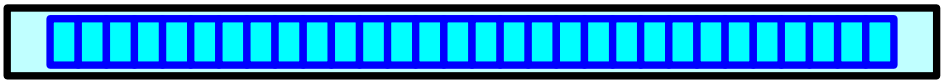
390 Chambers x 6.3 cf = 2,469.8 cf Chamber Storage
390 Chambers x 6.7 cf = 2,599.7 cf Displacement

4,735.6 cf Field - 2,599.7 cf Chambers = 2,135.8 cf Stone x 40.0% Voids = 854.3 cf Stone Storage

Chamber Storage + Stone Storage = 3,324.1 cf = 0.076 af
Overall Storage Efficiency = 70.2%
Overall System Size = 34.50' x 43.37' x 3.17'

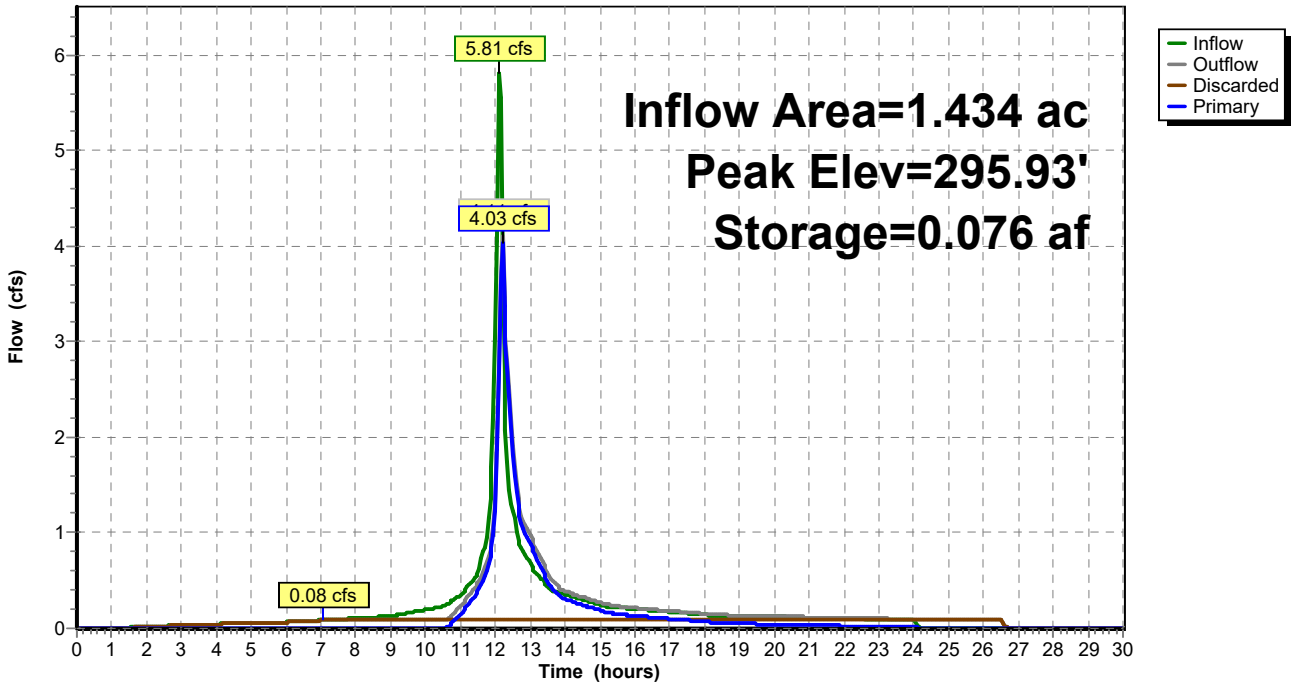
390 Chambers
175.4 cy Field
79.1 cy Stone





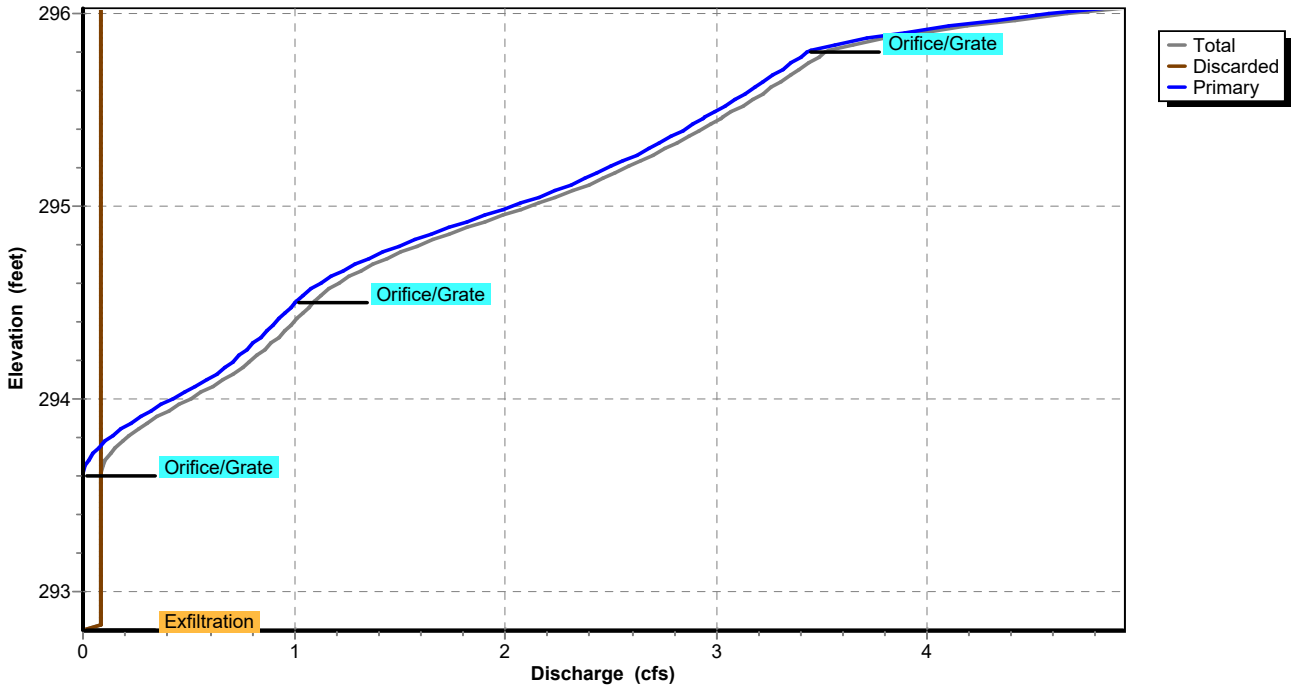
## Pond 2P: UG - system #2

Hydrograph




## Pond 2P: UG - system #2

Stage-Discharge

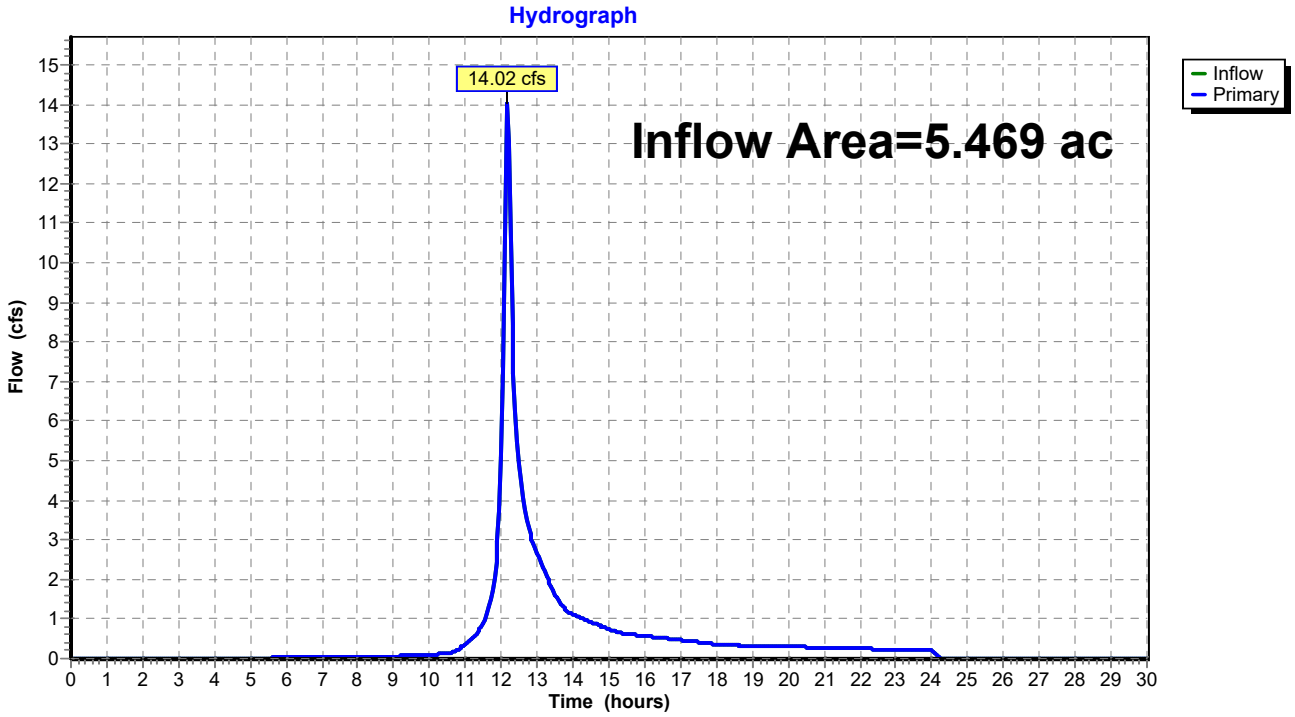


## Summary for Link 1L: STUDY POINT- Amethyst Brook

Inflow Area = 5.469 ac, 28.03% Impervious, Inflow Depth = 2.50" for 100-Year event
Inflow = 14.02 cfs @ 12.17 hrs, Volume= 1.137 af
Primary = 14.02 cfs @ 12.17 hrs, Volume= 1.137 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

## Link 1L: STUDY POINT- Amethyst Brook



# Appendix D – Groundwater Recharge Calculations

Berkshire Design Group

December 21, 2020

**Pelham – 20-22 Amherst Road**
**Stormwater Standard 3 – Recharge Calculations**

Existing Impervious Area

**Table 1** shows the existing and proposed impervious and gravel areas on the re-development site.

**Table 1. Existing and Proposed Impervious Area**

| | Existing Area (sf) | Proposed Area (sf) | Increase in Area (sf) |
|---|---|---|---|
| Impervious | 27,450 | 41,840 | 14,410 |
| Gravel driveways | 1,210 | - | (1,210) |
| TOTAL | 28,660 | 41,840 | 13,200 |

Proposed Impervious Area & Required Recharge Volume

**Table 2** shows the required recharge volume.

Required Recharge Volume is calculated by applying the following equation:

Required Recharge Volume, $Rv = F \times I$

Where, $F =$ Target Depth Factor, 0.60" (for HSG A)
$I =$ Impervious Area

**Table 2. Proposed Increase in Impervious Area and Required Recharge Volume**

| Increase in Impervious area (sq. ft.) | Required Recharge Volume (cu. ft.) | Provided Recharge Volume (cu. ft.) |
|---|---|---|
| 13,200 | 660 | 1,170 |

The storage volume provided in **Table 2** is provided through storage below the outlets of the underground stormwater facilities.

This analysis utilizes the "Static Method" for determining required storage volume for infiltration features. Therefore, the minimum required storage volume is equal to the required recharge volume, tabulated above.

The provided infiltration storage volume of 1,170 cu. ft. exceeds the required recharge volume of 660 cu. ft. (considering all proposed new impervious surfaces at the future site).

Capture Area Adjustment

The Massachusetts Stormwater Handbook requires an increase in storage capacity of infiltration features if only a portion of the site's impervious area is tributary to the stormwater practices. Because this is a redevelopment site, the recharge is calculated on the increase in impervious area. The increase in impervious area of 13,200 sf is entirely tributary to recharge facilities. The proposed design directs over 35,000 sf of impervious surfaces to storage and infiltration facilities.

Drawdown Time

The Rawls infiltration rate for the loamy sand (HSG A) is estimated at 2.41 inches per hour (Massachusetts Stormwater Standards). Drawdown time is dependent on the depth of the system below the lowest outlet and the rate of infiltration.

$$\frac{depth\ on\ inches}{2.41\frac{in}{hr}} = drawdown\ time$$

**Table 3. Drawdown Time for Each System**

| UG System # | Elevation at base of system | Elevation of lowest outlet | Depth to infiltrate | Time to infiltrate |
|---|---|---|---|---|
| 1 | 304.5 | 305.2 | 0.7 ft | 3.5 hours |
| 2 | 292.8 | 293.6 | 0.8 ft | 4 hours |

The storage areas should draw down in less than 4 hours which is below the 72-hour requirement.

# Appendix E – Water Quality Calculations

Berkshire Design Group

December 21, 2020

**20-22 Amherst Road, Pelham, MA**
**Stormwater Standard 4 – Water Quality Volume**

Existing conditions include untreated gravel and impervious areas of 28,640 sf. Proposed conditions include 41,840 sf of impervious areas (driveways, parking areas, walkways and roofs) The increase in impervious area is 13,200 sq. ft. (Table 1).

**Table 1. Existing and Proposed Impervious Areas**

| | Existing Area (sf) | Proposed Area (sf) | Increase in Area (sf) |
|---|---|---|---|
| Impervious | 28,640 | 41,840 | 13,200 |

Required Water Quality Volume is calculated by applying the following equation:

*Required Water Quality Volume,* $WQV = D \times I$
*Where,* $D$ *= Depth Factor, 1"*;* $I$ *= Impervious Area*
*Cold water fishery requires a 1" depth factor

Provided water quality volume is the storage provided below the outlet of the underground storage systems. Table 2 summarizes the water quality volume required and provided for the site.

**Table 2. Required and Provided WQv**

| Increase in Impervious Area (sf) | Water Quality Volume Required on increase (cf) | Water Quality Volume Provided in UG systems(cf) |
|---|---|---|
| 13,200 | 1,100 | 1,170 |

The water quality volume provided exceeds the water quality volume required on the increase in impervious area. Table 3 provides a breakdown of the water quality volume provided by drainage area.

**Table 3. Water Quality Volume for Change in Impervious Area by Drainage Area.**

| Facility | Prop. Impervious Area directed to facility (sf) | Approx. Ex. impervious area (sf) | Impervious Area increase (sf) | Water Quality Volume (cf) | Water Quality Volume Provided (cf) |
|---|---|---|---|---|---|
| UG system #1 | 11,900 | 9,600 | 2,300 | 192 | 430 |
| UG System #2 | 23,600 | 15,090 | 8,510 | 710 | 740 |

The proposed stormwater facilities provide water quality volume for the increased impervious areas within the tributary drainage areas.

Prior to entering the UG systems, runoff from driveways and parking is treated by Water Quality Units, rated by the manufacturer at over 90% TSS removal. Runoff from roofs (with the exception of the rear roof of #20) is conveyed without treatment.

**Table 4** provides a summary of the impervious areas tributary to the Water Quality Units.

**Table 4. Proposed Impervious Areas and TSS Removal**

| | WQU #1 | WQU #2 | WQU #3 | Total |
|---|---|---|---|---|
| Proposed | 10,400 sf | 6,700 sf | 11,900 | 29,000 sf |

The impervious surfaces treated for TSS removal exceeds the new impervious surfaces created by more than a factor of 2.

# Brief Stormceptor Sizing Report - WQ 1

| Project Information & Location | | | |
|---|---|---|---|
| **Project Name** | 20-22 Amherst Rd | **Project Number** | 645710 |
| **City** | Pelham | **State/ Province** | Massachusetts |
| **Country** | United States of America | **Date** | 12/10/2020 |
| **Designer Information** | | **EOR Information (optional)** | |
| **Name** | David Adams | **Name** | |
| **Company** | Contech | **Company** | Berkshire Design Group |
| **Phone #** | 207-855-6191 | **Phone #** | |
| **Email** | dadams@conteches.com | **Email** | |

**Stormwater Treatment Recommendation**
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

| | |
|---|---|
| **Site Name** | WQ 1 |
| **Target TSS Removal (%)** | 80 |
| **TSS Removal (%) Provided** | 93 |
| **Recommended Stormceptor Model** | STC 450i |

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

| Stormceptor Sizing Summary | |
|---|---|
| **Stormceptor Model** | **% TSS Removal Provided** |
| STC 450i | 93 |
| STC 900 | 96 |
| STC 1200 | 96 |
| STC 1800 | 97 |
| STC 2400 | 97 |
| STC 3600 | 98 |
| STC 4800 | 98 |
| STC 6000 | 99 |
| STC 7200 | 99 |
| STC 11000 | 99 |
| STC 13000 | 99 |
| STC 16000 | 99 |

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## Sizing Details

| Drainage Area | |
|---|---|
| Total Area (acres) | 0.24 |
| Imperviousness % | 100.0 |

| Rainfall | |
|---|---|
| Station Name | EAST BRIMFIELD LAKE |
| State/Province | Massachusetts |
| Station ID # | 2107 |
| Years of Records | 45 |
| Latitude | 42°7'0"N |
| Longitude | 72°8'0"W |

| Water Quality Objective | |
|---|---|
| TSS Removal (%) | 80.0 |
| Runoff Volume Capture (%) | |
| Oil Spill Capture Volume (Gal) | |
| Peak Conveyed Flow Rate (CFS) | |
| Water Quality Flow Rate (CFS) | |

| Up Stream Storage | |
|---|---|
| Storage (ac-ft) | Discharge (cfs) |
| 0.000 | 0.000 |

| Up Stream Flow Diversion | |
|---|---|
| Max. Flow to Stormceptor (cfs) | |

### Particle Size Distribution (PSD)
### The selected PSD defines TSS removal

**OK-110**

| Particle Diameter (microns) | Distribution % | Specific Gravity |
|---|---|---|
| 1.0 | 0.0 | 2.65 |
| 53.0 | 3.0 | 2.65 |
| 75.0 | 15.0 | 2.65 |
| 88.0 | 25.0 | 2.65 |
| 106.0 | 41.0 | 2.65 |
| 125.0 | 15.0 | 2.65 |
| 150.0 | 1.0 | 2.65 |
| 212.0 | 0.0 | 2.65 |

## Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

**For Stormceptor Specifications and Drawings Please Visit:**
**https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX**

# Brief Stormceptor Sizing Report - WQ 2

| Project Information & Location | | | |
|---|---|---|---|
| **Project Name** | 20-22 Amherst Rd | **Project Number** | 645710 |
| **City** | Pelham | **State/ Province** | Massachusetts |
| **Country** | United States of America | **Date** | 12/10/2020 |
| **Designer Information** | | **EOR Information (optional)** | |
| **Name** | David Adams | **Name** | |
| **Company** | Contech | **Company** | Berkshire Design Group |
| **Phone #** | 207-855-6191 | **Phone #** | |
| **Email** | dadams@conteches.com | **Email** | |

**Stormwater Treatment Recommendation**
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

| | |
|---|---|
| **Site Name** | WQ 2 |
| **Target TSS Removal (%)** | 80 |
| **TSS Removal (%) Provided** | 94 |
| **Recommended Stormceptor Model** | STC 450i |

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

| Stormceptor Sizing Summary | |
|---|---|
| **Stormceptor Model** | **% TSS Removal Provided** |
| STC 450i | 94 |
| STC 900 | 97 |
| STC 1200 | 97 |
| STC 1800 | 98 |
| STC 2400 | 98 |
| STC 3600 | 99 |
| STC 4800 | 99 |
| STC 6000 | 99 |
| STC 7200 | 99 |
| STC 11000 | 100 |
| STC 13000 | 100 |
| STC 16000 | 100 |

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## Sizing Details

| Drainage Area | |
|---|---|
| Total Area (acres) | 0.15 |
| Imperviousness % | 100.0 |

| Rainfall | |
|---|---|
| Station Name | EAST BRIMFIELD LAKE |
| State/Province | Massachusetts |
| Station ID # | 2107 |
| Years of Records | 45 |
| Latitude | 42°7'0"N |
| Longitude | 72°8'0"W |

| Water Quality Objective | |
|---|---|
| TSS Removal (%) | 80.0 |
| Runoff Volume Capture (%) | |
| Oil Spill Capture Volume (Gal) | |
| Peak Conveyed Flow Rate (CFS) | |
| Water Quality Flow Rate (CFS) | |

| Up Stream Storage | |
|---|---|
| Storage (ac-ft) | Discharge (cfs) |
| 0.000 | 0.000 |

| Up Stream Flow Diversion | |
|---|---|
| Max. Flow to Stormceptor (cfs) | |

### Particle Size Distribution (PSD)
### The selected PSD defines TSS removal

**OK-110**

| Particle Diameter (microns) | Distribution % | Specific Gravity |
|---|---|---|
| 1.0 | 0.0 | 2.65 |
| 53.0 | 3.0 | 2.65 |
| 75.0 | 15.0 | 2.65 |
| 88.0 | 25.0 | 2.65 |
| 106.0 | 41.0 | 2.65 |
| 125.0 | 15.0 | 2.65 |
| 150.0 | 1.0 | 2.65 |
| 212.0 | 0.0 | 2.65 |

## Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

**For Stormceptor Specifications and Drawings Please Visit:**
**https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX**

# Brief Stormceptor Sizing Report - WQ 3

| Project Information & Location | | | |
|---|---|---|---|
| **Project Name** | 20-22 Amherst Rd | **Project Number** | 645710 |
| **City** | Pelham | **State/ Province** | Massachusetts |
| **Country** | United States of America | **Date** | 12/10/2020 |
| **Designer Information** | | **EOR Information (optional)** | |
| **Name** | David Adams | **Name** | |
| **Company** | Contech | **Company** | Berkshire Design Group |
| **Phone #** | 207-855-6191 | **Phone #** | |
| **Email** | dadams@conteches.com | **Email** | |

**Stormwater Treatment Recommendation**
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

| | |
|---|---|
| **Site Name** | WQ 3 |
| **Target TSS Removal (%)** | 80 |
| **TSS Removal (%) Provided** | 92 |
| **Recommended Stormceptor Model** | STC 450i |

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

| Stormceptor Sizing Summary | |
|---|---|
| **Stormceptor Model** | **% TSS Removal Provided** |
| STC 450i | 92 |
| STC 900 | 96 |
| STC 1200 | 96 |
| STC 1800 | 96 |
| STC 2400 | 97 |
| STC 3600 | 98 |
| STC 4800 | 98 |
| STC 6000 | 98 |
| STC 7200 | 99 |
| STC 11000 | 99 |
| STC 13000 | 99 |
| STC 16000 | 99 |

Stormceptor®

CONTECH ENGINEERED SOLUTIONS
A FORTERRA COMPANY

## Sizing Details

| Drainage Area | |
|---|---|
| Total Area (acres) | 0.27 |
| Imperviousness % | 100.0 |

| Rainfall | |
|---|---|
| Station Name | EAST BRIMFIELD LAKE |
| State/Province | Massachusetts |
| Station ID # | 2107 |
| Years of Records | 45 |
| Latitude | 42°7'0"N |
| Longitude | 72°8'0"W |

| Water Quality Objective | |
|---|---|
| TSS Removal (%) | 80.0 |
| Runoff Volume Capture (%) | |
| Oil Spill Capture Volume (Gal) | |
| Peak Conveyed Flow Rate (CFS) | |
| Water Quality Flow Rate (CFS) | |

| Up Stream Storage | |
|---|---|
| Storage (ac-ft) | Discharge (cfs) |
| 0.000 | 0.000 |

| Up Stream Flow Diversion | |
|---|---|
| Max. Flow to Stormceptor (cfs) | |

### Particle Size Distribution (PSD)
### The selected PSD defines TSS removal

**OK-110**

| Particle Diameter (microns) | Distribution % | Specific Gravity |
|---|---|---|
| 1.0 | 0.0 | 2.65 |
| 53.0 | 3.0 | 2.65 |
| 75.0 | 15.0 | 2.65 |
| 88.0 | 25.0 | 2.65 |
| 106.0 | 41.0 | 2.65 |
| 125.0 | 15.0 | 2.65 |
| 150.0 | 1.0 | 2.65 |
| 212.0 | 0.0 | 2.65 |

## Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

**For Stormceptor Specifications and Drawings Please Visit:**
**https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX**

**Project:** 20-22 Amherst Rd
**Location:** Pelham, MA
**Prepared For:** Eugene T Sullivan

**Purpose:** To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

**Reference:** Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

**Procedure:** Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi$^2$/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

| Structure Name | Impv. (acres) | A (miles$^2$) | $t_c$ (min) | $t_c$ (hr) | WQV (in) | qu (csm/in.) | Q (cfs) |
|---|---|---|---|---|---|---|---|
| WQU #1 | 0.24 | 0.0003730 | 5.0 | 0.083 | 1.00 | 795.00 | 0.30 |
| WQU #2 | 0.15 | 0.0002403 | 5.0 | 0.083 | 1.00 | 795.00 | 0.19 |
| WQU #3 | 0.27 | 0.0004269 | 5.0 | 0.083 | 1.00 | 795.00 | 0.34 |
| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |

# Appendix F – Stormwater Management System – Operation & Maintenance Plan

# Stormwater Management System
# *Operation & Maintenance Plan*

## During Construction

The Contractor shall be responsible for inspection and maintenance during construction.

At all times, siltation fabric fencing, stakes and straw bales/wattles, sufficient to construct a sedimentation control barrier a minimum of 50 feet long, shall be stockpiled on the site in order to repair established barriers which may be damaged or breached.

An inspection of all erosion control and stormwater management systems shall be conducted by the Contractor at least once a week and during all rain storms until the completion of construction. In case of any noted breach or failure, the Contractor shall immediately make appropriate repairs to any erosion control system and notify the engineer of any problems involving stormwater management systems.

A rain storm shall be defined as any of the following:

- A storm in which rain is predicted to last for twelve consecutive hours or more.
- A storm for which a flash flood watch or warning is issued.
- A single storm predicted to have a cumulative rainfall of greater than one-half inch.
- A storm not meeting the previous three thresholds but which would mark a third consecutive day of measurable rainfall.

The Contractor shall also inspect the erosion control and stormwater management systems at times of significant increase in surface water runoff due to rapid thawing when the risk of failure of erosion control measures is elevated.

In such instances as remedial action is necessary, the Contractor shall repair any and all significant deficiencies in erosion control systems within two days.

The Pelham Department of Public Works shall be notified of any significant failure of stormwater management systems or erosion and sediment control measures and shall be notified of any release of pollutants to a water body (stream, brook, pond, etc.).

The Contractor shall remove the sediment from behind the fence of the sedimentation control barrier when the accumulated sediment has reached one-half of the original installed height of the barrier.

This project requires a NPDES General Permit for Stormwater Discharges from Construction Activities. Contractor and Owner are responsible for finalizing a Stormwater Pollution Prevention Plan (SWPPP) and filing for the NDPES permit prior to the start of construction. All clearing, grading, drainage, construction, and development shall be conducted in strict accordance with the SWPPP.

**Post-Construction**

Stormwater Management System Owner:

Home City Development Inc.

Party Responsible for Operation & Maintenance:

Home City Development Inc.

Inspection & Maintenance Schedule:

1) *Driveway and Parking Lot Sweeping*
Driveway and parking area sweeping shall take place annually during the spring cleanup.

2) *Grass and Stone Swales*

The Amethyst Apartments development includes grass swales to convey stormwater to yard drains and culverts.

Inspect swales or conveyances multiple times in the first few months after construction and twice per year thereafter. Look for signs of erosion and, if found, repair immediately. Swales shall be mowed at least once per year to prevent the growth of shrubs or trees but may be mowed more often at the discretion of the property owner.

3) *Catch basins*
Structures shall be inspected four times per year and cleaned if sediment build up exceeds 6" but no less than every 2 years. Oil and sediments shall be removed and disposed of in accordance with local, state and federal guidelines and regulations. In the case of an oil or bulk pollutant release, the system must be cleaned immediately following the spill and the proper authorities notified.

4) *Yard Drains*

Yard drains should be inspected quarterly and cleaned annually or more often if required. Oil and sediments should be removed and disposed of in accordance with local, state and federal guidelines and regulations. In the case of an oil or bulk pollutant release, the system must be cleaned immediately following the spill and the proper authorities notified.

5) *Water Quality Units*

The stormwater treatment chambers are Stormceptors manufactured by Contech. These units provide water quality for the driveways and parking lots.

The stormwater treatment chamber should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The system shall be inspected at least four times during the first year and at least twice per year thereafter. Sediment shall be removed any time it has built up to more than 6" deep. At a minimum, the unit shall be cleaned once per year. If sediment accumulates fast enough to require removal more than once per year, the inspection frequency shall be increased.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument.

The hydrodynamic separator system should be cleaned when the level of sediment has reached 6 inches or when an appreciable level of hydrocarbons and trash covers over 50% of the water surface of the separator. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Sediment shall be removed by a vacuum truck and disposed of in accordance with applicable regulations.

*7) Subsurface detention and Infiltration Systems*

Maintenance Requirements

A. A routine maintenance effort is required to ensure proper performance of the R-Tank system. The Maintenance program should be focused on pretreatment systems. Ensuring these structures are clean and functioning properly will reduce the risk of contamination of the R-Tank system and stormwater released from the site. Pre-treatment systems shall be inspected yearly, or as directed by the regulatory agency and by the manufacturer (for proprietary systems). Maintain as needed using acceptable practices or following manufacturer's guidelines (for proprietary systems).
B. Inspection and/or Maintenance Ports in the R-Tank system will need to be inspected for accumulation of sediments at least quarterly through the first year of operation and at least yearly thereafter. This is done by removing the cap of the port and using a measuring device long enough to reach the bottom of the R-Tank system and stiff enough to push through the loose sediments, allowing a depth measurement.
C. If sediment has accumulated to the level noted in the R-Tank Maintenance Guide or beyond a level acceptable to the Owner's engineer, the R-Tank system should be flushed.
D. A flushing event consists of pumping water into the Maintenance Port and/or adjacent structure, allowing the turbulent flows through the R-Tank system to re-suspend the fine sediments. If multiple Maintenance Ports have been installed, water should be pumped into each port to maximize flushing efficiency. Sediment-laden water can be filtered through a Dirtbag® or approved equivalent if permitted by the locality.

*8) Outlet Control Structures*

The outlet control structures for the R-Tanks shall be inspected quarterly and after large storms (greater than 2" in 24-hours) to ensure no debris is prohibiting flow through the outlet orifices in the riser pipe. Inspections should confirm that there is no standing water in the structure and that the bottom is visible. All materials removed from the outlet control structure shall be removed and disposed of in accordance with local, state and federal guidelines and regulations.

*9) Storm Drain Outlet Protection*

The integrity of riprap outlet armoring shall be inspected twice per year for signs of dislodged stones or erosion at the perimeter of the apron. Any damage shall be repaired to return the apron to the condition shown in the contract documents. While some growth of herbaceous plants is expected, regular trimming is required to prevent growth from restricting the free flow of water across the apron.

*10) Level Lip Spreader*

Inspect level lip spreaders multiple times in the first few months after construction and twice per year thereafter. Clean out any debris or sediment as needed. Note and repair any erosion or low spots at the ends of the curb of the spreader. It is recommended that sediment removal, if any, be performed after the completion of the spring snow melt.

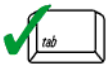
# Appendix G – Massachusetts DEP Stormwater Checklist

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## A. Introduction

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.





A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification

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[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

## B. Stormwater Checklist and Certification

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

## Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

Signature and Date

## Checklist

**Project Type:** Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

## Checklist (continued)

# Checklist for Stormwater Report

**LID Measures:** Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☒ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

**Standard 1: No New Untreated Discharges**

- ☐ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

## **Checklist** (continued)

# Checklist for Stormwater Report

**Standard 2: Peak Rate Attenuation**

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

**Standard 3: Recharge**

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

**Checklist** (continued)

# Checklist for Stormwater Report

**Standard 3: Recharge** (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

**Standard 4: Water Quality**

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☐ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☒ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

## **Checklist** (continued)

# Checklist for Stormwater Report

**Standard 4: Water Quality** (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

**Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)**

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

**Standard 6: Critical Areas**

☒ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☒ Critical areas and BMPs are identified in the Stormwater Report.

## **Checklist** (continued)

# Checklist for Stormwater Report

**Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable**

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☒ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☒ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

**Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control**

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

## **Checklist** (continued)

# Checklist for Stormwater Report

**Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control** (continued)

☒ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

**Standard 9: Operation and Maintenance Plan**

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☐ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

**Standard 10: Prohibition of Illicit Discharges**

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.