**STORMWATER REPORT**
**145 WARREN STREET**
**NEWTON, MASSACHUSETTS**

March 4, 2019

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## INTRODUCTION

VTP Associates has performed a stormwater management analysis to evaluate the post-development impacts created by the proposed residential at #145 Warren Street in Newton, Massachusetts. The project will include a new addition to the existing house. The new residence building will include three (3) units, a new surface driveway with two (2) parking, landscaped areas, and an associated stormwater management system.

VTP Associates analyzed the hydrology for the drainage areas impacted by the proposed work utilizing the Soil Conservation Service's (SCS) Runoff Curve Number (CN) methodology. VTP Associates used the HydroCAD computer modeling system in conjunction with the SCS's methods to determine the peak rate of runoff for the 2, 10, and 100-year storm events.

VTP Associates proposes the use of best management practices (BMPs) as defined by the Massachusetts Department of Environmental Protection (MA DEP) for stormwater management onsite to protect downstream receiving waters from adverse water quality impacts due to stormwater runoff. Mitigating the rate and quality of stormwater runoff from the project site will also help to lessen the environmental impact of the proposed development.

## METHODOLOGY

### Hydrology and Hydraulics

VTP Associates analyzed the survey base plan and conducted a site visit to determine the existing drainage flow patterns onsite. The existing conditions survey, in conjunction with aerial photography, and site visits were used to determine existing surface coverage areas for the site. VTP Associates determined that a majority of the pre-developed surface cover for the study area is impervious cover. Initial soil research was determined using the Natural Resources Conservation Service (NRCS) soil survey maps for Middlesex County, Massachusetts via Web Soil Survey 1.1. According to the soil survey, the soil on the site consists of the following:

629C:           Canton-Charlton-Urban land complex, 3 to 15 percent slopes

Test pit were conducted and determined that the site consists of a moderately high to high draining loamy sand. Based upon these findings, VTP Associates used a Hydrologic soil group 'A' for its drainage calculations. The test pits information has been included within this report. As per the Mass DEP Stormwater Hydrology Handbook for Conservation Commissions, VTP used a design infiltration rate of 2.41in/hr for 'A' soils.

For each subcatchment area, VTP Associates determined drainage flow path lengths, surface cover type and slopes for sheet and shallow concentrated flow. The information was used to calculate the time of concentration (Tc) for each subcatchment areas. Where applicable, a minimum Tc of 5 minutes was used; the minimum value for highly developed, small catchment areas. SCS Runoff Curve Numbers were selected by using the cover type and hydrologic soil group of each area. The peak runoff rates for the 2, 10 and 100-year storm events were then determined by inputting the weighted CN, Tc, drainage areas, and drainage system information into the HydroCAD storm water modeling system computer program. The storm events were based on the 24-hour duration storm with a SCS Type III storm distribution curve.

**Storm Event**

VTP Associates used Massachusetts rainfall data maps from Technical Paper 40, Rainfall Frequency Atlas of the United States and the City of Newton's Requirements for On-Site Drainage to estimate the rainfall depth for the 2, 10 and 100-year storms. The rainfall depths for the 24-hour storm events used are as follows:

| Storm Event | 24-Hour Rainfall Depth (inches) |
|---|---|
| 2-year | 3.1 |
| 10-year | 4.5 |
| 100-year | 8.78 |

## HYDROLOGICAL ANALYSIS

**Pre-Development Conditions**

The existing site consists of a one-story wood/brick building, a detached one-story garage, a surface driveway, and landscape areas. Approximately 5,879 square feet (25.1%) of the site is impervious cover. The site is bound by residential building to the east and west, MBTA to the north, and Warren Street to the south.

VTP Associates compiled the existing drainage areas from an existing conditions survey prepared by VTP Associates. Additionally, VTP Associates conducted site visits to evaluate the existing onsite drainage patterns and watershed divides from the existing conditions survey. At present, stormwater runoffs from the existing study area drain to Warren Street to the south (POD1), and to the north abutter (MBTA) (POD2). The pre-development drainage areas are shown on "Figure 1: Pre-Development Drainage Areas."

**Post Development Conditions**

The proposed project includes a two-story addition to the existing house. The new building will include 3 units, a surface driveway, walkways, landscaped areas, and associated drainage improvements. As a result, approximately 11,862 square feet (50.7%) of the site is impervious. The same overall area was analyzed for the proposed conditions as the pre-development conditions and is shown on "Figure 2: Post-Development Drainage Areas." Similar to pre-development conditions, the stormwater runoff flows in the same direction. The same design points were used as in the pre-development conditions.

The new residence will have approximately 7,513 square feet of impervious, or roof, and the driveway will be approximately 3,484 square feet. The roof runoff areas are separated into four drainage areas and discharge to a respective underground infiltration system. The roof runoff area (PR1) will be collected by roof leaders and discharge into the onsite infiltration system #1 (INF-1). The roof runoff areas (PR2) and (PR3) will be collected by roof leaders and discharge into the onsite infiltration system #2 (INF-2). The roof runoff area (PR4) will be collected by roof leaders and discharge into the onsite infiltration system #3 (INF-3). The driveway runoff (PD) will be collected by a catch basin and discharge into onsite infiltration system #4 (INF-4). The intent of the proposed stormwater management systems are to infiltrate stormwater runoff of the new building and driveway. The infiltration system was designed to control the 100-year storm with the addition of overflow to the infiltration systems and help mitigate proposed peak rates of runoff to less than existing conditions. The drainage areas can be seen on "Figure 2: Post-Development Drainage Areas."

VTP Associates analyzed the pre- and post-development site conditions to determine the peak rates of runoff at the design points. By incorporating the stormwater management features discussed above, the peak rates of runoff in the post-development condition is to be better than pre-development levels. Pre-development peak runoff rates vs. post-development peak runoff rates for the 2, 10, and 100-year storm events are presented in Table 1 below.

**Table 1, Pre-development vs. Post-Development Peak Rate of Runoff**

**Design Point #1 – Warren Street (South)**

| STORM EVENT (DESIGN POINT) | PRE-DEVELOPMENT PEAK RATE OF RUNOFF (CFS) | POST-DEVELOPMENT PEAK RATE OF RUNOFF (CFS) | PRE-DEVELOPMENT VOLUME OF RUNOFF (AF) | POST-DEVELOPMENT VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 2-YEAR | 0.01 | 0.00 | 0.001 | 0.000 |
| 10-YEAR | 0.05 | 0.01 | 0.004 | 0.001 |
| 100-YEAR | 0.21 | 0.10 | 0.015 | 0.007 |

**Design Point #2 – North Abutter (MBTA)**

| STORM EVENT (DESIGN POINT) | PRE-DEVELOPMENT PEAK RATE OF RUNOFF (CFS) | POST-DEVELOPMENT PEAK RATE OF RUNOFF (CFS) | PRE-DEVELOPMENT VOLUME OF RUNOFF (AF) | POST-DEVELOPMENT VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 2-YEAR | 0.01 | 0.00 | 0.004 | 0.000 |
| 10-YEAR | 0.14 | 0.04 | 0.021 | 0.007 |
| 100-YEAR | 1.44 | 1.09 | 0.113 | 0.072 |

**CONCLUSION**

The post-development peak rate of runoff is expected to be less than or equal to pre-development levels for the 2, 10, and 100-year storm events. Although there is increased impervious coverage on the site as a result of the proposed redevelopment, the addition of the underground infiltration systems controls the post-development runoff to pre-development levels or better.

**ENCLOSURES**
Test Pit
NRCS Soil Map
Pre-Development Drainage Areas (Figure 1)
Post-Development Drainage Areas (Figure 2)
Pre & Post Development HydroCAD Calculations
Operation and Maintenance Plan

TESTPIT #1 =158.9(JAN 28, 2019)
0-12"      TOP SOIL
12"-36"   SUBSOIL
36"-114"  MEDIUM LOAMY SAND
               W/GRAVEL

NO WATER
NO REFUSAL
NO MOTTLING

PERC. RATE . <2 mpi

TESTPIT #2 ELEV=148.7(JAN 28, 2019)
0-15"      TOP SOIL
15"-30"   SUBSOIL
30"-44"   SANDY LOAM W/GRAVEL


WATER @ 28"
NO REFUSAL

42° 19' 49" N
42° 19' 49" N
71° 11' 20" W
71° 11' 16" W

319660   319670   319680   319690   319700   319710   319720

4688770
4688760
4688750
4688740
4688730
4688720
4688710
4688700
4688690
4688680

629C

Soil Map may not be valid at this scale.

42° 19' 46" N
42° 19' 46" N
71° 11' 20" W
71° 11' 16" W

319660   319670   319680   319690   319700   319710   319720

Map Scale: 1:475 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0    5    10         20         30

Feet
0       20       40              80              120

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

USDA   **Natural Resources**
**Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

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# MAP LEGEND

# MAP INFORMATION
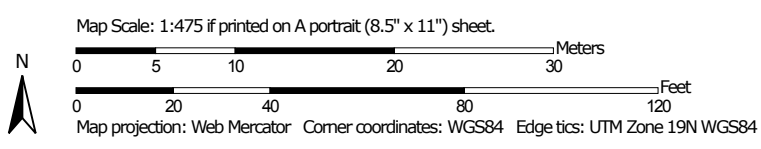
## Area of Interest (AOI)

☐ Area of Interest (AOI)

## Soils

### Soil Rating Polygons

☐ A

☐ A/D

☐ B

☐ B/D

☐ C

☐ C/D

☐ D

☐ Not rated or not available

### Soil Rating Lines

～ A

～ A/D

～ B

～ B/D

～ C

～ C/D

～ D

～ Not rated or not available

### Soil Rating Points

☐ A

☐ A/D

☐ B

☐ B/D

☐ C

☐ C/D

☐ D

☐ Not rated or not available

## Water Features

～ Streams and Canals

## Transportation

╫╫╫ Rails

～ Interstate Highways

～ US Routes

～ Major Roads

～ Local Roads

## Background

☐ Aerial Photography

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:  Middlesex County, Massachusetts
Survey Area Data:  Version 18, Sep 7, 2018

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

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

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

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      **Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

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# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 629C | Canton-Charlton-Urban land complex, 3 to 15 percent slopes | A | 0.5 | 100.0% |
| **Totals for Area of Interest** | | | **0.5** | **100.0%** |

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

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Web Soil Survey
National Cooperative Soil Survey

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TIME OF
CONCENTRATION

E2

E1

POD1

POD2

WARREN STREET

FIGURE 1:
PRE-DEVELOPMENT DRAINAGE AREAS
#145 WARREN STREET
NEWTON, MA

PROPOSED INFILTRATION SYSTEM #3

PROPOSED INFILTRATION SYSTEM #4

PROPOSED INFILTRATION SYSTEM #1

PROPOSED INFILTRATION SYSTEM #2

TIME OF CONCENTRATION

SCALE: 1in.=30ft.
DATE: MARCH 4, 2019
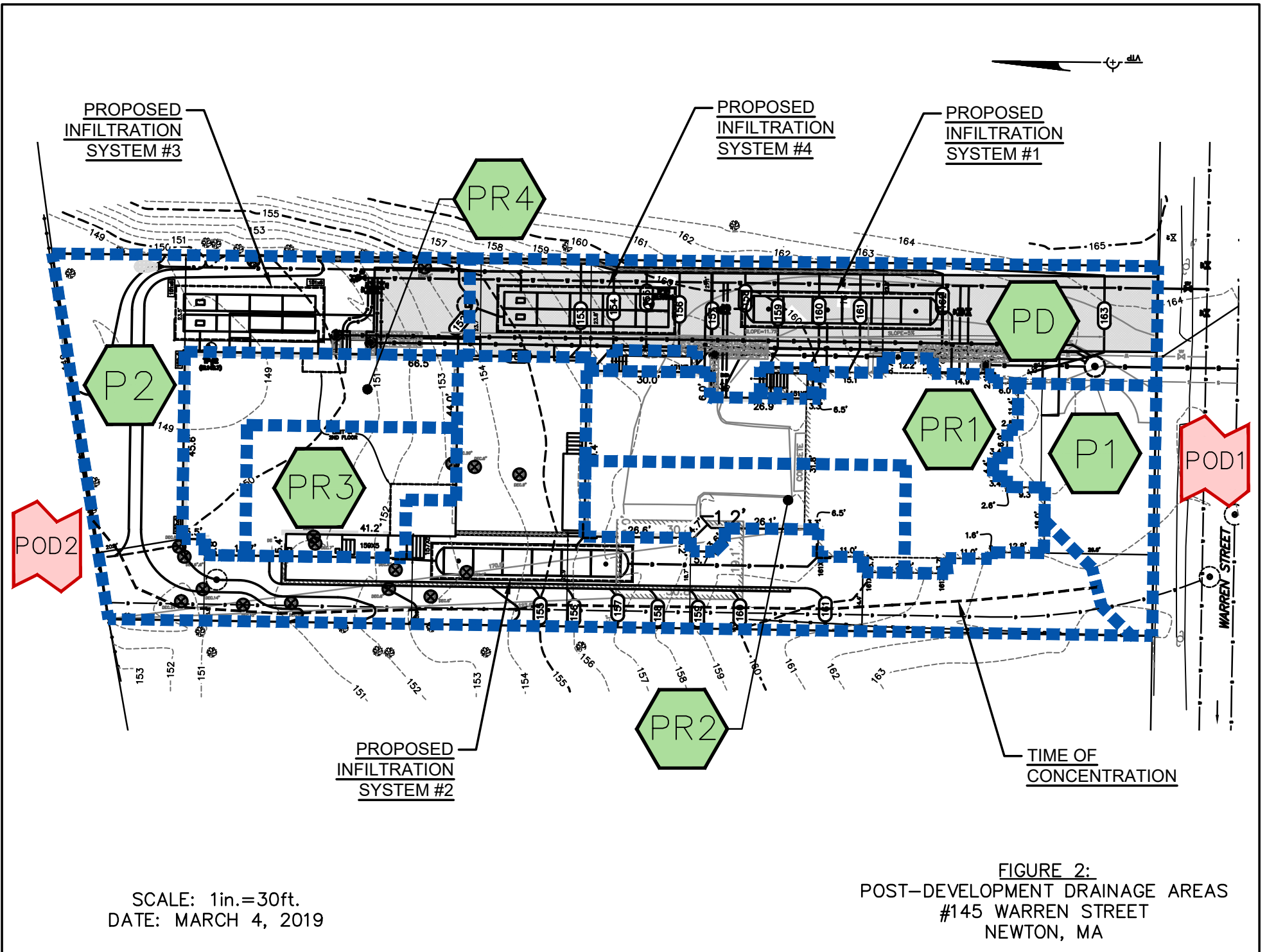
FIGURE 2:
POST-DEVELOPMENT DRAINAGE AREAS
#145 WARREN STREET
NEWTON, MA

# PRE-DEVELOPMENT CONDITIONS
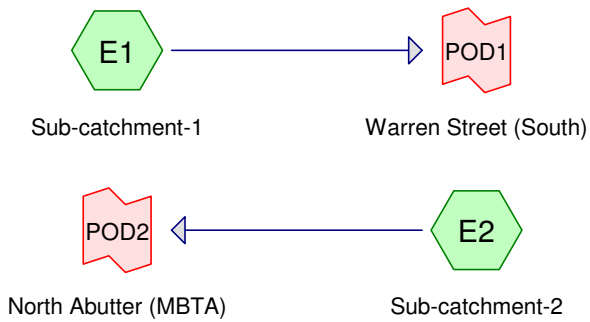
E1 → POD1

Sub-catchment-1 → Warren Street (South)

POD2 ← E2

North Abutter (MBTA) ← Sub-catchment-2

# POST-DEVELOPMENT CONDITIONS

P1 → POD1.

Sub-catchment-1 → Warren Street (South)

INF-4 ← PD

Inf. System #4
Ameration Chamber — Driveway

POD2. ← P2

North Abutter (MBTA) ← Sub-catchment-2

INF-3 ← PR4

Inf. System #3
Ameration Chamber — Roof-4

INF-1 ← PR1

Inf. System #1
Stormtech MC-3500 — Roof-1

PR3 → INF-2 ← PR2

Roof-3 — Inf. System #2
Stormtech MC-3500 — Roof-2

Subcat   Reach   Pond   Link
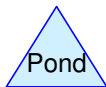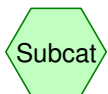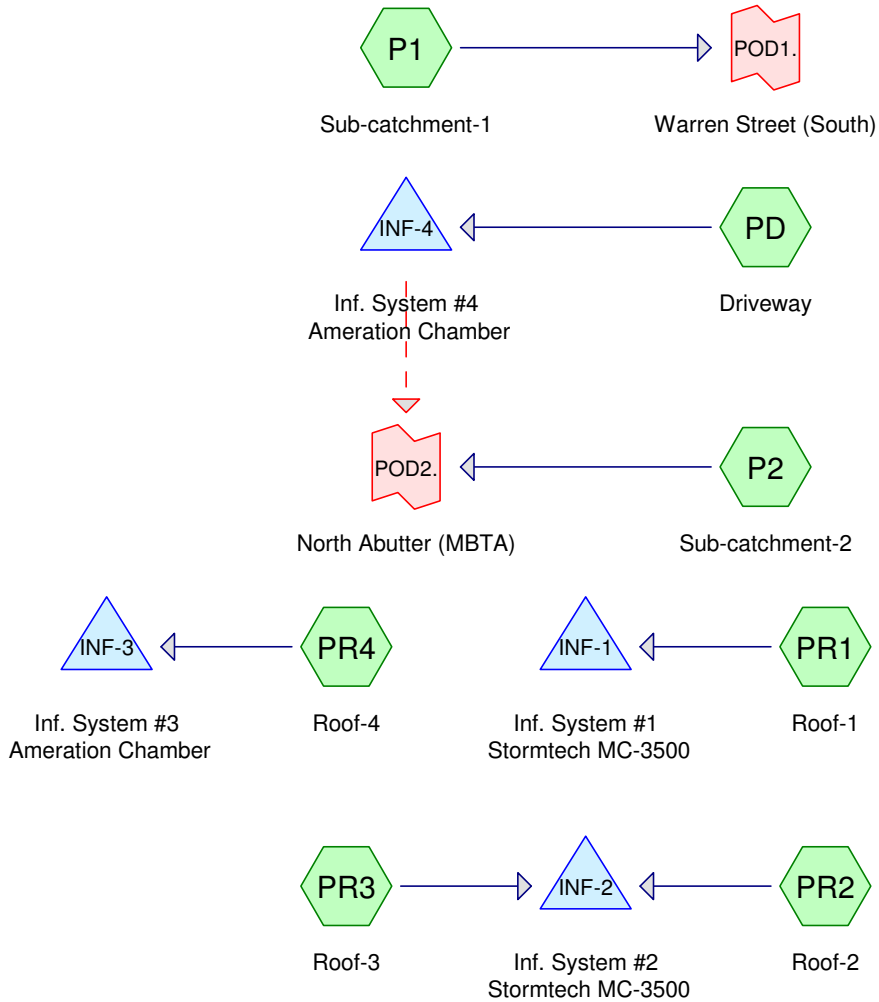
## Summary for Subcatchment E1: Sub-catchment-1

Runoff      =        0.01 cfs @  12.11 hrs,  Volume=            0.001 af,  Depth=  0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  2-Year Rainfall=3.10"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 472 | 98 | Roof (portion) |
| * | 233 | 98 | Landing/Walks |
| | 1,202 | 39 | >75% Grass cover, Good, HSG A |
| | 1,907 | 61 | Weighted Average |
| | 1,202 | | 63.03% Pervious Area |
| | 705 | | 36.97% Impervious Area |

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

### Subcatchment E1: Sub-catchment-1

**Hydrograph**



Type III 24-hr
2-Year Rainfall=3.10"
Runoff Area=1,907 sf
Runoff Volume=0.001 af
Runoff Depth=0.40"
Tc=5.0 min
CN=61

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*Type III 24-hr  2-Year Rainfall=3.10"*
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## Summary for Subcatchment E2: Sub-catchment-2

Runoff     =        0.01 cfs @  13.64 hrs,  Volume=         0.004 af,  Depth=  0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  2-Year Rainfall=3.10"

|  | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,954 | 98 | Roof (portion) |
| * | 587 | 98 | Garage |
| * | 2,392 | 98 | Bit. Driveway |
| * | 214 | 98 | Landing/Walks/Steps |
| * | 27 | 98 | Ret. Wall |
|  | 10,400 | 32 | Woods/grass comb., Good, HSG A |
|  | 5,918 | 39 | >75% Grass cover, Good, HSG A |
|  | 21,492 | 50 | Weighted Average |
|  | 16,318 |  | 75.93% Pervious Area |
|  | 5,174 |  | 24.07% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.2 | 13 | 0.0692 | 0.18 |  | **Sheet Flow, Segment: A - B** |
|  |  |  |  |  | Grass: Short   n= 0.150   P2= 3.10" |
| 0.3 | 27 | 0.0407 | 1.38 |  | **Sheet Flow, Segmend: B - C** |
|  |  |  |  |  | Smooth surfaces   n= 0.011   P2= 3.10" |
| 1.3 | 10 | 0.0310 | 0.13 |  | **Sheet Flow, Segment: C - D** |
|  |  |  |  |  | Grass: Short   n= 0.150   P2= 3.10" |
| 0.4 | 24 | 0.0251 | 1.11 |  | **Shallow Concentrated Flow, Segment: D - E** |
|  |  |  |  |  | Short Grass Pasture   Kv= 7.0 fps |
| 0.0 | 3 | 0.0251 | 3.22 |  | **Shallow Concentrated Flow, Segment: E - F** |
|  |  |  |  |  | Paved   Kv= 20.3 fps |
| 0.4 | 46 | 0.0720 | 1.88 |  | **Shallow Concentrated Flow, Segment: F - G** |
|  |  |  |  |  | Short Grass Pasture   Kv= 7.0 fps |
| 0.1 | 20 | 0.0490 | 4.49 |  | **Shallow Concentrated Flow, Segment: G - H** |
|  |  |  |  |  | Paved   Kv= 20.3 fps |
| 0.6 | 77 | 0.0910 | 2.11 |  | **Shallow Concentrated Flow, Segment: H - I** |
|  |  |  |  |  | Short Grass Pasture   Kv= 7.0 fps |
| 0.2 | 19 | 0.0520 | 1.60 |  | **Shallow Concentrated Flow, Segment: I - J** |
|  |  |  |  |  | Short Grass Pasture   Kv= 7.0 fps |
| 2.4 | 58 | 0.0034 | 0.41 |  | **Shallow Concentrated Flow, Segment: J - K** |
|  |  |  |  |  | Short Grass Pasture   Kv= 7.0 fps |
| 6.9 | 297 |  |  |  | Total |

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*Type III 24-hr  2-Year Rainfall=3.10"*
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## Subcatchment E2: Sub-catchment-2



**Hydrograph**

☐ Runoff

**Type III 24-hr
2-Year Rainfall=3.10"
Runoff Area=21,492 sf
Runoff Volume=0.004 af
Runoff Depth=0.11"
Flow Length=297'
Tc=6.9 min
CN=50**

0.01 cfs

## Summary for Subcatchment P1: Sub-catchment-1

Runoff      =        0.00 cfs @   14.74 hrs,  Volume=          0.000 af,  Depth=  0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  2-Year Rainfall=3.10"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 228 | 98 | Landing/Walks |
| | 1,307 | 39 | >75% Grass cover, Good, HSG A |
| | 1,535 | 48 | Weighted Average |
| | 1,307 | | 85.15% Pervious Area |
| | 228 | | 14.85% Impervious Area |

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

### Subcatchment P1: Sub-catchment-1

## Summary for Subcatchment P2: Sub-catchment-2

Runoff     =         0.00 cfs @  21.29 hrs,  Volume=          0.000 af,  Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  2-Year Rainfall=3.10"

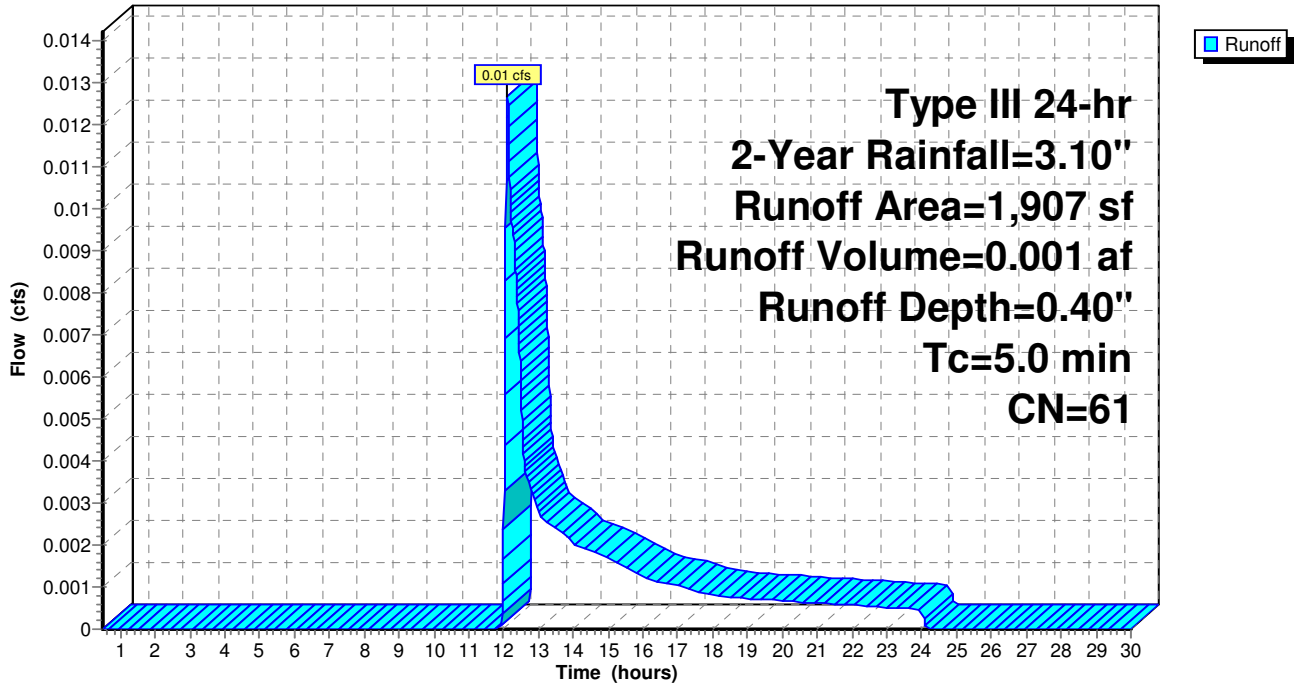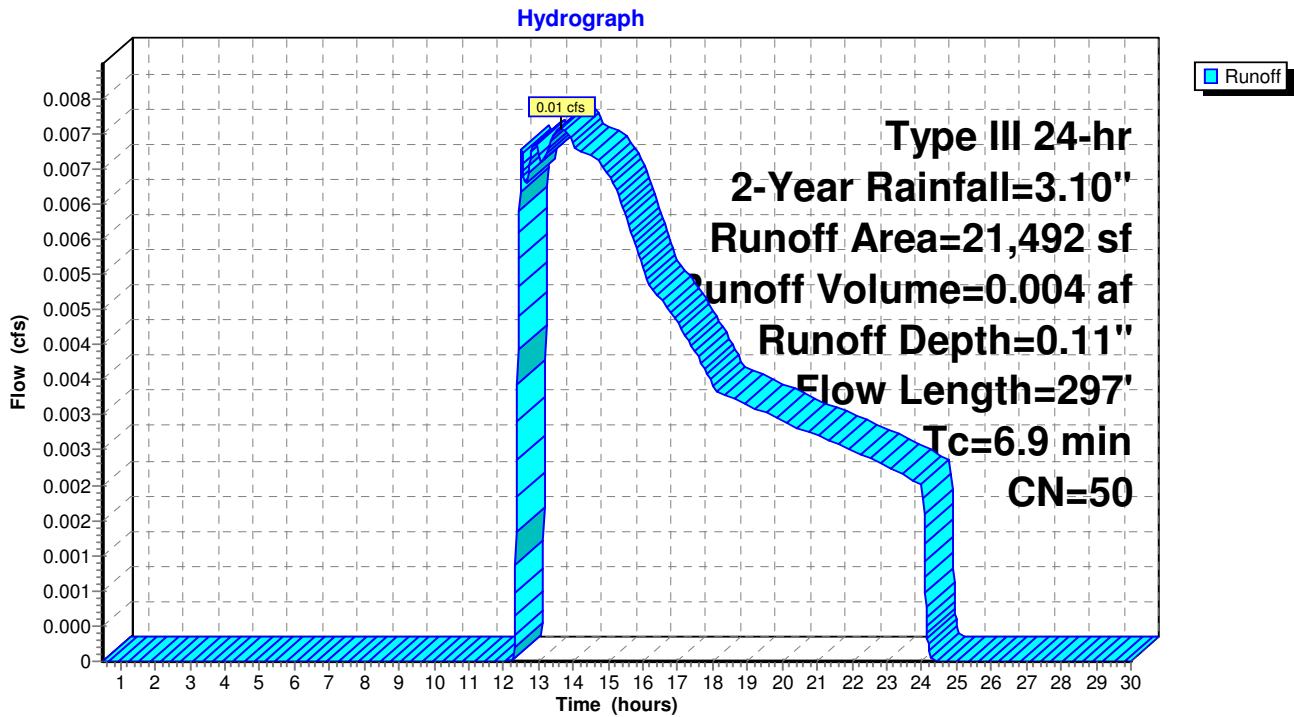| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 394 | 98 | Paved Driveway (portion) |
| * | 212 | 98 | Landing/Walks/Steps |
| * | 182 | 98 | Ret. Wall |
| | 12,019 | 39 | >75% Grass cover, Good, HSG A |
| | 12,807 | 43 | Weighted Average |
| | 12,019 | | 93.85% Pervious Area |
| | 788 | | 6.15% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.2 | 50 | 0.0250 | 0.16 | | **Sheet Flow, Segment: A - B** |
| | | | | | Grass: Short   n= 0.150   P2= 3.10" |
| 0.2 | 16 | 0.0250 | 1.11 | | **Shallow Concentrated Flow, Segment: B - C** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.2 | 21 | 0.0480 | 1.53 | | **Shallow Concentrated Flow, Segment: C -D** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.4 | 54 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, Segment: D - E** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.3 | 25 | 0.0400 | 1.40 | | **Shallow Concentrated Flow, Segment: E - F** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.2 | 28 | 0.0714 | 1.87 | | **Shallow Concentrated Flow, Segment: F - G** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.9 | 51 | 0.0196 | 0.98 | | **Shallow Concentrated Flow, Segment: G - H** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.1 | 10 | 0.0500 | 1.57 | | **Shallow Concentrated Flow, Segment: H - I** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 7.5 | 255 | Total | | | |

## Subcatchment P2: Sub-catchment-2



**Hydrograph**

**Type III 24-hr**
**2-Year Rainfall=3.10"**
**Runoff Area=12,807 sf**
**Runoff Volume=0.000 af**
**Runoff Depth=0.01"**
**Flow Length=255'**
**Tc=7.5 min**
**CN=43**

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*Type III 24-hr  2-Year Rainfall=3.10"*
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## Summary for Subcatchment PD: Driveway

Runoff      =        0.18 cfs @  12.08 hrs,  Volume=        0.013 af,  Depth=  1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  2-Year Rainfall=3.10"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 3,073 | 98 | Paved Driveway |
| * | 228 | 98 | Ret. Wall |
| * | 32 | 98 | Walks |
| | 1,190 | 39 | >75% Grass cover, Good, HSG A |
| | 4,523 | 82 | Weighted Average |
| | 1,190 | | 26.31% Pervious Area |
| | 3,333 | | 73.69% Impervious Area |

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

### Subcatchment PD: Driveway

**Hydrograph**



Type III 24-hr
2-Year Rainfall=3.10"
Runoff Area=4,523 sf
Runoff Volume=0.013 af
Runoff Depth=1.46"
Tc=5.0 min
CN=82

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*Type III 24-hr  2-Year Rainfall=3.10"*
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## Summary for Subcatchment PR1: Roof-1

Runoff      =        0.21 cfs @   12.07 hrs,  Volume=        0.016 af,  Depth=  2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  2-Year Rainfall=3.10"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 2,894 | 98 | Ex. Roof |
| | 2,894 | | 100.00% Impervious Area |

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

### Subcatchment PR1: Roof-1



**Hydrograph**

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## Summary for Subcatchment PR2: Roof-2

Runoff     =        0.11 cfs @   12.07 hrs,  Volume=          0.008 af,  Depth=  2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  2-Year Rainfall=3.10"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,526 | 98 | Ex. Roof |
| | 1,526 | | 100.00% Impervious Area |

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

### Subcatchment PR2: Roof-2

**Hydrograph**

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## Summary for Subcatchment PR3: Roof-3

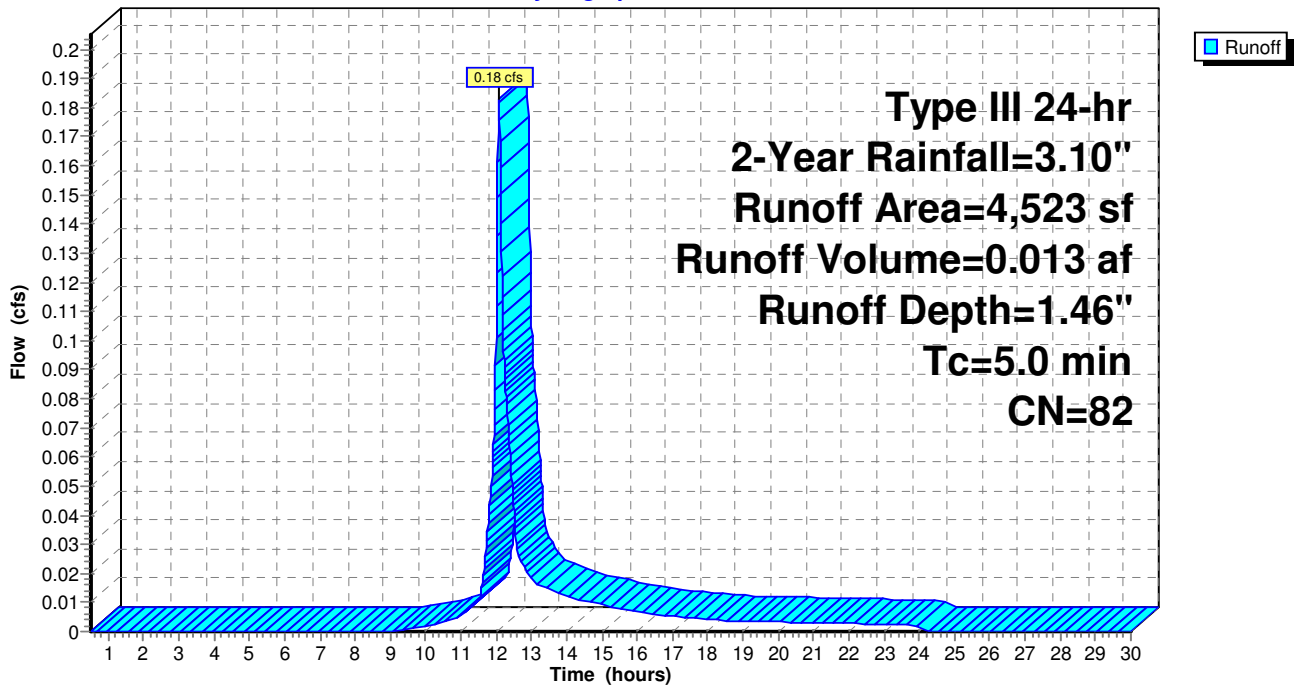Runoff     =        0.10 cfs @   12.07 hrs,  Volume=        0.008 af,  Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  2-Year Rainfall=3.10"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,452 | 98 | Ex. Roof |
| | 1,452 | | 100.00% Impervious Area |

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

### Subcatchment PR3: Roof-3

**Hydrograph**



Type III 24-hr
2-Year Rainfall=3.10"
Runoff Area=1,452 sf
Runoff Volume=0.008 af
Runoff Depth=2.87"
Tc=5.0 min
CN=98

## Summary for Subcatchment PR4: Roof-4

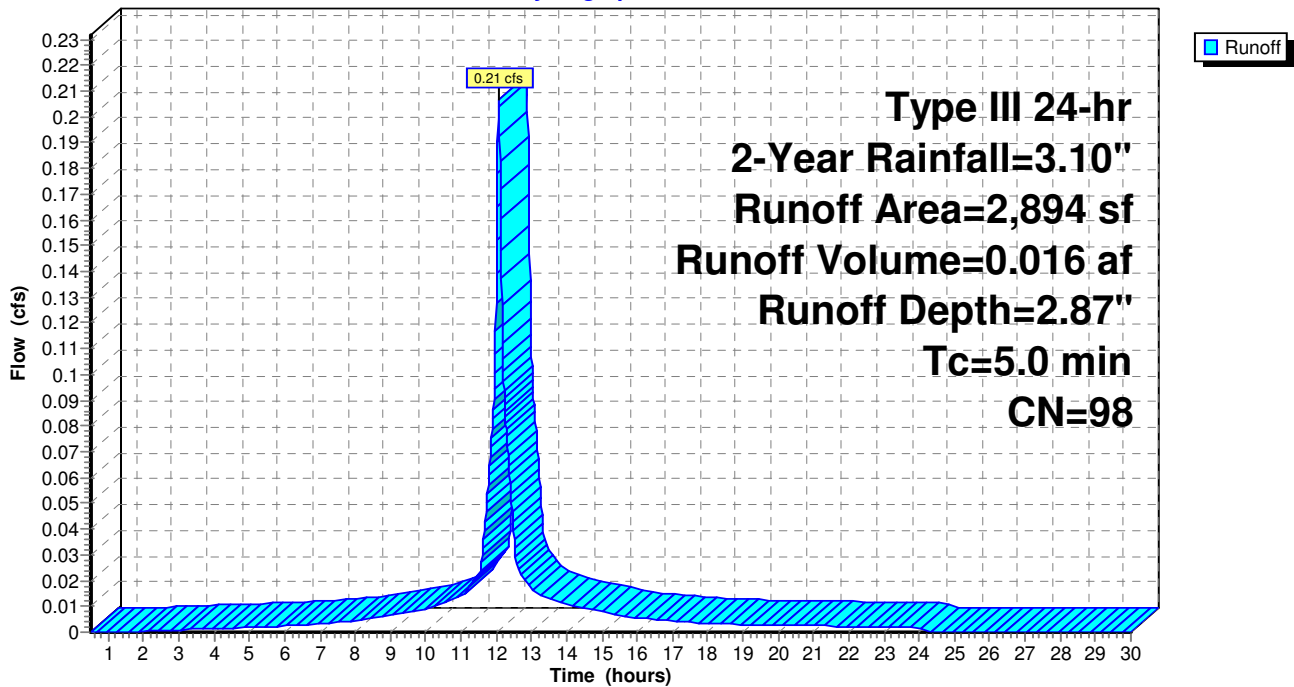Runoff     =        0.12 cfs @   12.07 hrs,  Volume=        0.009 af,  Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  2-Year Rainfall=3.10"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,641 | 98 | Ex. Roof |
| | 1,641 | | 100.00% Impervious Area |

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

### Subcatchment PR4: Roof-4



**Hydrograph**

Type III 24-hr
2-Year Rainfall=3.10"
Runoff Area=1,641 sf
Runoff Volume=0.009 af
Runoff Depth=2.87"
Tc=5.0 min
CN=98

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## Summary for Pond INF-1: Inf. System #1 Stormtech MC-3500

Inflow Area =       0.066 ac,100.00% Impervious,  Inflow Depth =  2.87"    for 2-Year event
Inflow      =     0.21 cfs @   12.07 hrs,  Volume=          0.016 af
Outflow    =     0.02 cfs @   11.71 hrs,  Volume=          0.016 af,  Atten= 89%,  Lag= 0.0 min
Discarded =     0.02 cfs @   11.71 hrs,  Volume=          0.016 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 152.48' @ 12.67 hrs   Surf.Area= 0.009 ac   Storage= 0.005 af

Plug-Flow detention time= 59.9 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 59.9 min ( 816.0 - 756.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 151.25' | 0.012 af | **8.42'W x 48.72'L x 5.25'H Field A**<br>0.049 af Overall - 0.016 af Embedded = 0.034 af  x 35.0% Voids |
| #2A | 152.25' | 0.016 af | **ADS_StormTech MC-3500 d +Cap**  x 6  Inside #1<br>Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf<br>Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap<br>Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf |
|  |  | 0.028 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 151.25' | **2.410 in/hr Exfiltration over Surface area**     Phase-In= 0.01' |

**Discarded OutFlow**  Max=0.02 cfs @ 11.71 hrs  HW=151.31'   (Free Discharge)
└─**1=Exfiltration**  (Exfiltration Controls 0.02 cfs)

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## Pond INF-1: Inf. System #1 Stormtech MC-3500 - Chamber Wizard Field A

**Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)**
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf

6 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 46.72' Row Length +12.0" End Stone x 2 = 48.72' Base Length
1 Rows x 77.0" Wide + 12.0" Side Stone x 2 = 8.42' Base Width
12.0" Base + 45.0" Chamber Height + 6.0" Cover = 5.25' Field Height

6 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 1 Rows = 689.5 cf Chamber Storage

2,152.8 cf Field - 689.5 cf Chambers = 1,463.3 cf Stone x 35.0% Voids = 512.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,201.7 cf = 0.028 af
Overall Storage Efficiency = 55.8%
Overall System Size = 48.72' x 8.42' x 5.25'

6 Chambers
79.7 cy Field
54.2 cy Stone

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## Pond INF-1: Inf. System #1 Stormtech MC-3500



**Inflow Area=0.066 ac**
**Peak Elev=152.48'**
**Storage=0.005 af**

## Summary for Pond INF-2: Inf. System #2 Stormtech MC-3500

Inflow Area =      0.068 ac,100.00% Impervious,  Inflow Depth =  2.87"    for  2-Year event
Inflow      =    0.21 cfs @  12.07 hrs, Volume=        0.016 af
Outflow    =    0.02 cfs @  11.70 hrs, Volume=        0.016 af, Atten= 89%, Lag= 0.0 min
Discarded =    0.02 cfs @  11.70 hrs, Volume=        0.016 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 152.51' @ 12.70 hrs   Surf.Area= 0.009 ac   Storage= 0.005 af

Plug-Flow detention time= 63.1 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 63.1 min ( 819.2 - 756.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---------------------|
| #1A | 151.25' | 0.012 af | **8.42'W x 48.72'L x 5.25'H Field A** |
|  |  |  | 0.049 af Overall - 0.016 af Embedded = 0.034 af  x 35.0% Voids |
| #2A | 152.25' | 0.016 af | **ADS_StormTech MC-3500 d +Cap**  x 6  Inside #1 |
|  |  |  | Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf |
|  |  |  | Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap |
|  |  |  | Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf |
|  |  | 0.028 af | Total Available Storage |

   Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|--------|---------|--------|----------------|
| #1 | Discarded | 151.25' | **2.410 in/hr Exfiltration over Surface area**    Phase-In= 0.01' |

**Discarded OutFlow**  Max=0.02 cfs @ 11.70 hrs  HW=151.30'   (Free Discharge)
└─**1=Exfiltration**  (Exfiltration Controls 0.02 cfs)

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## Pond INF-2: Inf. System #2 Stormtech MC-3500 - Chamber Wizard Field A

**Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)**
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf

6 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 46.72' Row Length +12.0" End Stone x 2 = 48.72'
Base Length
1 Rows x 77.0" Wide + 12.0" Side Stone x 2 = 8.42' Base Width
12.0" Base + 45.0" Chamber Height + 6.0" Cover = 5.25' Field Height

6 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 1 Rows = 689.5 cf Chamber Storage

2,152.8 cf Field - 689.5 cf Chambers = 1,463.3 cf Stone x 35.0% Voids = 512.2 cf Stone Storage
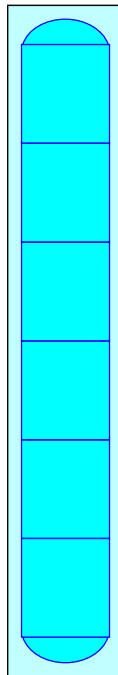
Chamber Storage + Stone Storage = 1,201.7 cf = 0.028 af
Overall Storage Efficiency = 55.8%
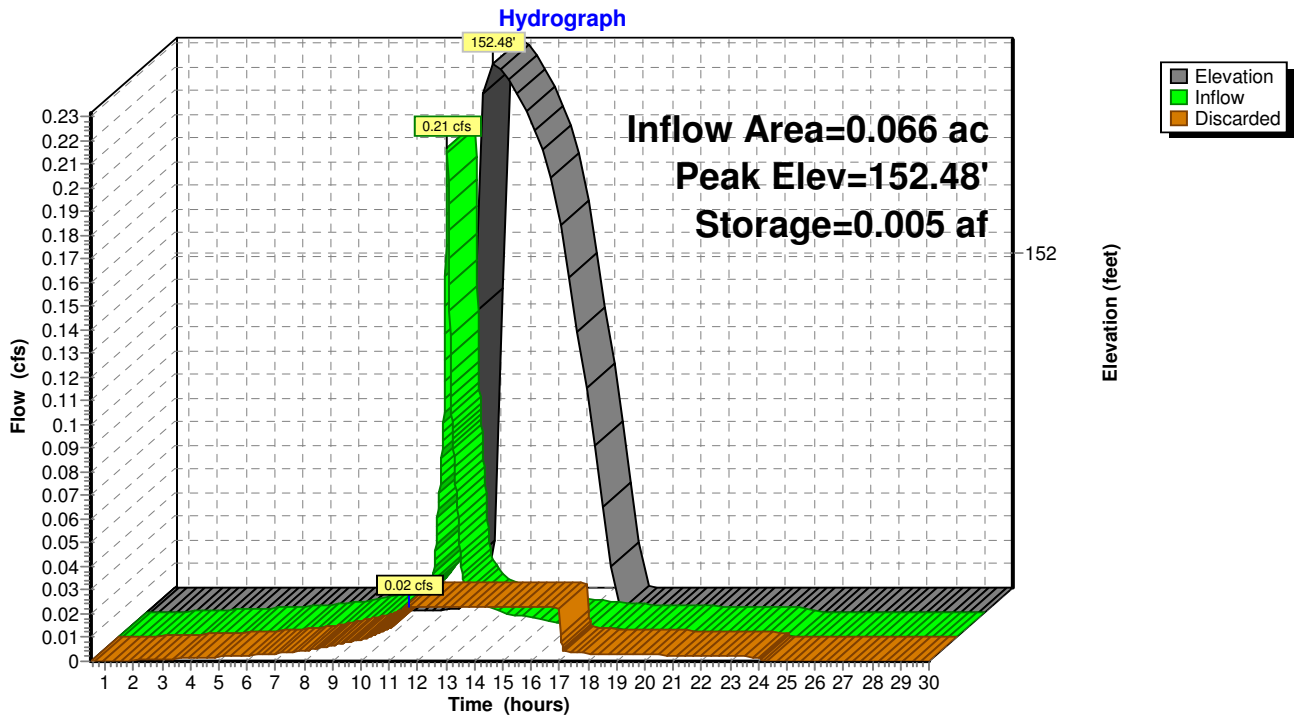Overall System Size = 48.72' x 8.42' x 5.25'

6 Chambers
79.7 cy Field
54.2 cy Stone

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## Pond INF-2: Inf. System #2 Stormtech MC-3500



Inflow Area=0.068 ac
Peak Elev=152.51'
Storage=0.005 af

## Summary for Pond INF-3: Inf. System #3 Ameration Chamber

Inflow Area =        0.038 ac,100.00% Impervious,  Inflow Depth =  2.87"    for  2-Year event
Inflow      =     0.12 cfs @  12.07 hrs, Volume=            0.009 af
Outflow     =     0.03 cfs @  11.81 hrs, Volume=            0.009 af, Atten= 78%, Lag= 0.0 min
Discarded   =     0.03 cfs @  11.81 hrs, Volume=            0.009 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 148.89' @ 12.46 hrs   Surf.Area= 0.011 ac   Storage= 0.002 af

Plug-Flow detention time= 14.9 min calculated for 0.009 af (100% of inflow)
Center-of-Mass det. time= 14.9 min ( 771.1 - 756.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---------------------|
| #1A | 148.40' | 0.005 af | **13.00'W x 36.00'L x 2.17'H Field A** |
|  |  |  | 0.023 af Overall - 0.010 af Embedded = 0.014 af  x 35.0% Voids |
| #2A | 148.90' | 0.006 af | **Concrete Galley  4x8x1.7**  x 8  Inside #1 |
|  |  |  | Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf |
|  |  |  | Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf |
|  |  |  | 2 Rows of 4 Chambers |
|  |  | 0.010 af | Total Available Storage |

   Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|--------|---------|--------|----------------|
| #1 | Discarded | 148.40' | **2.410 in/hr Exfiltration over Surface area**     Phase-In= 0.01' |

**Discarded OutFlow**  Max=0.03 cfs @ 11.81 hrs  HW=148.42'   (Free Discharge)
  ⌐—**1=Exfiltration**  (Exfiltration Controls 0.03 cfs)

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## Pond INF-3: Inf. System #3 Ameration Chamber - Chamber Wizard Field A

**Chamber Model = Concrete Galley  4x8x1.7 (Ameration Chamber, NEPCA LE-AC  or equivalent)**
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

48.0" Wide + 12.0" Spacing = 60.0" C-C Row Spacing

4 Chambers/Row x 8.00' Long = 32.00' Row Length +24.0" End Stone x 2 = 36.00' Base Length
2 Rows x 48.0" Wide + 12.0" Spacing x 1 + 24.0" Side Stone x 2 = 13.00' Base Width
6.0" Base + 20.0" Chamber Height = 2.17' Field Height

8 Chambers x 30.3 cf = 242.3 cf Chamber Storage
8 Chambers x 51.9 cf = 415.3 cf Displacement

1,015.6 cf Field - 415.3 cf Chambers = 600.3 cf Stone x 35.0% Voids = 210.1 cf Stone Storage
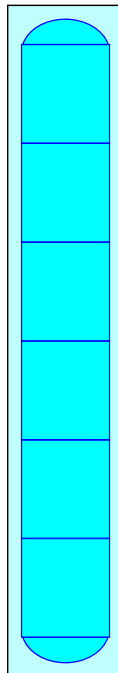
Chamber Storage + Stone Storage = 452.4 cf = 0.010 af
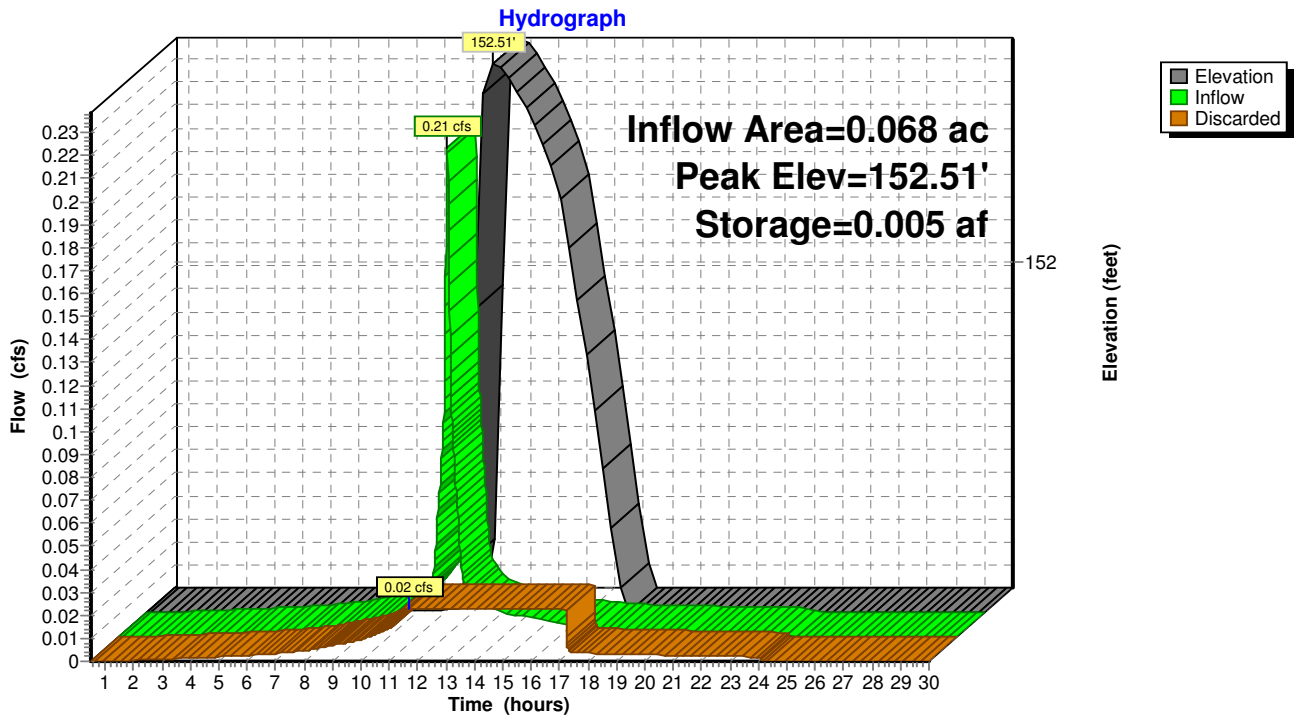Overall Storage Efficiency = 44.5%
Overall System Size = 36.00' x 13.00' x 2.17'

8 Chambers
37.6 cy Field
22.2 cy Stone

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## Pond INF-3: Inf. System #3 Ameration Chamber



**Hydrograph**

Inflow Area=0.038 ac
Peak Elev=148.89'
Storage=0.002 af

## Summary for Pond INF-4: Inf. System #4 Ameration Chamber

Inflow Area =        0.104 ac, 73.69% Impervious,  Inflow Depth =  1.46"    for  2-Year event
Inflow     =     0.18 cfs @  12.08 hrs,  Volume=          0.013 af
Outflow    =     0.03 cfs @  11.81 hrs,  Volume=          0.013 af, Atten= 86%, Lag= 0.0 min
Discarded  =     0.03 cfs @  11.81 hrs,  Volume=          0.013 af
Secondary  =     0.00 cfs @   0.50 hrs,  Volume=          0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 149.40' @ 12.62 hrs   Surf.Area= 473 sf   Storage= 165 cf

Plug-Flow detention time= 44.4 min calculated for 0.013 af (100% of inflow)
Center-of-Mass det. time= 44.4 min ( 881.2 - 836.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---------------------|
| #1A | 148.40' | 260 cf | **11.00'W x 43.00'L x 2.67'H Field A** |
|  |  |  | 1,263 cf Overall - 519 cf Embedded = 744 cf  x 35.0% Voids |
| #2A | 149.40' | 303 cf | **Concrete Galley  4x8x1.7**  x 10  Inside #1 |
|  |  |  | Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf |
|  |  |  | Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf |
|  |  |  | 2 Rows of 5 Chambers |
|  |  | 563 cf | Total Available Storage |

   Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|--------|---------|--------|----------------|
| #1 | Discarded | 148.40' | **2.410 in/hr Exfiltration over Surface area**    Phase-In= 0.01' |
| #2 | Secondary | 149.90' | **6.0"  Round Overflow** |
|  |  |  | L= 91.0'  CPP, square edge headwall,  Ke= 0.500 |
|  |  |  | Inlet / Outlet Invert= 149.90' / 149.44'  S= 0.0051 '/'  Cc= 0.900 |
|  |  |  | n= 0.012,  Flow Area= 0.20 sf |

**Discarded OutFlow**  Max=0.03 cfs @ 11.81 hrs  HW=148.43'   (Free Discharge)
 ⬆1=Exfiltration  (Exfiltration Controls 0.03 cfs)

**Secondary OutFlow**  Max=0.00 cfs @ 0.50 hrs  HW=148.40'  TW=0.00'   (Dynamic Tailwater)
 ⬆2=Overflow  ( Controls 0.00 cfs)

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## Pond INF-4: Inf. System #4 Ameration Chamber - Chamber Wizard Field A

**Chamber Model = Concrete Galley  4x8x1.7 (Ameration Chamber, NEPCA LE-AC  or equivalent)**
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

5 Chambers/Row x 8.00' Long = 40.00' Row Length +18.0" End Stone x 2 = 43.00' Base Length
2 Rows x 48.0" Wide + 18.0" Side Stone x 2 = 11.00' Base Width
12.0" Base + 20.0" Chamber Height = 2.67' Field Height

10 Chambers x 30.3 cf = 302.8 cf Chamber Storage
10 Chambers x 51.9 cf = 519.1 cf Displacement

1,262.9 cf Field - 519.1 cf Chambers = 743.8 cf Stone x 35.0% Voids = 260.3 cf Stone Storage

Chamber Storage + Stone Storage = 563.2 cf = 0.013 af
Overall Storage Efficiency = 44.6%
Overall System Size = 43.00' x 11.00' x 2.67'

10 Chambers
46.8 cy Field
27.5 cy Stone

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## Pond INF-4: Inf. System #4 Ameration Chamber

**Hydrograph**



**Inflow Area=0.104 ac**
**Peak Elev=149.40'**
**Storage=165 cf**

Legend:
- Elevation
- Inflow
- Outflow
- Discarded
- Secondary

149.40'
0.18 cfs
0.03 cfs
0.03 cfs
0.00 cfs

Flow (cfs) axis: 0 to 0.2
Elevation (feet) axis: 148.4 to 149.35
Time (hours) axis: 2 to 30

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## Summary for Link POD1: Warren Street (South)

Inflow Area =        0.044 ac,  36.97% Impervious,  Inflow Depth =   0.40"    for  2-Year event
Inflow      =       0.01 cfs @   12.11 hrs,  Volume=            0.001 af
Primary    =       0.01 cfs @   12.11 hrs,  Volume=            0.001 af,  Atten= 0%,  Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD1: Warren Street (South)

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## Summary for Link POD1.: Warren Street (South)

Inflow Area =        0.035 ac,  14.85% Impervious,  Inflow Depth =   0.07"    for  2-Year event
Inflow       =        0.00 cfs @   14.74 hrs,  Volume=              0.000 af
Primary     =        0.00 cfs @   14.74 hrs,  Volume=                 0.000 af,  Atten= 0%,  Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD1.: Warren Street (South)

## Summary for Link POD2: North Abutter (MBTA)

Inflow Area =       0.493 ac, 24.07% Impervious,  Inflow Depth =  0.11"    for 2-Year event
Inflow      =       0.01 cfs @  13.64 hrs, Volume=         0.004 af
Primary     =       0.01 cfs @  13.64 hrs, Volume=         0.004 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD2: North Abutter (MBTA)

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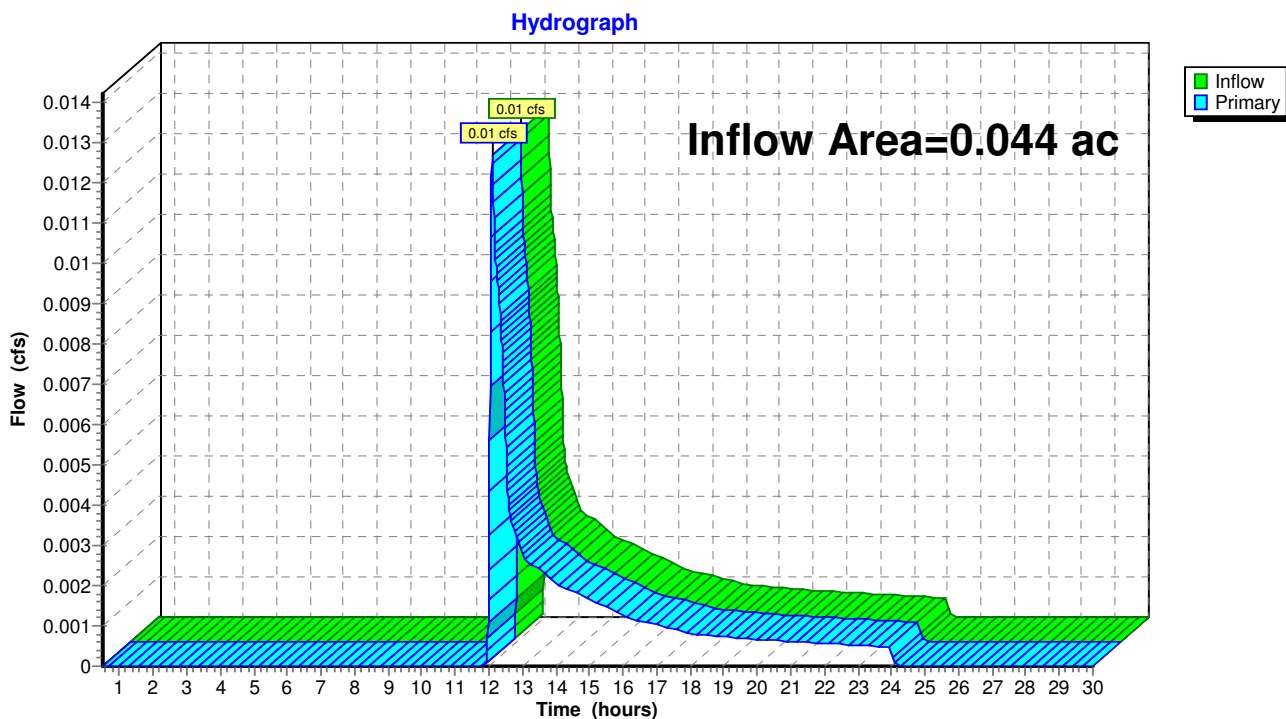Printed  3/4/2019
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## Summary for Link POD2.: North Abutter (MBTA)

Inflow Area =        0.294 ac,   6.15% Impervious,  Inflow Depth =   0.01"    for  2-Year event
Inflow      =        0.00 cfs @   21.29 hrs,  Volume=          0.000 af
Primary     =        0.00 cfs @   21.29 hrs,  Volume=          0.000 af,  Atten= 0%,  Lag= 0.0 min

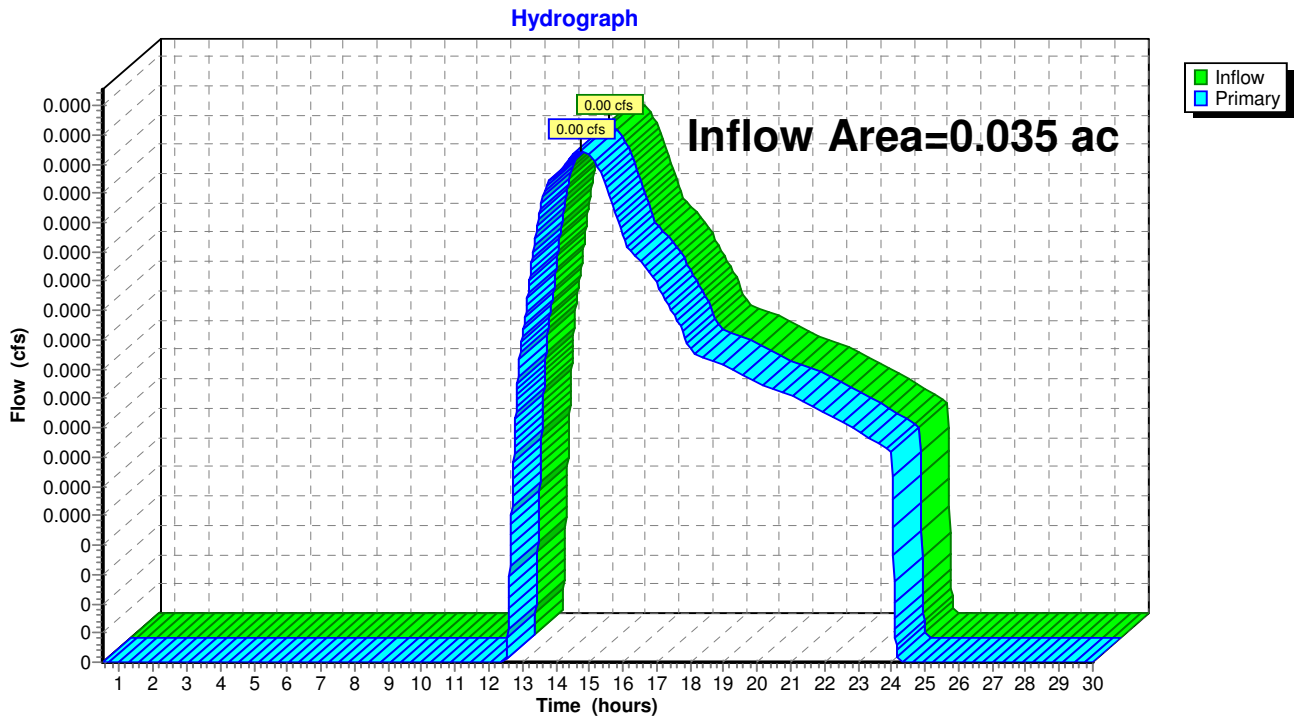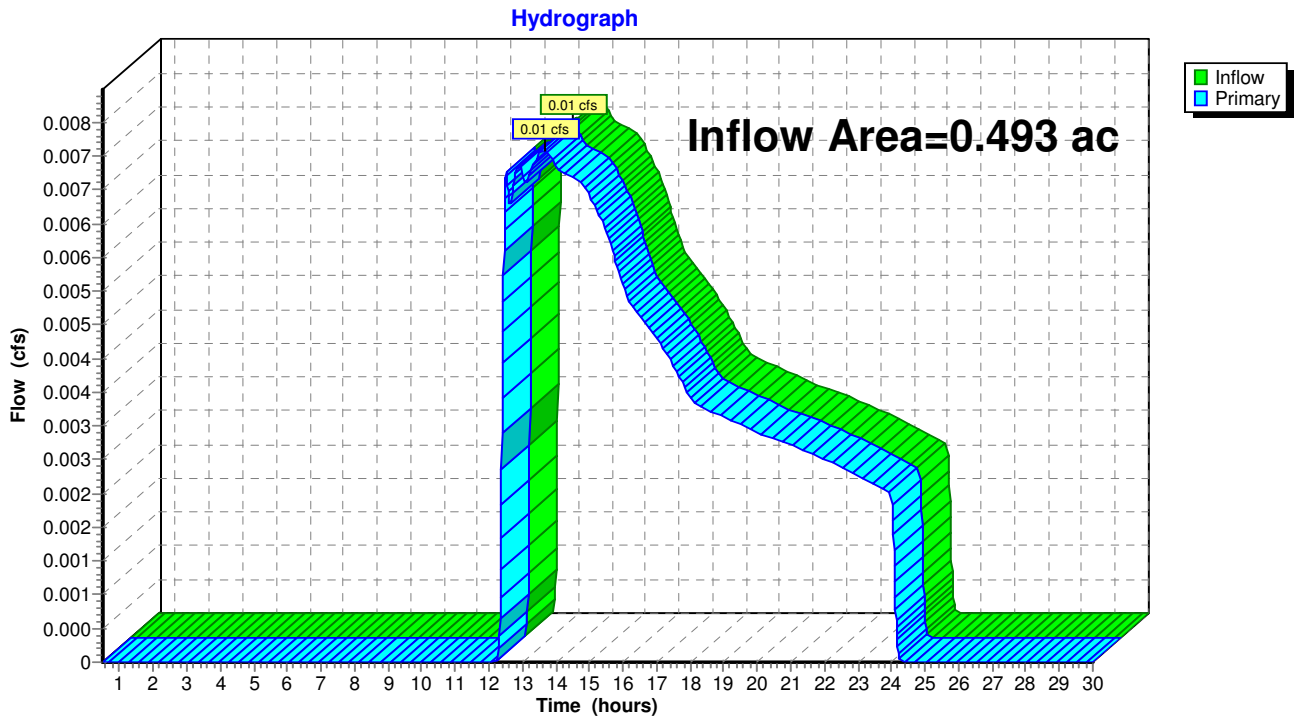Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD2.: North Abutter (MBTA)
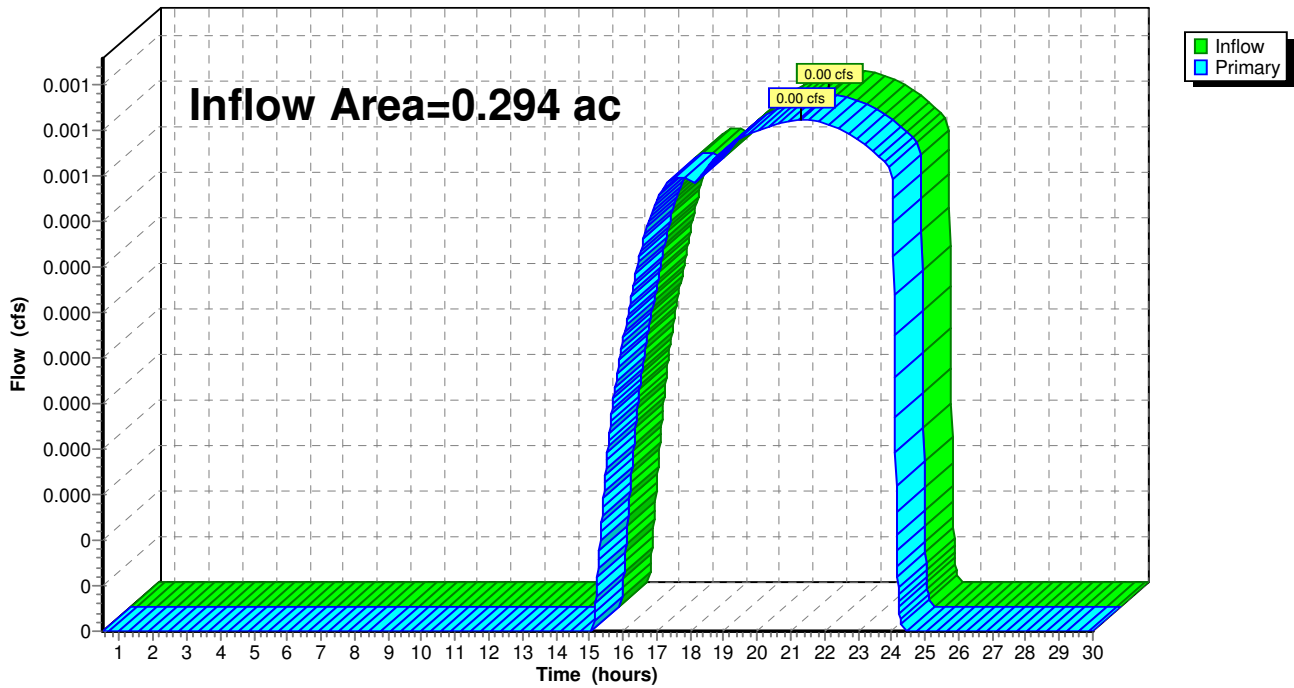
## Summary for Subcatchment E1: Sub-catchment-1

Runoff      =      0.05 cfs @  12.09 hrs,  Volume=          0.004 af,  Depth=  1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  10-Year Rainfall=4.50"

|   | Area (sf) | CN | Description |
|---|---|---|---|
| * | 472 | 98 | Roof (portion) |
| * | 233 | 98 | Landing/Walks |
|   | 1,202 | 39 | >75% Grass cover, Good, HSG A |
|   | 1,907 | 61 | Weighted Average |
|   | 1,202 |  | 63.03% Pervious Area |
|   | 705 |  | 36.97% Impervious Area |

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

### Subcatchment E1: Sub-catchment-1

**Hydrograph**



Type III 24-hr
10-Year Rainfall=4.50"
Runoff Area=1,907 sf
Runoff Volume=0.004 af
Runoff Depth=1.08"
Tc=5.0 min
CN=61

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*Type III 24-hr  10-Year Rainfall=4.50"*
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## Summary for Subcatchment E2: Sub-catchment-2

Runoff      =        0.14 cfs @  12.16 hrs,  Volume=              0.021 af,  Depth=  0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
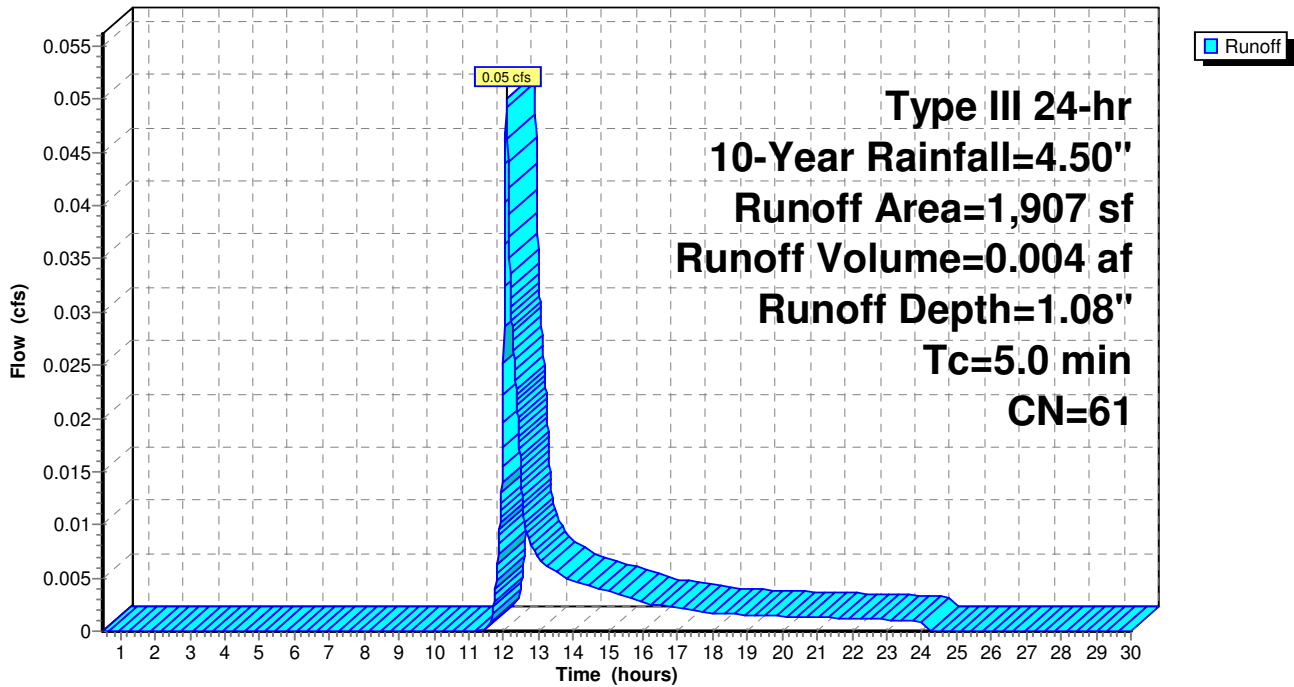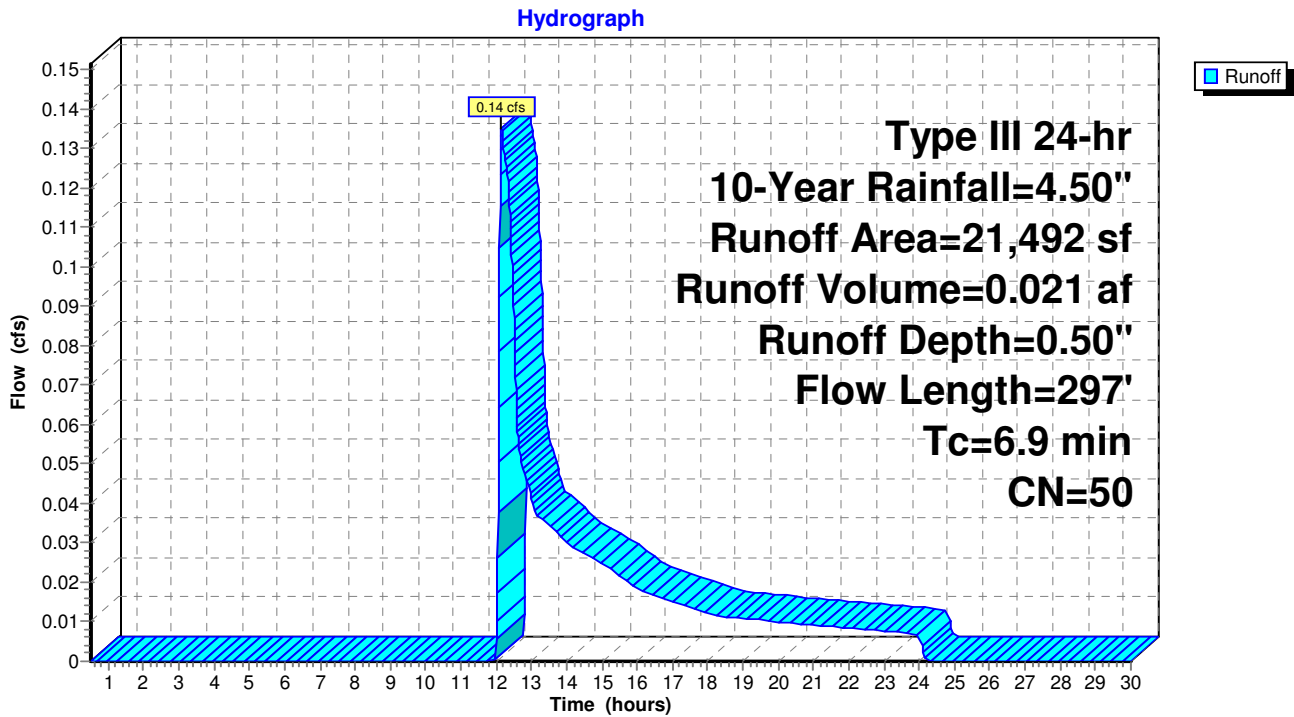Type III 24-hr  10-Year Rainfall=4.50"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,954 | 98 | Roof (portion) |
| * | 587 | 98 | Garage |
| * | 2,392 | 98 | Bit. Driveway |
| * | 214 | 98 | Landing/Walks/Steps |
| * | 27 | 98 | Ret. Wall |
| | 10,400 | 32 | Woods/grass comb., Good, HSG A |
| | 5,918 | 39 | >75% Grass cover, Good, HSG A |
| | 21,492 | 50 | Weighted Average |
| | 16,318 | | 75.93% Pervious Area |
| | 5,174 | | 24.07% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.2 | 13 | 0.0692 | 0.18 | | **Sheet Flow, Segment: A - B** |
| | | | | | Grass: Short   n= 0.150   P2= 3.10" |
| 0.3 | 27 | 0.0407 | 1.38 | | **Sheet Flow, Segmend: B - C** |
| | | | | | Smooth surfaces   n= 0.011   P2= 3.10" |
| 1.3 | 10 | 0.0310 | 0.13 | | **Sheet Flow, Segment: C - D** |
| | | | | | Grass: Short   n= 0.150   P2= 3.10" |
| 0.4 | 24 | 0.0251 | 1.11 | | **Shallow Concentrated Flow, Segment: D - E** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.0 | 3 | 0.0251 | 3.22 | | **Shallow Concentrated Flow, Segment: E - F** |
| | | | | | Paved   Kv= 20.3 fps |
| 0.4 | 46 | 0.0720 | 1.88 | | **Shallow Concentrated Flow, Segment: F - G** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.1 | 20 | 0.0490 | 4.49 | | **Shallow Concentrated Flow, Segment: G - H** |
| | | | | | Paved   Kv= 20.3 fps |
| 0.6 | 77 | 0.0910 | 2.11 | | **Shallow Concentrated Flow, Segment: H - I** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.2 | 19 | 0.0520 | 1.60 | | **Shallow Concentrated Flow, Segment: I - J** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 2.4 | 58 | 0.0034 | 0.41 | | **Shallow Concentrated Flow, Segment: J - K** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 6.9 | 297 | Total | | | |

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## Subcatchment E2: Sub-catchment-2



**Hydrograph**

Type III 24-hr
10-Year Rainfall=4.50"
Runoff Area=21,492 sf
Runoff Volume=0.021 af
Runoff Depth=0.50"
Flow Length=297'
Tc=6.9 min
CN=50

0.14 cfs

Runoff

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## Summary for Subcatchment P1: Sub-catchment-1

Runoff     =     0.01 cfs @  12.28 hrs,  Volume=     0.001 af,  Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  10-Year Rainfall=4.50"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 228 | 98 | Landing/Walks |
| | 1,307 | 39 | >75% Grass cover, Good, HSG A |
| | 1,535 | 48 | Weighted Average |
| | 1,307 | | 85.15% Pervious Area |
| | 228 | | 14.85% Impervious Area |

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

### Subcatchment P1: Sub-catchment-1



**Hydrograph**

□ Runoff

**Type III 24-hr
10-Year Rainfall=4.50"
Runoff Area=1,535 sf
Runoff Volume=0.001 af
Runoff Depth=0.41"
Tc=5.0 min
CN=48**

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## Summary for Subcatchment P2: Sub-catchment-2

Runoff     =       0.02 cfs @  12.45 hrs,  Volume=          0.006 af,  Depth= 0.23"
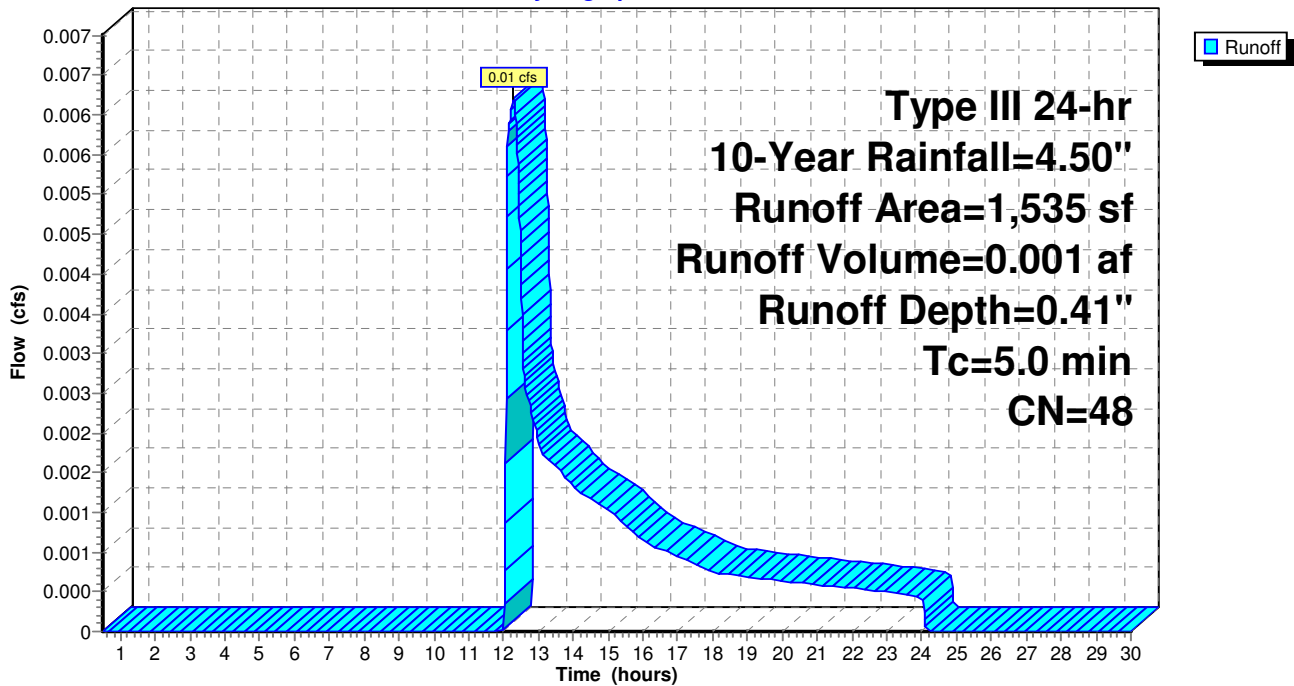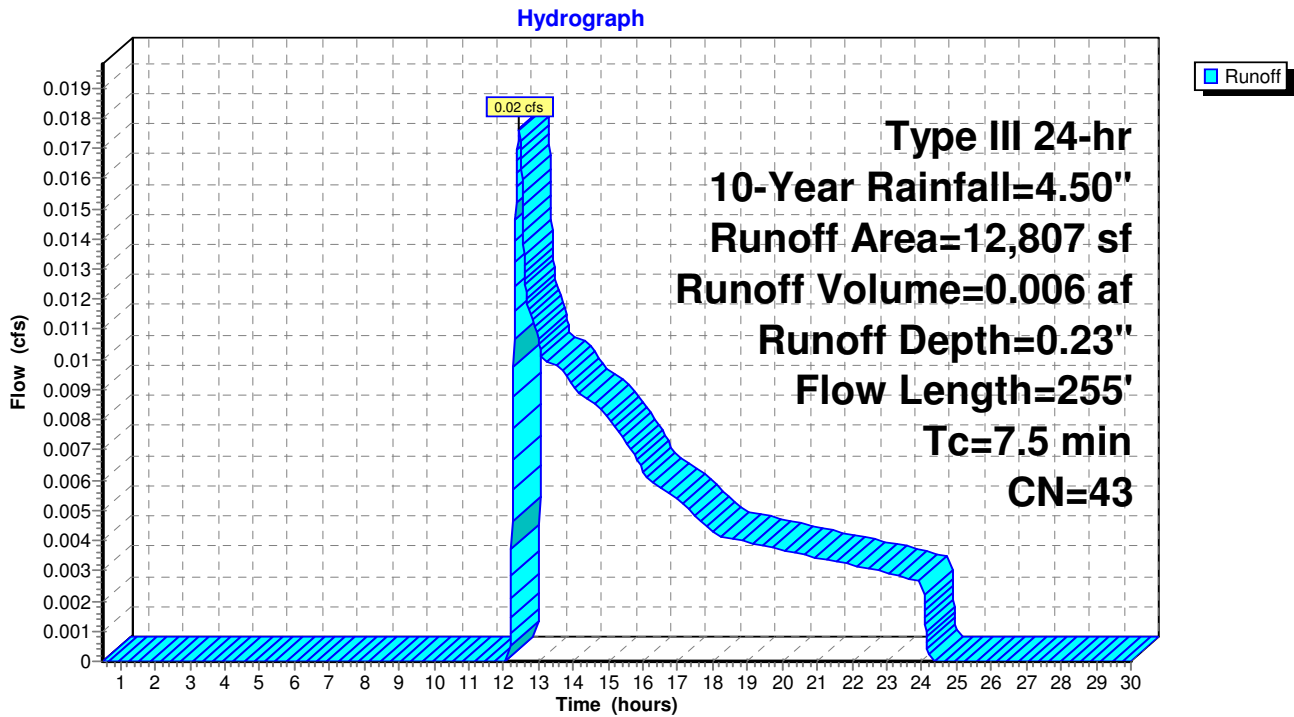
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  10-Year Rainfall=4.50"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 394 | 98 | Paved Driveway (portion) |
| * | 212 | 98 | Landing/Walks/Steps |
| * | 182 | 98 | Ret. Wall |
| | 12,019 | 39 | >75% Grass cover, Good, HSG A |
| | 12,807 | 43 | Weighted Average |
| | 12,019 | | 93.85% Pervious Area |
| | 788 | | 6.15% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.2 | 50 | 0.0250 | 0.16 | | **Sheet Flow, Segment: A - B** |
| | | | | | Grass: Short   n= 0.150   P2= 3.10" |
| 0.2 | 16 | 0.0250 | 1.11 | | **Shallow Concentrated Flow, Segment: B - C** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.2 | 21 | 0.0480 | 1.53 | | **Shallow Concentrated Flow, Segment: C -D** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.4 | 54 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, Segment: D - E** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.3 | 25 | 0.0400 | 1.40 | | **Shallow Concentrated Flow, Segment: E - F** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.2 | 28 | 0.0714 | 1.87 | | **Shallow Concentrated Flow, Segment: F - G** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.9 | 51 | 0.0196 | 0.98 | | **Shallow Concentrated Flow, Segment: G - H** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.1 | 10 | 0.0500 | 1.57 | | **Shallow Concentrated Flow, Segment: H - I** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 7.5 | 255 | Total | | | |

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## Subcatchment P2: Sub-catchment-2

**Hydrograph**



Type III 24-hr
10-Year Rainfall=4.50"
Runoff Area=12,807 sf
Runoff Volume=0.006 af
Runoff Depth=0.23"
Flow Length=255'
Tc=7.5 min
CN=43

□ Runoff

0.02 cfs

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## Summary for Subcatchment PD: Driveway

Runoff      =        0.33 cfs @   12.07 hrs,  Volume=           0.023 af,  Depth= 2.64"
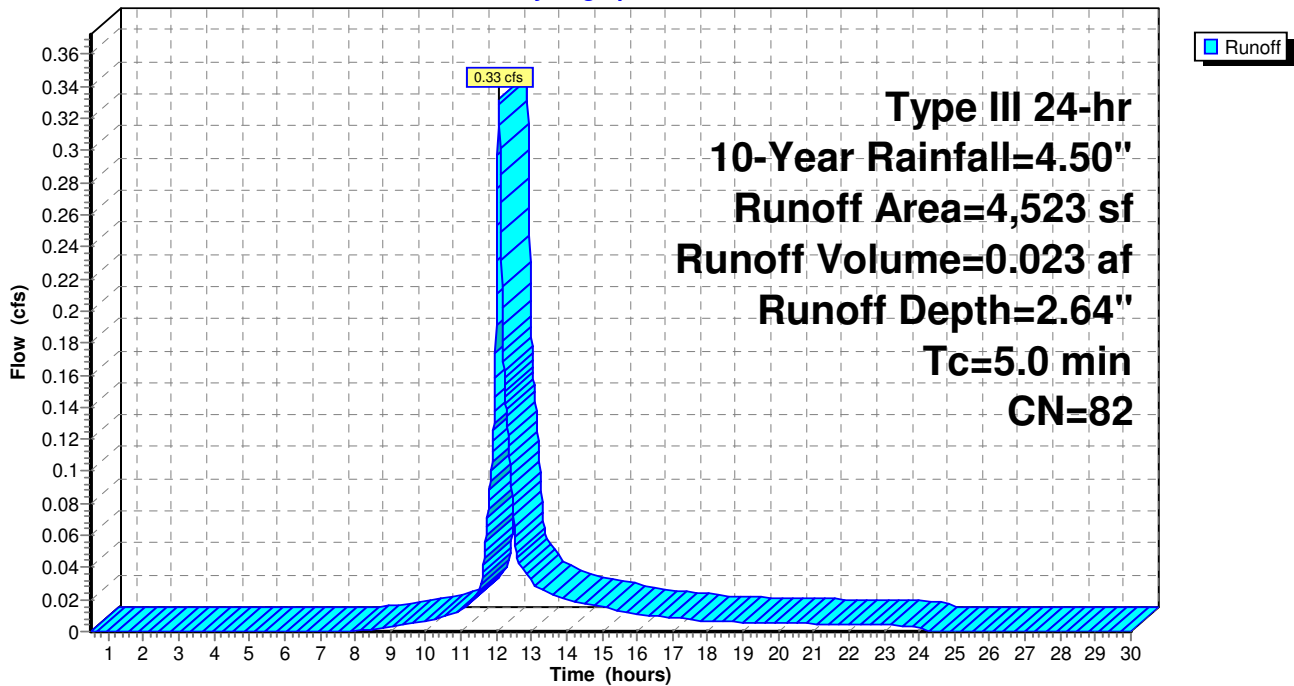
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  10-Year Rainfall=4.50"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 3,073 | 98 | Paved Driveway |
| * | 228 | 98 | Ret. Wall |
| * | 32 | 98 | Walks |
| | 1,190 | 39 | >75% Grass cover, Good, HSG A |
| | 4,523 | 82 | Weighted Average |
| | 1,190 | | 26.31% Pervious Area |
| | 3,333 | | 73.69% Impervious Area |

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

### Subcatchment PD: Driveway

**Hydrograph**



Type III 24-hr
10-Year Rainfall=4.50"
Runoff Area=4,523 sf
Runoff Volume=0.023 af
Runoff Depth=2.64"
Tc=5.0 min
CN=82

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## Summary for Subcatchment PR1: Roof-1

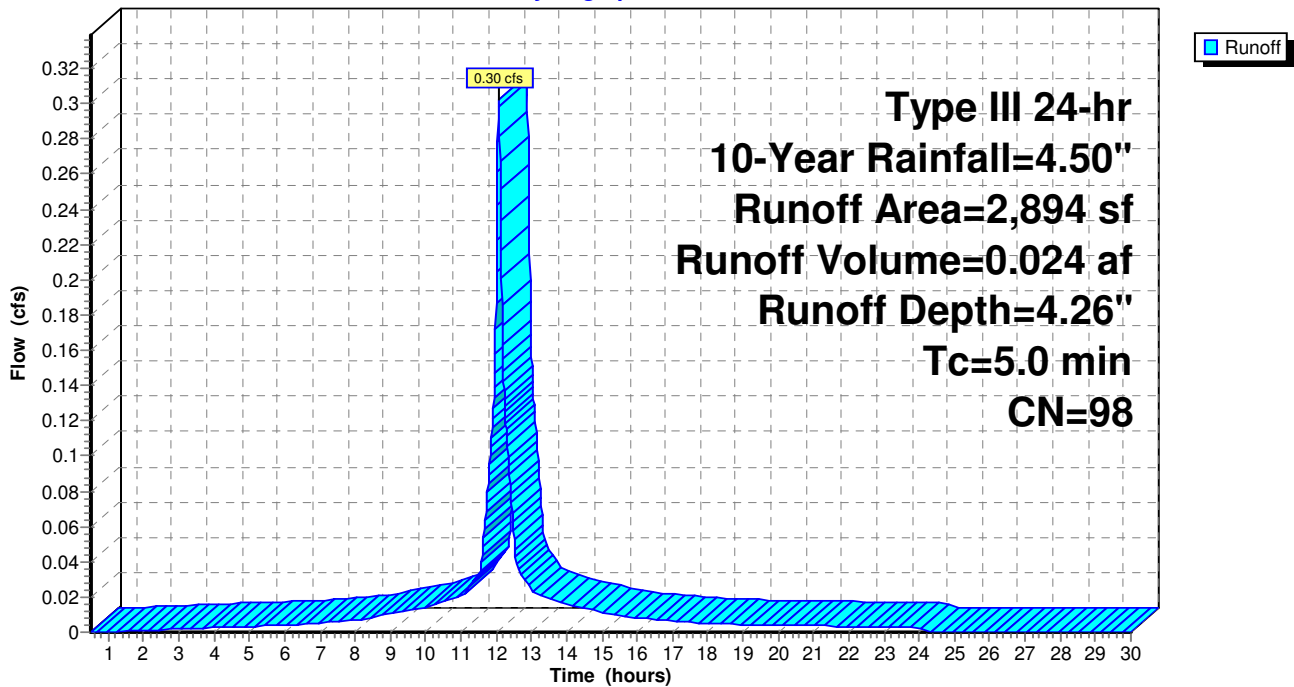Runoff     =        0.30 cfs @  12.07 hrs,  Volume=            0.024 af,  Depth=  4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  10-Year Rainfall=4.50"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 2,894 | 98 | Ex. Roof |
| | 2,894 | | 100.00% Impervious Area |

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

### Subcatchment PR1: Roof-1

**Hydrograph**

## Summary for Subcatchment PR2: Roof-2

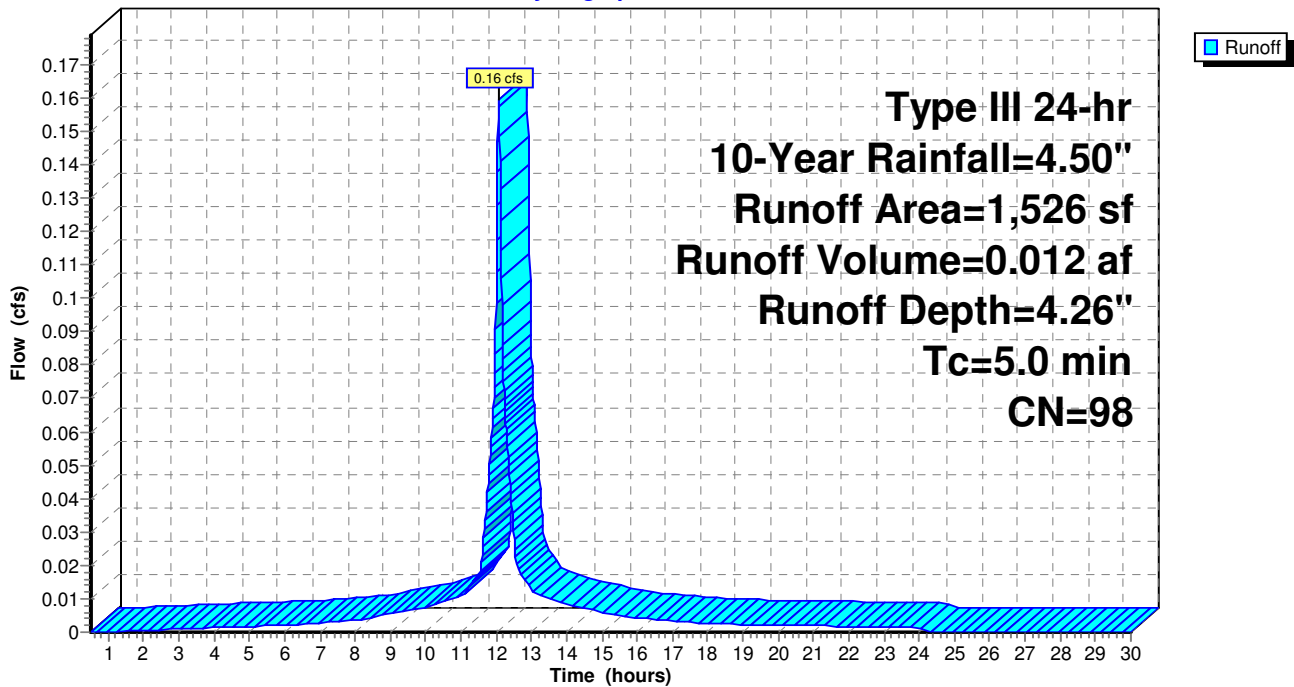Runoff      =          0.16 cfs @   12.07 hrs,  Volume=          0.012 af,  Depth=  4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  10-Year Rainfall=4.50"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,526 | 98 | Ex. Roof |
| | 1,526 | | 100.00% Impervious Area |

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

### Subcatchment PR2: Roof-2

**Hydrograph**



Type III 24-hr
10-Year Rainfall=4.50"
Runoff Area=1,526 sf
Runoff Volume=0.012 af
Runoff Depth=4.26"
Tc=5.0 min
CN=98

## Summary for Subcatchment PR3: Roof-3

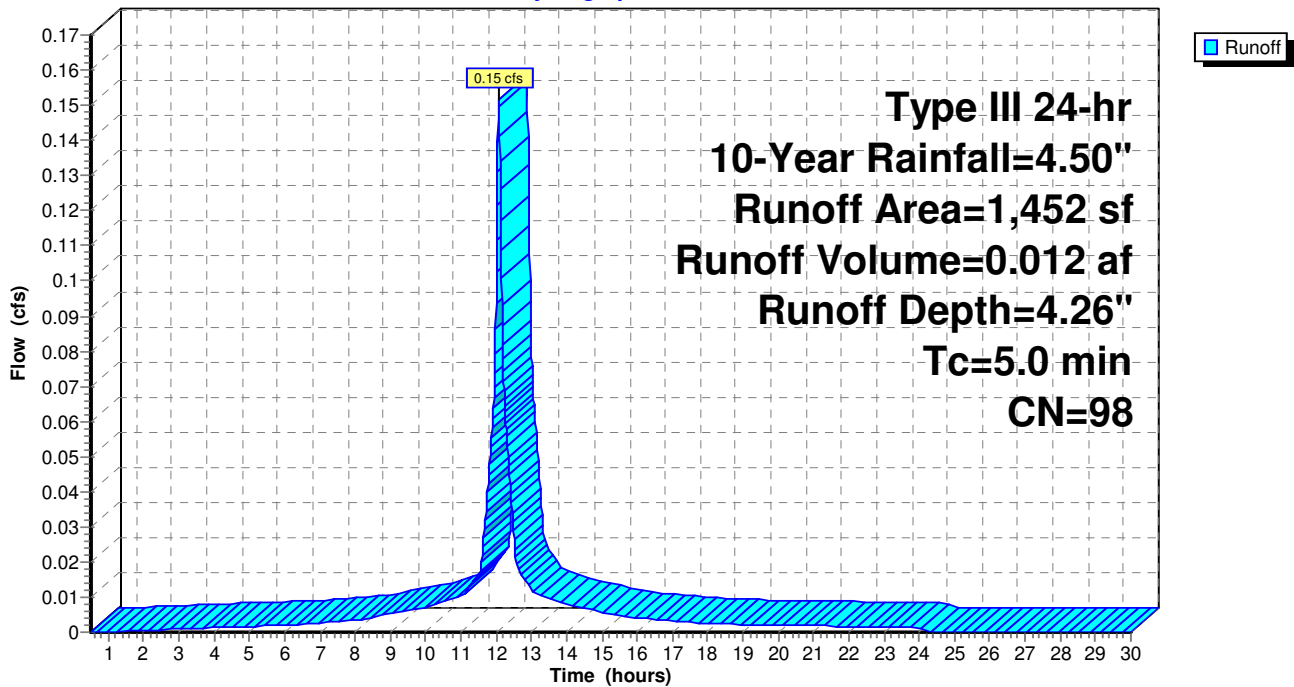Runoff      =        0.15 cfs @   12.07 hrs,  Volume=         0.012 af,  Depth=  4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  10-Year Rainfall=4.50"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,452 | 98 | Ex. Roof |
| | 1,452 | | 100.00% Impervious Area |

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

### Subcatchment PR3: Roof-3

**Hydrograph**

## Summary for Subcatchment PR4: Roof-4

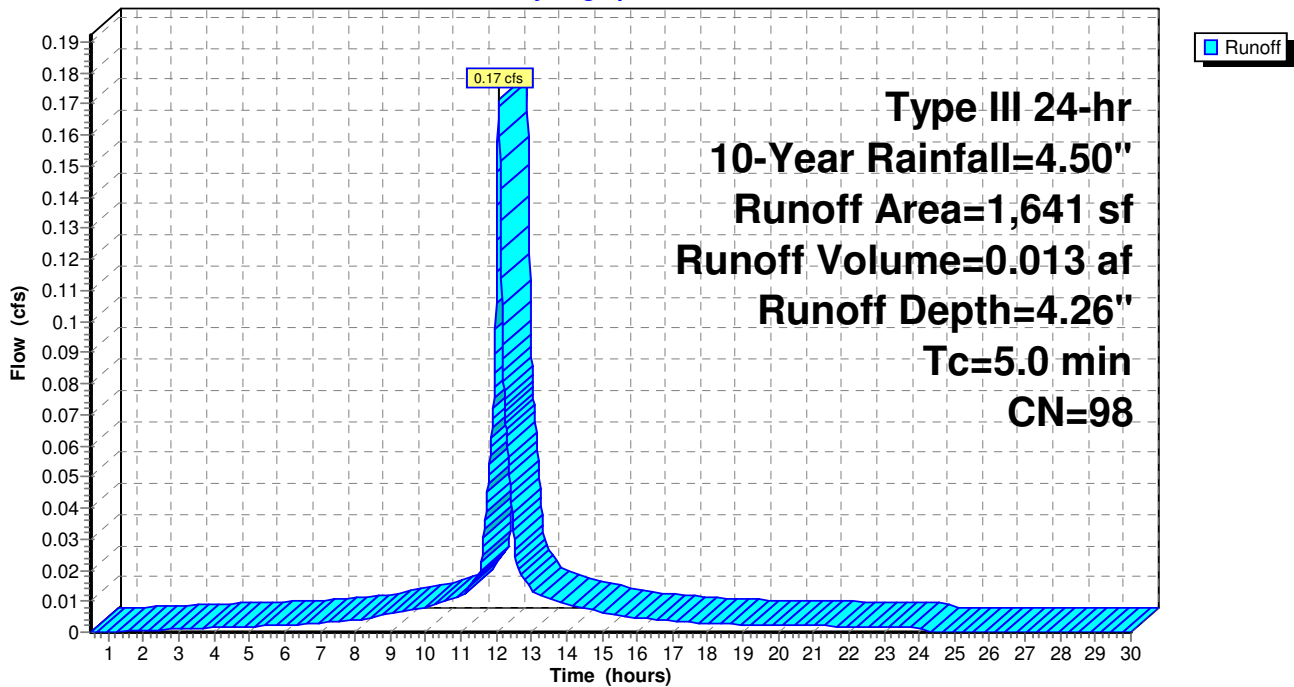Runoff      =        0.17 cfs @   12.07 hrs,  Volume=        0.013 af,  Depth=  4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  10-Year Rainfall=4.50"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,641 | 98 | Ex. Roof |
| | 1,641 | | 100.00% Impervious Area |

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

### Subcatchment PR4: Roof-4

**Hydrograph**



Type III 24-hr
10-Year Rainfall=4.50"
Runoff Area=1,641 sf
Runoff Volume=0.013 af
Runoff Depth=4.26"
Tc=5.0 min
CN=98

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## Summary for Pond INF-1: Inf. System #1 Stormtech MC-3500

Inflow Area =        0.066 ac,100.00% Impervious,  Inflow Depth =  4.26"    for  10-Year event
Inflow       =      0.30 cfs @  12.07 hrs, Volume=          0.024 af
Outflow     =      0.02 cfs @  11.49 hrs, Volume=          0.024 af, Atten= 92%, Lag= 0.0 min
Discarded =      0.02 cfs @  11.49 hrs, Volume=          0.024 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 152.99' @ 13.04 hrs   Surf.Area= 0.009 ac   Storage= 0.009 af

Plug-Flow detention time= 117.0 min calculated for 0.024 af (100% of inflow)
Center-of-Mass det. time= 116.9 min ( 865.8 - 748.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 151.25' | 0.012 af | **8.42'W x 48.72'L x 5.25'H Field A**<br>0.049 af Overall - 0.016 af Embedded = 0.034 af  x 35.0% Voids |
| #2A | 152.25' | 0.016 af | **ADS_StormTech MC-3500 d +Cap**  x 6  Inside #1<br>Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf<br>Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap<br>Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf |
| | | 0.028 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 151.25' | **2.410 in/hr Exfiltration over Surface area**     Phase-In= 0.01' |

**Discarded OutFlow**  Max=0.02 cfs @ 11.49 hrs  HW=151.30'   (Free Discharge)
└—**1=Exfiltration**  (Exfiltration Controls 0.02 cfs)

## Pond INF-1: Inf. System #1 Stormtech MC-3500 - Chamber Wizard Field A

**Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)**
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf

6 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 46.72' Row Length +12.0" End Stone x 2 = 48.72'
Base Length
1 Rows x 77.0" Wide + 12.0" Side Stone x 2 = 8.42' Base Width
12.0" Base + 45.0" Chamber Height + 6.0" Cover = 5.25' Field Height

6 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 1 Rows = 689.5 cf Chamber Storage

2,152.8 cf Field - 689.5 cf Chambers = 1,463.3 cf Stone x 35.0% Voids = 512.2 cf Stone Storage

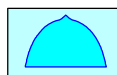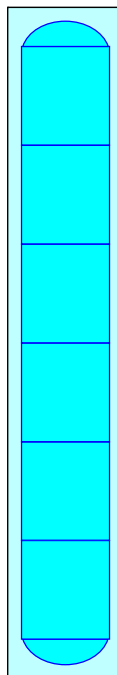Chamber Storage + Stone Storage = 1,201.7 cf = 0.028 af
Overall Storage Efficiency = 55.8%
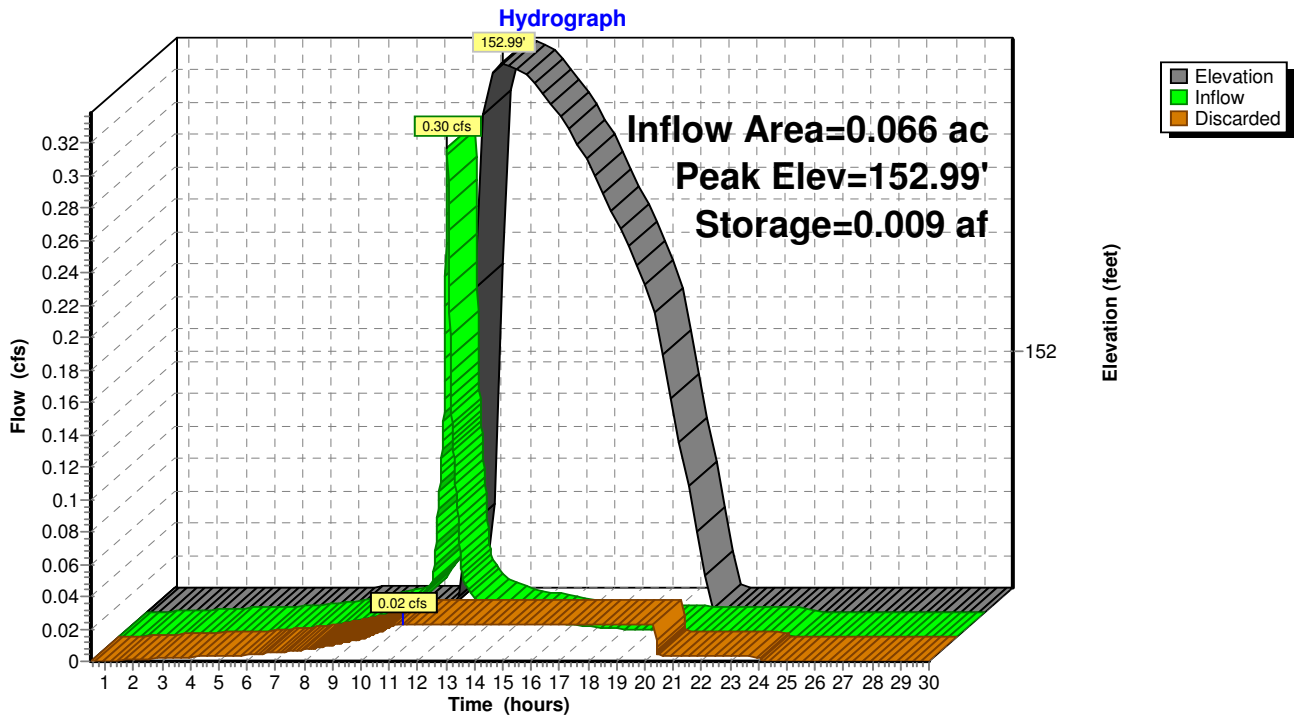Overall System Size = 48.72' x 8.42' x 5.25'

6 Chambers
79.7 cy Field
54.2 cy Stone

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## Pond INF-1: Inf. System #1 Stormtech MC-3500



**Inflow Area=0.066 ac**
**Peak Elev=152.99'**
**Storage=0.009 af**

### Summary for Pond INF-2: Inf. System #2 Stormtech MC-3500

Inflow Area =        0.068 ac,100.00% Impervious,  Inflow Depth =  4.26"    for  10-Year event
Inflow      =      0.31 cfs @  12.07 hrs, Volume=          0.024 af
Outflow    =      0.02 cfs @  11.46 hrs, Volume=          0.024 af, Atten= 93%, Lag= 0.0 min
Discarded =      0.02 cfs @  11.46 hrs, Volume=          0.024 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 153.04' @ 13.08 hrs   Surf.Area= 0.009 ac   Storage= 0.009 af

Plug-Flow detention time= 123.0 min calculated for 0.024 af (100% of inflow)
Center-of-Mass det. time= 123.0 min ( 871.9 - 748.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 151.25' | 0.012 af | **8.42'W x 48.72'L x 5.25'H Field A** |
|  |  |  | 0.049 af Overall - 0.016 af Embedded = 0.034 af  x 35.0% Voids |
| #2A | 152.25' | 0.016 af | **ADS_StormTech MC-3500 d +Cap**  x 6  Inside #1 |
|  |  |  | Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf |
|  |  |  | Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap |
|  |  |  | Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf |
|  |  | 0.028 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 151.25' | **2.410 in/hr Exfiltration over Surface area**    Phase-In= 0.01' |

**Discarded OutFlow**  Max=0.02 cfs @ 11.46 hrs  HW=151.30'   (Free Discharge)
└─**1=Exfiltration**  (Exfiltration Controls 0.02 cfs)

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## Pond INF-2: Inf. System #2 Stormtech MC-3500 - Chamber Wizard Field A

**Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)**
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf

6 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 46.72' Row Length +12.0" End Stone x 2 = 48.72' Base Length
1 Rows x 77.0" Wide + 12.0" Side Stone x 2 = 8.42' Base Width
12.0" Base + 45.0" Chamber Height + 6.0" Cover = 5.25' Field Height

6 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 1 Rows = 689.5 cf Chamber Storage

2,152.8 cf Field - 689.5 cf Chambers = 1,463.3 cf Stone x 35.0% Voids = 512.2 cf Stone Storage
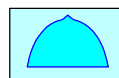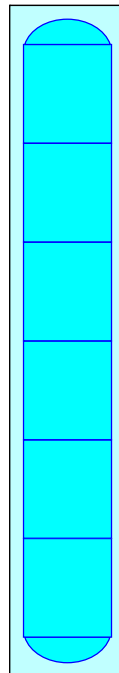
Chamber Storage + Stone Storage = 1,201.7 cf = 0.028 af
Overall Storage Efficiency = 55.8%
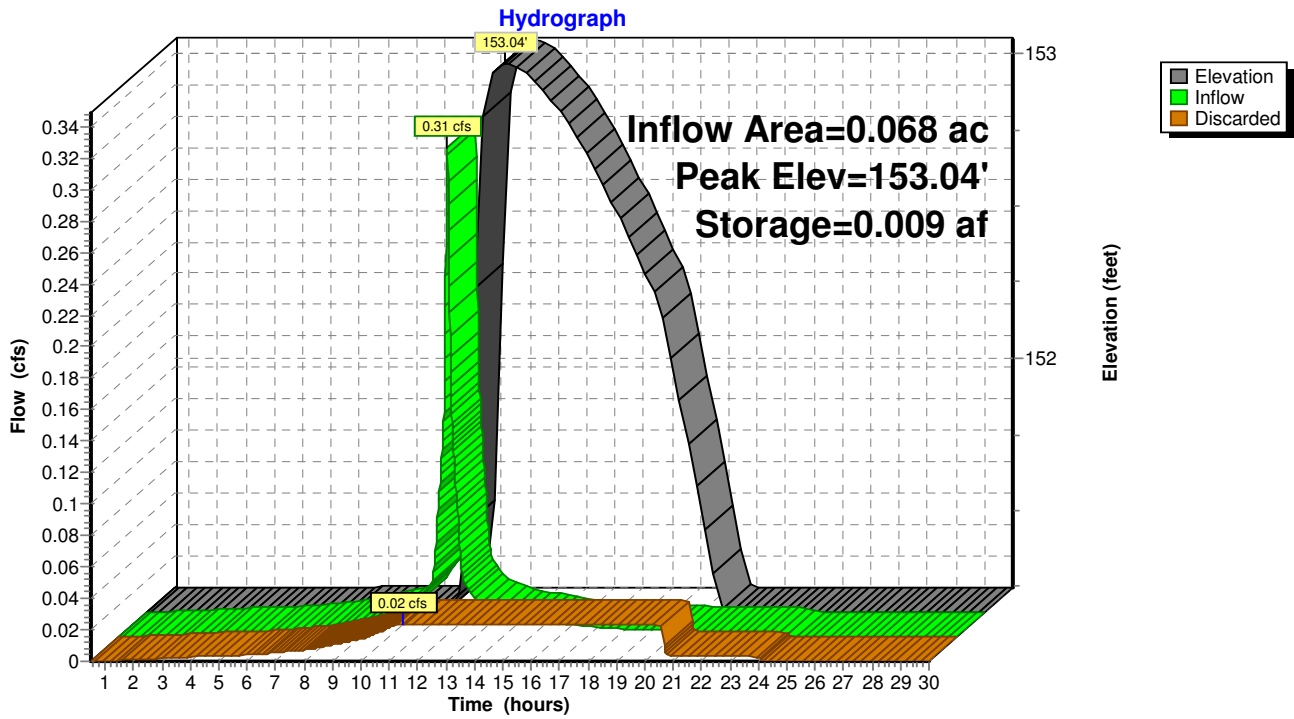Overall System Size = 48.72' x 8.42' x 5.25'

6 Chambers
79.7 cy Field
54.2 cy Stone

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## Pond INF-2: Inf. System #2 Stormtech MC-3500



**Hydrograph**

Inflow Area=0.068 ac
Peak Elev=153.04'
Storage=0.009 af

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## Summary for Pond INF-3: Inf. System #3 Ameration Chamber

Inflow Area =          0.038 ac,100.00% Impervious,  Inflow Depth =  4.26"    for  10-Year event
Inflow      =      0.17 cfs @  12.07 hrs, Volume=          0.013 af
Outflow    =      0.03 cfs @  11.71 hrs, Volume=          0.013 af, Atten= 85%, Lag= 0.0 min
Discarded =      0.03 cfs @  11.71 hrs, Volume=          0.013 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 149.15' @ 12.54 hrs   Surf.Area= 0.011 ac   Storage= 0.004 af

Plug-Flow detention time= 32.2 min calculated for 0.013 af (100% of inflow)
Center-of-Mass det. time= 32.2 min ( 781.1 - 748.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 148.40' | 0.005 af | **13.00'W x 36.00'L x 2.17'H Field A**<br>0.023 af Overall - 0.010 af Embedded = 0.014 af  x 35.0% Voids |
| #2A | 148.90' | 0.006 af | **Concrete Galley  4x8x1.7**  x 8  Inside #1<br>Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf<br>Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf<br>2 Rows of 4 Chambers |
| | | 0.010 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 148.40' | **2.410 in/hr Exfiltration over Surface area**     Phase-In= 0.01' |

**Discarded OutFlow**  Max=0.03 cfs @ 11.71 hrs  HW=148.42'   (Free Discharge)
└─**1=Exfiltration**  (Exfiltration Controls 0.03 cfs)

**Pond INF-3: Inf. System #3 Ameration Chamber - Chamber Wizard Field A**

**Chamber Model = Concrete Galley  4x8x1.7 (Ameration Chamber, NEPCA LE-AC  or equivalent)**
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

48.0" Wide + 12.0" Spacing = 60.0" C-C Row Spacing

4 Chambers/Row x 8.00' Long = 32.00' Row Length +24.0" End Stone x 2 = 36.00' Base Length
2 Rows x 48.0" Wide + 12.0" Spacing x 1 + 24.0" Side Stone x 2 = 13.00' Base Width
6.0" Base + 20.0" Chamber Height = 2.17' Field Height

8 Chambers x 30.3 cf = 242.3 cf Chamber Storage
8 Chambers x 51.9 cf = 415.3 cf Displacement

1,015.6 cf Field - 415.3 cf Chambers = 600.3 cf Stone x 35.0% Voids = 210.1 cf Stone Storage
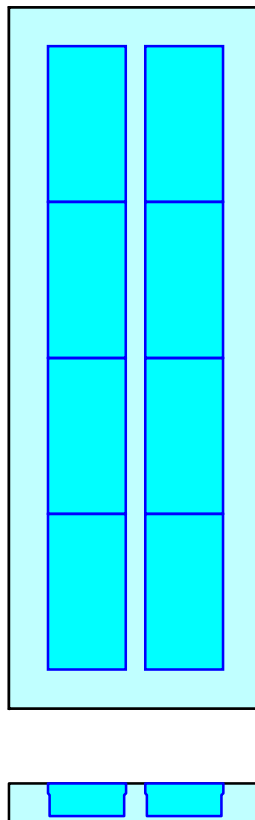
Chamber Storage + Stone Storage = 452.4 cf = 0.010 af
Overall Storage Efficiency = 44.5%
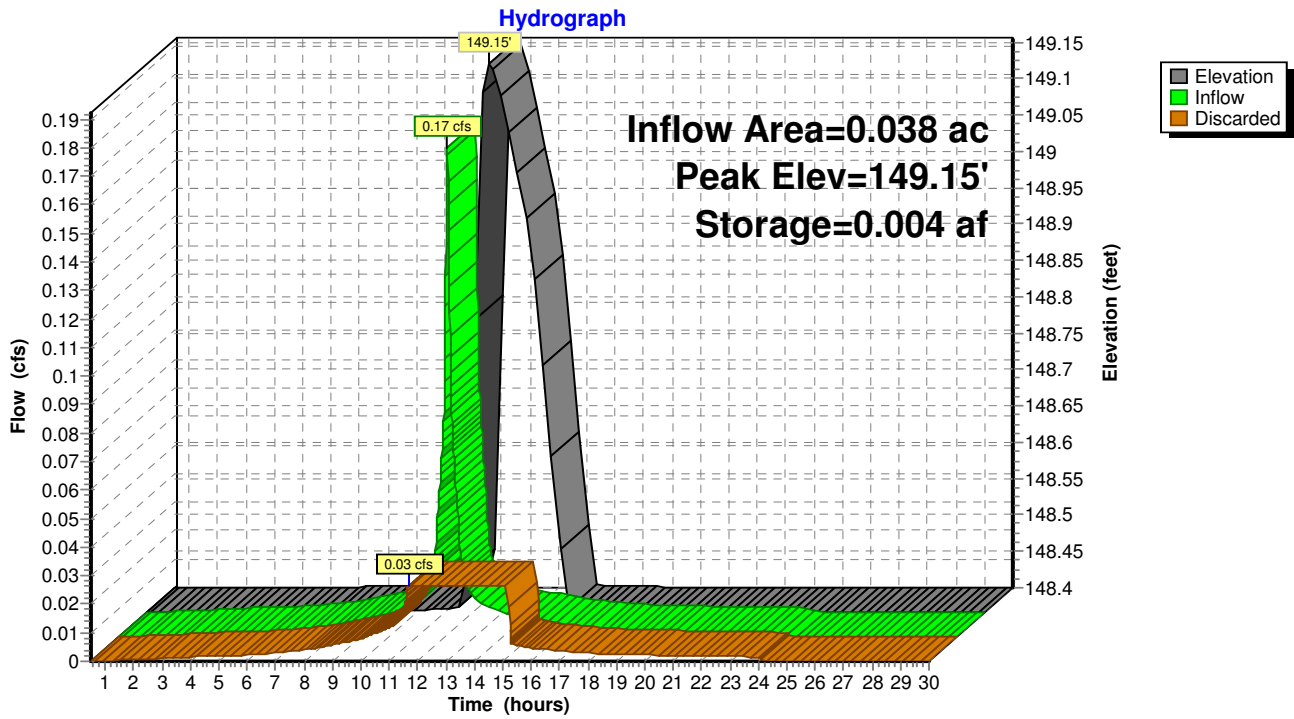Overall System Size = 36.00' x 13.00' x 2.17'

8 Chambers
37.6 cy Field
22.2 cy Stone

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## Pond INF-3: Inf. System #3 Ameration Chamber



**Hydrograph**

Inflow Area=0.038 ac
Peak Elev=149.15'
Storage=0.004 af

### Summary for Pond INF-4: Inf. System #4 Ameration Chamber

Inflow Area =     0.104 ac, 73.69% Impervious, Inflow Depth = 2.64"    for 10-Year event
Inflow    =   0.33 cfs @ 12.07 hrs, Volume=        0.023 af
Outflow   =   0.05 cfs @ 12.55 hrs, Volume=        0.023 af, Atten= 84%, Lag= 28.8 min
Discarded =   0.03 cfs @ 11.65 hrs, Volume=        0.021 af
Secondary =   0.03 cfs @ 12.55 hrs, Volume=        0.001 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 150.01' @ 12.55 hrs   Surf.Area= 473 sf   Storage= 360 cf

Plug-Flow detention time= 103.9 min calculated for 0.023 af (100% of inflow)
Center-of-Mass det. time= 103.8 min ( 923.6 - 819.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 148.40' | 260 cf | **11.00'W x 43.00'L x 2.67'H Field A**<br>1,263 cf Overall - 519 cf Embedded = 744 cf x 35.0% Voids |
| #2A | 149.40' | 303 cf | **Concrete Galley 4x8x1.7** x 10 Inside #1<br>Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf<br>Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf<br>2 Rows of 5 Chambers |
| | | 563 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 148.40' | **2.410 in/hr Exfiltration over Surface area**    Phase-In= 0.01' |
| #2 | Secondary | 149.90' | **6.0" Round Overflow**<br>L= 91.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 149.90' / 149.44'  S= 0.0051 '/'  Cc= 0.900<br>n= 0.012, Flow Area= 0.20 sf |

**Discarded OutFlow** Max=0.03 cfs @ 11.65 hrs  HW=148.43'  (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

**Secondary OutFlow** Max=0.03 cfs @ 12.55 hrs  HW=150.01' TW=0.00'  (Dynamic Tailwater)
└─**2=Overflow** (Barrel Controls 0.03 cfs @ 1.22 fps)

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## Pond INF-4: Inf. System #4 Ameration Chamber - Chamber Wizard Field A

**Chamber Model = Concrete Galley  4x8x1.7 (Ameration Chamber, NEPCA LE-AC  or equivalent)**
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

5 Chambers/Row x 8.00' Long = 40.00' Row Length +18.0" End Stone x 2 = 43.00' Base Length
2 Rows x 48.0" Wide + 18.0" Side Stone x 2 = 11.00' Base Width
12.0" Base + 20.0" Chamber Height = 2.67' Field Height

10 Chambers x 30.3 cf = 302.8 cf Chamber Storage
10 Chambers x 51.9 cf = 519.1 cf Displacement

1,262.9 cf Field - 519.1 cf Chambers = 743.8 cf Stone x 35.0% Voids = 260.3 cf Stone Storage
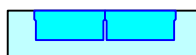
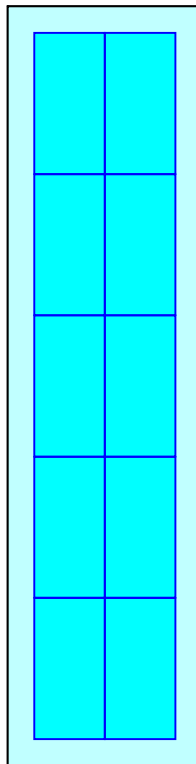Chamber Storage + Stone Storage = 563.2 cf = 0.013 af
Overall Storage Efficiency = 44.6%
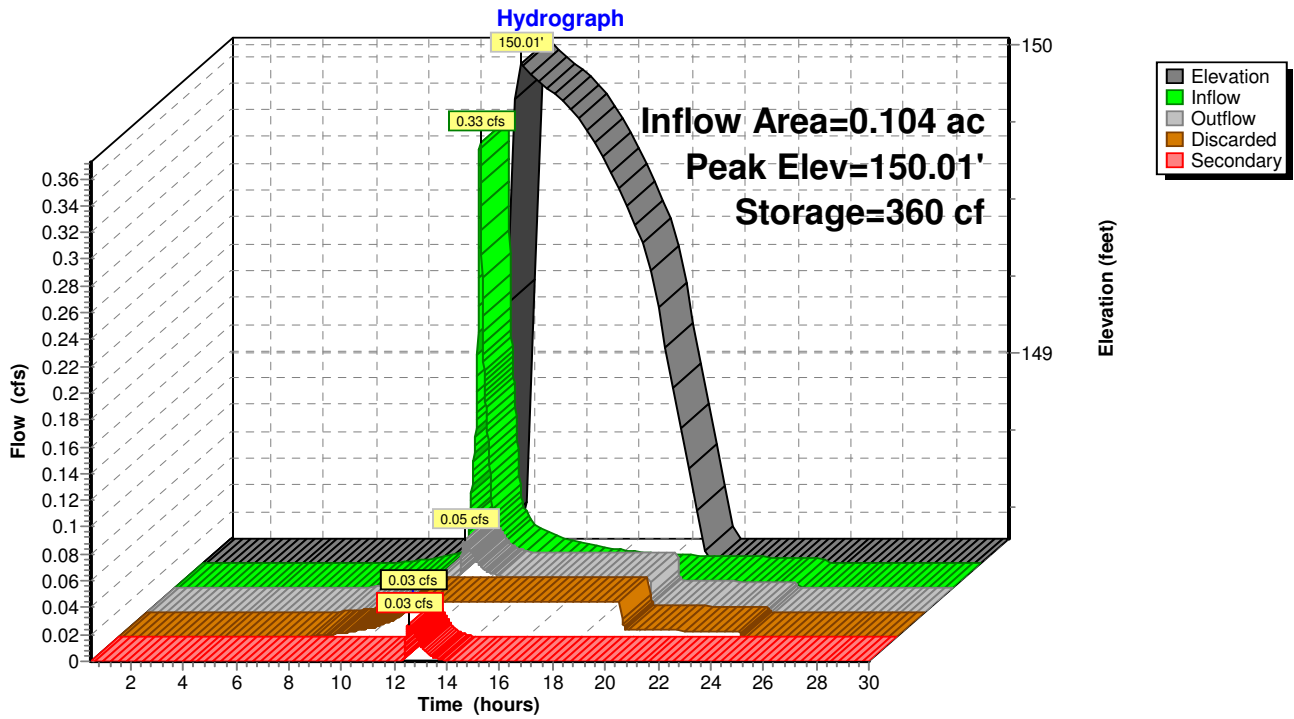Overall System Size = 43.00' x 11.00' x 2.67'

10 Chambers
46.8 cy Field
27.5 cy Stone

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## Pond INF-4: Inf. System #4 Ameration Chamber



**Hydrograph**

Inflow Area=0.104 ac
Peak Elev=150.01'
Storage=360 cf

Legend:
- Elevation
- Inflow
- Outflow
- Discarded
- Secondary

150.01'
0.33 cfs
0.05 cfs
0.03 cfs
0.03 cfs

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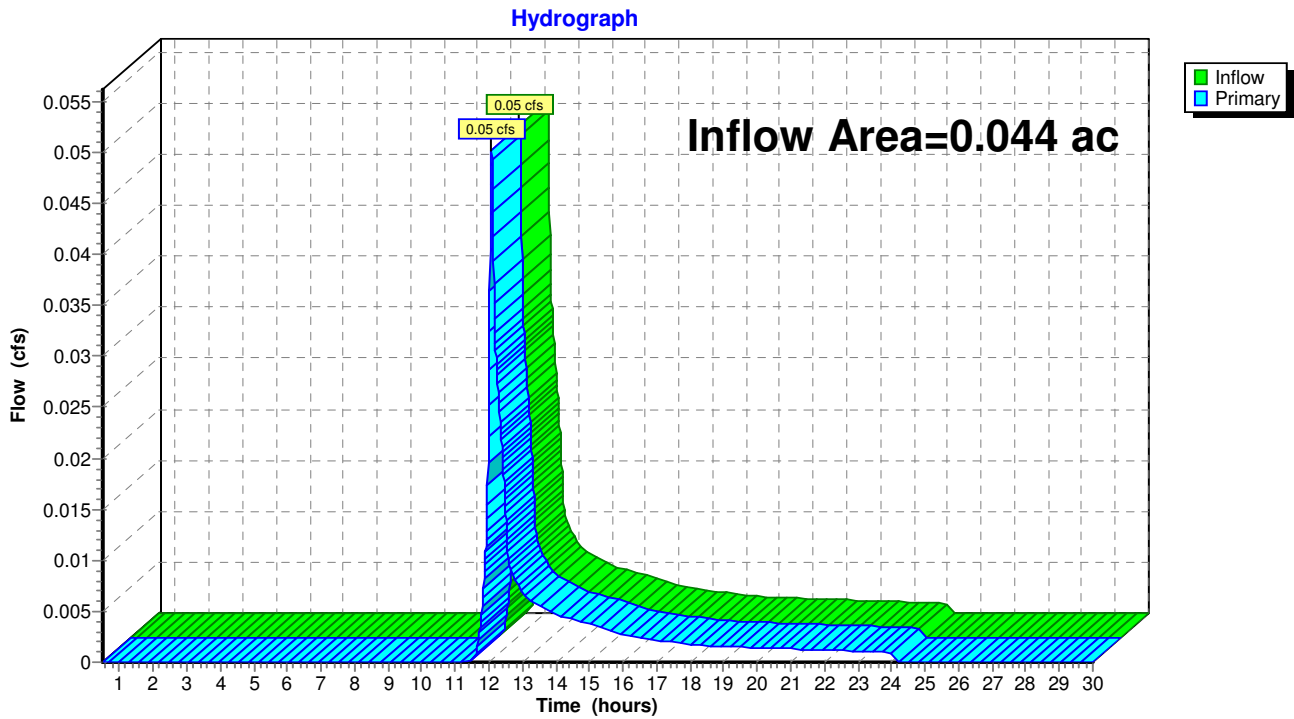Page 52

## Summary for Link POD1: Warren Street (South)

Inflow Area =        0.044 ac,  36.97% Impervious,  Inflow Depth =   1.08"    for  10-Year event
Inflow      =      0.05 cfs @   12.09 hrs,  Volume=           0.004 af
Primary     =      0.05 cfs @   12.09 hrs,  Volume=           0.004 af,  Atten= 0%,  Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD1: Warren Street (South)



**Hydrograph**

Inflow Area=0.044 ac

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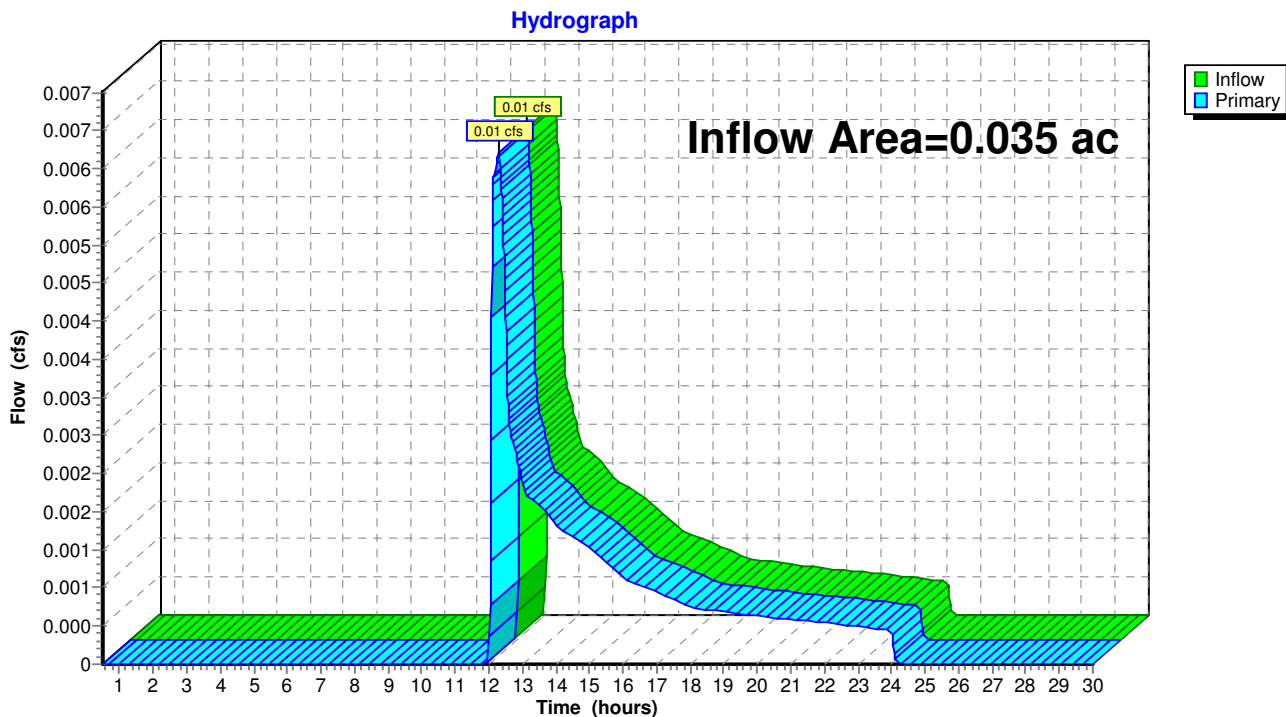Page 53

## Summary for Link POD1.: Warren Street (South)

Inflow Area =        0.035 ac,  14.85% Impervious,  Inflow Depth =  0.41"    for  10-Year event
Inflow      =        0.01 cfs @   12.28 hrs,  Volume=          0.001 af
Primary     =        0.01 cfs @   12.28 hrs,  Volume=          0.001 af,  Atten= 0%,  Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD1.: Warren Street (South)

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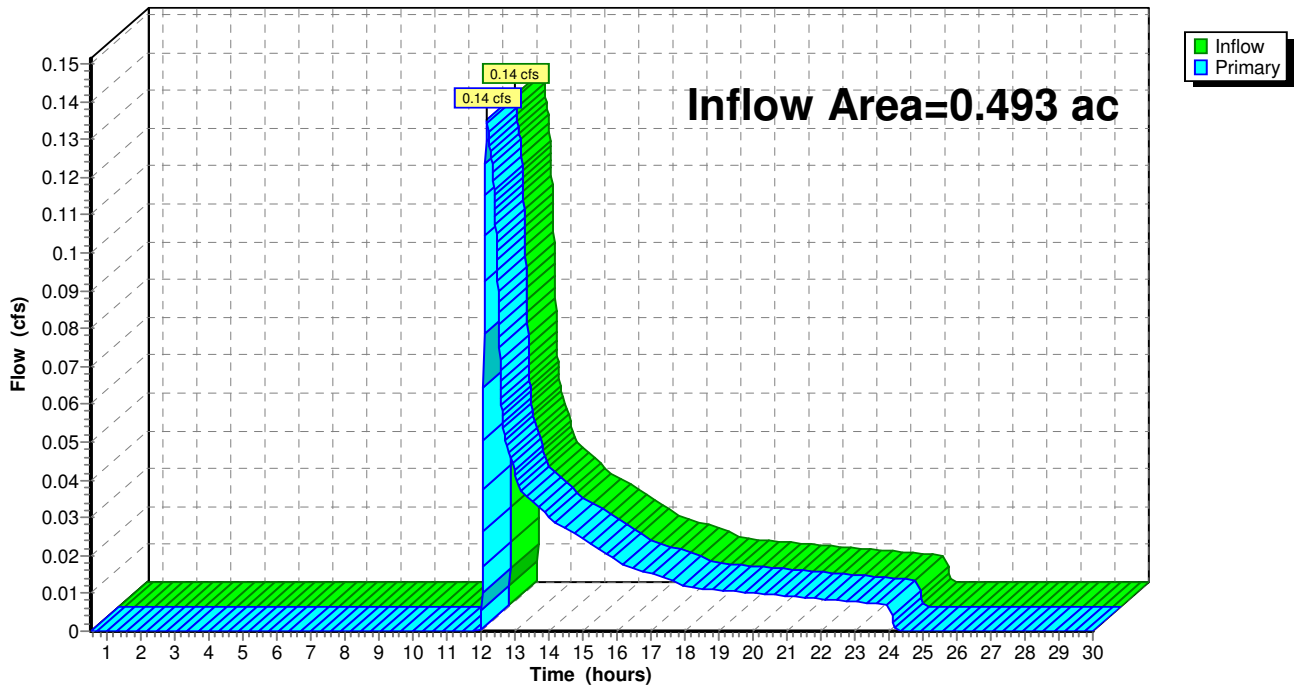Page 54

## Summary for Link POD2: North Abutter (MBTA)

Inflow Area =        0.493 ac,  24.07% Impervious,  Inflow Depth =   0.50"    for  10-Year event
Inflow      =       0.14 cfs @   12.16 hrs,  Volume=         0.021 af
Primary    =       0.14 cfs @   12.16 hrs,  Volume=         0.021 af,  Atten= 0%,  Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD2: North Abutter (MBTA)

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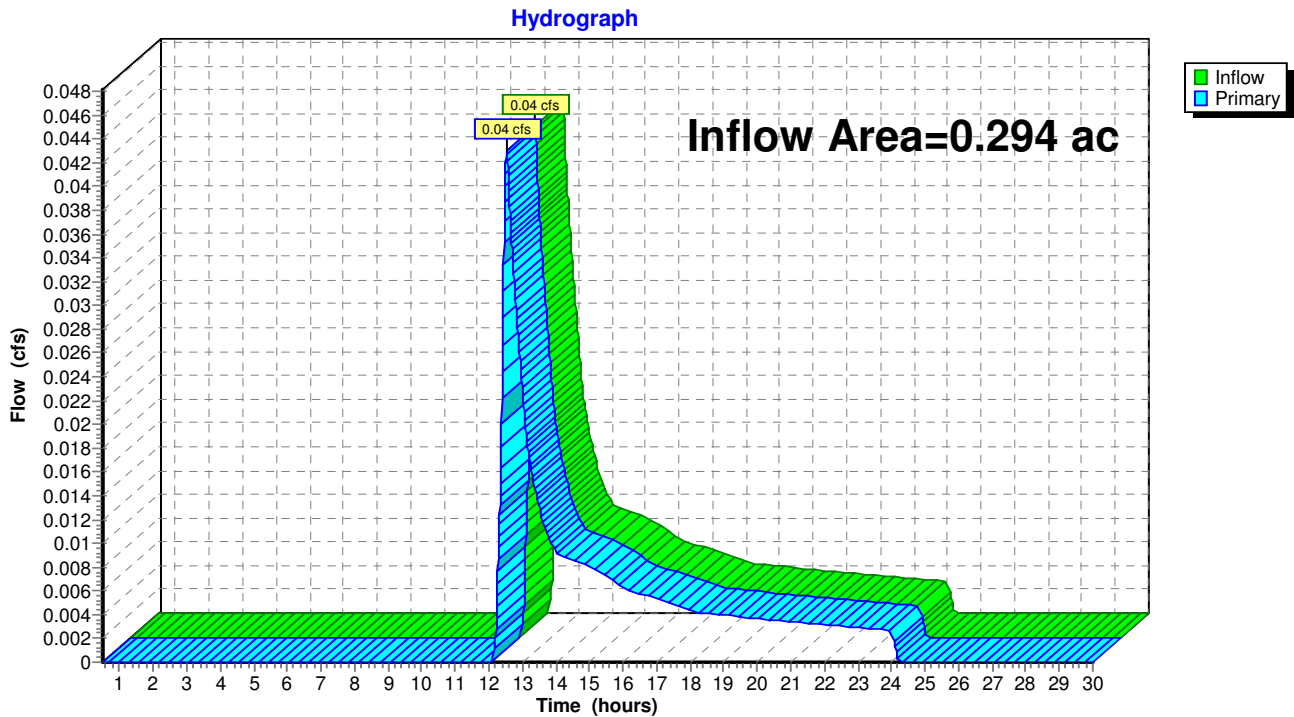Page 55

## Summary for Link POD2.: North Abutter (MBTA)

Inflow Area =      0.294 ac,   6.15% Impervious,  Inflow Depth =  0.28"    for  10-Year event
Inflow      =      0.04 cfs @  12.53 hrs,  Volume=          0.007 af
Primary     =      0.04 cfs @  12.53 hrs,  Volume=          0.007 af,  Atten= 0%,  Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD2.: North Abutter (MBTA)

## Summary for Subcatchment E1: Sub-catchment-1

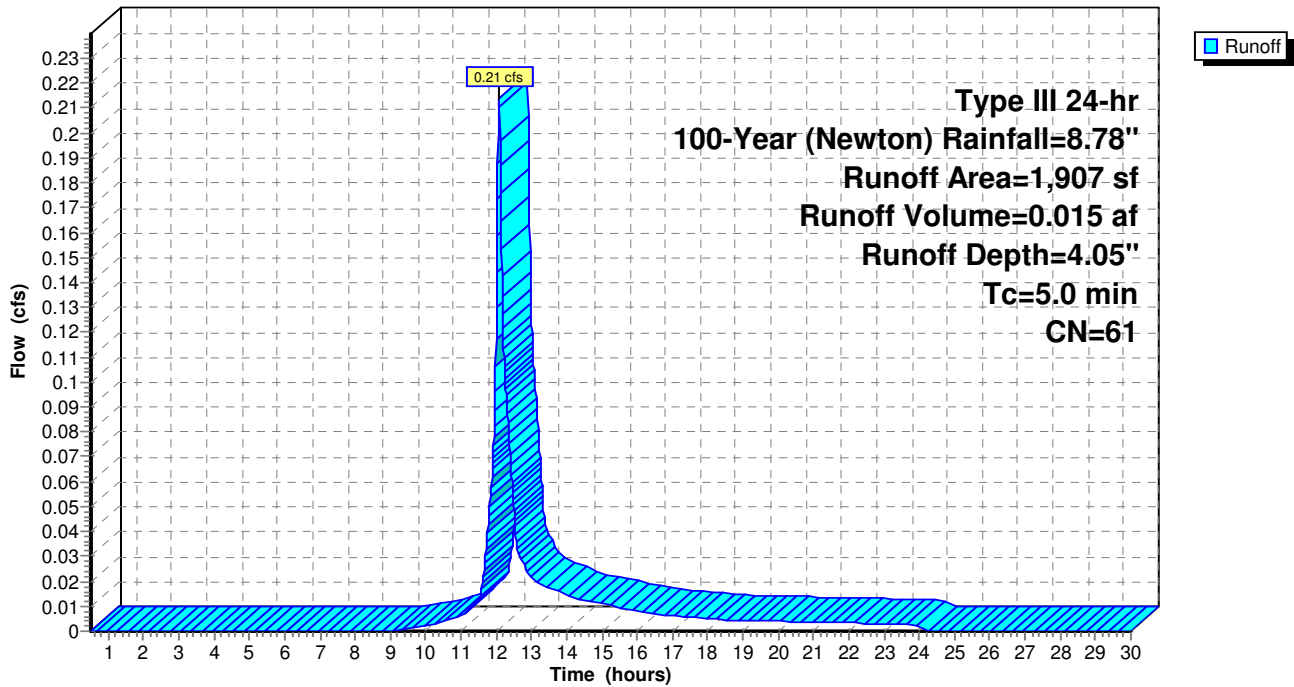Runoff   =   0.21 cfs @  12.08 hrs,  Volume=   0.015 af,  Depth=  4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  100-Year (Newton) Rainfall=8.78"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 472 | 98 | Roof (portion) |
| * | 233 | 98 | Landing/Walks |
| | 1,202 | 39 | >75% Grass cover, Good, HSG A |
| | 1,907 | 61 | Weighted Average |
| | 1,202 | | 63.03% Pervious Area |
| | 705 | | 36.97% Impervious Area |

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

### Subcatchment E1: Sub-catchment-1



**Hydrograph**

Type III 24-hr
100-Year (Newton) Rainfall=8.78"
Runoff Area=1,907 sf
Runoff Volume=0.015 af
Runoff Depth=4.05"
Tc=5.0 min
CN=61

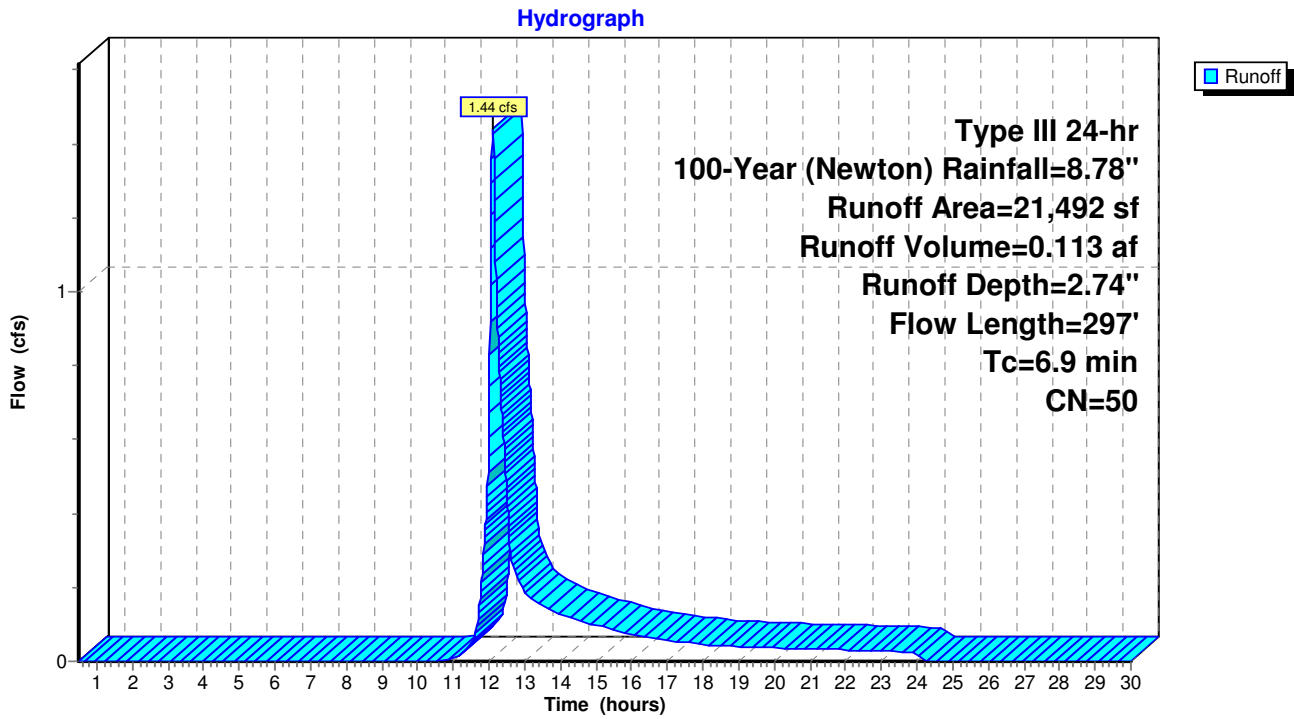## Summary for Subcatchment E2: Sub-catchment-2

Runoff     =        1.44 cfs @  12.11 hrs,  Volume=          0.113 af,  Depth=  2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  100-Year (Newton) Rainfall=8.78"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,954 | 98 | Roof (portion) |
| * | 587 | 98 | Garage |
| * | 2,392 | 98 | Bit. Driveway |
| * | 214 | 98 | Landing/Walks/Steps |
| * | 27 | 98 | Ret. Wall |
| | 10,400 | 32 | Woods/grass comb., Good, HSG A |
| | 5,918 | 39 | >75% Grass cover, Good, HSG A |
| | 21,492 | 50 | Weighted Average |
| | 16,318 | | 75.93% Pervious Area |
| | 5,174 | | 24.07% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.2 | 13 | 0.0692 | 0.18 | | **Sheet Flow, Segment: A - B** |
| | | | | | Grass: Short   n= 0.150   P2= 3.10" |
| 0.3 | 27 | 0.0407 | 1.38 | | **Sheet Flow, Segmend: B - C** |
| | | | | | Smooth surfaces   n= 0.011   P2= 3.10" |
| 1.3 | 10 | 0.0310 | 0.13 | | **Sheet Flow, Segment: C - D** |
| | | | | | Grass: Short   n= 0.150   P2= 3.10" |
| 0.4 | 24 | 0.0251 | 1.11 | | **Shallow Concentrated Flow, Segment: D - E** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.0 | 3 | 0.0251 | 3.22 | | **Shallow Concentrated Flow, Segment: E - F** |
| | | | | | Paved   Kv= 20.3 fps |
| 0.4 | 46 | 0.0720 | 1.88 | | **Shallow Concentrated Flow, Segment: F - G** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.1 | 20 | 0.0490 | 4.49 | | **Shallow Concentrated Flow, Segment: G - H** |
| | | | | | Paved   Kv= 20.3 fps |
| 0.6 | 77 | 0.0910 | 2.11 | | **Shallow Concentrated Flow, Segment: H - I** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.2 | 19 | 0.0520 | 1.60 | | **Shallow Concentrated Flow, Segment: I - J** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 2.4 | 58 | 0.0034 | 0.41 | | **Shallow Concentrated Flow, Segment: J - K** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 6.9 | 297 | Total | | | |

## Subcatchment E2: Sub-catchment-2



**Hydrograph**

Type III 24-hr
100-Year (Newton) Rainfall=8.78"
Runoff Area=21,492 sf
Runoff Volume=0.113 af
Runoff Depth=2.74"
Flow Length=297'
Tc=6.9 min
CN=50

1.44 cfs

Runoff

## Summary for Subcatchment P1: Sub-catchment-1

Runoff     =       0.10 cfs @  12.08 hrs,  Volume=           0.007 af,  Depth=  2.51"
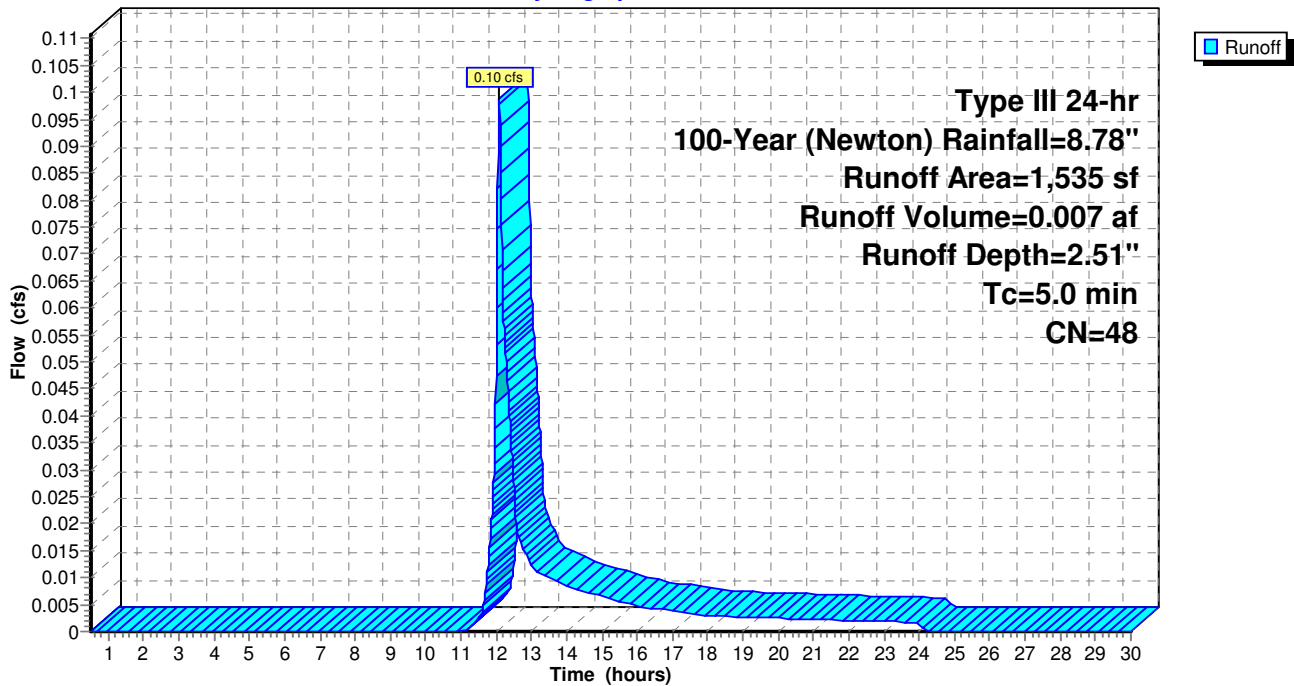
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  100-Year (Newton) Rainfall=8.78"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 228 | 98 | Landing/Walks |
| | 1,307 | 39 | >75% Grass cover, Good, HSG A |
| | 1,535 | 48 | Weighted Average |
| | 1,307 | | 85.15% Pervious Area |
| | 228 | | 14.85% Impervious Area |

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

### Subcatchment P1: Sub-catchment-1

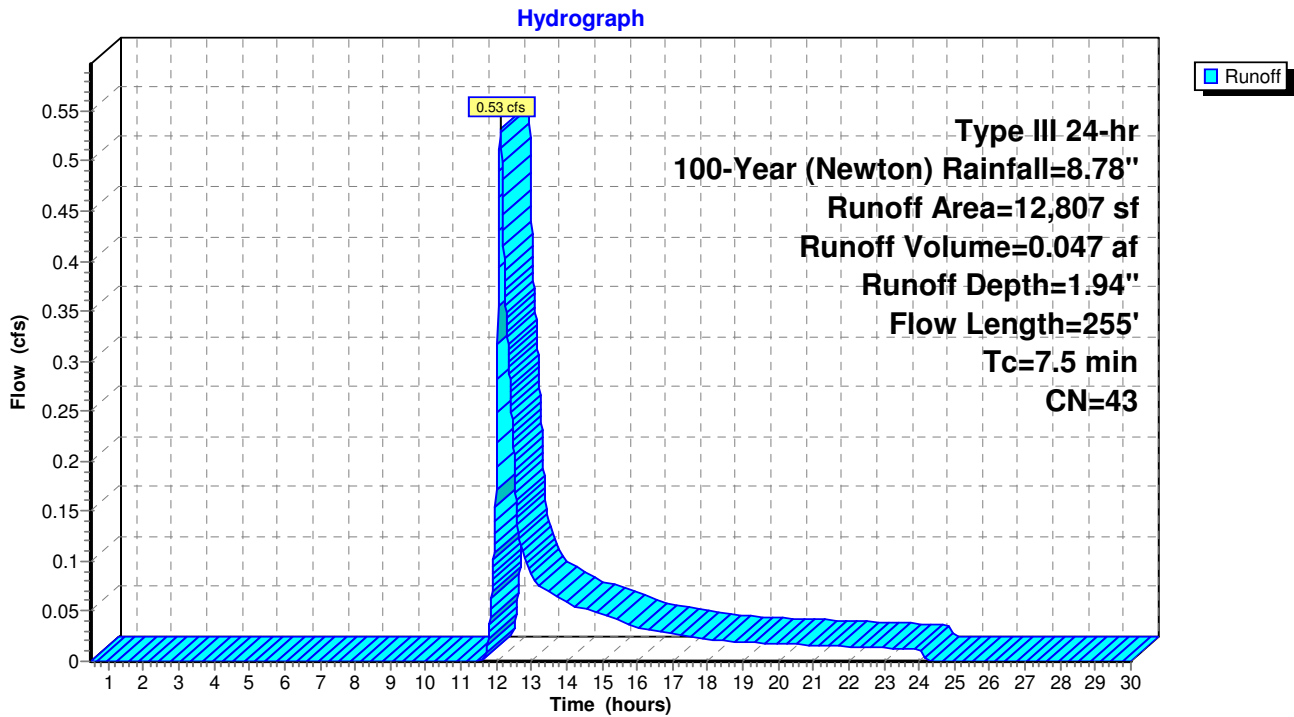## Summary for Subcatchment P2: Sub-catchment-2

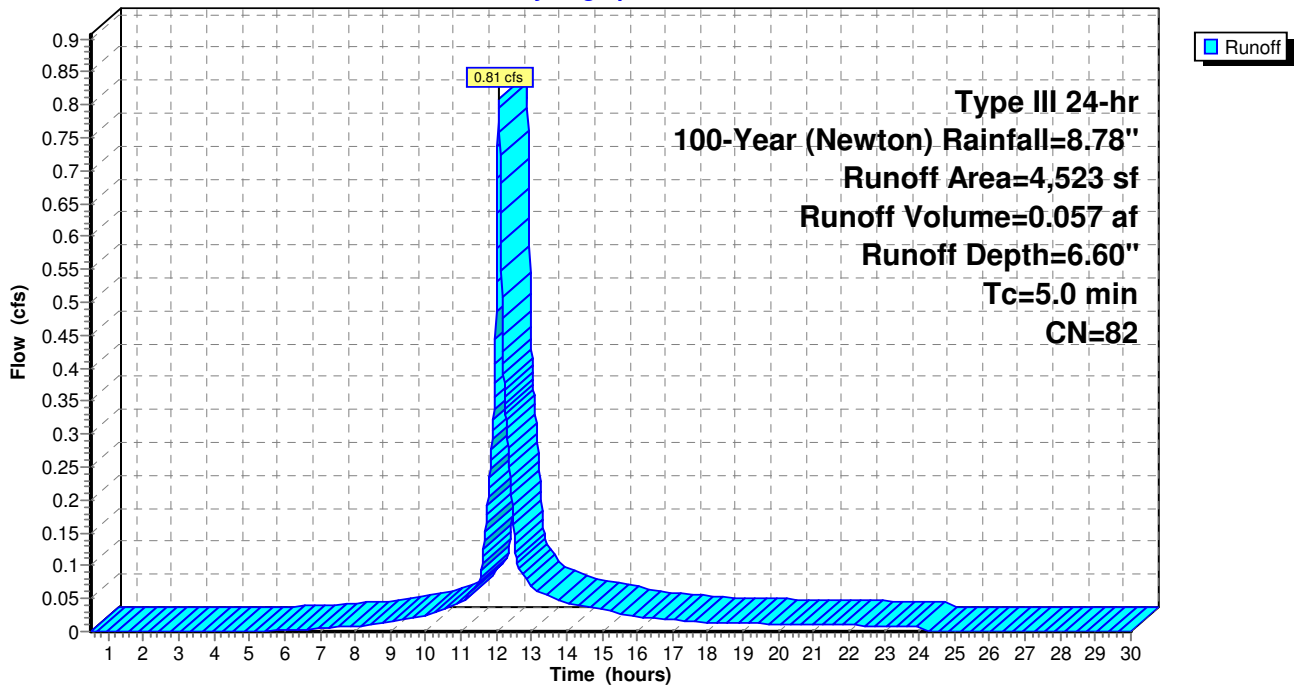Runoff    =      0.53 cfs @  12.12 hrs,  Volume=       0.047 af,  Depth= 1.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  100-Year (Newton) Rainfall=8.78"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 394 | 98 | Paved Driveway (portion) |
| * | 212 | 98 | Landing/Walks/Steps |
| * | 182 | 98 | Ret. Wall |
| | 12,019 | 39 | >75% Grass cover, Good, HSG A |
| | 12,807 | 43 | Weighted Average |
| | 12,019 | | 93.85% Pervious Area |
| | 788 | | 6.15% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.2 | 50 | 0.0250 | 0.16 | | **Sheet Flow, Segment: A - B** |
| | | | | | Grass: Short   n= 0.150   P2= 3.10" |
| 0.2 | 16 | 0.0250 | 1.11 | | **Shallow Concentrated Flow, Segment: B - C** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.2 | 21 | 0.0480 | 1.53 | | **Shallow Concentrated Flow, Segment: C -D** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.4 | 54 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, Segment: D - E** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.3 | 25 | 0.0400 | 1.40 | | **Shallow Concentrated Flow, Segment: E - F** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.2 | 28 | 0.0714 | 1.87 | | **Shallow Concentrated Flow, Segment: F - G** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.9 | 51 | 0.0196 | 0.98 | | **Shallow Concentrated Flow, Segment: G - H** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 0.1 | 10 | 0.0500 | 1.57 | | **Shallow Concentrated Flow, Segment: H - I** |
| | | | | | Short Grass Pasture   Kv= 7.0 fps |
| 7.5 | 255 | Total | | | |

## Subcatchment P2: Sub-catchment-2



**Hydrograph**

□ Runoff

0.53 cfs

**Type III 24-hr**
**100-Year (Newton) Rainfall=8.78"**
**Runoff Area=12,807 sf**
**Runoff Volume=0.047 af**
**Runoff Depth=1.94"**
**Flow Length=255'**
**Tc=7.5 min**
**CN=43**

## Summary for Subcatchment PD: Driveway

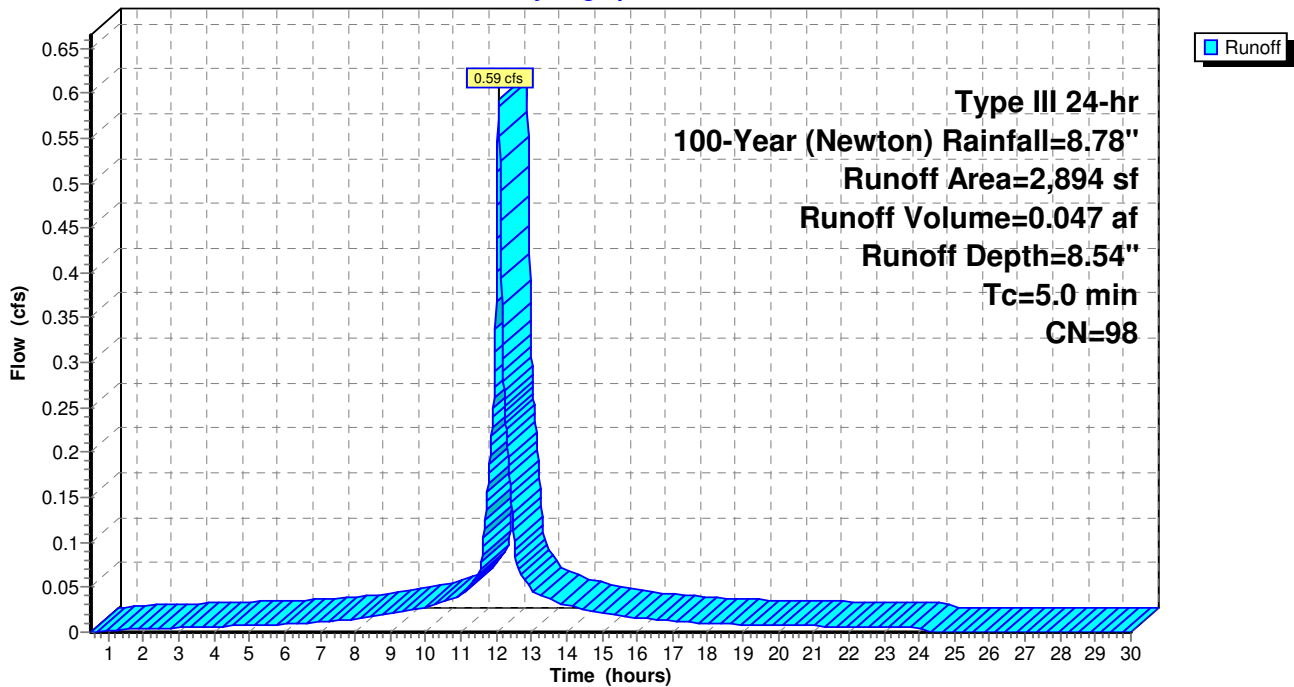Runoff      =        0.81 cfs @   12.07 hrs,  Volume=        0.057 af,  Depth=  6.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  100-Year (Newton) Rainfall=8.78"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 3,073 | 98 | Paved Driveway |
| * | 228 | 98 | Ret. Wall |
| * | 32 | 98 | Walks |
| | 1,190 | 39 | >75% Grass cover, Good, HSG A |
| | 4,523 | 82 | Weighted Average |
| | 1,190 | | 26.31% Pervious Area |
| | 3,333 | | 73.69% Impervious Area |

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

### Subcatchment PD: Driveway

**Hydrograph**



Type III 24-hr
100-Year (Newton) Rainfall=8.78"
Runoff Area=4,523 sf
Runoff Volume=0.057 af
Runoff Depth=6.60"
Tc=5.0 min
CN=82

## Summary for Subcatchment PR1: Roof-1

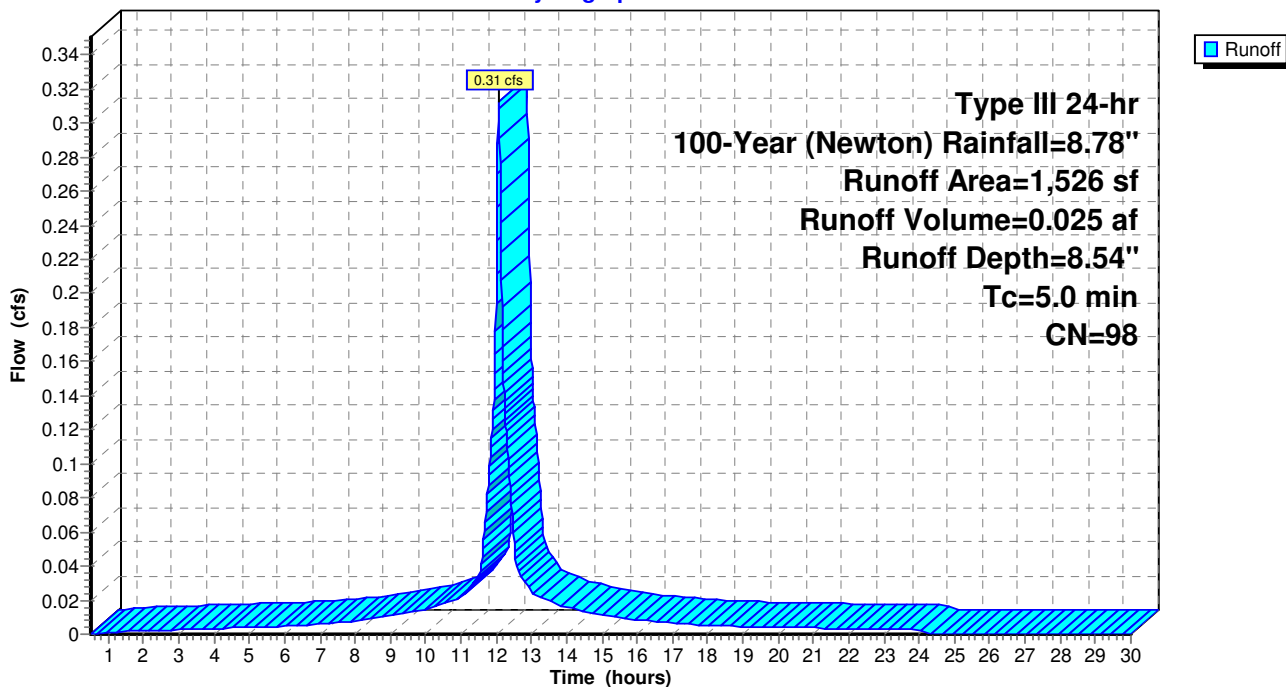Runoff     =        0.59 cfs @   12.07 hrs,  Volume=          0.047 af,  Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  100-Year (Newton) Rainfall=8.78"

| Area (sf) | CN | Description |
|---|---|---|
| * 2,894 | 98 | Ex. Roof |
| 2,894 | | 100.00% Impervious Area |

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

### Subcatchment PR1: Roof-1

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## Summary for Subcatchment PR2: Roof-2

Runoff      =        0.31 cfs @   12.07 hrs,  Volume=        0.025 af,  Depth=  8.54"
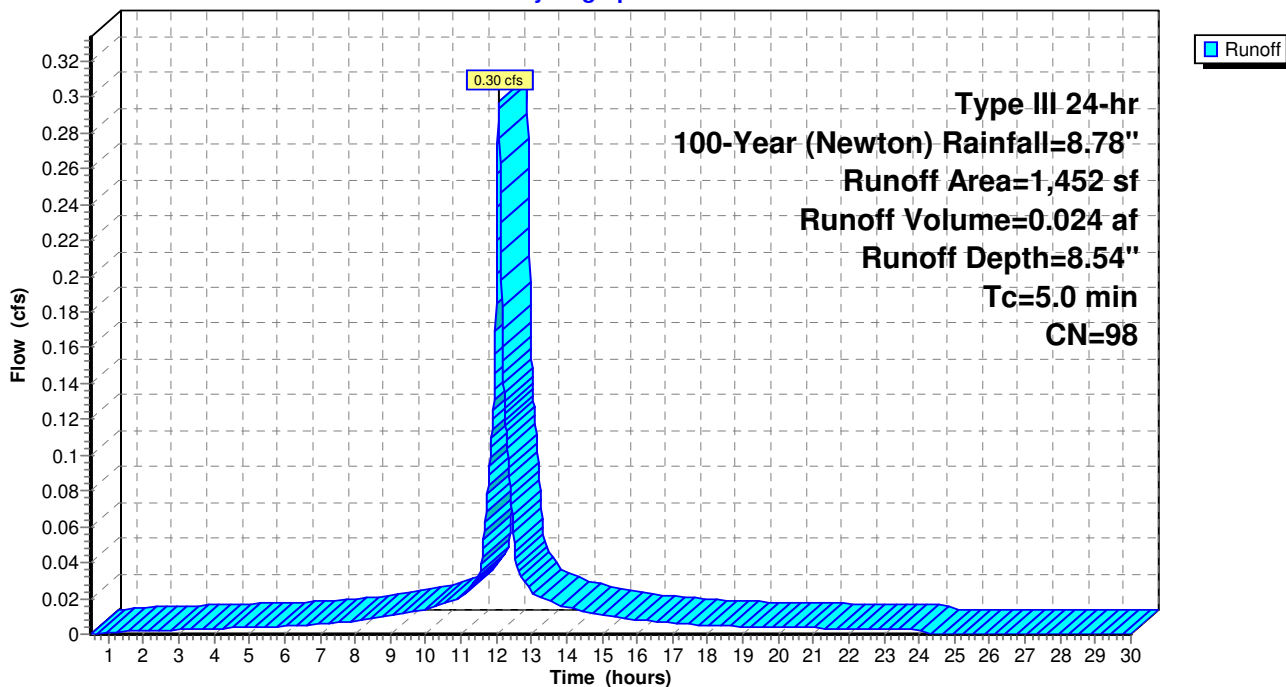
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  100-Year (Newton) Rainfall=8.78"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,526 | 98 | Ex. Roof |
| | 1,526 | | 100.00% Impervious Area |

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

### Subcatchment PR2: Roof-2

**Hydrograph**



Type III 24-hr
100-Year (Newton) Rainfall=8.78"
Runoff Area=1,526 sf
Runoff Volume=0.025 af
Runoff Depth=8.54"
Tc=5.0 min
CN=98

## Summary for Subcatchment PR3: Roof-3

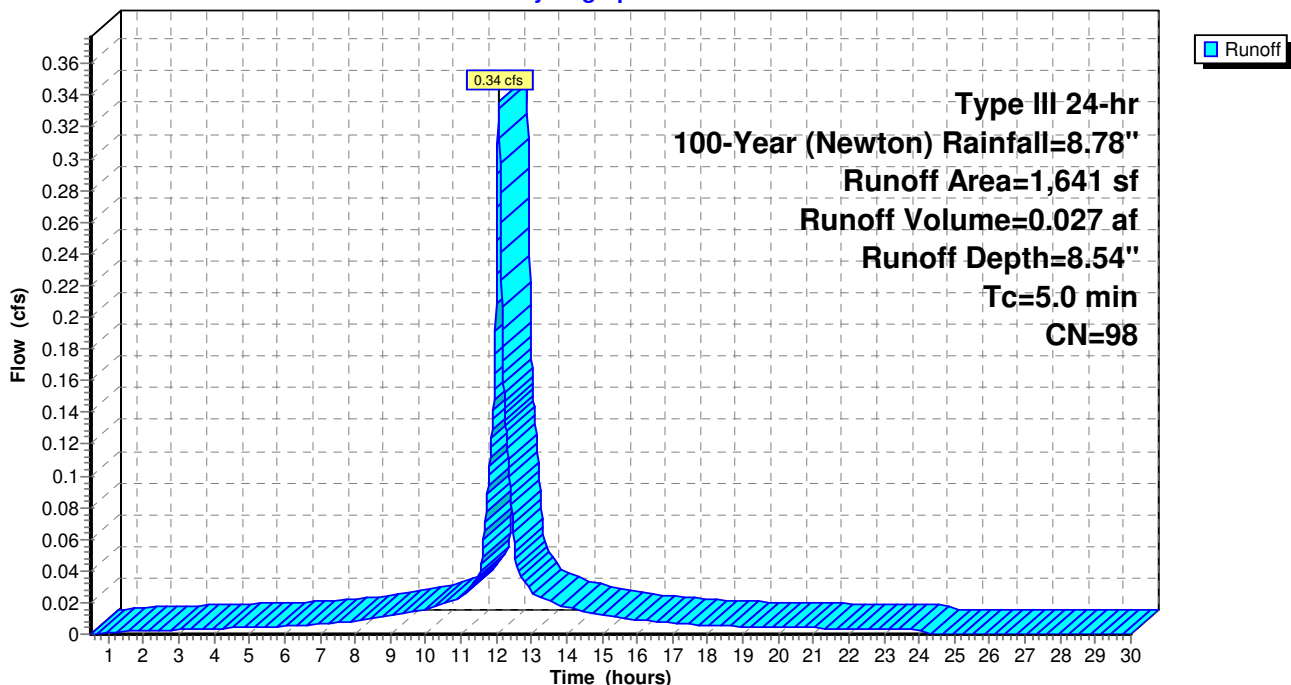Runoff     =        0.30 cfs @   12.07 hrs,  Volume=        0.024 af,  Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  100-Year (Newton) Rainfall=8.78"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,452 | 98 | Ex. Roof |
| | 1,452 | | 100.00% Impervious Area |

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

### Subcatchment PR3: Roof-3

**Hydrograph**



Type III 24-hr
100-Year (Newton) Rainfall=8.78"
Runoff Area=1,452 sf
Runoff Volume=0.024 af
Runoff Depth=8.54"
Tc=5.0 min
CN=98

## Summary for Subcatchment PR4: Roof-4

Runoff     =        0.34 cfs @   12.07 hrs,  Volume=           0.027 af,  Depth=  8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr  100-Year (Newton) Rainfall=8.78"

| Area (sf) | CN | Description |
|---|---|---|
| * 1,641 | 98 | Ex. Roof |
| 1,641 | | 100.00% Impervious Area |

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

### Subcatchment PR4: Roof-4

## Summary for Pond INF-1: Inf. System #1 Stormtech MC-3500

Inflow Area =        0.066 ac, 100.00% Impervious,  Inflow Depth =  8.54"    for  100-Year (Newton) event
Inflow        =      0.59 cfs @   12.07 hrs, Volume=            0.047 af
Outflow     =      0.02 cfs @    9.97 hrs, Volume=            0.045 af,  Atten= 96%,  Lag= 0.0 min
Discarded =      0.02 cfs @    9.97 hrs, Volume=            0.045 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 155.29' @ 14.95 hrs   Surf.Area= 0.009 ac   Storage= 0.023 af

Plug-Flow detention time= 354.5 min calculated for 0.045 af (96% of inflow)
Center-of-Mass det. time= 330.4 min ( 1,069.5 - 739.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 151.25' | 0.012 af | **8.42'W x 48.72'L x 5.25'H Field A**<br>0.049 af Overall - 0.016 af Embedded = 0.034 af  x 35.0% Voids |
| #2A | 152.25' | 0.016 af | **ADS_StormTech MC-3500 d +Cap**  x 6  Inside #1<br>Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf<br>Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap<br>Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf |
| | | 0.028 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 151.25' | **2.410 in/hr Exfiltration over Surface area**      Phase-In= 0.01' |

**Discarded OutFlow**  Max=0.02 cfs @ 9.97 hrs  HW=151.30'   (Free Discharge)
└─**1=Exfiltration**  (Exfiltration Controls 0.02 cfs)

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## Pond INF-1: Inf. System #1 Stormtech MC-3500 - Chamber Wizard Field A

**Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)**
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf

6 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 46.72' Row Length +12.0" End Stone x 2 = 48.72' Base Length
1 Rows x 77.0" Wide + 12.0" Side Stone x 2 = 8.42' Base Width
12.0" Base + 45.0" Chamber Height + 6.0" Cover = 5.25' Field Height

6 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 1 Rows = 689.5 cf Chamber Storage

2,152.8 cf Field - 689.5 cf Chambers = 1,463.3 cf Stone x 35.0% Voids = 512.2 cf Stone Storage

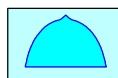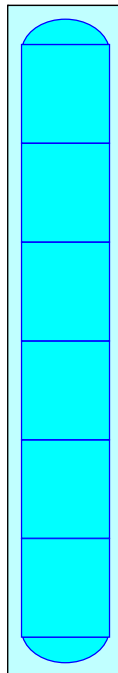Chamber Storage + Stone Storage = 1,201.7 cf = 0.028 af
Overall Storage Efficiency = 55.8%
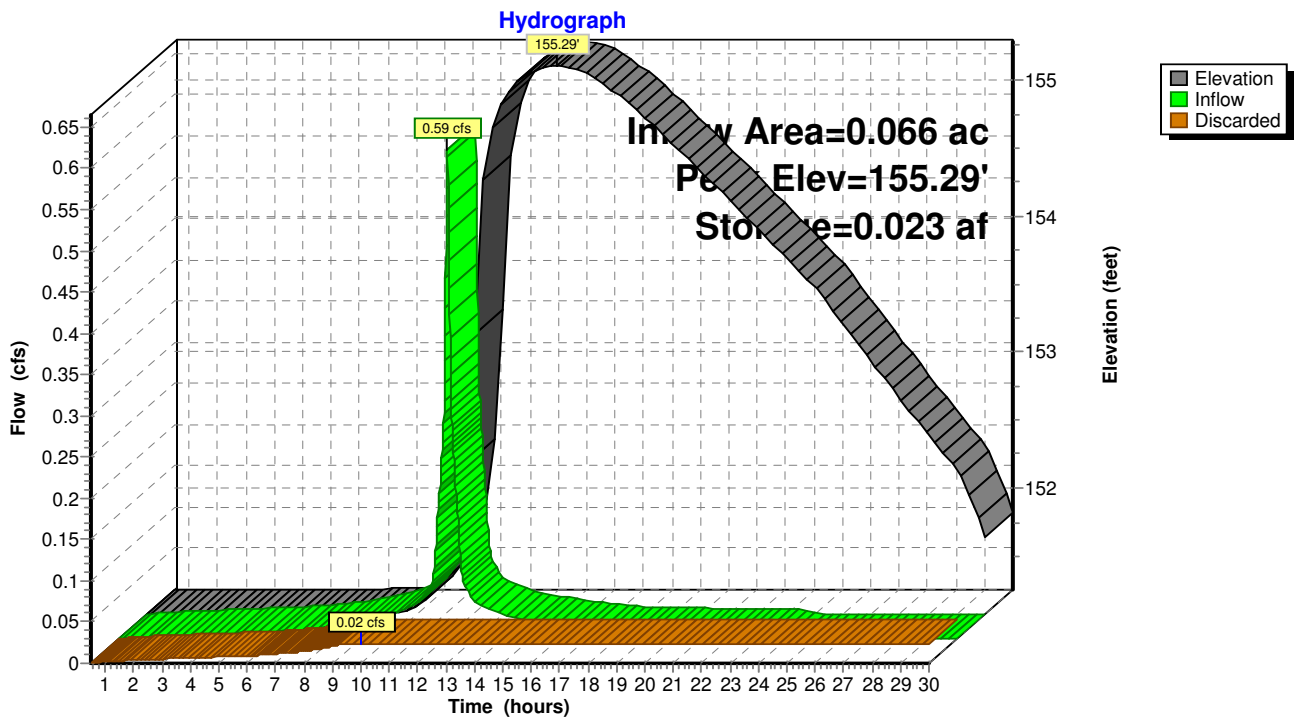Overall System Size = 48.72' x 8.42' x 5.25'

6 Chambers
79.7 cy Field
54.2 cy Stone

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## Pond INF-1: Inf. System #1 Stormtech MC-3500



**Hydrograph**

Inflow Area=0.066 ac
Peak Elev=155.29'
Storage=0.023 af

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## Summary for Pond INF-2: Inf. System #2 Stormtech MC-3500

Inflow Area =        0.068 ac,100.00% Impervious,  Inflow Depth =  8.54"    for  100-Year (Newton) event
Inflow      =     0.61 cfs @   12.07 hrs, Volume=          0.049 af
Outflow     =     0.02 cfs @    9.87 hrs, Volume=          0.046 af, Atten= 96%, Lag= 0.0 min
Discarded =     0.02 cfs @    9.87 hrs, Volume=          0.046 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 155.49' @ 15.05 hrs   Surf.Area= 0.009 ac   Storage= 0.024 af

Plug-Flow detention time= 363.4 min calculated for 0.046 af (94% of inflow)
Center-of-Mass det. time= 327.7 min ( 1,066.8 - 739.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 151.25' | 0.012 af | **8.42'W x 48.72'L x 5.25'H Field A** |
| | | | 0.049 af Overall - 0.016 af Embedded = 0.034 af  x 35.0% Voids |
| #2A | 152.25' | 0.016 af | **ADS_StormTech MC-3500 d +Cap**  x 6  Inside #1 |
| | | | Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf |
| | | | Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap |
| | | | Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf |
| | | 0.028 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 151.25' | **2.410 in/hr Exfiltration over Surface area**    Phase-In= 0.01' |

**Discarded OutFlow**  Max=0.02 cfs @ 9.87 hrs  HW=151.30'   (Free Discharge)
└─**1=Exfiltration**  (Exfiltration Controls 0.02 cfs)

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## Pond INF-2: Inf. System #2 Stormtech MC-3500 - Chamber Wizard Field A

**Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)**
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 1 rows = 29.8 cf

6 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 46.72' Row Length +12.0" End Stone x 2 = 48.72' Base Length
1 Rows x 77.0" Wide + 12.0" Side Stone x 2 = 8.42' Base Width
12.0" Base + 45.0" Chamber Height + 6.0" Cover = 5.25' Field Height

6 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 1 Rows = 689.5 cf Chamber Storage

2,152.8 cf Field - 689.5 cf Chambers = 1,463.3 cf Stone x 35.0% Voids = 512.2 cf Stone Storage

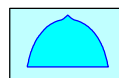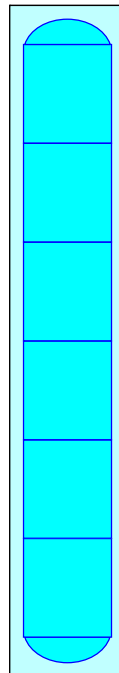Chamber Storage + Stone Storage = 1,201.7 cf = 0.028 af
Overall Storage Efficiency = 55.8%
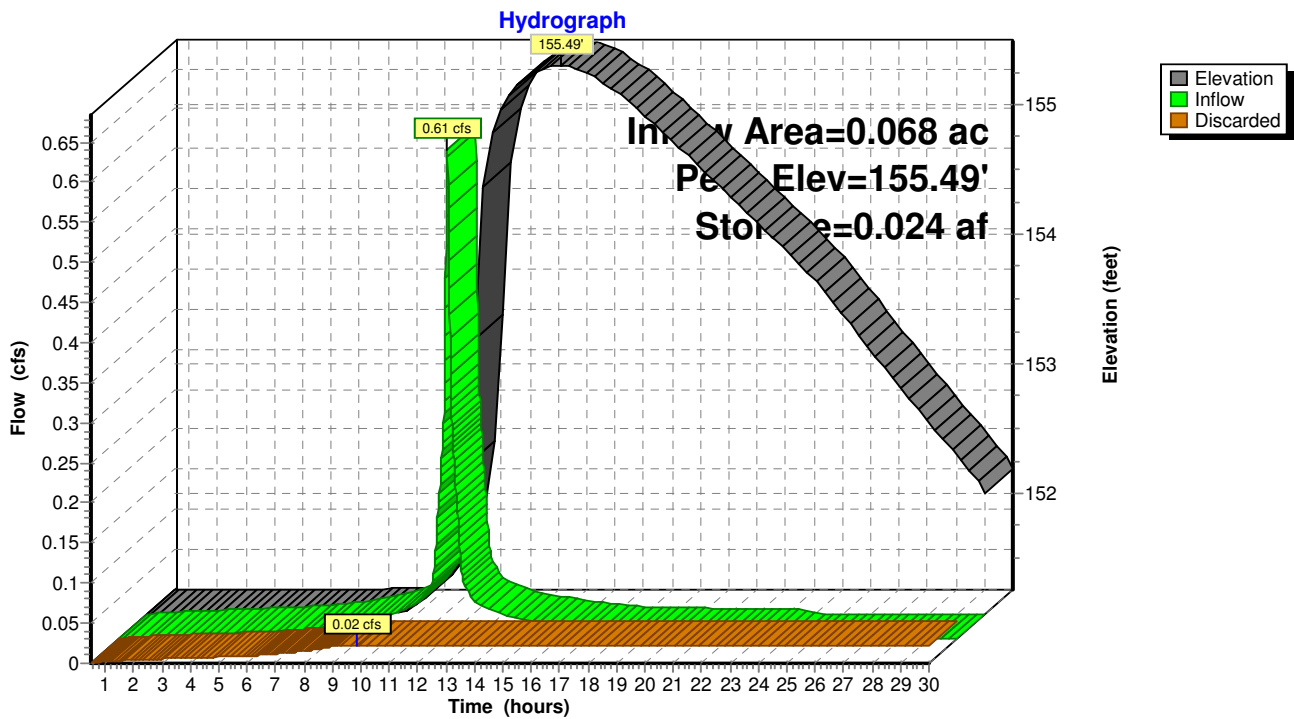Overall System Size = 48.72' x 8.42' x 5.25'

6 Chambers
79.7 cy Field
54.2 cy Stone

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## Pond INF-2: Inf. System #2 Stormtech MC-3500



Inflow Area=0.068 ac
Peak Elev=155.49'
Storage=0.024 af

## Summary for Pond INF-3: Inf. System #3 Ameration Chamber

Inflow Area =        0.038 ac,100.00% Impervious,  Inflow Depth =  8.54"    for  100-Year (Newton) event
Inflow      =      0.34 cfs @  12.07 hrs, Volume=            0.027 af
Outflow     =      0.03 cfs @  11.33 hrs, Volume=            0.027 af, Atten= 92%, Lag= 0.0 min
Discarded =      0.03 cfs @  11.33 hrs, Volume=            0.027 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 150.06' @ 13.02 hrs   Surf.Area= 0.011 ac   Storage= 0.009 af

Plug-Flow detention time= 109.6 min calculated for 0.027 af (100% of inflow)
Center-of-Mass det. time= 109.6 min ( 848.8 - 739.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---------------------|
| #1A | 148.40' | 0.005 af | **13.00'W x 36.00'L x 2.17'H Field A** |
| | | | 0.023 af Overall - 0.010 af Embedded = 0.014 af  x 35.0% Voids |
| #2A | 148.90' | 0.006 af | **Concrete Galley  4x8x1.7**  x 8  Inside #1 |
| | | | Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf |
| | | | Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf |
| | | | 2 Rows of 4 Chambers |
| | | 0.010 af | Total Available Storage |

   Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|--------|---------|--------|----------------|
| #1 | Discarded | 148.40' | **2.410 in/hr Exfiltration over Surface area**     Phase-In= 0.01' |

**Discarded OutFlow**  Max=0.03 cfs @ 11.33 hrs  HW=148.42'   (Free Discharge)
└─**1=Exfiltration**  (Exfiltration Controls 0.03 cfs)

## Pond INF-3: Inf. System #3 Ameration Chamber - Chamber Wizard Field A

**Chamber Model = Concrete Galley  4x8x1.7 (Ameration Chamber, NEPCA LE-AC  or equivalent)**
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

48.0" Wide + 12.0" Spacing = 60.0" C-C Row Spacing

4 Chambers/Row x 8.00' Long = 32.00' Row Length +24.0" End Stone x 2 = 36.00' Base Length
2 Rows x 48.0" Wide + 12.0" Spacing x 1 + 24.0" Side Stone x 2 = 13.00' Base Width
6.0" Base + 20.0" Chamber Height = 2.17' Field Height

8 Chambers x 30.3 cf = 242.3 cf Chamber Storage
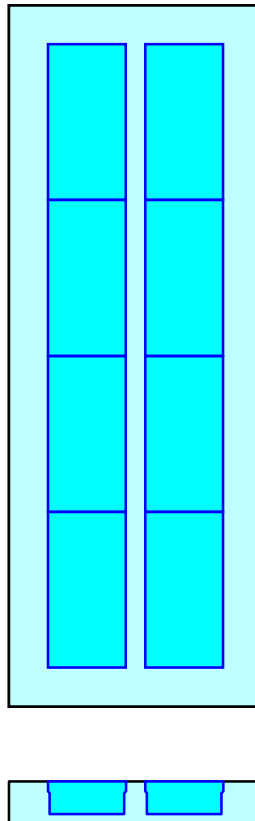8 Chambers x 51.9 cf = 415.3 cf Displacement

1,015.6 cf Field - 415.3 cf Chambers = 600.3 cf Stone x 35.0% Voids = 210.1 cf Stone Storage
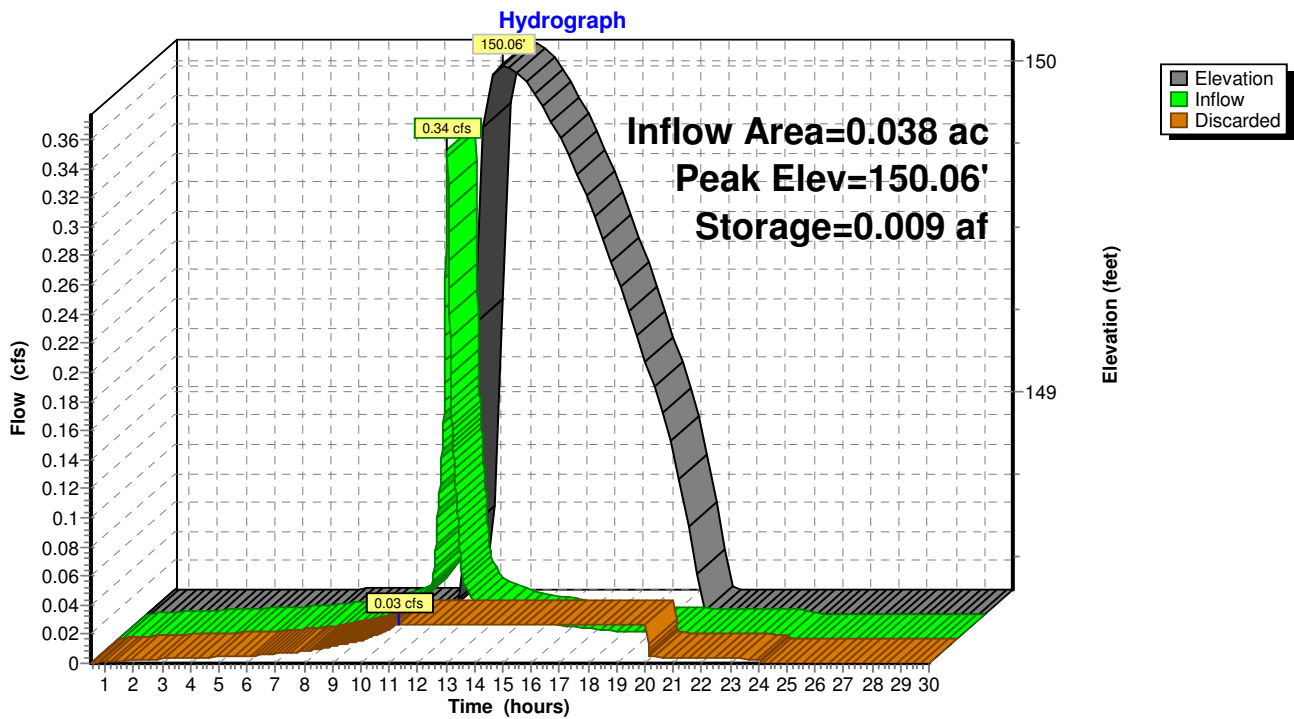
Chamber Storage + Stone Storage = 452.4 cf = 0.010 af
Overall Storage Efficiency = 44.5%
Overall System Size = 36.00' x 13.00' x 2.17'

8 Chambers
37.6 cy Field
22.2 cy Stone

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## Pond INF-3: Inf. System #3 Ameration Chamber



**Hydrograph**

Inflow Area=0.038 ac
Peak Elev=150.06'
Storage=0.009 af

Legend:
- Elevation
- Inflow
- Discarded

### Summary for Pond INF-4: Inf. System #4 Ameration Chamber

Inflow Area =        0.104 ac, 73.69% Impervious,  Inflow Depth = 6.60"   for 100-Year (Newton) event
Inflow      =     0.81 cfs @ 12.07 hrs, Volume=        0.057 af
Outflow     =     0.59 cfs @ 12.14 hrs, Volume=        0.057 af, Atten= 28%, Lag= 4.2 min
Discarded   =     0.03 cfs @ 10.37 hrs, Volume=        0.033 af
Secondary   =     0.56 cfs @ 12.14 hrs, Volume=        0.024 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 150.90' @ 12.14 hrs   Surf.Area= 473 sf   Storage= 554 cf

Plug-Flow detention time= 72.2 min calculated for 0.057 af (100% of inflow)
Center-of-Mass det. time= 72.2 min ( 866.1 - 793.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 148.40' | 260 cf | **11.00'W x 43.00'L x 2.67'H Field A** |
|  |  |  | 1,263 cf Overall - 519 cf Embedded = 744 cf  x 35.0% Voids |
| #2A | 149.40' | 303 cf | **Concrete Galley  4x8x1.7** x 10  Inside #1 |
|  |  |  | Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf |
|  |  |  | Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf |
|  |  |  | 2 Rows of 5 Chambers |
|  |  | 563 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 148.40' | **2.410 in/hr Exfiltration over Surface area**    Phase-In= 0.01' |
| #2 | Secondary | 149.90' | **6.0" Round Overflow** |
|  |  |  | L= 91.0'  CPP, square edge headwall,  Ke= 0.500 |
|  |  |  | Inlet / Outlet Invert= 149.90' / 149.44'   S= 0.0051 '/'  Cc= 0.900 |
|  |  |  | n= 0.012,  Flow Area= 0.20 sf |

**Discarded OutFlow** Max=0.03 cfs @ 10.37 hrs  HW=148.43'   (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

**Secondary OutFlow** Max=0.56 cfs @ 12.14 hrs  HW=150.90' TW=0.00'   (Dynamic Tailwater)
└─**2=Overflow** (Barrel Controls 0.56 cfs @ 2.84 fps)

## Pond INF-4: Inf. System #4 Ameration Chamber - Chamber Wizard Field A

**Chamber Model = Concrete Galley 4x8x1.7 (Ameration Chamber, NEPCA LE-AC or equivalent)**
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

5 Chambers/Row x 8.00' Long = 40.00' Row Length +18.0" End Stone x 2 = 43.00' Base Length
2 Rows x 48.0" Wide + 18.0" Side Stone x 2 = 11.00' Base Width
12.0" Base + 20.0" Chamber Height = 2.67' Field Height

10 Chambers x 30.3 cf = 302.8 cf Chamber Storage
10 Chambers x 51.9 cf = 519.1 cf Displacement

1,262.9 cf Field - 519.1 cf Chambers = 743.8 cf Stone x 35.0% Voids = 260.3 cf Stone Storage

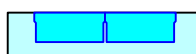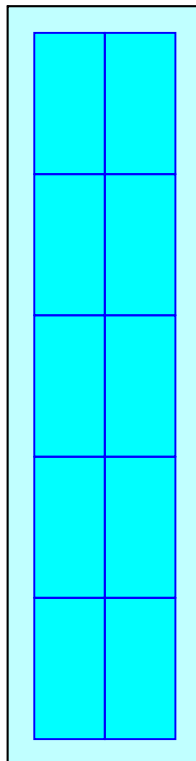Chamber Storage + Stone Storage = 563.2 cf = 0.013 af
Overall Storage Efficiency = 44.6%
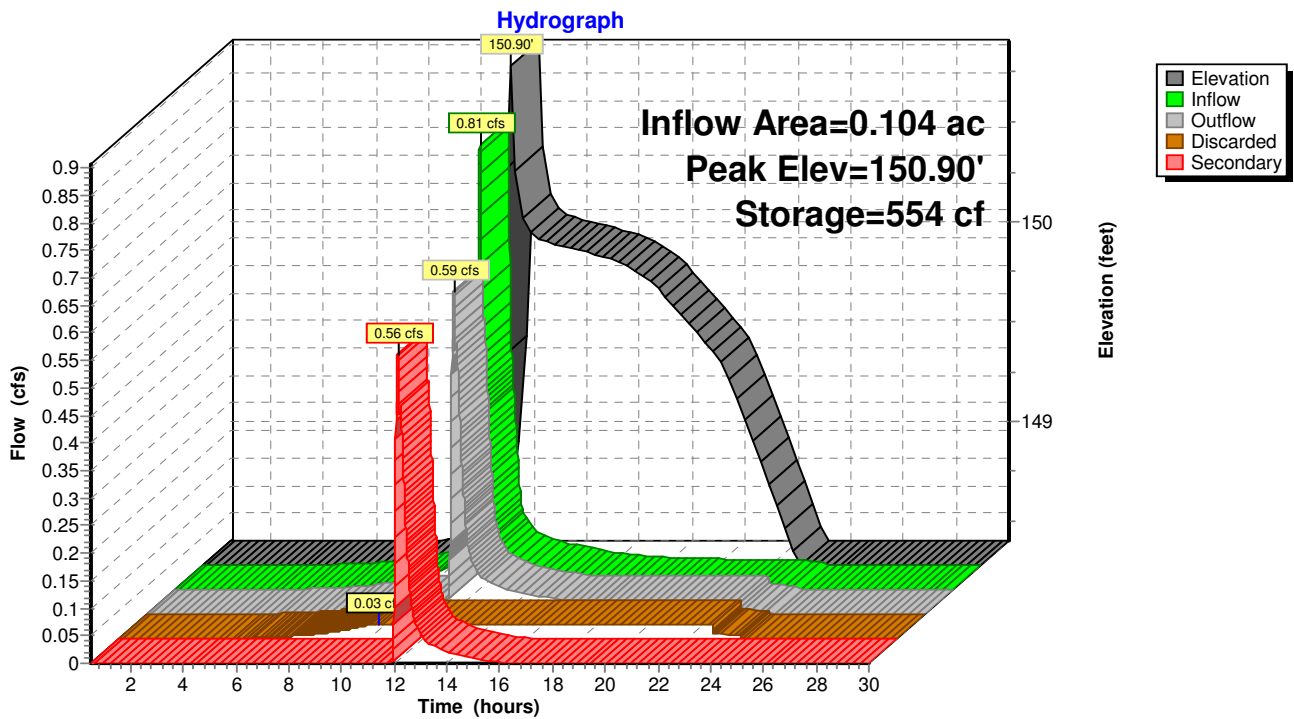Overall System Size = 43.00' x 11.00' x 2.67'

10 Chambers
46.8 cy Field
27.5 cy Stone

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## Pond INF-4: Inf. System #4 Ameration Chamber



**Hydrograph**

Inflow Area=0.104 ac
Peak Elev=150.90'
Storage=554 cf

Legend:
- Elevation
- Inflow
- Outflow
- Discarded
- Secondary

150.90'
0.81 cfs
0.59 cfs
0.56 cfs
0.03 cfs

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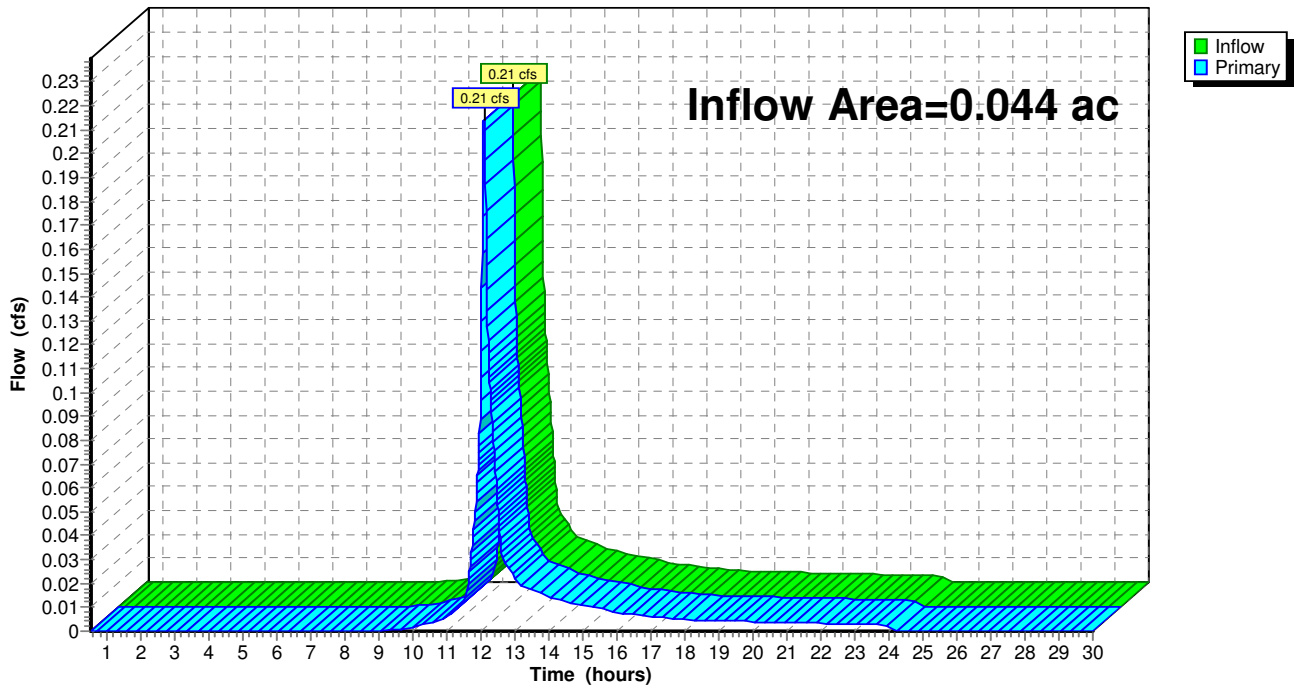Page 79

## Summary for Link POD1: Warren Street (South)

Inflow Area =      0.044 ac, 36.97% Impervious, Inflow Depth =  4.05"   for 100-Year (Newton) event
Inflow      =     0.21 cfs @  12.08 hrs, Volume=        0.015 af
Primary     =     0.21 cfs @  12.08 hrs, Volume=        0.015 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD1: Warren Street (South)

**217115_145 Warren St Newton, MA**
Prepared by {enter your company name here}
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*Type III 24-hr  100-Year (Newton) Rainfall=8.78"*
Printed  3/4/2019
Page 80
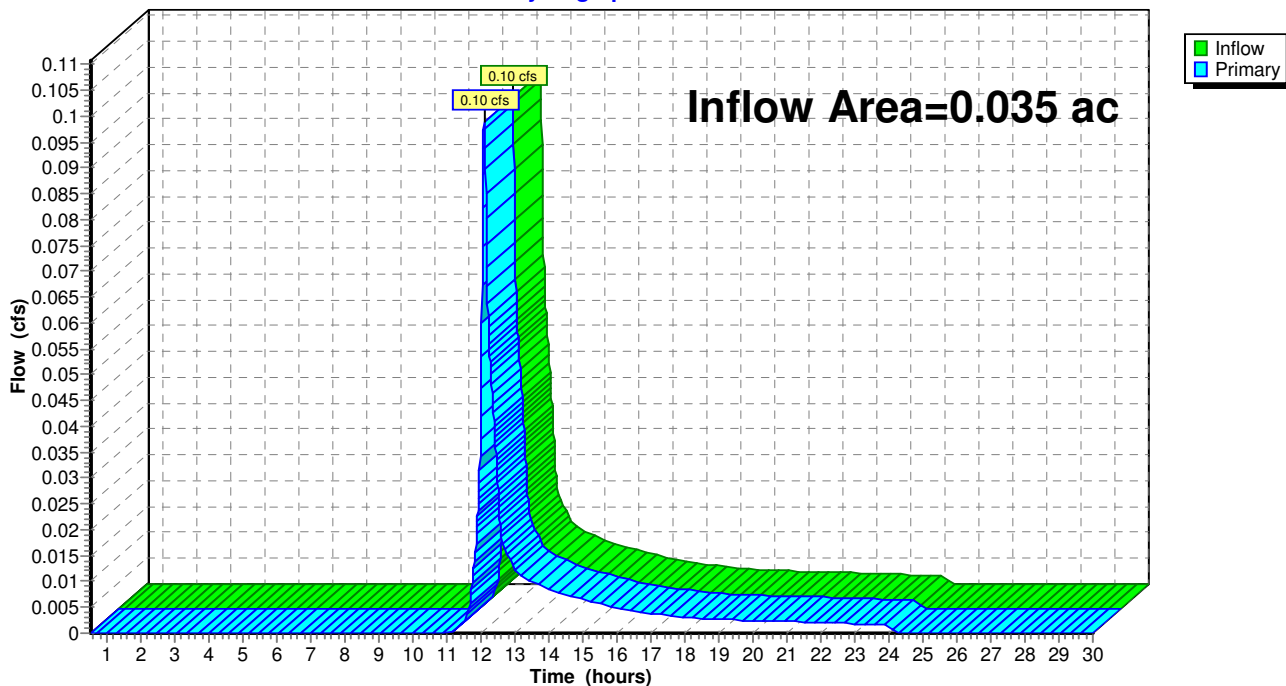
## Summary for Link POD1.: Warren Street (South)

Inflow Area =        0.035 ac,  14.85% Impervious,  Inflow Depth =  2.51"    for  100-Year (Newton) event
Inflow      =        0.10 cfs @   12.08 hrs,  Volume=            0.007 af
Primary     =        0.10 cfs @   12.08 hrs,  Volume=            0.007 af,  Atten= 0%,  Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD1.: Warren Street (South)

**217115_145 Warren St Newton, MA**
*Type III 24-hr 100-Year (Newton) Rainfall=8.78"*
Prepared by {enter your company name here}
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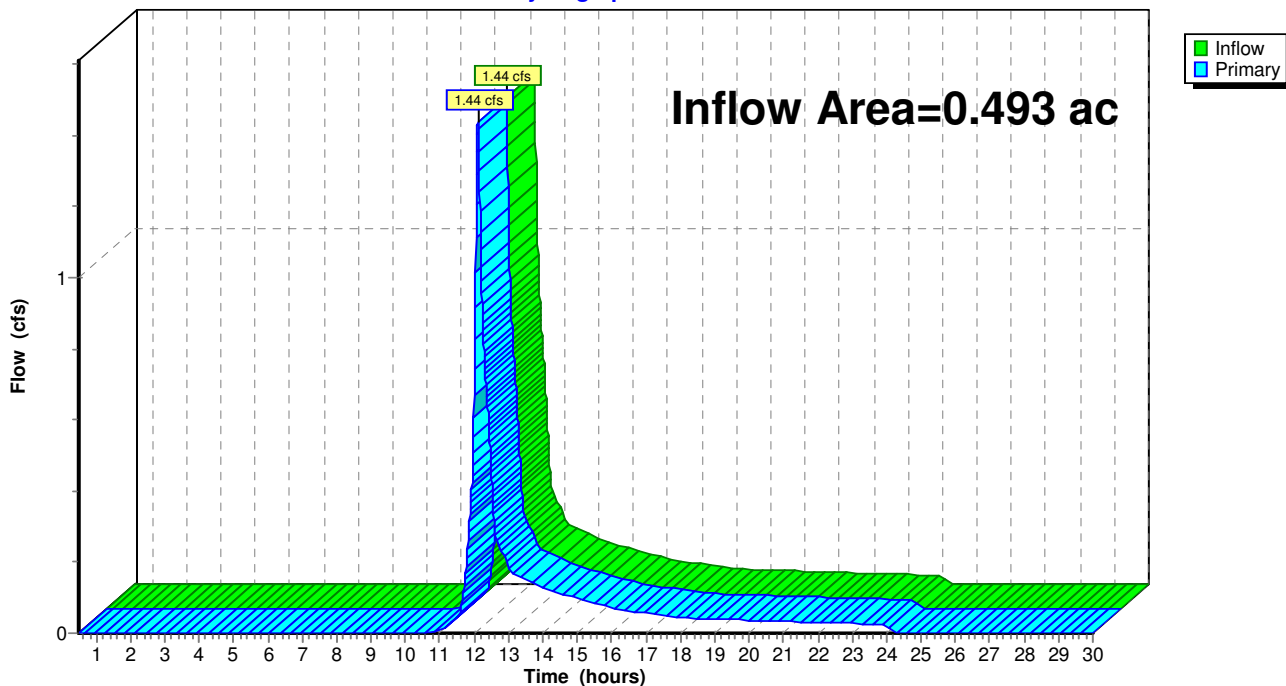Page 81

## Summary for Link POD2: North Abutter (MBTA)

Inflow Area =     0.493 ac, 24.07% Impervious, Inflow Depth = 2.74"   for 100-Year (Newton) event
Inflow     =     1.44 cfs @  12.11 hrs, Volume=        0.113 af
Primary    =     1.44 cfs @  12.11 hrs, Volume=        0.113 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD2: North Abutter (MBTA)

**217115_145 Warren St Newton, MA**
Prepared by {enter your company name here}
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*Type III 24-hr  100-Year (Newton) Rainfall=8.78"*
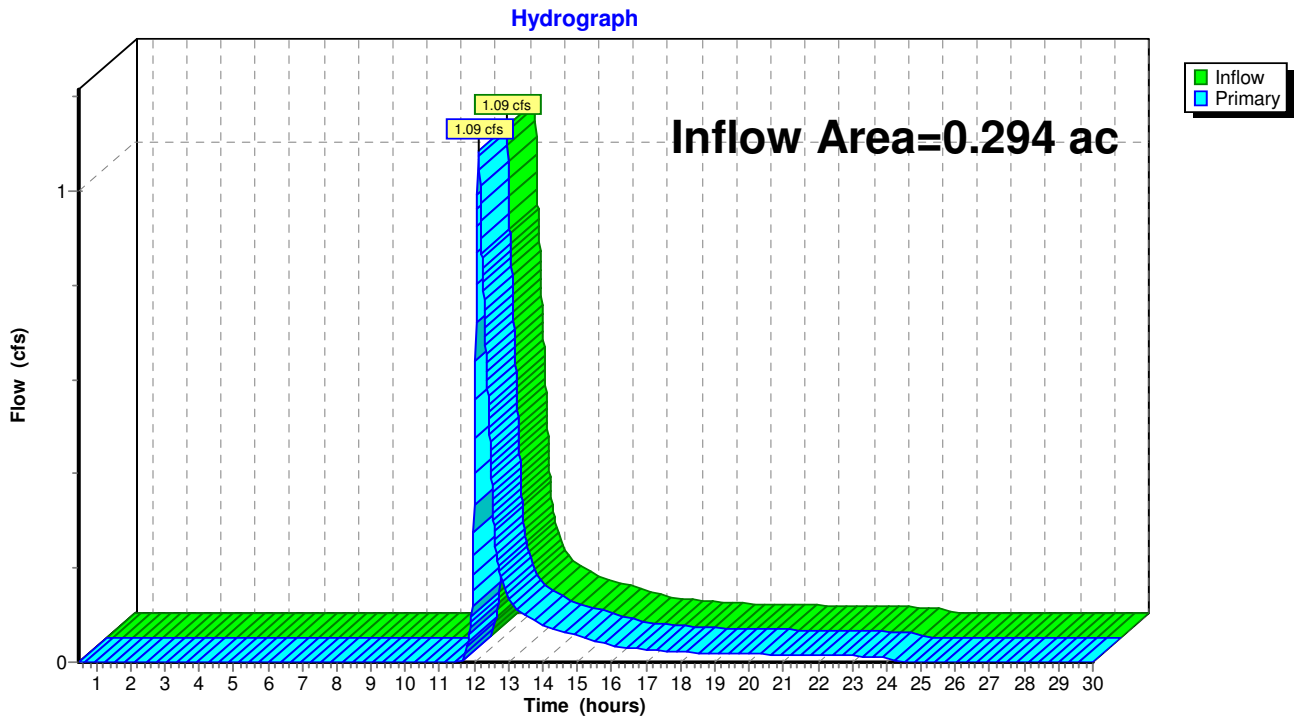Printed  3/4/2019
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## Summary for Link POD2.: North Abutter (MBTA)

Inflow Area =      0.294 ac,   6.15% Impervious,  Inflow Depth =  2.94"    for  100-Year (Newton) event
Inflow       =     1.09 cfs @  12.13 hrs,  Volume=         0.072 af
Primary     =     1.09 cfs @  12.13 hrs,  Volume=         0.072 af,  Atten= 0%,  Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

### Link POD2.: North Abutter (MBTA)

**OPERATION & MAINTENANCE PLAN**
**145 WARREN STREET**
**NEWTON, MASSACHUSETTS**

March 4, 2019

VTP Associates, Inc.
132 Adams Street
2nd Floor, Suite 3
Newton Massachusetts 02465
1-617-332-8271
Job # 217115

**OPERATION & MAINTENANCE PLAN**
**145 WARREN STREET**
**NEWTON, MASSACHUSETTS**

The proposed project includes stormwater runoff controls associated with the redevelopment of the existing site into a new residential development that will require continued maintenance by the property owner. The major components associated with maintenance needs are the catch basins and infiltration systems. These will need to be cleaned periodically as noted below. Cleaning of these structures shall be done by the developer & property owners via a specialty contractor with hydraulic cleaning ability. In addition to the facilities noted below, the property owner should maintain any roof gutters/drains on a regular basis to prevent clogging and carry over of debris into the driveway system. The property owner should also provide for the periodic cleaning of the driveway areas to remove large debris, grass cuttings and sand particles prior to discharge through the catch basin units. The following outlines the major maintenance issues associated with the project:

## Catch basin Cleaning:

The catch basin structures should be inspected after completion of construction to assure that all debris was removed and no construction material will be cause the system to clog. This inspection should also include the drain lines within the system.

The catch basin sumps should be inspect quarterly; if depth of sediment in sumps exceeds 50% capacity, sediment must be removed. The catch basin should be cleaned with a hydraulic vacuum system two (2) times per year (spring and fall season) to remove accumulated solids and debris. At the same time, the drain lines should be inspected and cleaned if needed. Assuming the catch basins, and drain lines are maintained and cleaning is in accordance with normal standards, the solids removal efficiency should be as required to prevent carry over of large solids to the infiltration systems.

## Storage / Infiltration System

The storage/infiltration system should be inspected after completion of construction to assure that all debris was removed and no construction material will be cause the system to clog.

The storage/infiltration system should be inspected over the first year of operation on a quarterly basis to determine the level of required maintenance. This inspection should be performed by the Owner's Engineer and a report issued to the City as to any cleaning / maintenance needs of that system. At the same time, the inspection of the catch basins and piping should be performed to determine any flushing / cleaning needs. As a preliminary schedule, the system piping should be cleaned once a year to remove accumulated sediments and sediments in the infiltration chambers should be removed when they reach two (2) inches in depth.

## Maintenance Responsibilities

The maintenance of the Drainage System is the responsibility of the Property Owner(s), via their owners association. The actual work should be subcontracted to a company that specializes in the cleaning of storm drainage facilities. Inspections should be performed by independent individual such as the design engineer or other experienced individual in the field.

## OPERATION & MAINTENANCE PLAN
## 145 WARREN STREET
## NEWTON, MASSACHUSETTS

**<u>INSPECTION REPORT:</u>**

Inspection Firm: _____

Inspectors Name: _____ Date: _____

Components Inspected: _____
_____

Signed: _____


**<u>SYSTEM MAINTENANCE:</u>**

Maintenance Firm: _____ Date: _____

Catch basins Cleaned:  Yes _____ No _____ Comments _____
_____
_____

Drain lines Inspected:  Yes _____ No _____ Comments: _____
_____
_____

Infiltration System(s) Cleaned:  Yes _____ No _____ Comments: _____
_____
_____


Estimate of Material Removed: _____

Other Comments: _____
_____

Signed: _____