HYDROLOGIC ANALYSIS
Of
51 Wenham Road
Topsfield, Massachusetts

May 10, 2016

Prepared for: Mark and Kristin Yannetti
51 Wenham Road
Topsfield, MA 01983

Prepared by: The Morin-Cameron Group, Inc.
447 Boston Street - US Route 1
Topsfield, MA 01983

INDEX

HYDOLOGY SUMMARY

Post Developed ( )

Storm Event

[All values in CFS]

Design Point	2	10	100
1	1.25 (1.04)	2.52 (2.44)	4.50 (4.45)

Pond Summary

Post Developed ( )

Pond	Top	100 Year Elevation
Proposed Infiltration Basin	174.0'	173.5'

HYDROLOGIC ANALYSIS

Existing Site Conditions

The project site is located within the Outlying Residential Agricultural (ORA) zoning district and has a mailing address of 51 Wenham Road, Topsfield, Massachusetts (See Figure 1: USGS Map for locus map). The subject property can also be identified on the Topsfield assessor's Map 71 as Parcel 18. The property is located within a Zone X as shown on the FEMA Federal Insurance Rate Map (FIRM) #25009C-0402F which has an effective date of July 2, 2012 (See Figure 2: FEMA Map). There are no known wetlands or critical areas located within the project limitations.

The existing property currently has a single-family dwelling, an accessory structure and a shed located on it. Two driveways with separate curb cuts exist to provide access from Wenham Road. Mostly lawn and landscaping areas, with a small portion of woods, account for the front yard. The front yard has a grade change of approximately 17' sloping from the west to the east. Nearly all of the front yard contributes runoff to the design point used in the drainage analysis, with a portion of the drainage area coming from the abutting property to the west (see Figure 4: Pre-Development Watershed Figure).

The property is shown to be mapped in the "Severe-Slow Perc" area on the "Topsfield, MA Map of Areas of Severe Soil Limitations" which has a date of 5/11/2012. The USDA Soils Maps have the area of interest mapped as Paxton fine sandy loam, with 3 to 8 percent slopes. In situ soil testing performed by Alex Parker (SE #1848) confirmed the presence of fine sandy loams (hydrologic soil group C) under the A soil horizon, with no fragipan soil layer located in the test pit locations. The estimated seasonal high groundwater ranged from 25-45" below existing grade (See Soil Evaluation Forms on page 78-85).

Proposed Site Conditions

The applicant is proposing to raze the dilapidated barn, construct a 3,200 sf± in-law addition (with a 3-car garage) and reconstruct/expand the western driveway. The majority of the front yard will be regraded to accommodate the structure and driveway. The driveway will use the existing curb cut and will be graded in order to reduce the amount of runoff that is currently flowing towards Wenham Road. A grassed swale will be added to direct the majority of the runoff to the new sediment forebay and infiltration basin. The forebay has been sized in order to adequately treat the water quality associated with the impervious pavement area. A portion of the new roof will be captured with gutters and directed with roof leaders into an underground infiltration chamber system. No pre-treatment was warranted for the roof prior to infiltration as it is considered clean runoff (See Figure 5: Post-Development Watershed Figure).

The proposed drainage system for the project will treat, infiltrate and attenuate the runoff associated with the proposed development.

Analysis

The purpose of this analysis is to design an onsite drainage system which complies with the Town of Topsfield and the MA DEP Stormwater Management Standards. This analysis was performed using the U.S. Soil Conservation Service (S.C.S) method of analysis contained in Technical Release #20 (TR-20) published by the U.S. Conservation Service. The model used for this calculation is referred to as HydroCAD. HydroCAD is a computer aided design program for analyzing the hydrology and hydraulics of storm water runoff. It utilizes the latest techniques of both fields to accurately predict the consequences of any given storm event. This analysis allows the engineer to verify that a given drainage system is adequate for the area under consideration, and further allows the engineer to predict where flooding or erosion are most likely to occur. This model was used to analyze the storm drainage system designed for the development in order to demonstrate that the drainage

system is in compliance with the Town's and the State of Massachusetts's Stormwater Management Standards.

The HydroCAD analysis was performed by examining one design point located at the intersection of the easterly driveway and Wenham Road. Peak rates of runoff are mitigated for the 2, 10 and 100 year rainfall events at the design point (see Hydrology Summary on page 3).

Stormwater Management Standards

The proposed drainage system will discharge towards the intersection of the easterly driveway and Wenham Road. The proposed project is considered to be a New Development due to the increase in impervious surface and, therefore, is required to meet all Stormwater Management Standards.

Flows entering the infiltration basin will be pre-treated by the use of a sediment forebay. The infiltration basin will also allow for recharge to the groundwater. The sediment forebay has been sized to meet the required removal of TSS from the contributing paved area. Flows exiting the infiltration basin will have approximately 85% TSS removal (see TSS removal worksheet page 63). Roof runoff does not need to be treated prior to discharge into the infiltration chamber system. The infiltration basin and infiltration chamber system provides more than the required recharge volume.

The following is an assessment of each Standard:

1. No stormwater conveyance system discharges untreated stormwater directly to or causes erosion in wetlands or waters of the Commonwealth.
   All new discharges that require treatment are treated prior to discharge, therefore this standard has been met.

2. The stormwater management system shall be designed so that post-development peak discharge rates do not exceed pre-development discharge rates for the 2 and 10 year storm events. Proponents must also evaluate the impact of peak discharges from the 100 year storm event.
   The post developed peak rates of runoff for the 2, 10 and 100 year storm events is equal to or less than the pre development peak rates. Therefore the proposed development complies/exceeds this standard.

3. Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures.
   The proposed stormwater management system is designed to infiltrate more than the required recharge volume, therefore the proposed development meets this standard.

4. The proposed stormwater management system shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).
   Through the use of a sediment forebay and an infiltration basin the proposed drainage system provides an 85% TSS removal; therefore the proposed project meets the standard.

5. Land uses with higher potential pollutant load.
   This standard does not apply.

6. Discharges to critical areas.
   This standard does not apply.

7. Redevelopment Projects.
   This standard does not apply.

8. Construction Phase Operation and Maintenance Plan.

A plan to control construction related impacts has been developed and is included herein. (see pages 73-74). The proposed development meets this standard.

9. A long-term operation and maintenance plan.

A long-term O&M has been developed to insure that stormwater management systems function as designed (see pages 75-76). The proposed development meets this standard.

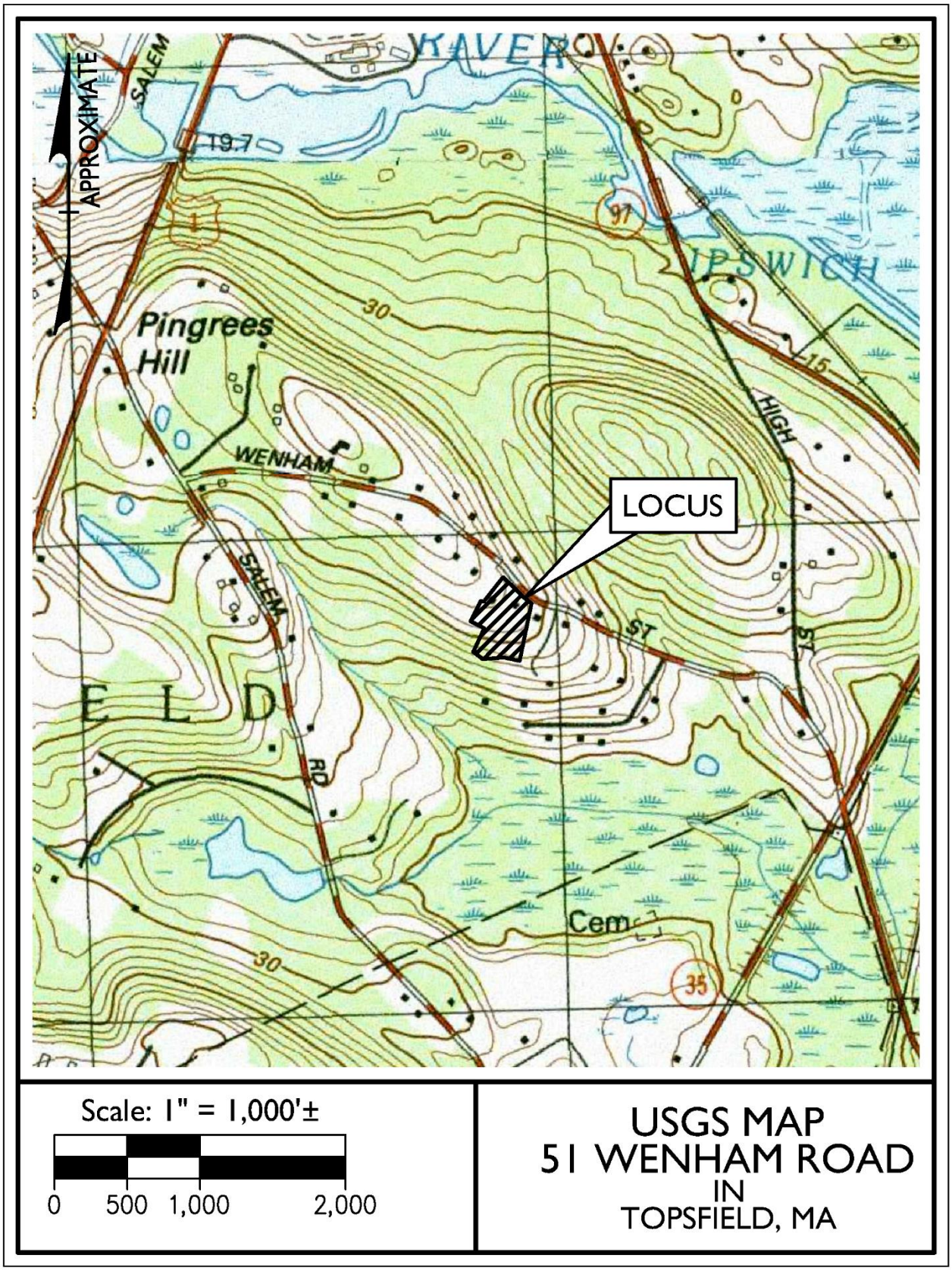
10 Illicit discharges

To the best of our knowledge and belief there are no illicit discharges to the stormwater management system on this site; find attached an Illicit Discharge Statement on page 77. The proposed redevelopment meets this standard.

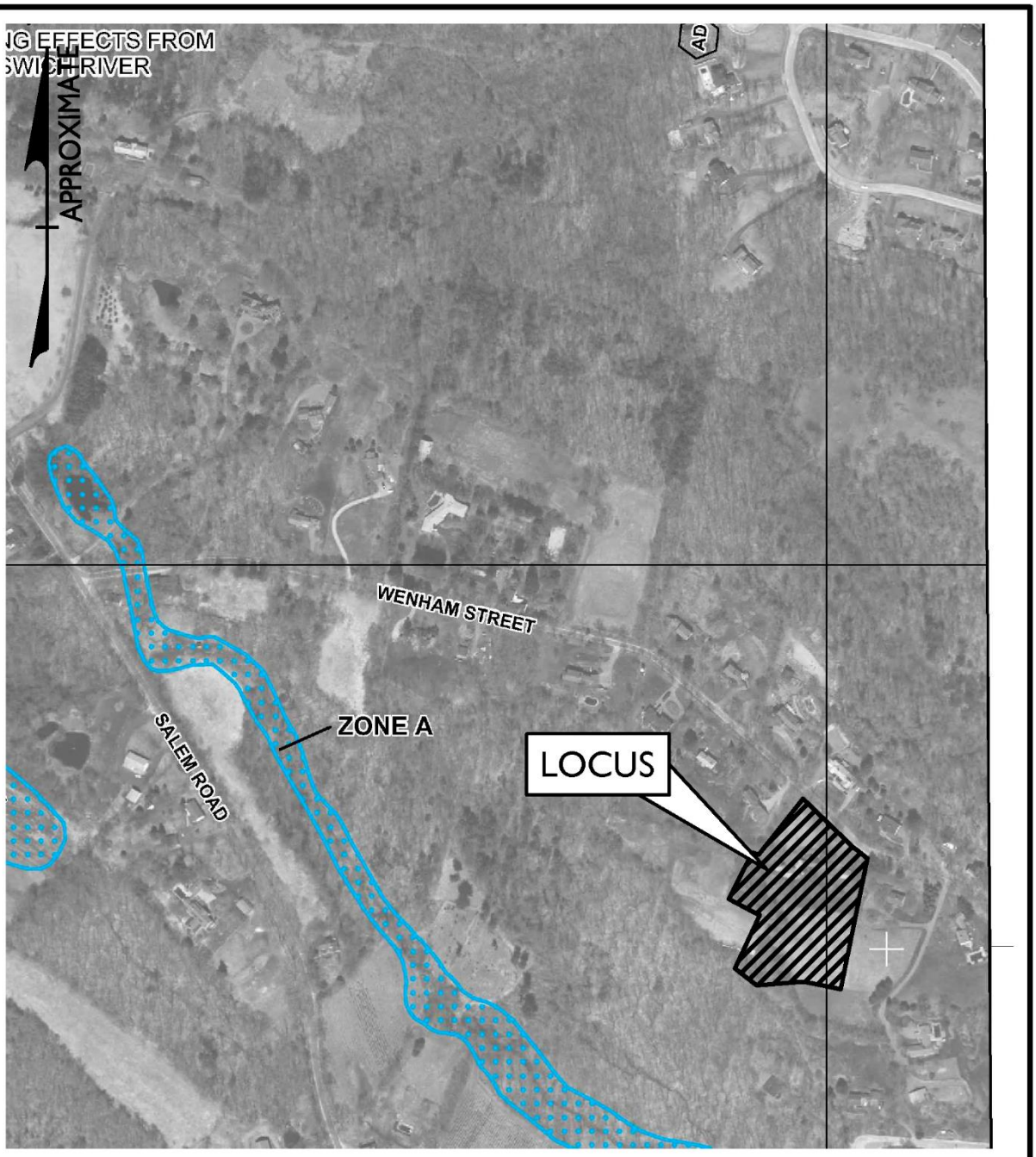
This project, as proposed, is in full compliance with the DEP and the Town of Topsfield Stormwater Standards as described above. The proposed development will enhance the quality of runoff discharging to the design point and all new discharges have been designed in compliance with the current stormwater standards.

The DEP Checklist for Stormwater Report is attached (see pages 64-72).

USGS MAP (FIGURE 1)



FEMA MAP (FIGURE 2)



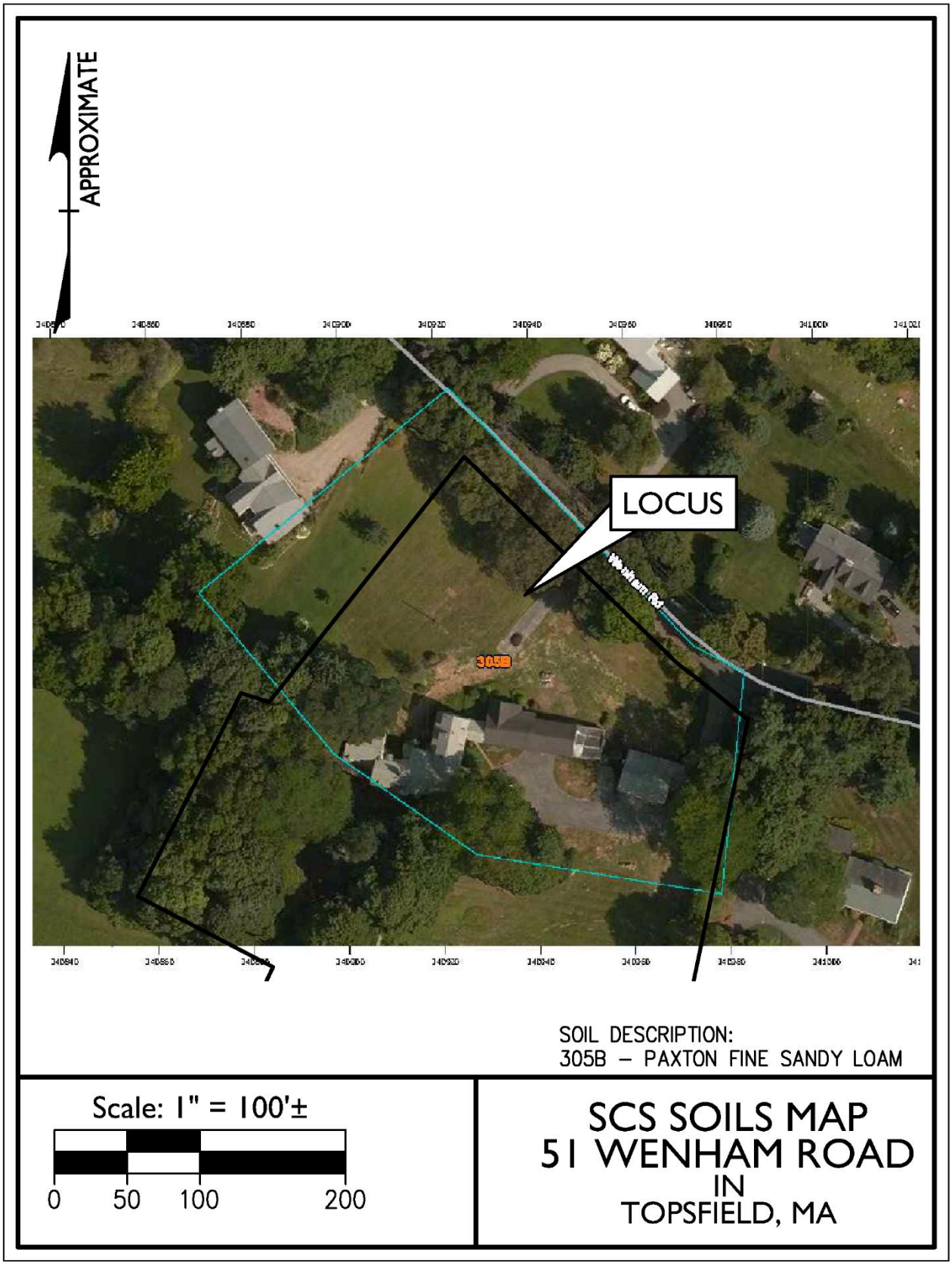
FEMA MAP #25009C0-402F

Scale: 1" = 500'±

0 500 1,000 2,000

FEMA MAP
51 WENHAM ROAD
IN
TOPSFIELD, MA

USDA SOILS MAP (FIGURE 3)



USDA Soils Data

Custom Soil Resource Report

Essex County, Massachusetts, Northern Part

305B—Paxton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2qp
Elevation: 0 to 1,570 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Paxton

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Nose slope, crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: C

Minor Components

Woodbridge

Percent of map unit: 9 percent

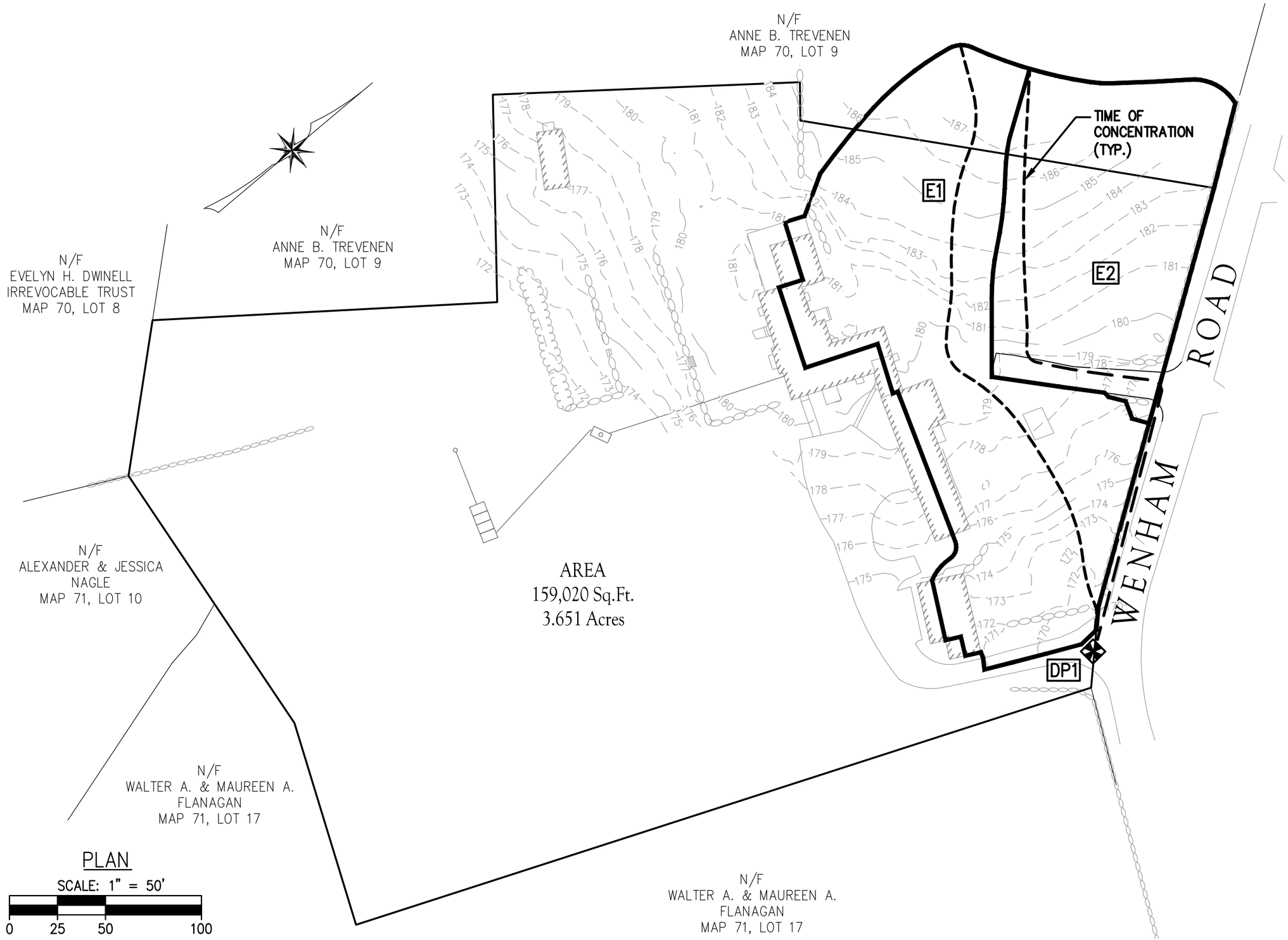
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Summit, footslope, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear

Ridgebury

Percent of map unit: 6 percent
Landform: Drainageways, hills, depressions, ground moraines
Landform position (two-dimensional): Toeslope, footslope, backslope
Landform position (three-dimensional): Head slope, base slope, dip
Down-slope shape: Concave
Across-slope shape: Concave

Charlton

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear

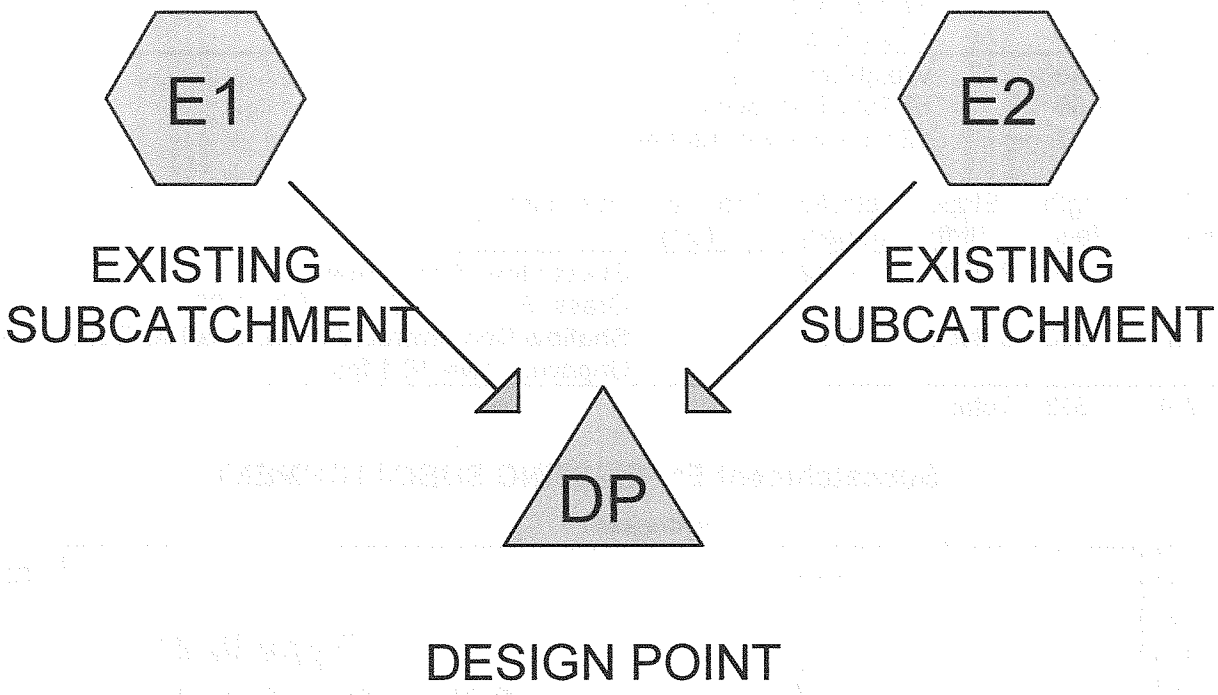


The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
447 BOSTON STREET - U.S. ROUTE 1, TOPSFIELD, MASSACHUSETTS 01983
P: 978-887-8586, F: 978-887-3480, W: WWW.MORINCAMERON.COM

DATE: MAY 10, 2016
SCALE: 1" = 50'

EXISTING DRAINAGE AREAS

AT:
51 WENHAM ROAD
TOPSFIELD, MASSACHUSETTS



DESIGN POINT

Subcat Reach Pond Link

Routing Diagram for 3450 Existing Conditions
Prepared by The Morin-Cameron Group, Inc., Printed 5/10/2016

Summary for Subcatchment E1: EXISTING SUBCATCHMENT

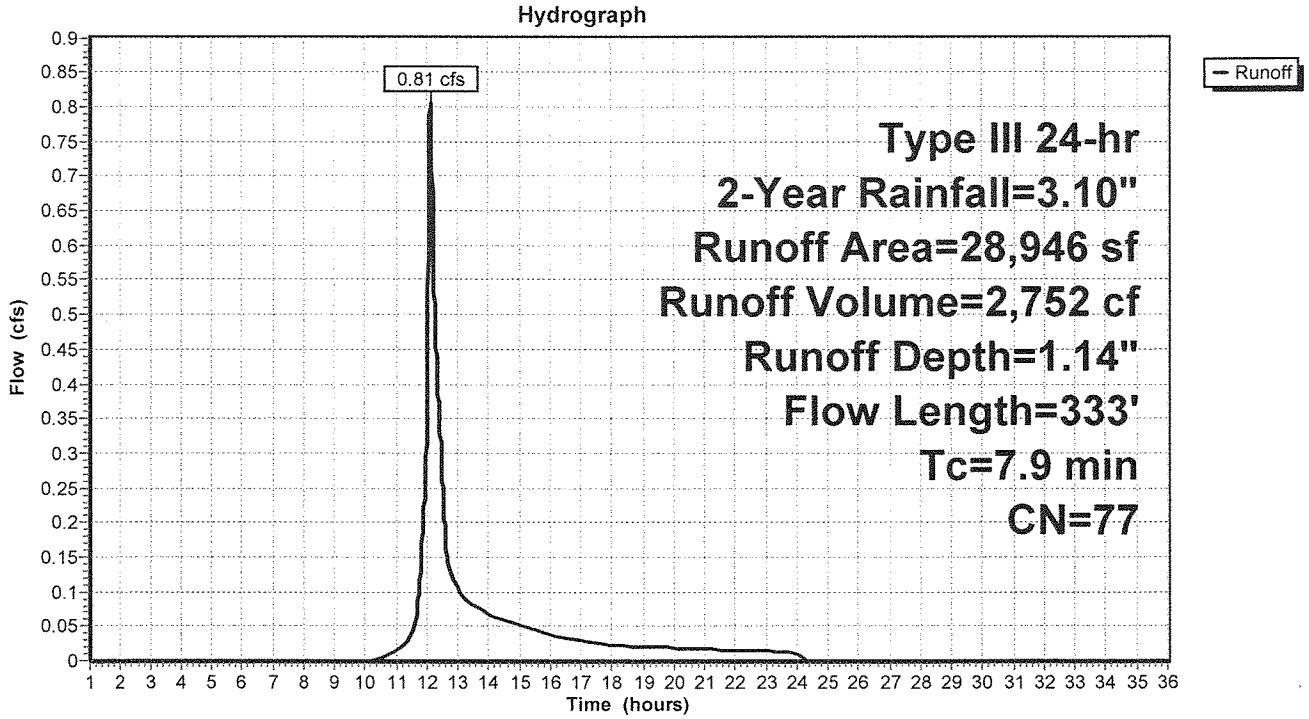
Runoff = 0.81 cfs @ 12.12 hrs, Volume= 2,752 cf, Depth= 1.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
3,070	98	Roofs, HSG C
407	98	Paved parking, HSG C
600	70	Woods, Good, HSG C
24,869	74	>75% Grass cover, Good, HSG C
28,946	77	Weighted Average
25,469		87.99% Pervious Area
3,477		12.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0500	0.12		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
1.2	283	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
7.9	333	Total			

Subcatchment E1: EXISTING SUBCATCHMENT



Summary for Subcatchment E2: EXISTING SUBCATCHMENT

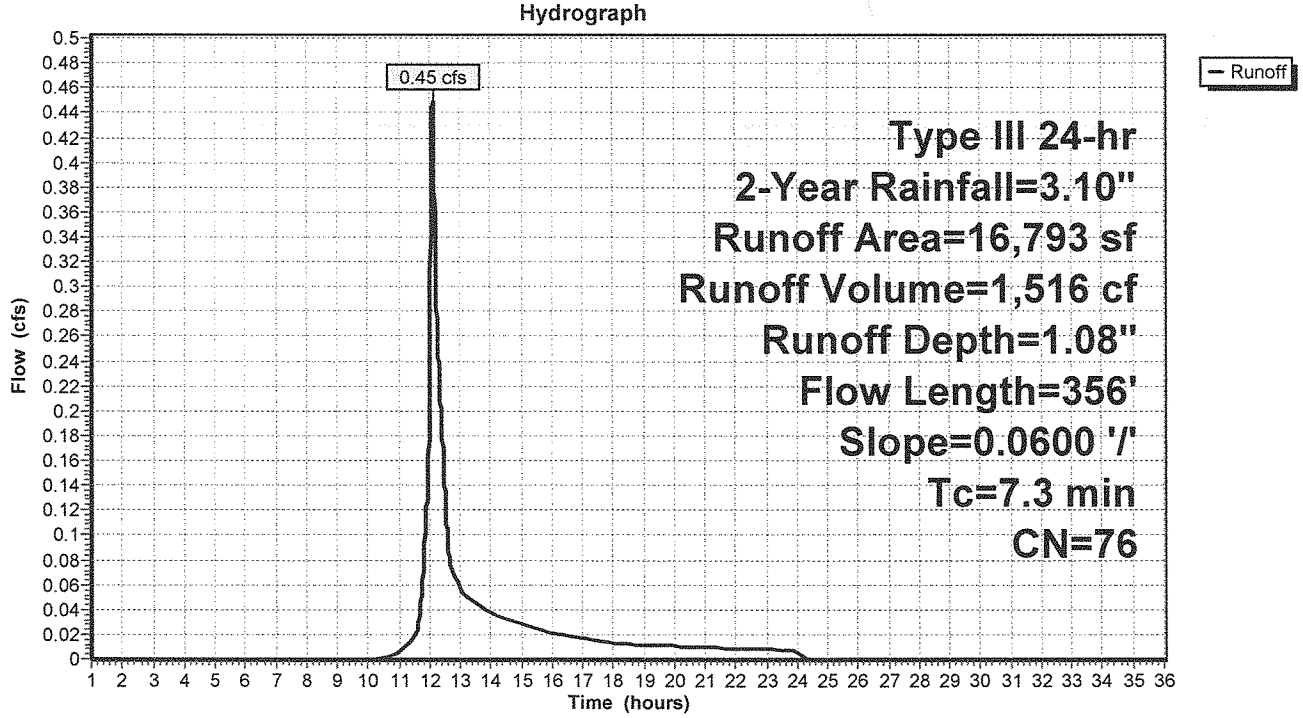
Runoff = 0.45 cfs @ 12.11 hrs, Volume= 1,516 cf, Depth= 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,096	98	Paved parking, HSG C
15,697	74	>75% Grass cover, Good, HSG C
16,793	76	Weighted Average
15,697		93.47% Pervious Area
1,096		6.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0600	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
0.4	100	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	206	0.0600	4.97		**Shallow Concentrated Flow, Shallow Concentrated- Pavement** Paved Kv= 20.3 fps
7.3	356	Total			

Subcatchment E2: EXISTING SUBCATCHMENT

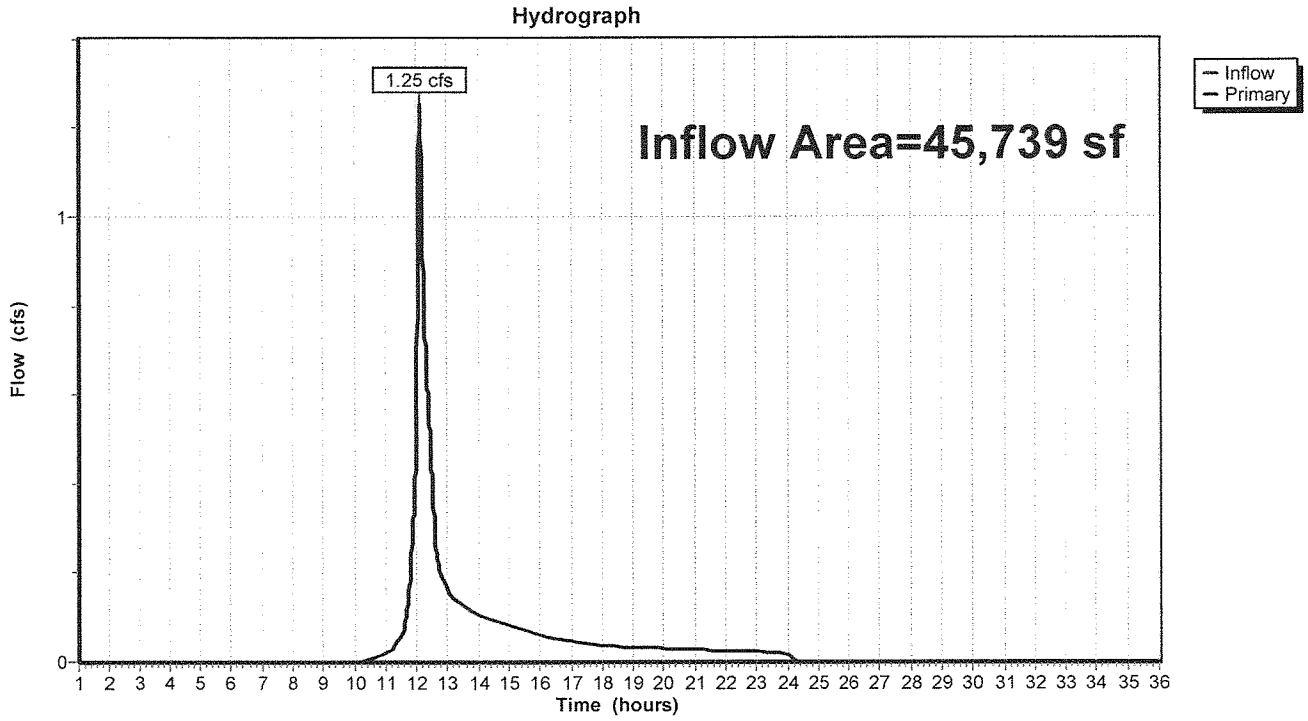


Summary for Pond DP: DESIGN POINT

Inflow Area = 45,739 sf, 10.00% Impervious, Inflow Depth = 1.12" for 2-Year event
Inflow = 1.25 cfs @ 12.12 hrs, Volume= 4,268 cf
Primary = 1.25 cfs @ 12.12 hrs, Volume= 4,268 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.01 hrs

Pond DP: DESIGN POINT



Summary for Subcatchment E1: EXISTING SUBCATCHMENT

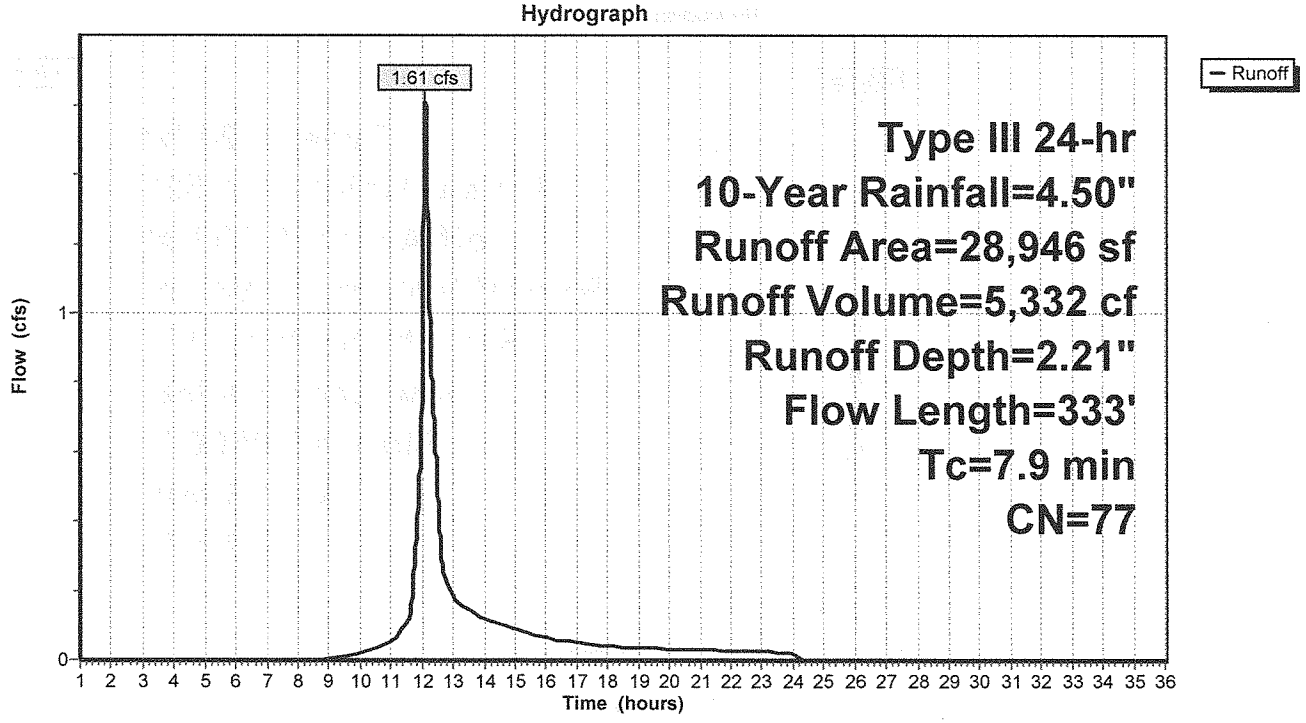
Runoff = 1.61 cfs @ 12.12 hrs, Volume= 5,332 cf, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
3,070	98	Roofs, HSG C
407	98	Paved parking, HSG C
600	70	Woods, Good, HSG C
24,869	74	>75% Grass cover, Good, HSG C
28,946	77	Weighted Average
25,469		87.99% Pervious Area
3,477		12.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0500	0.12		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
1.2	283	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
7.9	333	Total			

Subcatchment E1: EXISTING SUBCATCHMENT



Summary for Subcatchment E2: EXISTING SUBCATCHMENT

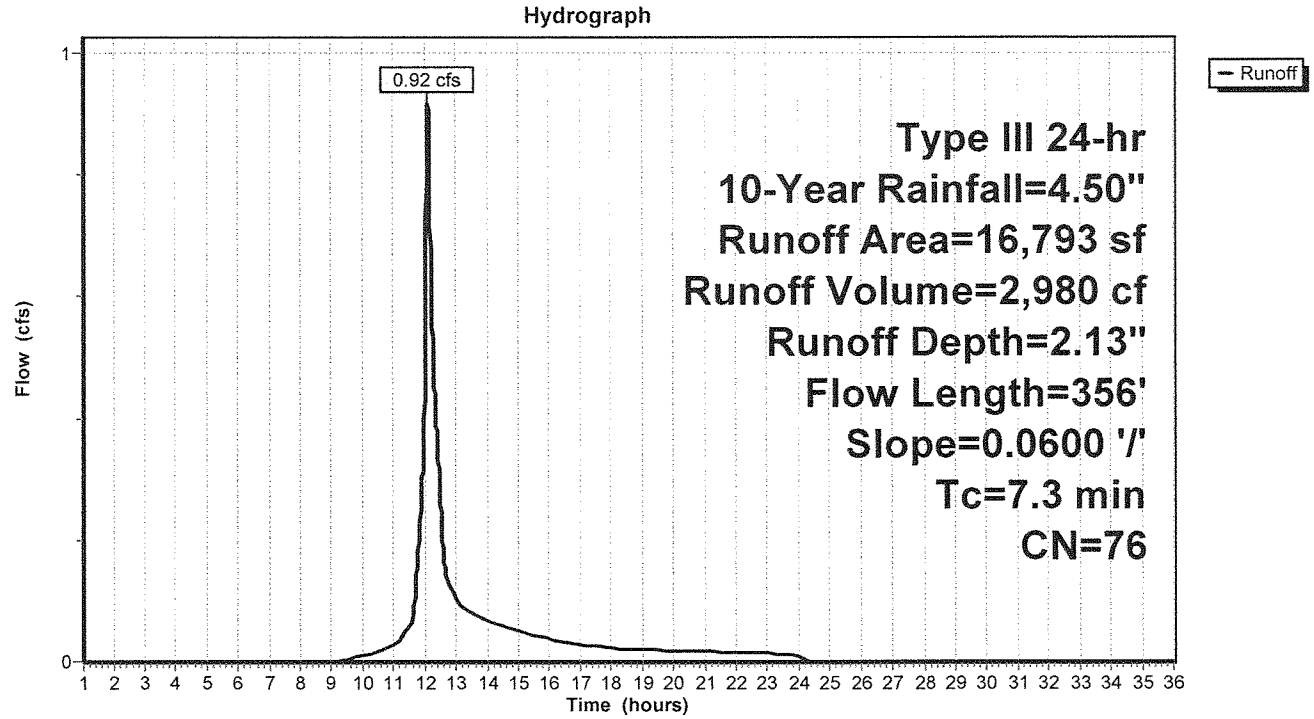
Runoff = 0.92 cfs @ 12.11 hrs, Volume= 2,980 cf, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,096	98	Paved parking, HSG C
15,697	74	>75% Grass cover, Good, HSG C
16,793	76	Weighted Average
15,697		93.47% Pervious Area
1,096		6.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0600	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
0.4	100	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	206	0.0600	4.97		**Shallow Concentrated Flow, Shallow Concentrated- Pavement** Paved Kv= 20.3 fps
7.3	356	Total			

Subcatchment E2: EXISTING SUBCATCHMENT

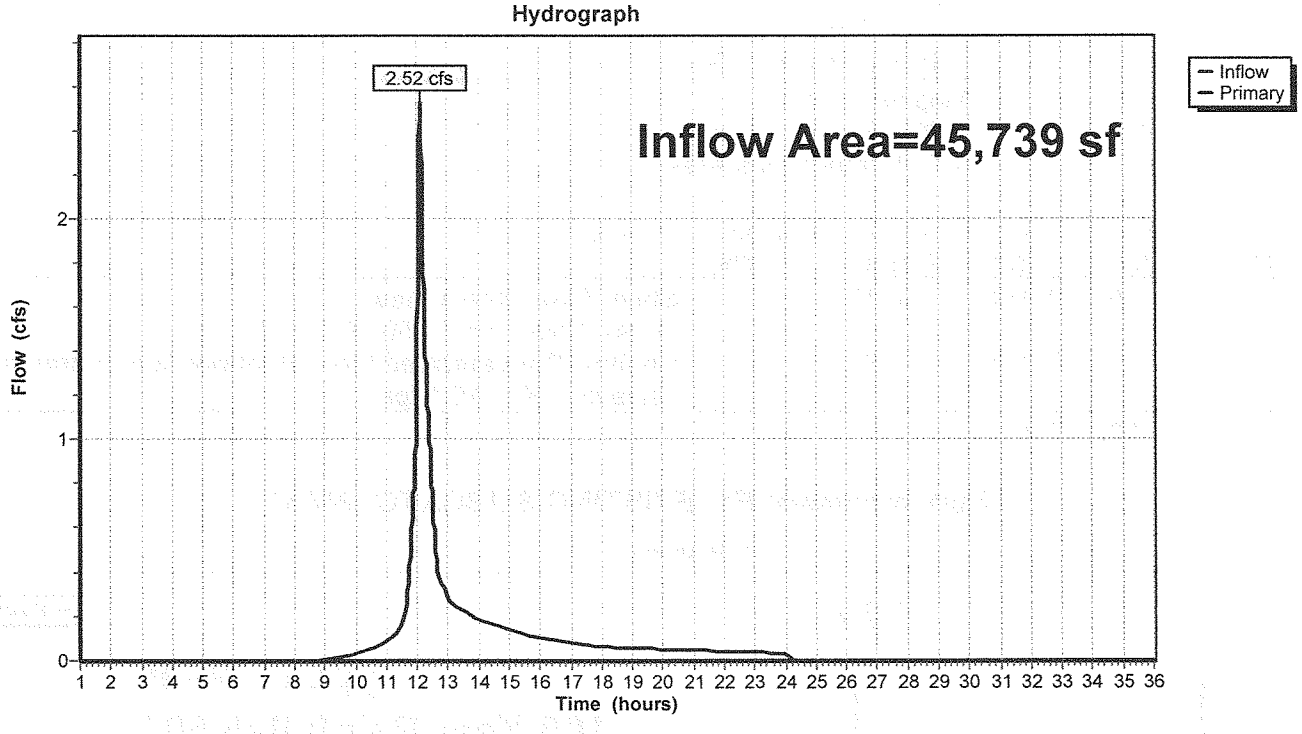


Summary for Pond DP: DESIGN POINT

Inflow Area = 45,739 sf, 10.00% Impervious, Inflow Depth = 2.18" for 10-Year event
Inflow = 2.52 cfs @ 12.11 hrs, Volume= 8,313 cf
Primary = 2.52 cfs @ 12.11 hrs, Volume= 8,313 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.01 hrs

Pond DP: DESIGN POINT



Summary for Subcatchment E1: EXISTING SUBCATCHMENT

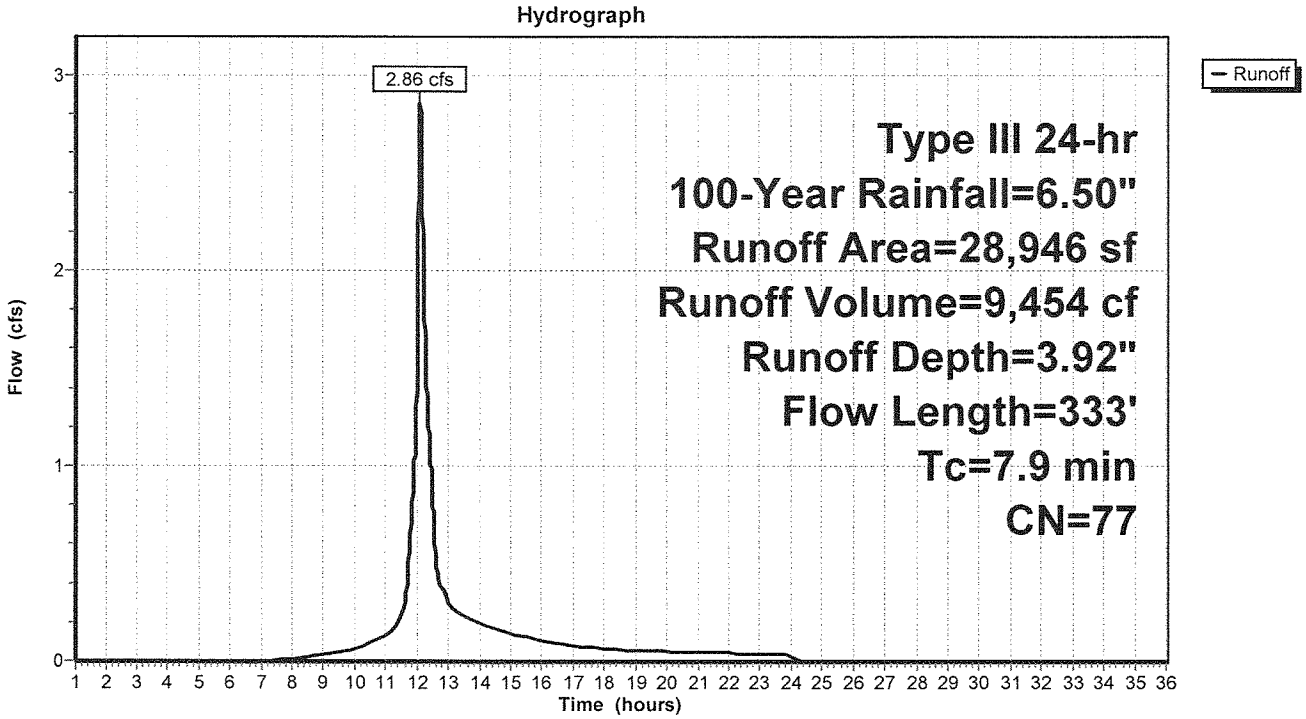
Runoff = 2.86 cfs @ 12.11 hrs, Volume= 9,454 cf, Depth= 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
3,070	98	Roofs, HSG C
407	98	Paved parking, HSG C
600	70	Woods, Good, HSG C
24,869	74	>75% Grass cover, Good, HSG C
28,946	77	Weighted Average
25,469		87.99% Pervious Area
3,477		12.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0500	0.12		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
1.2	283	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
7.9	333	Total			

Subcatchment E1: EXISTING SUBCATCHMENT



Summary for Subcatchment E2: EXISTING SUBCATCHMENT

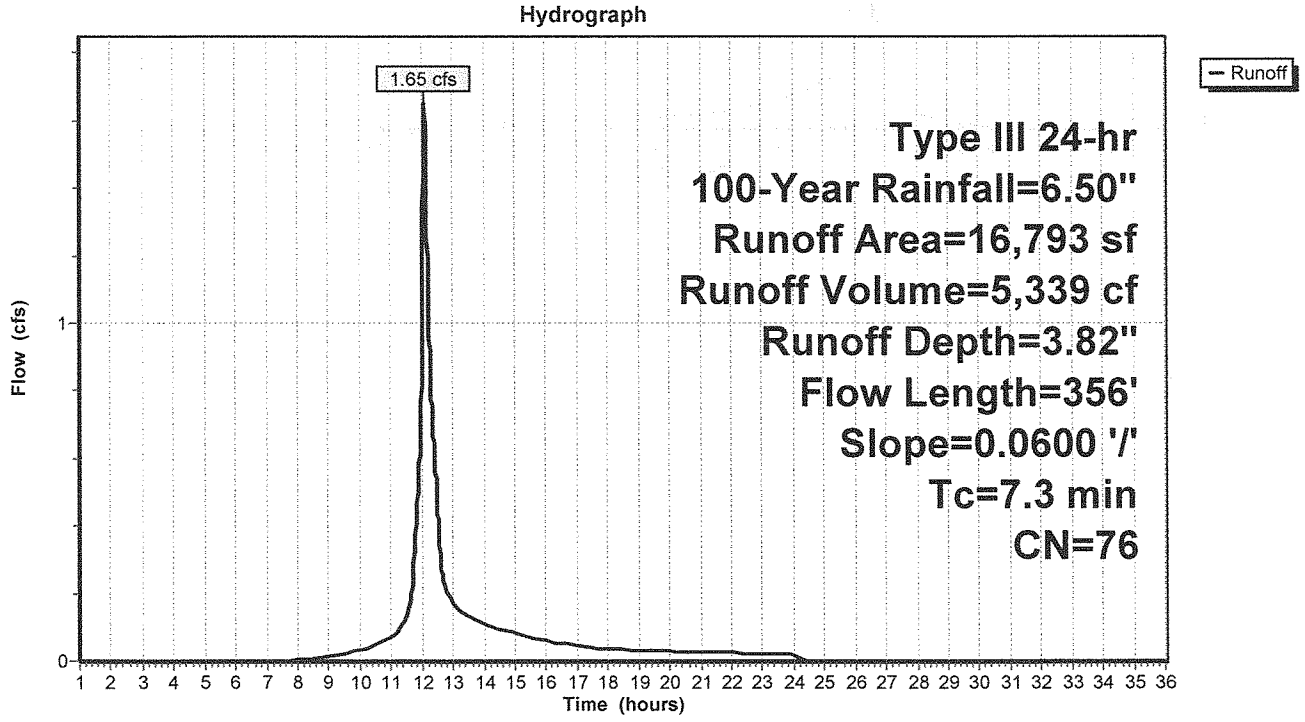
Runoff = 1.65 cfs @ 12.11 hrs, Volume= 5,339 cf, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,096	98	Paved parking, HSG C
15,697	74	>75% Grass cover, Good, HSG C
16,793	76	Weighted Average
15,697		93.47% Pervious Area
1,096		6.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0600	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
0.4	100	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	206	0.0600	4.97		**Shallow Concentrated Flow, Shallow Concentrated- Pavement** Paved Kv= 20.3 fps
7.3	356	Total			

Subcatchment E2: EXISTING SUBCATCHMENT

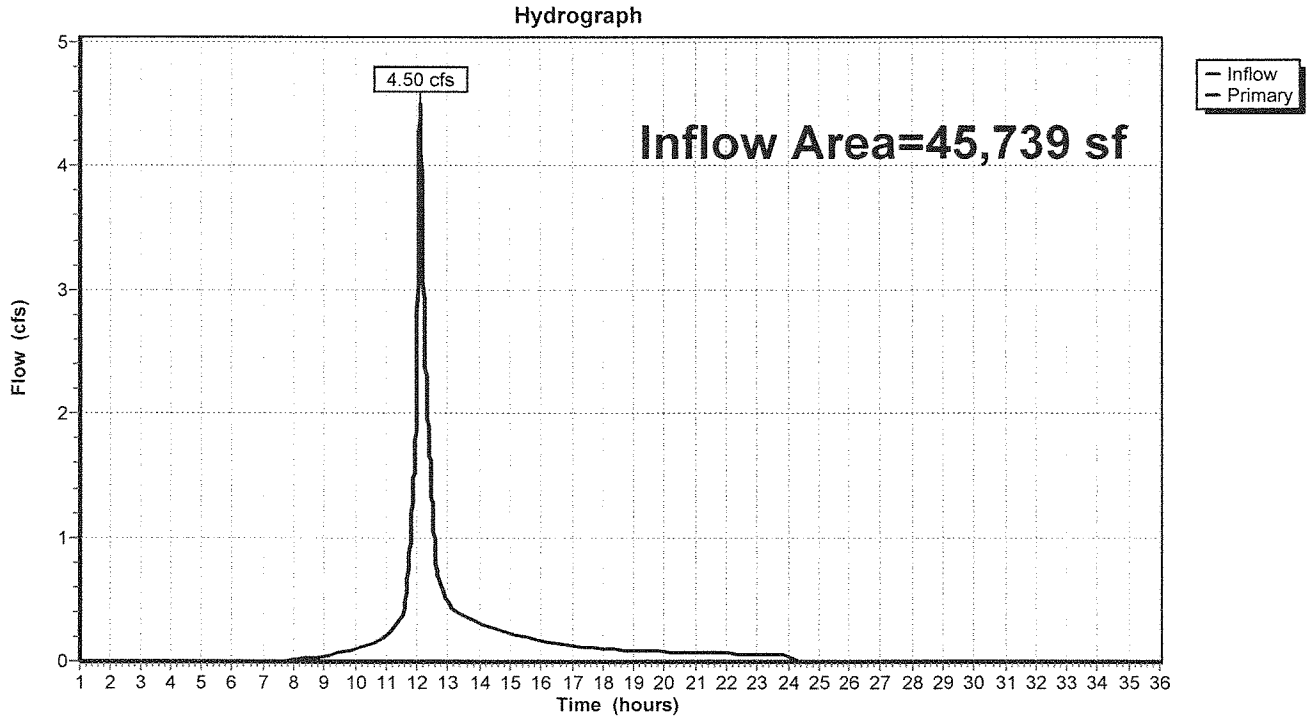


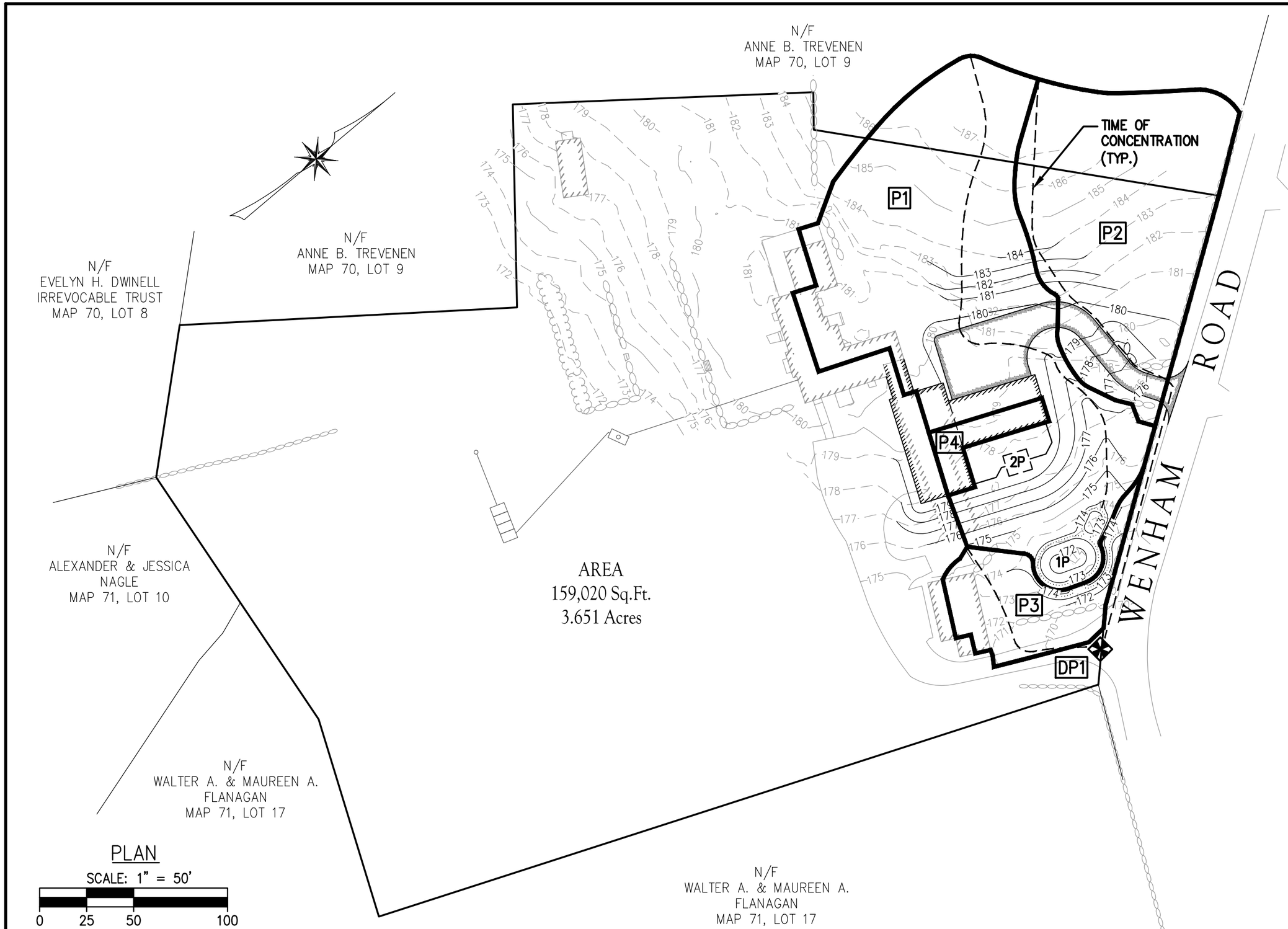
Summary for Pond DP: DESIGN POINT

Inflow Area = 45,739 sf, 10.00% Impervious, Inflow Depth = 3.88" for 100-Year event
Inflow = 4.50 cfs @ 12.11 hrs, Volume= 14,793 cf
Primary = 4.50 cfs @ 12.11 hrs, Volume= 14,793 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.01 hrs

Pond DP: DESIGN POINT





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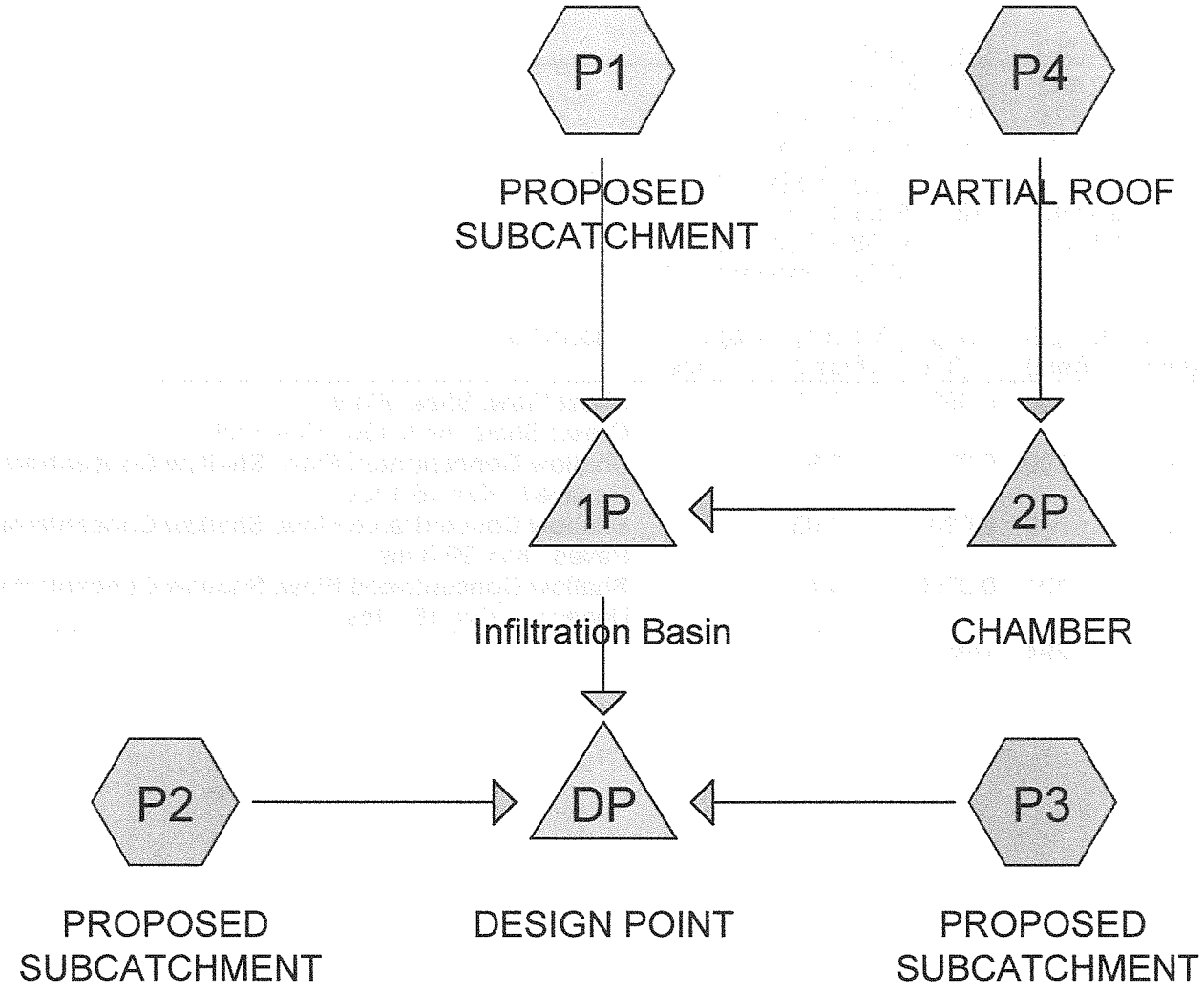
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
447 BOSTON STREET - U.S. ROUTE 1, TOPSFIELD, MASSACHUSETTS 01983
P: 978-887-8586, F: 978-887-3480, W: WWW.MORINCAMERON.COM

DATE: MAY 10, 2016
SCALE: 1" = 50'

PROPOSED DRAINAGE AREAS

AT:
51 WENHAM ROAD
TOPSFIELD, MASSACHUSETTS



Subcat Reach Pond Link

Routing Diagram for 3450 Proposed Conditions
Prepared by The Morin-Cameron Group, Inc., Printed 5/10/2016

Summary for Subcatchment P1: PROPOSED SUBCATCHMENT

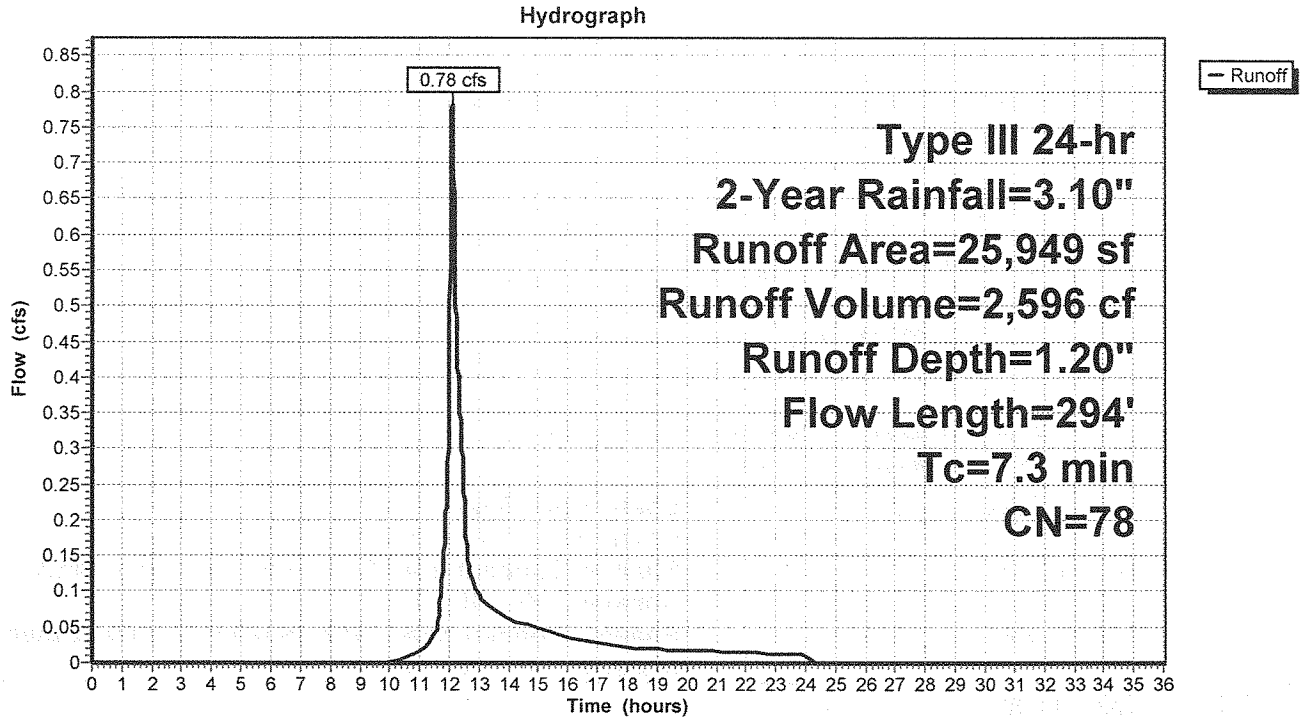
Runoff = 0.78 cfs @ 12.11 hrs, Volume= 2,596 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,402	98	Roofs, HSG C
1,912	98	Paved parking, HSG C
600	70	Woods, Good, HSG C
21,035	74	>75% Grass cover, Good, HSG C
25,949	78	Weighted Average
21,635		83.38% Pervious Area
4,314		16.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0600	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
0.4	100	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.3	40	0.0100	2.03		**Shallow Concentrated Flow, Shallow Concentrated - Pavement** Paved Kv= 20.3 fps
0.4	104	0.0750	4.41		**Shallow Concentrated Flow, Shallow Concentrated - Lawn** Unpaved Kv= 16.1 fps
7.3	294	Total			

Subcatchment P1: PROPOSED SUBCATCHMENT



Summary for Subcatchment P2: PROPOSED SUBCATCHMENT

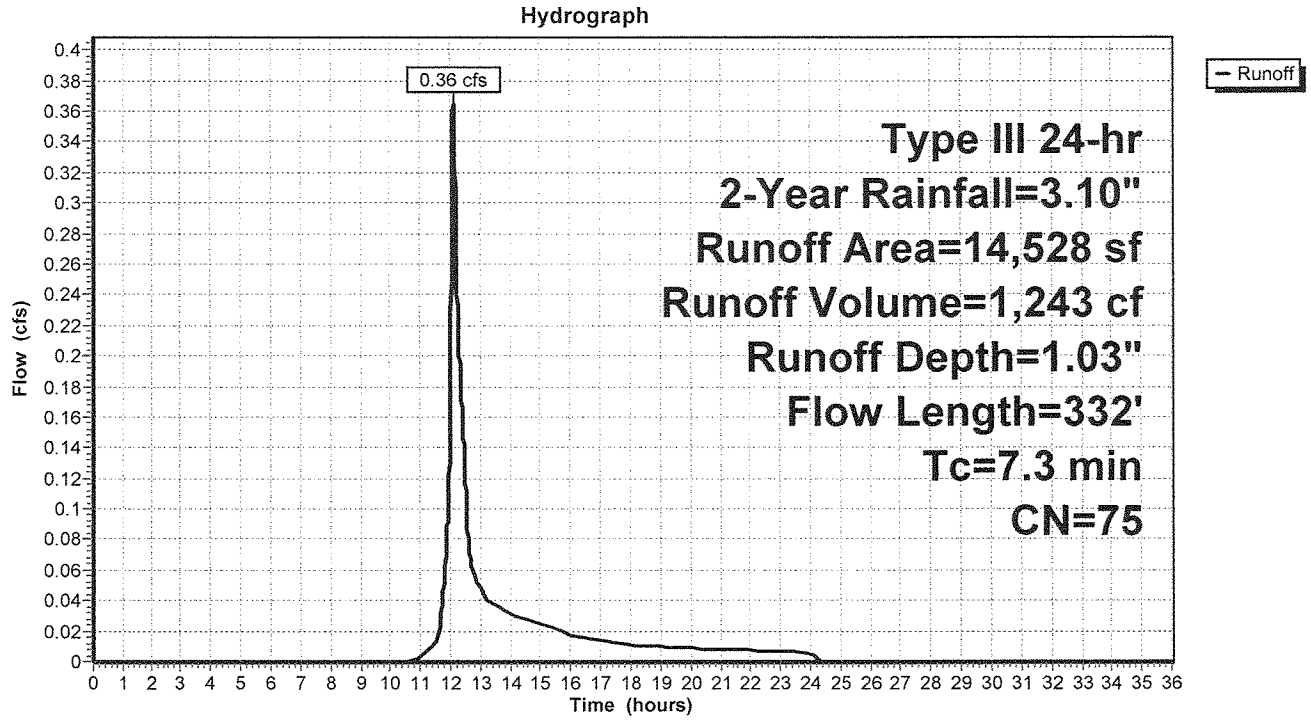
Runoff = 0.36 cfs @ 12.11 hrs, Volume= 1,243 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
888	98	Paved parking, HSG C
13,640	74	>75% Grass cover, Good, HSG C
14,528	75	Weighted Average
13,640		93.89% Pervious Area
888		6.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0600	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
0.5	140	0.0750	4.41		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.6	142	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated - Pavement** Unpaved Kv= 16.1 fps
7.3	332	Total			

Subcatchment P2: PROPOSED SUBCATCHMENT



Summary for Subcatchment P3: PROPOSED SUBCATCHMENT

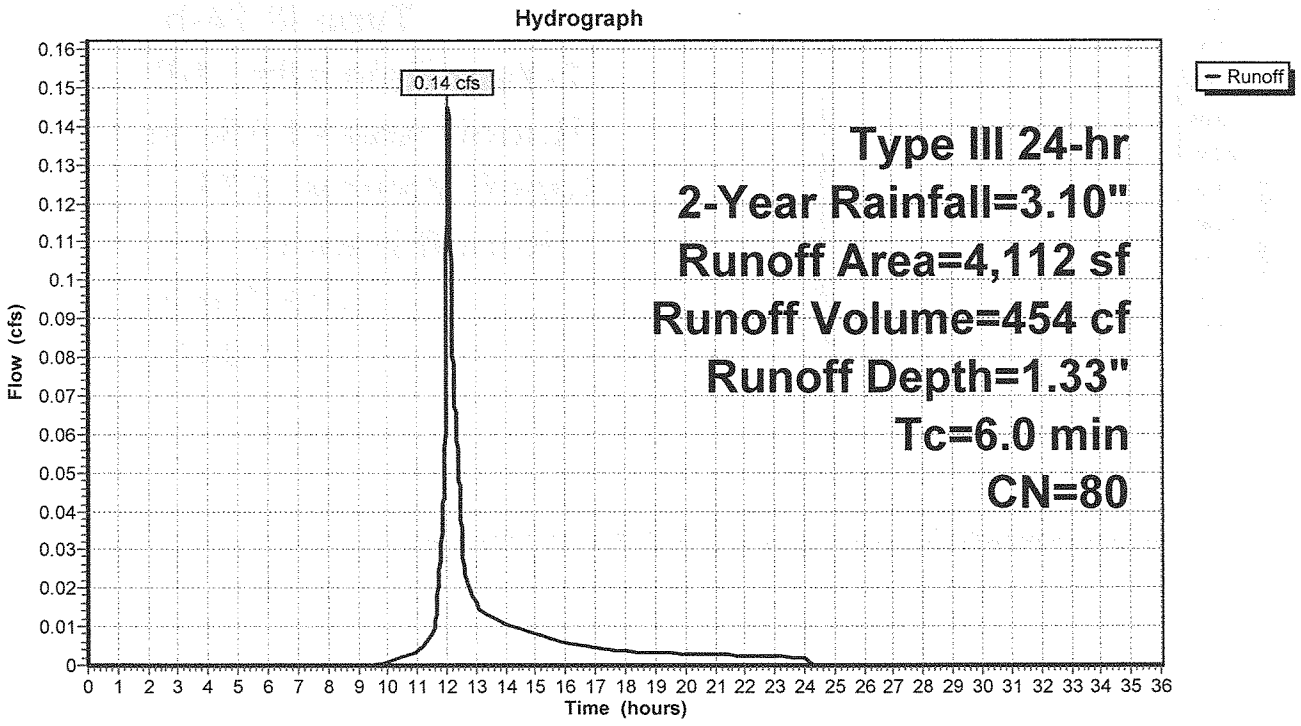
Runoff = 0.14 cfs @ 12.09 hrs, Volume= 454 cf, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
619	98	Roofs, HSG C
407	98	Paved parking, HSG C
3,086	74	>75% Grass cover, Good, HSG C
4,112	80	Weighted Average
3,086		75.05% Pervious Area
1,026		24.95% Impervious Area

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

Subcatchment P3: PROPOSED SUBCATCHMENT



Summary for Subcatchment P4: PARTIAL ROOF

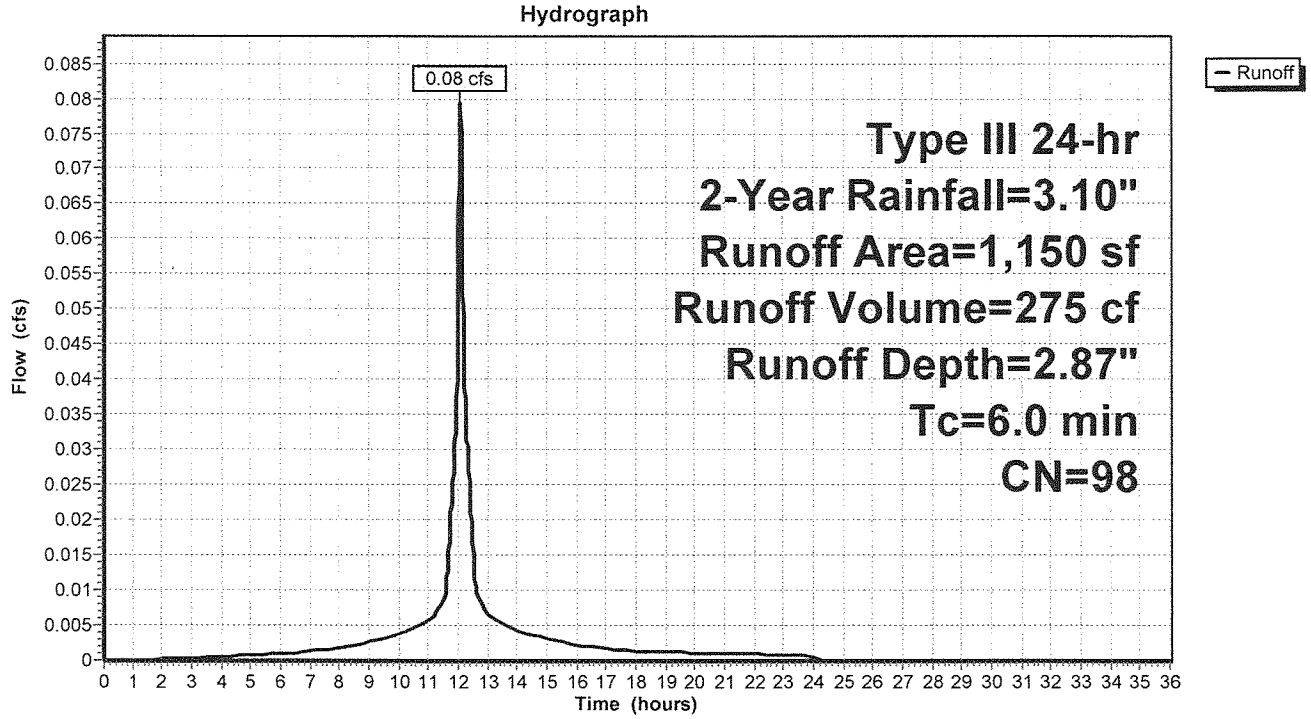
Runoff = 0.08 cfs @ 12.08 hrs, Volume= 275 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,150	98	Roofs, HSG C
1,150		100.00% Impervious Area

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

Subcatchment P4: PARTIAL ROOF



Summary for Pond 1P: Infiltration Basin

Inflow Area = 27,099 sf, 20.16% Impervious, Inflow Depth = 1.15" for 2-Year event
Inflow = 0.78 cfs @ 12.11 hrs, Volume= 2,596 cf
Outflow = 0.63 cfs @ 12.18 hrs, Volume= 2,584 cf, Atten= 19%, Lag= 4.0 min
Discarded = 0.02 cfs @ 12.18 hrs, Volume= 1,115 cf
Primary = 0.62 cfs @ 12.18 hrs, Volume= 1,469 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 173.26' @ 12.18 hrs Surf.Area= 704 sf Storage= 553 cf

Plug-Flow detention time= 177.2 min calculated for 2,583 cf (100% of inflow)
Center-of-Mass det. time= 174.6 min (1,026.7 - 852.1)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	1,185 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

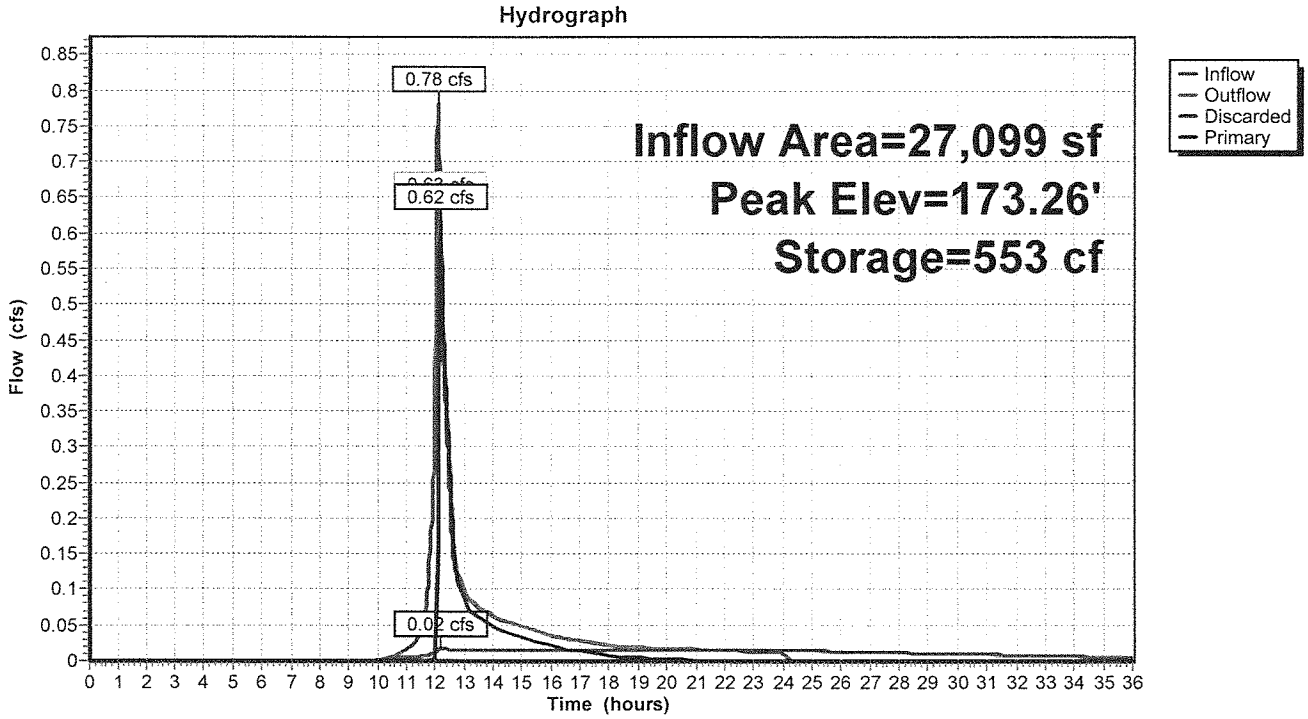
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
172.00	178	0	0
173.00	590	384	384
173.50	807	349	733
174.00	1,000	452	1,185

Device	Routing	Invert	Outlet Devices
#1	Discarded	172.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	173.10'	**4.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.02 cfs @ 12.18 hrs HW=173.26' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=0.62 cfs @ 12.18 hrs HW=173.26' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.62 cfs @ 0.95 fps)

Pond 1P: Infiltration Basin



Summary for Pond 2P: CHAMBER

Inflow Area = 1,150 sf,100.00% Impervious, Inflow Depth = 2.87" for 2-Year event
Inflow = 0.08 cfs @ 12.08 hrs, Volume= 275 cf
Outflow = 0.00 cfs @ 14.66 hrs, Volume= 275 cf, Atten= 96%, Lag= 154.8 min
Discarded = 0.00 cfs @ 14.66 hrs, Volume= 275 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 177.05' @ 14.66 hrs Surf.Area= 146 sf Storage= 135 cf

Plug-Flow detention time= 333.5 min calculated for 275 cf (100% of inflow)
Center-of-Mass det. time= 333.5 min (1,090.6 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	175.50'	114 cf	**11.25'W x 13.00'L x 2.54'H Field A** 372 cf Overall - 87 cf Embedded = 284 cf x 40.0% Voids
#2A	176.00'	87 cf	**Cultec R-150XLHD** x 3 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 3 rows
#3	178.04'	0 cf	**0.33'D x 3.00'H Vertical Cone/Cylinder**-Impervious
		201 cf	Total Available Storage

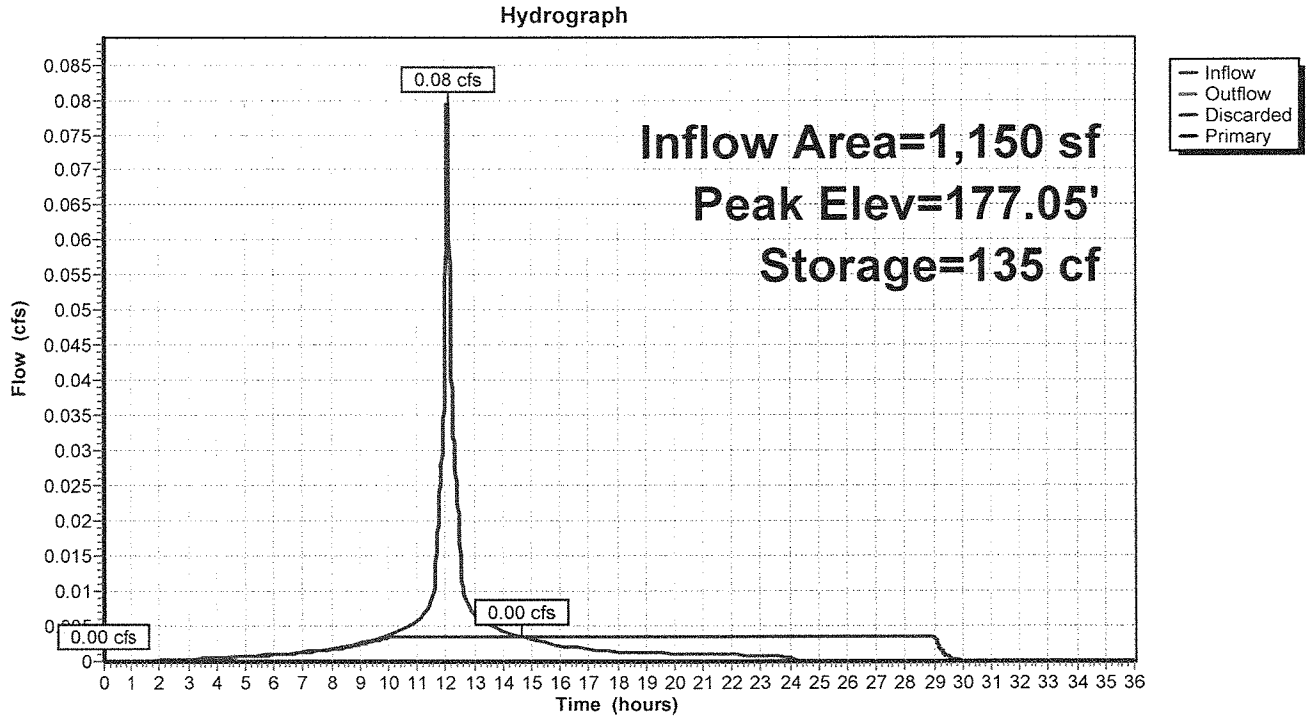
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	175.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	180.20'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 14.66 hrs HW=177.05' (Free Discharge)
↑**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=175.50' (Free Discharge)
↑**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: CHAMBER

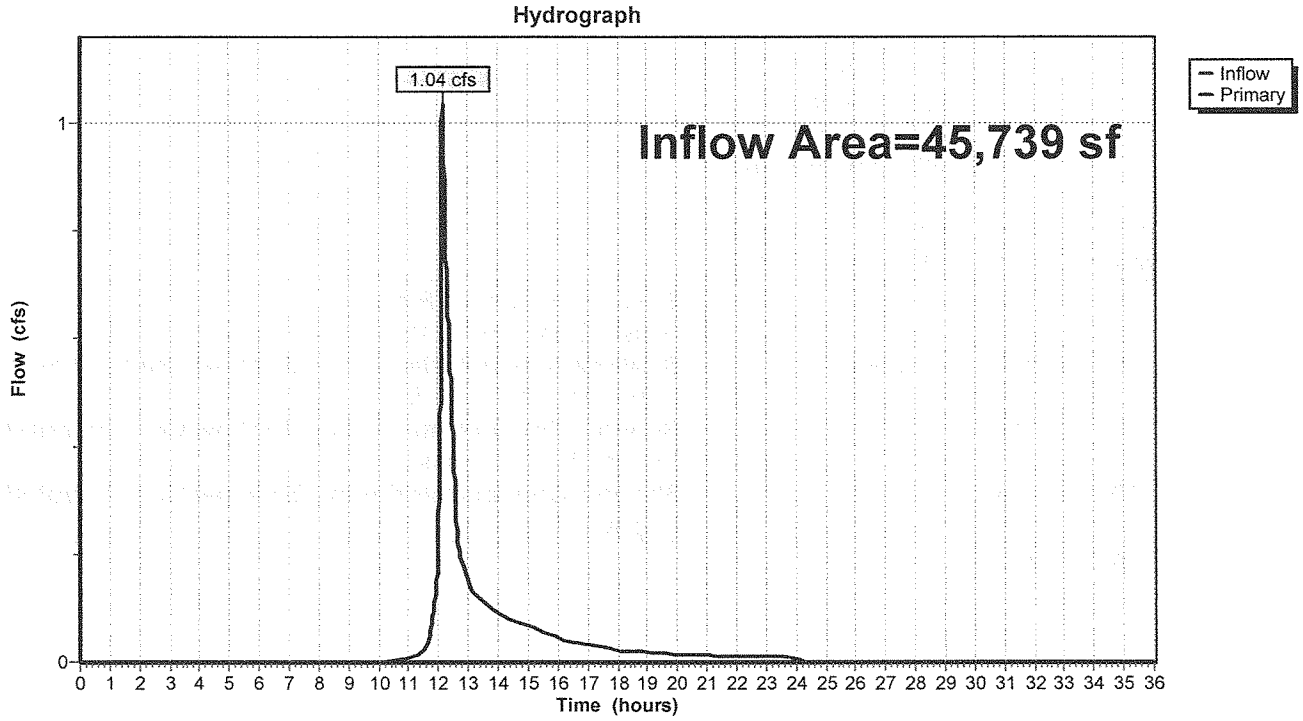


Summary for Pond DP: DESIGN POINT

Inflow Area = 45,739 sf, 16.13% Impervious, Inflow Depth = 0.83" for 2-Year event
Inflow = 1.04 cfs @ 12.16 hrs, Volume= 3,167 cf
Primary = 1.04 cfs @ 12.16 hrs, Volume= 3,167 cf, Atten= 0%, Lag= 0.0 min

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

Pond DP: DESIGN POINT



Summary for Subcatchment P1: PROPOSED SUBCATCHMENT

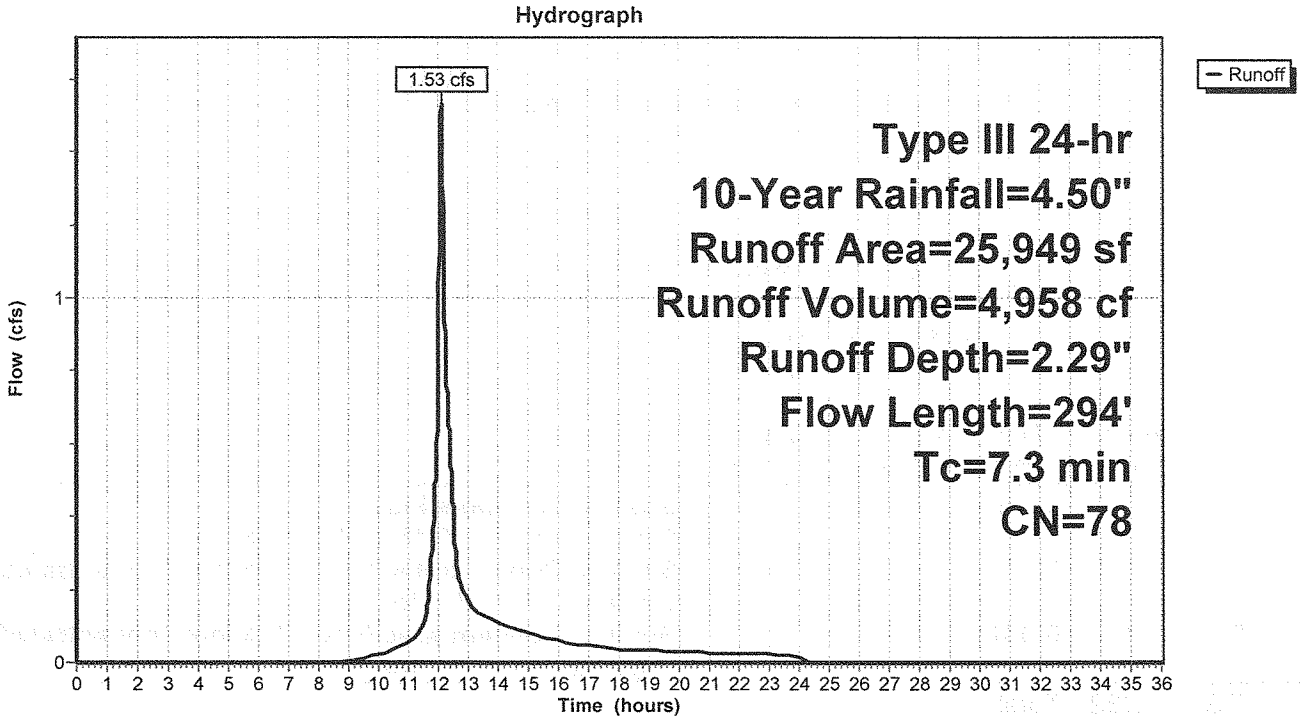
Runoff = 1.53 cfs @ 12.11 hrs, Volume= 4,958 cf, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,402	98	Roofs, HSG C
1,912	98	Paved parking, HSG C
600	70	Woods, Good, HSG C
21,035	74	>75% Grass cover, Good, HSG C
25,949	78	Weighted Average
21,635		83.38% Pervious Area
4,314		16.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0600	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
0.4	100	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.3	40	0.0100	2.03		**Shallow Concentrated Flow, Shallow Concentrated - Pavement** Paved Kv= 20.3 fps
0.4	104	0.0750	4.41		**Shallow Concentrated Flow, Shallow Concentrated - Lawn** Unpaved Kv= 16.1 fps
7.3	294	Total			

Subcatchment P1: PROPOSED SUBCATCHMENT



Summary for Subcatchment P2: PROPOSED SUBCATCHMENT

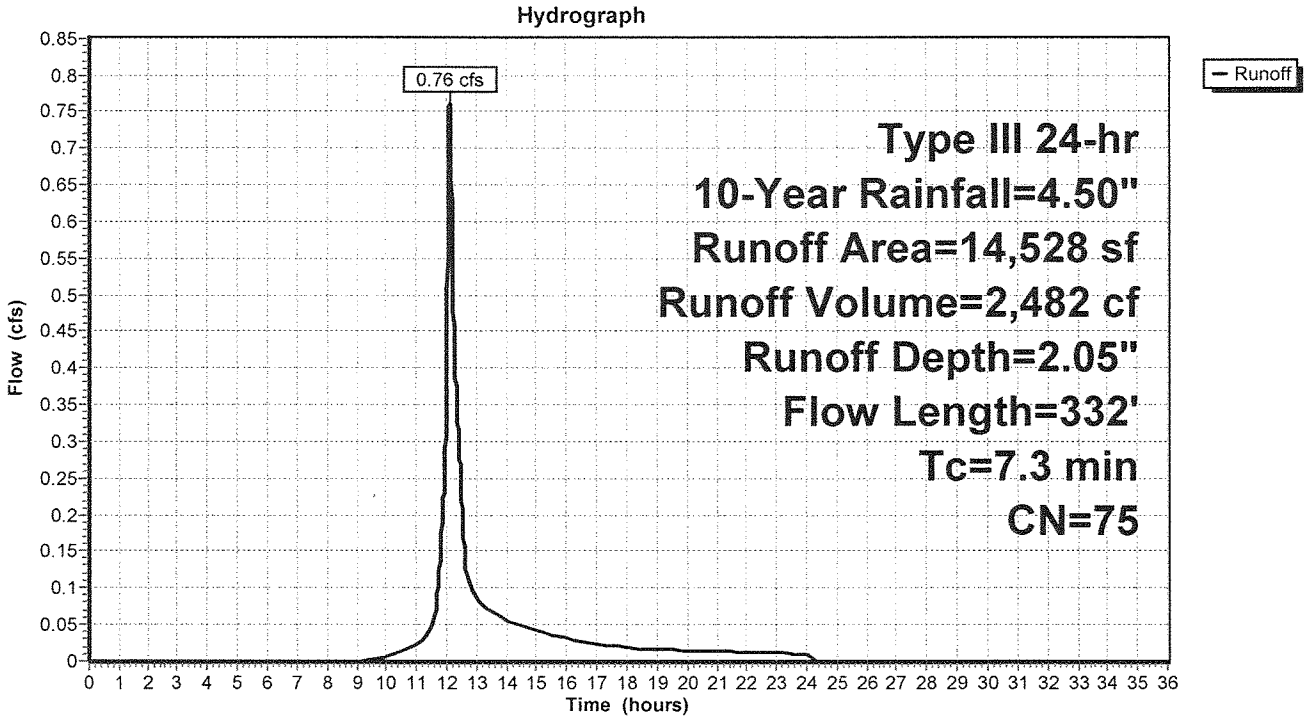
Runoff = 0.76 cfs @ 12.11 hrs, Volume= 2,482 cf, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
888	98	Paved parking, HSG C
13,640	74	>75% Grass cover, Good, HSG C
14,528	75	Weighted Average
13,640		93.89% Pervious Area
888		6.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0600	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
0.5	140	0.0750	4.41		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.6	142	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated - Pavement** Unpaved Kv= 16.1 fps
7.3	332	Total			

Subcatchment P2: PROPOSED SUBCATCHMENT



Summary for Subcatchment P3: PROPOSED SUBCATCHMENT

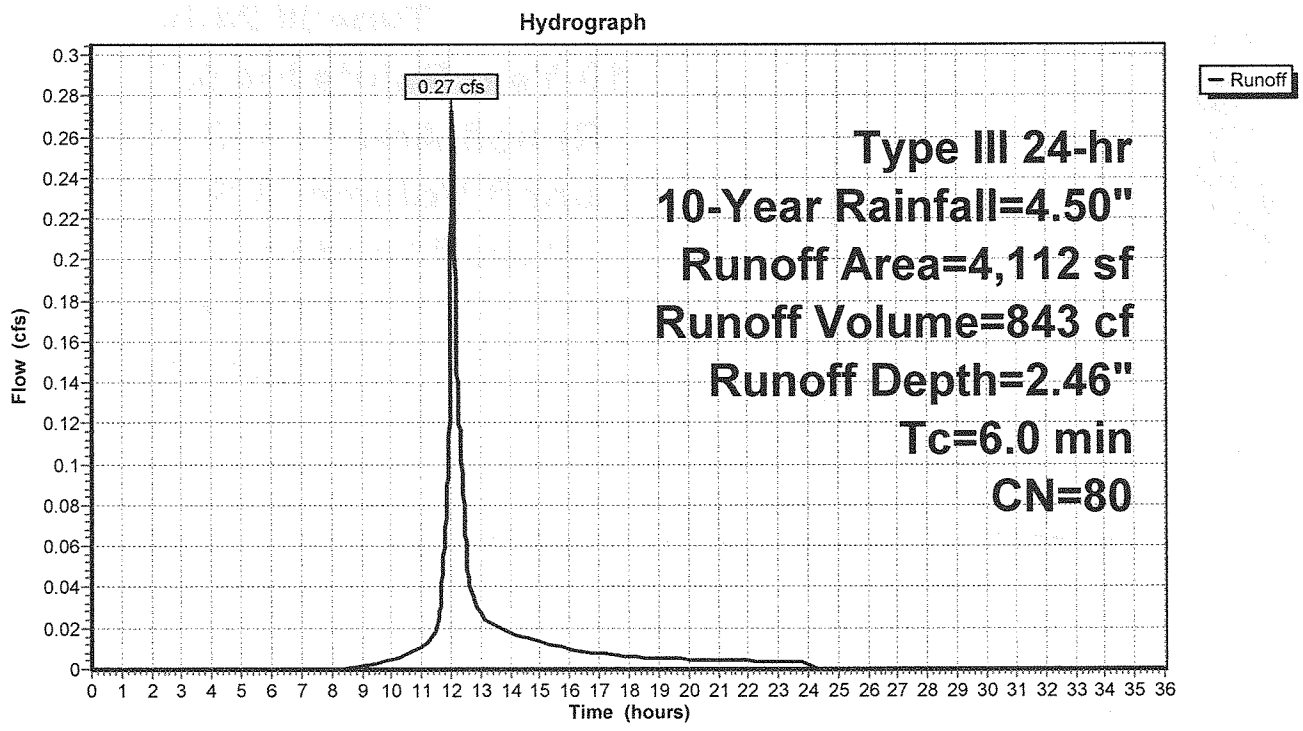
Runoff = 0.27 cfs @ 12.09 hrs, Volume= 843 cf, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
619	98	Roofs, HSG C
407	98	Paved parking, HSG C
3,086	74	>75% Grass cover, Good, HSG C
4,112	80	Weighted Average
3,086		75.05% Pervious Area
1,026		24.95% Impervious Area

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

Subcatchment P3: PROPOSED SUBCATCHMENT



Summary for Subcatchment P4: PARTIAL ROOF

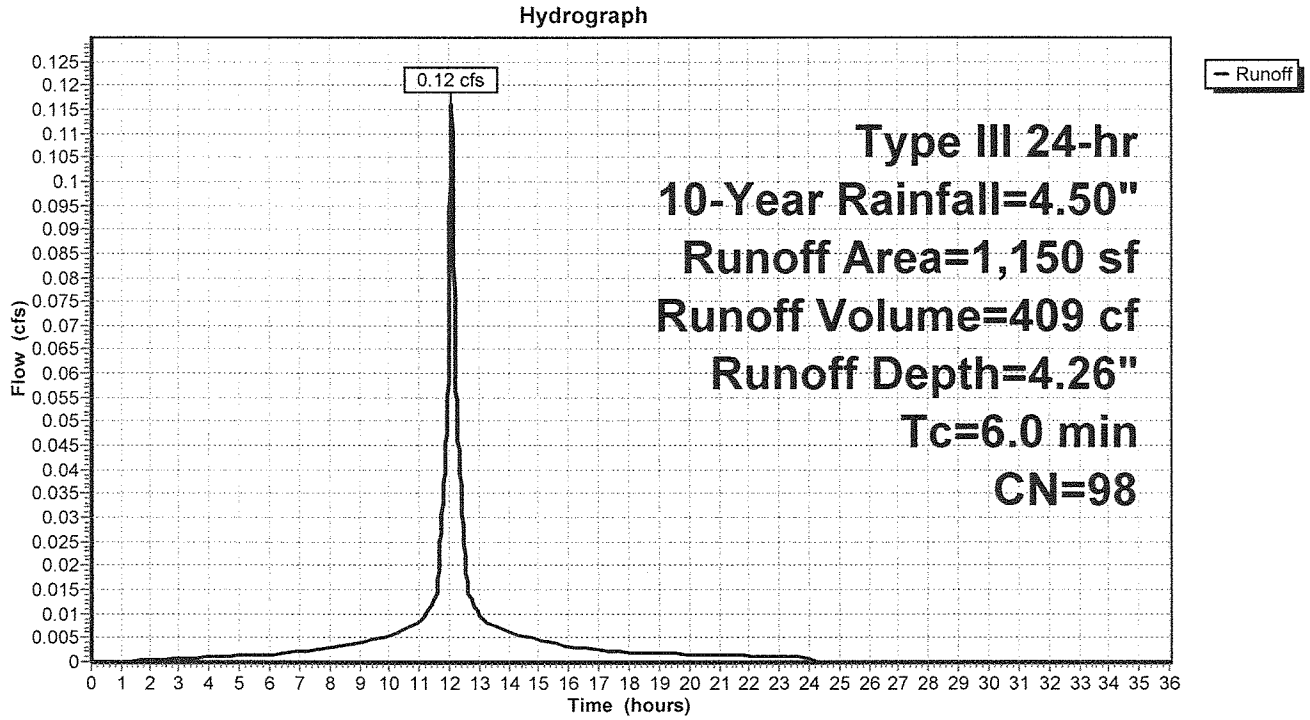
Runoff = 0.12 cfs @ 12.08 hrs, Volume= 409 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,150	98	Roofs, HSG C
1,150		100.00% Impervious Area

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

Subcatchment P4: PARTIAL ROOF



Summary for Pond 1P: Infiltration Basin

Inflow Area = 27,099 sf, 20.16% Impervious, Inflow Depth = 2.21" for 10-Year event
Inflow = 1.53 cfs @ 12.11 hrs, Volume= 4,988 cf
Outflow = 1.47 cfs @ 12.13 hrs, Volume= 4,970 cf, Atten= 4%, Lag= 1.5 min
Discarded = 0.02 cfs @ 12.13 hrs, Volume= 1,186 cf
Primary = 1.45 cfs @ 12.13 hrs, Volume= 3,784 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 173.38' @ 12.13 hrs Surf.Area= 756 sf Storage= 641 cf

Plug-Flow detention time= 98.2 min calculated for 4,969 cf (100% of inflow)
Center-of-Mass det. time= 96.2 min (929.2 - 833.1)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	1,185 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

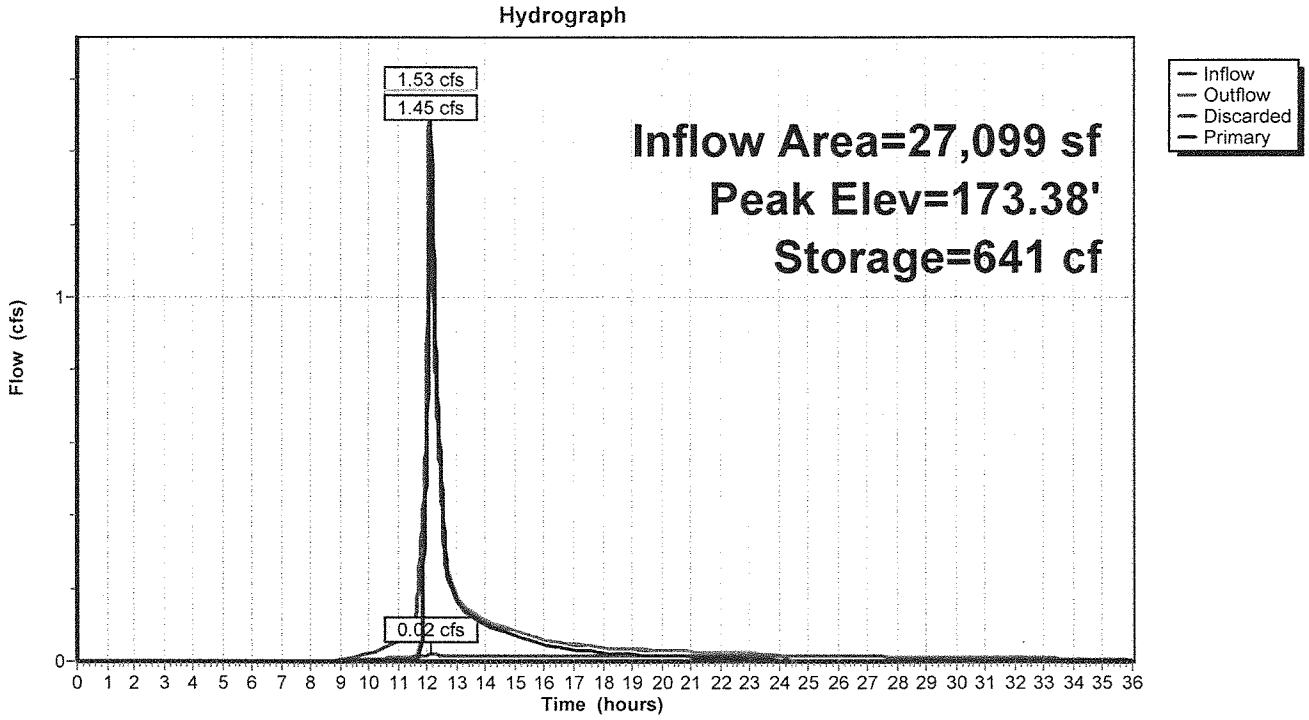
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
172.00	178	0	0
173.00	590	384	384
173.50	807	349	733
174.00	1,000	452	1,185

Device	Routing	Invert	Outlet Devices
#1	Discarded	172.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	173.10'	**4.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.02 cfs @ 12.13 hrs HW=173.38' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=1.45 cfs @ 12.13 hrs HW=173.38' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 1.45 cfs @ 1.29 fps)

Pond 1P: Infiltration Basin



Summary for Pond 2P: CHAMBER

Inflow Area = 1,150 sf,100.00% Impervious, Inflow Depth = 4.26" for 10-Year event
Inflow = 0.12 cfs @ 12.08 hrs, Volume= 409 cf
Outflow = 0.02 cfs @ 12.74 hrs, Volume= 407 cf, Atten= 85%, Lag= 39.4 min
Discarded = 0.00 cfs @ 12.74 hrs, Volume= 377 cf
Primary = 0.01 cfs @ 12.74 hrs, Volume= 30 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 180.25' @ 12.74 hrs Surf.Area= 146 sf Storage= 201 cf

Plug-Flow detention time= 468.1 min calculated for 407 cf (100% of inflow)
Center-of-Mass det. time= 465.7 min (1,215.6 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	175.50'	114 cf	**11.25'W x 13.00'L x 2.54'H Field A** 372 cf Overall - 87 cf Embedded = 284 cf x 40.0% Voids
#2A	176.00'	87 cf	**Cultec R-150XLHD** x 3 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 3 rows
#3	178.04'	0 cf	**0.33'D x 3.00'H Vertical Cone/Cylinder**-Impervious
		201 cf	Total Available Storage

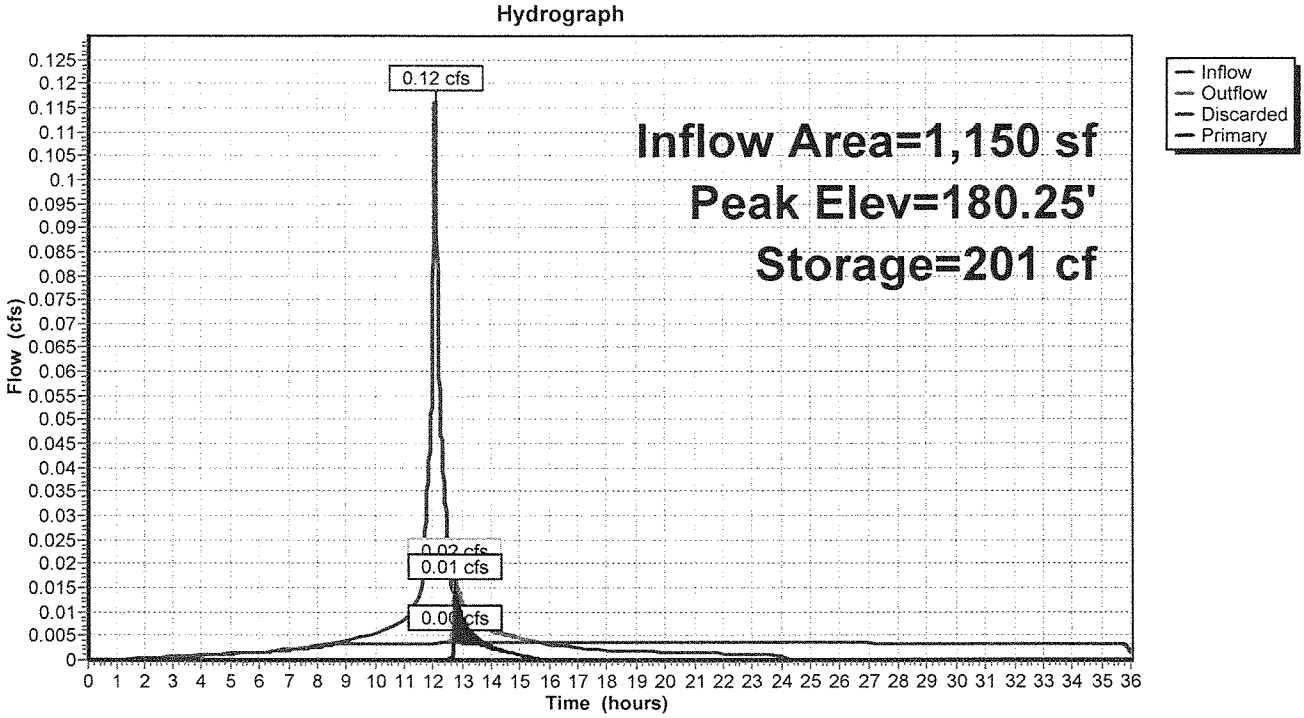
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	175.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	180.20'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 12.74 hrs HW=180.25' (Free Discharge)
↑**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.01 cfs @ 12.74 hrs HW=180.25' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.74 fps)

Pond 2P: CHAMBER

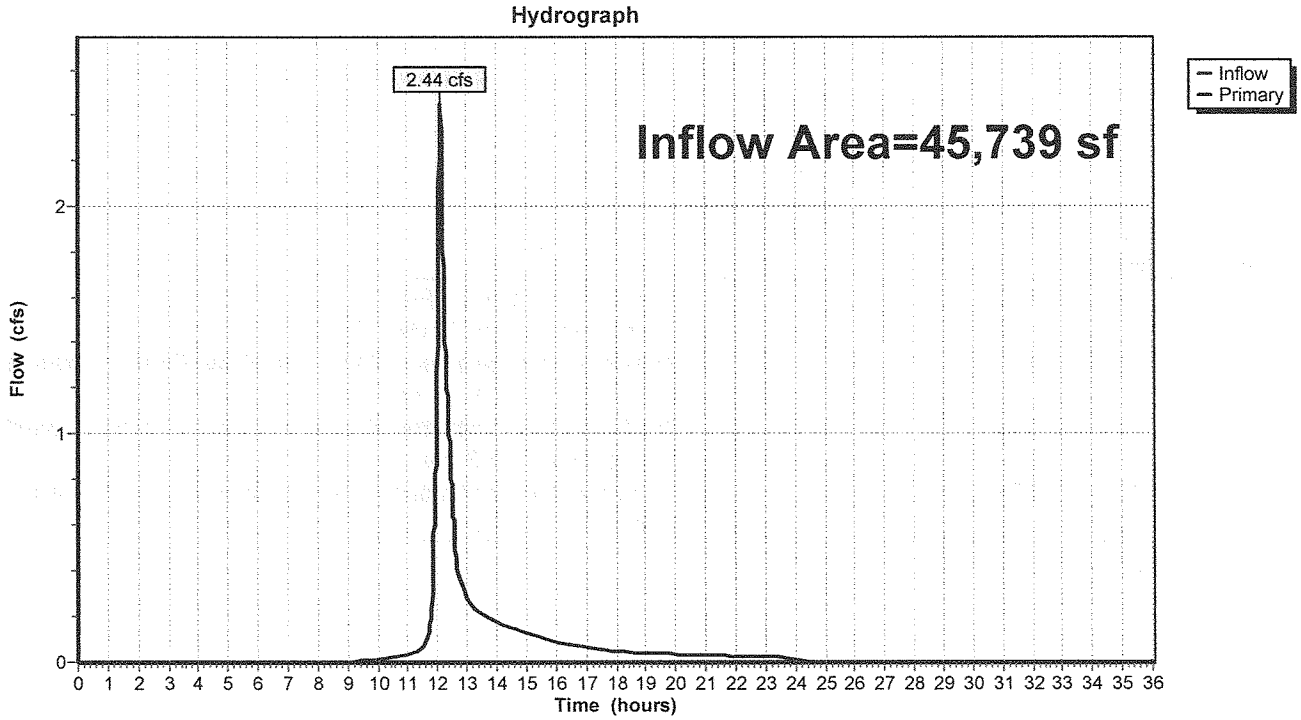


Summary for Pond DP: DESIGN POINT

Inflow Area = 45,739 sf, 16.13% Impervious, Inflow Depth = 1.87" for 10-Year event
Inflow = 2.44 cfs @ 12.12 hrs, Volume= 7,110 cf
Primary = 2.44 cfs @ 12.12 hrs, Volume= 7,110 cf, Atten= 0%, Lag= 0.0 min

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

Pond DP: DESIGN POINT



Summary for Subcatchment P1: PROPOSED SUBCATCHMENT

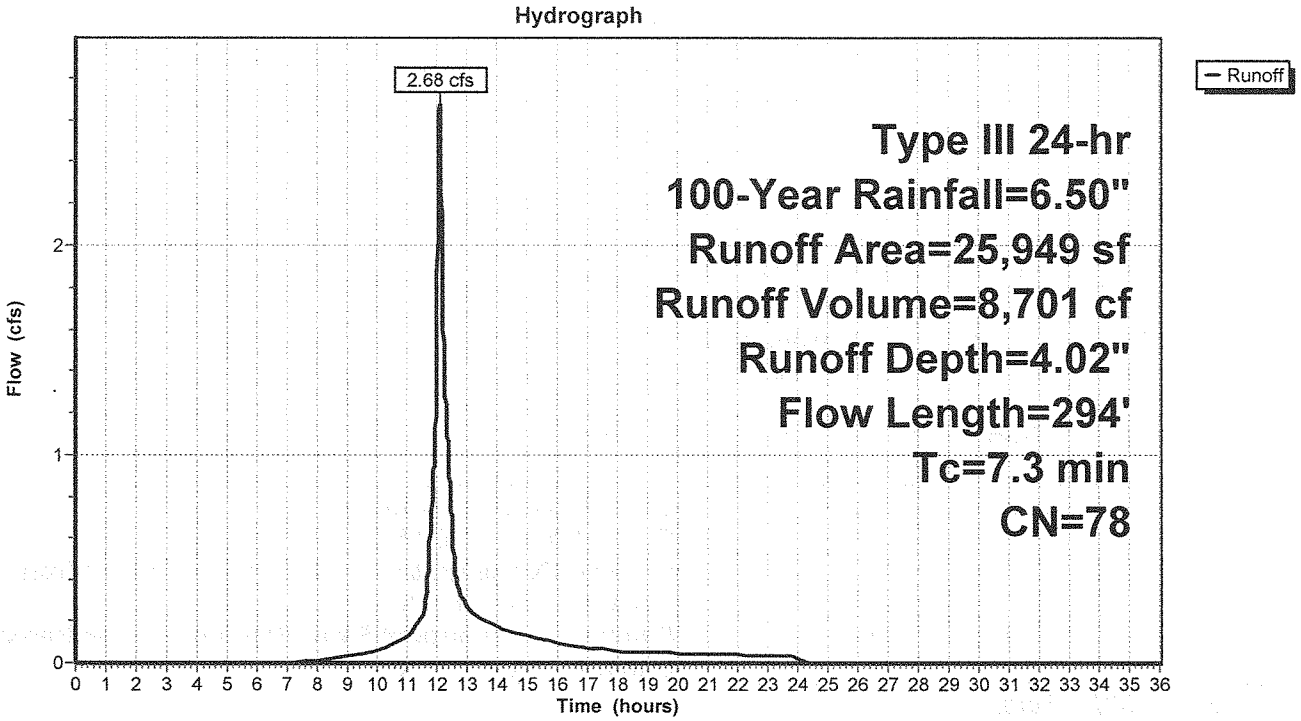
Runoff = 2.68 cfs @ 12.10 hrs, Volume= 8,701 cf, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
2,402	98	Roofs, HSG C
1,912	98	Paved parking, HSG C
600	70	Woods, Good, HSG C
21,035	74	>75% Grass cover, Good, HSG C
25,949	78	Weighted Average
21,635		83.38% Pervious Area
4,314		16.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0600	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
0.4	100	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.3	40	0.0100	2.03		**Shallow Concentrated Flow, Shallow Concentrated - Pavement** Paved Kv= 20.3 fps
0.4	104	0.0750	4.41		**Shallow Concentrated Flow, Shallow Concentrated - Lawn** Unpaved Kv= 16.1 fps
7.3	294	Total			

Subcatchment P1: PROPOSED SUBCATCHMENT



Summary for Subcatchment P2: PROPOSED SUBCATCHMENT

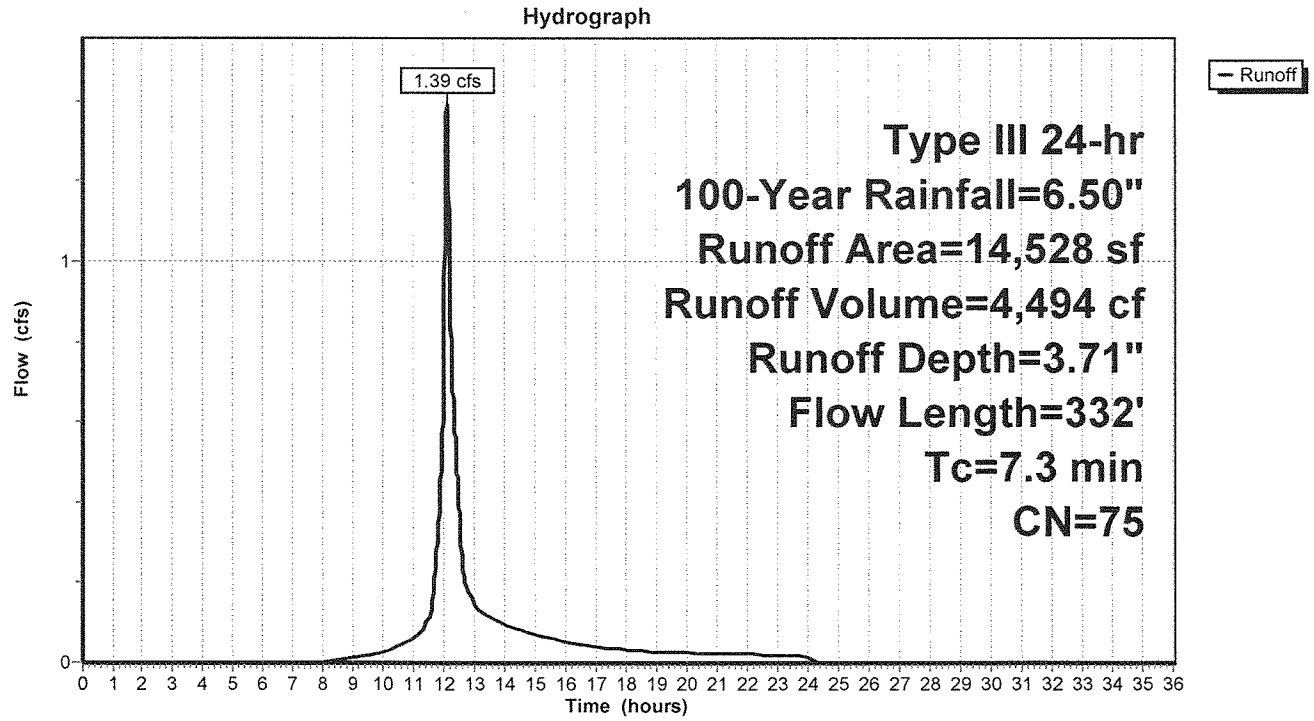
Runoff = 1.39 cfs @ 12.11 hrs, Volume= 4,494 cf, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
888	98	Paved parking, HSG C
13,640	74	>75% Grass cover, Good, HSG C
14,528	75	Weighted Average
13,640		93.89% Pervious Area
888		6.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0600	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.08"
0.5	140	0.0750	4.41		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.6	142	0.0600	3.94		**Shallow Concentrated Flow, Shallow Concentrated - Pavement** Unpaved Kv= 16.1 fps
7.3	332	Total			

Subcatchment P2: PROPOSED SUBCATCHMENT



Summary for Subcatchment P3: PROPOSED SUBCATCHMENT

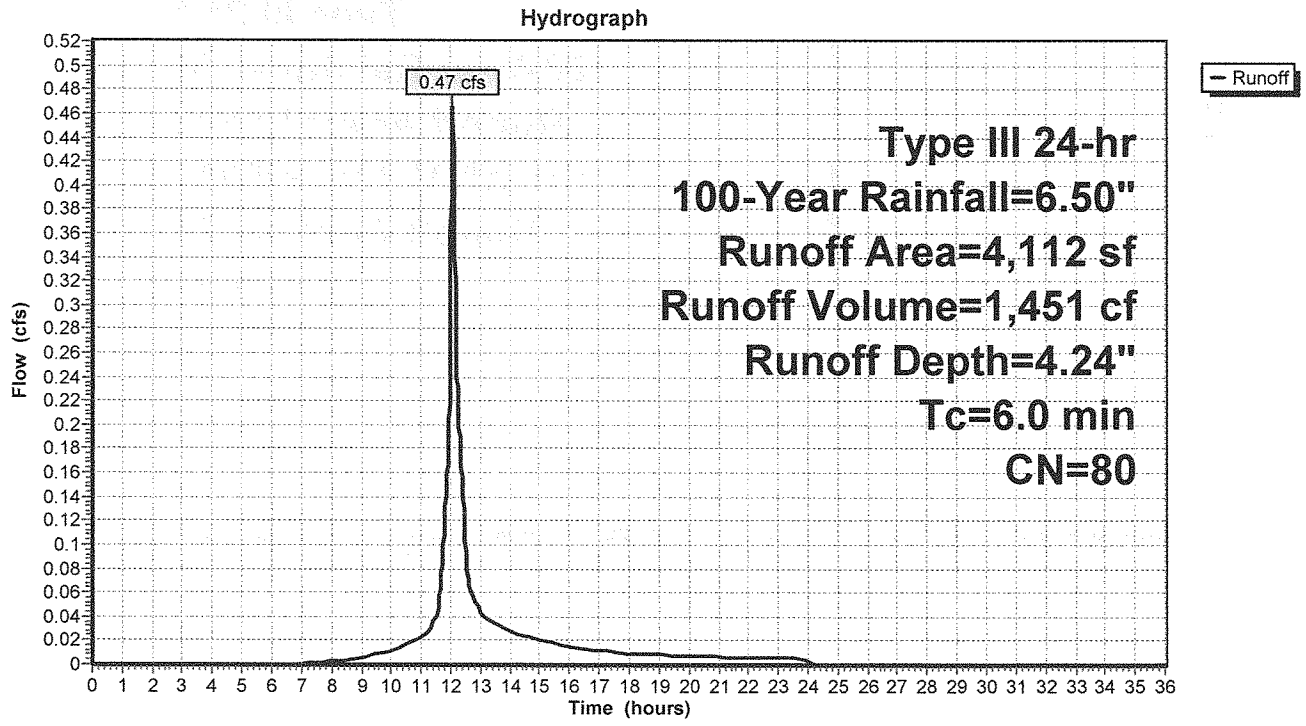
Runoff = 0.47 cfs @ 12.09 hrs, Volume= 1,451 cf, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
619	98	Roofs, HSG C
407	98	Paved parking, HSG C
3,086	74	>75% Grass cover, Good, HSG C
4,112	80	Weighted Average
3,086		75.05% Pervious Area
1,026		24.95% Impervious Area

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

Subcatchment P3: PROPOSED SUBCATCHMENT



Summary for Subcatchment P4: PARTIAL ROOF

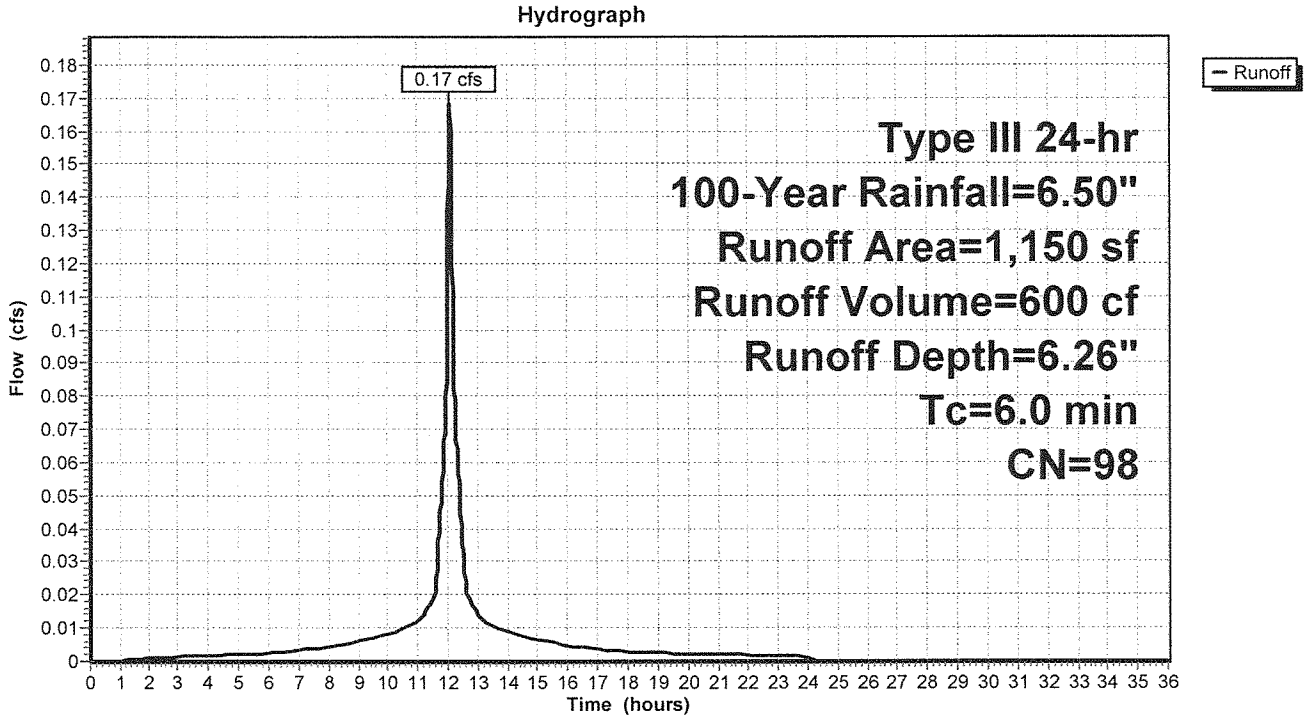
Runoff = 0.17 cfs @ 12.08 hrs, Volume= 600 cf, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,150	98	Roofs, HSG C
1,150		100.00% Impervious Area

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

Subcatchment P4: PARTIAL ROOF



Summary for Pond 1P: Infiltration Basin

Inflow Area = 27,099 sf, 20.16% Impervious, Inflow Depth = 3.93" for 100-Year event
Inflow = 2.85 cfs @ 12.12 hrs, Volume= 8,883 cf
Outflow = 2.70 cfs @ 12.13 hrs, Volume= 8,864 cf, Atten= 5%, Lag= 0.9 min
Discarded = 0.02 cfs @ 12.13 hrs, Volume= 1,271 cf
Primary = 2.68 cfs @ 12.13 hrs, Volume= 7,592 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 173.51' @ 12.13 hrs Surf.Area= 812 sf Storage= 744 cf

Plug-Flow detention time= 60.0 min calculated for 8,861 cf (100% of inflow)
Center-of-Mass det. time= 58.8 min (874.9 - 816.1)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	1,185 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

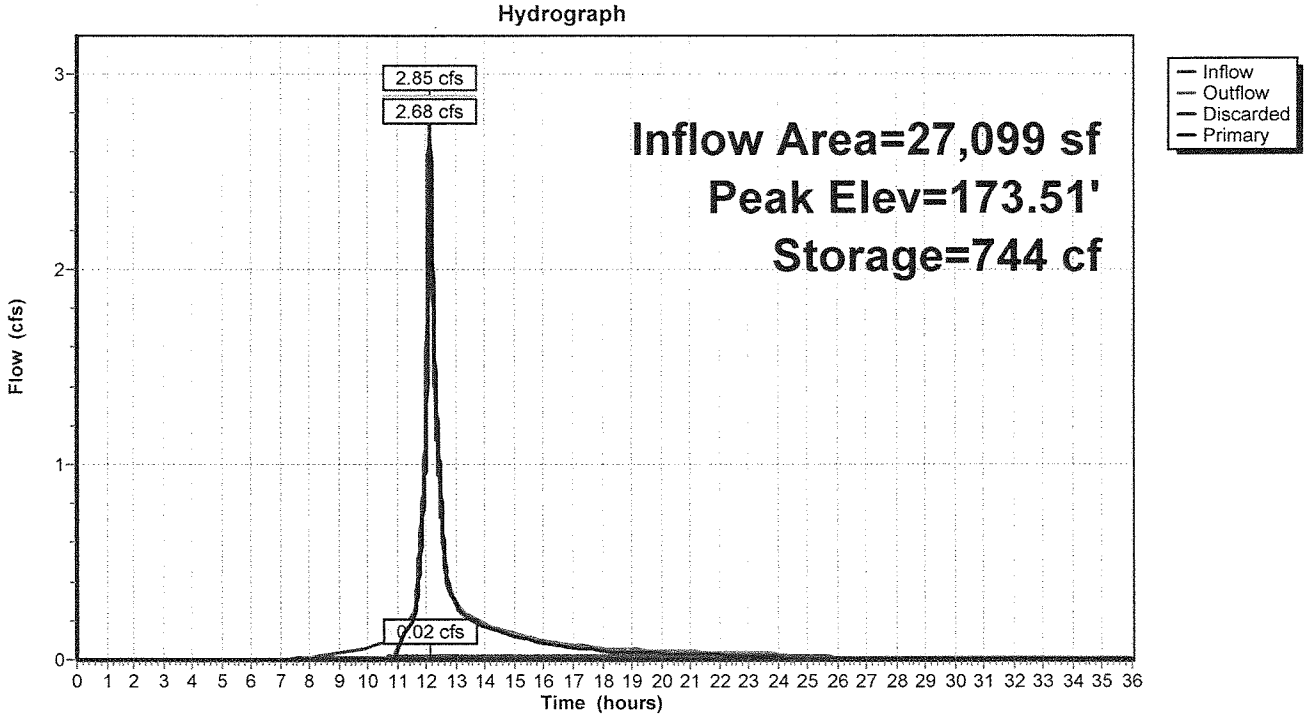
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
172.00	178	0	0
173.00	590	384	384
173.50	807	349	733
174.00	1,000	452	1,185

Device	Routing	Invert	Outlet Devices
#1	Discarded	172.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	173.10'	**4.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.02 cfs @ 12.13 hrs HW=173.51' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=2.67 cfs @ 12.13 hrs HW=173.51' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 2.67 cfs @ 1.62 fps)

Pond 1P: Infiltration Basin



Summary for Pond 2P: CHAMBER

Inflow Area = 1,150 sf,100.00% Impervious, Inflow Depth = 6.26" for 100-Year event
Inflow = 0.17 cfs @ 12.08 hrs, Volume= 600 cf
Outflow = 0.22 cfs @ 12.12 hrs, Volume= 580 cf, Atten= 0%, Lag= 2.2 min
Discarded = 0.00 cfs @ 12.12 hrs, Volume= 398 cf
Primary = 0.21 cfs @ 12.12 hrs, Volume= 181 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 180.43' @ 12.12 hrs Surf.Area= 146 sf Storage= 201 cf

Plug-Flow detention time= 345.7 min calculated for 580 cf (97% of inflow)
Center-of-Mass det. time= 324.8 min (1,068.8 - 744.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	175.50'	114 cf	**11.25'W x 13.00'L x 2.54'H Field A** 372 cf Overall - 87 cf Embedded = 284 cf x 40.0% Voids
#2A	176.00'	87 cf	**Cultec R-150XLHD** x 3 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 3 rows
#3	178.04'	0 cf	**0.33'D x 3.00'H Vertical Cone/Cylinder**-Impervious
		201 cf	Total Available Storage

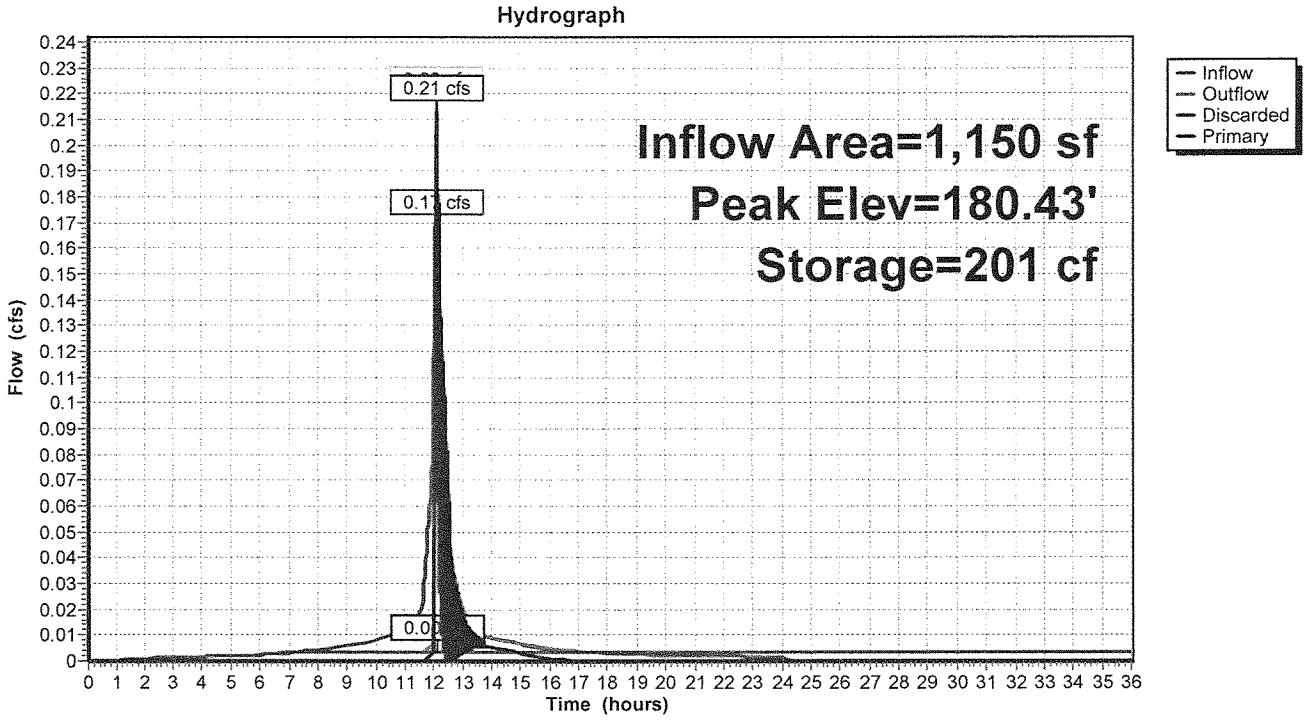
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	175.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#2	Primary	180.20'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 12.12 hrs HW=180.43' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.21 cfs @ 12.12 hrs HW=180.43' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.21 cfs @ 1.63 fps)

Pond 2P: CHAMBER

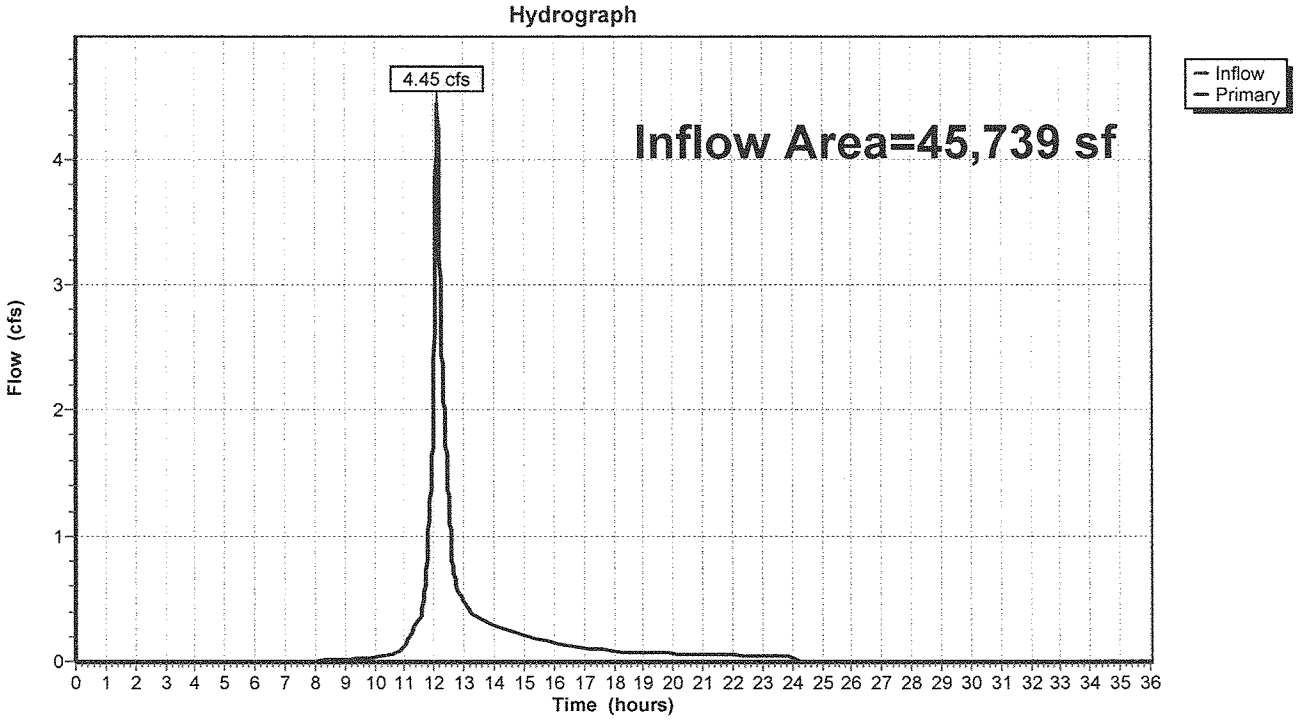


Summary for Pond DP: DESIGN POINT

Inflow Area = 45,739 sf, 16.13% Impervious, Inflow Depth = 3.55" for 100-Year event
Inflow = 4.45 cfs @ 12.12 hrs, Volume= 13,538 cf
Primary = 4.45 cfs @ 12.12 hrs, Volume= 13,538 cf, Atten= 0%, Lag= 0.0 min

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

Pond DP: DESIGN POINT



STORMWATER MANAGEMENT CALCULATIONS

Standard 3: Recharge to Groundwater

Existing Impervious Area (within project analysis area) = 4,573 sf

Proposed Impervious Area (within project analysis area) = 7,378 sf

Proposed Increase in Impervious Area (within project analysis area) = 7,378 sf – 4,573 sf = 2,805 sf

Hydrologic Soil Group	Required Recharge Rainfall Depth
C	0.25 in

Required Recharge Volume = [0.25 in x (1 ft/12 in) x 2,805 sf] = 59 cf

Infiltration System	Provided Recharge Volume (Below Outlet Invert)
Infiltration Chambers	200 cf
Infiltration Basin	445 cf
Total	645 cf (> 59 cf - OK)

Standard 4: Water Quality Volume (WQV)

Water Quality Volume Depth = 0.5 in x Impervious Area

WQV required = 2,805 sf x 0.5 in x 1ft/12 in = 117 cf

WQV provided in Infiltration Basin below Invert (Elev. = 173.10) = 445 cf

Sediment Forebay Sizing = 0.1 in x Impervious Area (Pavement) = 0.1 in x 1,912 sf x (1 ft/12 in) =16cf

Volume provided in sediment forebay = 54 cf

Infiltration Basin Drawdown Analysis:

Infiltration Basin
Volume Below Weir (Elev. = 173.10) = 445 cf

Average Bottom Area of Infiltration Basin (172 ft to 173 ft) = 346 sf

Drawdown Time = [(445 cf / (1.02in/hr)) x 12 in/ft) / 346 sf] = 15.2 hrs

Infiltration Chambers
Bottom Area = 147 sf

Volume Below Outlet (Scupper) = 201 cf

Drawdown Time = [(201 cf / (1.02in/hr)) x 12 in/ft) / 147 sf] = 11.8 hrs

TSS Calculations

Location: Outlet Infiltration Basin

TSS Removal Calculation Worksheet

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Sediment Forebay	25%	1.0	0.25	0.75
Infiltration Basin	80%	0.75	0.60	0.15
		Total TSS Removal =	0.85	

Project: 51 WENHAM ROAD, TOPSFIELD
Prepared By: WAS
Date: 5/6/16

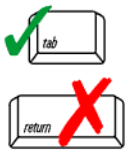
*Equals remaining load from previous BMP (E) which enters the BMP

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 65) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

Checklist for Stormwater Report

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

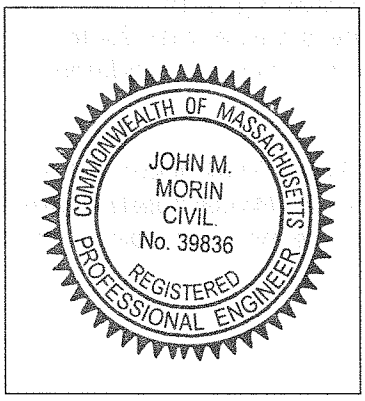
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



John M. Morin 5/10/16
Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

Checklist for Stormwater Report

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☒ Use of “country drainage” versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☒ Grass Channel

☐ Green Roof

☒ Other (describe): Infiltration Basin, Underground Recharge Chambers

Checklist for Stormwater Report

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

Checklist for Stormwater Report

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☒ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

Checklist for Stormwater Report

☐ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☒ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

Checklist for Stormwater Report

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found

in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☒ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

Checklist for Stormwater Report

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☐ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN

Erosion and Sedimentation will be controlled at the site by utilizing Structural Practices, Stabilization Practices, and Dust Control. These practices correspond with plans entitled "Site Plan of Land in Topsfield, Massachusetts, 51 Wenham Road (Assessor's Map 71, Lot 18), Prepared For Mark and Kristin Yannetti" as revised and approved by the Topsfield Planning Board, hereinafter referred to as the Site Plans.

Responsible Party and
Stormwater Management System Owner: Mark and Kristin Yannetti
51 Wenham Road
Topsfield, MA 01983
P: (978) 239-0800

Site Design Engineer Information: The Morin-Cameron Group, Inc.
447 Boston Street, Route 1
Topsfield, MA 01983
Phone: (978) 887-8586

During Construction:

The Contractor constructing the site and drainage system shall be responsible for maintaining the stormwater system during construction

Routine maintenance of all items shall be performed in order to ensure adequate runoff and pollution control during construction.

After Construction:

Once construction is complete, the property owner shall assume responsibility to operate and maintain the stormwater management components. The owner shall be responsible for all maintenance activities needed following the construction. The maintenance schedule shown in Table 1 and attached manufacturers recommendations shall be done in perpetuity.

- Inspections of the infiltration basin and sediment forebay as required in Table 1.
- Cleaning of the infiltration basins as required in Table 1.
- Monitoring the erosion control systems until establishment of natural vegetation.
- Inspection of the infiltration chambers.

TABLE 1: MAINTENANCE SCHEDULE FOR DRAINAGE STRUCTURES

Structure	Inspection	Maintenance
Sediment Forebay/ Infiltration Basin	Inspect twice a year and after every major storm event* (April / October) Note the time that water remains standing in the basin after a storm event. Standing water within the basin 48 to 72 hours after a storm may indicate that the bottom of the basin is clogged. If the reason is clogging, determine the cause, e.g. erosion, excessive compaction, or low spots and take the necessary corrective action. Inspections should include the following: • Signs of differential settlement • Cracking • Erosion • Leakage in the embankments • Tree growth on the embankments that were not part of the design plan • Sediment accumulation • Health of turf	Side slopes and bottom to be mowed twice during growing season and grass clippings, accumulated trash and debris removed (May & August). Sediment to be removed as necessary. Sediment removal should not take place until bottom of basin is dry. Use light equipment to remove the top layer to prevent compacting the underlying soil. Deep till the remaining soil and revegetate as soon as possible. Deep tilling can be used to break up clogged surface areas. Any tilled area to be revegetated immediately. (If Reseeding occurs utilize practices such as hydroseeding with a tackifier, blanket, or similar practice to ensure that no scour occurs and allow the seeds to germinate and develop roots.)
Infiltration Chambers	Inspect after every major storm event for first 3 months after construction to ensure the structures are working properly.* Thereafter, twice a year (April / October) Inspections should include the following: • Signs of differential settlement • Erosion • Tree growth on the embankments that were not part of the design plan • Sediment accumulation • Health of turf • Cracked/Disconnected Roof Leaders	Rehabilitate structure if it fails due to clogging as generally evidenced by retention of water for more than 72 hours after a storm event

* Major storm event: 3.1 inches of rainfall in a 24 hour period (2 year storm)

LONG TERM POLLUTION PREVENTION PLAN (O & M PLAN)

51 Wenham Road
Topsfield, Massachusetts

May 6, 2016

The following operation and maintenance plan has been provided to satisfy the requirements of Standard 9 of the MassDEP Stormwater Management Handbook. The success of the Stormwater Management Plan depends on the proper implementation, operation and maintenance of several management components. The following procedures shall be implemented to ensure success of the Stormwater Management Plan:

1. The contractor shall comply with the details of construction of the site as shown on the approved plans.
2. The sediment forebay, infiltration basin, and infiltration chambers shall be inspected and maintained as indicated in Table 1: Maintenance Schedule for Drainage Structures.
3. Effective erosion control measurers during and after construction shall be maintained until a stable turf is established on all altered areas.

Basic Information

Stormwater Management System Owner: Mark and Kristin Yannetti
51 Wenham Road
Topsfield, MA 01983
P: (978) 239-0800

Erosion and Sedimentation Controls During Construction:

The site and drainage construction contractor shall be responsible for maintaining the stormwater system during construction. Routine maintenance of all items shall be performed to ensure adequate runoff and pollution control during construction.
A proposed silt sock backed with silt fence will be placed as shown on the proposed plan prior to the commencement of any clearing, grubbing, and earth removal or construction activity. The integrity of the erosion control barrier will be maintained by periodic inspection and replacement as necessary. The erosion control barrier will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established. Operations and maintenance plans for the Stormwater Management construction phase and long term operation of the system have been attached to this report.

General Conditions

1. The property owner shall be responsible for scheduling regular inspections and maintenance of the stormwater BMP's as detailed in Table 1: Maintenance Schedule for Drainage Structures and illustrated on the approved design plans:
   "Site Plan of Land" in Topsfield, Massachusetts, 51 Wenham Road (Assessor's Map 71, Lot 18), Prepared For Mark and Kristin Yannetti, prepared by The Morin-Cameron Group, Inc. dated May 10, 2016 as revised and approved by the Topsfield Planning, hereinafter referred to as the Site Plans.
2. All Stormwater BMP's shall be operated and maintained in accordance with the design plans and Table 1: Maintenance Schedule for Drainage Structures.
3. The owner shall:

a. Maintain an Operation and Maintenance Log for three years. The log shall include all BMP inspections, repairs, replacement activities and disposal activities (disposal material and disposal location shall be included in the log);
b. Make the log available to the Topsfield Department of Public Work and Planning Department upon request;

4. A recommended inspection and maintenance schedule is outlined below based on statewide averages. This inspection and maintenance schedule shall be adhered to at a minimum for the first year of service of all BMP's referenced in this document. At the commencement of the first year of service, a more accurate inspection/maintenance schedule shall be determined based on the level of service for this site.

Vegetated Areas:

Immediately after construction, monitoring of the erosion control systems shall occur until establishment of natural vegetation. Afterwards, vegetated areas shall be maintained as such. Vegetation shall be replaced as necessary to ensure proper stabilization of the site.

Sediment Forebay/Infiltration Basin:

The sediment forebay/infiltration basin shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.1 inches of rainfall in a 24 hour period (2 year storm). Thereafter, the basin shall be inspected twice per year (April/October). If the system does not drain within 72 hours of a rainstorm, the operator shall inform the design engineer. Refer to Table 1: Maintenance Schedule For Drainage Structures for inspection and maintenance requirements.

Infiltration Chambers:

The infiltration chambers shall be inspected after every major storm event for first 3 months after construction to ensure the structures are working properly. Thereafter, twice a year (April/ October). Measure water depths in inspection ports at 24 and 48 hour intervals after a storm event to verify structure is draining. Rehabilitate structure if it fails due to clogging. Refer to Table 1: Maintenance Schedule For Drainage Structures for inspection and maintenance requirements.

Debris & Litter:

All debris and litter shall be removed from the parking area as necessary to prevent migration into the drainage system.

Prevention of Illicit Discharges:

Illicit discharges to the stormwater management system are not allowed. Illicit discharges are discharges that are not comprised entirely of stormwater. Pursuant to MassDEP Stormwater Standards the following activities or facilities are not considered illicit discharges: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential building without detergents.

To prevent illicit discharges to the stormwater management system the following policies should be implemented:

1. Provisions For Storing Materials and Waste Products Inside or Under Cover
2. Vehicle Maintenance and Washing Controls
3. Requirements for Routine Inspections of the Stormwater Management System (ie: sediment forebays and subsurface infiltration systems)
4. Spill Prevention and Response Plans.

ILLICIT DISCHARGE COMPLIANCE STATEMENT

I, John Morin, hereby notify the Topsfield Planning Board that I have not witnessed, nor am aware of any existing illicit discharges at the site known as 51 Wenham Road in Topsfield, Massachusetts. I also hereby certify that the development of said property as illustrated on the final plans entitled "Site Plan of Land in Topsfield, Massachusetts, 51 Wenham Road (Assessor's Map 71, Lot 18), Prepared For Mark and Kristin Yannetti" prepared by The Morin-Cameron Group, Inc. dated May 6, 2016 and as revised and approved by the Topsfield Planning Board and maintenance thereof in accordance with the "Construction Period Pollution Prevention Plan" and "Long-Term Pollution Prevention Plan" prepared by The Morin-Cameron Group, Inc. dated May 6, 2016 and as revised and approved by the Topsfield Planning Board will not create any new illicit discharges. There is no warranty implied regarding future illicit discharges that may occur as a result of improper construction or maintenance of the stormwater management system or unforeseen accidents.

Name: John M. Morin, P.E.

Company: The Morin-Cameron Group, Inc.

Title: Owner's Representative

Signature: John M. Morin

Date: 5/10/16

SOIL SUITABILITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS

TOPSFIELD, MASSACHUSETTS

SOIL EVALUATION FOR CONSTRUCTION OF ON-SITE STORMATER MANAGMENT

SITE INFORMATION

Street Address: 51 Wenham Street Town: Topsfield State: Massachusetts Zip Code: 01983 County: Essex

Land Use: Residential; single family Latitude: ~42° 37' 00.2" N Longitude: ~70° 56' 23.0" W

PUBLISHED SOIL DATA AND MAP UNIT DESCRIPTION

Physiographic Division: Appalachian Highlands Physio. Province: New England Physio. Section: Seaboard lowland section

Soil map unit: 305B – Paxton fine sandy loam (Coarse-loamy, mixed, mesic, Typic Udipsamments), 3-8% slopes

NRCS/USDA web soil survey: Essex County, Massachusetts, Northern part. Map Scale: 1:600'

Soil hydric or upland: Upland Average depth to water table: >80" Depth to restrictive feature: >80"

Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (~2.8")

Drainage Class: Well drained Hydrologic Soil Group: C Ksat: Very low to moderately high (0.00 – 0.20 in/hr)

Soil limitations: Moderately compact substratum, shallow seasonal & apparent groundwater table, deep phreatic water table

WETLAND AREA & CLOSEST USGS WELL MEASUREMENTS

National Wetland Inventory Map: NA Wetlands Conservancy Program: NA Bordering vegetative wetland: >200 feet

Current Water Resource Condition (USGS*)*: Well Site # 424520070562401- MA-NIW 27 Newbury, MA

Well completed in Sand and gravel aquifers and ice-contact deposits, including kames and eskers.

Well depth: 19.8 feet Land surface altitude: 55.00 feet above NGVD29 Latitude: ~42°45'19.3" N Longitude: ~70°56'22.1"

Most recent data value: 4.04 on 04/10/16 (depth to water level in feet below land surface). Range: Normal

SURFICIAL & BEDROCK GEOLOGY:

Surficial geology map: Qgm: Early Wisconsin glacial-stage ground moraine

Geologic parent material: Ice-contact lodgment till Geomorphic landform: Drumlinoid hill

Landform position (2D): Back slope Landform position (3D): Side slope Slope aspect: Southerly

Slope gradient: ~03-15% Down slope shape: Convex Across slope shape: Concave Slope complexity: Simple

Bedrock outcropping in vicinity: Not observed Glacial erratics in vicinity: None observed

Bedrock Type: Topsfield granodiorite – Gray to gray-green, porphyritic granodiorite containing blue quartz; cataclastically foliated.

TP16-1 DEEP OBSERVATION HOLE

51 Wenham Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 09:15 Weather: Overcast, light rain, cool, ~48°F, light East wind

Position on landscape: Backslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10+ feet Drainage way: 50+ feet Drinking water well: 100+ feet

Wetlands: 100+ feet Open water body: 400+ feet Abutting septic system: NA

SOIL PROFILE ► TP16-1

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 22”	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Anthropic layer - mechanically mixed; very friable; moderate-grade fine to medium granular structure; cohesive matrix; fine grained mineral content; damp to slightly moist; common fine to medium roots; 10% gravel content; brick and coal ash within matrix; diffuse smooth boundary.
22 → 69”	C	Sandy Loam	2.5Y5/4 lite olive brown	38” (c,2,p) 7.5YR4/8 N/Gley 7	Friable; moderate grade fine-to-medium angular-blocky structure; moderately compact; slightly silty; mixed fine-to-medium grained mineral content; 20% sub-angular to sub-rounded gravel content & 20% angular to sub-rounded cobble content of mixed lithology; few fine roots to 36”; common-to-many iron stains within matrix below 38”; moist to wet matrix; observed apparent groundwater at 41” and no bedrock refusal at test hole depth. Excavation difficulty: Low

Depth to bedrock: >69” Seasonal High Groundwater Table: 38” Apparent water table (weep): 41”

TP16-1 DEEP OBSERVATION HOLE

51 Wenham Street, Topsfield, Massachusetts

DEPTH TO APPARENT GROUNDWATER TABLE:

Apparent water seeping from pit face: 41" Below land surface Depth to stabilized apparent water: 41" Below land surface

Soil moisture state: Moist to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 38" (below land surface)

Type: Masses and stringers on and within peds Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular/ spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color: N/Gley 7 (light gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 45" inches below grade

Observed water weeping from side of deep hole: 45" inches below grade

Observed depth to redoximorphic features: 24" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 3.92 feet

Depth of naturally occurring pervious material in TP16-1 Upper boundary: 22"
Lower boundary: 69"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Printed name of evaluator & license number Date of Soil Evaluator Certification

TP16-2 DEEP OBSERVATION HOLE

51 Wenham Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 09:45 Weather: Overcast, light rain, cool, ~48°F, light East wind

Position on landscape: Backslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10+ feet Drainage way: 50+ feet Drinking water well: 100+ feet

Wetlands: 100+ feet Open water body: 400+ feet Abutting septic system: NA

SOIL PROFILE ► TP16-2

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 28”	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Anthropic layer - mechanically mixed; very friable; moderate-grade fine to medium granular structure; cohesive matrix; fine grained mineral content; damp to slightly moist; common fine to medium roots; 10-15% gravel content; brick and coal ash within matrix; diffuse smooth boundary.
28 → 74”	C	Sandy Loam	2.5Y5/4 lite olive brown	45” (c,2,p) 7.5YR4/8 N/Gley 7	Friable; moderate grade fine-to-medium angular-blocky structure; moderately compact; slightly silty; mixed fine-to-medium grained mineral content; 20% sub-angular to sub-rounded gravel content & 25% angular to sub-rounded cobble content of mixed lithology; few fine roots to 55”; common-to-many iron stains within matrix below 45”; moist to wet matrix; observed apparent groundwater at 43” and no bedrock refusal at test hole depth. Excavation difficulty: Low

Depth to bedrock: >74” Seasonal High Groundwater Table: 45” Apparent water table (weep): 43”

TP16-2 DEEP OBSERVATION HOLE

51 Wenham Street, Topsfield, Massachusetts

DEPTH TO APPARENT GROUNDWATER TABLE:

Apparent water seeping from pit face: 43" Below land surface Depth to stabilized apparent water: 43" Below land surface

Soil moisture state: Moist to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 45" (below land surface)

Type: Masses and stringers on and within peds Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular/ spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color: N/Gley 7 (light gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 43" inches below grade

Observed water weeping from side of deep hole: 43" inches below grade

Observed depth to redoximorphic features: 45" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 3.83 feet

Depth of naturally occurring pervious material in TP16-2 Upper boundary: 28"
Lower boundary: 74"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Printed name of evaluator & license number Date of Soil Evaluator Certification

TP16-3 DEEP OBSERVATION HOLE

51 Wenham Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 10:13 Weather: Overcast, light rain, cool, ~48°F, light East wind

Position on landscape: Backslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10+ feet Drainage way: 50+ feet Drinking water well: 100+ feet

Wetlands: 100+ feet Open water body: 400+ feet Abutting septic system: NA

SOIL PROFILE ► TP16-3

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 15”	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Anthropic layer - mechanically mixed; very friable; moderate-grade fine to medium granular structure; cohesive matrix; fine grained mineral content; damp to slightly moist; common fine to medium roots; 10-15% gravel content; brick and coal ash within matrix; diffuse smooth boundary.
15 → 77”	C	Sandy Loam	2.5Y5/4 lite olive brown	25” (c,2,p) 7.5YR4/8 N/Gley 7	Friable; moderate grade fine-to-medium angular-blocky structure; moderately compact; slightly silty; mixed fine-to-medium grained mineral content; 20% sub-angular to sub-rounded gravel content & 25% angular to sub-rounded cobble content of mixed lithology; few fine roots to 29”; common-to-many iron stains within matrix below 25”; moist to wet matrix; observed apparent groundwater at 37” and no bedrock refusal at test hole depth. Excavation difficulty: Low

Depth to bedrock: >77” Seasonal High Groundwater Table: 25” Apparent water table (weep): 37”

TP16-3 DEEP OBSERVATION HOLE

51 Wenham Street, Topsfield, Massachusetts

DEPTH TO APPARENT GROUNDWATER TABLE:

Apparent water seeping from pit face: 37" Below land surface Depth to stabilized apparent water: 37" Below land surface

Soil moisture state: Moist to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 25" (below land surface)

Type: Masses and stringers on and within peds Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular/ spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color: N/Gley 7 (light gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 37" inches below grade

Observed water weeping from side of deep hole: 37" inches below grade

Observed depth to redoximorphic features: 25" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 5.16 feet

Depth of naturally occurring pervious material in TP16-3 Upper boundary: 15"
Lower boundary: 77"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Printed name of evaluator & license number Date of Soil Evaluator Certification

HYDROLOGIC SOIL PROPERTIES

1982 Rawls Rates

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02