Nitsch Engineering

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October 6, 2014

Mike Gowing, Chair
Board of Selectman
Town of Acton
472 Main Street
Acton, MA 01720

RE: Nitsch Project #10079
Continuation of Use
37 Knox Trail
Acton, MA

Dear Mr. Gowing:

On behalf of Concord Public Schools, Nitsch Engineering is pleased to submit revised plans based on Town of Acton's comments for the Application for Continuation of Use at 37 Knox Trail in Acton, Massachusetts. Comments were received from the Acton Engineering Department, Zoning Enforcement and Assistant Town Planner, and Water Supply District of Acton. Comments received from the Water Supply District of Acton were addressed by Blatman, Bobrowski & Mead's letter attached to this letter. Nitsch Engineering is providing the following information for your review:

1. HydroCAD Output with summary of calculations;
2. Pre- and Post-Development Drainage Areas;
3. A letter entitled "37 Knox Trail, Site Plan Special Permit," dated October 2, 2014 prepared by Blatman, Bobrowski & Mead, LLC;
4. Plan Set including the following:
    a. Cover Sheet - C0.0;
    b. Site Plan - C1.0;
    c. Turning Movements - C2.0;
    d. Details - C3.0
    e. Snow Storage Plan – C4.0
    f. Topographic Plan of Land

Nitsch Engineering provided three (3) hard copies to the Planning Department and provided the plans electronically in Portable Document Format (PDF) to Scott Mutch, Town of Acton Zoning Enforcement Officer and Assistant Town Planner.

As stated during the September 22, 2014 public meeting, bus parking is no longer proposed at 37 Knox Trail and the site will be used for office use only. In response to the Town's comments Nitsch Engineering revised the size of the bio-retention to capture the first inch of runoff from the entire existing parking lot and proposed pavement as requested at the Board of Selectman hearing on September 22, 2014. Bicycle parking is being provided as required under Section 6.3.7.

Nitsch Engineering reviewed the comments and updated the plans and calculations. Nitsch Engineering offers the following responses, noting that the numbering conventions from the comment letters are being followed:

RESPONSES TO ENGINEERING DEPARTMENT COMMENTS

1. Nitsch Engineering agrees that the bio-retention basin meets the requirements of the Groundwater Regulations.
2. Nitsch Engineering provided a note on the bio-retention basin that addresses the pollution safe guards by providing the owner a cover for the area drain.

3. Nitsch Engineering used nearby well data to estimate seasonal high groundwater for the bio-retention basin. Nitsch Engineering requests that test pits for the rain garden be conditioned as part of the approval, if granted, prior to construction. If test pits determine that groundwater is closer than two (2) feet from the bottom of the bio-retention basin than Nitsch Engineering will discuss other drainage options with the Town of Acton Engineering Department.
4. Nitsch Engineering has included drainage area plans for the pre- and post-development condition in original submittal or is providing them now?.
5. Nitsch Engineering added a conversion note from NAVD 1988 to NGVD 1929 on Sheet C1.0.
6. Nitsch Engineering added turning templates for an SU-30 and Fire Truck turning template on Sheet C2.0.
7. Nitsch Engineering added a note for sediment clean-up and hazardous material disposal on Sheet C1.0.
8. Nitsch Engineering revised the pavement detail to meet the Town of Acton standard depths.
9. Nitsch Engineering did not previously add a side walked because the addition of a sidewalk for 37 Knox Trail is not appropriate as there are no other connecting sidewalks available within the Knox Trail Technology District (TD) area.
10. Nitsch Engineering requests that the as-built plan for any new work at 37 Knox Trail be included as a condition of approval, if granted.

RESPONSE TO ZONING AND PLANNING DEPARTMENT COMMENTS

1. Nitsch Engineering added a bicycle parking area for three (3) bicycles as required under the Zoning By-law Section 6.3.7. The bicycle parking takes up one (1) car parking space and brings the total available parking spaces to 37 Knox Trail to 40 parking spaces;
2. The Planning Board notes that the new impervious surface should not be located within 10 feet of the Acton/Concord town line as stated in Regulation 6.7.2. Nitsch Engineering recommends that a condition of approval be granted to allow pavement up to the town line once the WR Grace land is under control by the Town of Concord.

There are no other improvements proposed for the site at this time.

Nitsch Engineering respectfully requests that the 37 Knox Trail project be conditionally approved at the next Board of Selectman's hearing.

Please let me know if you have any questions.

Very truly yours,

Nitsch Engineering, Inc.

Steven Ventresca

Steven Ventresca, PE LEED® AP BD+C
Project Manager

SV/

cc: File, Concord Public Schools

BLATMAN, BOBROWSKI & MEAD, LLC
ATTORNEYS AT LAW

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CONCORD, MA 01742
PHONE 978.371.3930
FAX 978.371.3828

MARK BOBROWSKI
mark@bbmatlaw.com

October 2, 2014

TO: Acton Board of Selectmen
Chris Allen, District Manager
FR: Mark Bobrowski
RE: 37 Knox Trail
Site Plan Special Permit Application

Please be advised that I represent the Town of Concord with regard to its application for site plan approval.

I would like to take this opportunity to address the issues raised by the Water Supply District of Acton in its correspondence to Scott Mutch, dated August 1, 2014:

1. Concord respectfully requests that the Board of Selectmen move toward a decision now without the delay requested by the District.

2. Again, respectfully, the Board of Selectmen does not have the authority to place a condition in site plan approval requiring Concod to pay for the District's peer review of the stormwater management system.

   However, it should be noted that Concord has now oversized the proposed rain garden to handle one inch of water in a storm event from the existing parking area. The revised plan shows these details.

3. A snow management plan will be submitted as suggested.

4. Concord respectfully declines to install monitoring wells. However, the District may install a monitoring well at 37 Knox Trail, at its own expense, assuming we can work out the liability and other issues.

5. The work at 37 Knox Trail will comply with all applicable soil management standards.

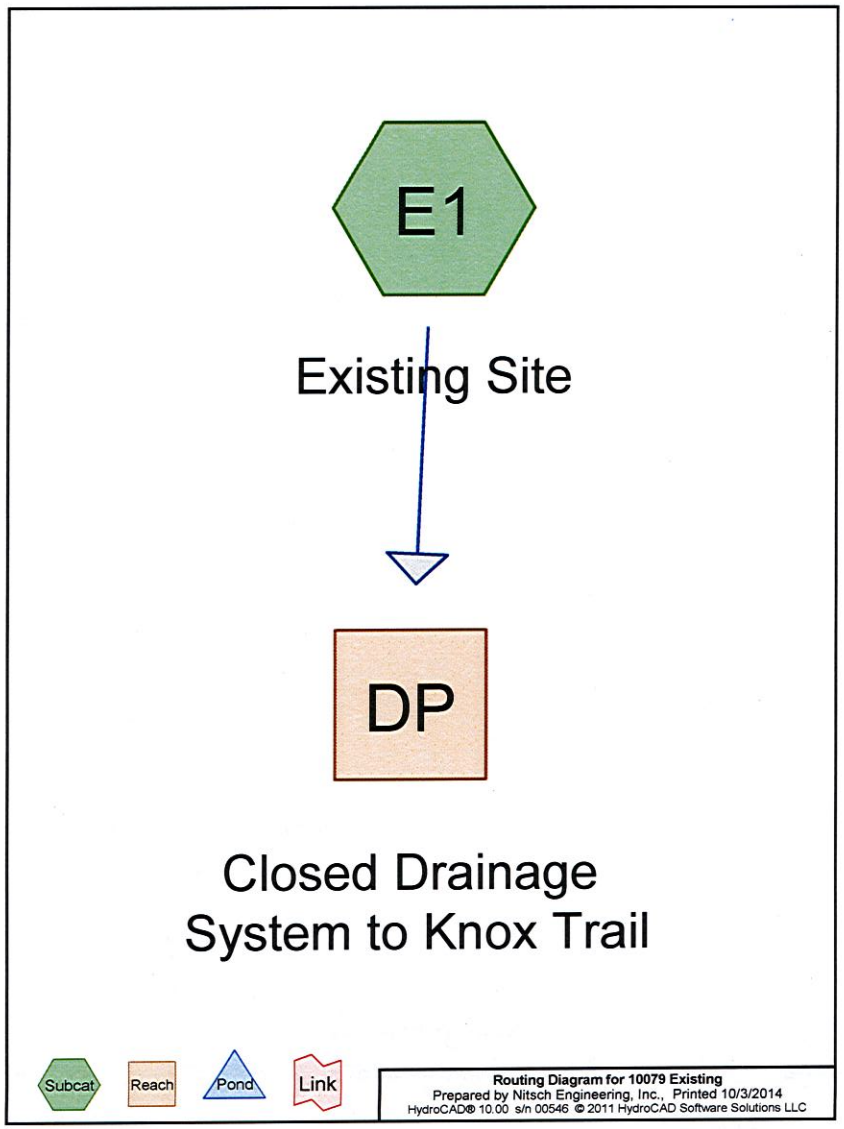
6. Concord does not intend to maintain or fuel vehicles at 37 Knox Trail.

Thank you.

	Storm Event – Rate, cfs				
	2-year	10-year	25-year	100-year	1 inch
Existing					
	0.27	1.06	1.62	2.55	0.00
Proposed					
	0.00	0.76	1.52	2.38	0.00

	Storm Event – volume, a/f				
	2-year	10-year	25-year	100-year	1 inch
Existing					
	0.031	0.084	0.121	0.183	0.00
Proposed					
	0.002	0.035	0.059	0.098	0.00

COMMONWEALTH OF MASSACHUSETTS
STEVEN VENTRESCA
CIVIL
No. 46872
REGISTERED PROFESSIONAL ENGINEER



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.507	30	Woods, Good, HSG A (E1)
0.429	98	Building and Parking Lot, HSG A (E1)
0.935	**61**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.935	HSG A	E1
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.935		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.429	0.000	0.000	0.000	0.000	0.429	Building and Parking Lot	E1
0.507	0.000	0.000	0.000	0.000	0.507	Woods, Good	E1
0.935	**0.000**	**0.000**	**0.000**	**0.000**	**0.935**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site Runoff Area=40,741 sf 45.83% Impervious Runoff Depth>0.40"
Tc=5.0 min CN=61 Runoff=0.27 cfs 0.031 af

Reach DP: Closed Drainage System to Knox Trail Inflow=0.27 cfs 0.031 af
Outflow=0.27 cfs 0.031 af

Total Runoff Area = 0.935 ac Runoff Volume = 0.031 af Average Runoff Depth = 0.40"
54.17% Pervious = 0.507 ac 45.83% Impervious = 0.429 ac

Summary for Subcatchment E1: Existing Site

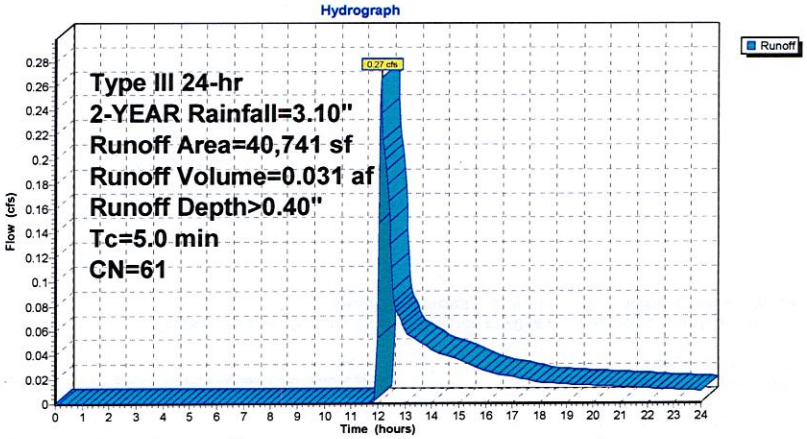
Runoff = 0.27 cfs @ 12.12 hrs, Volume= 0.031 af, Depth> 0.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 2-YEAR Rainfall=3.10"

	Area (sf)	CN	Description
*	18,670	98	Building and Parking Lot, HSG A
	22,071	30	Woods, Good, HSG A
	40,741	61	Weighted Average
	22,071		54.17% Pervious Area
	18,670		45.83% Impervious Area

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

Subcatchment E1: Existing Site



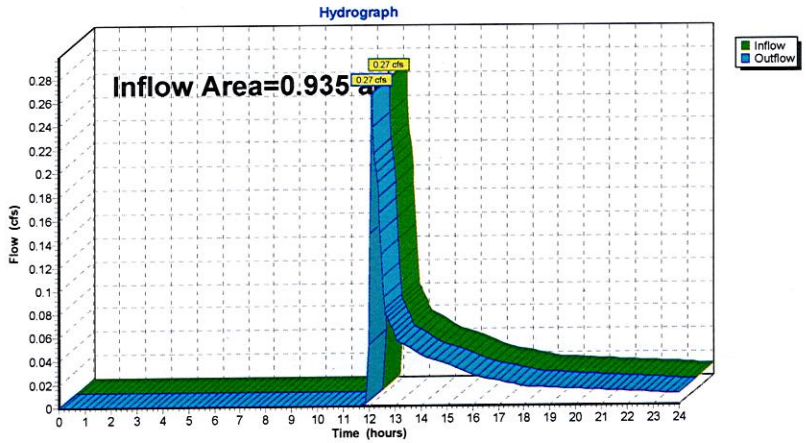
Summary for Reach DP: Closed Drainage System to Knox Trail

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

Inflow Area = 0.935 ac, 45.83% Impervious, Inflow Depth > 0.40" for 2-YEAR event
Inflow = 0.27 cfs @ 12.12 hrs, Volume= 0.031 af
Outflow = 0.27 cfs @ 12.12 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site Runoff Area=40,741 sf 45.83% Impervious Runoff Depth>1.08"
Tc=5.0 min CN=61 Runoff=1.06 cfs 0.084 af

Reach DP: Closed Drainage System to Knox Trail Inflow=1.06 cfs 0.084 af
Outflow=1.06 cfs 0.084 af

Total Runoff Area = 0.935 ac Runoff Volume = 0.084 af Average Runoff Depth = 1.08"
54.17% Pervious = 0.507 ac 45.83% Impervious = 0.429 ac

Summary for Subcatchment E1: Existing Site

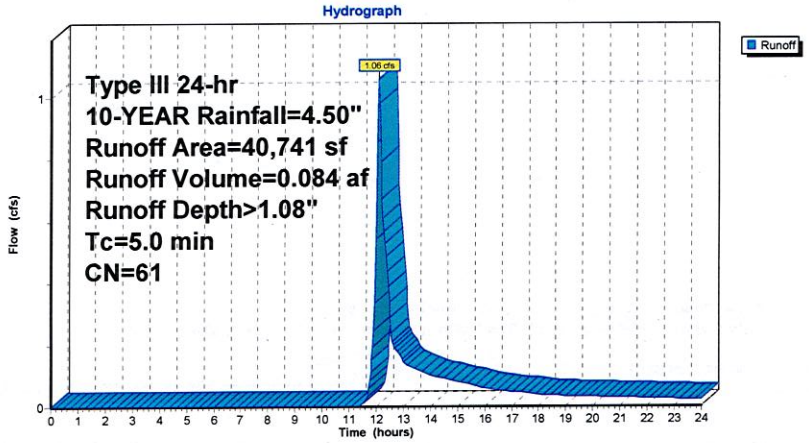
Runoff = 1.06 cfs @ 12.09 hrs, Volume= 0.084 af, Depth> 1.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 10-YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	18,670	98	Building and Parking Lot, HSG A
	22,071	30	Woods, Good, HSG A
	40,741	61	Weighted Average
	22,071		54.17% Pervious Area
	18,670		45.83% Impervious Area

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

Subcatchment E1: Existing Site



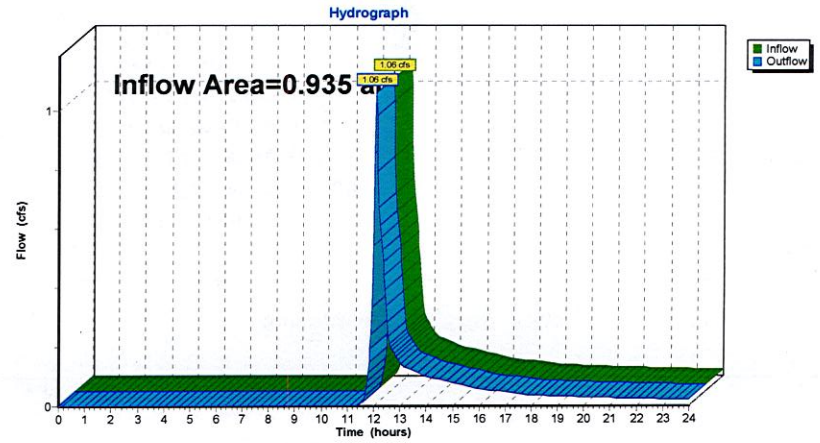
Summary for Reach DP: Closed Drainage System to Knox Trail

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

Inflow Area = 0.935 ac, 45.83% Impervious, Inflow Depth > 1.08" for 10-YEAR event
Inflow = 1.06 cfs @ 12.09 hrs, Volume= 0.084 af
Outflow = 1.06 cfs @ 12.09 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site Runoff Area=40,741 sf 45.83% Impervious Runoff Depth>1.55"
Tc=5.0 min CN=61 Runoff=1.62 cfs 0.121 af

Reach DP: Closed Drainage System to Knox Trail Inflow=1.62 cfs 0.121 af
Outflow=1.62 cfs 0.121 af

Total Runoff Area = 0.935 ac Runoff Volume = 0.121 af Average Runoff Depth = 1.55"
54.17% Pervious = 0.507 ac 45.83% Impervious = 0.429 ac

Summary for Subcatchment E1: Existing Site

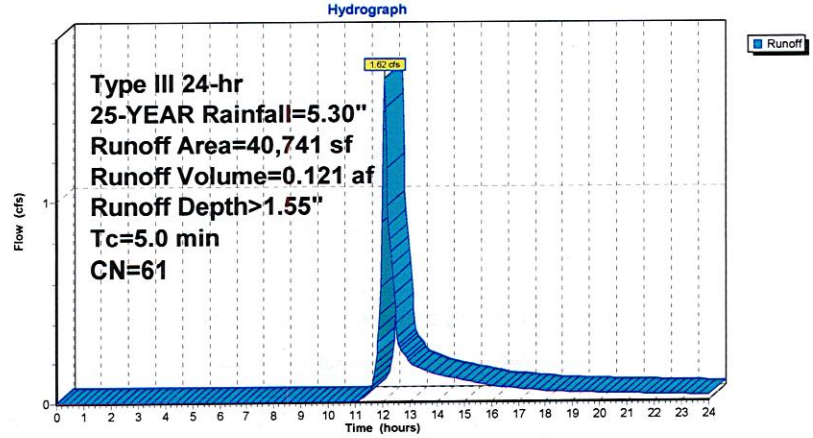
Runoff = 1.62 cfs @ 12.09 hrs, Volume= 0.121 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 25-YEAR Rainfall=5.30"

	Area (sf)	CN	Description
*	18,670	98	Building and Parking Lot, HSG A
	22,071	30	Woods, Good, HSG A
	40,741	61	Weighted Average
	22,071		54.17% Pervious Area
	18,670		45.83% Impervious Area

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

Subcatchment E1: Existing Site



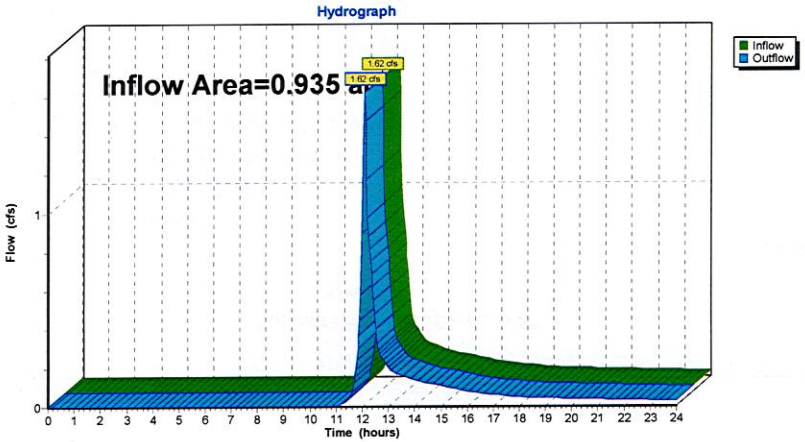
Summary for Reach DP: Closed Drainage System to Knox Trail

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

Inflow Area = 0.935 ac, 45.83% Impervious, Inflow Depth > 1.55" for 25-YEAR event
Inflow = 1.62 cfs @ 12.09 hrs, Volume= 0.121 af
Outflow = 1.62 cfs @ 12.09 hrs, Volume= 0.121 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site Runoff Area=40,741 sf 45.83% Impervious Runoff Depth>2.34"
Tc=5.0 min CN=61 Runoff=2.55 cfs 0.183 af

Reach DP: Closed Drainage System to Knox Trail Inflow=2.55 cfs 0.183 af
Outflow=2.55 cfs 0.183 af

Total Runoff Area = 0.935 ac Runoff Volume = 0.183 af Average Runoff Depth = 2.34"
54.17% Pervious = 0.507 ac 45.83% Impervious = 0.429 ac

Summary for Subcatchment E1: Existing Site

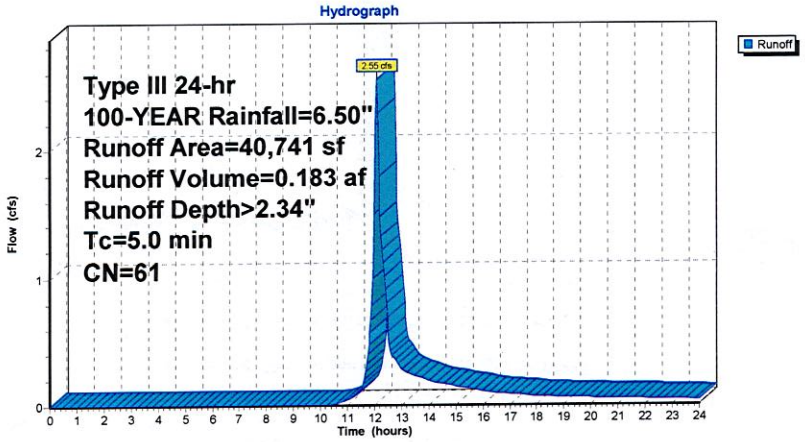
Runoff = 2.55 cfs @ 12.08 hrs, Volume= 0.183 af, Depth> 2.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 100-YEAR Rainfall=6.50"

	Area (sf)	CN	Description
*	18,670	98	Building and Parking Lot, HSG A
	22,071	30	Woods, Good, HSG A
	40,741	61	Weighted Average
	22,071		54.17% Pervious Area
	18,670		45.83% Impervious Area

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

Subcatchment E1: Existing Site



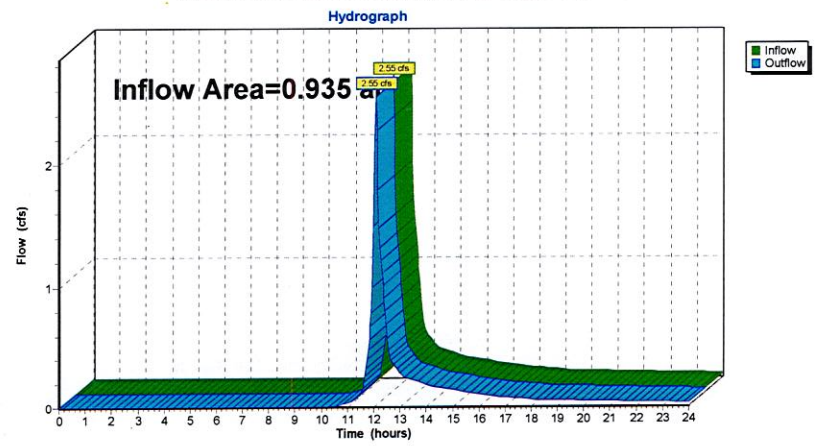
Summary for Reach DP: Closed Drainage System to Knox Trail

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

Inflow Area = 0.935 ac, 45.83% Impervious, Inflow Depth > 2.34" for 100-YEAR event
Inflow = 2.55 cfs @ 12.08 hrs, Volume= 0.183 af
Outflow = 2.55 cfs @ 12.08 hrs, Volume= 0.183 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site Runoff Area=40,741 sf 45.83% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=61 Runoff=0.00 cfs 0.000 af

Reach DP: Closed Drainage System to Knox Trail Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 0.935 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
54.17% Pervious = 0.507 ac 45.83% Impervious = 0.429 ac

Summary for Subcatchment E1: Existing Site

[45] Hint: Runoff=Zero

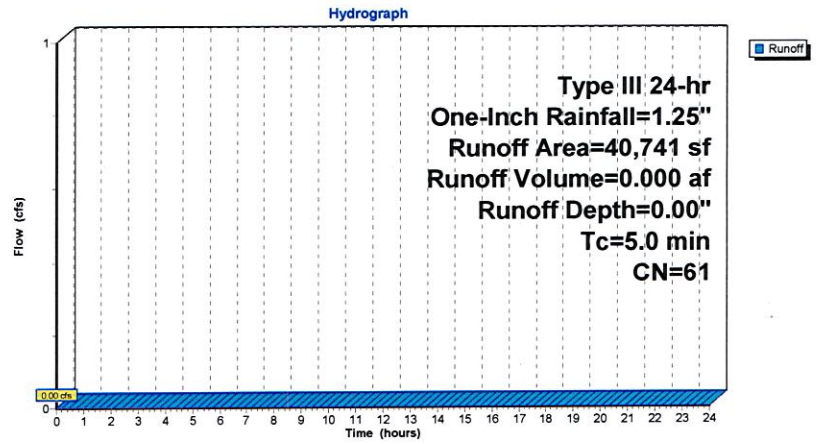
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr One-Inch Rainfall=1.25"

	Area (sf)	CN	Description
*	18,670	98	Building and Parking Lot, HSG A
	22,071	30	Woods, Good, HSG A
	40,741	61	Weighted Average
	22,071		54.17% Pervious Area
	18,670		45.83% Impervious Area

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

Subcatchment E1: Existing Site



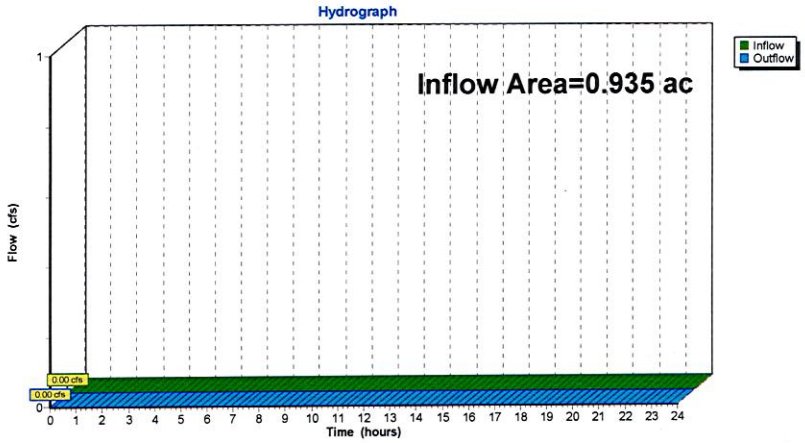
Summary for Reach DP: Closed Drainage System to Knox Trail

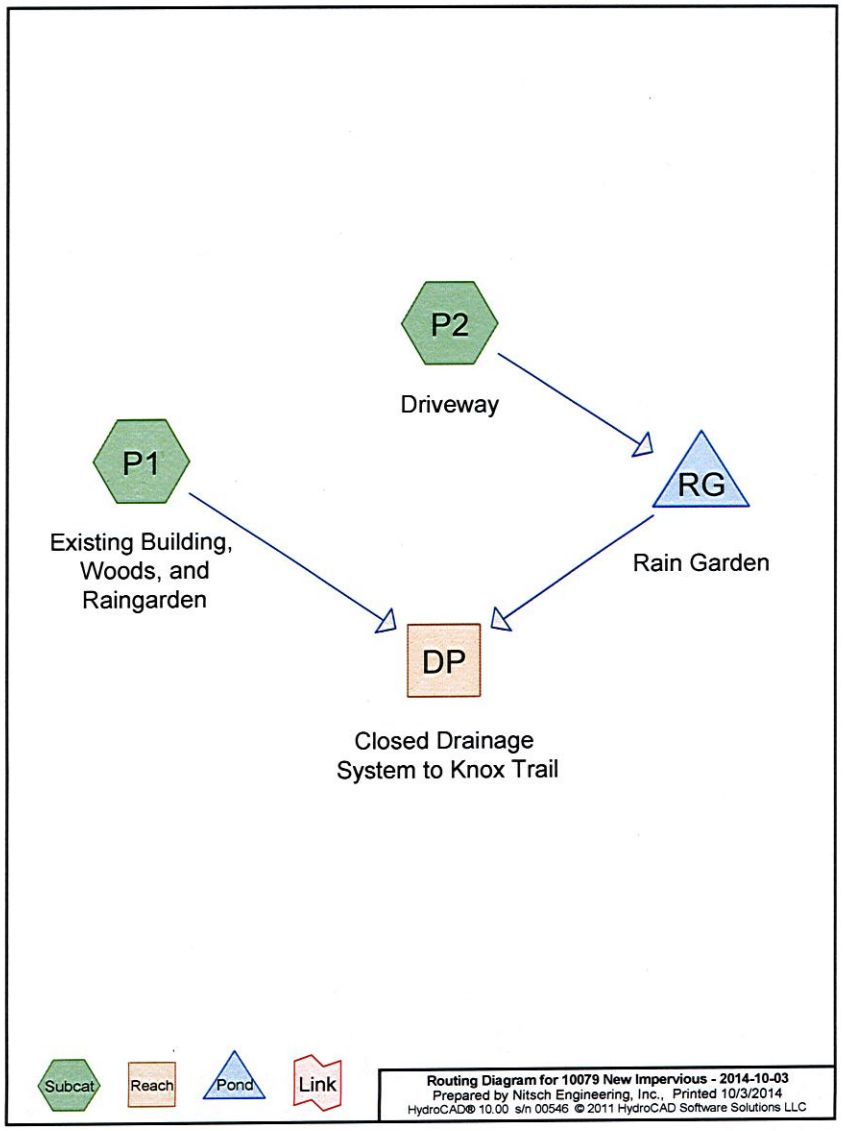
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.935 ac, 45.83% Impervious, Inflow Depth = 0.00" for One-Inch event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail





Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.191	30	Woods, Good, HSG A (P1)
0.057	39	>75% Grass cover, Good, HSG A (P1)
0.083	98	Building and Parking Lot, HSG A (P1)
0.344	98	Paved parking, HSG A (P2)
0.675	**74**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.675	HSG A	P1, P2
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.675		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.083	0.000	0.000	0.000	0.000	0.083	Building and Parking Lot	P1
0.057	0.000	0.000	0.000	0.000	0.057	>75% Grass cover, Good	P1
0.344	0.000	0.000	0.000	0.000	0.344	Paved parking	P2
0.191	0.000	0.000	0.000	0.000	0.191	Woods, Good	P1
0.675	**0.000**	**0.000**	**0.000**	**0.000**	**0.675**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	RG	144.50	144.30	15.0	0.0133	0.013	12.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Existing Building, Runoff Area=14,415 sf 25.08% Impervious Runoff Depth>0.09"
Tc=5.0 min CN=49 Runoff=0.00 cfs 0.002 af

Subcatchment P2: Driveway Runoff Area=14,990 sf 100.00% Impervious Runoff Depth>2.87"
Tc=5.0 min CN=98 Runoff=1.06 cfs 0.082 af

Reach DP: Closed Drainage System to Knox Trail Inflow=0.00 cfs 0.002 af
Outflow=0.00 cfs 0.002 af

Pond RG: Rain Garden Peak Elev=148.44' Storage=1,445 cf Inflow=1.06 cfs 0.082 af
Discarded=0.08 cfs 0.082 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.082 af

Total Runoff Area = 0.675 ac Runoff Volume = 0.085 af Average Runoff Depth = 1.51"
36.73% Pervious = 0.248 ac 63.27% Impervious = 0.427 ac

Summary for Subcatchment P1: Existing Building, Woods, and Raingarden

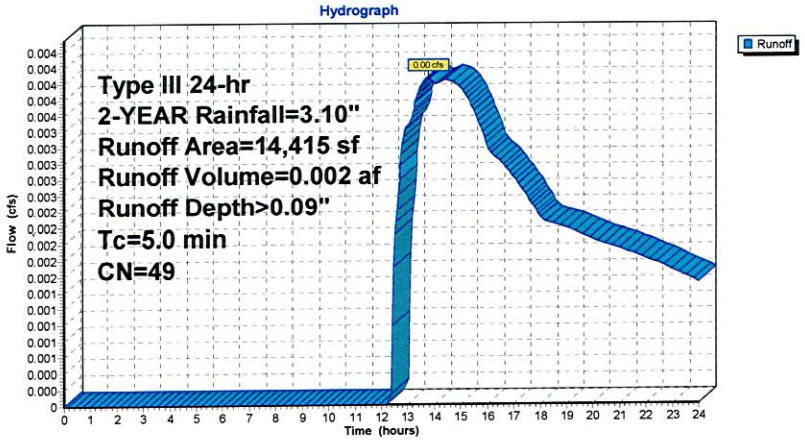
Runoff = 0.00 cfs @ 13.79 hrs, Volume= 0.002 af, Depth> 0.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 2-YEAR Rainfall=3.10"

	Area (sf)	CN	Description
*	3,615	98	Building and Parking Lot, HSG A
	8,300	30	Woods, Good, HSG A
	2,500	39	>75% Grass cover, Good, HSG A
	14,415	49	Weighted Average
	10,800		74.92% Pervious Area
	3,615		25.08% Impervious Area

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

Subcatchment P1: Existing Building, Woods, and Raingarden



Summary for Subcatchment P2: Driveway

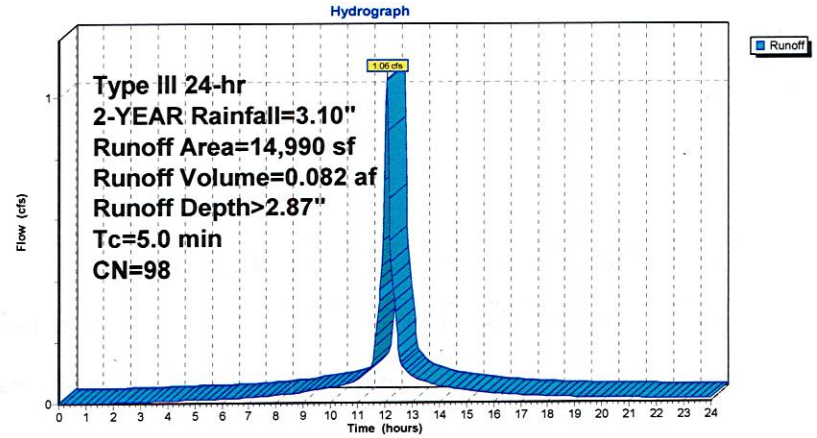
Runoff = 1.06 cfs @ 12.07 hrs, Volume= 0.082 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990		100.00% Impervious Area

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

Subcatchment P2: Driveway



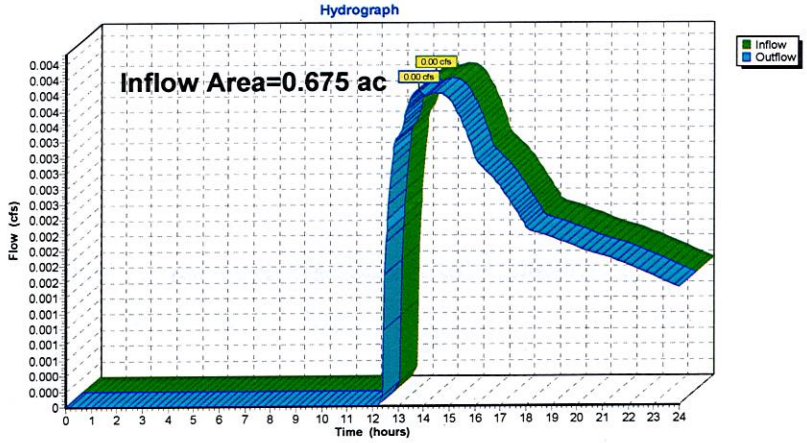
Summary for Reach DP: Closed Drainage System to Knox Trail

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

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth > 0.04" for 2-YEAR event
Inflow = 0.00 cfs @ 13.79 hrs, Volume= 0.002 af
Outflow = 0.00 cfs @ 13.79 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



Summary for Pond RG: Rain Garden

Inflow Area = 0.344 ac,100.00% Impervious, Inflow Depth > 2.87" for 2-YEAR event
Inflow = 1.06 cfs @ 12.07 hrs, Volume= 0.082 af
Outflow = 0.08 cfs @ 13.13 hrs, Volume= 0.082 af, Atten= 93%, Lag= 63.2 min
Discarded = 0.08 cfs @ 13.13 hrs, Volume= 0.082 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 148.44' @ 13.13 hrs Surf.Area= 1,382 sf Storage= 1,445 cf

Plug-Flow detention time= 155.3 min calculated for 0.082 af (100% of inflow)
Center-of-Mass det. time= 154.8 min (910.6 - 755.8)

Volume	Invert	Avail.Storage	Storage Description
#1	147.25'	1,883 cf	**Rain Garden (Prismatic)** Listed below (Recalc)

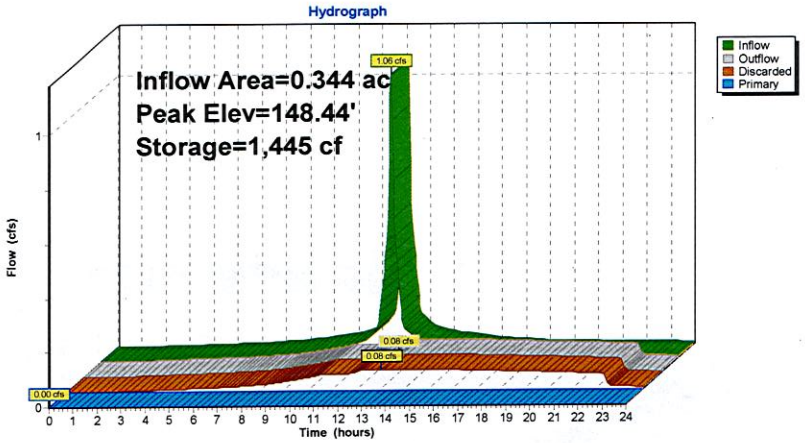
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
147.25	1,040	0	0
148.75	1,470	1,883	1,883

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**12.0" Round New Drain to existing DMH** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	**24.0" Horiz. Dome Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 13.13 hrs HW=148.44' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=147.25' (Free Discharge)
└**2=New Drain to existing DMH** (Passes 0.00 cfs of 4.48 cfs potential flow)
└**3=Dome Grate** (Controls 0.00 cfs)

Pond RG: Rain Garden



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Existing Building, Runoff Area=14,415 sf 25.08% Impervious Runoff Depth>0.46"
Tc=5.0 min CN=49 Runoff=0.08 cfs 0.013 af

Subcatchment P2: Driveway Runoff Area=14,990 sf 100.00% Impervious Runoff Depth>4.26"
Tc=5.0 min CN=98 Runoff=1.54 cfs 0.122 af

Reach DP: Closed Drainage System to Knox Trail Inflow=0.76 cfs 0.035 af
Outflow=0.76 cfs 0.035 af

Pond RG: Rain Garden Peak Elev=148.60' Storage=1,670 cf Inflow=1.54 cfs 0.122 af
Discarded=0.08 cfs 0.099 af Primary=0.68 cfs 0.022 af Outflow=0.76 cfs 0.120 af

Total Runoff Area = 0.675 ac Runoff Volume = 0.135 af Average Runoff Depth = 2.40"
36.73% Pervious = 0.248 ac 63.27% Impervious = 0.427 ac

Summary for Subcatchment P1: Existing Building, Woods, and Raingarden

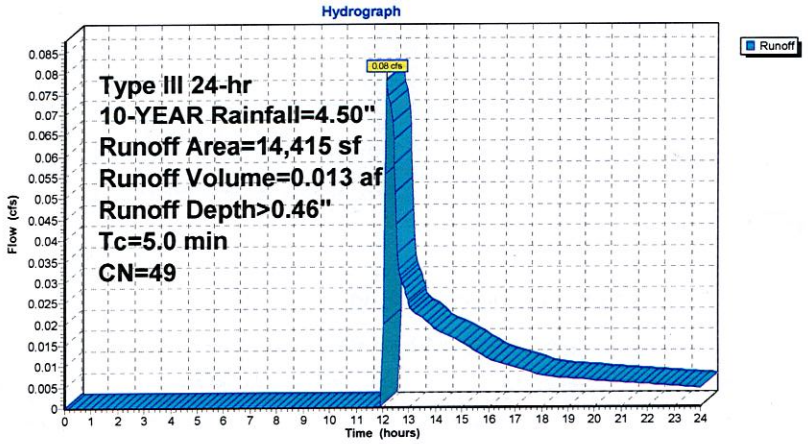
Runoff = 0.08 cfs @ 12.14 hrs, Volume= 0.013 af, Depth> 0.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 10-YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	3,615	98	Building and Parking Lot, HSG A
	8,300	30	Woods, Good, HSG A
	2,500	39	>75% Grass cover, Good, HSG A
	14,415	49	Weighted Average
	10,800		74.92% Pervious Area
	3,615		25.08% Impervious Area

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

Subcatchment P1: Existing Building, Woods, and Raingarden



Summary for Subcatchment P2: Driveway

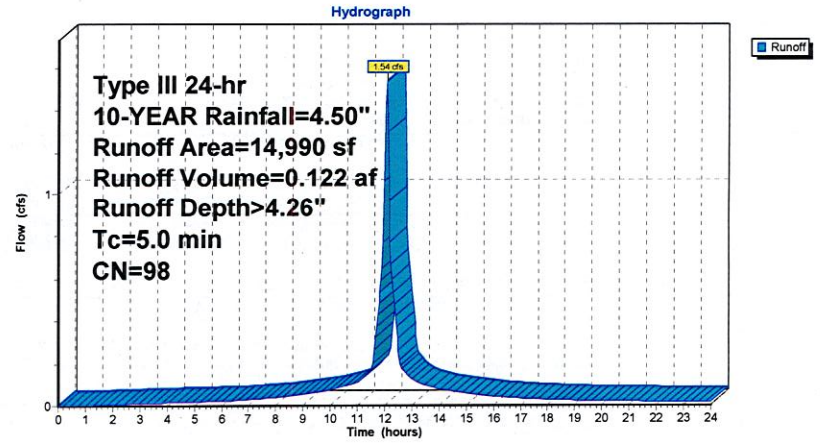
Runoff = 1.54 cfs @ 12.07 hrs, Volume= 0.122 af, Depth> 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 10-YEAR Rainfall=4.50"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990		100.00% Impervious Area

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

Subcatchment P2: Driveway



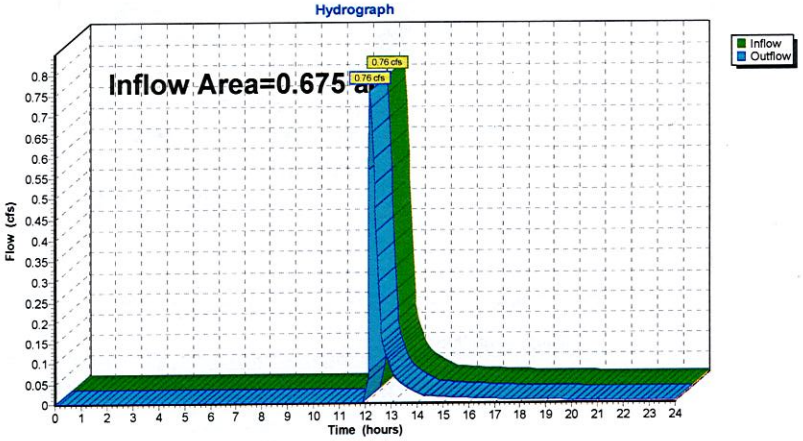
Summary for Reach DP: Closed Drainage System to Knox Trail

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

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth > 0.61" for 10-YEAR event
Inflow = 0.76 cfs @ 12.22 hrs, Volume= 0.035 af
Outflow = 0.76 cfs @ 12.22 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



Summary for Pond RG: Rain Garden

Inflow Area = 0.344 ac,100.00% Impervious, Inflow Depth > 4.26" for 10-YEAR event
Inflow = 1.54 cfs @ 12.07 hrs, Volume= 0.122 af
Outflow = 0.76 cfs @ 12.22 hrs, Volume= 0.120 af, Atten= 50%, Lag= 8.6 min
Discarded = 0.08 cfs @ 12.22 hrs, Volume= 0.099 af
Primary = 0.68 cfs @ 12.22 hrs, Volume= 0.022 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 148.60' @ 12.22 hrs Surf.Area= 1,428 sf Storage= 1,670 cf

Plug-Flow detention time= 143.6 min calculated for 0.120 af (98% of inflow)
Center-of-Mass det. time= 134.2 min (882.7 - 748.5)

Volume	Invert	Avail.Storage	Storage Description
#1	147.25'	1,883 cf	**Rain Garden (Prismatic)** Listed below (Recalc)

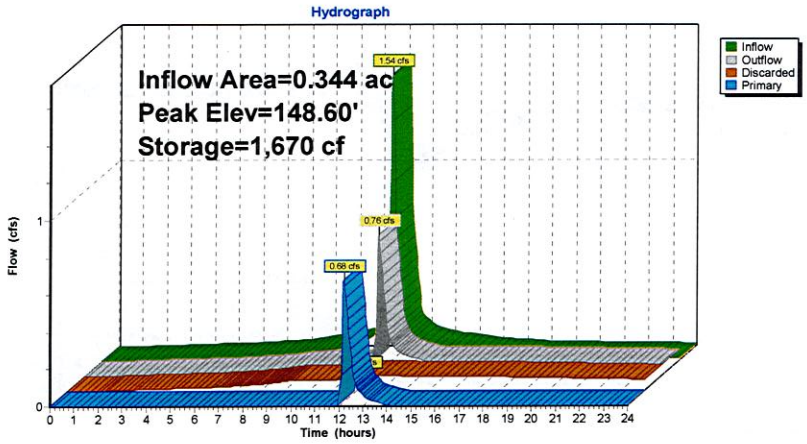
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
147.25	1,040	0	0
148.75	1,470	1,883	1,883

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**12.0" Round New Drain to existing DMH** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	**24.0" Horiz. Dome Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 12.22 hrs HW=148.60' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.66 cfs @ 12.22 hrs HW=148.60' (Free Discharge)
└─**2=New Drain to existing DMH** (Passes 0.66 cfs of 5.67 cfs potential flow)
└─**3=Dome Grate** (Weir Controls 0.66 cfs @ 1.04 fps)

Pond RG: Rain Garden



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Existing Building, Runoff Area=14,415 sf 25.08% Impervious Runoff Depth>0.76"
Tc=5.0 min CN=49 Runoff=0.19 cfs 0.021 af

Subcatchment P2: Driveway Runoff Area=14,990 sf 100.00% Impervious Runoff Depth>5.06"
Tc=5.0 min CN=98 Runoff=1.82 cfs 0.145 af

Reach DP: Closed Drainage System to Knox Trail Inflow=1.52 cfs 0.059 af
Outflow=1.52 cfs 0.059 af

Pond RG: Rain Garden Peak Elev=148.66' Storage=1,755 cf Inflow=1.82 cfs 0.145 af
Discarded=0.08 cfs 0.103 af Primary=1.33 cfs 0.038 af Outflow=1.41 cfs 0.141 af

Total Runoff Area = 0.675 ac Runoff Volume = 0.166 af Average Runoff Depth = 2.95"
36.73% Pervious = 0.248 ac 63.27% Impervious = 0.427 ac

Summary for Subcatchment P1: Existing Building, Woods, and Raingarden

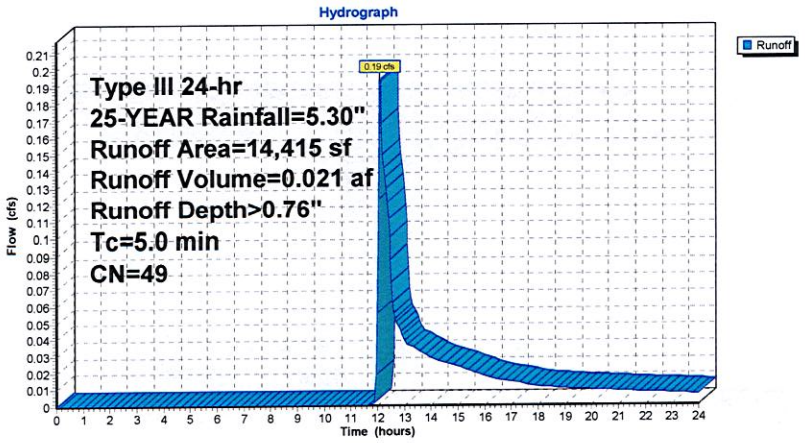
Runoff = 0.19 cfs @ 12.11 hrs, Volume= 0.021 af, Depth> 0.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 25-YEAR Rainfall=5.30"

	Area (sf)	CN	Description
*	3,615	98	Building and Parking Lot, HSG A
	8,300	30	Woods, Good, HSG A
	2,500	39	>75% Grass cover, Good, HSG A
	14,415	49	Weighted Average
	10,800		74.92% Pervious Area
	3,615		25.08% Impervious Area

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

Subcatchment P1: Existing Building, Woods, and Raingarden



Summary for Subcatchment P2: Driveway

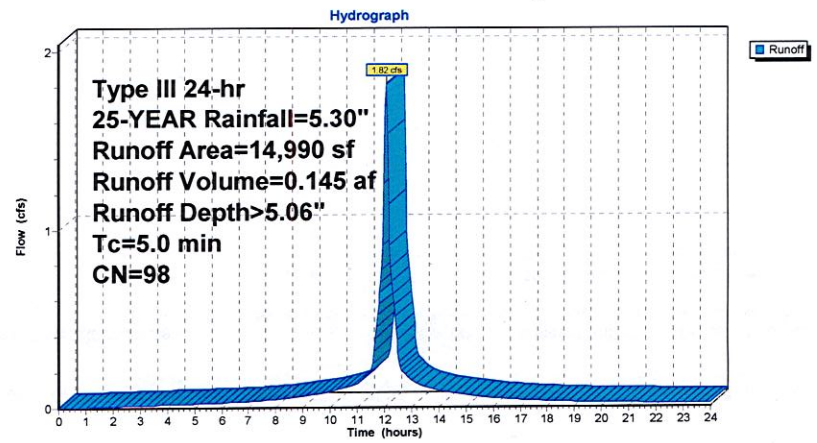
Runoff = 1.82 cfs @ 12.07 hrs, Volume= 0.145 af, Depth> 5.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 25-YEAR Rainfall=5.30"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990		100.00% Impervious Area

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

Subcatchment P2: Driveway



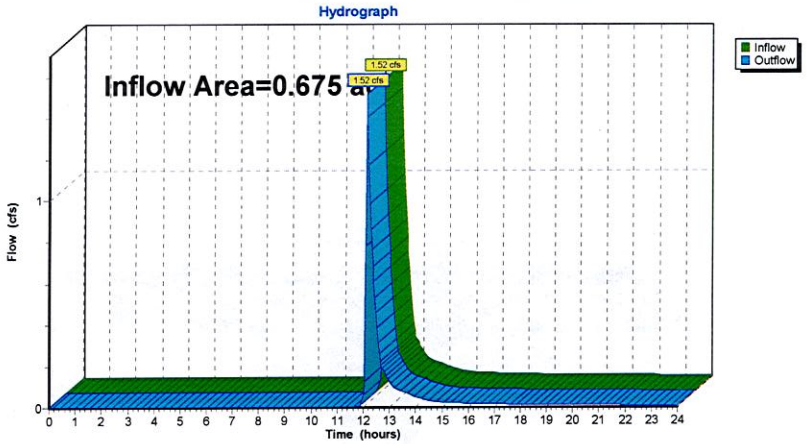
Summary for Reach DP: Closed Drainage System to Knox Trail

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

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth > 1.04" for 25-YEAR event
Inflow = 1.52 cfs @ 12.14 hrs, Volume= 0.059 af
Outflow = 1.52 cfs @ 12.14 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



Summary for Pond RG: Rain Garden

Inflow Area = 0.344 ac,100.00% Impervious, Inflow Depth > 5.06" for 25-YEAR event
Inflow = 1.82 cfs @ 12.07 hrs, Volume= 0.145 af
Outflow = 1.41 cfs @ 12.14 hrs, Volume= 0.141 af, Atten= 22%, Lag= 4.0 min
Discarded = 0.08 cfs @ 12.14 hrs, Volume= 0.103 af
Primary = 1.33 cfs @ 12.14 hrs, Volume= 0.038 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 148.66' @ 12.14 hrs Surf.Area= 1,445 sf Storage= 1,755 cf

Plug-Flow detention time= 131.7 min calculated for 0.141 af (97% of inflow)
Center-of-Mass det. time= 112.1 min (857.9 - 745.8)

Volume	Invert	Avail.Storage	Storage Description
#1	147.25'	1,883 cf	**Rain Garden (Prismatic)** Listed below (Recalc)

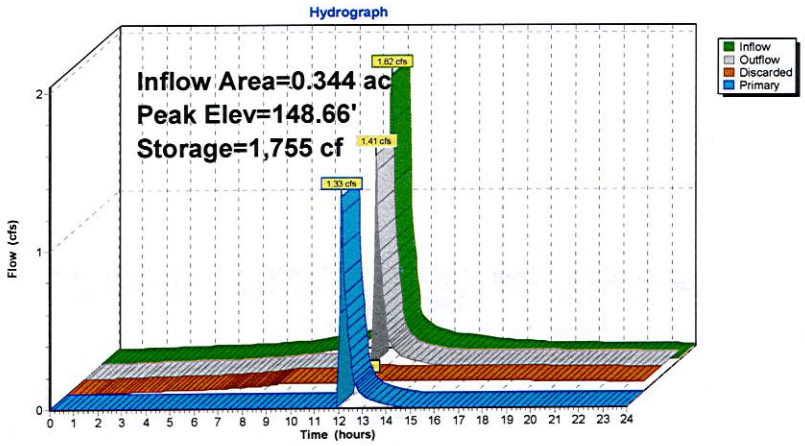
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
147.25	1,040	0	0
148.75	1,470	1,883	1,883

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**12.0" Round New Drain to existing DMH** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	**24.0" Horiz. Dome Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 12.14 hrs HW=148.65' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=1.25 cfs @ 12.14 hrs HW=148.65' (Free Discharge)
└**2=New Drain to existing DMH** (Passes 1.25 cfs of 5.71 cfs potential flow)
└**3=Dome Grate** (Weir Controls 1.25 cfs @ 1.29 fps)

Pond RG: Rain Garden



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Existing Building, Runoff Area=14,415 sf 25.08% Impervious Runoff Depth>1.32"
Tc=5.0 min CN=49 Runoff=0.43 cfs 0.036 af

Subcatchment P2: Driveway Runoff Area=14,990 sf 100.00% Impervious Runoff Depth>6.26"
Tc=5.0 min CN=98 Runoff=2.24 cfs 0.179 af

Reach DP: Closed Drainage System to Knox Trail Inflow=2.38 cfs 0.098 af
Outflow=2.38 cfs 0.098 af

Pond RG: Rain Garden Peak Elev=148.71' Storage=1,823 cf Inflow=2.24 cfs 0.179 af
Discarded=0.08 cfs 0.109 af Primary=1.97 cfs 0.062 af Outflow=2.05 cfs 0.171 af

Total Runoff Area = 0.675 ac Runoff Volume = 0.216 af Average Runoff Depth = 3.83"
36.73% Pervious = 0.248 ac 63.27% Impervious = 0.427 ac

Summary for Subcatchment P1: Existing Building, Woods, and Raingarden

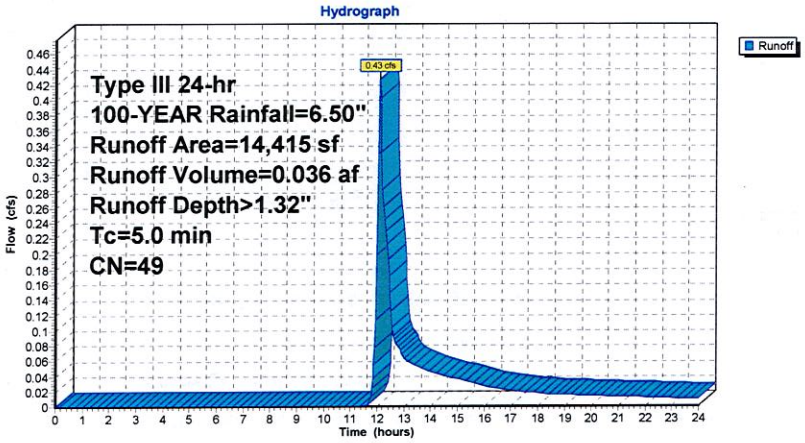
Runoff = 0.43 cfs @ 12.09 hrs, Volume= 0.036 af, Depth> 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 100-YEAR Rainfall=6.50"

	Area (sf)	CN	Description
*	3,615	98	Building and Parking Lot, HSG A
	8,300	30	Woods, Good, HSG A
	2,500	39	>75% Grass cover, Good, HSG A
	14,415	49	Weighted Average
	10,800		74.92% Pervious Area
	3,615		25.08% Impervious Area

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

Subcatchment P1: Existing Building, Woods, and Raingarden



Summary for Subcatchment P2: Driveway

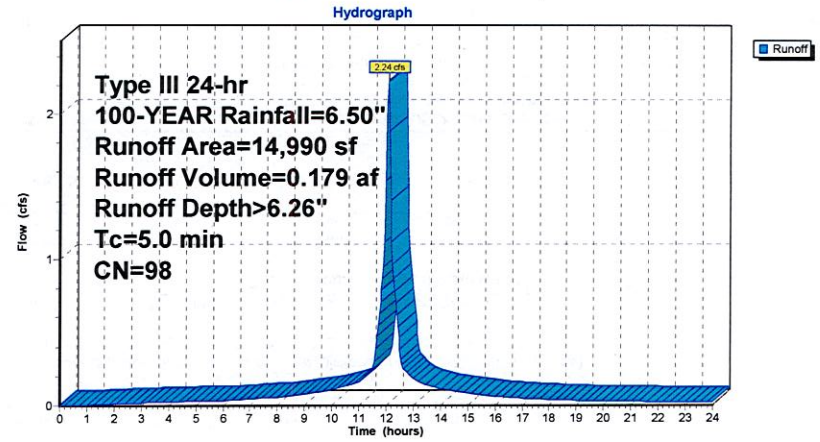
Runoff = 2.24 cfs @ 12.07 hrs, Volume= 0.179 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 100-YEAR Rainfall=6.50"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990		100.00% Impervious Area

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

Subcatchment P2: Driveway



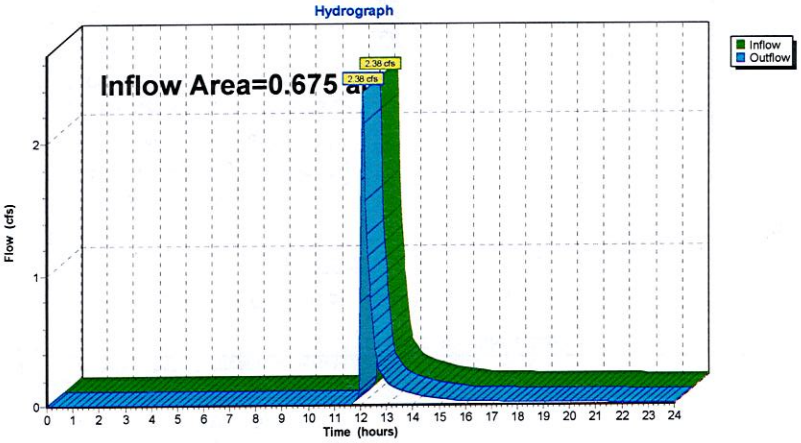
Summary for Reach DP: Closed Drainage System to Knox Trail

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

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth > 1.75" for 100-YEAR event
Inflow = 2.38 cfs @ 12.10 hrs, Volume= 0.098 af
Outflow = 2.38 cfs @ 12.10 hrs, Volume= 0.098 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



Summary for Pond RG: Rain Garden

Inflow Area = 0.344 ac,100.00% Impervious, Inflow Depth > 6.26" for 100-YEAR event
Inflow = 2.24 cfs @ 12.07 hrs, Volume= 0.179 af
Outflow = 2.05 cfs @ 12.10 hrs, Volume= 0.171 af, Atten= 9%, Lag= 1.8 min
Discarded = 0.08 cfs @ 12.10 hrs, Volume= 0.109 af
Primary = 1.97 cfs @ 12.10 hrs, Volume= 0.062 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 148.71' @ 12.10 hrs Surf.Area= 1,458 sf Storage= 1,823 cf

Plug-Flow detention time= 117.4 min calculated for 0.171 af (95% of inflow)
Center-of-Mass det. time= 88.8 min (831.5 - 742.7)

Volume	Invert	Avail.Storage	Storage Description
#1	147.25'	1,883 cf	**Rain Garden (Prismatic)** Listed below (Recalc)

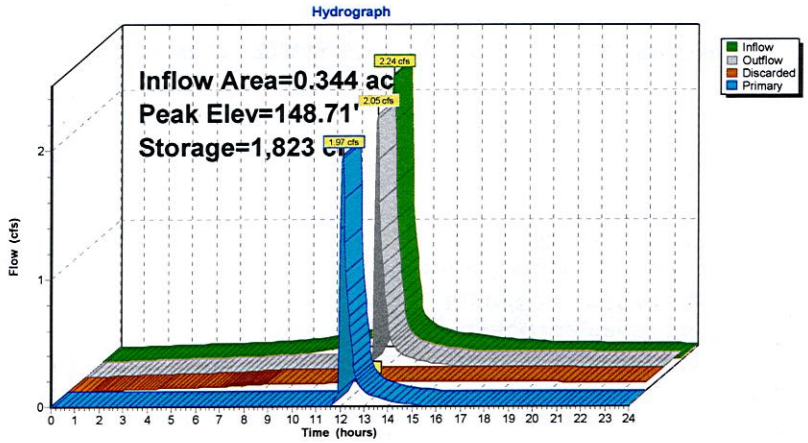
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
147.25	1,040	0	0
148.75	1,470	1,883	1,883

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**12.0" Round New Drain to existing DMH** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	**24.0" Horiz. Dome Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 12.10 hrs HW=148.71' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=1.92 cfs @ 12.10 hrs HW=148.71' (Free Discharge)
└**2=New Drain to existing DMH** (Passes 1.92 cfs of 5.75 cfs potential flow)
└**3=Dome Grate** (Weir Controls 1.92 cfs @ 1.48 fps)

Pond RG: Rain Garden



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Existing Building, Runoff Area=14,415 sf 25.08% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=49 Runoff=0.00 cfs 0.000 af

Subcatchment P2: Driveway Runoff Area=14,990 sf 100.00% Impervious Runoff Depth>1.03"
Tc=5.0 min CN=98 Runoff=0.40 cfs 0.030 af

Reach DP: Closed Drainage System to Knox Trail Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond RG: Rain Garden Peak Elev=147.60' Storage=378 cf Inflow=0.40 cfs 0.030 af
Discarded=0.06 cfs 0.030 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.030 af

Total Runoff Area = 0.675 ac Runoff Volume = 0.030 af Average Runoff Depth = 0.53"
36.73% Pervious = 0.248 ac 63.27% Impervious = 0.427 ac

Summary for Subcatchment P1: Existing Building, Woods, and Raingarden

[45] Hint: Runoff=Zero

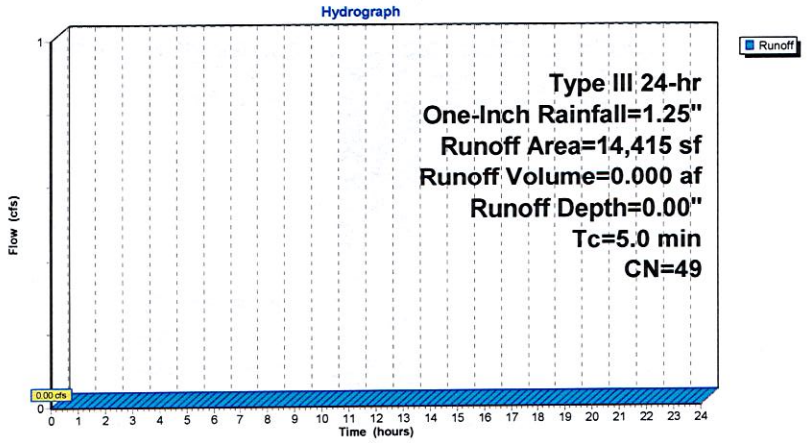
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr One-Inch Rainfall=1.25"

	Area (sf)	CN	Description
*	3,615	98	Building and Parking Lot, HSG A
	8,300	30	Woods, Good, HSG A
	2,500	39	>75% Grass cover, Good, HSG A
	14,415	49	Weighted Average
	10,800		74.92% Pervious Area
	3,615		25.08% Impervious Area

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

Subcatchment P1: Existing Building, Woods, and Raingarden



Summary for Subcatchment P2: Driveway

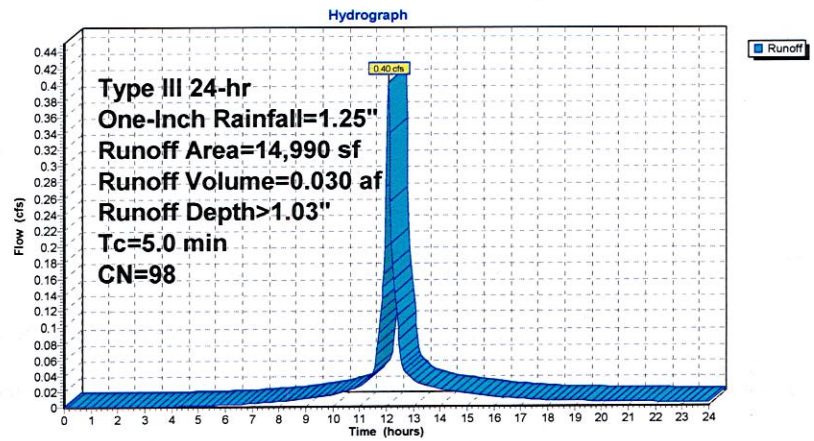
Runoff = 0.40 cfs @ 12.07 hrs, Volume= 0.030 af, Depth> 1.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr One-Inch Rainfall=1.25"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990		100.00% Impervious Area

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

Subcatchment P2: Driveway



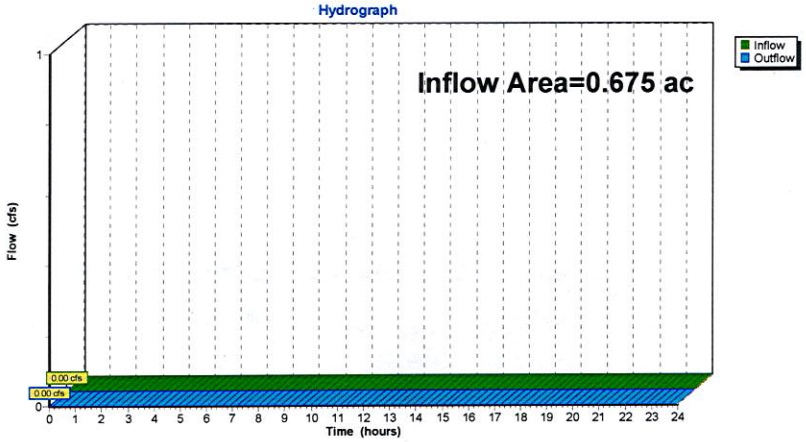
Summary for Reach DP: Closed Drainage System to Knox Trail

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

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth = 0.00" for One-Inch event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



Summary for Pond RG: Rain Garden

Inflow Area = 0.344 ac,100.00% Impervious, Inflow Depth > 1.03" for One-Inch event
Inflow = 0.40 cfs @ 12.07 hrs, Volume= 0.030 af
Outflow = 0.06 cfs @ 12.54 hrs, Volume= 0.030 af, Atten= 84%, Lag= 28.2 min
Discarded = 0.06 cfs @ 12.54 hrs, Volume= 0.030 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 147.60' @ 12.54 hrs Surf.Area= 1,140 sf Storage= 378 cf

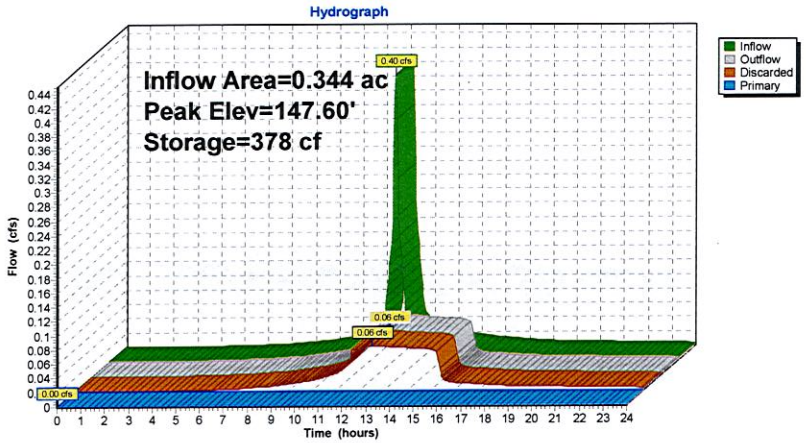
Plug-Flow detention time= 38.3 min calculated for 0.030 af (100% of inflow)
Center-of-Mass det. time= 37.8 min (817.2 - 779.4)

Volume	Invert	Avail.Storage	Storage Description
#1	147.25'	1,883 cf	**Rain Garden (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
147.25	1,040	0	0
148.75	1,470	1,883	1,883

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**12.0" Round New Drain to existing DMH** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	**24.0" Horiz. Dome Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.06 cfs @ 12.54 hrs HW=147.60' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=147.25' (Free Discharge)
└─**2=New Drain to existing DMH** (Passes 0.00 cfs of 4.48 cfs potential flow)
  └─**3=Dome Grate** (Controls 0.00 cfs)

Pond RG: Rain Garden