

STORMWATER CALCULATIONS

Hopping Brook Road

Modification Plans to the Amended Definitive Plan of Land

Holliston, Massachusetts

Prepared For:

New Hopping Brook Trust
42 Westboro Road
North Grafton, Massachusetts 01536

Prepared By:

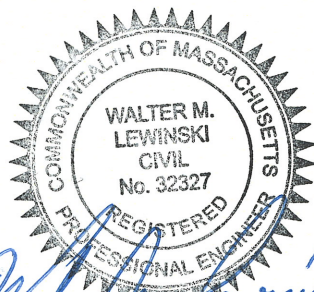
**Engineering
Design
Consultants, Inc.**

32 Turnpike Road
Southborough, Massachusetts 01772

October 4, 2016

Revised: October 27, 2016

Revised: December 5, 2016



Walter M. Lewinski

TABLE OF CONTENTS

	Page No.
Cover Page	1
Table of Contents	2
Project Narrative	3
Drainage Narrative	3-5
Pre/Post-development peak discharge rates	4
Detention Basin summary	5
DEP Stormwater Management Standards	6
Stormwater Management Calculations	
Routing Diagram	7
2-year	8-18
10-year	19-29
25-year	30-40
100-year	41-84
Detention Basin (No-Infiltration) Hydrographs for time to drain	85-92
Attachments:	
TSS Removal Calculation	93
Contech Water Quality Calculations	94-96
Precipitation Table	97
Precipitation Chart	98
Average “c” Values For Manning’s Equation	99
Culvert Report (Culvert 28 – STA 55+50)	100
Culvert Report (Culvert 30 – STA 50+75)	101
Manning’s Pipe Flow (100-Year)	102
Contech CDS Unit Detail	103
Pre-development Runoff Areas Plan	104
Post-development Runoff Areas Plan	105

PROJECT NARRATIVE

This revision eliminates the second detention basin and lowers the remaining detention basin as well as modifying the outlet control structure from the October 4, 2016 proposal and adds items from the peer review.

This project, “Modifications to the Amended Definitive Plan of Land,” Hopping Brook Road, encompasses the construction of a roadway extension including drainage and utilities.

The design of the drainage system, including the detention/infiltration basin was calculated based on a future building and parking area expansion, however, this drainage report will focus on just the development of the roadway, drainage and utilities. Proposed site drainage will be presented as each site is designed and submitted for approval. The proposed site designs will include roof infiltration and runoff treatment at the individual sites.

The original design included two detention basins one to the east and the other to the west of the proposed roadway. This design moves the proposed road further to the east to allow for one major detention basin on the westerly side of the roadway, allowing for grading that reduces the impact on the adjacent wetland buffer zone.

DRAINAGE NARRATIVE

As required by the Town of Holliston, Massachusetts and MassDEP’s Stormwater Handbook, a storm water analysis was performed for the project at Hopping Brook Road. The method of analysis is the SCS method for hydrologic conditions. The SCS method utilized TR-55 and HydroCAD stormwater modeling system to analysis the 2-year, 10-year, 25-year and 100-year, 24 hour storm events. The “Rational Method” and “Manning’s Equation” was utilized for the 25-year storm for the analysis of the roadway piped drainage system.

The Cross Culverts in the wetland area have no change from the original design, no design information on them is provided in this report as they have more than enough capacity as designed.

Hydrologic Existing Conditions:

The existing site runoff generally flows toward the west. The predominant hydrologic soils group for the project is “Woodbridge fine sandy loam” with a hydrologic value of “C” and “Paxton fine sandy loam with a hydrologic value of “C” and a smaller area of “Charlton Hollis Rock Outcrop,” with a hydrologic value of “A” is present, this was also noted in a report titled “Permeability Testing and Measured groundwater levels, Hopping Brook Park, Holliston, MA,” prepared by The Geotechnical Group, Inc. dated August 2005. In this design an overall Hydrologic Group “C” was used for the pre-developed analysis as well as the post-developed analysis.

Subcatchment Area 1S contains approximately 2,539,490 sf and drains to the wetland to the west and is generally wooded. Subcatchment 2S, also flows to the wetland area to the west and contains 1,970,057 sf of wooded area.

The overall pre-developed flow to the west is represented by Link 1L, “PreDeveloped”.

Hydrologic Proposed Conditions:

Under proposed conditions the same design point location was analyzed for peak flow discharge for the 2-year, 10-year, 25-year and 100-year, 24 hour storm events.

There are eleven Subcatchments 10AS, 10BS, 10CS, 11S, through 16S, 18S, & 19S, included in the proposed condition.

Subcatchment 10S from the previous report was broken down into three (3) Subcatchments, 10AS, 10BS and 10CS to show that the culverts will carry the flow from 10AS and 10BS, and that 10CS will flow down to the main cross culverts without any increase in the post-developed condition. All Subcatchments are undeveloped except 13S and 14S which is the location of the detention/infiltration basin and contain grass areas, also Subcatchments 15S and 18S represent the improved roadway section.

The Stormwater for the roadway will be treated using forebays and extended detention as well as two structural BMP's, Contech CDS units.

Proposed site development stormwater design will be presented as sites are designed and submitted for approval.

Because Subcatchment 2S(19S) will remain undeveloped for this phase, the developed portion of the site will be summarized. When Subcatchment 19S is proposed to have the roadway extended and sites in that location designed, drainage reports will be submitted for review with the site plans.

The developed flow to the east is summarized by the link "10L", labeled "PostDeveloped." The preconstruction flow is summarized by the Subcatchment 1S.

The peak discharge results are in the following table.

	Peak Discharge Summary Table (cfs)			
	Design Storms			
	2-Year	10-Year	25-Year	100-year
Pre-Developed (1S)	14.32	34.49	46.62	65.87
Post-Developed (10L)	10.05	22.75	30.65	43.33

In conclusion, the 2-year, 10-year, and 100-year peak rates of runoff are predominately maintained under proposed conditions to the design point.

DETENTION BASIN/INFILTRATION SUMMARY

Detention basin “10P” is designed with two forebays to treat for TSS removal from the two inlet pipes from the roadway runoff. Infiltration is provided by the detention basin, additional infiltration of roof runoff will be provided when the project is developed.

	Detention Basin Data (10P) Berm Top of Slope Elev: 282.00			
	2-Year	10-Year	25-Year	100-year
Peak Elevation (ft.)	277.07	277.98	278.42	279.06
Time to Drain (hours)	12±	15±	15±	15±
Recharge (cf)	17,643	29,284	34,641	41,494
Time to Drain (hours) (No Recharge)	15±	15±	15±	18±
Peak Elevation (ft.) (No Recharge)	277.14	278.06	278.50	279.14

TSS Removal

Two roadway sections (15S) flow into Forebays sized to treat 1-inch of runoff over the paved areas (sidewalk and roadway). Another two roadway sections (16S & 18S) use structural treatment units, Contech CDS units to treat for over 80% TSS removal for the roadway and sidewalk impervious areas.

Manning’s Pipe Calculations and Culverts

The storm drainage calculations on page 102 are based on the 100-year storm. The culvert data on pages 100 and 101 as well as in the stormwater management calculations indicate that the culvert pipes are designed to handle the 100-year storm.

DEP STORMWATER MANAGEMENT STANDARDS:

Standard 1: All proposed impervious surfaces are treated and will not cause erosion in adjacent wetlands and waters of the Commonwealth, as BMP measures are proposed in accordance with the design requirements of the Stormwater Management Handbook.

Standard 2. The proposed development peak discharge rates predominately meet predevelopment discharge rates for the 2-year, 10-year, 25-year and 100-year storm events for the design point.

Standard 3. 73,660 s.f. of additional impervious surfaces (Roadway & sidewalk) will be created as part of the proposed project. The amount of recharge required is $(73,660 \times 0.25/12) = 1,534$ c.f., based upon an underlying hydrologic soil group C. As seen in the detention basin data tables, more than adequate recharge is provided.

This project meets Standard 3 requirements.

Standard 4. TSS Removal of 80% or greater.

Two Contech, CDS structural units will be used on this project. The units were analyzed for 1-inch of runoff over the paved and sidewalk areas. CDS16 will remove 88.9% of the TSS and CDS22 will remove 82.5%.

(See the CDS TSS reduction calculation within this report.)

The forebays has been sized to treat 1" over the paved and sidewalk surface area flowing into the basin. Impervious area to the north forebay is 17,545 s.f. $\times 1"/12 = 1,462$ c.f. The forebay will provide 4,101 c.f. of storage. Impervious area to the south forebay is 22,036 s.f. $\times 1"/12 = 1,836$ c.f. The forebay will provide 5,731 c.f. of storage. The forebays and extended detention basin as well as the structural units, will provide 80% TSS removal. (Note; as individual lots are designed, they will be designed to meet all DEP stormwater requirements and the Town of Holliston's requirements.

This project meets Standard 4 requirements.

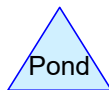
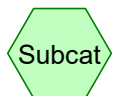
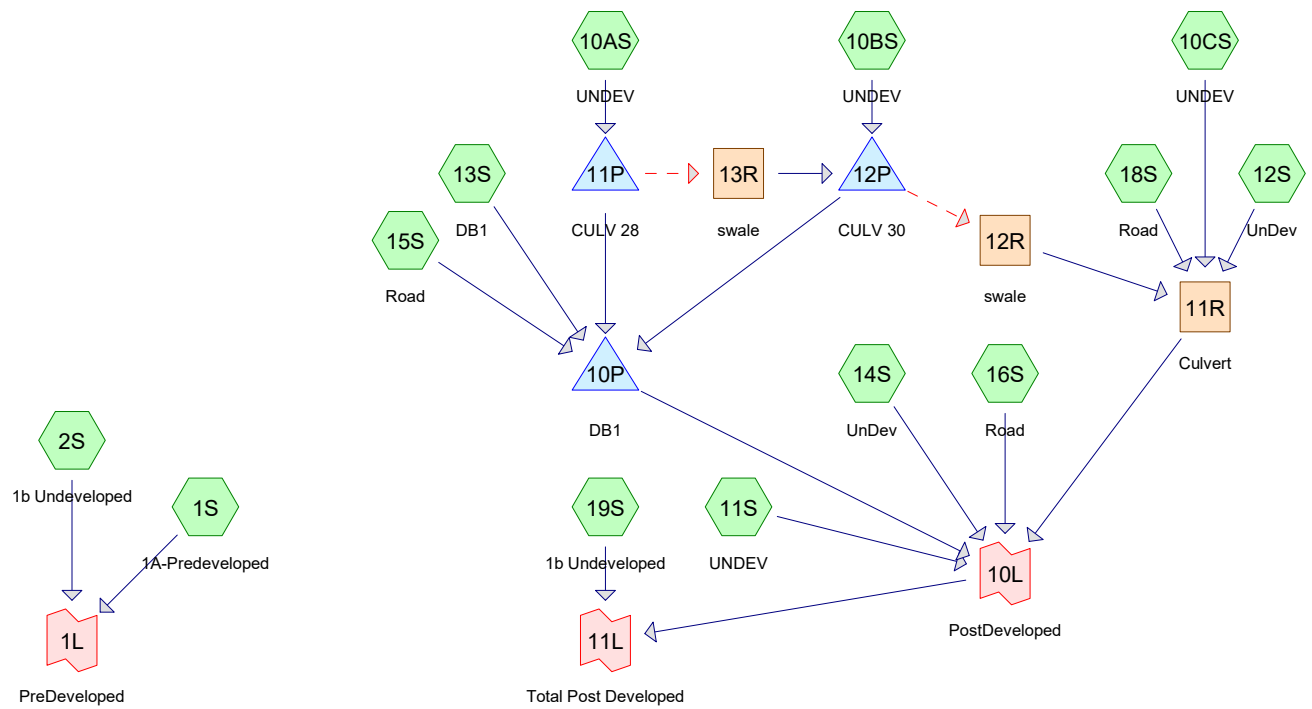
Standard 5. The proposed development will not generate higher potential pollutant loads, and therefore will not require additional BMP practices. Future site design may have this requirement.

Standard 6. The proposed work is not within an Outstanding Resource Water. The 1-inch rule was used to calculate the water quality volume for the Contech units and the forebays.

Standard 7. Not applicable.

Standard 8. Erosion and sediment control measures are proposed during construction. They include first the installation of an erosion control barrier and catch basin protection prior to construction. Construction period pollution prevention and erosion and sedimentation control plans were previously submitted under the previous amendment and remain the same.

Standard 9. An operation and maintenance plan was previously submitted under the previous amendment and is updated in this submittal.



3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 2-Year Rainfall=3.20"

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Page 2

Summary for Subcatchment 1S: 1A-Predeveloped

Runoff = 14.32 cfs @ 13.41 hrs, Volume= 175,241 cf, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
2,539,490	70	Woods, Good, HSG C
2,539,490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
22.8	483	0.0200	0.35		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
20.8	623	0.0400	0.50		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
32.8	1,254	0.0650	0.64		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
97.9	2,410	Total			

Summary for Subcatchment 2S: 1b Undeveloped

Runoff = 12.81 cfs @ 13.15 hrs, Volume= 135,947 cf, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
1,970,057	70	Woods, Good, HSG C
1,970,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
25.8	387	0.0100	0.25		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.2	196	0.0440	0.52		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
25.8	1,142	0.0870	0.74		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
79.3	1,775	Total			

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 2-Year Rainfall=3.20"

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Page 3

Summary for Subcatchment 10AS: UNDEV

Runoff = 2.24 cfs @ 12.93 hrs, Volume= 20,234 cf, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
205,255	70	Woods, Good, HSG C
87,967	70	Woods, Good, HSG C
293,222	70	Weighted Average
293,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
30.4	922	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
2.7	163	0.1600	1.00		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
0.4	365	0.0480	14.68	484.46	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=3.00' Z= 3.0 ' Top.W=20.00' n= 0.030
61.8	1,500	Total			

Summary for Subcatchment 10BS: UNDEV

Runoff = 6.07 cfs @ 12.83 hrs, Volume= 50,952 cf, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
406,100	70	Woods, Good, HSG C
270,269	70	Woods, Good, HSG C
61,995	70	Woods, Good, HSG C
738,364	70	Weighted Average
738,364		100.00% Pervious Area

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Type III 24-hr 2-Year Rainfall=3.20"

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Page 4

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
24.5	745	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
3.9	236	0.1600	1.00		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
9.1	277	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
0.9	356	0.0100	6.70	221.13	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=3.00' Z= 3.0 ' / Top.W=20.00' n= 0.030
54.7	1,664	Total			

Summary for Subcatchment 10CS: UNDEV

Runoff = 5.36 cfs @ 13.09 hrs, Volume= 54,329 cf, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
551,113	70	Woods, Good, HSG C
236,191	70	Woods, Good, HSG C
787,304	70	Weighted Average
787,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
18.9	522	0.0340	0.46		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
5.6	240	0.0830	0.72		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
33.2	1,008	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
74.0	1,820	Total			

Summary for Subcatchment 11S: UNDEV

Runoff = 1.75 cfs @ 12.44 hrs, Volume= 10,340 cf, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.20"

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Type III 24-hr 2-Year Rainfall=3.20"

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Page 5

Area (sf)	CN	Description
126,252	70	Woods, Good, HSG C
23,590	70	Woods, Good, HSG C
149,842	70	Weighted Average
149,842		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	50	0.0290	0.08		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
16.9	340	0.0180	0.34		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
27.5	390	Total			

Summary for Subcatchment 12S: UnDev

Runoff = 1.26 cfs @ 12.33 hrs, Volume= 6,712 cf, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
97,262	70	Woods, Good, HSG C
97,262		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0400	0.05		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
5.0	150	0.0400	0.50		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
21.3	200	Total			

Summary for Subcatchment 13S: DB1

Runoff = 3.00 cfs @ 12.10 hrs, Volume= 9,851 cf, Depth= 1.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
113,939	74	>75% Grass cover, Good, HSG C
113,939		100.00% Pervious Area

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

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Type III 24-hr 2-Year Rainfall=3.20"

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Page 6

Summary for Subcatchment 14S: UnDev

Runoff = 4.09 cfs @ 12.23 hrs, Volume= 18,773 cf, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
188,821	70	Woods, Good, HSG C
57,197	74	>75% Grass cover, Good, HSG C
10,527	74	>75% Grass cover, Good, HSG C
256,545	71	Weighted Average
256,545		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	50	0.0700	0.06		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
2.3	110	0.1000	0.79		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
15.3	160	Total			

Summary for Subcatchment 15S: Road

Runoff = 3.92 cfs @ 12.09 hrs, Volume= 12,483 cf, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
63,726	92	Paved roads w/open ditches, 50% imp, HSG C
31,863		50.00% Pervious Area
31,863		50.00% Impervious Area

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

Summary for Subcatchment 16S: Road

Runoff = 1.11 cfs @ 12.09 hrs, Volume= 3,527 cf, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
18,005	92	Paved roads w/open ditches, 50% imp, HSG C
9,003		50.00% Pervious Area
9,003		50.00% Impervious Area

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Type III 24-hr 2-Year Rainfall=3.20"

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Page 7

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

Summary for Subcatchment 18S: Road

Runoff = 1.35 cfs @ 12.09 hrs, Volume= 4,295 cf, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
21,926	92	Paved roads w/open ditches, 50% imp, HSG C
10,963		50.00% Pervious Area
10,963		50.00% Impervious Area

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

Summary for Subcatchment 19S: 1b Undeveloped

Runoff = 12.81 cfs @ 13.15 hrs, Volume= 135,947 cf, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
1,970,057	70	Woods, Good, HSG C
1,970,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
25.8	387	0.0100	0.25		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.2	196	0.0440	0.52		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
25.8	1,142	0.0870	0.74		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
79.3	1,775	Total			

Summary for Reach 11R: Culvert

Inflow Area = 906,492 sf, 1.21% Impervious, Inflow Depth = 0.86" for 2-Year event

Inflow = 5.80 cfs @ 13.08 hrs, Volume= 65,336 cf

Outflow = 5.80 cfs @ 13.08 hrs, Volume= 65,336 cf, Atten= 0%, Lag= 0.3 min

Type III 24-hr 2-Year Rainfall=3.20"

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Page 8

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 3.99 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 1.60 fps, Avg. Travel Time= 0.5 min

Peak Storage= 73 cf @ 13.08 hrs

Average Depth at Peak Storage= 0.66'

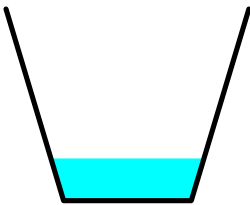
Bank-Full Depth= 3.00' Flow Area= 8.7 sf, Capacity= 63.07 cfs

2.00' x 3.00' deep channel, $n = 0.030$ Earth, grassed & winding

Side Slope Z-value= 0.3 '/' Top Width= 3.80'

Length= 50.0' Slope= 0.0200 '/'

Inlet Invert= 280.00', Outlet Invert= 279.00'



Summary for Reach 12R: swale

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

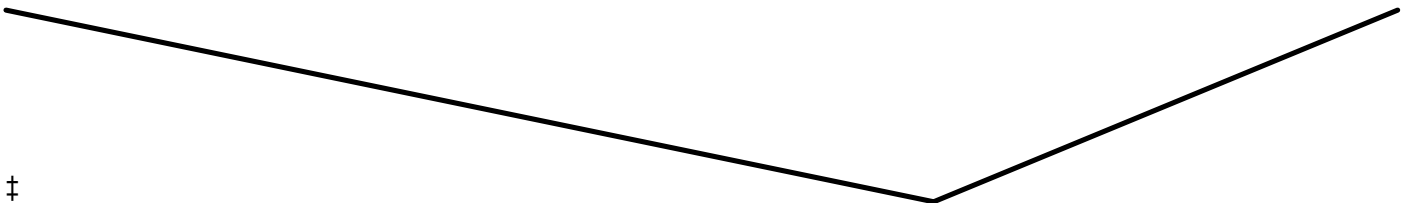
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 95.69 cfs

0.00' x 2.00' deep channel, $n = 0.035$ Earth, dense weeds

Side Slope Z-value= 6.0 3.0 ' Top Width= 18.00'

Length= 400.0' Slope= 0.0163 '/'

Inlet Invert= 283.50', Outlet Invert= 277.00'



Summary for Reach 13R: swale

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

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Type III 24-hr 2-Year Rainfall=3.20"

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Page 9

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 77.12 cfs

2.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 3.0 '/' Top Width= 14.00'

Length= 480.0' Slope= 0.0115 '/'

Inlet Invert= 289.50', Outlet Invert= 284.00'

**Summary for Pond 10P: DB1**

Inflow Area = 1,209,251 sf, 2.63% Impervious, Inflow Depth = 0.93" for 2-Year event

Inflow = 9.11 cfs @ 12.84 hrs, Volume= 93,471 cf

Outflow = 3.84 cfs @ 13.86 hrs, Volume= 93,471 cf, Atten= 58%, Lag= 61.2 min

Discarded = 0.62 cfs @ 13.86 hrs, Volume= 17,643 cf

Primary = 3.22 cfs @ 13.86 hrs, Volume= 75,828 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 3

Peak Elev= 277.07' @ 13.86 hrs Surf.Area= 37,116 sf Storage= 27,941 cf

Plug-Flow detention time= 94.9 min calculated for 93,471 cf (100% of inflow)

Center-of-Mass det. time= 94.6 min (994.9 - 900.3)

Volume	Invert	Avail.Storage	Storage Description
#1	275.50'	493,204 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	273.00'	113 cf	4.00'D x 9.00'H Vertical Cone/Cylinder
		493,317 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
275.50	0	0.0	0	0	0
276.00	12,880	650.0	2,147	2,147	33,622
277.00	35,500	1,100.0	23,254	25,401	96,295
278.00	62,400	1,310.0	48,322	73,723	136,587
279.00	78,375	1,380.0	70,236	143,959	151,632
280.00	83,150	1,400.0	80,751	224,710	156,270
283.00	96,000	1,500.0	268,494	493,204	179,754

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 2-Year Rainfall=3.20"

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Page 10

Device	Routing	Invert	Outlet Devices
#1	Primary	273.00'	24.0" Round Culvert L= 90.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 273.00' / 265.80' S= 0.0800 '/ Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	275.50'	0.5' long x 3.84' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#3	Device 1	279.34'	2.8' long x 2.66' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#4	Primary	282.30'	6.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#5	Discarded	273.00'	0.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.62 cfs @ 13.86 hrs HW=277.07' (Free Discharge)↳ **5=Exfiltration** (Exfiltration Controls 0.62 cfs)**Primary OutFlow** Max=3.22 cfs @ 13.86 hrs HW=277.07' (Free Discharge)

↳ **1=Culvert** (Passes 3.22 cfs of 26.50 cfs potential flow)
 ↳ **2=Sharp-Crested Vee/Trap Weir** (Weir Controls 3.22 cfs @ 4.10 fps)
 ↳ **3=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)
 ↳ **4=Emergency Spillway** (Controls 0.00 cfs)

Summary for Pond 11P: CULV 28

Inflow Area = 293,222 sf, 0.00% Impervious, Inflow Depth = 0.83" for 2-Year event
 Inflow = 2.24 cfs @ 12.93 hrs, Volume= 20,234 cf
 Outflow = 2.24 cfs @ 12.94 hrs, Volume= 20,185 cf, Atten= 0%, Lag= 0.8 min
 Primary = 2.24 cfs @ 12.94 hrs, Volume= 20,185 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 6
 Peak Elev= 288.58' @ 12.94 hrs Surf.Area= 280 sf Storage= 160 cf

Plug-Flow detention time= 3.2 min calculated for 20,180 cf (100% of inflow)
 Center-of-Mass det. time= 1.8 min (929.2 - 927.5)

Volume	Invert	Avail.Storage	Storage Description
#1	287.00'	855 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.00	0	0	0
288.00	100	50	50
289.00	410	255	305
290.00	690	550	855

Device	Routing	Invert	Outlet Devices
#1	Primary	288.00'	30.0" Round Culvert L= 108.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 288.00' / 279.00' S= 0.0833 '/ Cc= 0.900 n= 0.013, Flow Area= 4.91 sf
#2	Secondary	289.95'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 289.95 290.00 291.00 292.00 Width (feet) 0.00 6.00 14.00 22.00

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Type III 24-hr 2-Year Rainfall=3.20"

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Page 11

Primary OutFlow Max=2.23 cfs @ 12.94 hrs HW=288.58' (Free Discharge)↑**1=Culvert** (Inlet Controls 2.23 cfs @ 2.59 fps)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=287.00' (Free Discharge)↑**2=Custom Weir/Orifice** (Controls 0.00 cfs)**Summary for Pond 12P: CULV 30**

Inflow Area = 738,364 sf, 0.00% Impervious, Inflow Depth = 0.83" for 2-Year event
 Inflow = 6.07 cfs @ 12.83 hrs, Volume= 50,952 cf
 Outflow = 6.07 cfs @ 12.84 hrs, Volume= 50,952 cf, Atten= 0%, Lag= 0.5 min
 Primary = 6.07 cfs @ 12.84 hrs, Volume= 50,952 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 6

Peak Elev= 281.98' @ 12.84 hrs Surf.Area= 345 sf Storage= 170 cf

Plug-Flow detention time= 0.4 min calculated for 50,939 cf (100% of inflow)

Center-of-Mass det. time= 0.4 min (921.3 - 920.9)

Volume	Invert	Avail.Storage	Storage Description
#1	281.00'	3,725 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
281.00	0	0	0
282.00	350	175	175
283.00	875	613	788
284.00	1,400	1,138	1,925
285.00	2,200	1,800	3,725

Device	Routing	Invert	Outlet Devices
#1	Primary	281.00'	30.0" Round Culvert L= 115.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 281.00' / 279.00' S= 0.0174 ' /' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf
#2	Secondary	284.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 284.50 285.00 286.00 Width (feet) 0.00 10.00 50.00

Primary OutFlow Max=6.07 cfs @ 12.84 hrs HW=281.98' (Free Discharge)↑**1=Culvert** (Inlet Controls 6.07 cfs @ 3.38 fps)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=281.00' (Free Discharge)↑**2=Custom Weir/Orifice** (Controls 0.00 cfs)

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Page 12

Summary for Link 1L: PreDeveloped

Inflow Area = 4,509,547 sf, 0.00% Impervious, Inflow Depth = 0.83" for 2-Year event
 Inflow = 26.54 cfs @ 13.31 hrs, Volume= 311,188 cf
 Primary = 26.54 cfs @ 13.31 hrs, Volume= 311,188 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Summary for Link 10L: PostDeveloped

Inflow Area = 2,540,135 sf, 2.04% Impervious, Inflow Depth = 0.82" for 2-Year event
 Inflow = 10.05 cfs @ 13.07 hrs, Volume= 173,803 cf
 Primary = 10.05 cfs @ 13.07 hrs, Volume= 173,803 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Summary for Link 11L: Total Post Developed

Inflow Area = 4,510,192 sf, 1.15% Impervious, Inflow Depth = 0.82" for 2-Year event
 Inflow = 22.79 cfs @ 13.14 hrs, Volume= 309,750 cf
 Primary = 22.79 cfs @ 13.14 hrs, Volume= 309,750 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

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Type III 24-hr 10-Year Rainfall=4.70"

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Page 13

Summary for Subcatchment 1S: 1A-Predeveloped

Runoff = 34.49 cfs @ 13.38 hrs, Volume= 384,467 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
2,539,490	70	Woods, Good, HSG C
2,539,490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
22.8	483	0.0200	0.35		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
20.8	623	0.0400	0.50		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
32.8	1,254	0.0650	0.64		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
97.9	2,410	Total			

Summary for Subcatchment 2S: 1b Undeveloped

Runoff = 30.78 cfs @ 13.13 hrs, Volume= 298,258 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
1,970,057	70	Woods, Good, HSG C
1,970,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
25.8	387	0.0100	0.25		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.2	196	0.0440	0.52		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
25.8	1,142	0.0870	0.74		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
79.3	1,775	Total			

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Type III 24-hr 10-Year Rainfall=4.70"

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Page 14

Summary for Subcatchment 10AS: UNDEV

Runoff = 5.37 cfs @ 12.86 hrs, Volume= 44,392 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
205,255	70	Woods, Good, HSG C
87,967	70	Woods, Good, HSG C
293,222	70	Weighted Average
293,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
30.4	922	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
2.7	163	0.1600	1.00		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
0.4	365	0.0480	14.68	484.46	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=3.00' Z= 3.0 ' Top.W=20.00' n= 0.030
61.8	1,500	Total			

Summary for Subcatchment 10BS: UNDEV

Runoff = 14.51 cfs @ 12.79 hrs, Volume= 111,785 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
406,100	70	Woods, Good, HSG C
270,269	70	Woods, Good, HSG C
61,995	70	Woods, Good, HSG C
738,364	70	Weighted Average
738,364		100.00% Pervious Area

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Type III 24-hr 10-Year Rainfall=4.70"

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Page 15

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
24.5	745	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
3.9	236	0.1600	1.00		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
9.1	277	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
0.9	356	0.0100	6.70	221.13	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=3.00' Z= 3.0 ' /' Top.W=20.00' n= 0.030
54.7	1,664	Total			

Summary for Subcatchment 10CS: UNDEV

Runoff = 12.83 cfs @ 13.06 hrs, Volume= 119,194 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
551,113	70	Woods, Good, HSG C
236,191	70	Woods, Good, HSG C
787,304	70	Weighted Average
787,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
18.9	522	0.0340	0.46		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
5.6	240	0.0830	0.72		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
33.2	1,008	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
74.0	1,820	Total			

Summary for Subcatchment 11S: UNDEV

Runoff = 4.19 cfs @ 12.40 hrs, Volume= 22,685 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

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Type III 24-hr 10-Year Rainfall=4.70"

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Page 16

Area (sf)	CN	Description
126,252	70	Woods, Good, HSG C
23,590	70	Woods, Good, HSG C
149,842	70	Weighted Average
149,842		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	50	0.0290	0.08		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
16.9	340	0.0180	0.34		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
27.5	390	Total			

Summary for Subcatchment 12S: UnDev

Runoff = 3.03 cfs @ 12.31 hrs, Volume= 14,725 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
97,262	70	Woods, Good, HSG C
97,262		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0400	0.05		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
5.0	150	0.0400	0.50		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
21.3	200	Total			

Summary for Subcatchment 13S: DB1

Runoff = 6.44 cfs @ 12.09 hrs, Volume= 20,199 cf, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
113,939	74	>75% Grass cover, Good, HSG C
113,939		100.00% Pervious Area

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

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Type III 24-hr 10-Year Rainfall=4.70"

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Page 17

Summary for Subcatchment 14S: UnDev

Runoff = 9.56 cfs @ 12.22 hrs, Volume= 40,459 cf, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
188,821	70	Woods, Good, HSG C
57,197	74	>75% Grass cover, Good, HSG C
10,527	74	>75% Grass cover, Good, HSG C
256,545	71	Weighted Average
256,545		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	50	0.0700	0.06		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
2.3	110	0.1000	0.79		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
15.3	160	Total			

Summary for Subcatchment 15S: Road

Runoff = 6.17 cfs @ 12.09 hrs, Volume= 20,162 cf, Depth= 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
63,726	92	Paved roads w/open ditches, 50% imp, HSG C
31,863		50.00% Pervious Area
31,863		50.00% Impervious Area

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

Summary for Subcatchment 16S: Road

Runoff = 1.74 cfs @ 12.09 hrs, Volume= 5,697 cf, Depth= 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
18,005	92	Paved roads w/open ditches, 50% imp, HSG C
9,003		50.00% Pervious Area
9,003		50.00% Impervious Area

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Type III 24-hr 10-Year Rainfall=4.70"

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Page 18

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

Summary for Subcatchment 18S: Road

Runoff = 2.12 cfs @ 12.09 hrs, Volume= 6,937 cf, Depth= 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
21,926	92	Paved roads w/open ditches, 50% imp, HSG C
10,963		50.00% Pervious Area
10,963		50.00% Impervious Area

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

Summary for Subcatchment 19S: 1b Undeveloped

Runoff = 30.78 cfs @ 13.13 hrs, Volume= 298,258 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
1,970,057	70	Woods, Good, HSG C
1,970,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
25.8	387	0.0100	0.25		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.2	196	0.0440	0.52		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
25.8	1,142	0.0870	0.74		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
79.3	1,775	Total			

Summary for Reach 11R: Culvert

Inflow Area = 906,492 sf, 1.21% Impervious, Inflow Depth = 1.86" for 10-Year event

Inflow = 13.71 cfs @ 13.00 hrs, Volume= 140,856 cf

Outflow = 13.71 cfs @ 13.02 hrs, Volume= 140,856 cf, Atten= 0%, Lag= 0.9 min

Type III 24-hr 10-Year Rainfall=4.70"

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Page 19

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 5.06 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 1.92 fps, Avg. Travel Time= 0.4 min

Peak Storage= 135 cf @ 13.01 hrs

Average Depth at Peak Storage= 1.15'

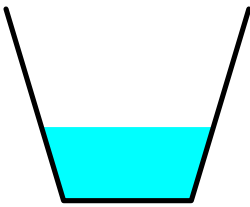
Bank-Full Depth= 3.00' Flow Area= 8.7 sf, Capacity= 63.07 cfs

2.00' x 3.00' deep channel, $n = 0.030$ Earth, grassed & winding

Side Slope Z-value= 0.3 '/' Top Width= 3.80'

Length= 50.0' Slope= 0.0200 '/'

Inlet Invert= 280.00', Outlet Invert= 279.00'



Summary for Reach 12R: swale

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

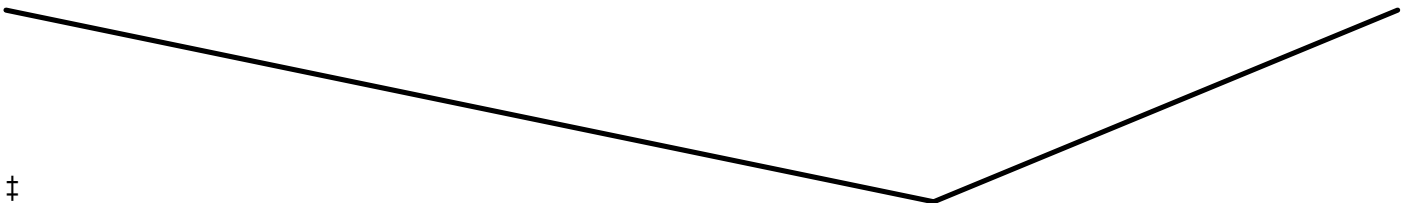
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 95.69 cfs

0.00' x 2.00' deep channel, $n = 0.035$ Earth, dense weeds

Side Slope Z-value= 6.0 3.0 ' Top Width= 18.00'

Length= 400.0' Slope= 0.0163 '/'

Inlet Invert= 283.50', Outlet Invert= 277.00'



Summary for Reach 13R: swale

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

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Type III 24-hr 10-Year Rainfall=4.70"

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Page 20

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 77.12 cfs

2.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 3.0 ' / ' Top Width= 14.00'

Length= 480.0' Slope= 0.0115 ' / '

Inlet Invert= 289.50', Outlet Invert= 284.00'

**Summary for Pond 10P: DB1**

Inflow Area = 1,209,251 sf, 2.63% Impervious, Inflow Depth = 1.95" for 10-Year event

Inflow = 21.28 cfs @ 12.81 hrs, Volume= 196,488 cf

Outflow = 7.25 cfs @ 13.95 hrs, Volume= 196,488 cf, Atten= 66%, Lag= 68.3 min

Discarded = 0.85 cfs @ 13.95 hrs, Volume= 29,284 cf

Primary = 6.40 cfs @ 13.95 hrs, Volume= 167,204 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 3

Peak Elev= 277.98' @ 13.95 hrs Surf.Area= 61,870 sf Storage= 72,685 cf

Plug-Flow detention time= 132.0 min calculated for 196,439 cf (100% of inflow)

Center-of-Mass det. time= 132.2 min (1,013.3 - 881.1)

Volume	Invert	Avail.Storage	Storage Description
#1	275.50'	493,204 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	273.00'	113 cf	4.00'D x 9.00'H Vertical Cone/Cylinder
		493,317 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
275.50	0	0.0	0	0	0
276.00	12,880	650.0	2,147	2,147	33,622
277.00	35,500	1,100.0	23,254	25,401	96,295
278.00	62,400	1,310.0	48,322	73,723	136,587
279.00	78,375	1,380.0	70,236	143,959	151,632
280.00	83,150	1,400.0	80,751	224,710	156,270
283.00	96,000	1,500.0	268,494	493,204	179,754

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 10-Year Rainfall=4.70"

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Page 21

Device	Routing	Invert	Outlet Devices
#1	Primary	273.00'	24.0" Round Culvert L= 90.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 273.00' / 265.80' S= 0.0800 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	275.50'	0.5' long x 3.84' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#3	Device 1	279.34'	2.8' long x 2.66' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#4	Primary	282.30'	6.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#5	Discarded	273.00'	0.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.85 cfs @ 13.95 hrs HW=277.98' (Free Discharge)

5=Exfiltration (Exfiltration Controls 0.85 cfs)

Primary OutFlow Max=6.40 cfs @ 13.95 hrs HW=277.98' (Free Discharge)

1=Culvert (Passes 6.40 cfs of 30.19 cfs potential flow)

2=Sharp-Crested Vee/Trap Weir (Weir Controls 6.40 cfs @ 5.16 fps)

3=Sharp-Crested Vee/Trap Weir (Controls 0.00 cfs)

4=Emergency Spillway (Controls 0.00 cfs)

Summary for Pond 11P: CULV 28

Inflow Area = 293,222 sf, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year event

Inflow = 5.37 cfs @ 12.86 hrs, Volume= 44,392 cf

Outflow = 5.37 cfs @ 12.88 hrs, Volume= 44,342 cf, Atten= 0%, Lag= 1.3 min

Primary = 5.37 cfs @ 12.88 hrs, Volume= 44,342 cf

Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 6

Peak Elev= 288.92' @ 12.88 hrs Surf.Area= 385 sf Storage= 274 cf

Plug-Flow detention time= 2.0 min calculated for 44,331 cf (100% of inflow)

Center-of-Mass det. time= 1.3 min (904.1 - 902.8)

Volume	Invert	Avail.Storage	Storage Description
#1	287.00'	855 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.00	0	0	0
288.00	100	50	50
289.00	410	255	305
290.00	690	550	855

Device	Routing	Invert	Outlet Devices
#1	Primary	288.00'	30.0" Round Culvert L= 108.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 288.00' / 279.00' S= 0.0833 '/' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf
#2	Secondary	289.95'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 289.95 290.00 291.00 292.00 Width (feet) 0.00 6.00 14.00 22.00

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Type III 24-hr 10-Year Rainfall=4.70"

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Page 22

Primary OutFlow Max=5.36 cfs @ 12.88 hrs HW=288.92' (Free Discharge)↑**1=Culvert** (Inlet Controls 5.36 cfs @ 3.27 fps)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=287.00' (Free Discharge)↑**2=Custom Weir/Orifice** (Controls 0.00 cfs)**Summary for Pond 12P: CULV 30**

Inflow Area = 738,364 sf, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year event
 Inflow = 14.51 cfs @ 12.79 hrs, Volume= 111,785 cf
 Outflow = 14.51 cfs @ 12.80 hrs, Volume= 111,784 cf, Atten= 0%, Lag= 0.7 min
 Primary = 14.51 cfs @ 12.80 hrs, Volume= 111,784 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 6

Peak Elev= 282.61' @ 12.80 hrs Surf.Area= 673 sf Storage= 489 cf

Plug-Flow detention time= 0.5 min calculated for 111,756 cf (100% of inflow)

Center-of-Mass det. time= 0.5 min (896.7 - 896.2)

Volume	Invert	Avail.Storage	Storage Description
#1	281.00'	3,725 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
281.00	0	0	0
282.00	350	175	175
283.00	875	613	788
284.00	1,400	1,138	1,925
285.00	2,200	1,800	3,725

Device	Routing	Invert	Outlet Devices
#1	Primary	281.00'	30.0" Round Culvert L= 115.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 281.00' / 279.00' S= 0.0174 ' /' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf
#2	Secondary	284.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 284.50 285.00 286.00 Width (feet) 0.00 10.00 50.00

Primary OutFlow Max=14.50 cfs @ 12.80 hrs HW=282.61' (Free Discharge)↑**1=Culvert** (Inlet Controls 14.50 cfs @ 4.33 fps)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=281.00' (Free Discharge)↑**2=Custom Weir/Orifice** (Controls 0.00 cfs)

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Page 23

Summary for Link 1L: PreDeveloped

Inflow Area = 4,509,547 sf, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year event
 Inflow = 63.70 cfs @ 13.24 hrs, Volume= 682,725 cf
 Primary = 63.70 cfs @ 13.24 hrs, Volume= 682,725 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Summary for Link 10L: PostDeveloped

Inflow Area = 2,540,135 sf, 2.04% Impervious, Inflow Depth = 1.78" for 10-Year event
 Inflow = 22.75 cfs @ 12.31 hrs, Volume= 376,901 cf
 Primary = 22.75 cfs @ 12.31 hrs, Volume= 376,901 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Summary for Link 11L: Total Post Developed

Inflow Area = 4,510,192 sf, 1.15% Impervious, Inflow Depth = 1.80" for 10-Year event
 Inflow = 52.74 cfs @ 13.09 hrs, Volume= 675,159 cf
 Primary = 52.74 cfs @ 13.09 hrs, Volume= 675,159 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

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Type III 24-hr 25-Year Rainfall=5.50"

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Page 24

Summary for Subcatchment 1S: 1A-Predeveloped

Runoff = 46.62 cfs @ 13.37 hrs, Volume= 510,921 cf, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
2,539,490	70	Woods, Good, HSG C
2,539,490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
22.8	483	0.0200	0.35		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
20.8	623	0.0400	0.50		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
32.8	1,254	0.0650	0.64		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
97.9	2,410	Total			

Summary for Subcatchment 2S: 1b Undeveloped

Runoff = 41.56 cfs @ 13.11 hrs, Volume= 396,357 cf, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
1,970,057	70	Woods, Good, HSG C
1,970,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
25.8	387	0.0100	0.25		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.2	196	0.0440	0.52		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
25.8	1,142	0.0870	0.74		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
79.3	1,775	Total			

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Type III 24-hr 25-Year Rainfall=5.50"

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Page 25

Summary for Subcatchment 10AS: UNDEV

Runoff = 7.26 cfs @ 12.85 hrs, Volume= 58,993 cf, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
205,255	70	Woods, Good, HSG C
87,967	70	Woods, Good, HSG C
293,222	70	Weighted Average
293,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
30.4	922	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
2.7	163	0.1600	1.00		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
0.4	365	0.0480	14.68	484.46	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=3.00' Z= 3.0 ' Top.W=20.00' n= 0.030
61.8	1,500	Total			

Summary for Subcatchment 10BS: UNDEV

Runoff = 19.59 cfs @ 12.77 hrs, Volume= 148,552 cf, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
406,100	70	Woods, Good, HSG C
270,269	70	Woods, Good, HSG C
61,995	70	Woods, Good, HSG C
738,364	70	Weighted Average
738,364		100.00% Pervious Area

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Type III 24-hr 25-Year Rainfall=5.50"

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Page 26

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
24.5	745	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
3.9	236	0.1600	1.00		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
9.1	277	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
0.9	356	0.0100	6.70	221.13	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=3.00' Z= 3.0 ' / Top.W=20.00' n= 0.030
54.7	1,664	Total			

Summary for Subcatchment 10CS: UNDEV

Runoff = 17.32 cfs @ 13.04 hrs, Volume= 158,398 cf, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
551,113	70	Woods, Good, HSG C
236,191	70	Woods, Good, HSG C
787,304	70	Weighted Average
787,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
18.9	522	0.0340	0.46		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
5.6	240	0.0830	0.72		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
33.2	1,008	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
74.0	1,820	Total			

Summary for Subcatchment 11S: UNDEV

Runoff = 5.65 cfs @ 12.40 hrs, Volume= 30,147 cf, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 25-Year Rainfall=5.50"

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Type III 24-hr 25-Year Rainfall=5.50"

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Page 27

Area (sf)	CN	Description
126,252	70	Woods, Good, HSG C
23,590	70	Woods, Good, HSG C
149,842	70	Weighted Average
149,842		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	50	0.0290	0.08		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
16.9	340	0.0180	0.34		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
27.5	390	Total			

Summary for Subcatchment 12S: UnDev

Runoff = 4.09 cfs @ 12.31 hrs, Volume= 19,568 cf, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
97,262	70	Woods, Good, HSG C
97,262		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0400	0.05		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
5.0	150	0.0400	0.50		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
21.3	200	Total			

Summary for Subcatchment 13S: DB1

Runoff = 8.44 cfs @ 12.09 hrs, Volume= 26,293 cf, Depth= 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
113,939	74	>75% Grass cover, Good, HSG C
113,939		100.00% Pervious Area

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

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Type III 24-hr 25-Year Rainfall=5.50"

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Page 28

Summary for Subcatchment 14S: UnDev

Runoff = 12.81 cfs @ 12.22 hrs, Volume= 53,477 cf, Depth= 2.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
188,821	70	Woods, Good, HSG C
57,197	74	>75% Grass cover, Good, HSG C
10,527	74	>75% Grass cover, Good, HSG C
256,545	71	Weighted Average
256,545		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	50	0.0700	0.06		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
2.3	110	0.1000	0.79		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
15.3	160	Total			

Summary for Subcatchment 15S: Road

Runoff = 7.36 cfs @ 12.09 hrs, Volume= 24,314 cf, Depth= 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
63,726	92	Paved roads w/open ditches, 50% imp, HSG C
31,863		50.00% Pervious Area
31,863		50.00% Impervious Area

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

Summary for Subcatchment 16S: Road

Runoff = 2.08 cfs @ 12.09 hrs, Volume= 6,870 cf, Depth= 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
18,005	92	Paved roads w/open ditches, 50% imp, HSG C
9,003		50.00% Pervious Area
9,003		50.00% Impervious Area

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Type III 24-hr 25-Year Rainfall=5.50"

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Page 29

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

Summary for Subcatchment 18S: Road

Runoff = 2.53 cfs @ 12.09 hrs, Volume= 8,366 cf, Depth= 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
21,926	92	Paved roads w/open ditches, 50% imp, HSG C
10,963		50.00% Pervious Area
10,963		50.00% Impervious Area

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

Summary for Subcatchment 19S: 1b Undeveloped

Runoff = 41.56 cfs @ 13.11 hrs, Volume= 396,357 cf, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
1,970,057	70	Woods, Good, HSG C
1,970,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
25.8	387	0.0100	0.25		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.2	196	0.0440	0.52		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
25.8	1,142	0.0870	0.74		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
79.3	1,775	Total			

Summary for Reach 11R: Culvert

Inflow Area = 906,492 sf, 1.21% Impervious, Inflow Depth = 2.47" for 25-Year event

Inflow = 18.49 cfs @ 12.99 hrs, Volume= 186,332 cf

Outflow = 18.48 cfs @ 13.00 hrs, Volume= 186,332 cf, Atten= 0%, Lag= 0.2 min

Type III 24-hr 25-Year Rainfall=5.50"

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Page 30

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 5.46 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.06 fps, Avg. Travel Time= 0.4 min

Peak Storage= 169 cf @ 13.00 hrs

Average Depth at Peak Storage= 1.40'

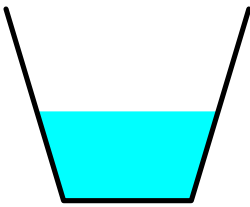
Bank-Full Depth= 3.00' Flow Area= 8.7 sf, Capacity= 63.07 cfs

2.00' x 3.00' deep channel, $n = 0.030$ Earth, grassed & winding

Side Slope Z-value= 0.3 '/' Top Width= 3.80'

Length= 50.0' Slope= 0.0200 '/'

Inlet Invert= 280.00', Outlet Invert= 279.00'



Summary for Reach 12R: swale

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

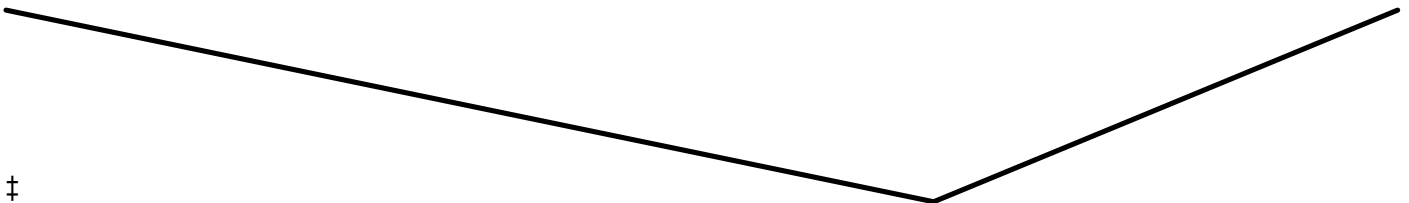
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 95.69 cfs

0.00' x 2.00' deep channel, $n = 0.035$ Earth, dense weeds

Side Slope Z-value= 6.0 3.0 ' Top Width= 18.00'

Length= 400.0' Slope= 0.0163 '/'

Inlet Invert= 283.50', Outlet Invert= 277.00'



Summary for Reach 13R: swale

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 25-Year Rainfall=5.50"

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Page 31

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 77.12 cfs

2.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 3.0 '/' Top Width= 14.00'

Length= 480.0' Slope= 0.0115 '/'

Inlet Invert= 289.50', Outlet Invert= 284.00'

**Summary for Pond 10P: DB1**

Inflow Area = 1,209,251 sf, 2.63% Impervious, Inflow Depth = 2.56" for 25-Year event

Inflow = 28.56 cfs @ 12.80 hrs, Volume= 258,102 cf

Outflow = 9.07 cfs @ 13.98 hrs, Volume= 258,102 cf, Atten= 68%, Lag= 71.0 min

Discarded = 0.89 cfs @ 13.98 hrs, Volume= 34,641 cf

Primary = 8.18 cfs @ 13.98 hrs, Volume= 223,461 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 3

Peak Elev= 278.42' @ 13.98 hrs Surf.Area= 68,939 sf Storage= 101,516 cf

Plug-Flow detention time= 148.0 min calculated for 258,037 cf (100% of inflow)

Center-of-Mass det. time= 148.2 min (1,022.3 - 874.1)

Volume	Invert	Avail.Storage	Storage Description
#1	275.50'	493,204 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	273.00'	113 cf	4.00'D x 9.00'H Vertical Cone/Cylinder
		493,317 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
275.50	0	0.0	0	0	0
276.00	12,880	650.0	2,147	2,147	33,622
277.00	35,500	1,100.0	23,254	25,401	96,295
278.00	62,400	1,310.0	48,322	73,723	136,587
279.00	78,375	1,380.0	70,236	143,959	151,632
280.00	83,150	1,400.0	80,751	224,710	156,270
283.00	96,000	1,500.0	268,494	493,204	179,754

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 25-Year Rainfall=5.50"

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Page 32

Device	Routing	Invert	Outlet Devices
#1	Primary	273.00'	24.0" Round Culvert L= 90.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 273.00' / 265.80' S= 0.0800 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	275.50'	0.5' long x 3.84' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#3	Device 1	279.34'	2.8' long x 2.66' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#4	Primary	282.30'	6.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#5	Discarded	273.00'	0.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.89 cfs @ 13.98 hrs HW=278.42' (Free Discharge)↳ **5=Exfiltration** (Exfiltration Controls 0.89 cfs)**Primary OutFlow** Max=8.18 cfs @ 13.98 hrs HW=278.42' (Free Discharge)↳ **1=Culvert** (Passes 8.18 cfs of 31.81 cfs potential flow)↳ **2=Sharp-Crested Vee/Trap Weir** (Weir Controls 8.18 cfs @ 5.60 fps)↳ **3=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)↳ **4=Emergency Spillway** (Controls 0.00 cfs)**Summary for Pond 11P: CULV 28**

Inflow Area =	293,222 sf,	0.00% Impervious,	Inflow Depth = 2.41" for 25-Year event
Inflow =	7.26 cfs @	12.85 hrs,	Volume= 58,993 cf
Outflow =	7.25 cfs @	12.86 hrs,	Volume= 58,944 cf, Atten= 0%, Lag= 0.9 min
Primary =	7.25 cfs @	12.86 hrs,	Volume= 58,944 cf
Secondary =	0.00 cfs @	0.00 hrs,	Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 6

Peak Elev= 289.09' @ 12.86 hrs Surf.Area= 434 sf Storage= 341 cf

Plug-Flow detention time= 1.7 min calculated for 58,944 cf (100% of inflow)

Center-of-Mass det. time= 1.2 min (895.5 - 894.4)

Volume	Invert	Avail.Storage	Storage Description
#1	287.00'	855 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.00	0	0	0
288.00	100	50	50
289.00	410	255	305
290.00	690	550	855

Device	Routing	Invert	Outlet Devices
#1	Primary	288.00'	30.0" Round Culvert L= 108.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 288.00' / 279.00' S= 0.0833 '/' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf
#2	Secondary	289.95'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 289.95 290.00 291.00 292.00 Width (feet) 0.00 6.00 14.00 22.00

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 25-Year Rainfall=5.50"

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Page 33

Primary OutFlow Max=7.25 cfs @ 12.86 hrs HW=289.09' (Free Discharge)↑**1=Culvert** (Inlet Controls 7.25 cfs @ 3.55 fps)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=287.00' (Free Discharge)↑**2=Custom Weir/Orifice** (Controls 0.00 cfs)**Summary for Pond 12P: CULV 30**

Inflow Area = 738,364 sf, 0.00% Impervious, Inflow Depth = 2.41" for 25-Year event

Inflow = 19.59 cfs @ 12.77 hrs, Volume= 148,552 cf

Outflow = 19.57 cfs @ 12.79 hrs, Volume= 148,550 cf, Atten= 0%, Lag= 1.1 min

Primary = 19.57 cfs @ 12.79 hrs, Volume= 148,550 cf

Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 6

Peak Elev= 282.95' @ 12.79 hrs Surf.Area= 850 sf Storage= 747 cf

Plug-Flow detention time= 0.5 min calculated for 148,513 cf (100% of inflow)

Center-of-Mass det. time= 0.5 min (888.3 - 887.8)

Volume	Invert	Avail.Storage	Storage Description
#1	281.00'	3,725 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
281.00	0	0	0
282.00	350	175	175
283.00	875	613	788
284.00	1,400	1,138	1,925
285.00	2,200	1,800	3,725

Device	Routing	Invert	Outlet Devices
#1	Primary	281.00'	30.0" Round Culvert L= 115.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 281.00' / 279.00' S= 0.0174 ' / Cc= 0.900 n= 0.013, Flow Area= 4.91 sf
#2	Secondary	284.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 284.50 285.00 286.00 Width (feet) 0.00 10.00 50.00

Primary OutFlow Max=19.57 cfs @ 12.79 hrs HW=282.95' (Free Discharge)↑**1=Culvert** (Inlet Controls 19.57 cfs @ 4.76 fps)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=281.00' (Free Discharge)↑**2=Custom Weir/Orifice** (Controls 0.00 cfs)

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Page 34

Summary for Link 1L: PreDeveloped

Inflow Area = 4,509,547 sf, 0.00% Impervious, Inflow Depth = 2.41" for 25-Year event
Inflow = 86.19 cfs @ 13.20 hrs, Volume= 907,278 cf
Primary = 86.19 cfs @ 13.20 hrs, Volume= 907,278 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Summary for Link 10L: PostDeveloped

Inflow Area = 2,540,135 sf, 2.04% Impervious, Inflow Depth = 2.36" for 25-Year event
Inflow = 30.65 cfs @ 12.30 hrs, Volume= 500,287 cf
Primary = 30.65 cfs @ 12.30 hrs, Volume= 500,287 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Summary for Link 11L: Total Post Developed

Inflow Area = 4,510,192 sf, 1.15% Impervious, Inflow Depth = 2.39" for 25-Year event
Inflow = 70.58 cfs @ 13.06 hrs, Volume= 896,644 cf
Primary = 70.58 cfs @ 13.06 hrs, Volume= 896,644 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 35

Summary for Subcatchment 1S: 1A-Predeveloped

Runoff = 65.87 cfs @ 13.37 hrs, Volume= 713,292 cf, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
2,539,490	70	Woods, Good, HSG C
2,539,490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
22.8	483	0.0200	0.35		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
20.8	623	0.0400	0.50		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
32.8	1,254	0.0650	0.64		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
97.9	2,410	Total			

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 36

Hydrograph for Subcatchment 1S: 1A-Predeveloped

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.37	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.37	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.37	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.37	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.37	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.37	0.00
9.00	0.98	0.00	0.01	90.00	6.70	3.37	0.00
10.50	1.45	0.07	1.14	91.50	6.70	3.37	0.00
12.00	3.35	0.92	7.26	93.00	6.70	3.37	0.00
13.50	5.25	2.22	63.92	94.50	6.70	3.37	0.00
15.00	5.72	2.59	23.30	96.00	6.70	3.37	0.00
16.50	6.02	2.82	12.30	97.50	6.70	3.37	0.00
18.00	6.22	2.98	7.63	99.00	6.70	3.37	0.00
19.50	6.37	3.10	5.39	100.50	6.70	3.37	0.00
21.00	6.50	3.20	4.42	102.00	6.70	3.37	0.00
22.50	6.61	3.29	3.82	103.50	6.70	3.37	0.00
24.00	6.70	3.37	3.29	105.00	6.70	3.37	0.00
25.50	6.70	3.37	1.27	106.50	6.70	3.37	0.00
27.00	6.70	3.37	0.13	108.00	6.70	3.37	0.00
28.50	6.70	3.37	0.01	109.50	6.70	3.37	0.00
30.00	6.70	3.37	0.00	111.00	6.70	3.37	0.00
31.50	6.70	3.37	0.00	112.50	6.70	3.37	0.00
33.00	6.70	3.37	0.00	114.00	6.70	3.37	0.00
34.50	6.70	3.37	0.00	115.50	6.70	3.37	0.00
36.00	6.70	3.37	0.00	117.00	6.70	3.37	0.00
37.50	6.70	3.37	0.00	118.50	6.70	3.37	0.00
39.00	6.70	3.37	0.00	120.00	6.70	3.37	0.00
40.50	6.70	3.37	0.00				
42.00	6.70	3.37	0.00				
43.50	6.70	3.37	0.00				
45.00	6.70	3.37	0.00				
46.50	6.70	3.37	0.00				
48.00	6.70	3.37	0.00				
49.50	6.70	3.37	0.00				
51.00	6.70	3.37	0.00				
52.50	6.70	3.37	0.00				
54.00	6.70	3.37	0.00				
55.50	6.70	3.37	0.00				
57.00	6.70	3.37	0.00				
58.50	6.70	3.37	0.00				
60.00	6.70	3.37	0.00				
61.50	6.70	3.37	0.00				
63.00	6.70	3.37	0.00				
64.50	6.70	3.37	0.00				
66.00	6.70	3.37	0.00				
67.50	6.70	3.37	0.00				
69.00	6.70	3.37	0.00				
70.50	6.70	3.37	0.00				
72.00	6.70	3.37	0.00				
73.50	6.70	3.37	0.00				
75.00	6.70	3.37	0.00				
76.50	6.70	3.37	0.00				
78.00	6.70	3.37	0.00				
79.50	6.70	3.37	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 37

Summary for Subcatchment 2S: 1b Undeveloped

Runoff = 58.70 cfs @ 13.10 hrs, Volume= 553,350 cf, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
1,970,057	70	Woods, Good, HSG C
1,970,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
25.8	387	0.0100	0.25		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.2	196	0.0440	0.52		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
25.8	1,142	0.0870	0.74		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
79.3	1,775	Total			

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 38

Hydrograph for Subcatchment 2S: 1b Undeveloped

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.37	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.37	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.37	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.37	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.37	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.37	0.00
9.00	0.98	0.00	0.01	90.00	6.70	3.37	0.00
10.50	1.45	0.07	1.23	91.50	6.70	3.37	0.00
12.00	3.35	0.92	7.47	93.00	6.70	3.37	0.00
13.50	5.25	2.22	47.13	94.50	6.70	3.37	0.00
15.00	5.72	2.59	14.75	96.00	6.70	3.37	0.00
16.50	6.02	2.82	8.33	97.50	6.70	3.37	0.00
18.00	6.22	2.98	5.45	99.00	6.70	3.37	0.00
19.50	6.37	3.10	3.94	100.50	6.70	3.37	0.00
21.00	6.50	3.20	3.31	102.00	6.70	3.37	0.00
22.50	6.61	3.29	2.88	103.50	6.70	3.37	0.00
24.00	6.70	3.37	2.47	105.00	6.70	3.37	0.00
25.50	6.70	3.37	0.57	106.50	6.70	3.37	0.00
27.00	6.70	3.37	0.03	108.00	6.70	3.37	0.00
28.50	6.70	3.37	0.00	109.50	6.70	3.37	0.00
30.00	6.70	3.37	0.00	111.00	6.70	3.37	0.00
31.50	6.70	3.37	0.00	112.50	6.70	3.37	0.00
33.00	6.70	3.37	0.00	114.00	6.70	3.37	0.00
34.50	6.70	3.37	0.00	115.50	6.70	3.37	0.00
36.00	6.70	3.37	0.00	117.00	6.70	3.37	0.00
37.50	6.70	3.37	0.00	118.50	6.70	3.37	0.00
39.00	6.70	3.37	0.00	120.00	6.70	3.37	0.00
40.50	6.70	3.37	0.00				
42.00	6.70	3.37	0.00				
43.50	6.70	3.37	0.00				
45.00	6.70	3.37	0.00				
46.50	6.70	3.37	0.00				
48.00	6.70	3.37	0.00				
49.50	6.70	3.37	0.00				
51.00	6.70	3.37	0.00				
52.50	6.70	3.37	0.00				
54.00	6.70	3.37	0.00				
55.50	6.70	3.37	0.00				
57.00	6.70	3.37	0.00				
58.50	6.70	3.37	0.00				
60.00	6.70	3.37	0.00				
61.50	6.70	3.37	0.00				
63.00	6.70	3.37	0.00				
64.50	6.70	3.37	0.00				
66.00	6.70	3.37	0.00				
67.50	6.70	3.37	0.00				
69.00	6.70	3.37	0.00				
70.50	6.70	3.37	0.00				
72.00	6.70	3.37	0.00				
73.50	6.70	3.37	0.00				
75.00	6.70	3.37	0.00				
76.50	6.70	3.37	0.00				
78.00	6.70	3.37	0.00				
79.50	6.70	3.37	0.00				

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 100-Year Rainfall=6.70"

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Page 39

Summary for Subcatchment 10AS: UNDEV

Runoff = 10.26 cfs @ 12.84 hrs, Volume= 82,360 cf, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
205,255	70	Woods, Good, HSG C
87,967	70	Woods, Good, HSG C
293,222	70	Weighted Average
293,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
30.4	922	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
2.7	163	0.1600	1.00		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
0.4	365	0.0480	14.68	484.46	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=3.00' Z= 3.0 ' Top.W=20.00' n= 0.030
61.8	1,500	Total			

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 40

Hydrograph for Subcatchment 10AS: UNDEV

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.37	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.37	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.37	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.37	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.37	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.37	0.00
9.00	0.98	0.00	0.00	90.00	6.70	3.37	0.00
10.50	1.45	0.07	0.24	91.50	6.70	3.37	0.00
12.00	3.35	0.92	1.54	93.00	6.70	3.37	0.00
13.50	5.25	2.22	5.55	94.50	6.70	3.37	0.00
15.00	5.72	2.59	1.84	96.00	6.70	3.37	0.00
16.50	6.02	2.82	1.12	97.50	6.70	3.37	0.00
18.00	6.22	2.98	0.76	99.00	6.70	3.37	0.00
19.50	6.37	3.10	0.56	100.50	6.70	3.37	0.00
21.00	6.50	3.20	0.48	102.00	6.70	3.37	0.00
22.50	6.61	3.29	0.42	103.50	6.70	3.37	0.00
24.00	6.70	3.37	0.36	105.00	6.70	3.37	0.00
25.50	6.70	3.37	0.04	106.50	6.70	3.37	0.00
27.00	6.70	3.37	0.00	108.00	6.70	3.37	0.00
28.50	6.70	3.37	0.00	109.50	6.70	3.37	0.00
30.00	6.70	3.37	0.00	111.00	6.70	3.37	0.00
31.50	6.70	3.37	0.00	112.50	6.70	3.37	0.00
33.00	6.70	3.37	0.00	114.00	6.70	3.37	0.00
34.50	6.70	3.37	0.00	115.50	6.70	3.37	0.00
36.00	6.70	3.37	0.00	117.00	6.70	3.37	0.00
37.50	6.70	3.37	0.00	118.50	6.70	3.37	0.00
39.00	6.70	3.37	0.00	120.00	6.70	3.37	0.00
40.50	6.70	3.37	0.00				
42.00	6.70	3.37	0.00				
43.50	6.70	3.37	0.00				
45.00	6.70	3.37	0.00				
46.50	6.70	3.37	0.00				
48.00	6.70	3.37	0.00				
49.50	6.70	3.37	0.00				
51.00	6.70	3.37	0.00				
52.50	6.70	3.37	0.00				
54.00	6.70	3.37	0.00				
55.50	6.70	3.37	0.00				
57.00	6.70	3.37	0.00				
58.50	6.70	3.37	0.00				
60.00	6.70	3.37	0.00				
61.50	6.70	3.37	0.00				
63.00	6.70	3.37	0.00				
64.50	6.70	3.37	0.00				
66.00	6.70	3.37	0.00				
67.50	6.70	3.37	0.00				
69.00	6.70	3.37	0.00				
70.50	6.70	3.37	0.00				
72.00	6.70	3.37	0.00				
73.50	6.70	3.37	0.00				
75.00	6.70	3.37	0.00				
76.50	6.70	3.37	0.00				
78.00	6.70	3.37	0.00				
79.50	6.70	3.37	0.00				

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 100-Year Rainfall=6.70"

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Page 41

Summary for Subcatchment 10BS: UNDEV

Runoff = 27.66 cfs @ 12.75 hrs, Volume= 207,392 cf, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
406,100	70	Woods, Good, HSG C
270,269	70	Woods, Good, HSG C
61,995	70	Woods, Good, HSG C
738,364	70	Weighted Average
738,364		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
24.5	745	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
3.9	236	0.1600	1.00		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
9.1	277	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
0.9	356	0.0100	6.70	221.13	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=3.00' Z= 3.0 ' Top.W=20.00' n= 0.030
54.7	1,664	Total			

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 42

Hydrograph for Subcatchment 10BS: UNDEV

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.37	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.37	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.37	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.37	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.37	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.37	0.00
9.00	0.98	0.00	0.01	90.00	6.70	3.37	0.00
10.50	1.45	0.07	0.69	91.50	6.70	3.37	0.00
12.00	3.35	0.92	4.53	93.00	6.70	3.37	0.00
13.50	5.25	2.22	12.20	94.50	6.70	3.37	0.00
15.00	5.72	2.59	4.34	96.00	6.70	3.37	0.00
16.50	6.02	2.82	2.71	97.50	6.70	3.37	0.00
18.00	6.22	2.98	1.85	99.00	6.70	3.37	0.00
19.50	6.37	3.10	1.39	100.50	6.70	3.37	0.00
21.00	6.50	3.20	1.19	102.00	6.70	3.37	0.00
22.50	6.61	3.29	1.04	103.50	6.70	3.37	0.00
24.00	6.70	3.37	0.89	105.00	6.70	3.37	0.00
25.50	6.70	3.37	0.06	106.50	6.70	3.37	0.00
27.00	6.70	3.37	0.00	108.00	6.70	3.37	0.00
28.50	6.70	3.37	0.00	109.50	6.70	3.37	0.00
30.00	6.70	3.37	0.00	111.00	6.70	3.37	0.00
31.50	6.70	3.37	0.00	112.50	6.70	3.37	0.00
33.00	6.70	3.37	0.00	114.00	6.70	3.37	0.00
34.50	6.70	3.37	0.00	115.50	6.70	3.37	0.00
36.00	6.70	3.37	0.00	117.00	6.70	3.37	0.00
37.50	6.70	3.37	0.00	118.50	6.70	3.37	0.00
39.00	6.70	3.37	0.00	120.00	6.70	3.37	0.00
40.50	6.70	3.37	0.00				
42.00	6.70	3.37	0.00				
43.50	6.70	3.37	0.00				
45.00	6.70	3.37	0.00				
46.50	6.70	3.37	0.00				
48.00	6.70	3.37	0.00				
49.50	6.70	3.37	0.00				
51.00	6.70	3.37	0.00				
52.50	6.70	3.37	0.00				
54.00	6.70	3.37	0.00				
55.50	6.70	3.37	0.00				
57.00	6.70	3.37	0.00				
58.50	6.70	3.37	0.00				
60.00	6.70	3.37	0.00				
61.50	6.70	3.37	0.00				
63.00	6.70	3.37	0.00				
64.50	6.70	3.37	0.00				
66.00	6.70	3.37	0.00				
67.50	6.70	3.37	0.00				
69.00	6.70	3.37	0.00				
70.50	6.70	3.37	0.00				
72.00	6.70	3.37	0.00				
73.50	6.70	3.37	0.00				
75.00	6.70	3.37	0.00				
76.50	6.70	3.37	0.00				
78.00	6.70	3.37	0.00				
79.50	6.70	3.37	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 43

Summary for Subcatchment 10CS: UNDEV

Runoff = 24.48 cfs @ 13.00 hrs, Volume= 221,138 cf, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
551,113	70	Woods, Good, HSG C
236,191	70	Woods, Good, HSG C
787,304	70	Weighted Average
787,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
18.9	522	0.0340	0.46		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
5.6	240	0.0830	0.72		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
33.2	1,008	0.0410	0.51		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
74.0	1,820	Total			

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 44

Hydrograph for Subcatchment 10CS: UNDEV

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.37	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.37	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.37	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.37	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.37	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.37	0.00
9.00	0.98	0.00	0.00	90.00	6.70	3.37	0.00
10.50	1.45	0.07	0.54	91.50	6.70	3.37	0.00
12.00	3.35	0.92	3.25	93.00	6.70	3.37	0.00
13.50	5.25	2.22	17.76	94.50	6.70	3.37	0.00
15.00	5.72	2.59	5.57	96.00	6.70	3.37	0.00
16.50	6.02	2.82	3.22	97.50	6.70	3.37	0.00
18.00	6.22	2.98	2.13	99.00	6.70	3.37	0.00
19.50	6.37	3.10	1.55	100.50	6.70	3.37	0.00
21.00	6.50	3.20	1.31	102.00	6.70	3.37	0.00
22.50	6.61	3.29	1.14	103.50	6.70	3.37	0.00
24.00	6.70	3.37	0.98	105.00	6.70	3.37	0.00
25.50	6.70	3.37	0.18	106.50	6.70	3.37	0.00
27.00	6.70	3.37	0.01	108.00	6.70	3.37	0.00
28.50	6.70	3.37	0.00	109.50	6.70	3.37	0.00
30.00	6.70	3.37	0.00	111.00	6.70	3.37	0.00
31.50	6.70	3.37	0.00	112.50	6.70	3.37	0.00
33.00	6.70	3.37	0.00	114.00	6.70	3.37	0.00
34.50	6.70	3.37	0.00	115.50	6.70	3.37	0.00
36.00	6.70	3.37	0.00	117.00	6.70	3.37	0.00
37.50	6.70	3.37	0.00	118.50	6.70	3.37	0.00
39.00	6.70	3.37	0.00	120.00	6.70	3.37	0.00
40.50	6.70	3.37	0.00				
42.00	6.70	3.37	0.00				
43.50	6.70	3.37	0.00				
45.00	6.70	3.37	0.00				
46.50	6.70	3.37	0.00				
48.00	6.70	3.37	0.00				
49.50	6.70	3.37	0.00				
51.00	6.70	3.37	0.00				
52.50	6.70	3.37	0.00				
54.00	6.70	3.37	0.00				
55.50	6.70	3.37	0.00				
57.00	6.70	3.37	0.00				
58.50	6.70	3.37	0.00				
60.00	6.70	3.37	0.00				
61.50	6.70	3.37	0.00				
63.00	6.70	3.37	0.00				
64.50	6.70	3.37	0.00				
66.00	6.70	3.37	0.00				
67.50	6.70	3.37	0.00				
69.00	6.70	3.37	0.00				
70.50	6.70	3.37	0.00				
72.00	6.70	3.37	0.00				
73.50	6.70	3.37	0.00				
75.00	6.70	3.37	0.00				
76.50	6.70	3.37	0.00				
78.00	6.70	3.37	0.00				
79.50	6.70	3.37	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 45

Summary for Subcatchment 11S: UNDEV

Runoff = 7.97 cfs @ 12.39 hrs, Volume= 42,088 cf, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
126,252	70	Woods, Good, HSG C
23,590	70	Woods, Good, HSG C
149,842	70	Weighted Average
149,842		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	50	0.0290	0.08		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
16.9	340	0.0180	0.34		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
27.5	390	Total			

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 46

Hydrograph for Subcatchment 11S: UNDEV

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.37	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.37	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.37	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.37	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.37	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.37	0.00
9.00	0.98	0.00	0.01	90.00	6.70	3.37	0.00
10.50	1.45	0.07	0.21	91.50	6.70	3.37	0.00
12.00	3.35	0.92	2.27	93.00	6.70	3.37	0.00
13.50	5.25	2.22	1.33	94.50	6.70	3.37	0.00
15.00	5.72	2.59	0.76	96.00	6.70	3.37	0.00
16.50	6.02	2.82	0.48	97.50	6.70	3.37	0.00
18.00	6.22	2.98	0.34	99.00	6.70	3.37	0.00
19.50	6.37	3.10	0.27	100.50	6.70	3.37	0.00
21.00	6.50	3.20	0.23	102.00	6.70	3.37	0.00
22.50	6.61	3.29	0.20	103.50	6.70	3.37	0.00
24.00	6.70	3.37	0.17	105.00	6.70	3.37	0.00
25.50	6.70	3.37	0.00	106.50	6.70	3.37	0.00
27.00	6.70	3.37	0.00	108.00	6.70	3.37	0.00
28.50	6.70	3.37	0.00	109.50	6.70	3.37	0.00
30.00	6.70	3.37	0.00	111.00	6.70	3.37	0.00
31.50	6.70	3.37	0.00	112.50	6.70	3.37	0.00
33.00	6.70	3.37	0.00	114.00	6.70	3.37	0.00
34.50	6.70	3.37	0.00	115.50	6.70	3.37	0.00
36.00	6.70	3.37	0.00	117.00	6.70	3.37	0.00
37.50	6.70	3.37	0.00	118.50	6.70	3.37	0.00
39.00	6.70	3.37	0.00	120.00	6.70	3.37	0.00
40.50	6.70	3.37	0.00				
42.00	6.70	3.37	0.00				
43.50	6.70	3.37	0.00				
45.00	6.70	3.37	0.00				
46.50	6.70	3.37	0.00				
48.00	6.70	3.37	0.00				
49.50	6.70	3.37	0.00				
51.00	6.70	3.37	0.00				
52.50	6.70	3.37	0.00				
54.00	6.70	3.37	0.00				
55.50	6.70	3.37	0.00				
57.00	6.70	3.37	0.00				
58.50	6.70	3.37	0.00				
60.00	6.70	3.37	0.00				
61.50	6.70	3.37	0.00				
63.00	6.70	3.37	0.00				
64.50	6.70	3.37	0.00				
66.00	6.70	3.37	0.00				
67.50	6.70	3.37	0.00				
69.00	6.70	3.37	0.00				
70.50	6.70	3.37	0.00				
72.00	6.70	3.37	0.00				
73.50	6.70	3.37	0.00				
75.00	6.70	3.37	0.00				
76.50	6.70	3.37	0.00				
78.00	6.70	3.37	0.00				
79.50	6.70	3.37	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 47

Summary for Subcatchment 12S: UnDev

Runoff = 5.77 cfs @ 12.30 hrs, Volume= 27,319 cf, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
97,262	70	Woods, Good, HSG C
97,262		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0400	0.05		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
5.0	150	0.0400	0.50		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
21.3	200	Total			

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 48

Hydrograph for Subcatchment 12S: UnDev

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.37	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.37	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.37	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.37	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.37	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.37	0.00
9.00	0.98	0.00	0.01	90.00	6.70	3.37	0.00
10.50	1.45	0.07	0.15	91.50	6.70	3.37	0.00
12.00	3.35	0.92	1.96	93.00	6.70	3.37	0.00
13.50	5.25	2.22	0.79	94.50	6.70	3.37	0.00
15.00	5.72	2.59	0.48	96.00	6.70	3.37	0.00
16.50	6.02	2.82	0.30	97.50	6.70	3.37	0.00
18.00	6.22	2.98	0.21	99.00	6.70	3.37	0.00
19.50	6.37	3.10	0.17	100.50	6.70	3.37	0.00
21.00	6.50	3.20	0.15	102.00	6.70	3.37	0.00
22.50	6.61	3.29	0.13	103.50	6.70	3.37	0.00
24.00	6.70	3.37	0.11	105.00	6.70	3.37	0.00
25.50	6.70	3.37	0.00	106.50	6.70	3.37	0.00
27.00	6.70	3.37	0.00	108.00	6.70	3.37	0.00
28.50	6.70	3.37	0.00	109.50	6.70	3.37	0.00
30.00	6.70	3.37	0.00	111.00	6.70	3.37	0.00
31.50	6.70	3.37	0.00	112.50	6.70	3.37	0.00
33.00	6.70	3.37	0.00	114.00	6.70	3.37	0.00
34.50	6.70	3.37	0.00	115.50	6.70	3.37	0.00
36.00	6.70	3.37	0.00	117.00	6.70	3.37	0.00
37.50	6.70	3.37	0.00	118.50	6.70	3.37	0.00
39.00	6.70	3.37	0.00	120.00	6.70	3.37	0.00
40.50	6.70	3.37	0.00				
42.00	6.70	3.37	0.00				
43.50	6.70	3.37	0.00				
45.00	6.70	3.37	0.00				
46.50	6.70	3.37	0.00				
48.00	6.70	3.37	0.00				
49.50	6.70	3.37	0.00				
51.00	6.70	3.37	0.00				
52.50	6.70	3.37	0.00				
54.00	6.70	3.37	0.00				
55.50	6.70	3.37	0.00				
57.00	6.70	3.37	0.00				
58.50	6.70	3.37	0.00				
60.00	6.70	3.37	0.00				
61.50	6.70	3.37	0.00				
63.00	6.70	3.37	0.00				
64.50	6.70	3.37	0.00				
66.00	6.70	3.37	0.00				
67.50	6.70	3.37	0.00				
69.00	6.70	3.37	0.00				
70.50	6.70	3.37	0.00				
72.00	6.70	3.37	0.00				
73.50	6.70	3.37	0.00				
75.00	6.70	3.37	0.00				
76.50	6.70	3.37	0.00				
78.00	6.70	3.37	0.00				
79.50	6.70	3.37	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 49

Summary for Subcatchment 13S: DB1

Runoff = 11.54 cfs @ 12.09 hrs, Volume= 35,907 cf, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
113,939	74	>75% Grass cover, Good, HSG C
113,939		100.00% Pervious Area

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

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 50

Hydrograph for Subcatchment 13S: DB1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.78	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.78	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.78	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.78	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.78	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.78	0.00
9.00	0.98	0.02	0.08	90.00	6.70	3.78	0.00
10.50	1.45	0.13	0.32	91.50	6.70	3.78	0.00
12.00	3.35	1.14	6.75	93.00	6.70	3.78	0.00
13.50	5.25	2.56	0.90	94.50	6.70	3.78	0.00
15.00	5.72	2.95	0.57	96.00	6.70	3.78	0.00
16.50	6.02	3.20	0.36	97.50	6.70	3.78	0.00
18.00	6.22	3.37	0.25	99.00	6.70	3.78	0.00
19.50	6.37	3.50	0.21	100.50	6.70	3.78	0.00
21.00	6.50	3.61	0.18	102.00	6.70	3.78	0.00
22.50	6.61	3.70	0.16	103.50	6.70	3.78	0.00
24.00	6.70	3.78	0.13	105.00	6.70	3.78	0.00
25.50	6.70	3.78	0.00	106.50	6.70	3.78	0.00
27.00	6.70	3.78	0.00	108.00	6.70	3.78	0.00
28.50	6.70	3.78	0.00	109.50	6.70	3.78	0.00
30.00	6.70	3.78	0.00	111.00	6.70	3.78	0.00
31.50	6.70	3.78	0.00	112.50	6.70	3.78	0.00
33.00	6.70	3.78	0.00	114.00	6.70	3.78	0.00
34.50	6.70	3.78	0.00	115.50	6.70	3.78	0.00
36.00	6.70	3.78	0.00	117.00	6.70	3.78	0.00
37.50	6.70	3.78	0.00	118.50	6.70	3.78	0.00
39.00	6.70	3.78	0.00	120.00	6.70	3.78	0.00
40.50	6.70	3.78	0.00				
42.00	6.70	3.78	0.00				
43.50	6.70	3.78	0.00				
45.00	6.70	3.78	0.00				
46.50	6.70	3.78	0.00				
48.00	6.70	3.78	0.00				
49.50	6.70	3.78	0.00				
51.00	6.70	3.78	0.00				
52.50	6.70	3.78	0.00				
54.00	6.70	3.78	0.00				
55.50	6.70	3.78	0.00				
57.00	6.70	3.78	0.00				
58.50	6.70	3.78	0.00				
60.00	6.70	3.78	0.00				
61.50	6.70	3.78	0.00				
63.00	6.70	3.78	0.00				
64.50	6.70	3.78	0.00				
66.00	6.70	3.78	0.00				
67.50	6.70	3.78	0.00				
69.00	6.70	3.78	0.00				
70.50	6.70	3.78	0.00				
72.00	6.70	3.78	0.00				
73.50	6.70	3.78	0.00				
75.00	6.70	3.78	0.00				
76.50	6.70	3.78	0.00				
78.00	6.70	3.78	0.00				
79.50	6.70	3.78	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 51

Summary for Subcatchment 14S: UnDev

Runoff = 17.94 cfs @ 12.21 hrs, Volume= 74,234 cf, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
188,821	70	Woods, Good, HSG C
57,197	74	>75% Grass cover, Good, HSG C
10,527	74	>75% Grass cover, Good, HSG C
256,545	71	Weighted Average
256,545		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	50	0.0700	0.06		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.20"
2.3	110	0.1000	0.79		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
15.3	160	Total			

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 52

Hydrograph for Subcatchment 14S: UnDev

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.47	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.47	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.47	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.47	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.47	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.47	0.00
9.00	0.98	0.01	0.07	90.00	6.70	3.47	0.00
10.50	1.45	0.09	0.49	91.50	6.70	3.47	0.00
12.00	3.35	0.97	7.23	93.00	6.70	3.47	0.00
13.50	5.25	2.31	2.03	94.50	6.70	3.47	0.00
15.00	5.72	2.68	1.27	96.00	6.70	3.47	0.00
16.50	6.02	2.91	0.79	97.50	6.70	3.47	0.00
18.00	6.22	3.08	0.56	99.00	6.70	3.47	0.00
19.50	6.37	3.20	0.46	100.50	6.70	3.47	0.00
21.00	6.50	3.30	0.40	102.00	6.70	3.47	0.00
22.50	6.61	3.39	0.34	103.50	6.70	3.47	0.00
24.00	6.70	3.47	0.29	105.00	6.70	3.47	0.00
25.50	6.70	3.47	0.00	106.50	6.70	3.47	0.00
27.00	6.70	3.47	0.00	108.00	6.70	3.47	0.00
28.50	6.70	3.47	0.00	109.50	6.70	3.47	0.00
30.00	6.70	3.47	0.00	111.00	6.70	3.47	0.00
31.50	6.70	3.47	0.00	112.50	6.70	3.47	0.00
33.00	6.70	3.47	0.00	114.00	6.70	3.47	0.00
34.50	6.70	3.47	0.00	115.50	6.70	3.47	0.00
36.00	6.70	3.47	0.00	117.00	6.70	3.47	0.00
37.50	6.70	3.47	0.00	118.50	6.70	3.47	0.00
39.00	6.70	3.47	0.00	120.00	6.70	3.47	0.00
40.50	6.70	3.47	0.00				
42.00	6.70	3.47	0.00				
43.50	6.70	3.47	0.00				
45.00	6.70	3.47	0.00				
46.50	6.70	3.47	0.00				
48.00	6.70	3.47	0.00				
49.50	6.70	3.47	0.00				
51.00	6.70	3.47	0.00				
52.50	6.70	3.47	0.00				
54.00	6.70	3.47	0.00				
55.50	6.70	3.47	0.00				
57.00	6.70	3.47	0.00				
58.50	6.70	3.47	0.00				
60.00	6.70	3.47	0.00				
61.50	6.70	3.47	0.00				
63.00	6.70	3.47	0.00				
64.50	6.70	3.47	0.00				
66.00	6.70	3.47	0.00				
67.50	6.70	3.47	0.00				
69.00	6.70	3.47	0.00				
70.50	6.70	3.47	0.00				
72.00	6.70	3.47	0.00				
73.50	6.70	3.47	0.00				
75.00	6.70	3.47	0.00				
76.50	6.70	3.47	0.00				
78.00	6.70	3.47	0.00				
79.50	6.70	3.47	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 53

Summary for Subcatchment 15S: Road

Runoff = 9.14 cfs @ 12.08 hrs, Volume= 30,582 cf, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
63,726	92	Paved roads w/open ditches, 50% imp, HSG C
31,863		50.00% Pervious Area
31,863		50.00% Impervious Area

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

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 54

Hydrograph for Subcatchment 15S: Road

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	5.76	0.00
1.50	0.10	0.00	0.00	82.50	6.70	5.76	0.00
3.00	0.21	0.00	0.01	84.00	6.70	5.76	0.00
4.50	0.33	0.02	0.04	85.50	6.70	5.76	0.00
6.00	0.48	0.08	0.07	87.00	6.70	5.76	0.00
7.50	0.68	0.19	0.13	88.50	6.70	5.76	0.00
9.00	0.98	0.39	0.26	90.00	6.70	5.76	0.00
10.50	1.45	0.76	0.48	91.50	6.70	5.76	0.00
12.00	3.35	2.49	5.74	93.00	6.70	5.76	0.00
13.50	5.25	4.33	0.61	94.50	6.70	5.76	0.00
15.00	5.72	4.80	0.37	96.00	6.70	5.76	0.00
16.50	6.02	5.09	0.23	97.50	6.70	5.76	0.00
18.00	6.22	5.28	0.16	99.00	6.70	5.76	0.00
19.50	6.37	5.43	0.14	100.50	6.70	5.76	0.00
21.00	6.50	5.56	0.12	102.00	6.70	5.76	0.00
22.50	6.61	5.67	0.10	103.50	6.70	5.76	0.00
24.00	6.70	5.76	0.08	105.00	6.70	5.76	0.00
25.50	6.70	5.76	0.00	106.50	6.70	5.76	0.00
27.00	6.70	5.76	0.00	108.00	6.70	5.76	0.00
28.50	6.70	5.76	0.00	109.50	6.70	5.76	0.00
30.00	6.70	5.76	0.00	111.00	6.70	5.76	0.00
31.50	6.70	5.76	0.00	112.50	6.70	5.76	0.00
33.00	6.70	5.76	0.00	114.00	6.70	5.76	0.00
34.50	6.70	5.76	0.00	115.50	6.70	5.76	0.00
36.00	6.70	5.76	0.00	117.00	6.70	5.76	0.00
37.50	6.70	5.76	0.00	118.50	6.70	5.76	0.00
39.00	6.70	5.76	0.00	120.00	6.70	5.76	0.00
40.50	6.70	5.76	0.00				
42.00	6.70	5.76	0.00				
43.50	6.70	5.76	0.00				
45.00	6.70	5.76	0.00				
46.50	6.70	5.76	0.00				
48.00	6.70	5.76	0.00				
49.50	6.70	5.76	0.00				
51.00	6.70	5.76	0.00				
52.50	6.70	5.76	0.00				
54.00	6.70	5.76	0.00				
55.50	6.70	5.76	0.00				
57.00	6.70	5.76	0.00				
58.50	6.70	5.76	0.00				
60.00	6.70	5.76	0.00				
61.50	6.70	5.76	0.00				
63.00	6.70	5.76	0.00				
64.50	6.70	5.76	0.00				
66.00	6.70	5.76	0.00				
67.50	6.70	5.76	0.00				
69.00	6.70	5.76	0.00				
70.50	6.70	5.76	0.00				
72.00	6.70	5.76	0.00				
73.50	6.70	5.76	0.00				
75.00	6.70	5.76	0.00				
76.50	6.70	5.76	0.00				
78.00	6.70	5.76	0.00				
79.50	6.70	5.76	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 55

Summary for Subcatchment 16S: Road

Runoff = 2.58 cfs @ 12.08 hrs, Volume= 8,641 cf, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
18,005	92	Paved roads w/open ditches, 50% imp, HSG C
9,003		50.00% Pervious Area
9,003		50.00% Impervious Area

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

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 56

Hydrograph for Subcatchment 16S: Road

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	5.76	0.00
1.50	0.10	0.00	0.00	82.50	6.70	5.76	0.00
3.00	0.21	0.00	0.00	84.00	6.70	5.76	0.00
4.50	0.33	0.02	0.01	85.50	6.70	5.76	0.00
6.00	0.48	0.08	0.02	87.00	6.70	5.76	0.00
7.50	0.68	0.19	0.04	88.50	6.70	5.76	0.00
9.00	0.98	0.39	0.07	90.00	6.70	5.76	0.00
10.50	1.45	0.76	0.14	91.50	6.70	5.76	0.00
12.00	3.35	2.49	1.62	93.00	6.70	5.76	0.00
13.50	5.25	4.33	0.17	94.50	6.70	5.76	0.00
15.00	5.72	4.80	0.11	96.00	6.70	5.76	0.00
16.50	6.02	5.09	0.07	97.50	6.70	5.76	0.00
18.00	6.22	5.28	0.05	99.00	6.70	5.76	0.00
19.50	6.37	5.43	0.04	100.50	6.70	5.76	0.00
21.00	6.50	5.56	0.03	102.00	6.70	5.76	0.00
22.50	6.61	5.67	0.03	103.50	6.70	5.76	0.00
24.00	6.70	5.76	0.02	105.00	6.70	5.76	0.00
25.50	6.70	5.76	0.00	106.50	6.70	5.76	0.00
27.00	6.70	5.76	0.00	108.00	6.70	5.76	0.00
28.50	6.70	5.76	0.00	109.50	6.70	5.76	0.00
30.00	6.70	5.76	0.00	111.00	6.70	5.76	0.00
31.50	6.70	5.76	0.00	112.50	6.70	5.76	0.00
33.00	6.70	5.76	0.00	114.00	6.70	5.76	0.00
34.50	6.70	5.76	0.00	115.50	6.70	5.76	0.00
36.00	6.70	5.76	0.00	117.00	6.70	5.76	0.00
37.50	6.70	5.76	0.00	118.50	6.70	5.76	0.00
39.00	6.70	5.76	0.00	120.00	6.70	5.76	0.00
40.50	6.70	5.76	0.00				
42.00	6.70	5.76	0.00				
43.50	6.70	5.76	0.00				
45.00	6.70	5.76	0.00				
46.50	6.70	5.76	0.00				
48.00	6.70	5.76	0.00				
49.50	6.70	5.76	0.00				
51.00	6.70	5.76	0.00				
52.50	6.70	5.76	0.00				
54.00	6.70	5.76	0.00				
55.50	6.70	5.76	0.00				
57.00	6.70	5.76	0.00				
58.50	6.70	5.76	0.00				
60.00	6.70	5.76	0.00				
61.50	6.70	5.76	0.00				
63.00	6.70	5.76	0.00				
64.50	6.70	5.76	0.00				
66.00	6.70	5.76	0.00				
67.50	6.70	5.76	0.00				
69.00	6.70	5.76	0.00				
70.50	6.70	5.76	0.00				
72.00	6.70	5.76	0.00				
73.50	6.70	5.76	0.00				
75.00	6.70	5.76	0.00				
76.50	6.70	5.76	0.00				
78.00	6.70	5.76	0.00				
79.50	6.70	5.76	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 57

Summary for Subcatchment 18S: Road

Runoff = 3.14 cfs @ 12.08 hrs, Volume= 10,522 cf, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
21,926	92	Paved roads w/open ditches, 50% imp, HSG C
10,963		50.00% Pervious Area
10,963		50.00% Impervious Area

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

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 58

Hydrograph for Subcatchment 18S: Road

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	5.76	0.00
1.50	0.10	0.00	0.00	82.50	6.70	5.76	0.00
3.00	0.21	0.00	0.00	84.00	6.70	5.76	0.00
4.50	0.33	0.02	0.01	85.50	6.70	5.76	0.00
6.00	0.48	0.08	0.02	87.00	6.70	5.76	0.00
7.50	0.68	0.19	0.05	88.50	6.70	5.76	0.00
9.00	0.98	0.39	0.09	90.00	6.70	5.76	0.00
10.50	1.45	0.76	0.17	91.50	6.70	5.76	0.00
12.00	3.35	2.49	1.98	93.00	6.70	5.76	0.00
13.50	5.25	4.33	0.21	94.50	6.70	5.76	0.00
15.00	5.72	4.80	0.13	96.00	6.70	5.76	0.00
16.50	6.02	5.09	0.08	97.50	6.70	5.76	0.00
18.00	6.22	5.28	0.06	99.00	6.70	5.76	0.00
19.50	6.37	5.43	0.05	100.50	6.70	5.76	0.00
21.00	6.50	5.56	0.04	102.00	6.70	5.76	0.00
22.50	6.61	5.67	0.03	103.50	6.70	5.76	0.00
24.00	6.70	5.76	0.03	105.00	6.70	5.76	0.00
25.50	6.70	5.76	0.00	106.50	6.70	5.76	0.00
27.00	6.70	5.76	0.00	108.00	6.70	5.76	0.00
28.50	6.70	5.76	0.00	109.50	6.70	5.76	0.00
30.00	6.70	5.76	0.00	111.00	6.70	5.76	0.00
31.50	6.70	5.76	0.00	112.50	6.70	5.76	0.00
33.00	6.70	5.76	0.00	114.00	6.70	5.76	0.00
34.50	6.70	5.76	0.00	115.50	6.70	5.76	0.00
36.00	6.70	5.76	0.00	117.00	6.70	5.76	0.00
37.50	6.70	5.76	0.00	118.50	6.70	5.76	0.00
39.00	6.70	5.76	0.00	120.00	6.70	5.76	0.00
40.50	6.70	5.76	0.00				
42.00	6.70	5.76	0.00				
43.50	6.70	5.76	0.00				
45.00	6.70	5.76	0.00				
46.50	6.70	5.76	0.00				
48.00	6.70	5.76	0.00				
49.50	6.70	5.76	0.00				
51.00	6.70	5.76	0.00				
52.50	6.70	5.76	0.00				
54.00	6.70	5.76	0.00				
55.50	6.70	5.76	0.00				
57.00	6.70	5.76	0.00				
58.50	6.70	5.76	0.00				
60.00	6.70	5.76	0.00				
61.50	6.70	5.76	0.00				
63.00	6.70	5.76	0.00				
64.50	6.70	5.76	0.00				
66.00	6.70	5.76	0.00				
67.50	6.70	5.76	0.00				
69.00	6.70	5.76	0.00				
70.50	6.70	5.76	0.00				
72.00	6.70	5.76	0.00				
73.50	6.70	5.76	0.00				
75.00	6.70	5.76	0.00				
76.50	6.70	5.76	0.00				
78.00	6.70	5.76	0.00				
79.50	6.70	5.76	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 59

Summary for Subcatchment 19S: 1b Undeveloped

Runoff = 58.70 cfs @ 13.10 hrs, Volume= 553,350 cf, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
1,970,057	70	Woods, Good, HSG C
1,970,057		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0050	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
25.8	387	0.0100	0.25		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.2	196	0.0440	0.52		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
25.8	1,142	0.0870	0.74		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
79.3	1,775	Total			

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 60

Hydrograph for Subcatchment 19S: 1b Undeveloped

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	81.00	6.70	3.37	0.00
1.50	0.10	0.00	0.00	82.50	6.70	3.37	0.00
3.00	0.21	0.00	0.00	84.00	6.70	3.37	0.00
4.50	0.33	0.00	0.00	85.50	6.70	3.37	0.00
6.00	0.48	0.00	0.00	87.00	6.70	3.37	0.00
7.50	0.68	0.00	0.00	88.50	6.70	3.37	0.00
9.00	0.98	0.00	0.01	90.00	6.70	3.37	0.00
10.50	1.45	0.07	1.23	91.50	6.70	3.37	0.00
12.00	3.35	0.92	7.47	93.00	6.70	3.37	0.00
13.50	5.25	2.22	47.13	94.50	6.70	3.37	0.00
15.00	5.72	2.59	14.75	96.00	6.70	3.37	0.00
16.50	6.02	2.82	8.33	97.50	6.70	3.37	0.00
18.00	6.22	2.98	5.45	99.00	6.70	3.37	0.00
19.50	6.37	3.10	3.94	100.50	6.70	3.37	0.00
21.00	6.50	3.20	3.31	102.00	6.70	3.37	0.00
22.50	6.61	3.29	2.88	103.50	6.70	3.37	0.00
24.00	6.70	3.37	2.47	105.00	6.70	3.37	0.00
25.50	6.70	3.37	0.57	106.50	6.70	3.37	0.00
27.00	6.70	3.37	0.03	108.00	6.70	3.37	0.00
28.50	6.70	3.37	0.00	109.50	6.70	3.37	0.00
30.00	6.70	3.37	0.00	111.00	6.70	3.37	0.00
31.50	6.70	3.37	0.00	112.50	6.70	3.37	0.00
33.00	6.70	3.37	0.00	114.00	6.70	3.37	0.00
34.50	6.70	3.37	0.00	115.50	6.70	3.37	0.00
36.00	6.70	3.37	0.00	117.00	6.70	3.37	0.00
37.50	6.70	3.37	0.00	118.50	6.70	3.37	0.00
39.00	6.70	3.37	0.00	120.00	6.70	3.37	0.00
40.50	6.70	3.37	0.00				
42.00	6.70	3.37	0.00				
43.50	6.70	3.37	0.00				
45.00	6.70	3.37	0.00				
46.50	6.70	3.37	0.00				
48.00	6.70	3.37	0.00				
49.50	6.70	3.37	0.00				
51.00	6.70	3.37	0.00				
52.50	6.70	3.37	0.00				
54.00	6.70	3.37	0.00				
55.50	6.70	3.37	0.00				
57.00	6.70	3.37	0.00				
58.50	6.70	3.37	0.00				
60.00	6.70	3.37	0.00				
61.50	6.70	3.37	0.00				
63.00	6.70	3.37	0.00				
64.50	6.70	3.37	0.00				
66.00	6.70	3.37	0.00				
67.50	6.70	3.37	0.00				
69.00	6.70	3.37	0.00				
70.50	6.70	3.37	0.00				
72.00	6.70	3.37	0.00				
73.50	6.70	3.37	0.00				
75.00	6.70	3.37	0.00				
76.50	6.70	3.37	0.00				
78.00	6.70	3.37	0.00				
79.50	6.70	3.37	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 61

Summary for Reach 11R: Culvert

Inflow Area = 906,492 sf, 1.21% Impervious, Inflow Depth = 3.43" for 100-Year event
 Inflow = 26.06 cfs @ 12.98 hrs, Volume= 258,979 cf
 Outflow = 26.05 cfs @ 12.99 hrs, Volume= 258,979 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 5.93 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.25 fps, Avg. Travel Time= 0.4 min

Peak Storage= 220 cf @ 12.99 hrs

Average Depth at Peak Storage= 1.74'

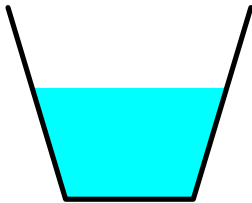
Bank-Full Depth= 3.00' Flow Area= 8.7 sf, Capacity= 63.07 cfs

2.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding

Side Slope Z-value= 0.3 ' Top Width= 3.80'

Length= 50.0' Slope= 0.0200 ' /'

Inlet Invert= 280.00', Outlet Invert= 279.00'



3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 62

Hydrograph for Reach 11R: Culvert

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)
0.00	0.00	0	280.00	0.00	81.00	0.00	0	280.00	0.00
1.50	0.00	0	280.00	0.00	82.50	0.00	0	280.00	0.00
3.00	0.00	0	280.00	0.00	84.00	0.00	0	280.00	0.00
4.50	0.01	1	280.01	0.01	85.50	0.00	0	280.00	0.00
6.00	0.02	2	280.02	0.02	87.00	0.00	0	280.00	0.00
7.50	0.05	3	280.03	0.05	88.50	0.00	0	280.00	0.00
9.00	0.10	5	280.05	0.10	90.00	0.00	0	280.00	0.00
10.50	0.85	20	280.19	0.85	91.50	0.00	0	280.00	0.00
12.00	7.18	84	280.75	7.05	93.00	0.00	0	280.00	0.00
13.50	18.76	171	281.41	18.84	94.50	0.00	0	280.00	0.00
15.00	6.18	76	280.69	6.19	96.00	0.00	0	280.00	0.00
16.50	3.60	52	280.49	3.60	97.50	0.00	0	280.00	0.00
18.00	2.40	40	280.38	2.41	99.00	0.00	0	280.00	0.00
19.50	1.77	32	280.31	1.77	100.50	0.00	0	280.00	0.00
21.00	1.50	29	280.28	1.50	102.00	0.00	0	280.00	0.00
22.50	1.31	26	280.25	1.31	103.50	0.00	0	280.00	0.00
24.00	1.12	24	280.23	1.12	105.00	0.00	0	280.00	0.00
25.50	0.18	8	280.08	0.19	106.50	0.00	0	280.00	0.00
27.00	0.01	1	280.01	0.01	108.00	0.00	0	280.00	0.00
28.50	0.00	0	280.00	0.00	109.50	0.00	0	280.00	0.00
30.00	0.00	0	280.00	0.00	111.00	0.00	0	280.00	0.00
31.50	0.00	0	280.00	0.00	112.50	0.00	0	280.00	0.00
33.00	0.00	0	280.00	0.00	114.00	0.00	0	280.00	0.00
34.50	0.00	0	280.00	0.00	115.50	0.00	0	280.00	0.00
36.00	0.00	0	280.00	0.00	117.00	0.00	0	280.00	0.00
37.50	0.00	0	280.00	0.00	118.50	0.00	0	280.00	0.00
39.00	0.00	0	280.00	0.00	120.00	0.00	0	280.00	0.00
40.50	0.00	0	280.00	0.00					
42.00	0.00	0	280.00	0.00					
43.50	0.00	0	280.00	0.00					
45.00	0.00	0	280.00	0.00					
46.50	0.00	0	280.00	0.00					
48.00	0.00	0	280.00	0.00					
49.50	0.00	0	280.00	0.00					
51.00	0.00	0	280.00	0.00					
52.50	0.00	0	280.00	0.00					
54.00	0.00	0	280.00	0.00					
55.50	0.00	0	280.00	0.00					
57.00	0.00	0	280.00	0.00					
58.50	0.00	0	280.00	0.00					
60.00	0.00	0	280.00	0.00					
61.50	0.00	0	280.00	0.00					
63.00	0.00	0	280.00	0.00					
64.50	0.00	0	280.00	0.00					
66.00	0.00	0	280.00	0.00					
67.50	0.00	0	280.00	0.00					
69.00	0.00	0	280.00	0.00					
70.50	0.00	0	280.00	0.00					
72.00	0.00	0	280.00	0.00					
73.50	0.00	0	280.00	0.00					
75.00	0.00	0	280.00	0.00					
76.50	0.00	0	280.00	0.00					
78.00	0.00	0	280.00	0.00					
79.50	0.00	0	280.00	0.00					

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 63

Summary for Reach 12R: swale

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

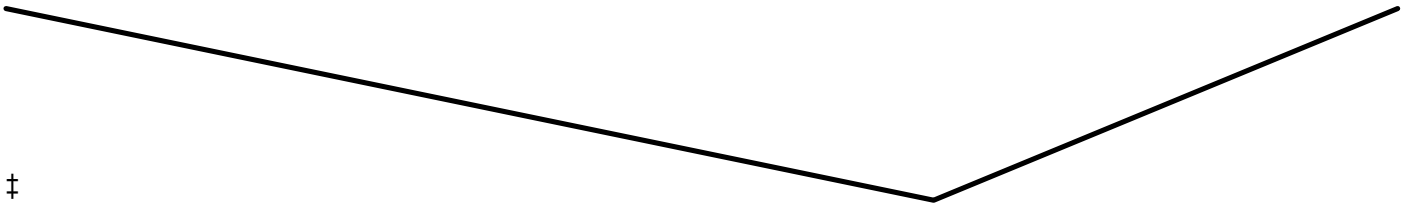
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 95.69 cfs

0.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 6.0 3.0 '/' Top Width= 18.00'

Length= 400.0' Slope= 0.0163 '/'

Inlet Invert= 283.50', Outlet Invert= 277.00'



3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 64

Hydrograph for Reach 12R: swale

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00	283.50	0.00	81.00	0.00	283.50	0.00
1.50	0.00	283.50	0.00	82.50	0.00	283.50	0.00
3.00	0.00	283.50	0.00	84.00	0.00	283.50	0.00
4.50	0.00	283.50	0.00	85.50	0.00	283.50	0.00
6.00	0.00	283.50	0.00	87.00	0.00	283.50	0.00
7.50	0.00	283.50	0.00	88.50	0.00	283.50	0.00
9.00	0.00	283.50	0.00	90.00	0.00	283.50	0.00
10.50	0.00	283.50	0.00	91.50	0.00	283.50	0.00
12.00	0.00	283.50	0.00	93.00	0.00	283.50	0.00
13.50	0.00	283.50	0.00	94.50	0.00	283.50	0.00
15.00	0.00	283.50	0.00	96.00	0.00	283.50	0.00
16.50	0.00	283.50	0.00	97.50	0.00	283.50	0.00
18.00	0.00	283.50	0.00	99.00	0.00	283.50	0.00
19.50	0.00	283.50	0.00	100.50	0.00	283.50	0.00
21.00	0.00	283.50	0.00	102.00	0.00	283.50	0.00
22.50	0.00	283.50	0.00	103.50	0.00	283.50	0.00
24.00	0.00	283.50	0.00	105.00	0.00	283.50	0.00
25.50	0.00	283.50	0.00	106.50	0.00	283.50	0.00
27.00	0.00	283.50	0.00	108.00	0.00	283.50	0.00
28.50	0.00	283.50	0.00	109.50	0.00	283.50	0.00
30.00	0.00	283.50	0.00	111.00	0.00	283.50	0.00
31.50	0.00	283.50	0.00	112.50	0.00	283.50	0.00
33.00	0.00	283.50	0.00	114.00	0.00	283.50	0.00
34.50	0.00	283.50	0.00	115.50	0.00	283.50	0.00
36.00	0.00	283.50	0.00	117.00	0.00	283.50	0.00
37.50	0.00	283.50	0.00	118.50	0.00	283.50	0.00
39.00	0.00	283.50	0.00	120.00	0.00	283.50	0.00
40.50	0.00	283.50	0.00				
42.00	0.00	283.50	0.00				
43.50	0.00	283.50	0.00				
45.00	0.00	283.50	0.00				
46.50	0.00	283.50	0.00				
48.00	0.00	283.50	0.00				
49.50	0.00	283.50	0.00				
51.00	0.00	283.50	0.00				
52.50	0.00	283.50	0.00				
54.00	0.00	283.50	0.00				
55.50	0.00	283.50	0.00				
57.00	0.00	283.50	0.00				
58.50	0.00	283.50	0.00				
60.00	0.00	283.50	0.00				
61.50	0.00	283.50	0.00				
63.00	0.00	283.50	0.00				
64.50	0.00	283.50	0.00				
66.00	0.00	283.50	0.00				
67.50	0.00	283.50	0.00				
69.00	0.00	283.50	0.00				
70.50	0.00	283.50	0.00				
72.00	0.00	283.50	0.00				
73.50	0.00	283.50	0.00				
75.00	0.00	283.50	0.00				
76.50	0.00	283.50	0.00				
78.00	0.00	283.50	0.00				
79.50	0.00	283.50	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 65

Summary for Reach 13R: swale

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 77.12 cfs

2.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 3.0 ' Top Width= 14.00'

Length= 480.0' Slope= 0.0115 ' / '

Inlet Invert= 289.50', Outlet Invert= 284.00'



3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 66

Hydrograph for Reach 13R: swale

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00	289.50	0.00	81.00	0.00	289.50	0.00
1.50	0.00	289.50	0.00	82.50	0.00	289.50	0.00
3.00	0.00	289.50	0.00	84.00	0.00	289.50	0.00
4.50	0.00	289.50	0.00	85.50	0.00	289.50	0.00
6.00	0.00	289.50	0.00	87.00	0.00	289.50	0.00
7.50	0.00	289.50	0.00	88.50	0.00	289.50	0.00
9.00	0.00	289.50	0.00	90.00	0.00	289.50	0.00
10.50	0.00	289.50	0.00	91.50	0.00	289.50	0.00
12.00	0.00	289.50	0.00	93.00	0.00	289.50	0.00
13.50	0.00	289.50	0.00	94.50	0.00	289.50	0.00
15.00	0.00	289.50	0.00	96.00	0.00	289.50	0.00
16.50	0.00	289.50	0.00	97.50	0.00	289.50	0.00
18.00	0.00	289.50	0.00	99.00	0.00	289.50	0.00
19.50	0.00	289.50	0.00	100.50	0.00	289.50	0.00
21.00	0.00	289.50	0.00	102.00	0.00	289.50	0.00
22.50	0.00	289.50	0.00	103.50	0.00	289.50	0.00
24.00	0.00	289.50	0.00	105.00	0.00	289.50	0.00
25.50	0.00	289.50	0.00	106.50	0.00	289.50	0.00
27.00	0.00	289.50	0.00	108.00	0.00	289.50	0.00
28.50	0.00	289.50	0.00	109.50	0.00	289.50	0.00
30.00	0.00	289.50	0.00	111.00	0.00	289.50	0.00
31.50	0.00	289.50	0.00	112.50	0.00	289.50	0.00
33.00	0.00	289.50	0.00	114.00	0.00	289.50	0.00
34.50	0.00	289.50	0.00	115.50	0.00	289.50	0.00
36.00	0.00	289.50	0.00	117.00	0.00	289.50	0.00
37.50	0.00	289.50	0.00	118.50	0.00	289.50	0.00
39.00	0.00	289.50	0.00	120.00	0.00	289.50	0.00
40.50	0.00	289.50	0.00				
42.00	0.00	289.50	0.00				
43.50	0.00	289.50	0.00				
45.00	0.00	289.50	0.00				
46.50	0.00	289.50	0.00				
48.00	0.00	289.50	0.00				
49.50	0.00	289.50	0.00				
51.00	0.00	289.50	0.00				
52.50	0.00	289.50	0.00				
54.00	0.00	289.50	0.00				
55.50	0.00	289.50	0.00				
57.00	0.00	289.50	0.00				
58.50	0.00	289.50	0.00				
60.00	0.00	289.50	0.00				
61.50	0.00	289.50	0.00				
63.00	0.00	289.50	0.00				
64.50	0.00	289.50	0.00				
66.00	0.00	289.50	0.00				
67.50	0.00	289.50	0.00				
69.00	0.00	289.50	0.00				
70.50	0.00	289.50	0.00				
72.00	0.00	289.50	0.00				
73.50	0.00	289.50	0.00				
75.00	0.00	289.50	0.00				
76.50	0.00	289.50	0.00				
78.00	0.00	289.50	0.00				
79.50	0.00	289.50	0.00				

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 100-Year Rainfall=6.70"

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Page 67

Summary for Pond 10P: DB1

Inflow Area = 1,209,251 sf, 2.63% Impervious, Inflow Depth = 3.53" for 100-Year event
 Inflow = 40.06 cfs @ 12.80 hrs, Volume= 356,191 cf
 Outflow = 11.94 cfs @ 14.00 hrs, Volume= 356,190 cf, Atten= 70%, Lag= 72.4 min
 Discarded = 0.95 cfs @ 14.00 hrs, Volume= 41,494 cf
 Primary = 10.99 cfs @ 14.00 hrs, Volume= 314,696 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 3
 Peak Elev= 279.06' @ 14.00 hrs Surf.Area= 78,665 sf Storage= 148,654 cf

Plug-Flow detention time= 167.9 min calculated for 356,190 cf (100% of inflow)
 Center-of-Mass det. time= 167.4 min (1,033.1 - 865.8)

Volume	Invert	Avail.Storage	Storage Description
#1	275.50'	493,204 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	273.00'	113 cf	4.00'D x 9.00'H Vertical Cone/Cylinder
		493,317 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
275.50	0	0.0	0	0	0
276.00	12,880	650.0	2,147	2,147	33,622
277.00	35,500	1,100.0	23,254	25,401	96,295
278.00	62,400	1,310.0	48,322	73,723	136,587
279.00	78,375	1,380.0	70,236	143,959	151,632
280.00	83,150	1,400.0	80,751	224,710	156,270
283.00	96,000	1,500.0	268,494	493,204	179,754

Device	Routing	Invert	Outlet Devices
#1	Primary	273.00'	24.0" Round Culvert L= 90.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 273.00' / 265.80' S= 0.0800 ' / ' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	275.50'	0.5' long x 3.84' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#3	Device 1	279.34'	2.8' long x 2.66' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#4	Primary	282.30'	6.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#5	Discarded	273.00'	0.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.95 cfs @ 14.00 hrs HW=279.06' (Free Discharge)

↑ **5=Exfiltration** (Exfiltration Controls 0.95 cfs)

Primary OutFlow Max=10.99 cfs @ 14.00 hrs HW=279.06' (Free Discharge)

↑ **1=Culvert** (Passes 10.99 cfs of 34.02 cfs potential flow)
 ↑ **2=Sharp-Crested Vee/Trap Weir** (Weir Controls 10.99 cfs @ 6.18 fps)
 ↑ **3=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)
 ↑ **4=Emergency Spillway** (Controls 0.00 cfs)

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Page 68

Hydrograph for Pond 10P: DB1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	273.00	0.00	0.00	0.00
3.00	0.01	4	273.30	0.00	0.00	0.00
6.00	0.07	54	275.60	0.06	0.01	0.06
9.00	0.35	328	275.75	0.26	0.05	0.21
12.00	18.42	20,383	276.85	3.09	0.53	2.56
15.00	7.14	139,037	278.94	11.37	0.94	10.43
18.00	3.02	84,285	278.16	7.99	0.87	7.12
21.00	1.97	40,797	277.38	4.92	0.69	4.23
24.00	1.46	18,125	276.77	2.85	0.50	2.35
27.00	0.00	2,463	276.02	0.83	0.22	0.62
30.00	0.00	30	275.43	0.00	0.00	0.00
33.00	0.00	28	275.20	0.00	0.00	0.00
36.00	0.00	25	274.99	0.00	0.00	0.00
39.00	0.00	23	274.80	0.00	0.00	0.00
42.00	0.00	20	274.62	0.00	0.00	0.00
45.00	0.00	18	274.45	0.00	0.00	0.00
48.00	0.00	16	274.29	0.00	0.00	0.00
51.00	0.00	14	274.14	0.00	0.00	0.00
54.00	0.00	13	274.00	0.00	0.00	0.00
57.00	0.00	11	273.87	0.00	0.00	0.00
60.00	0.00	9	273.74	0.00	0.00	0.00
63.00	0.00	8	273.63	0.00	0.00	0.00
66.00	0.00	7	273.52	0.00	0.00	0.00
69.00	0.00	5	273.43	0.00	0.00	0.00
72.00	0.00	4	273.33	0.00	0.00	0.00
75.00	0.00	3	273.25	0.00	0.00	0.00
78.00	0.00	2	273.16	0.00	0.00	0.00
81.00	0.00	1	273.09	0.00	0.00	0.00
84.00	0.00	1	273.04	0.00	0.00	0.00
87.00	0.00	0	273.02	0.00	0.00	0.00
90.00	0.00	0	273.01	0.00	0.00	0.00
93.00	0.00	0	273.00	0.00	0.00	0.00
96.00	0.00	0	273.00	0.00	0.00	0.00
99.00	0.00	0	273.00	0.00	0.00	0.00
102.00	0.00	0	273.00	0.00	0.00	0.00
105.00	0.00	0	273.00	0.00	0.00	0.00
108.00	0.00	0	273.00	0.00	0.00	0.00
111.00	0.00	0	273.00	0.00	0.00	0.00
114.00	0.00	0	273.00	0.00	0.00	0.00
117.00	0.00	0	273.00	0.00	0.00	0.00
120.00	0.00	0	273.00	0.00	0.00	0.00

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 100-Year Rainfall=6.70"

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Page 69

Summary for Pond 11P: CULV 28

Inflow Area = 293,222 sf, 0.00% Impervious, Inflow Depth = 3.37" for 100-Year event
 Inflow = 10.26 cfs @ 12.84 hrs, Volume= 82,360 cf
 Outflow = 10.25 cfs @ 12.85 hrs, Volume= 82,310 cf, Atten= 0%, Lag= 0.6 min
 Primary = 10.25 cfs @ 12.85 hrs, Volume= 82,310 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 6

Peak Elev= 289.32' @ 12.85 hrs Surf.Area= 499 sf Storage= 449 cf

Plug-Flow detention time= 1.4 min calculated for 82,290 cf (100% of inflow)

Center-of-Mass det. time= 1.0 min (885.7 - 884.7)

Volume	Invert	Avail.Storage	Storage Description
#1	287.00'	855 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.00	0	0	0
288.00	100	50	50
289.00	410	255	305
290.00	690	550	855

Device	Routing	Invert	Outlet Devices
#1	Primary	288.00'	30.0" Round Culvert L= 108.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 288.00' / 279.00' S= 0.0833 '/' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf
#2	Secondary	289.95'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 289.95 290.00 291.00 292.00 Width (feet) 0.00 6.00 14.00 22.00

Primary OutFlow Max=10.24 cfs @ 12.85 hrs HW=289.32' (Free Discharge)

↑1=Culvert (Inlet Controls 10.24 cfs @ 3.91 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=287.00' (Free Discharge)

↑2=Custom Weir/Orifice (Controls 0.00 cfs)

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 70

Hydrograph for Pond 11P: CULV 28

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0	287.00	0.00	0.00	0.00
3.00	0.00	0	287.00	0.00	0.00	0.00
6.00	0.00	0	287.00	0.00	0.00	0.00
9.00	0.00	1	287.13	0.00	0.00	0.00
12.00	1.54	131	288.47	1.50	1.50	0.00
15.00	1.84	145	288.52	1.84	1.84	0.00
18.00	0.76	100	288.33	0.76	0.76	0.00
21.00	0.48	87	288.26	0.48	0.48	0.00
24.00	0.36	80	288.22	0.36	0.36	0.00
27.00	0.00	50	288.00	0.00	0.00	0.00
30.00	0.00	50	288.00	0.00	0.00	0.00
33.00	0.00	50	288.00	0.00	0.00	0.00
36.00	0.00	50	288.00	0.00	0.00	0.00
39.00	0.00	50	288.00	0.00	0.00	0.00
42.00	0.00	50	288.00	0.00	0.00	0.00
45.00	0.00	50	288.00	0.00	0.00	0.00
48.00	0.00	50	288.00	0.00	0.00	0.00
51.00	0.00	50	288.00	0.00	0.00	0.00
54.00	0.00	50	288.00	0.00	0.00	0.00
57.00	0.00	50	288.00	0.00	0.00	0.00
60.00	0.00	50	288.00	0.00	0.00	0.00
63.00	0.00	50	288.00	0.00	0.00	0.00
66.00	0.00	50	288.00	0.00	0.00	0.00
69.00	0.00	50	288.00	0.00	0.00	0.00
72.00	0.00	50	288.00	0.00	0.00	0.00
75.00	0.00	50	288.00	0.00	0.00	0.00
78.00	0.00	50	288.00	0.00	0.00	0.00
81.00	0.00	50	288.00	0.00	0.00	0.00
84.00	0.00	50	288.00	0.00	0.00	0.00
87.00	0.00	50	288.00	0.00	0.00	0.00
90.00	0.00	50	288.00	0.00	0.00	0.00
93.00	0.00	50	288.00	0.00	0.00	0.00
96.00	0.00	50	288.00	0.00	0.00	0.00
99.00	0.00	50	288.00	0.00	0.00	0.00
102.00	0.00	50	288.00	0.00	0.00	0.00
105.00	0.00	50	288.00	0.00	0.00	0.00
108.00	0.00	50	288.00	0.00	0.00	0.00
111.00	0.00	50	288.00	0.00	0.00	0.00
114.00	0.00	50	288.00	0.00	0.00	0.00
117.00	0.00	50	288.00	0.00	0.00	0.00
120.00	0.00	50	288.00	0.00	0.00	0.00

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 100-Year Rainfall=6.70"

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Page 71

Summary for Pond 12P: CULV 30

Inflow Area = 738,364 sf, 0.00% Impervious, Inflow Depth = 3.37" for 100-Year event
 Inflow = 27.66 cfs @ 12.75 hrs, Volume= 207,392 cf
 Outflow = 27.57 cfs @ 12.79 hrs, Volume= 207,391 cf, Atten= 0%, Lag= 2.3 min
 Primary = 27.57 cfs @ 12.79 hrs, Volume= 207,391 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 6

Peak Elev= 283.61' @ 12.79 hrs Surf.Area= 1,196 sf Storage= 1,420 cf

Plug-Flow detention time= 0.6 min calculated for 207,339 cf (100% of inflow)

Center-of-Mass det. time= 0.6 min (878.6 - 878.1)

Volume	Invert	Avail.Storage	Storage Description
#1	281.00'	3,725 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
281.00	0	0	0
282.00	350	175	175
283.00	875	613	788
284.00	1,400	1,138	1,925
285.00	2,200	1,800	3,725

Device	Routing	Invert	Outlet Devices
#1	Primary	281.00'	30.0" Round Culvert L= 115.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 281.00' / 279.00' S= 0.0174 ' / ' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf
#2	Secondary	284.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Elev. (feet) 284.50 285.00 286.00 Width (feet) 0.00 10.00 50.00

Primary OutFlow Max=27.56 cfs @ 12.79 hrs HW=283.61' (Free Discharge)↑**1=Culvert** (Inlet Controls 27.56 cfs @ 5.61 fps)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=281.00' (Free Discharge)↑**2=Custom Weir/Orifice** (Controls 0.00 cfs)

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Page 72

Hydrograph for Pond 12P: CULV 30

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0	281.00	0.00	0.00	0.00
3.00	0.00	0	281.00	0.00	0.00	0.00
6.00	0.00	0	281.00	0.00	0.00	0.00
9.00	0.01	0	281.03	0.01	0.01	0.00
12.00	4.53	121	281.83	4.44	4.44	0.00
15.00	4.34	119	281.82	4.35	4.35	0.00
18.00	1.85	48	281.53	1.85	1.85	0.00
21.00	1.19	31	281.42	1.20	1.20	0.00
24.00	0.89	23	281.36	0.89	0.89	0.00
27.00	0.00	0	281.00	0.00	0.00	0.00
30.00	0.00	0	281.00	0.00	0.00	0.00
33.00	0.00	0	281.00	0.00	0.00	0.00
36.00	0.00	0	281.00	0.00	0.00	0.00
39.00	0.00	0	281.00	0.00	0.00	0.00
42.00	0.00	0	281.00	0.00	0.00	0.00
45.00	0.00	0	281.00	0.00	0.00	0.00
48.00	0.00	0	281.00	0.00	0.00	0.00
51.00	0.00	0	281.00	0.00	0.00	0.00
54.00	0.00	0	281.00	0.00	0.00	0.00
57.00	0.00	0	281.00	0.00	0.00	0.00
60.00	0.00	0	281.00	0.00	0.00	0.00
63.00	0.00	0	281.00	0.00	0.00	0.00
66.00	0.00	0	281.00	0.00	0.00	0.00
69.00	0.00	0	281.00	0.00	0.00	0.00
72.00	0.00	0	281.00	0.00	0.00	0.00
75.00	0.00	0	281.00	0.00	0.00	0.00
78.00	0.00	0	281.00	0.00	0.00	0.00
81.00	0.00	0	281.00	0.00	0.00	0.00
84.00	0.00	0	281.00	0.00	0.00	0.00
87.00	0.00	0	281.00	0.00	0.00	0.00
90.00	0.00	0	281.00	0.00	0.00	0.00
93.00	0.00	0	281.00	0.00	0.00	0.00
96.00	0.00	0	281.00	0.00	0.00	0.00
99.00	0.00	0	281.00	0.00	0.00	0.00
102.00	0.00	0	281.00	0.00	0.00	0.00
105.00	0.00	0	281.00	0.00	0.00	0.00
108.00	0.00	0	281.00	0.00	0.00	0.00
111.00	0.00	0	281.00	0.00	0.00	0.00
114.00	0.00	0	281.00	0.00	0.00	0.00
117.00	0.00	0	281.00	0.00	0.00	0.00
120.00	0.00	0	281.00	0.00	0.00	0.00

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 73

Summary for Link 1L: PreDeveloped

Inflow Area = 4,509,547 sf, 0.00% Impervious, Inflow Depth = 3.37" for 100-Year event

Inflow = 122.12 cfs @ 13.18 hrs, Volume= 1,266,642 cf

Primary = 122.12 cfs @ 13.18 hrs, Volume= 1,266,642 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 74

Hydrograph for Link 1L: PreDeveloped

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	81.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00	82.50	0.00	0.00	0.00
3.00	0.00	0.00	0.00	84.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00	85.50	0.00	0.00	0.00
6.00	0.00	0.00	0.00	87.00	0.00	0.00	0.00
7.50	0.00	0.00	0.00	88.50	0.00	0.00	0.00
9.00	0.01	0.00	0.01	90.00	0.00	0.00	0.00
10.50	2.37	0.00	2.37	91.50	0.00	0.00	0.00
12.00	14.73	0.00	14.73	93.00	0.00	0.00	0.00
13.50	111.06	0.00	111.06	94.50	0.00	0.00	0.00
15.00	38.05	0.00	38.05	96.00	0.00	0.00	0.00
16.50	20.63	0.00	20.63	97.50	0.00	0.00	0.00
18.00	13.08	0.00	13.08	99.00	0.00	0.00	0.00
19.50	9.33	0.00	9.33	100.50	0.00	0.00	0.00
21.00	7.74	0.00	7.74	102.00	0.00	0.00	0.00
22.50	6.70	0.00	6.70	103.50	0.00	0.00	0.00
24.00	5.75	0.00	5.75	105.00	0.00	0.00	0.00
25.50	1.84	0.00	1.84	106.50	0.00	0.00	0.00
27.00	0.16	0.00	0.16	108.00	0.00	0.00	0.00
28.50	0.01	0.00	0.01	109.50	0.00	0.00	0.00
30.00	0.00	0.00	0.00	111.00	0.00	0.00	0.00
31.50	0.00	0.00	0.00	112.50	0.00	0.00	0.00
33.00	0.00	0.00	0.00	114.00	0.00	0.00	0.00
34.50	0.00	0.00	0.00	115.50	0.00	0.00	0.00
36.00	0.00	0.00	0.00	117.00	0.00	0.00	0.00
37.50	0.00	0.00	0.00	118.50	0.00	0.00	0.00
39.00	0.00	0.00	0.00	120.00	0.00	0.00	0.00
40.50	0.00	0.00	0.00				
42.00	0.00	0.00	0.00				
43.50	0.00	0.00	0.00				
45.00	0.00	0.00	0.00				
46.50	0.00	0.00	0.00				
48.00	0.00	0.00	0.00				
49.50	0.00	0.00	0.00				
51.00	0.00	0.00	0.00				
52.50	0.00	0.00	0.00				
54.00	0.00	0.00	0.00				
55.50	0.00	0.00	0.00				
57.00	0.00	0.00	0.00				
58.50	0.00	0.00	0.00				
60.00	0.00	0.00	0.00				
61.50	0.00	0.00	0.00				
63.00	0.00	0.00	0.00				
64.50	0.00	0.00	0.00				
66.00	0.00	0.00	0.00				
67.50	0.00	0.00	0.00				
69.00	0.00	0.00	0.00				
70.50	0.00	0.00	0.00				
72.00	0.00	0.00	0.00				
73.50	0.00	0.00	0.00				
75.00	0.00	0.00	0.00				
76.50	0.00	0.00	0.00				
78.00	0.00	0.00	0.00				
79.50	0.00	0.00	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 75

Summary for Link 10L: PostDeveloped

Inflow Area = 2,540,135 sf, 2.04% Impervious, Inflow Depth = 3.30" for 100-Year event
Inflow = 43.23 cfs @ 12.29 hrs, Volume= 698,638 cf
Primary = 43.23 cfs @ 12.29 hrs, Volume= 698,638 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 76

Hydrograph for Link 10L: PostDeveloped

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	81.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00	82.50	0.00	0.00	0.00
3.00	0.00	0.00	0.00	84.00	0.00	0.00	0.00
4.50	0.05	0.00	0.05	85.50	0.00	0.00	0.00
6.00	0.10	0.00	0.10	87.00	0.00	0.00	0.00
7.50	0.18	0.00	0.18	88.50	0.00	0.00	0.00
9.00	0.46	0.00	0.46	90.00	0.00	0.00	0.00
10.50	2.29	0.00	2.29	91.50	0.00	0.00	0.00
12.00	20.73	0.00	20.73	93.00	0.00	0.00	0.00
13.50	33.01	0.00	33.01	94.50	0.00	0.00	0.00
15.00	18.75	0.00	18.75	96.00	0.00	0.00	0.00
16.50	13.78	0.00	13.78	97.50	0.00	0.00	0.00
18.00	10.47	0.00	10.47	99.00	0.00	0.00	0.00
19.50	8.10	0.00	8.10	100.50	0.00	0.00	0.00
21.00	6.40	0.00	6.40	102.00	0.00	0.00	0.00
22.50	5.05	0.00	5.05	103.50	0.00	0.00	0.00
24.00	3.96	0.00	3.96	105.00	0.00	0.00	0.00
25.50	1.62	0.00	1.62	106.50	0.00	0.00	0.00
27.00	0.62	0.00	0.62	108.00	0.00	0.00	0.00
28.50	0.07	0.00	0.07	109.50	0.00	0.00	0.00
30.00	0.00	0.00	0.00	111.00	0.00	0.00	0.00
31.50	0.00	0.00	0.00	112.50	0.00	0.00	0.00
33.00	0.00	0.00	0.00	114.00	0.00	0.00	0.00
34.50	0.00	0.00	0.00	115.50	0.00	0.00	0.00
36.00	0.00	0.00	0.00	117.00	0.00	0.00	0.00
37.50	0.00	0.00	0.00	118.50	0.00	0.00	0.00
39.00	0.00	0.00	0.00	120.00	0.00	0.00	0.00
40.50	0.00	0.00	0.00				
42.00	0.00	0.00	0.00				
43.50	0.00	0.00	0.00				
45.00	0.00	0.00	0.00				
46.50	0.00	0.00	0.00				
48.00	0.00	0.00	0.00				
49.50	0.00	0.00	0.00				
51.00	0.00	0.00	0.00				
52.50	0.00	0.00	0.00				
54.00	0.00	0.00	0.00				
55.50	0.00	0.00	0.00				
57.00	0.00	0.00	0.00				
58.50	0.00	0.00	0.00				
60.00	0.00	0.00	0.00				
61.50	0.00	0.00	0.00				
63.00	0.00	0.00	0.00				
64.50	0.00	0.00	0.00				
66.00	0.00	0.00	0.00				
67.50	0.00	0.00	0.00				
69.00	0.00	0.00	0.00				
70.50	0.00	0.00	0.00				
72.00	0.00	0.00	0.00				
73.50	0.00	0.00	0.00				
75.00	0.00	0.00	0.00				
76.50	0.00	0.00	0.00				
78.00	0.00	0.00	0.00				
79.50	0.00	0.00	0.00				

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 77

Summary for Link 11L: Total Post Developed

Inflow Area = 4,510,192 sf, 1.15% Impervious, Inflow Depth = 3.33" for 100-Year event
Inflow = 98.87 cfs @ 13.05 hrs, Volume= 1,251,988 cf
Primary = 98.87 cfs @ 13.05 hrs, Volume= 1,251,988 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs

3520 HOPPING BK RD PHASE1 Undev cn*Type III 24-hr 100-Year Rainfall=6.70"*

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Page 78

Hydrograph for Link 11L: Total Post Developed

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	81.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00	82.50	0.00	0.00	0.00
3.00	0.00	0.00	0.00	84.00	0.00	0.00	0.00
4.50	0.05	0.00	0.05	85.50	0.00	0.00	0.00
6.00	0.10	0.00	0.10	87.00	0.00	0.00	0.00
7.50	0.18	0.00	0.18	88.50	0.00	0.00	0.00
9.00	0.47	0.00	0.47	90.00	0.00	0.00	0.00
10.50	3.52	0.00	3.52	91.50	0.00	0.00	0.00
12.00	28.20	0.00	28.20	93.00	0.00	0.00	0.00
13.50	80.15	0.00	80.15	94.50	0.00	0.00	0.00
15.00	33.50	0.00	33.50	96.00	0.00	0.00	0.00
16.50	22.11	0.00	22.11	97.50	0.00	0.00	0.00
18.00	15.92	0.00	15.92	99.00	0.00	0.00	0.00
19.50	12.04	0.00	12.04	100.50	0.00	0.00	0.00
21.00	9.71	0.00	9.71	102.00	0.00	0.00	0.00
22.50	7.93	0.00	7.93	103.50	0.00	0.00	0.00
24.00	6.42	0.00	6.42	105.00	0.00	0.00	0.00
25.50	2.19	0.00	2.19	106.50	0.00	0.00	0.00
27.00	0.66	0.00	0.66	108.00	0.00	0.00	0.00
28.50	0.07	0.00	0.07	109.50	0.00	0.00	0.00
30.00	0.00	0.00	0.00	111.00	0.00	0.00	0.00
31.50	0.00	0.00	0.00	112.50	0.00	0.00	0.00
33.00	0.00	0.00	0.00	114.00	0.00	0.00	0.00
34.50	0.00	0.00	0.00	115.50	0.00	0.00	0.00
36.00	0.00	0.00	0.00	117.00	0.00	0.00	0.00
37.50	0.00	0.00	0.00	118.50	0.00	0.00	0.00
39.00	0.00	0.00	0.00	120.00	0.00	0.00	0.00
40.50	0.00	0.00	0.00				
42.00	0.00	0.00	0.00				
43.50	0.00	0.00	0.00				
45.00	0.00	0.00	0.00				
46.50	0.00	0.00	0.00				
48.00	0.00	0.00	0.00				
49.50	0.00	0.00	0.00				
51.00	0.00	0.00	0.00				
52.50	0.00	0.00	0.00				
54.00	0.00	0.00	0.00				
55.50	0.00	0.00	0.00				
57.00	0.00	0.00	0.00				
58.50	0.00	0.00	0.00				
60.00	0.00	0.00	0.00				
61.50	0.00	0.00	0.00				
63.00	0.00	0.00	0.00				
64.50	0.00	0.00	0.00				
66.00	0.00	0.00	0.00				
67.50	0.00	0.00	0.00				
69.00	0.00	0.00	0.00				
70.50	0.00	0.00	0.00				
72.00	0.00	0.00	0.00				
73.50	0.00	0.00	0.00				
75.00	0.00	0.00	0.00				
76.50	0.00	0.00	0.00				
78.00	0.00	0.00	0.00				
79.50	0.00	0.00	0.00				

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 2-Year Rainfall=3.20"

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Page 1

Summary for Pond 10P: DB1

Inflow Area = 1,209,251 sf, 2.63% Impervious, Inflow Depth = 0.93" for 2-Year event
 Inflow = 9.11 cfs @ 12.84 hrs, Volume= 93,471 cf
 Outflow = 3.45 cfs @ 14.02 hrs, Volume= 93,440 cf, Atten= 62%, Lag= 70.7 min
 Primary = 3.45 cfs @ 14.02 hrs, Volume= 93,440 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 3
 Peak Elev= 277.14' @ 14.02 hrs Surf.Area= 38,869 sf Storage= 30,725 cf

Plug-Flow detention time= 121.5 min calculated for 93,440 cf (100% of inflow)
 Center-of-Mass det. time= 121.2 min (1,021.5 - 900.3)

Volume	Invert	Avail.Storage	Storage Description
#1	275.50'	493,204 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	273.00'	113 cf	4.00'D x 9.00'H Vertical Cone/Cylinder
		493,317 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
275.50	0	0.0	0	0	0
276.00	12,880	650.0	2,147	2,147	33,622
277.00	35,500	1,100.0	23,254	25,401	96,295
278.00	62,400	1,310.0	48,322	73,723	136,587
279.00	78,375	1,380.0	70,236	143,959	151,632
280.00	83,150	1,400.0	80,751	224,710	156,270
283.00	96,000	1,500.0	268,494	493,204	179,754

Device	Routing	Invert	Outlet Devices
#1	Primary	273.00'	24.0" Round Culvert L= 90.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 273.00' / 265.80' S= 0.0800 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	275.50'	0.5' long x 3.84' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#3	Device 1	279.34'	2.8' long x 2.66' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#4	Primary	282.30'	6.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=3.44 cfs @ 14.02 hrs HW=277.14' (Free Discharge)

- 1=Culvert (Passes 3.44 cfs of 26.81 cfs potential flow)
- 2=Sharp-Crested Vee/Trap Weir (Weir Controls 3.44 cfs @ 4.20 fps)
- 3=Sharp-Crested Vee/Trap Weir (Controls 0.00 cfs)
- 4=Emergency Spillway (Controls 0.00 cfs)

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 2-Year Rainfall=3.20"

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Page 2

Hydrograph for Pond 10P: DB1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	273.00	0.00	81.00	0.00	31	275.50	0.00
1.50	0.00	0	273.00	0.00	82.50	0.00	31	275.50	0.00
3.00	0.00	0	273.00	0.00	84.00	0.00	31	275.50	0.00
4.50	0.00	0	273.00	0.00	85.50	0.00	31	275.50	0.00
6.00	0.01	15	274.23	0.00	87.00	0.00	31	275.50	0.00
7.50	0.03	41	275.55	0.03	88.50	0.00	31	275.50	0.00
9.00	0.07	63	275.61	0.06	90.00	0.00	31	275.50	0.00
10.50	0.17	159	275.69	0.14	91.50	0.00	31	275.50	0.00
12.00	4.17	2,537	276.03	0.63	93.00	0.00	31	275.50	0.00
13.50	5.23	29,248	277.10	3.32	94.50	0.00	31	275.50	0.00
15.00	2.26	28,528	277.08	3.26	96.00	0.00	31	275.50	0.00
16.50	1.46	22,183	276.90	2.72	97.50	0.00	31	275.50	0.00
18.00	1.01	15,667	276.69	2.12	99.00	0.00	31	275.50	0.00
19.50	0.78	10,462	276.48	1.58	100.50	0.00	31	275.50	0.00
21.00	0.68	6,985	276.31	1.19	102.00	0.00	31	275.50	0.00
22.50	0.59	4,782	276.18	0.92	103.50	0.00	31	275.50	0.00
24.00	0.51	3,330	276.08	0.73	105.00	0.00	31	275.50	0.00
25.50	0.04	1,329	275.92	0.44	106.50	0.00	31	275.50	0.00
27.00	0.00	53	275.60	0.05	108.00	0.00	31	275.50	0.00
28.50	0.00	31	275.50	0.00	109.50	0.00	31	275.50	0.00
30.00	0.00	31	275.50	0.00	111.00	0.00	31	275.50	0.00
31.50	0.00	31	275.50	0.00	112.50	0.00	31	275.50	0.00
33.00	0.00	31	275.50	0.00	114.00	0.00	31	275.50	0.00
34.50	0.00	31	275.50	0.00	115.50	0.00	31	275.50	0.00
36.00	0.00	31	275.50	0.00	117.00	0.00	31	275.50	0.00
37.50	0.00	31	275.50	0.00	118.50	0.00	31	275.50	0.00
39.00	0.00	31	275.50	0.00	120.00	0.00	31	275.50	0.00
40.50	0.00	31	275.50	0.00					
42.00	0.00	31	275.50	0.00					
43.50	0.00	31	275.50	0.00					
45.00	0.00	31	275.50	0.00					
46.50	0.00	31	275.50	0.00					
48.00	0.00	31	275.50	0.00					
49.50	0.00	31	275.50	0.00					
51.00	0.00	31	275.50	0.00					
52.50	0.00	31	275.50	0.00					
54.00	0.00	31	275.50	0.00					
55.50	0.00	31	275.50	0.00					
57.00	0.00	31	275.50	0.00					
58.50	0.00	31	275.50	0.00					
60.00	0.00	31	275.50	0.00					
61.50	0.00	31	275.50	0.00					
63.00	0.00	31	275.50	0.00					
64.50	0.00	31	275.50	0.00					
66.00	0.00	31	275.50	0.00					
67.50	0.00	31	275.50	0.00					
69.00	0.00	31	275.50	0.00					
70.50	0.00	31	275.50	0.00					
72.00	0.00	31	275.50	0.00					
73.50	0.00	31	275.50	0.00					
75.00	0.00	31	275.50	0.00					
76.50	0.00	31	275.50	0.00					
78.00	0.00	31	275.50	0.00					
79.50	0.00	31	275.50	0.00					

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 10-Year Rainfall=4.70"

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Page 3

Summary for Pond 10P: DB1

Inflow Area = 1,209,251 sf, 2.63% Impervious, Inflow Depth = 1.95" for 10-Year event
 Inflow = 21.28 cfs @ 12.81 hrs, Volume= 196,488 cf
 Outflow = 6.69 cfs @ 14.06 hrs, Volume= 196,456 cf, Atten= 69%, Lag= 75.0 min
 Primary = 6.69 cfs @ 14.06 hrs, Volume= 196,456 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 3
 Peak Elev= 278.06' @ 14.06 hrs Surf.Area= 63,249 sf Storage= 77,262 cf

Plug-Flow detention time= 158.7 min calculated for 196,407 cf (100% of inflow)
 Center-of-Mass det. time= 158.6 min (1,039.7 - 881.1)

Volume	Invert	Avail.Storage	Storage Description
#1	275.50'	493,204 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	273.00'	113 cf	4.00'D x 9.00'H Vertical Cone/Cylinder
		493,317 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
275.50	0	0.0	0	0	0
276.00	12,880	650.0	2,147	2,147	33,622
277.00	35,500	1,100.0	23,254	25,401	96,295
278.00	62,400	1,310.0	48,322	73,723	136,587
279.00	78,375	1,380.0	70,236	143,959	151,632
280.00	83,150	1,400.0	80,751	224,710	156,270
283.00	96,000	1,500.0	268,494	493,204	179,754

Device	Routing	Invert	Outlet Devices
#1	Primary	273.00'	24.0" Round Culvert L= 90.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 273.00' / 265.80' S= 0.0800 ' / ' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	275.50'	0.5' long x 3.84' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#3	Device 1	279.34'	2.8' long x 2.66' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#4	Primary	282.30'	6.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.69 cfs @ 14.06 hrs HW=278.06' (Free Discharge)

- 1=Culvert (Passes 6.69 cfs of 30.46 cfs potential flow)
- 2=Sharp-Crested Vee/Trap Weir (Weir Controls 6.69 cfs @ 5.24 fps)
- 3=Sharp-Crested Vee/Trap Weir (Controls 0.00 cfs)
- 4=Emergency Spillway (Controls 0.00 cfs)

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 10-Year Rainfall=4.70"

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Page 4

Hydrograph for Pond 10P: DB1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	273.00	0.00	81.00	0.00	31	275.50	0.00
1.50	0.00	0	273.00	0.00	82.50	0.00	31	275.50	0.00
3.00	0.00	0	273.00	0.00	84.00	0.00	31	275.50	0.00
4.50	0.01	17	274.32	0.00	85.50	0.00	31	275.50	0.00
6.00	0.03	42	275.56	0.03	87.00	0.00	31	275.50	0.00
7.50	0.07	62	275.61	0.06	88.50	0.00	31	275.50	0.00
9.00	0.15	146	275.68	0.13	90.00	0.00	31	275.50	0.00
10.50	0.43	517	275.80	0.27	91.50	0.00	31	275.50	0.00
12.00	9.67	8,271	276.37	1.33	93.00	0.00	31	275.50	0.00
13.50	10.99	73,514	278.00	6.46	94.50	0.00	31	275.50	0.00
15.00	4.29	72,813	277.98	6.41	96.00	0.00	31	275.50	0.00
16.50	2.70	58,999	277.75	5.52	97.50	0.00	31	275.50	0.00
18.00	1.85	44,081	277.45	4.47	99.00	0.00	31	275.50	0.00
19.50	1.42	31,265	277.15	3.49	100.50	0.00	31	275.50	0.00
21.00	1.22	21,781	276.89	2.69	102.00	0.00	31	275.50	0.00
22.50	1.06	15,183	276.67	2.07	103.50	0.00	31	275.50	0.00
24.00	0.91	10,662	276.48	1.60	105.00	0.00	31	275.50	0.00
25.50	0.06	5,740	276.24	1.03	106.50	0.00	31	275.50	0.00
27.00	0.00	1,753	275.96	0.51	108.00	0.00	31	275.50	0.00
28.50	0.00	107	275.65	0.10	109.50	0.00	31	275.50	0.00
30.00	0.00	31	275.50	0.00	111.00	0.00	31	275.50	0.00
31.50	0.00	31	275.50	0.00	112.50	0.00	31	275.50	0.00
33.00	0.00	31	275.50	0.00	114.00	0.00	31	275.50	0.00
34.50	0.00	31	275.50	0.00	115.50	0.00	31	275.50	0.00
36.00	0.00	31	275.50	0.00	117.00	0.00	31	275.50	0.00
37.50	0.00	31	275.50	0.00	118.50	0.00	31	275.50	0.00
39.00	0.00	31	275.50	0.00	120.00	0.00	31	275.50	0.00
40.50	0.00	31	275.50	0.00					
42.00	0.00	31	275.50	0.00					
43.50	0.00	31	275.50	0.00					
45.00	0.00	31	275.50	0.00					
46.50	0.00	31	275.50	0.00					
48.00	0.00	31	275.50	0.00					
49.50	0.00	31	275.50	0.00					
51.00	0.00	31	275.50	0.00					
52.50	0.00	31	275.50	0.00					
54.00	0.00	31	275.50	0.00					
55.50	0.00	31	275.50	0.00					
57.00	0.00	31	275.50	0.00					
58.50	0.00	31	275.50	0.00					
60.00	0.00	31	275.50	0.00					
61.50	0.00	31	275.50	0.00					
63.00	0.00	31	275.50	0.00					
64.50	0.00	31	275.50	0.00					
66.00	0.00	31	275.50	0.00					
67.50	0.00	31	275.50	0.00					
69.00	0.00	31	275.50	0.00					
70.50	0.00	31	275.50	0.00					
72.00	0.00	31	275.50	0.00					
73.50	0.00	31	275.50	0.00					
75.00	0.00	31	275.50	0.00					
76.50	0.00	31	275.50	0.00					
78.00	0.00	31	275.50	0.00					
79.50	0.00	31	275.50	0.00					

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 25-Year Rainfall=5.50"

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Page 5

Summary for Pond 10P: DB1

Inflow Area = 1,209,251 sf, 2.63% Impervious, Inflow Depth = 2.56" for 25-Year event
 Inflow = 28.56 cfs @ 12.80 hrs, Volume= 258,102 cf
 Outflow = 8.50 cfs @ 14.07 hrs, Volume= 258,070 cf, Atten= 70%, Lag= 76.4 min
 Primary = 8.50 cfs @ 14.07 hrs, Volume= 258,070 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 3
 Peak Elev= 278.50' @ 14.07 hrs Surf.Area= 70,151 sf Storage= 106,817 cf

Plug-Flow detention time= 173.8 min calculated for 258,070 cf (100% of inflow)
 Center-of-Mass det. time= 173.7 min (1,047.8 - 874.1)

Volume	Invert	Avail.Storage	Storage Description
#1	275.50'	493,204 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	273.00'	113 cf	4.00'D x 9.00'H Vertical Cone/Cylinder
		493,317 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
275.50	0	0.0	0	0	0
276.00	12,880	650.0	2,147	2,147	33,622
277.00	35,500	1,100.0	23,254	25,401	96,295
278.00	62,400	1,310.0	48,322	73,723	136,587
279.00	78,375	1,380.0	70,236	143,959	151,632
280.00	83,150	1,400.0	80,751	224,710	156,270
283.00	96,000	1,500.0	268,494	493,204	179,754

Device	Routing	Invert	Outlet Devices
#1	Primary	273.00'	24.0" Round Culvert L= 90.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 273.00' / 265.80' S= 0.0800 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	275.50'	0.5' long x 3.84' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#3	Device 1	279.34'	2.8' long x 2.66' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#4	Primary	282.30'	6.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=8.50 cfs @ 14.07 hrs HW=278.50' (Free Discharge)

- 1=Culvert (Passes 8.50 cfs of 32.08 cfs potential flow)
- 2=Sharp-Crested Vee/Trap Weir (Weir Controls 8.50 cfs @ 5.67 fps)
- 3=Sharp-Crested Vee/Trap Weir (Controls 0.00 cfs)
- 4=Emergency Spillway (Controls 0.00 cfs)

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 25-Year Rainfall=5.50"

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Page 6

Hydrograph for Pond 10P: DB1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	273.00	0.00	81.00	0.00	31	275.50	0.00
1.50	0.00	0	273.00	0.00	82.50	0.00	31	275.50	0.00
3.00	0.00	0	273.00	0.00	84.00	0.00	31	275.50	0.00
4.50	0.02	38	275.53	0.02	85.50	0.00	31	275.50	0.00
6.00	0.05	47	275.59	0.04	87.00	0.00	31	275.50	0.00
7.50	0.10	89	275.63	0.08	88.50	0.00	31	275.50	0.00
9.00	0.22	212	275.71	0.16	90.00	0.00	31	275.50	0.00
10.50	0.84	1,034	275.88	0.39	91.50	0.00	31	275.50	0.00
12.00	13.03	13,073	276.59	1.86	93.00	0.00	31	275.50	0.00
13.50	14.33	101,649	278.42	8.19	94.50	0.00	31	275.50	0.00
15.00	5.42	101,136	278.42	8.16	96.00	0.00	31	275.50	0.00
16.50	3.39	83,231	278.15	7.06	97.50	0.00	31	275.50	0.00
18.00	2.32	63,559	277.83	5.82	99.00	0.00	31	275.50	0.00
19.50	1.77	46,171	277.50	4.63	100.50	0.00	31	275.50	0.00
21.00	1.52	32,869	277.20	3.62	102.00	0.00	31	275.50	0.00
22.50	1.32	23,262	276.94	2.82	103.50	0.00	31	275.50	0.00
24.00	1.13	16,424	276.71	2.19	105.00	0.00	31	275.50	0.00
25.50	0.08	9,329	276.42	1.45	106.50	0.00	31	275.50	0.00
27.00	0.00	3,585	276.10	0.76	108.00	0.00	31	275.50	0.00
28.50	0.00	710	275.83	0.32	109.50	0.00	31	275.50	0.00
30.00	0.00	32	275.50	0.00	111.00	0.00	31	275.50	0.00
31.50	0.00	31	275.50	0.00	112.50	0.00	31	275.50	0.00
33.00	0.00	31	275.50	0.00	114.00	0.00	31	275.50	0.00
34.50	0.00	31	275.50	0.00	115.50	0.00	31	275.50	0.00
36.00	0.00	31	275.50	0.00	117.00	0.00	31	275.50	0.00
37.50	0.00	31	275.50	0.00	118.50	0.00	31	275.50	0.00
39.00	0.00	31	275.50	0.00	120.00	0.00	31	275.50	0.00
40.50	0.00	31	275.50	0.00					
42.00	0.00	31	275.50	0.00					
43.50	0.00	31	275.50	0.00					
45.00	0.00	31	275.50	0.00					
46.50	0.00	31	275.50	0.00					
48.00	0.00	31	275.50	0.00					
49.50	0.00	31	275.50	0.00					
51.00	0.00	31	275.50	0.00					
52.50	0.00	31	275.50	0.00					
54.00	0.00	31	275.50	0.00					
55.50	0.00	31	275.50	0.00					
57.00	0.00	31	275.50	0.00					
58.50	0.00	31	275.50	0.00					
60.00	0.00	31	275.50	0.00					
61.50	0.00	31	275.50	0.00					
63.00	0.00	31	275.50	0.00					
64.50	0.00	31	275.50	0.00					
66.00	0.00	31	275.50	0.00					
67.50	0.00	31	275.50	0.00					
69.00	0.00	31	275.50	0.00					
70.50	0.00	31	275.50	0.00					
72.00	0.00	31	275.50	0.00					
73.50	0.00	31	275.50	0.00					
75.00	0.00	31	275.50	0.00					
76.50	0.00	31	275.50	0.00					
78.00	0.00	31	275.50	0.00					
79.50	0.00	31	275.50	0.00					

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 100-Year Rainfall=6.70"

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Page 7

Summary for Pond 10P: DB1

Inflow Area = 1,209,251 sf, 2.63% Impervious, Inflow Depth = 3.53" for 100-Year event
 Inflow = 40.06 cfs @ 12.80 hrs, Volume= 356,191 cf
 Outflow = 11.36 cfs @ 14.07 hrs, Volume= 356,159 cf, Atten= 72%, Lag= 76.6 min
 Primary = 11.36 cfs @ 14.07 hrs, Volume= 356,159 cf

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.03 hrs / 3
 Peak Elev= 279.14' @ 14.07 hrs Surf.Area= 79,033 sf Storage= 154,817 cf

Plug-Flow detention time= 191.1 min calculated for 356,070 cf (100% of inflow)
 Center-of-Mass det. time= 191.1 min (1,056.8 - 865.8)

Volume	Invert	Avail.Storage	Storage Description
#1	275.50'	493,204 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	273.00'	113 cf	4.00'D x 9.00'H Vertical Cone/Cylinder
		493,317 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
275.50	0	0.0	0	0	0
276.00	12,880	650.0	2,147	2,147	33,622
277.00	35,500	1,100.0	23,254	25,401	96,295
278.00	62,400	1,310.0	48,322	73,723	136,587
279.00	78,375	1,380.0	70,236	143,959	151,632
280.00	83,150	1,400.0	80,751	224,710	156,270
283.00	96,000	1,500.0	268,494	493,204	179,754

Device	Routing	Invert	Outlet Devices
#1	Primary	273.00'	24.0" Round Culvert L= 90.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 273.00' / 265.80' S= 0.0800 ' / ' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	275.50'	0.5' long x 3.84' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#3	Device 1	279.34'	2.8' long x 2.66' rise Sharp-Crested Vee/Trap Weir Cv= 2.62 (C= 3.28)
#4	Primary	282.30'	6.0' long x 10.0' breadth Emergency Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=11.36 cfs @ 14.07 hrs HW=279.14' (Free Discharge)

- 1=Culvert (Passes 11.36 cfs of 34.28 cfs potential flow)
- 2=Sharp-Crested Vee/Trap Weir (Weir Controls 11.36 cfs @ 6.25 fps)
- 3=Sharp-Crested Vee/Trap Weir (Controls 0.00 cfs)
- 4=Emergency Spillway (Controls 0.00 cfs)

3520 HOPPING BK RD PHASE1 Undev cn

Type III 24-hr 100-Year Rainfall=6.70"

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Page 8

Hydrograph for Pond 10P: DB1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	273.00	0.00	81.00	0.00	31	275.50	0.00
1.50	0.00	0	273.00	0.00	82.50	0.00	31	275.50	0.00
3.00	0.01	4	273.30	0.00	84.00	0.00	31	275.50	0.00
4.50	0.04	44	275.57	0.03	85.50	0.00	31	275.50	0.00
6.00	0.07	64	275.61	0.06	87.00	0.00	31	275.50	0.00
7.50	0.13	135	275.67	0.12	88.50	0.00	31	275.50	0.00
9.00	0.35	416	275.77	0.24	90.00	0.00	31	275.50	0.00
10.50	1.72	2,898	276.05	0.67	91.50	0.00	31	275.50	0.00
12.00	18.42	21,976	276.90	2.71	93.00	0.00	31	275.50	0.00
13.50	19.51	147,589	279.05	10.93	94.50	0.00	31	275.50	0.00
15.00	7.14	147,031	279.04	10.90	96.00	0.00	31	275.50	0.00
16.50	4.43	122,513	278.72	9.45	97.50	0.00	31	275.50	0.00
18.00	3.02	95,622	278.34	7.82	99.00	0.00	31	275.50	0.00
19.50	2.30	71,513	277.96	6.33	100.50	0.00	31	275.50	0.00
21.00	1.97	52,340	277.62	5.06	102.00	0.00	31	275.50	0.00
22.50	1.72	37,897	277.32	4.01	103.50	0.00	31	275.50	0.00
24.00	1.46	27,212	277.05	3.16	105.00	0.00	31	275.50	0.00
25.50	0.10	16,371	276.71	2.19	106.50	0.00	31	275.50	0.00
27.00	0.00	7,416	276.33	1.24	108.00	0.00	31	275.50	0.00
28.50	0.00	2,540	276.03	0.63	109.50	0.00	31	275.50	0.00
30.00	0.00	316	275.74	0.20	111.00	0.00	31	275.50	0.00
31.50	0.00	31	275.50	0.00	112.50	0.00	31	275.50	0.00
33.00	0.00	31	275.50	0.00	114.00	0.00	31	275.50	0.00
34.50	0.00	31	275.50	0.00	115.50	0.00	31	275.50	0.00
36.00	0.00	31	275.50	0.00	117.00	0.00	31	275.50	0.00
37.50	0.00	31	275.50	0.00	118.50	0.00	31	275.50	0.00
39.00	0.00	31	275.50	0.00	120.00	0.00	31	275.50	0.00
40.50	0.00	31	275.50	0.00					
42.00	0.00	31	275.50	0.00					
43.50	0.00	31	275.50	0.00					
45.00	0.00	31	275.50	0.00					
46.50	0.00	31	275.50	0.00					
48.00	0.00	31	275.50	0.00					
49.50	0.00	31	275.50	0.00					
51.00	0.00	31	275.50	0.00					
52.50	0.00	31	275.50	0.00					
54.00	0.00	31	275.50	0.00					
55.50	0.00	31	275.50	0.00					
57.00	0.00	31	275.50	0.00					
58.50	0.00	31	275.50	0.00					
60.00	0.00	31	275.50	0.00					
61.50	0.00	31	275.50	0.00					
63.00	0.00	31	275.50	0.00					
64.50	0.00	31	275.50	0.00					
66.00	0.00	31	275.50	0.00					
67.50	0.00	31	275.50	0.00					
69.00	0.00	31	275.50	0.00					
70.50	0.00	31	275.50	0.00					
72.00	0.00	31	275.50	0.00					
73.50	0.00	31	275.50	0.00					
75.00	0.00	31	275.50	0.00					
76.50	0.00	31	275.50	0.00					
78.00	0.00	31	275.50	0.00					
79.50	0.00	31	275.50	0.00					

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: Hopping Brook Rd.

A	B	C	D	E
BMP ¹	TSS Removal Rate ¹	Starting TSS Load*	Amount Removed (B*C)	Remaining Load (C-D)
Deep Sump CB	.25	1.00	.25	.75
Sediment Forebay	.25	.75	.19	.56
W/FILTRATION Extended Det.	.80	.56	.45	.11

Separate Form Needs to
be Completed for Each
Outlet or BMP Train

Total TSS Removal =

89%

Project: 3520

Prepared By: WH

Date: 10-4-16

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

Project: Hopping Brook Road
Location: Holliston, MA
Prepared For: Walter Lewinski - Engineering Design Consultants, Inc.



Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1.0" of runoff.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Given:

Structure Name	Impv. (acres)	A (miles ²)	t _c (min)	t _c (hr)	WQV (in)
CDS-16	0.21	0.0003229	6.0	0.100	1.00
CDS-22	0.94	0.0014675	6.0	0.100	1.00

Procedure:

Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the t_c, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi²/watershed inches (csm/in).

Structure Name	qu (csm/in.)
CDS-16	774.00
CDS-22	774.00

1. Compute Q Rate using the following equation:

$$Q_1 = (qu) (A) (WQV)$$

where:

Q₁ = flow rate associated with first 1.0" of runoff

qu = the unit peak discharge, in csm/in.

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1.0" in this case)

Structure Name	Q ₁ (cfs)
CDS-16	0.25
CDS-22	1.14

CDS ESTIMATED NET ANNUAL TSS REDUCTION BASED ON THE RATIONAL RAINFALL METHOD



HOPPING BROOK ROAD HOLLISTON, MA for SYSTEM: CDS-16

Area 0.21 acres
Weighted C 0.90
Tc 6 minutes

CDS Model
2015-4
CDS Treatment Capacity
1.4 cfs

<u>Rainfall Intensity¹</u> <u>(in/hr)</u>	<u>Percent Rainfall Volume¹</u>	<u>Cumulative Rainfall Volume</u>	<u>Total Flowrate (cfs)</u>	<u>Treated Flowrate (cfs)</u>	<u>Removal Efficiency (%)</u>	<u>Incremental Removal (%)</u>
0.02	10.2%	10.2%	0.00	0.00	97.0	9.9
0.04	9.6%	19.8%	0.01	0.01	96.8	9.3
0.06	9.4%	29.3%	0.01	0.01	96.7	9.1
0.08	7.7%	37.0%	0.02	0.02	96.5	7.5
0.10	8.6%	45.6%	0.02	0.02	96.3	8.3
0.12	6.3%	51.9%	0.02	0.02	96.1	6.1
0.14	4.7%	56.5%	0.03	0.03	95.9	4.5
0.16	4.6%	61.2%	0.03	0.03	95.7	4.4
0.18	3.5%	64.7%	0.03	0.03	95.6	3.4
0.20	4.3%	69.1%	0.04	0.04	95.4	4.1
0.25	8.0%	77.1%	0.05	0.05	94.9	7.6
0.30	5.6%	82.7%	0.06	0.06	94.5	5.3
0.35	4.4%	87.0%	0.07	0.07	94.0	4.1
0.40	2.5%	89.5%	0.08	0.08	93.5	2.4
0.45	2.5%	92.1%	0.09	0.09	93.1	2.4
0.50	1.4%	93.5%	0.09	0.09	92.6	1.3
0.75	5.0%	98.5%	0.14	0.14	90.3	4.6
1.00	1.0%	99.5%	0.19	0.19	88.0	0.9
1.50	0.0%	99.5%	0.28	0.28	83.4	0.0
2.00	0.0%	99.5%	0.38	0.38	78.8	0.0
3.00	0.5%	100.0%	0.57	0.57	69.6	0.3
						95.3
Removal Efficiency Adjustment ² =						6.5%
Predicted % Annual Rainfall Treated =						93.5%
Predicted Net Annual Load Removal Efficiency =						88.9%

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

**CDS ESTIMATED NET ANNUAL TSS REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD**



**HOPPING BROOK ROAD
HOLLISTON, MA
for SYSTEM: CDS-22**

Area	0.94	acres	CDS Model
Weighted C	0.90		2015-4
Tc	6	minutes	CDS Treatment Capacity
			1.4 cfs

<u>Rainfall Intensity¹</u> <u>(in/hr)</u>	<u>Percent Rainfall Volume¹</u>	<u>Cumulative Rainfall Volume</u>	<u>Total Flowrate (cfs)</u>	<u>Treated Flowrate (cfs)</u>	<u>Removal Efficiency (%)</u>	<u>Incremental Removal (%)</u>
0.02	10.2%	10.2%	0.02	0.02	96.4	9.8
0.04	9.6%	19.8%	0.03	0.03	95.6	9.2
0.06	9.4%	29.3%	0.05	0.05	94.7	9.0
0.08	7.7%	37.0%	0.07	0.07	93.9	7.3
0.10	8.6%	45.6%	0.08	0.08	93.1	8.0
0.12	6.3%	51.9%	0.10	0.10	92.3	5.8
0.14	4.7%	56.5%	0.12	0.12	91.5	4.3
0.16	4.6%	61.2%	0.14	0.14	90.6	4.2
0.18	3.5%	64.7%	0.15	0.15	89.8	3.2
0.20	4.3%	69.1%	0.17	0.17	89.0	3.9
0.25	8.0%	77.1%	0.21	0.21	86.9	7.0
0.30	5.6%	82.7%	0.25	0.25	84.9	4.7
0.35	4.4%	87.0%	0.30	0.30	82.8	3.6
0.40	2.5%	89.5%	0.34	0.34	80.8	2.0
0.45	2.5%	92.1%	0.38	0.38	78.7	2.0
0.50	1.4%	93.5%	0.42	0.42	76.6	1.1
0.75	5.0%	98.5%	0.63	0.63	66.3	3.3
1.00	1.0%	99.5%	0.85	0.85	56.1	0.6
1.50	0.0%	99.5%	1.27	1.27	35.5	0.0
2.00	0.0%	99.5%	1.69	1.40	24.1	0.0
3.00	0.5%	100.0%	2.54	1.40	16.1	0.1
						88.9
						Removal Efficiency Adjustment ² = 6.5%
						Predicted % Annual Rainfall Treated = 93.3%
						Predicted Net Annual Load Removal Efficiency = 82.5%

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

PRECIPITATION

STORM RUNOFF DATA

Date: **10/4/16**

Revised:

Project: **Hopping Brook Road**Job No: **3,520**Town: **Holliston, MA**Calc. by: **WML**

INTENSITY (INCHES)

Frequency (YEARS)	Duration (minutes)				
	5	10	15	30	60
2	0.35	0.54	0.67	0.88	1.10
5	0.42	0.66	0.83	1.14	1.46
10	0.47	0.74	0.94	1.32	1.71
25	0.54	0.87	1.10	1.57	2.06
50	0.59	0.97	1.23	1.77	2.33
100	0.65	1.06	1.35	1.96	2.60

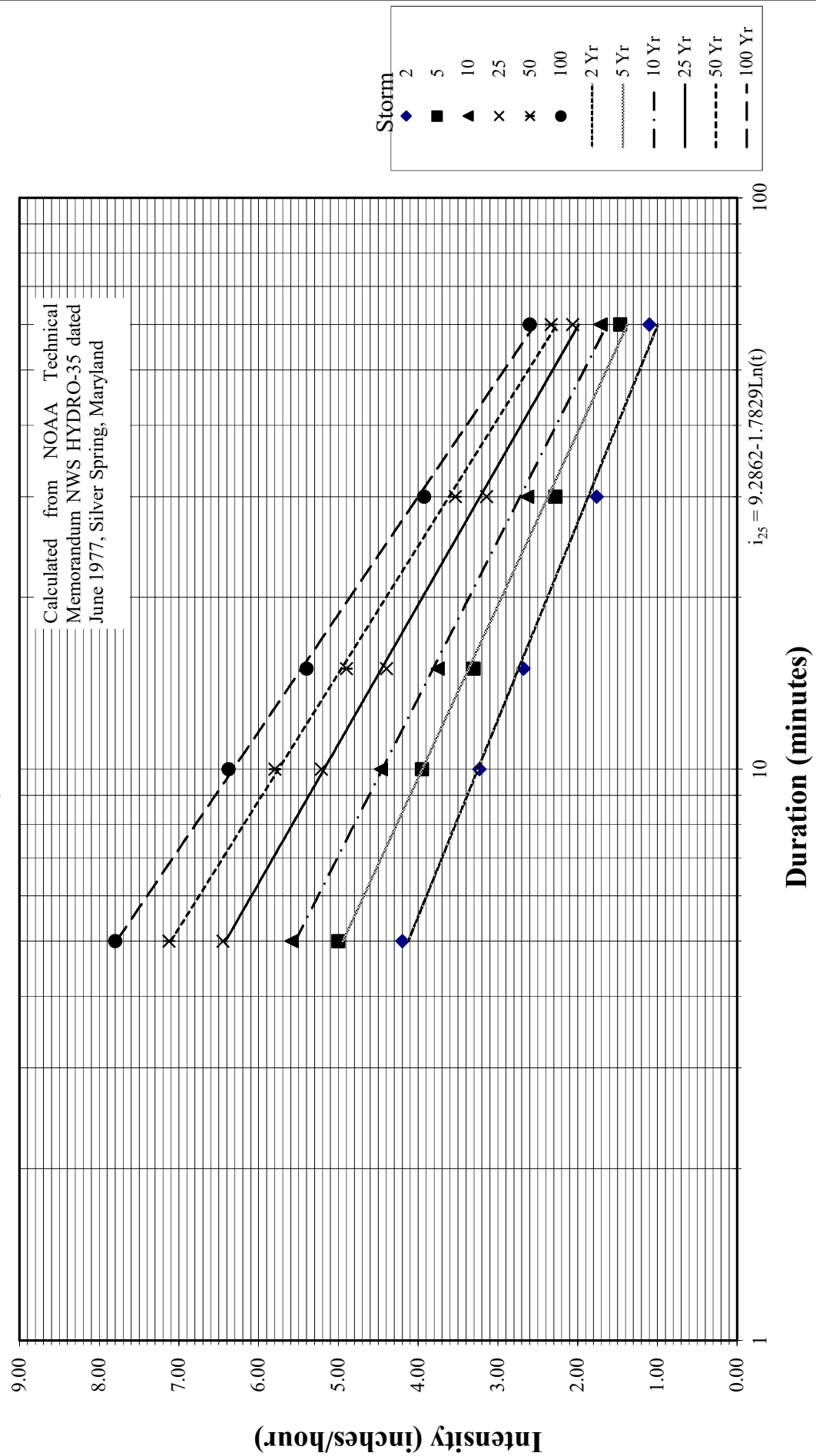
INTENSITY (INCHES/HOUR)

Frequency (YEARS)	Duration (minutes)				
	5	10	15	30	60
2	4.20	3.23	2.68	1.76	1.10
5	5.00	3.95	3.31	2.28	1.46
10	5.59	4.47	3.75	2.64	1.71
25	6.45	5.21	4.40	3.14	2.06
50	7.13	5.80	4.90	3.53	2.33
100	7.80	6.38	5.40	3.93	2.60

Calculated from NOAA
Technical Memorandum NWS
HYDRO-35 dated June 1977,
Silver Spring, Maryland

HOLLISTON, MA 10/4/2016

Intensity-Duration Curve



AVERAGE 'c' VALUE

STORM RUNOFF DATA

Date: **10/4/16**

Revised:

Project: **Hopping Brook Road**
 Town: **Holliston, MA**

Job No: **3,520**
 Calc. by: **WML**

CB	Total Area (SF)	Ground Cover	Area (SF)	c	$\Sigma(\text{Area} \cdot c)$	Average c	Total Area (Ac)
CB1	6,970	imp	5,576	0.95	5,296.90	0.82	0.160
		lawn	1,394	0.30	418.18		
		wooded	0	0.20	0.00		
CB2	8,712	imp	7,841	0.95	7,448.76	0.89	0.200
		lawn	871	0.30	261.36		
		wooded	0	0.20	0.00		
CB5	5,663	imp	2,831	0.95	2,689.83	0.63	0.130
		lawn	2,831	0.30	849.42		
		wooded	0	0.20	0.00		
CB6	5,663	imp	4,530	0.95	4,303.73	0.82	0.130
		lawn	1,133	0.30	339.77		
		wooded	0	0.20	0.00		
HW28	241,322	imp	180,992	0.95	171,942.21	0.77	5.540
		lawn	24,132	0.30	7,239.67		
		wooded	36,198	0.20	7,239.67		
CB8	8,712	imp	4,356	0.95	4,138.20	0.63	0.200
		lawn	4,356	0.30	1,306.80		
		wooded	0	0.20	0.00		
CB9	9,148	imp	7,318	0.95	6,952.18	0.82	0.210
		lawn	1,830	0.30	548.86		
		wooded	0	0.20	0.00		
CB11	9,148	imp	4,574	0.95	4,345.11	0.63	0.210
		lawn	4,574	0.30	1,372.14		
		wooded	0	0.20	0.00		
CB12	9,148	imp	7,318	0.95	6,952.18	0.82	0.210
		lawn	1,830	0.30	548.86		
		wooded	0	0.20	0.00		
HW30	433,422	imp	325,067	0.95	308,813.18	0.77	9.950
		lawn	43,342	0.30	13,002.66		
		wooded	65,013	0.20	13,002.66		
CB14	9,148	imp	4,574	0.95	4,345.11	0.63	0.210
		lawn	4,574	0.30	1,372.14		
		wooded	0	0.20	0.00		
CB15	9,148	imp	7,318	0.95	6,952.18	0.82	0.210
		lawn	1,830	0.30	548.86		
		wooded	0	0.20	0.00		
CB18	8,712	imp	4,356	0.95	4,138.20	0.63	0.200
		lawn	4,356	0.30	1,306.80		
		wooded	0	0.20	0.00		
CB19	8,712	imp	6,970	0.95	6,621.12	0.82	0.200
		lawn	1,742	0.30	522.72		
		wooded	0	0.20	0.00		
CB24	11,326	imp	5,663	0.95	5,379.66	0.63	0.260
		lawn	5,663	0.30	1,698.84		
		wooded	0	0.20	0.00		
CB25	12,197	imp	9,757	0.95	9,269.57	0.82	0.280
		lawn	2,439	0.30	731.81		
		wooded	0	0.20	0.00		

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Thursday, Dec 8 2016

Culvert 55+50

Invert Elev Dn (ft) = 279.00
 Pipe Length (ft) = 108.00
 Slope (%) = 8.33
 Invert Elev Up (ft) = 288.00
 Rise (in) = 30.0
 Shape = Circular
 Span (in) = 30.0
 No. Barrels = 1
 n-Value = 0.013
 Culvert Type = Circular Concrete
 Culvert Entrance = Square edge w/headwall (C)
 Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

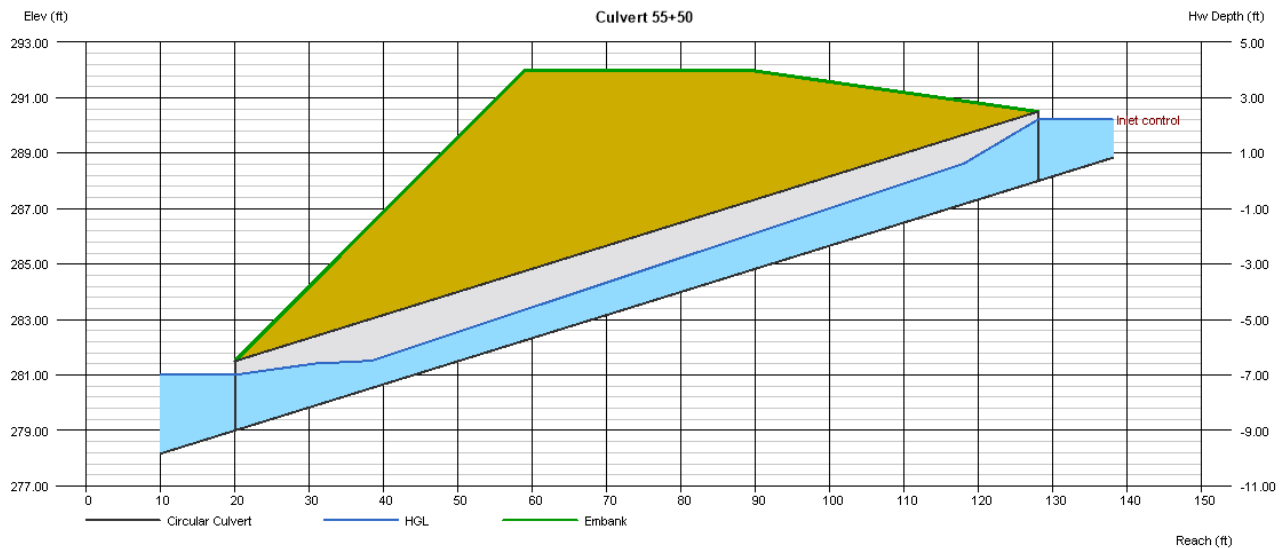
Top Elevation (ft) = 292.00
 Top Width (ft) = 30.00
 Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 0.00
 Qmax (cfs) = 50.00
 Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 20.00
 Qpipe (cfs) = 20.00
 Qovertop (cfs) = 0.00
 Veloc Dn (ft/s) = 4.73
 Veloc Up (ft/s) = 6.42
 HGL Dn (ft) = 281.01
 HGL Up (ft) = 289.52
 Hw Elev (ft) = 290.22
 Hw/D (ft) = 0.89
 Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Thursday, Dec 8 2016

Culvert 50+75

Invert Elev Dn (ft) = 279.00
 Pipe Length (ft) = 115.00
 Slope (%) = 1.74
 Invert Elev Up (ft) = 281.00
 Rise (in) = 30.0
 Shape = Circular
 Span (in) = 30.0
 No. Barrels = 1
 n-Value = 0.013
 Culvert Type = Circular Concrete
 Culvert Entrance = Square edge w/headwall (C)
 Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

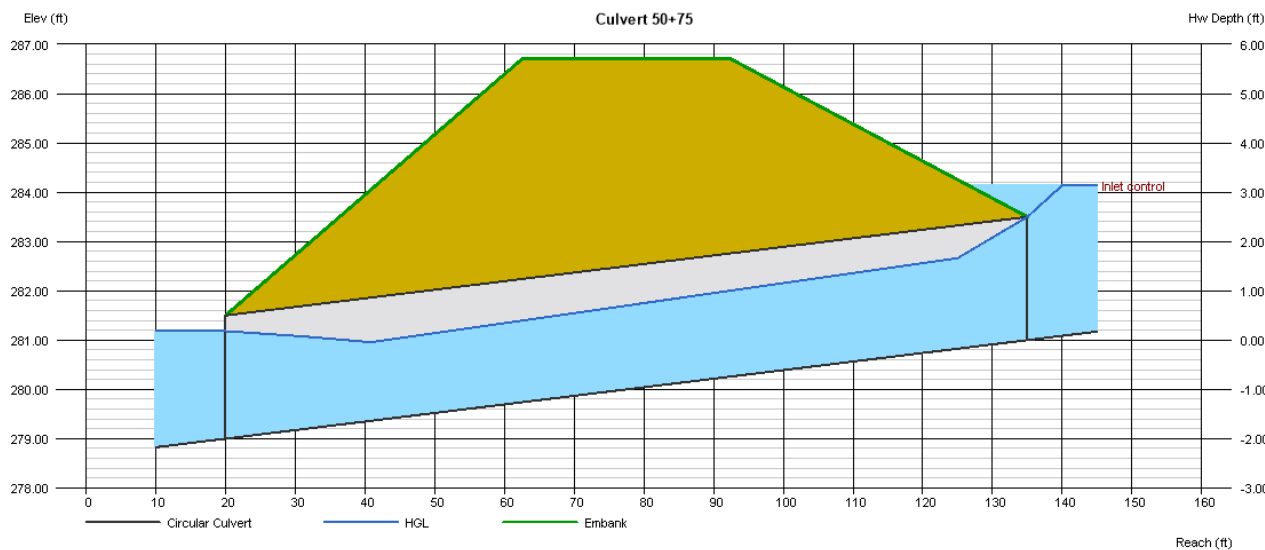
Top Elevation (ft) = 286.70
 Top Width (ft) = 30.00
 Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 0.00
 Qmax (cfs) = 50.00
 Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 30.00
 Qpipe (cfs) = 30.00
 Qovertop (cfs) = 0.00
 Veloc Dn (ft/s) = 6.60
 Veloc Up (ft/s) = 7.64
 HGL Dn (ft) = 281.18
 HGL Up (ft) = 282.87
 Hw Elev (ft) = 284.14
 Hw/D (ft) = 1.26
 Flow Regime = Inlet Control



STORM DRAINAGE CALCULATIONS
Pipe Flow Calculations - Manning's Equation

i = Rainfall Intensity at 100 Year Storm

Project: Hopping Brook Road
Town: Holliston, MA

Date: 10/4/16
Revised: 11/10/2016
Job No: 3,520
Calc. by: WML

Line		Length (Feet)	Drain Area (Ac)	Total Area (Ac)	Runoff "C"	Time of Concentration (min.)			Rainfall i (in./hr.)	Required Capacity Q(cfs)		Pipe Diameter (in.)	Slope (ft./ft.)	Design Conditions		Invert Elevation		Rim Elev. Upper	n
From	To					Upper End	In Pipe	Total		Inlet	Pipe			Depth (in.)	Velocity (f.p.s.)	Upper	Lower		
CB1	DMH3	26	0.16		0.82	5.00	0.09	5.09	7.79	1.02		12	0.018	3.77	4.84				0.013
CB2	DMH3	19	0.20		0.89	5.00	0.06	5.06	7.79	1.39		12	0.017	4.49	5.16				0.013
DMH3	DMH4	201		0.36	0.86	5.09	0.39	5.48	7.75	2.40	2.40	12	0.046	4.61	8.61				0.013
CB5	DMH4	32	0.13		0.63	5.00	0.13	5.13	7.79	0.64		12	0.015	3.10	3.97	S	S	S	0.013
CB6	DMH4	27	0.13		0.82	5.00	0.11	5.11	7.79	0.83		12	0.012	3.76	3.95	E	E	E	0.013
																E	E	E	
DMH4	OUT HW29	111		0.62	0.80	5.48		5.48	7.59	3.78	3.78	12	0.050	5.82	10.01				0.013
CB8	DMH7	28	0.20		0.63	5.00	0.12	5.12	7.79	0.98		12	0.010	4.30	3.87	P	P	P	0.013
CB9	DMH7	22	0.21		0.82	5.00	0.09	5.09	7.79	1.34		12	0.010	5.10	4.21	L	L	L	0.013
DMH7	DMH10	255		0.41	0.73	7.79		7.79	6.85	2.04	2.04	12	0.012	6.16	5.03	A	A	A	0.013
CB11	DMH10	32	0.21		0.63	5.00	0.14	5.14	7.79	1.03		12	0.010	4.42	3.93	N	N	N	0.013
CB12	DMH10	27	0.21		0.82	5.00	0.11	5.11	7.79	1.34		12	0.010	5.10	4.21	S	S	S	0.013
DMH10	OUT HW13	54		0.83	0.73	7.79		7.79	6.85	4.13	4.13	12	0.015	9.30	6.32				0.013
CB14	CDS16	22	0.21		0.63	5.00	0.09	5.09	7.79	1.03		12	0.010	4.42	3.93	S	S	S	0.013
CB15	CDS16	14	0.21		0.85	5.00	0.05	5.05	7.79	1.39		12	0.010	5.20	4.26	E	E	E	0.013
CDS16	OUT HW17	64		0.42	0.74	5.09		5.09	7.75	2.41	2.41	12	0.040	4.81	8.19	E	E	E	0.013
CB18	DMH20	32	0.20		0.63	5.00	0.14	5.14	7.79	0.98		12	0.010	4.30	3.87				0.013
CB19	DMH20	27	0.20		0.82	5.00	0.11	5.11	7.79	1.28		12	0.010	4.96	4.16	P	P	P	0.013
DMH20	DMH21	259		0.40	0.73	5.14	0.94	6.08	7.73	2.24	2.24	12	0.009	7.14	4.60	L	L	L	0.013
CB24	DMH21	26	0.26		0.63	5.00	0.10	5.10	7.79	1.28		12	0.010	4.96	4.16	A	A	A	0.013
CB25	DMH21	19	0.28		0.82	5.00	0.07	5.07	7.79	1.79		12	0.010	6.01	4.54	N	N	N	0.013
DMH21	CDS22	12		0.94	0.73	6.08	0.03	6.11	7.37	5.04	5.04	12	0.012	11.24	5.95	S	S	S	0.013
CDS22	DMH23	20		0.94	0.73	6.11	0.05	6.16	7.36	5.03	5.03	12	0.020	9.82	7.31				0.013
DMH26	DMH23	86										30	0.006						0.013
DMH23	OUT HW27	101			Existing Design = 30" @ S=0.004 < .005 OK							30	0.005						0.013
CULVERT28			5.54		0.77	30.00			4.00	17.06	17.06								
CULVERT30		35	9.95		0.77	30.00			4.00	30.64	30.64								

HOLLISTON: i_{100yr} = 11.186 - [2.113 * Ln(t)]

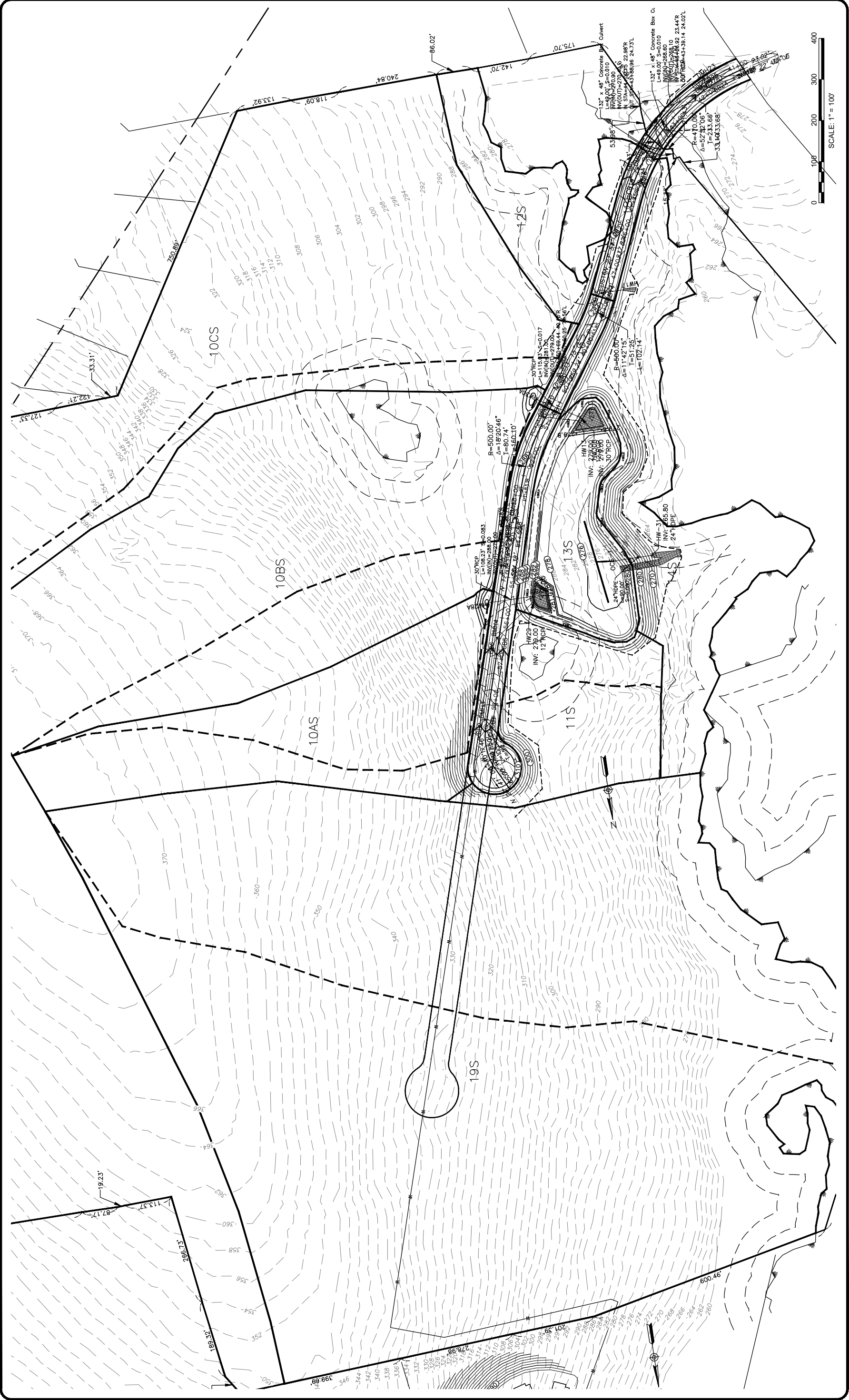


REVISIONS	DATE	DESCRIPTION
0	9/15/16	ISSUED FOR REVIEW

DATE BY:	WML
CHKD BY:	PSB
APP'D BY:	PSB

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REV	DATE	DESCRIPTION
3	10/5/16	REDESIGN COMMENTS
2	10/10/16	DROP INLETS REMOVED/CULVERTS ADDED
1	10/27/16	DETENTION BASINS, 1 REMOVED, 1 REMOVED
0	10/4/16	ISSUED FOR REVIEW

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