

# **STORMWATER ANALYSIS AND CALCULATIONS**

*for*

**62 MAPLE STREET  
WENHAM, MASSACHUSETTS**

**Applicant:**

Maple Woods Housing, LLC  
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**November 6, 2014**



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## **CALCULATION METHODS**

- TR 20 SCS Unit Hydrograph Procedure
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## **SOURCE OF DATA**

- Technical Report No. 20
- Technical Report No. 55
- Technical Paper No. 40
- Partial Field Survey by MAI
- Massachusetts Stormwater Management Handbook, February 2008

## REPORT SUMMARY:

### Calculation Objectives

The objective of these calculations is to document that the proposed project described in the Stormwater Management Report does not result in an increase of offsite rates of runoff or flooding down gradient of the site. The analysis is separated into existing and proposed conditions. Watershed plans have been incorporated into this report to depict existing and proposed watershed areas.

### Selection of Storm Events

The storm events have been compiled from the Soil Conservation Service Technical Report No. 55 and the U.S. Department of Commerce Technical Paper No. 40. Rainfall frequency data has been provided as follows:

<u>Frequency (Years)</u>	<u>Rainfall [ 24-Hour Event (inches)]</u>
2	3.1
10	4.5
100	6.5

### Classification of Soils

Drainage classes have been established based on soil maps provided by U.S. Department of Agriculture Soil Conservation Service as well as onsite soil testing. Soil maps and descriptions are part of "Soil Survey of Essex County, Southern Part". According to NRCS, the following soil types and hydrologic groups are delineated within the limit of the hydrologic study:

242B: Hinckley gravelly fine sandy loam - hydrologic soil group A  
600: Pits, gravel - hydrologic soil group not established

Hydrologic soil groups are assigned to each soil type by NRCS based on their potential rate of water infiltration. Group A soils typically have a high infiltration rate when thoroughly wet and consist of deep well drained sands or gravelly sands. Soil testing performed on the locus property confirm the presence of sands and gravels.

### Existing Conditions Overview

The locus property is part of an existing 16.1± acre parcel located at 62 Maple Street in Wenham, MA. The site is bordered on the north by existing woods and wetland areas and to the south by residentially developed properties along Maple Street. Burley Brook cuts through the property on the western side.

The project area for the hydrologic study consists of approximately 11 acres on and adjoining the locus property. This area includes an existing dwelling and associated driveway located directly off Maple Street. Lawn area extends back from Maple Street approximately 400'. Existing wooded areas with paths comprise the remainder of the project area groundcover up to an existing bordering vegetated wetland. The topography of the site consists of mild slopes ranging from 1% to 10% on the majority of the property.

For the purpose of analyzing existing and proposed stormwater runoff, a single design point has been designated for comparison. The design point selected is the limit of bordering vegetated wetland delineated on the plan. Two (2) subcatchment areas have been delineated based on topography.

#### **Existing Design Point and Subcatchment Areas:**

Design Point #1 is designated as the limit of bordering vegetated wetlands delineated on the plan. Stormwater from each of the two (2) subcatchment areas culminates at some point along the wetland line.

Subcatchment #1 includes area along the eastern edge of the locus property down gradient of existing berm to the central area of the project site including additional area estimated to contribute stormwater from offsite properties. High topographic points within the subcatchment direct stormwater overland to the wetland area.

Subcatchment #2 encompasses the remaining portion of locus property on the northern side up to the wetland boundary. Stormwater flows overland through the woods to the existing wetland.

#### **Proposed Conditions Overview**

The applicant is proposing a multi-family residential apartment building under a comprehensive permit. A 24' wide access driveway is proposed from Maple Street to an associated parking lot. Area to the north of the proposed building will remain undeveloped.

#### **Stormwater Management:**

This proposal utilizes conventional stormwater management techniques for stormwater management. Incorporated in this design is a subsurface infiltration basin, Stormceptor vortex units and deep sump catchbasins for treatment and recharge of stormwater. Design strategies for the stormwater system follow methods from the Massachusetts Stormwater Handbook.

#### **Subsurface Infiltration Basin:**

A subsurface infiltration facility has been incorporated into this design to provide recharge of stormwater from impervious surfaces. The facility consists of plastic chambers with an open bottom placed atop a stone bed. Chambers are constructed to store stormwater temporarily and let it infiltrate

into the underlying soil. The facility has been designed to recharge stormwater from the proposed roof and the proposed impervious areas. A TSS removal rate of 80% is achieved by this BMP.

**Stormceptor:**

The Stormceptor is a Proprietary Separator Vortex Stormwater Treatment Unit that consists of a precast concrete vault with a plastic weir and drop pipe that separates the top chamber and bottom sediment holding chamber. Incoming stormwater is diverted down through the drop pipe into the lower sediment chamber, where suspended solids are removed and settled. The treated runoff can then flow through the outlet pipe. This BMP achieves a TSS Removal Rate of 77% based on MA STEP program and proprietary structure sizing calculations issued by MA DEP effective on October 15, 2013.

**Deep Sump Catchbasin:**

Deep sump catchbasins are similar to an ordinary catchbasin but fitted with an outlet hood to separate floatables such as oil, grease, trash and debris. They also have four foot deep sumps that promote settling of suspended solids. A TSS removal rate of 25% is achieved by this BMP.

**Proposed Design Points and Subcatchment Areas**

The design point remains the same in the existing and proposed conditions as the limit of bordering vegetated wetland delineated on the plans. The proposed development has been divided into eight (8) subcatchment areas based on existing and proposed topography. General descriptions of these are as follows:

Subcatchment #11 includes the proposed rooftop runoff which is collected and directly discharged into the subsurface infiltration system.

Subcatchment #12 falls in a similar location to existing subcatchment #2 residing on the northern portion of the locus property up to the wetland boundary. It also includes the cleared area around the back of the length of proposed structure, which will act as a fire access. Stormwater flows overland through the woods to the existing wetland.

Subcatchment #13 includes the southern portion of the parking area adjacent to the proposed building and the grassed area bounded by the southern end of the proposed building and the property line. Stormwater will flow overland and onto the paved parking lot where it will collect at a set of double catchbasins and directed to a drainage manhole, followed by a Stormceptor Vortex unit and the subsurface infiltration system for storage and recharge. Excess stormwater will be directed from the facility by means of an emergency overflow pipe into the design point.

Subcatchment #14 includes the grassed community space along the southern property line and abutting offsite area estimated to contribute to stormwater to the site. Stormwater will flow down overland and be captured

by a proposed yard drain that will pipe the runoff into the proposed subsurface infiltration system.

Subcatchment #15 is composed of the northern half of the parking lot and incidental impervious and grass areas around the northern portion of the proposed building. Similar to Subcatchment #13, stormwater will collect at a set of double catchbasins and directed to a drainage manhole, followed by a Stormceptor Vortex unit and the subsurface infiltration system for storage and recharge. Excess stormwater will be directed from the facility by means of an emergency overflow pipe into the design point.

Subcatchment #16 includes the eastern half of the access drive from the crown of the road to the curb and bounded by Maple Street and the parking lot. Runoff will be collected by a catchbasin that is located on the same side of the driveway and is directed into a Stormceptor Vortex unit and then into the subsurface infiltration system for storage and recharge. Excess stormwater will be directed from the facility by means of an emergency overflow pipe into the design point.

Subcatchment #17 contains area abutting Maple Street which houses an existing structure with impervious driveway through the western half of the proposed driveway. Stormwater will flow overland and similar to Subcatchment #16 runoff will be collected by a catchbasin that is located on the same side of the driveway and is directed into a Stormceptor Vortex unit and then into the subsurface infiltration system for storage and recharge. Excess stormwater will be directed from the facility by means of an emergency overflow pipe into the design point.

Subcatchment #18 includes the area to the east of the proposed driveway. Stormwater flow is directed overland culminating at design point #1.

#### **Summary of Flows at All Design Points (CFS)**

A detailed analysis of existing and proposed subcatchment areas, ponds, and reaches is included in the HydroCAD analysis section of this report.

	<b><u>2-Year 24-Hour Storm Event</u></b>	<b><u>10-Year 24-Hour Storm Event</u></b>	<b><u>100-Year 24-Hour Storm Event</u></b>
Existing	0.0 CFS	0.11 CFS	1.42 CFS
Proposed	0.0 CFS	0.00 CFS	0.14 CFS

## Conclusion

The calculations indicate peaks have been met or reduced for the 2-year, 10-year, and 100-year storm events. We can therefore anticipate no adverse impacts or downstream flooding with the completion of this project. In addition the design provides for the required TSS removal and recharge volumes required by the MA DEP Stormwater Management Requirements.

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**EXISTING CONDITIONS  
WATERSHED ROUTING DIAGRAM**

DP1

bordering vegetated wetland

1S

southeast half

2S

northwest half



**EXISTING CONDITIONS  
2-YEAR 24-HOUR STORM EVENT ANALYSIS**

**Summary for Subcatchment 1S: southeast half**

Runoff = 0.00 cfs @ 24.08 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
* 4,280	98	impervious area
85,505	30	Woods, Good, HSG A
60,175	39	>75% Grass cover, Good, HSG A
71,925	51	1 acre lots, 20% imp, HSG A
* 1,135	98	impervious area
23,760	30	Woods, Good, HSG A
5,215	39	>75% Grass cover, Good, HSG A
251,995	40	Weighted Average
232,195		92.14% Pervious Area
19,800		7.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	50	0.0050	0.04		<b>Sheet Flow, central plateau</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.7	85	0.0110	0.52		<b>Shallow Concentrated Flow, overland path</b> Woodland Kv= 5.0 fps
2.4	147	0.0400	1.00		<b>Shallow Concentrated Flow, overland path</b> Woodland Kv= 5.0 fps
2.7	176	0.0480	1.10		<b>Shallow Concentrated Flow, overland to wetland</b> Woodland Kv= 5.0 fps
29.7	458	Total			

**Summary for Subcatchment 2S: northwest half**

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

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
239,210	30	Woods, Good, HSG A
239,210		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		<b>Sheet Flow, central high point</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.5	123	0.0260	0.81		<b>Shallow Concentrated Flow, overland</b> Woodland Kv= 5.0 fps
1.9	136	0.0570	1.19		<b>Shallow Concentrated Flow, overland to wetland</b> Woodland Kv= 5.0 fps
11.6	309	Total			

**Summary for Reach DP1: bordering vegetated wetland**

Inflow Area = 11.277 ac, 4.03% Impervious, Inflow Depth = 0.00" for 2 yr event  
 Inflow = 0.00 cfs @ 24.08 hrs, Volume= 0.000 af  
 Outflow = 0.00 cfs @ 24.08 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

**EXISTING CONDITIONS  
10-YEAR 24-HOUR STORM EVENT ANALYSIS**

**Summary for Subcatchment 1S: southeast half**

Runoff = 0.11 cfs @ 14.16 hrs, Volume= 0.066 af, Depth= 0.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
* 4,280	98	impervious area
85,505	30	Woods, Good, HSG A
60,175	39	>75% Grass cover, Good, HSG A
71,925	51	1 acre lots, 20% imp, HSG A
* 1,135	98	impervious area
23,760	30	Woods, Good, HSG A
5,215	39	>75% Grass cover, Good, HSG A
251,995	40	Weighted Average
232,195		92.14% Pervious Area
19,800		7.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	50	0.0050	0.04		<b>Sheet Flow, central plateau</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.7	85	0.0110	0.52		<b>Shallow Concentrated Flow, overland path</b> Woodland Kv= 5.0 fps
2.4	147	0.0400	1.00		<b>Shallow Concentrated Flow, overland path</b> Woodland Kv= 5.0 fps
2.7	176	0.0480	1.10		<b>Shallow Concentrated Flow, overland to wetland</b> Woodland Kv= 5.0 fps
29.7	458	Total			

**Summary for Subcatchment 2S: northwest half**

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

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
239,210	30	Woods, Good, HSG A
239,210		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		<b>Sheet Flow, central high point</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.5	123	0.0260	0.81		<b>Shallow Concentrated Flow, overland</b> Woodland Kv= 5.0 fps
1.9	136	0.0570	1.19		<b>Shallow Concentrated Flow, overland to wetland</b> Woodland Kv= 5.0 fps
11.6	309	Total			

**Summary for Reach DP1: bordering vegetated wetland**

Inflow Area = 11.277 ac, 4.03% Impervious, Inflow Depth = 0.07" for 10 yr event  
 Inflow = 0.11 cfs @ 14.16 hrs, Volume= 0.066 af  
 Outflow = 0.11 cfs @ 14.16 hrs, Volume= 0.066 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

**EXISTING CONDITIONS**  
**100-YEAR 24-HOUR STORM EVENT ANALYSIS**

**Summary for Subcatchment 1S: southeast half**

Runoff = 1.42 cfs @ 12.63 hrs, Volume= 0.319 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
* 4,280	98	impervious area
85,505	30	Woods, Good, HSG A
60,175	39	>75% Grass cover, Good, HSG A
71,925	51	1 acre lots, 20% imp, HSG A
* 1,135	98	impervious area
23,760	30	Woods, Good, HSG A
5,215	39	>75% Grass cover, Good, HSG A
251,995	40	Weighted Average
232,195		92.14% Pervious Area
19,800		7.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	50	0.0050	0.04		<b>Sheet Flow, central plateau</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.7	85	0.0110	0.52		<b>Shallow Concentrated Flow, overland path</b> Woodland Kv= 5.0 fps
2.4	147	0.0400	1.00		<b>Shallow Concentrated Flow, overland path</b> Woodland Kv= 5.0 fps
2.7	176	0.0480	1.10		<b>Shallow Concentrated Flow, overland to wetland</b> Woodland Kv= 5.0 fps
29.7	458	Total			

**Summary for Subcatchment 2S: northwest half**

Runoff = 0.10 cfs @ 14.99 hrs, Volume= 0.061 af, Depth= 0.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
239,210	30	Woods, Good, HSG A
239,210		100.00% Pervious Area

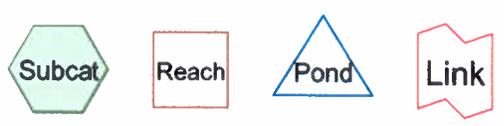
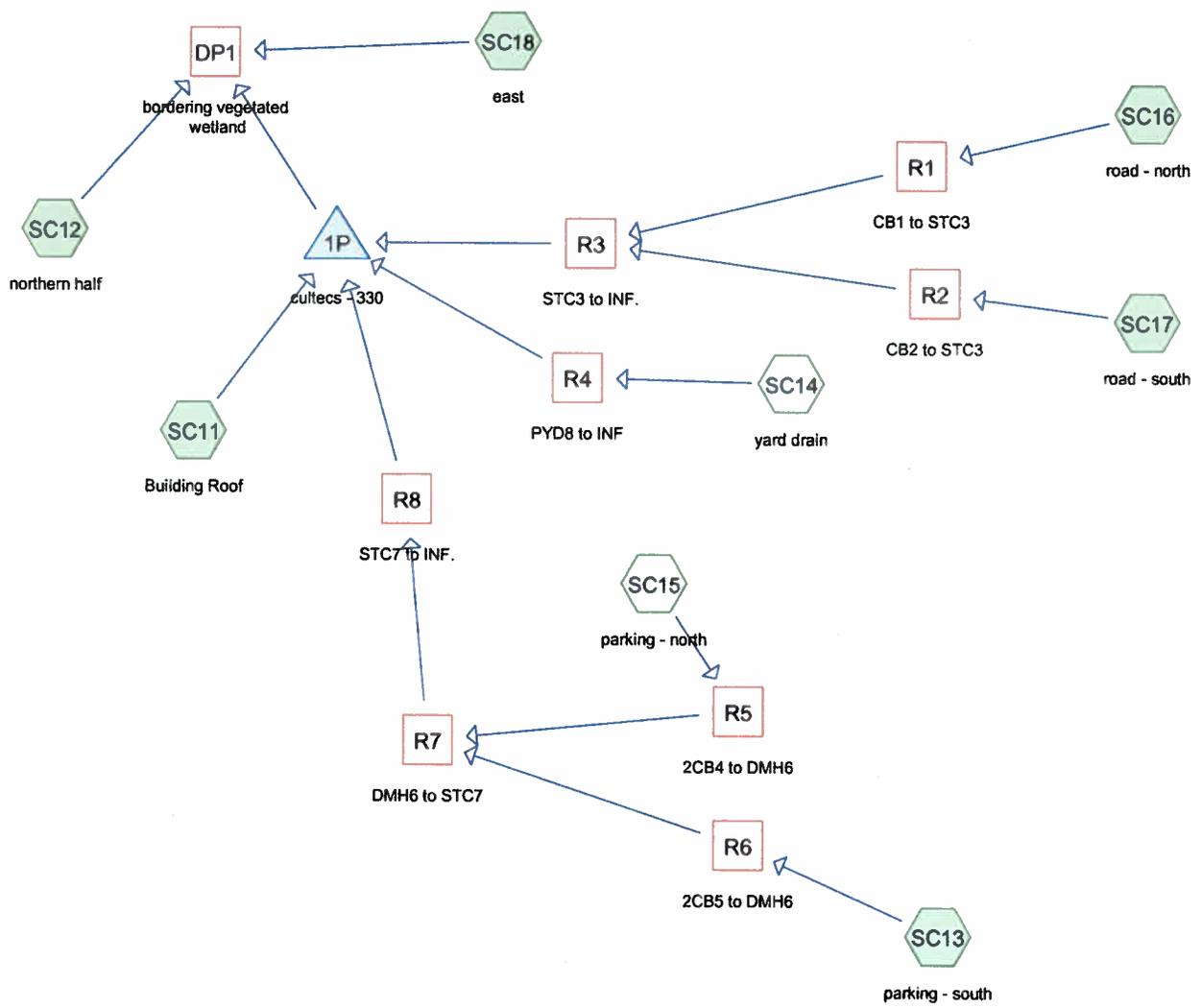
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		<b>Sheet Flow, central high point</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.5	123	0.0260	0.81		<b>Shallow Concentrated Flow, overland</b> Woodland Kv= 5.0 fps
1.9	136	0.0570	1.19		<b>Shallow Concentrated Flow, overland to wetland</b> Woodland Kv= 5.0 fps
11.6	309	Total			

**Summary for Reach DP1: bordering vegetated wetland**

Inflow Area = 11.277 ac, 4.03% Impervious, Inflow Depth = 0.40" for 100 yr event  
 Inflow = 1.42 cfs @ 12.63 hrs, Volume= 0.380 af  
 Outflow = 1.42 cfs @ 12.63 hrs, Volume= 0.380 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

**PROPOSED CONDITIONS  
WATERSHED ROUTING DIAGRAM**



**Routing Diagram for 5652-POST**  
 Prepared by Meridian Associates, Inc., Printed 11/6/2014  
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**PROPOSED CONDITIONS**  
**2-YEAR 24-HOUR STORM EVENT ANALYSIS**

**5652-POST**

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Type III 24-hr 2 yr Rainfall=3.10"

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**Summary for Subcatchment SC11: Building Roof**

Runoff = 1.37 cfs @ 12.08 hrs, Volume= 4,759 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
19,911	98	Roofs, HSG A
19,911		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC12: northern half**

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
209,103	30	Woods, Good, HSG A
22,028	39	>75% Grass cover, Good, HSG A
231,131	31	Weighted Average
231,131		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		<b>Sheet Flow, central point</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.5	123	0.0260	0.81		<b>Shallow Concentrated Flow, overland</b> Woodland Kv= 5.0 fps
1.9	136	0.0570	1.19		<b>Shallow Concentrated Flow, overland to wetland</b> Woodland Kv= 5.0 fps
11.6	309	Total			

**Summary for Subcatchment SC13: parking - south**

Runoff = 1.01 cfs @ 12.09 hrs, Volume= 3,168 cf, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

**5652-POST**

Type III 24-hr 2 yr Rainfall=3.10"

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Area (sf)	CN	Description
20,448	98	Paved parking, HSG A
9,673	39	>75% Grass cover, Good, HSG A
30,121	79	Weighted Average
9,673		32.11% Pervious Area
20,448		67.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC14: yard drain**

Runoff = 0.02 cfs @ 14.74 hrs, Volume= 621 cf, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
28,715	39	>75% Grass cover, Good, HSG A
71,925	51	1 acre lots, 20% imp, HSG A
100,640	48	Weighted Average
86,255		85.71% Pervious Area
14,385		14.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC15: parking - north**

Runoff = 1.11 cfs @ 12.09 hrs, Volume= 3,491 cf, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
16,973	98	Paved parking, HSG A
2,380	39	>75% Grass cover, Good, HSG A
19,353	91	Weighted Average
2,380		12.30% Pervious Area
16,973		87.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**5652-POST**

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Type III 24-hr 2 yr Rainfall=3.10"

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**Summary for Subcatchment SC16: road - north**

Runoff = 0.10 cfs @ 12.14 hrs, Volume= 625 cf, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
8,028	98	Paved parking, HSG A
11,924	39	>75% Grass cover, Good, HSG A
2,270	30	Woods, Good, HSG A
22,222	59	Weighted Average
14,194		63.87% Pervious Area
8,028		36.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC17: road - south**

Runoff = 0.21 cfs @ 12.13 hrs, Volume= 1,210 cf, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
12,442	98	Paved parking, HSG A
1,571	98	Roofs, HSG A
25,208	39	>75% Grass cover, Good, HSG A
39,221	60	Weighted Average
25,208		64.27% Pervious Area
14,013		35.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC18: east**

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
8,086	39	>75% Grass cover, Good, HSG A
21,080	30	Woods, Good, HSG A
29,166	32	Weighted Average
29,166		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Reach DP1: bordering vegetated wetland**

Inflow Area = 491,765 sf, 19.07% Impervious, Inflow Depth = 0.00" for 2 yr event  
 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 Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

**Summary for Reach R1: CB1 to STC3**

Inflow Area = 22,222 sf, 36.13% Impervious, Inflow Depth = 0.34" for 2 yr event  
 Inflow = 0.10 cfs @ 12.14 hrs, Volume= 625 cf  
 Outflow = 0.10 cfs @ 12.14 hrs, Volume= 625 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 2.03 fps, Min. Travel Time= 0.1 min  
 Avg. Velocity= 1.07 fps, Avg. Travel Time= 0.3 min

Peak Storage= 1 cf @ 12.14 hrs  
 Average Depth at Peak Storage= 0.11'  
 Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.76 cfs

12.0" Round Pipe  
 n= 0.013  
 Length= 18.0' Slope= 0.0111 1/100  
 Inlet Invert= 59.00', Outlet Invert= 58.80'



**Summary for Reach R2: CB2 to STC3**

Inflow Area = 39,221 sf, 35.73% Impervious, Inflow Depth = 0.37" for 2 yr event  
 Inflow = 0.21 cfs @ 12.13 hrs, Volume= 1,210 cf  
 Outflow = 0.21 cfs @ 12.13 hrs, Volume= 1,210 cf, Atten= 0%, Lag= 0.0 min

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Type III 24-hr 2 yr Rainfall=3.10"

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Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 3.16 fps, Min. Travel Time= 0.0 min  
Avg. Velocity = 1.59 fps, Avg. Travel Time= 0.1 min

Peak Storage= 0 cf @ 12.13 hrs  
Average Depth at Peak Storage= 0.14'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.04 cfs

12.0" Round Pipe  
n= 0.013  
Length= 5.0' Slope= 0.0200 '/'  
Inlet Invert= 59.00', Outlet Invert= 58.90'



**Summary for Reach R3: STC3 to INF.**

Inflow Area = 61,443 sf, 35.87% Impervious, Inflow Depth = 0.36" for 2 yr event  
Inflow = 0.30 cfs @ 12.14 hrs, Volume= 1,835 cf  
Outflow = 0.30 cfs @ 12.14 hrs, Volume= 1,835 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 6.21 fps, Min. Travel Time= 0.0 min  
Avg. Velocity = 3.17 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.14 hrs  
Average Depth at Peak Storage= 0.11'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 11.27 cfs

12.0" Round Pipe  
n= 0.013  
Length= 5.0' Slope= 0.1000 '/'  
Inlet Invert= 58.50', Outlet Invert= 58.00'



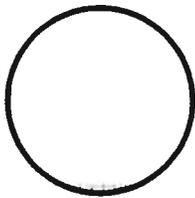
Summary for Reach R4: PYD8 to INF

Inflow Area = 100,640 sf, 14.29% Impervious, Inflow Depth = 0.07" for 2 yr event
Inflow = 0.02 cfs @ 14.74 hrs, Volume= 621 cf
Outflow = 0.02 cfs @ 14.74 hrs, Volume= 621 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.41 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.95 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 14.74 hrs
Average Depth at Peak Storage= 0.03'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 4.57 cfs

8.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 7.0' Slope= 0.1429 '/'
Inlet Invert= 58.50', Outlet Invert= 57.50'



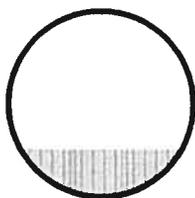
Summary for Reach R5: 2CB4 to DMH6

Inflow Area = 19,353 sf, 87.70% Impervious, Inflow Depth = 2.16" for 2 yr event
Inflow = 1.11 cfs @ 12.09 hrs, Volume= 3,491 cf
Outflow = 1.11 cfs @ 12.09 hrs, Volume= 3,491 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.99 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.34 fps, Avg. Travel Time= 0.1 min

Peak Storage= 3 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 7.73 cfs

12.0" Round Pipe
n= 0.013
Length= 17.0' Slope= 0.0471 '/'
Inlet Invert= 60.90', Outlet Invert= 60.10'



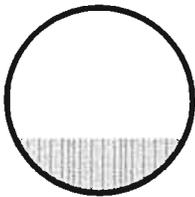
Summary for Reach R6: 2CB5 to DMH6

Inflow Area = 30,121 sf, 67.89% Impervious, Inflow Depth = 1.26" for 2 yr event
Inflow = 1.01 cfs @ 12.09 hrs, Volume= 3,168 cf
Outflow = 1.01 cfs @ 12.09 hrs, Volume= 3,168 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.15 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.92 fps, Avg. Travel Time= 0.3 min

Peak Storage= 7 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.24 cfs

12.0" Round Pipe
n= 0.013
Length= 37.0' Slope= 0.0216 '/'
Inlet Invert= 60.90', Outlet Invert= 60.10'



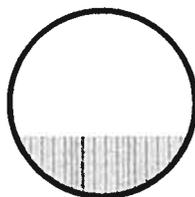
Summary for Reach R7: DMH6 to STC7

Inflow Area = 49,474 sf, 75.64% Impervious, Inflow Depth = 1.62" for 2 yr event
Inflow = 2.11 cfs @ 12.09 hrs, Volume= 6,659 cf
Outflow = 2.11 cfs @ 12.09 hrs, Volume= 6,659 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.06 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.01 fps, Avg. Travel Time= 0.2 min

Peak Storage= 10 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 9.14 cfs

15.0" Round Pipe
n= 0.013
Length= 30.0' Slope= 0.0200 '/'
Inlet Invert= 60.00', Outlet Invert= 59.40'



**Summary for Reach R8: STC7 to INF.**

Inflow Area = 49,474 sf, 75.64% Impervious, Inflow Depth = 1.62" for 2 yr event  
 Inflow = 2.11 cfs @ 12.09 hrs, Volume= 6,659 cf  
 Outflow = 2.11 cfs @ 12.09 hrs, Volume= 6,659 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 11.24 fps, Min. Travel Time= 0.0 min  
 Avg. Velocity= 3.72 fps, Avg. Travel Time= 0.1 min

Peak Storage= 6 cf @ 12.09 hrs  
 Average Depth at Peak Storage= 0.26'  
 Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 21.75 cfs

15.0" Round Pipe  
 n= 0.013  
 Length= 30.0' Slope= 0.1133 1/  
 Inlet Invert= 59.10', Outlet Invert= 55.70'



**Summary for Pond 1P: cultecs - 330**

Inflow Area = 231,468 sf, 40.51% Impervious, Inflow Depth = 0.72" for 2 yr event  
 Inflow = 3.73 cfs @ 12.09 hrs, Volume= 13,873 cf  
 Outflow = 1.65 cfs @ 12.32 hrs, Volume= 13,873 cf, Atten= 56%, Lag= 13.9 min  
 Discarded = 1.65 cfs @ 12.32 hrs, Volume= 13,873 cf  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Peak Elev= 55.56' @ 12.32 hrs Surf.Area= 8,473 sf Storage= 1,216 cf

Plug-Flow detention time= 2.9 min calculated for 13,869 cf (100% of inflow)  
 Center-of-Mass det. time= 2.9 min ( 828.5 - 825.6 )

Volume	Invert	Avail.Storage	Storage Description
#1A	55.20'	6,975 cf	<b>69.17'W x 122.50'L x 3.54'H Field A</b> 30,008 cf Overall - 12,570 cf Embedded = 17,438 cf x 40.0% Voids
#2A	55.70'	12,570 cf	<b>Cultec R-330XL x 238 Inside #1</b> Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 14 rows
		19,545 cf	Total Available Storage

Storage Group A created with Chamber Wizard

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Type III 24-hr 2 yr Rainfall=3.10"

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Device	Routing	Invert	Outlet Devices
#1	Discarded	55.20'	<b>8.270 in/hr Exfiltration over Wetted area</b> Phase-In= 0.01'
#2	Primary	57.90'	<b>12.0" Round Culvert</b> L= 126.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 57.90' / 50.50' S= 0.0587 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

**Discarded OutFlow** Max=1.65 cfs @ 12.32 hrs HW=55.56' (Free Discharge)↑**1=Exfiltration** (Exfiltration Controls 1.65 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=55.20' TW=0.00' (Dynamic Tailwater)↑**2=Culvert** ( Controls 0.00 cfs)

**PROPOSED CONDITIONS**  
**10-YEAR 24-HOUR STORM EVENT ANALYSIS**

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Type III 24-hr 10 yr Rainfall=4.50"

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### Summary for Subcatchment SC11: Building Roof

Runoff = 2.01 cfs @ 12.08 hrs, Volume= 7,075 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
19,911	98	Roofs, HSG A
19,911		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

### Summary for Subcatchment SC12: northern half

Runoff = 0.00 cfs @ 24.04 hrs, Volume= 2 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
209,103	30	Woods, Good, HSG A
22,028	39	>75% Grass cover, Good, HSG A
231,131	31	Weighted Average
231,131		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		<b>Sheet Flow, central point</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.5	123	0.0260	0.81		<b>Shallow Concentrated Flow, overland</b> Woodland Kv= 5.0 fps
1.9	136	0.0570	1.19		<b>Shallow Concentrated Flow, overland to wetland</b> Woodland Kv= 5.0 fps
11.6	309	Total			

### Summary for Subcatchment SC13: parking - south

Runoff = 1.93 cfs @ 12.09 hrs, Volume= 5,965 cf, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10 yr Rainfall=4.50"

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Type III 24-hr 10 yr Rainfall=4.50"

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Area (sf)	CN	Description
20,448	98	Paved parking, HSG A
9,673	39	>75% Grass cover, Good, HSG A
30,121	79	Weighted Average
9,673		32.11% Pervious Area
20,448		67.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC14: yard drain**

Runoff = 0.44 cfs @ 12.30 hrs, Volume= 3,468 cf, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
28,715	39	>75% Grass cover, Good, HSG A
71,925	51	1 acre lots, 20% imp, HSG A
100,640	48	Weighted Average
86,255		85.71% Pervious Area
14,385		14.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC15: parking - north**

Runoff = 1.76 cfs @ 12.09 hrs, Volume= 5,641 cf, Depth= 3.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
16,973	98	Paved parking, HSG A
2,380	39	>75% Grass cover, Good, HSG A
19,353	91	Weighted Average
2,380		12.30% Pervious Area
16,973		87.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC16: road - north**

Runoff = 0.48 cfs @ 12.10 hrs, Volume= 1,781 cf, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
8,028	98	Paved parking, HSG A
11,924	39	>75% Grass cover, Good, HSG A
2,270	30	Woods, Good, HSG A
22,222	59	Weighted Average
14,194		63.87% Pervious Area
8,028		36.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC17: road - south**

Runoff = 0.92 cfs @ 12.10 hrs, Volume= 3,333 cf, Depth= 1.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
12,442	98	Paved parking, HSG A
1,571	98	Roofs, HSG A
25,208	39	>75% Grass cover, Good, HSG A
39,221	60	Weighted Average
25,208		64.27% Pervious Area
14,013		35.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC18: east**

Runoff = 0.00 cfs @ 24.01 hrs, Volume= 7 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
8,086	39	>75% Grass cover, Good, HSG A
21,080	30	Woods, Good, HSG A
29,166	32	Weighted Average
29,166		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Reach DP1: bordering vegetated wetland**

Inflow Area = 491,765 sf, 19.07% Impervious, Inflow Depth = 0.00" for 10 yr event  
 Inflow = 0.00 cfs @ 24.02 hrs, Volume= 9 cf  
 Outflow = 0.00 cfs @ 24.02 hrs, Volume= 9 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

**Summary for Reach R1: CB1 to STC3**

Inflow Area = 22,222 sf, 36.13% Impervious, Inflow Depth = 0.96" for 10 yr event  
 Inflow = 0.48 cfs @ 12.10 hrs, Volume= 1,781 cf  
 Outflow = 0.48 cfs @ 12.11 hrs, Volume= 1,781 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 3.28 fps, Min. Travel Time= 0.1 min  
 Avg. Velocity= 1.39 fps, Avg. Travel Time= 0.2 min

Peak Storage= 3 cf @ 12.11 hrs  
 Average Depth at Peak Storage= 0.24'  
 Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.76 cfs

12.0" Round Pipe  
 n= 0.013  
 Length= 18.0' Slope= 0.0111 '/'  
 Inlet Invert= 59.00', Outlet Invert= 58.80'



**Summary for Reach R2: CB2 to STC3**

Inflow Area = 39,221 sf, 35.73% Impervious, Inflow Depth = 1.02" for 10 yr event  
 Inflow = 0.92 cfs @ 12.10 hrs, Volume= 3,333 cf  
 Outflow = 0.92 cfs @ 12.10 hrs, Volume= 3,333 cf, Atten= 0%, Lag= 0.0 min

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Type III 24-hr 10 yr Rainfall=4.50"

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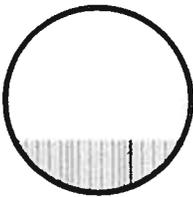
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Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 4.88 fps, Min. Travel Time= 0.0 min  
Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.10 hrs  
Average Depth at Peak Storage= 0.29'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.04 cfs

12.0" Round Pipe  
n= 0.013  
Length= 5.0' Slope= 0.0200 '/'  
Inlet Invert= 59.00', Outlet Invert= 58.90'



**Summary for Reach R3: STC3 to INF.**

Inflow Area = 61,443 sf, 35.87% Impervious, Inflow Depth = 1.00" for 10 yr event  
Inflow = 1.40 cfs @ 12.10 hrs, Volume= 5,114 cf  
Outflow = 1.40 cfs @ 12.10 hrs, Volume= 5,114 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 9.77 fps, Min. Travel Time= 0.0 min  
Avg. Velocity = 4.10 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.10 hrs  
Average Depth at Peak Storage= 0.24'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 11.27 cfs

12.0" Round Pipe  
n= 0.013  
Length= 5.0' Slope= 0.1000 '/'  
Inlet Invert= 58.50', Outlet Invert= 58.00'



Summary for Reach R4: PYD8 to INF

Inflow Area = 100,640 sf, 14.29% Impervious, Inflow Depth = 0.41" for 10 yr event
Inflow = 0.44 cfs @ 12.30 hrs, Volume= 3,468 cf
Outflow = 0.44 cfs @ 12.30 hrs, Volume= 3,468 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.27 fps, Min. Travel Time= 0.0 min
Avg. Velocity= 4.66 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.30 hrs
Average Depth at Peak Storage= 0.14'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 4.57 cfs

8.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 7.0' Slope= 0.1429 '/'
Inlet Invert= 58.50', Outlet Invert= 57.50'



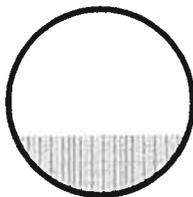
Summary for Reach R5: 2CB4 to DMH6

Inflow Area = 19,353 sf, 87.70% Impervious, Inflow Depth = 3.50" for 10 yr event
Inflow = 1.76 cfs @ 12.09 hrs, Volume= 5,641 cf
Outflow = 1.76 cfs @ 12.09 hrs, Volume= 5,641 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.96 fps, Min. Travel Time= 0.0 min
Avg. Velocity= 2.62 fps, Avg. Travel Time= 0.1 min

Peak Storage= 4 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 7.73 cfs

12.0" Round Pipe
n= 0.013
Length= 17.0' Slope= 0.0471 '/'
Inlet Invert= 60.90', Outlet Invert= 60.10'



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Type III 24-hr 10 yr Rainfall=4.50"

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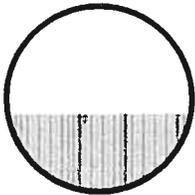
**Summary for Reach R6: 2CB5 to DMH6**

Inflow Area = 30,121 sf, 67.89% Impervious, Inflow Depth = 2.38" for 10 yr event  
Inflow = 1.93 cfs @ 12.09 hrs, Volume= 5,965 cf  
Outflow = 1.93 cfs @ 12.09 hrs, Volume= 5,965 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 6.16 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 2.22 fps, Avg. Travel Time= 0.3 min

Peak Storage= 12 cf @ 12.09 hrs  
Average Depth at Peak Storage= 0.42'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.24 cfs

12.0" Round Pipe  
n= 0.013  
Length= 37.0' Slope= 0.0216 '/'  
Inlet Invert= 60.90', Outlet Invert= 60.10'



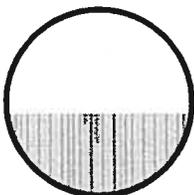
**Summary for Reach R7: DMH6 to STC7**

Inflow Area = 49,474 sf, 75.64% Impervious, Inflow Depth = 2.82" for 10 yr event  
Inflow = 3.68 cfs @ 12.09 hrs, Volume= 11,607 cf  
Outflow = 3.68 cfs @ 12.09 hrs, Volume= 11,607 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 7.04 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 2.29 fps, Avg. Travel Time= 0.2 min

Peak Storage= 16 cf @ 12.09 hrs  
Average Depth at Peak Storage= 0.55'  
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 9.14 cfs

15.0" Round Pipe  
n= 0.013  
Length= 30.0' Slope= 0.0200 '/'  
Inlet Invert= 60.00', Outlet Invert= 59.40'



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Type III 24-hr 10 yr Rainfall=4.50"

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**Summary for Reach R8: STC7 to INF.**

Inflow Area = 49,474 sf, 75.64% Impervious, Inflow Depth = 2.82" for 10 yr event  
 Inflow = 3.68 cfs @ 12.09 hrs, Volume= 11,607 cf  
 Outflow = 3.68 cfs @ 12.09 hrs, Volume= 11,607 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 13.20 fps, Min. Travel Time= 0.0 min  
 Avg. Velocity= 4.23 fps, Avg. Travel Time= 0.1 min

Peak Storage= 8 cf @ 12.09 hrs  
 Average Depth at Peak Storage= 0.35'  
 Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 21.75 cfs

15.0" Round Pipe  
 n= 0.013  
 Length= 30.0' Slope= 0.1133 '/'  
 Inlet Invert= 59.10', Outlet Invert= 55.70'



**Summary for Pond 1P: cultecs - 330**

Inflow Area = 231,468 sf, 40.51% Impervious, Inflow Depth = 1.41" for 10 yr event  
 Inflow = 7.30 cfs @ 12.10 hrs, Volume= 27,263 cf  
 Outflow = 1.70 cfs @ 12.54 hrs, Volume= 27,263 cf, Atten= 77%, Lag= 26.9 min  
 Discarded = 1.70 cfs @ 12.54 hrs, Volume= 27,263 cf  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Peak Elev= 56.22' @ 12.54 hrs Surf.Area= 8,473 sf Storage= 5,482 cf

Plug-Flow detention time= 16.8 min calculated for 27,254 cf (100% of inflow)  
 Center-of-Mass det. time= 16.8 min ( 842.5 - 825.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	55.20'	6,975 cf	<b>69.17'W x 122.50'L x 3.54'H Field A</b> 30,008 cf Overall - 12,570 cf Embedded = 17,438 cf x 40.0% Voids
#2A	55.70'	12,570 cf	<b>Cultec R-330XL x 238 Inside #1</b> Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 14 rows
		19,545 cf	Total Available Storage

Storage Group A created with Chamber Wizard

**5652-POST**

Type III 24-hr 10 yr Rainfall=4.50"

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Device	Routing	Invert	Outlet Devices
#1	Discarded	55.20'	<b>8.270 in/hr Exfiltration over Wetted area</b> Phase-In= 0.01'
#2	Primary	57.90'	<b>12.0" Round Culvert</b> L= 126.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 57.90' / 50.50' S= 0.0587 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

**Discarded OutFlow** Max=1.70 cfs @ 12.54 hrs HW=56.22' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 1.70 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=55.20' TW=0.00' (Dynamic Tailwater)

↑**2=Culvert** ( Controls 0.00 cfs)

**PROPOSED CONDITIONS**  
**100-YEAR 24-HOUR STORM EVENT ANALYSIS**

**Summary for Subcatchment SC11: Building Roof**

Runoff = 2.91 cfs @ 12.08 hrs, Volume= 10,389 cf, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
19,911	98	Roofs, HSG A
19,911		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC12: northern half**

Runoff = 0.12 cfs @ 14.68 hrs, Volume= 3,325 cf, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
209,103	30	Woods, Good, HSG A
22,028	39	>75% Grass cover, Good, HSG A
231,131	31	Weighted Average
231,131		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		<b>Sheet Flow, central point</b> Woods: Light underbrush n= 0.400 P2= 3.10"
2.5	123	0.0260	0.81		<b>Shallow Concentrated Flow, overland</b> Woodland Kv= 5.0 fps
1.9	136	0.0570	1.19		<b>Shallow Concentrated Flow, overland to wetland</b> Woodland Kv= 5.0 fps
11.6	309	Total			

**Summary for Subcatchment SC13: parking - south**

Runoff = 3.33 cfs @ 12.09 hrs, Volume= 10,365 cf, Depth= 4.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

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Type III 24-hr 100 yr Rainfall=6.50"

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Area (sf)	CN	Description
20,448	98	Paved parking, HSG A
9,673	39	>75% Grass cover, Good, HSG A
30,121	79	Weighted Average
9,673		32.11% Pervious Area
20,448		67.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC14: yard drain**

Runoff = 2.64 cfs @ 12.11 hrs, Volume= 10,383 cf, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
28,715	39	>75% Grass cover, Good, HSG A
71,925	51	1 acre lots, 20% imp, HSG A
100,640	48	Weighted Average
86,255		85.71% Pervious Area
14,385		14.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC15: parking - north**

Runoff = 2.67 cfs @ 12.08 hrs, Volume= 8,785 cf, Depth= 5.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
16,973	98	Paved parking, HSG A
2,380	39	>75% Grass cover, Good, HSG A
19,353	91	Weighted Average
2,380		12.30% Pervious Area
16,973		87.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC16: road - north**

Runoff = 1.23 cfs @ 12.10 hrs, Volume= 4,010 cf, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
8,028	98	Paved parking, HSG A
11,924	39	>75% Grass cover, Good, HSG A
2,270	30	Woods, Good, HSG A
22,222	59	Weighted Average
14,194		63.87% Pervious Area
8,028		36.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC17: road - south**

Runoff = 2.29 cfs @ 12.09 hrs, Volume= 7,373 cf, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
12,442	98	Paved parking, HSG A
1,571	98	Roofs, HSG A
25,208	39	>75% Grass cover, Good, HSG A
39,221	60	Weighted Average
25,208		64.27% Pervious Area
14,013		35.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Subcatchment SC18: east**

Runoff = 0.02 cfs @ 13.70 hrs, Volume= 524 cf, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
8,086	39	>75% Grass cover, Good, HSG A
21,080	30	Woods, Good, HSG A
29,166	32	Weighted Average
29,166		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Min. Standard Engineering Practice

**Summary for Reach DP1: bordering vegetated wetland**

Inflow Area = 491,765 sf, 19.07% Impervious, Inflow Depth = 0.09" for 100 yr event  
 Inflow = 0.14 cfs @ 14.68 hrs, Volume= 3,848 cf  
 Outflow = 0.14 cfs @ 14.68 hrs, Volume= 3,848 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

**Summary for Reach R1: CB1 to STC3**

Inflow Area = 22,222 sf, 36.13% Impervious, Inflow Depth = 2.17" for 100 yr event  
 Inflow = 1.23 cfs @ 12.10 hrs, Volume= 4,010 cf  
 Outflow = 1.23 cfs @ 12.10 hrs, Volume= 4,010 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 4.28 fps, Min. Travel Time= 0.1 min  
 Avg. Velocity = 1.68 fps, Avg. Travel Time= 0.2 min

Peak Storage= 5 cf @ 12.10 hrs  
 Average Depth at Peak Storage= 0.39'  
 Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.76 cfs

12.0" Round Pipe  
 n= 0.013  
 Length= 18.0' Slope= 0.0111 '/'  
 Inlet Invert= 59.00', Outlet Invert= 58.80'



**Summary for Reach R2: CB2 to STC3**

Inflow Area = 39,221 sf, 35.73% Impervious, Inflow Depth = 2.26" for 100 yr event  
 Inflow = 2.29 cfs @ 12.09 hrs, Volume= 7,373 cf  
 Outflow = 2.29 cfs @ 12.09 hrs, Volume= 7,373 cf, Atten= 0%, Lag= 0.0 min

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Type III 24-hr 100 yr Rainfall=6.50"

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Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 6.26 fps, Min. Travel Time= 0.0 min  
Avg. Velocity = 2.46 fps, Avg. Travel Time= 0.0 min

Peak Storage= 2 cf @ 12.09 hrs  
Average Depth at Peak Storage= 0.47'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.04 cfs

12.0" Round Pipe  
n= 0.013  
Length= 5.0' Slope= 0.0200 '/'  
Inlet Invert= 59.00', Outlet Invert= 58.90'



**Summary for Reach R3: STC3 to INF.**

Inflow Area = 61,443 sf, 35.87% Impervious, Inflow Depth = 2.22" for 100 yr event  
Inflow = 3.52 cfs @ 12.10 hrs, Volume= 11,383 cf  
Outflow = 3.52 cfs @ 12.10 hrs, Volume= 11,383 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 12.67 fps, Min. Travel Time= 0.0 min  
Avg. Velocity = 4.92 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.10 hrs  
Average Depth at Peak Storage= 0.38'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 11.27 cfs

12.0" Round Pipe  
n= 0.013  
Length= 5.0' Slope= 0.1000 '/'  
Inlet Invert= 58.50', Outlet Invert= 58.00'



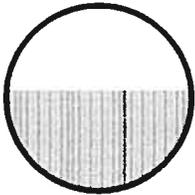
**Summary for Reach R4: PYD8 to INF**

Inflow Area = 100,640 sf, 14.29% Impervious, Inflow Depth = 1.24" for 100 yr event  
Inflow = 2.64 cfs @ 12.11 hrs, Volume= 10,383 cf  
Outflow = 2.64 cfs @ 12.11 hrs, Volume= 10,383 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 13.56 fps, Min. Travel Time= 0.0 min  
Avg. Velocity = 6.13 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.11 hrs  
Average Depth at Peak Storage= 0.36'  
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 4.57 cfs

8.0" Round Pipe  
n= 0.013 Corrugated PE, smooth interior  
Length= 7.0' Slope= 0.1429 '/  
Inlet Invert= 58.50', Outlet Invert= 57.50'



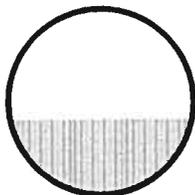
**Summary for Reach R5: 2CB4 to DMH6**

Inflow Area = 19,353 sf, 87.70% Impervious, Inflow Depth = 5.45" for 100 yr event  
Inflow = 2.67 cfs @ 12.08 hrs, Volume= 8,785 cf  
Outflow = 2.67 cfs @ 12.08 hrs, Volume= 8,785 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 8.93 fps, Min. Travel Time= 0.0 min  
Avg. Velocity = 2.95 fps, Avg. Travel Time= 0.1 min

Peak Storage= 5 cf @ 12.08 hrs  
Average Depth at Peak Storage= 0.41'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 7.73 cfs

12.0" Round Pipe  
n= 0.013  
Length= 17.0' Slope= 0.0471 '/  
Inlet Invert= 60.90', Outlet Invert= 60.10'



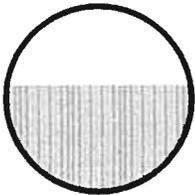
**Summary for Reach R6: 2CB5 to DMH6**

Inflow Area = 30,121 sf, 67.89% Impervious, Inflow Depth = 4.13" for 100 yr event  
Inflow = 3.33 cfs @ 12.09 hrs, Volume= 10,365 cf  
Outflow = 3.33 cfs @ 12.09 hrs, Volume= 10,365 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 7.07 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 2.51 fps, Avg. Travel Time= 0.2 min

Peak Storage= 17 cf @ 12.09 hrs  
Average Depth at Peak Storage= 0.58'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.24 cfs

12.0" Round Pipe  
n= 0.013  
Length= 37.0' Slope= 0.0216 '/  
Inlet Invert= 60.90', Outlet Invert= 60.10'



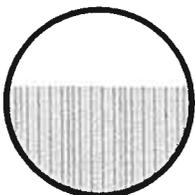
**Summary for Reach R7: DMH6 to STC7**

Inflow Area = 49,474 sf, 75.64% Impervious, Inflow Depth = 4.64" for 100 yr event  
Inflow = 6.00 cfs @ 12.09 hrs, Volume= 19,150 cf  
Outflow = 6.00 cfs @ 12.09 hrs, Volume= 19,150 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Max. Velocity= 7.94 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 2.61 fps, Avg. Travel Time= 0.2 min

Peak Storage= 23 cf @ 12.09 hrs  
Average Depth at Peak Storage= 0.74'  
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 9.14 cfs

15.0" Round Pipe  
n= 0.013  
Length= 30.0' Slope= 0.0200 '/  
Inlet Invert= 60.00', Outlet Invert= 59.40'



**Summary for Reach R8: STC7 to INF.**

Inflow Area = 49,474 sf, 75.64% Impervious, Inflow Depth = 4.64" for 100 yr event  
 Inflow = 6.00 cfs @ 12.09 hrs, Volume= 19,150 cf  
 Outflow = 6.00 cfs @ 12.09 hrs, Volume= 19,150 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 15.14 fps, Min. Travel Time= 0.0 min  
 Avg. Velocity = 4.81 fps, Avg. Travel Time= 0.1 min

Peak Storage= 12 cf @ 12.09 hrs  
 Average Depth at Peak Storage= 0.45'  
 Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 21.75 cfs

15.0" Round Pipe  
 n= 0.013  
 Length= 30.0' Slope= 0.1133 '/  
 Inlet Invert= 59.10', Outlet Invert= 55.70'



**Summary for Pond 1P: cultecs - 330**

Inflow Area = 231,468 sf, 40.51% Impervious, Inflow Depth = 2.66" for 100 yr event  
 Inflow = 14.99 cfs @ 12.09 hrs, Volume= 51,306 cf  
 Outflow = 1.81 cfs @ 12.91 hrs, Volume= 51,306 cf, Atten= 88%, Lag= 49.0 min  
 Discarded = 1.81 cfs @ 12.91 hrs, Volume= 51,306 cf  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
 Peak Elev= 57.82' @ 12.91 hrs Surf.Area= 8,473 sf Storage= 16,053 cf

Plug-Flow detention time= 68.3 min calculated for 51,289 cf (100% of inflow)  
 Center-of-Mass det. time= 68.3 min ( 888.3 - 820.0 )

Volume	Invert	Avail.Storage	Storage Description
#1A	55.20'	6,975 cf	<b>69.17'W x 122.50'L x 3.54'H Field A</b> 30,008 cf Overall - 12,570 cf Embedded = 17,438 cf x 40.0% Voids
#2A	55.70'	12,570 cf	<b>Cultec R-330XL</b> x 238 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 14 rows
		19,545 cf	Total Available Storage

Storage Group A created with Chamber Wizard

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Device	Routing	Invert	Outlet Devices
#1	Discarded	55.20'	<b>8.270 in/hr Exfiltration over Wetted area</b> Phase-In= 0.01'
#2	Primary	57.90'	<b>12.0" Round Culvert</b> L= 126.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 57.90' / 50.50' S= 0.0587 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

**Discarded OutFlow** Max=1.81 cfs @ 12.91 hrs HW=57.82' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 1.81 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=55.20' TW=0.00' (Dynamic Tailwater)

↑ **2=Culvert** ( Controls 0.00 cfs)

# **APPENDIX**