

Attachment 7

Stormwater Management Report

STORMWATER MANAGEMENT REPORT

Dollar General Retail Store

Chadbourn Ridge Road
North Waterboro, Maine

Prepared For:
North Waterboro DMEP X, LLC
9010 Overlook Blvd.
Brentwood, TN 37027

October 2014

Prepared by:



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34386

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1. INTRODUCTION

Waterboro DMEP X, LLC is proposing a Dollar General Retail Store at the intersection of Chadbourn Ridge Road and Sokokis Trail in Waterboro, Maine. The site is currently undeveloped and consists of a sloped pasture with a small abandoned cobbler building. Northeast Civil Solutions, Inc. (NCS) is designing the site to comply with the Town of Waterboro Site Plan Regulations.

The stormwater runoff from this site currently sheet flows southerly across the parcel to a freshwater wetland located in the rear of the property. The site is located in the watershed of Little Ossipee Lake.

2. STUDY METHODOLOGY

In this study, the Soil Conservation Services Urban Hydrology for Small watersheds, Technical Release 20 (also known as SCS-TR20) was utilized to model the surface water drainage patterns for the pre- and post-development drainage conditions. HydroCAD Stormwater Modeling System Software (Version 10.0) was used for the SCS TR20 calculations. The SCS TR-55 method was used to estimate the Time of Concentration (Tc). This method involves estimating the length of sheet flow, shallow concentrated flow and channel flow that occurs within each subcatchment. Each Tc Path and corresponding length and slope is identified on the Drainage Development Area Plans. From this information, the time of concentration is determined for each watershed. Modeling was conducted using the 2, 10, and 25-year storm events. The HydroCAD results for the pre- and post-development are displayed in Appendix B.

The soils on the site were classified using the Natural Resources Conservation Service's Web Soil Survey. The following soil(s) and conditions were reported:

AdB Adams Loamy Sand, 0%-8% Hydrological Group A

The curve numbers (CN) used in this analysis relate to the ground cover observed and proposed on the site. The curve numbers in Table 1 below were used in this analysis.

Description	HSG A
Grass, Good	39
Woods, Good	30
Grass, Good	98

3. PRE-DEVELOPMENT CONDITIONS

The existing site consists of meadow, woods and a small abandoned cobbler shack. Under pre-development conditions, the site is modeled as single drainage area (See Plan Set for Pre-Development Drainage Area Plan).

Pre-Development Drainage Area S1

This area encompasses approximately 2.42 acres and consists of primarily meadow. Stormwater flows southerly down a sloped meadow to an existing 18 inch culvert, that runs under Sokokis Trail, identified as Study Point #1 (SP-1).

Table 2 – Pre-Development Discharges

Return Period	Study Point #1 Pre- Flows (cfs)
2	0.00
10	0.04
25	0.14

4. POST-DEVELOPMENT CONDITIONS

The project will include the construction of a 9,100 s.f. retail facility, associated parking, landscaped areas, stormwater infrastructure, and paved access driveway to Chadbourn Ridge Road. The stormwater runoff will sheet flow across the parking area and the building roof to grassed swales and then into an infiltration basing that will allow stormwater to be detained and slowly infiltrate.

Upon completion of the project, the total new impervious area is 30,425 s.f. / 0.69 acres. Total landscaped area is 20,000 s.f. / 0.46 acres.

Under post-development conditions, the site is modeled as two drainage areas (See Plan Set for Post-Development Drainage Area Plan).

Post-Development Drainage Area S1

This area encompasses approximately 1.36 acres and consists of Pavement, building and grassed area. Stormwater flows southeast to an infiltration basin. Overflow from the basin is directed to an existing 18 inch culver labeled Study Point #1 (SP-1).

Post-Development Drainage Area S2

This area encompasses approximately 1.06 acres and consists primarily of meadow. Stormwater flows southeasterly to an existing 18 inch culver labeled Study Point #1 (SP-1).

Table 3 – Post-Development Discharges

Return Period	Study Point #1 Post-Flows (cfs)
2	0.00
10	0.02
25	0.07

Table 4 – Comparison of Pre- and Post-Development Discharges for Study Point #1

Return Period (yr)	SP-1 Pre Flows (cfs)	SP-1 Post-Flows (cfs)	Diff. (cfs)
2	0.00	0.00	0.00
10	0.04	0.02	-0.02
25	0.14	0.07	-0.07

5. PHOSPHORUS STANDARD BMP REQUIREMENTS

The Maine Department of Environmental Protection (DEP) has developed phosphorus budgets for the watershed of each lake in the State of Maine. Each budget is based on how much additional phosphorus loading a lake could accept without risking a perceivable change in the lake's water quality. The budget allocates this additional phosphorus load amongst anticipated new development sources in the lakes watershed on a per acre basis. The per acre phosphorus allocation defines how much phosphorus each acre of land in a lake's watershed is allowed to discharge in stormwater runoff when developed. The proposed retail facility is located in the Woodbury Pond watershed.

Appendix C of *Stormwater Management for Maine, Volume II*, provides the per acre phosphorus allocations for selected Maine Lakes and specified the loading rate for Little Ossipee Lake of 0.046 lbs P/year. This rate is used to calculate the sites Phosphorous budget. The accumulation of this rate over the entire project area of 2.06 acres provides a budget of 0.0948 lbs P/year. There are no areas on the site meeting the criteria of a steep slopes preventing development. Please refer to "Worksheet 1- PPB Calculations" in Appendix C for further detail.

The development will increase the impervious area to roughly 30,425 sf and have a total landscaped area of 20,000 sf. Left untreated this would translate to a phosphorous export of 0.7576 lbs P/year.

The Maine DEP requires a minimum treatment factor (TF) of 0.4 for projects that must meet the phosphorous standard. With a combination of underdrained biofiltration systems and an undisturbed meadow/forested buffer the site provides a TF of 0.1329 for most of the developed area. Refer to calculations in Appendix D for more detail.

The proposed development proposes a phosphorous export of 0.0984 lbs P/year, 0.0039 lbs P/year more than the phosphorous budget of 0.0945 lbs P/year, therefore meeting the Maine DEP regulations.

The DEP understands that not all sites will be able to design phosphorous treatment to reduce the export to pre-development levels and assess a fee of \$25,000 /lb P over the budget. The calculated fee for this site will be \$97.50.

In summary, this project meets the Phosphorus Budget by:

- a.) Treating 0.69 acres of impervious cover (building and pavement/driveway) and 0.46 acres of landscape areas.
- b.) Use of an infiltration basin to treat stormwater

6. MAINTENANCE PLAN

Waterboro DMEP X, LLC shall be responsible for the maintenance of the stormwater infrastructure. At a minimum, the appropriate and relevant activities for each of the stormwater management facilities will be performed on the prescribed schedule. A sample maintenance log is included for use in tracking stormwater maintenance on the site and can be found in Appendix E.

Stormwater Maintenance Items

Sweeping

Paved surfaces shall be swept or vacuumed at least twice annually in the spring to remove all winter sand, and periodically during the year on an as-needed basis to minimize transportation of sediment during rainfall events.

Culverts

If sediment in culverts or piped drainage systems exceeds 20% of the diameter of the pipe, it should be removed. Hydraulic flushing or any mechanical means may accomplish this; however, care should be taken as to not flush the sediment into the detention pond as it will reduce the pond's capacity and hasten the time when it must be cleaned. All pipes should be inspected on an annual basis.

Ditches and Swales

Open swales and ditches need to be inspected on a monthly basis or after a major rainfall even to insure that debris or sediments do not reduce the effectiveness of the system. Debris needs to be removed. Any sign of erosion or blockage shall be immediately repaired to promote a vigorous growth of vegetation.

Vegetated ditches should be mowed at least monthly during the growing season. Larger brush or trees must be prevented from becoming established in the channel. Any areas where the vegetation falls will be subjected to erosion and should be repaired and re-vegetated.

Infiltration Basin

Preventive maintenance is vital for the long-term effectiveness of an infiltration system. Since infiltration is less conspicuous than most BMPs, it is easy to overlook during maintenance inspections.

- I. **Fertilization:** Fertilization of the area over the infiltration bed should be avoided unless absolutely necessary to establish vegetation.
- II. **Snow Storage Prohibited:** Snow removed from any on-site or off-site areas may not be stored over an infiltration area, with the exception of storage on pavement alternatives approved by the department.
- III. **Monitoring and Inspections:** Inspect the infiltration system several times in the first year of operation and at least annually thereafter. Conduct the inspections after large storms to check for surface ponding at the inlet that may indicate clogging. Water levels in the observation well should be recorded over several days after the storm to ensure that the system drains within 72 hours after filling.
- IV. **Pollution-Control Devices:** Pollution-control devices such as oil-water separators, skimmers, and booms must be inspected regularly to determine if they need to be cleaned or replaced.
- V. **Sediment Removal and Maintenance of System Performance:** Sediment must be removed from the system at least annually to prevent deterioration of system performance. The pre-treatment inlets should be checked periodically and cleaned out when accumulated sediment occupies more than 10% of available capacity. This can be done manually or by a vacuum pump. Inlet and outlet pipes should be checked for clogging. Accumulated grease and oil from separator devices should be removed frequently and disposed of in accordance with applicable state and local regulations. The system must be rehabilitated or replaced if its performance is degraded to the point that applicable stormwater standards are not met.
- VI. **Pretreatment Buffer Strips:** If a grass buffer strip is used in conjunction with the infiltration BMP it should be inspected regularly. Growth should be vigorous and dense. Bare spots or eroded areas should be repaired and/or re-seeded or re-sodded. Watering and/or fertilization should be provided during the first few months after the strip is established, and may periodically be needed in times of drought. Grass filter strips should be mowed regularly to prevent the uncontrolled growth of briars and weeds. Filter strips in residential or commercial areas will need to be mowed more frequently, but filter strip performance will be impaired if the grass is cut too short. Lawn clippings should be removed to prevent them from clogging the BMP.

- VII. **Observation Wells**, Measure of Sediment Accumulation, and Points of Access for
- VIII. **Sediment Removal**: Observation wells to determine the system's performance and access points to allow for the removal of accumulated sediment must be included in the design of infiltration systems. Dry wells and infiltration basins must have staff gauges, marked rods, or similar instrumentation to measure the accumulation of sediment and determine how quickly the system drains after a storm. The maintenance plan must indicate the expected rate of drainage of the infiltration system and provide for removal of sediment from the infiltration system.
- IX. **Groundwater Monitoring**: Groundwater quality monitoring may be required as part of the system maintenance to demonstrate that pollutant removal practices are effective. Groundwater quality monitoring will generally be required for activities infiltrating water from areas of heavy turf-chemical use, such as golf courses and certain athletic fields, and large connected impervious areas, such as parking lots and runways. Groundwater quality monitoring will generally not be required for systems infiltrating water from lawn areas and other vegetated areas, residential developments, playing fields, and roofs of residential and commercial structures.
- X. **Groundwater Testing**: Groundwater should be analyzed quarterly for indicator parameters such as pH, specific conductance, dissolved oxygen, and chloride. Zinc has been found to be a stable heavy metal and should also be measured quarterly; it tends to appear anywhere from two to ten years after operation of large systems. Sampling for diesel-range and gasoline range organics, BTEX and MTBE, should be performed if draining large impervious areas of urbanized areas.
- XI. **Deed**: A commitment to regularly maintain privately-owned trenches will have to be legally conditioned in the property deed, development permit, or home-owner association agreement.

7. CONCLUSION

By inspection of the pre- and post-development flows at study point #1 (SP-1) there is no increase in any of the storm events due to the development. The infiltration basin will improve the drainage on the site by both helping to reduce the peak stormwater flows and by removing phosphorous from entering Little Ossipee Lake.

**APPENDIX A
PRE-DEVELOPMENT DRAINAGE CALCULATIONS**

HydroCAD
2-yr, 10-yr & 25-yr Storm Results



Meadow



Culvert



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.356	39	Pasture/grassland/range, Good, HSG A (S1)
0.005	98	Unconnected roofs, HSG A (S1)
0.058	30	Woods, Good, HSG A (S1)
2.419	39	TOTAL AREA

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.419	HSG A	S1
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.419		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchmer Numbers
2.356	0.000	0.000	0.000	0.000	2.356	Pasture/grassland/range, Good	S1
0.005	0.000	0.000	0.000	0.000	0.005	Unconnected roofs	S1
0.058	0.000	0.000	0.000	0.000	0.058	Woods, Good	S1
2.419	0.000	0.000	0.000	0.000	2.419	TOTAL AREA	

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Type III 24-hr 2-Year Rainfall=3.00"

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Time span=10.00-20.00 hrs, dt=0.01 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1: Meadow

Runoff Area=105,391 sf 0.20% Impervious Runoff Depth=0.00"
Flow Length=478' Tc=29.6 min CN=39 Runoff=0.00 cfs 0.000 af

Link SP1: Culvert

Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 2.419 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
99.80% Pervious = 2.415 ac 0.20% Impervious = 0.005 ac

Summary for Subcatchment S1: Meadow

Runoff = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
2,544	30	Woods, Good, HSG A
212	98	Unconnected roofs, HSG A
102,635	39	Pasture/grassland/range, Good, HSG A
105,391	39	Weighted Average
105,179		99.80% Pervious Area
212		0.20% Impervious Area
212		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.7	100	0.0050	0.06		Sheet Flow, A-B Sheet Grass: Dense n= 0.240 P2= 3.00"
2.8	193	0.0260	1.13		Shallow Concentrated Flow, B-C Shallow Short Grass Pasture Kv= 7.0 fps
1.1	185	0.0324	2.70		Shallow Concentrated Flow, C-D Shallow Grassed Waterway Kv= 15.0 fps
29.6	478	Total			

Summary for Link SP1: Culvert

Inflow Area = 2.419 ac, 0.20% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af
 Primary = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs

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Type III 24-hr 10-Year Rainfall=4.60"

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Time span=10.00-20.00 hrs, dt=0.01 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1: Meadow

Runoff Area=105,391 sf 0.20% Impervious Runoff Depth>0.09"
Flow Length=478' Tc=29.6 min CN=39 Runoff=0.04 cfs 0.019 af

Link SP1: Culvert

Inflow=0.04 cfs 0.019 af
Primary=0.04 cfs 0.019 af

Total Runoff Area = 2.419 ac Runoff Volume = 0.019 af Average Runoff Depth = 0.09"
99.80% Pervious = 2.415 ac 0.20% Impervious = 0.005 ac

Summary for Subcatchment S1: Meadow

Runoff = 0.04 cfs @ 14.90 hrs, Volume= 0.019 af, Depth > 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
2,544	30	Woods, Good, HSG A
212	98	Unconnected roofs, HSG A
102,635	39	Pasture/grassland/range, Good, HSG A
105,391	39	Weighted Average
105,179		99.80% Pervious Area
212		0.20% Impervious Area
212		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.7	100	0.0050	0.06		Sheet Flow, A-B Sheet Grass: Dense n= 0.240 P2= 3.00"
2.8	193	0.0260	1.13		Shallow Concentrated Flow, B-C Shallow Short Grass Pasture Kv= 7.0 fps
1.1	185	0.0324	2.70		Shallow Concentrated Flow, C-D Shallow Grassed Waterway Kv= 15.0 fps
29.6	478	Total			

Summary for Link SP1: Culvert

Inflow Area = 2.419 ac, 0.20% Impervious, Inflow Depth > 0.09" for 10-Year event
 Inflow = 0.04 cfs @ 14.90 hrs, Volume= 0.019 af
 Primary = 0.04 cfs @ 14.90 hrs, Volume= 0.019 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs

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Type III 24-hr 25-Year Rainfall=5.40"

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Time span=10.00-20.00 hrs, dt=0.01 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1: Meadow

Runoff Area=105,391 sf 0.20% Impervious Runoff Depth>0.23"
Flow Length=478' Tc=29.6 min CN=39 Runoff=0.14 cfs 0.046 af

Link SP1: Culvert

Inflow=0.14 cfs 0.046 af
Primary=0.14 cfs 0.046 af

Total Runoff Area = 2.419 ac Runoff Volume = 0.046 af Average Runoff Depth = 0.23"
99.80% Pervious = 2.415 ac 0.20% Impervious = 0.005 ac

Summary for Subcatchment S1: Meadow

Runoff = 0.14 cfs @ 12.79 hrs, Volume= 0.046 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
2,544	30	Woods, Good, HSG A
212	98	Unconnected roofs, HSG A
102,635	39	Pasture/grassland/range, Good, HSG A
105,391	39	Weighted Average
105,179		99.80% Pervious Area
212		0.20% Impervious Area
212		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.7	100	0.0050	0.06		Sheet Flow, A-B Sheet Grass: Dense n= 0.240 P2= 3.00"
2.8	193	0.0260	1.13		Shallow Concentrated Flow, B-C Shallow Short Grass Pasture Kv= 7.0 fps
1.1	185	0.0324	2.70		Shallow Concentrated Flow, C-D Shallow Grassed Waterway Kv= 15.0 fps
29.6	478	Total			

Summary for Link SP1: Culvert

Inflow Area = 2.419 ac, 0.20% Impervious, Inflow Depth > 0.23" for 25-Year event

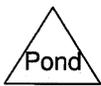
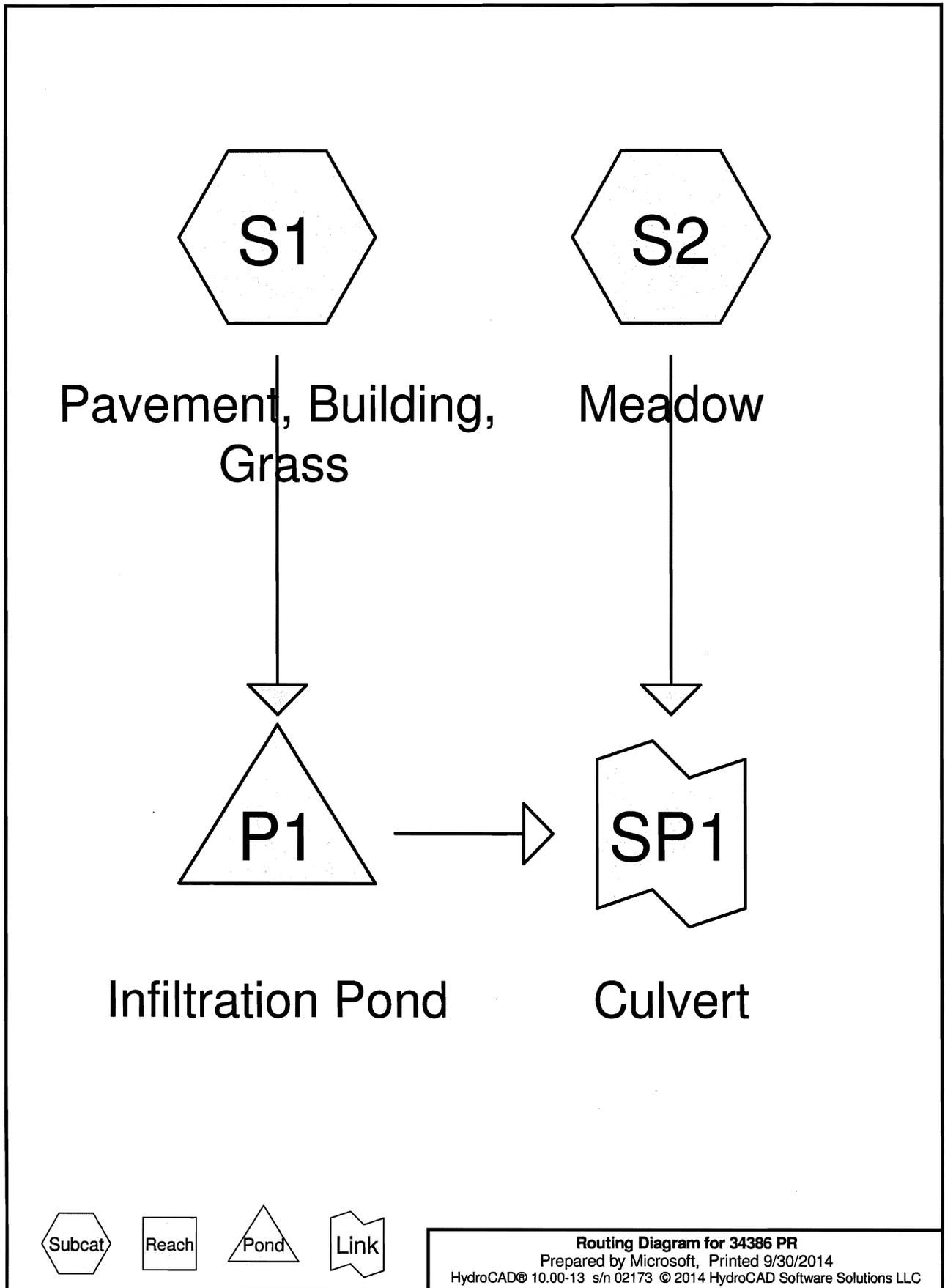
Inflow = 0.14 cfs @ 12.79 hrs, Volume= 0.046 af

Primary = 0.14 cfs @ 12.79 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs

APPENDIX B
POST-DEVELOPMENT DRAINAGE CALCULATIONS

HydroCAD
2-yr, 10-yr & 25-yr Storm Results



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.663	39	>75% Grass cover, Good, HSG A (S1, S2)
0.698	98	Paved parking, HSG A (S1)
0.058	30	Woods, Good, HSG A (S2)
2.419	56	TOTAL AREA

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.419	HSG A	S1, S2
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.419		TOTAL AREA

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
1.663	0.000	0.000	0.000	0.000	1.663	>75% Grass cover, Good	S1, S2
0.698	0.000	0.000	0.000	0.000	0.698	Paved parking	S1
0.058	0.000	0.000	0.000	0.000	0.058	Woods, Good	S2
2.419	0.000	0.000	0.000	0.000	2.419	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	S1	0.00	0.00	70.0	0.0100	0.011	12.0	0.0	0.0

Time span=10.00-20.00 hrs, dt=0.01 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1: Pavement, Building, Runoff Area=59,065 sf 51.51% Impervious Runoff Depth>0.60"
Flow Length=441' Tc=13.7 min CN=69 Runoff=0.70 cfs 0.068 af

Subcatchment S2: Meadow Runoff Area=46,324 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=282' Tc=18.5 min CN=39 Runoff=0.00 cfs 0.000 af

Pond P1: Infiltration Pond Peak Elev=343.79' Storage=1,516 cf Inflow=0.70 cfs 0.068 af
Discarded=0.06 cfs 0.040 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.040 af

Link SP1: Culvert Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 2.419 ac Runoff Volume = 0.068 af Average Runoff Depth = 0.33"
71.13% Pervious = 1.721 ac 28.87% Impervious = 0.698 ac

Summary for Subcatchment S1: Pavement, Building, Grass

Runoff = 0.70 cfs @ 12.22 hrs, Volume= 0.068 af, Depth> 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
0	30	Woods, Good, HSG A
30,425	98	Paved parking, HSG A
28,640	39	>75% Grass cover, Good, HSG A
59,065	69	Weighted Average
28,640		48.49% Pervious Area
30,425		51.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	83	0.0301	0.13		Sheet Flow, A-B Sheet Grass: Dense n= 0.240 P2= 3.00"
0.2	70	0.0100	5.36	4.21	Pipe Channel, B-C Pipe 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.7	288	0.0139	1.77		Shallow Concentrated Flow, C-D Shallow Grassed Waterway Kv= 15.0 fps
13.7	441	Total			

Summary for Subcatchment S2: Meadow

Runoff = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
2,544	30	Woods, Good, HSG A
0	98	Paved parking, HSG A
43,780	39	>75% Grass cover, Good, HSG A
46,324	39	Weighted Average
46,324		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0150	0.10		Sheet Flow, A-B Sheet Grass: Dense n= 0.240 P2= 3.00"
2.0	182	0.0462	1.50		Shallow Concentrated Flow, B-C Shallow Short Grass Pasture Kv= 7.0 fps
18.5	282	Total			

Summary for Pond P1: Infiltration Pond

Inflow Area = 1.356 ac, 51.51% Impervious, Inflow Depth > 0.60" for 2-Year event
 Inflow = 0.70 cfs @ 12.22 hrs, Volume= 0.068 af
 Outflow = 0.06 cfs @ 12.02 hrs, Volume= 0.040 af, Atten= 91%, Lag= 0.0 min
 Discarded = 0.06 cfs @ 12.02 hrs, Volume= 0.040 af
 Primary = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
 Peak Elev= 343.79' @ 15.81 hrs Surf.Area= 1,000 sf Storage= 1,516 cf

Plug-Flow detention time= 204.3 min calculated for 0.040 af (59% of inflow)
 Center-of-Mass det. time= 117.5 min (957.8 - 840.3)

Volume	Invert	Avail.Storage	Storage Description
#1	340.00'	4,000 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 10,000 cf Overall x 40.0% Voids
#2	350.00'	9,496 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		13,496 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
340.00	1,000	0	0
350.00	1,000	10,000	10,000

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
350.00	1,001	0	0
351.00	1,895	1,448	1,448
352.00	3,907	2,901	4,349
353.00	6,387	5,147	9,496

Device	Routing	Invert	Outlet Devices
#1	Discarded	340.00'	0.06 cfs Exfiltration when above 340.00'
#2	Primary	352.00'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir 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

Discarded OutFlow Max=0.06 cfs @ 12.02 hrs HW=340.13' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 10.00 hrs HW=340.00' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link SP1: Culvert

Inflow Area = 2.419 ac, 28.87% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af
 Primary = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs

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Type III 24-hr 10-Year Rainfall=4.60"

Prepared by Microsoft

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Time span=10.00-20.00 hrs, dt=0.01 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1: Pavement, Building, Runoff Area=59,065 sf 51.51% Impervious Runoff Depth>1.53"
Flow Length=441' Tc=13.7 min CN=69 Runoff=2.00 cfs 0.172 af

Subcatchment S2: Meadow Runoff Area=46,324 sf 0.00% Impervious Runoff Depth>0.09"
Flow Length=282' Tc=18.5 min CN=39 Runoff=0.02 cfs 0.008 af

Pond P1: Infiltration Pond Peak Elev=351.07' Storage=5,591 cf Inflow=2.00 cfs 0.172 af
Discarded=0.06 cfs 0.044 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.044 af

Link SP1: Culvert Inflow=0.02 cfs 0.008 af
Primary=0.02 cfs 0.008 af

Total Runoff Area = 2.419 ac Runoff Volume = 0.181 af Average Runoff Depth = 0.90"
71.13% Pervious = 1.721 ac 28.87% Impervious = 0.698 ac

Summary for Subcatchment S1: Pavement, Building, Grass

Runoff = 2.00 cfs @ 12.20 hrs, Volume= 0.172 af, Depth> 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
0	30	Woods, Good, HSG A
30,425	98	Paved parking, HSG A
28,640	39	>75% Grass cover, Good, HSG A
59,065	69	Weighted Average
28,640		48.49% Pervious Area
30,425		51.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	83	0.0301	0.13		Sheet Flow, A-B Sheet Grass: Dense n= 0.240 P2= 3.00"
0.2	70	0.0100	5.36	4.21	Pipe Channel, B-C Pipe 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.7	288	0.0139	1.77		Shallow Concentrated Flow, C-D Shallow Grassed Waterway Kv= 15.0 fps
13.7	441	Total			

Summary for Subcatchment S2: Meadow

Runoff = 0.02 cfs @ 14.78 hrs, Volume= 0.008 af, Depth> 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
2,544	30	Woods, Good, HSG A
0	98	Paved parking, HSG A
43,780	39	>75% Grass cover, Good, HSG A
46,324	39	Weighted Average
46,324		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0150	0.10		Sheet Flow, A-B Sheet Grass: Dense n= 0.240 P2= 3.00"
2.0	182	0.0462	1.50		Shallow Concentrated Flow, B-C Shallow Short Grass Pasture Kv= 7.0 fps
18.5	282	Total			

Summary for Pond P1: Infiltration Pond

Inflow Area = 1.356 ac, 51.51% Impervious, Inflow Depth > 1.53" for 10-Year event
 Inflow = 2.00 cfs @ 12.20 hrs, Volume= 0.172 af
 Outflow = 0.06 cfs @ 11.50 hrs, Volume= 0.044 af, Atten= 97%, Lag= 0.0 min
 Discarded = 0.06 cfs @ 11.50 hrs, Volume= 0.044 af
 Primary = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
 Peak Elev= 351.07' @ 19.54 hrs Surf.Area= 3,041 sf Storage= 5,591 cf

Plug-Flow detention time= 213.6 min calculated for 0.044 af (26% of inflow)
 Center-of-Mass det. time= 114.2 min (932.9 - 818.7)

Volume	Invert	Avail.Storage	Storage Description
#1	340.00'	4,000 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 10,000 cf Overall x 40.0% Voids
#2	350.00'	9,496 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		13,496 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
340.00	1,000	0	0
350.00	1,000	10,000	10,000

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
350.00	1,001	0	0
351.00	1,895	1,448	1,448
352.00	3,907	2,901	4,349
353.00	6,387	5,147	9,496

Device	Routing	Invert	Outlet Devices
#1	Discarded	340.00'	0.06 cfs Exfiltration when above 340.00'
#2	Primary	352.00'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir 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

Discarded OutFlow Max=0.06 cfs @ 11.50 hrs HW=340.13' (Free Discharge)
 ↳1=Exfiltration (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 10.00 hrs HW=340.00' (Free Discharge)
 ↳2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Link SP1: Culvert

Inflow Area = 2.419 ac, 28.87% Impervious, Inflow Depth > 0.04" for 10-Year event
 Inflow = 0.02 cfs @ 14.78 hrs, Volume= 0.008 af
 Primary = 0.02 cfs @ 14.78 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs

Time span=10.00-20.00 hrs, dt=0.01 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1: Pavement, Building, Runoff Area=59,065 sf 51.51% Impervious Runoff Depth>2.07"
Flow Length=441' Tc=13.7 min CN=69 Runoff=2.75 cfs 0.234 af

Subcatchment S2: Meadow Runoff Area=46,324 sf 0.00% Impervious Runoff Depth>0.23"
Flow Length=282' Tc=18.5 min CN=39 Runoff=0.07 cfs 0.020 af

Pond P1: Infiltration Pond Peak Elev=351.95' Storage=8,146 cf Inflow=2.75 cfs 0.234 af
Discarded=0.06 cfs 0.047 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.047 af

Link SP1: Culvert Inflow=0.07 cfs 0.020 af
Primary=0.07 cfs 0.020 af

Total Runoff Area = 2.419 ac Runoff Volume = 0.254 af Average Runoff Depth = 1.26"
71.13% Pervious = 1.721 ac 28.87% Impervious = 0.698 ac

Summary for Subcatchment S1: Pavement, Building, Grass

Runoff = 2.75 cfs @ 12.19 hrs, Volume= 0.234 af, Depth> 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
0	30	Woods, Good, HSG A
30,425	98	Paved parking, HSG A
28,640	39	>75% Grass cover, Good, HSG A
59,065	69	Weighted Average
28,640		48.49% Pervious Area
30,425		51.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	83	0.0301	0.13		Sheet Flow, A-B Sheet Grass: Dense n= 0.240 P2= 3.00"
0.2	70	0.0100	5.36	4.21	Pipe Channel, B-C Pipe 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
2.7	288	0.0139	1.77		Shallow Concentrated Flow, C-D Shallow Grassed Waterway Kv= 15.0 fps
13.7	441	Total			

Summary for Subcatchment S2: Meadow

Runoff = 0.07 cfs @ 12.60 hrs, Volume= 0.020 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
2,544	30	Woods, Good, HSG A
0	98	Paved parking, HSG A
43,780	39	>75% Grass cover, Good, HSG A
46,324	39	Weighted Average
46,324		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0150	0.10		Sheet Flow, A-B Sheet Grass: Dense n= 0.240 P2= 3.00"
2.0	182	0.0462	1.50		Shallow Concentrated Flow, B-C Shallow Short Grass Pasture Kv= 7.0 fps
18.5	282	Total			

Summary for Pond P1: Infiltration Pond

Inflow Area = 1.356 ac, 51.51% Impervious, Inflow Depth > 2.07" for 25-Year event
 Inflow = 2.75 cfs @ 12.19 hrs, Volume= 0.234 af
 Outflow = 0.06 cfs @ 11.07 hrs, Volume= 0.047 af, Atten= 98%, Lag= 0.0 min
 Discarded = 0.06 cfs @ 11.07 hrs, Volume= 0.047 af
 Primary = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs
 Peak Elev= 351.95' @ 20.00 hrs Surf.Area= 4,801 sf Storage= 8,146 cf

Plug-Flow detention time= 209.0 min calculated for 0.047 af (20% of inflow)
 Center-of-Mass det. time= 105.7 min (917.8 - 812.1)

Volume	Invert	Avail.Storage	Storage Description
#1	340.00'	4,000 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 10,000 cf Overall x 40.0% Voids
#2	350.00'	9,496 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		13,496 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
340.00	1,000	0	0
350.00	1,000	10,000	10,000

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
350.00	1,001	0	0
351.00	1,895	1,448	1,448
352.00	3,907	2,901	4,349
353.00	6,387	5,147	9,496

Device	Routing	Invert	Outlet Devices
#1	Discarded	340.00'	0.06 cfs Exfiltration when above 340.00'
#2	Primary	352.00'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir 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

Discarded OutFlow Max=0.06 cfs @ 11.07 hrs HW=340.13' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 10.00 hrs HW=340.00' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Link SP1: Culvert

Inflow Area = 2.419 ac, 28.87% Impervious, Inflow Depth > 0.10" for 25-Year event
 Inflow = 0.07 cfs @ 12.60 hrs, Volume= 0.020 af
 Primary = 0.07 cfs @ 12.60 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 10.00-20.00 hrs, dt= 0.01 hrs

APPENDIX C
Phosphorus Calculations

Worksheet 1			
PPB Calculations			
Project Name:	Retail Facility		
Standard Calculations			
Watershed per acre phosphorus allocation (Appendix C):	P	0.046	lbs/acre/year
Total acreage of development parcel	TA	2.060	acres
Existing impervious area (Pre 1980)	EIA _B	0.005	acres
Existing impervious area (Post 1980)	EIA _A	0.000	acres
NWI wetland acreage:	WA	0.000	acres
Steep slope acreage:	SA	0	acres
Project acreage: A = TA - (WA + SA + EIA _B + EIA _A)	A	2.06	acres
Project Phosphorus Budget: PPB = P x A	PPB	0.0945	lbs P/yr

Worksheet 2 Pre-PPE Calculations						
Project Name: Dollar General Litchfield			Development Type: Commercial			
Land Surface Type of Lot #(s) with description	Acres/#	Export Coefficient from Table 3.1	Pre-treatment Algal Av. P Export (lbs P/year)	Treatment Factor for BMP(s) from Chapter 6	Post-treatment Algal Av. P Export (lbs P/year)	Description of BMPs
Lawn/Landscape (HSG A)	0.00	0.10	0.0000	1.0	0.0000	
Acces Road/Driveway (low export)	0.47	1.25	0.5865	0.13	0.0780	Infiltration
Access Road (high export)	0.00	1.75	0.0000	0.13	0.0000	Infiltration
Buildings	0.22	0.50	0.1076	0.13	0.0143	Infiltration
Lawn/Landscape (HSG A)	0.46	0.10	0.0459	0.13	0.0061	Infiltration
			Pre-PPE (lbs P/year)	0.7401	Post-PPE (lbs P/year)	0.0984

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Worksheet 3 Mitigation: Source Elimination Credit								
Project Name: Retail Facility					Development Type: Commercial			
Mitigation Source Area Land Use	Acres	Export Coefficient (lbs P/acre/year)	Modifier	Pre-Treatment Historical P Export (lbs P/year)	Treatment Factor for Historical BMP(s) (1.0 if no BMPs)	Historical P Export (lbs P/year)	Mitigation Credit (lbs P/year)	Comments
Roof	0.0046	0.5	0.5	0.0011	1.0	0.0011	0.0011	Removal of Cobble Building
Total Source Elimination Mitigation Credit							0.0011 lbs P/year	

Worksheet 4			
Project Phosphorus Export Summary			
Summarizing the project's algal available phosphorus export (PPE)			
Project Name: Dollar General Sabattus			
Project Phosphorus Budget	PPB	0.0945	lbs P/year
Mitigation Credit- Source Elimination Credit	SEC	0.0011	lbs P/year
Source Treatment Credit	STC	0.0000	lbs P/year
Total Phosphorus Mitigation Credit (SEC+STC)	TMC	0.0011	lbs P/year
Total Pre-treatment Phosphorus Export Worksheet 2	Pre-PPE	0.7401	lbs P/year
Total Post-treatment Phosphorus Export Worksheet 2	Post-PPE	0.0984	lbs P/year
Project Phosphorus Export (Post-PPE - TMC)	PPE	0.0972	lbs P/year

APPENDIX D
Infiltration Sizing and TF Calculations

APPENDIX E
Sample Maintenance Log

DEP Project #

Retail Facility
BMP MAINTENANCE LOG

PAGE ____

BMP STRUCTURE	INSPECTOR (NAME)	WORK PERFORMED	DATE PERFORMED	COMMENTS
Ditches/Swales				
Culverts				
Infiltration Basin				
Other				
Additional Comments:				