CASE FILE #PL201900220

CREEKVIEW
EAST PARKING LOT

Stormwater Management Report

Bloomington, MN

11/20/19

I hereby certify that this report
was prepared by me or under my direct
supervision, and that I am a duly Registered
Professional Engineer under the laws of
the State of Minnesota

Vicki J. VanDell, P.E.

Date: 11/20/19 Reg. No. 41352

CASE FILE #PL201900220

STORMWATER MANAGEMENT REPORT
CREEKVIEW FRAUNENSHUH PARKING LOT ADDITION
BLOOMINGTON, MN

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Summary

This is a project in the Northwest portion of the City of Bloomington MN. The site is between I-494 and West 78th St. The existing site consists of a wooded lot between office parks. The proposed use is a parking lot. The project includes construction of a parking lot totaling 23 stalls. The surrounding site to the north is W 78th St and residential, the south side of the site is South Fork Nine Mile Creek and I-494, and to the east and west are office buildings. This site is 2.71 acres. The development will also include an infiltration basin for storm water treatment.

Existing

The existing site consists of a wooded area with moderate underbrush. The site drains to the southeast into the South Fork of Nine Mile Creek. The existing soils, per soils report dated November 19, 2019 shows silty sand for the top 4'and poorly graded sand with silt soils from 4' to 9' deep.

Proposed

The proposed site will include a twenty-three stall parking lot with a paved connection to the existing drive on the west side of the project. We are proposing an infiltration basin treatment system to account for rate control as well as water quality treatment. The basin has been shifted in location to avoid Boring 1 location and maintain the needed three-foot separation from the groundwater elevation. Boring 1 showed less than desirable soils and a higher groundwater elevation.

Stormwater Management Requirements

- **Rate Retention:**
  The Nine Mile Water Shed requires rate retention of 1.1" of runoff from the regulated imperious surface of the disturbed area.

- **Rate Control:**
  The Nine Mile Creek Watershed District requirements state that discharge rates leaving the site must not exceed the current rates for the 2, 10 and 100-year, critical duration (24-hour) storm events.

Rainfall Frequency	Rainfall (Inches)
2-Year 24-Hour	2.86
10-Year 24-Hour	4.26
100-Year 24-Hour	7.32

- **Water Quality:**
  Nine Mile Creek Watershed District requirements state the water quality treatment provide for at least 90 percent annual removal efficiency for total suspended solids and 60 percent annual efficiency for total Phosphorus from disturbed site area runoff. Onsite retention systems may be included in demonstrating compliance with the total suspended solids and total phosphorus removal requirements.

Rate Control

We are proposing an infiltration basin to meet the rate control requirements. Storm water will discharge to the basin where it will be held back until it can discharge into the South Fork Nine Mile Creek.

EXISTING

Drainage Area	2-YR. (2.86") (CFS)	10-Yr. (4.26") (CFS)	100-Yr. (7.32") (CFS)
EX-1	0.32	1.03	3.09
Total	**0.32**	**1.03**	**3.09**

PROPOSED

Drainage Area	2-YR. (2.86") (CFS)	10-Yr. (4.26") (CFS)	100-Yr. (7.32") (CFS)
PR-2	0.03	0.11	0.35
PR-3	0.11	0.46	1.11
P-1	0.01	0.22	0.91
Total	**0.15**	**0.79**	**2.37**

DIFFERENCE

	2-YR. (2.86") (CFS)	10-Yr. (4.26") (CFS)	100-Yr. (7.32") (CFS)
Total	**-0.17**	**-0.24**	**-0.72**

Retention

We have an increase in impervious area of 12,943 square feet requiring 1,259 cubic feet of storage and we are providing 2,560 cubic feet of storage. Therefore, we exceed the retention requirements.

Water Quality

We are proposing an infiltration basin. Storm water will discharge to the south into the South Fork Nine Mile creek drainage area. The soils report attached states that the soils are C soils with an infiltration rate of 0.20 inches/hour per the Minnesota Stormwater Manual. The infiltration depth for soils with an infiltration rate of 0.20 in/hr using the 48-hr draw-down requirement is 0.8-ft. The surface infiltration basin has a depth of 0.8 ft for infiltration.

The P8 model attached shows that the site meets the removals required. All impervious surface is directed to the infiltration basin with a pre-treatment Turret structure. The basin has a volume greater than the 1.1-inch required.

REMOVAL %

Variable	OVERALL	INF BASIN
TSS	94.9	94.9
TP	90.2	90.2

Floodplain Mitigation

The floodplain along Nine Mile Creek has an elevation of approximately 825.5. The section along the proposed parking lot is proposed to be filled to bring the grade up to the parking lot elevation. The proposed area to be filled has a volume of 363 cubic-feet. An area south of the proposed infiltration basin is excavated to mitigate for the floodplain fill. This area creates an additional floodplain volume of 364 cubic-feet.

Erosion Control

Best Management Practices will be followed for all erosion control measures. Silt fence will be used around the perimeter of the site where the green area drains off-site. The catch basins will have inlet protection. The flared end sections will be installed with rip rap at the outlets. We will have a rock construction entrance to reduce the amount of sediment leaving the site. Additional information on erosion control can be found in the Plan Set.

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Appendix A

HydroCAD Report, Existing
HydroCAD Report, Proposed

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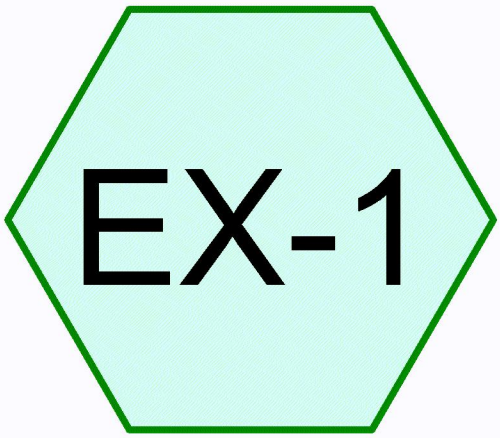

DA1

Subcat Reach Pond Link

Routing Diagram for Existing Drainage
Prepared by {enter your company name here}, Printed 11/19/2019
HydroCAD® 10.00-24 s/n 02676 © 2018 HydroCAD Software Solutions LLC

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.015	98	Paved parking, HSG B (EX-1)
0.850	65	Woods/grass comb., Fair, HSG B (EX-1)
0.865	**66**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.865	HSG B	EX-1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.865		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.015	0.000	0.000	0.000	0.015	Paved parking	EX-1
0.000	0.850	0.000	0.000	0.000	0.850	Woods/grass comb., Fair	EX-1
0.000	**0.865**	**0.000**	**0.000**	**0.000**	**0.865**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 EX-1: DA1 Runoff Area=37,697 sf 1.79% Impervious Runoff Depth>0.41"
Flow Length=133' Tc=22.3 min CN=66 Runoff=0.32 cfs 0.030 af

Total Runoff Area = 0.865 ac Runoff Volume = 0.030 af Average Runoff Depth = 0.41"
98.21% Pervious = 0.850 ac 1.79% Impervious = 0.015 ac

Summary for Subcatchment EX-1: DA1

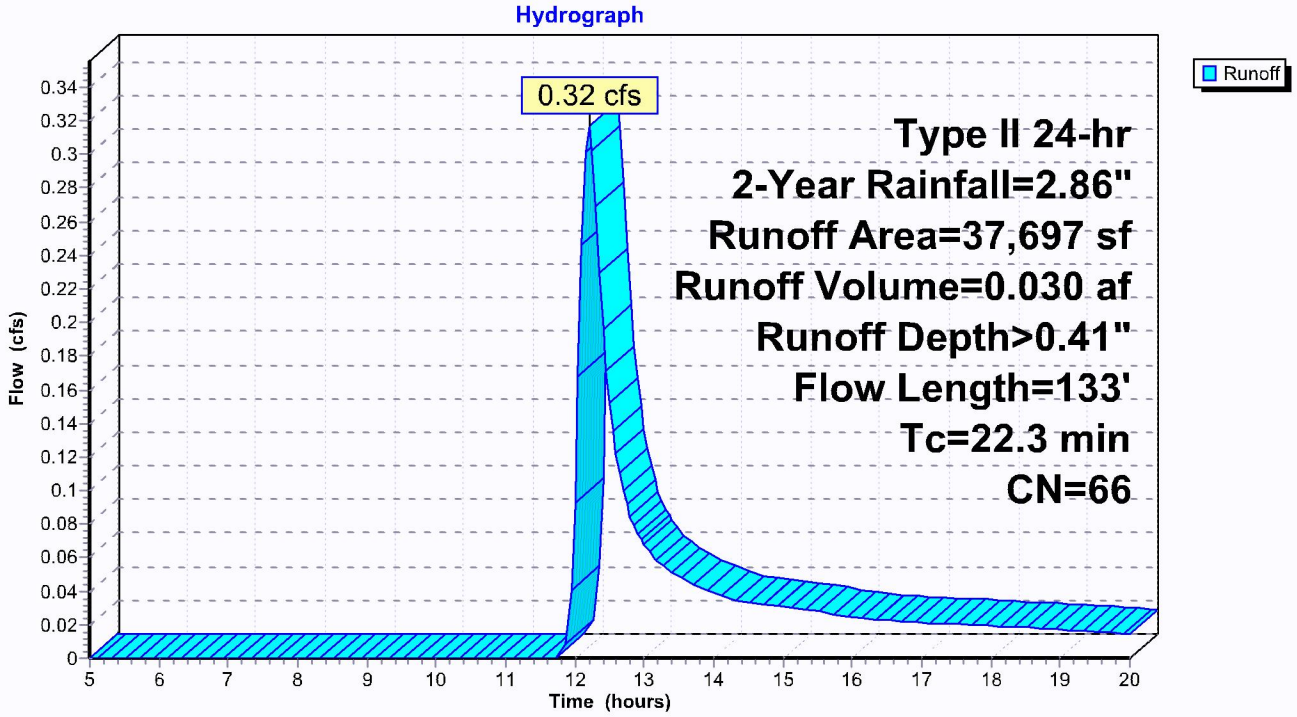
Runoff = 0.32 cfs @ 12.20 hrs, Volume= 0.030 af, Depth> 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.86"

Area (sf)	CN	Description
37,024	65	Woods/grass comb., Fair, HSG B
673	98	Paved parking, HSG B
37,697	66	Weighted Average
37,024		98.21% Pervious Area
673		1.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	7	0.1240	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
16.8	98	0.0410	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
4.2	28	0.1070	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
22.3	133	Total			

Subcatchment EX-1: DA1



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 EX-1: DA1 Runoff Area=37,697 sf 1.79% Impervious Runoff Depth>1.11"
Flow Length=133' Tc=22.3 min CN=66 Runoff=1.03 cfs 0.080 af

Total Runoff Area = 0.865 ac Runoff Volume = 0.080 af Average Runoff Depth = 1.11"
98.21% Pervious = 0.850 ac 1.79% Impervious = 0.015 ac

Summary for Subcatchment EX-1: DA1

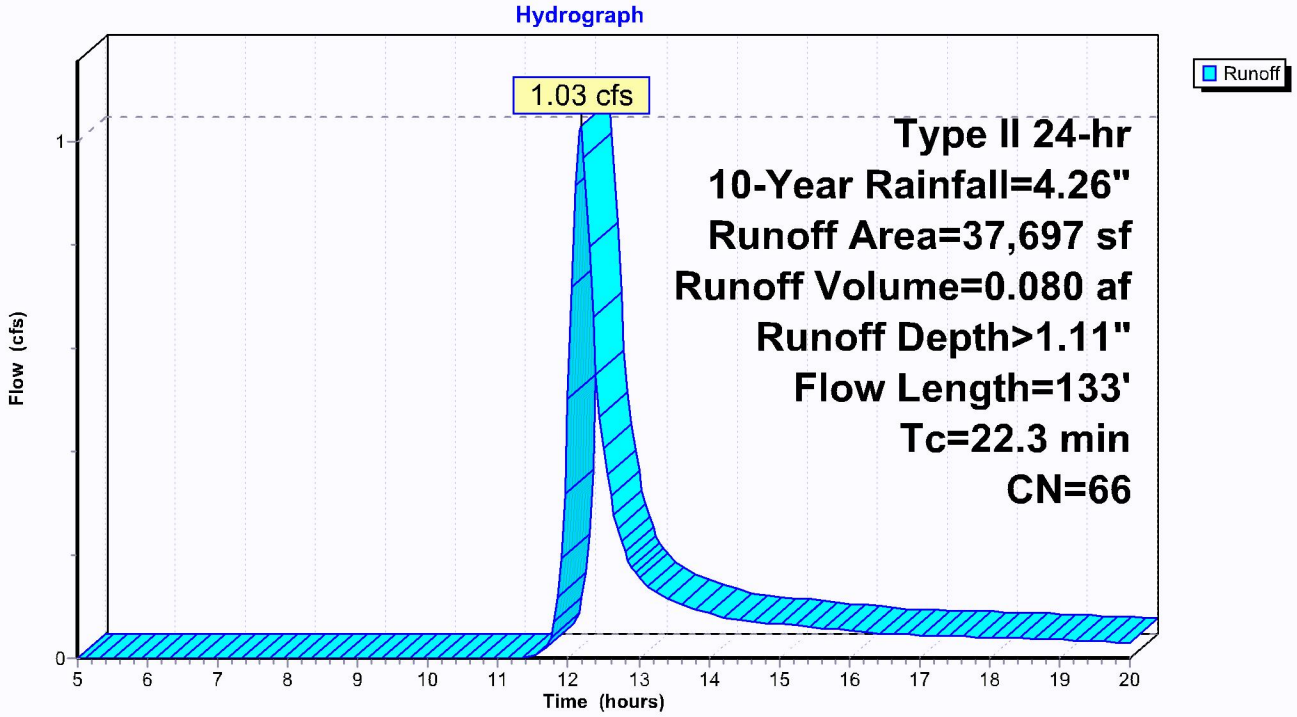
Runoff = 1.03 cfs @ 12.17 hrs, Volume= 0.080 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=4.26"

Area (sf)	CN	Description
37,024	65	Woods/grass comb., Fair, HSG B
673	98	Paved parking, HSG B
37,697	66	Weighted Average
37,024		98.21% Pervious Area
673		1.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	7	0.1240	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
16.8	98	0.0410	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
4.2	28	0.1070	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
22.3	133	Total			

Subcatchment EX-1: DA1



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 EX-1: DA1 Runoff Area=37,697 sf 1.79% Impervious Runoff Depth>3.16"
Flow Length=133' Tc=22.3 min CN=66 Runoff=3.09 cfs 0.228 af

Total Runoff Area = 0.865 ac Runoff Volume = 0.228 af Average Runoff Depth = 3.16"
98.21% Pervious = 0.850 ac 1.79% Impervious = 0.015 ac

Summary for Subcatchment EX-1: DA1

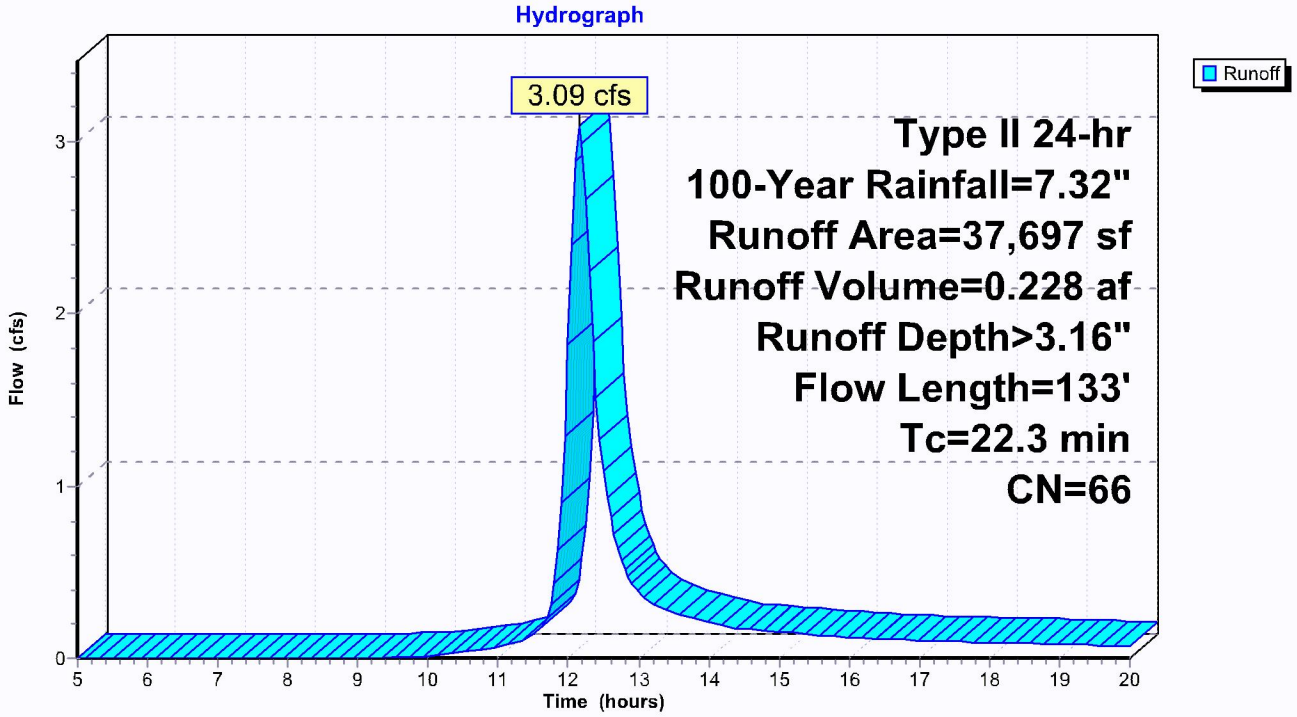
Runoff = 3.09 cfs @ 12.16 hrs, Volume= 0.228 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.32"

Area (sf)	CN	Description
37,024	65	Woods/grass comb., Fair, HSG B
673	98	Paved parking, HSG B
37,697	66	Weighted Average
37,024		98.21% Pervious Area
673		1.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	7	0.1240	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
16.8	98	0.0410	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
4.2	28	0.1070	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
22.3	133	Total			

Subcatchment EX-1: DA1



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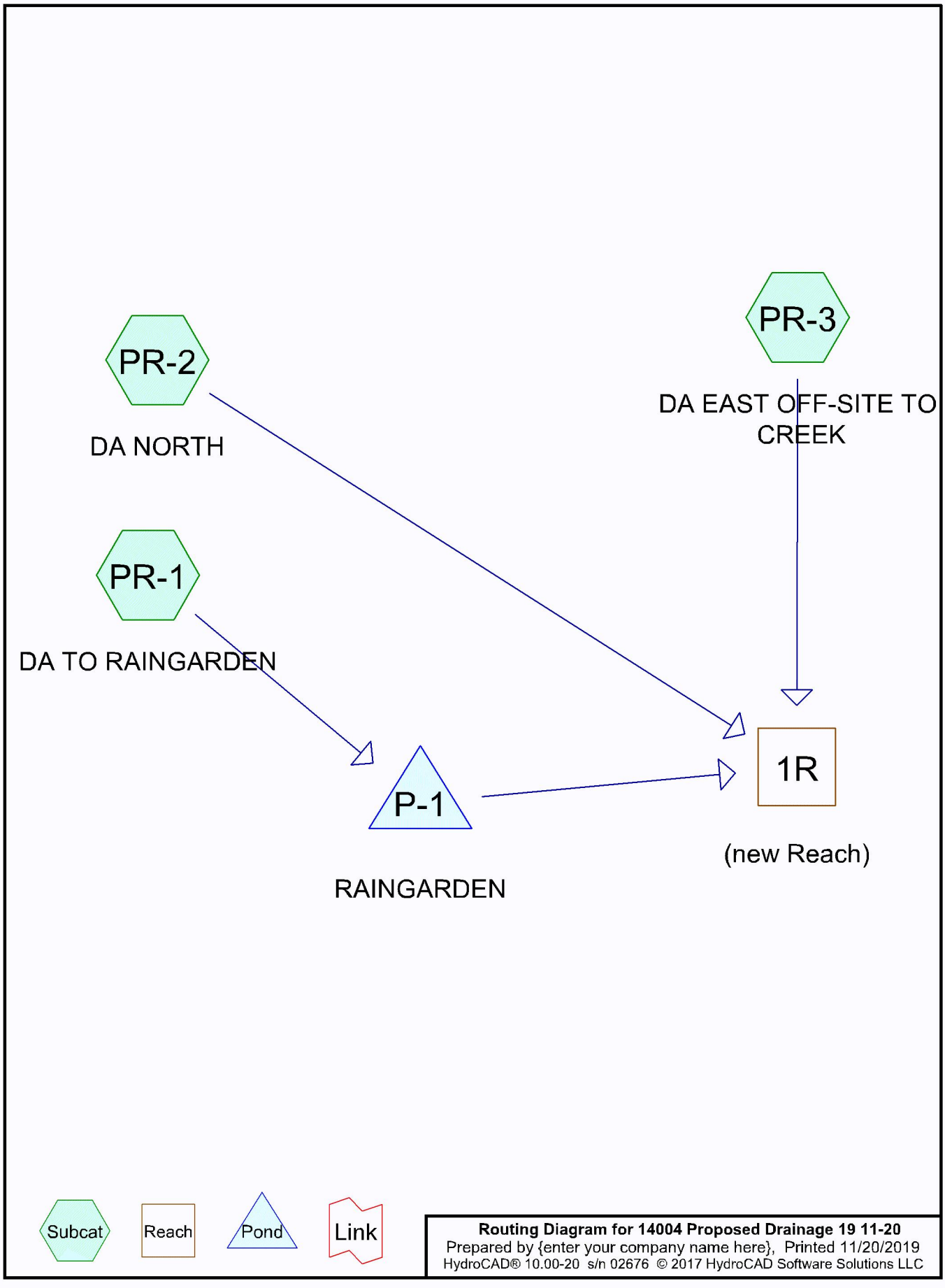

Routing Diagram for 14004 Proposed Drainage 19 11-20
Prepared by {enter your company name here}, Printed 11/20/2019
HydroCAD® 10.00-20 s/n 02676 © 2017 HydroCAD Software Solutions LLC

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.355	61	>75% Grass cover, Good, HSG B (PR-2, PR-3)
0.313	98	Paved parking, HSG B (PR-1)
0.210	65	Woods/grass comb., Fair, HSG B (PR-1)

Summary for Subcatchment PR-1: DA TO RAINGARDEN

Runoff = 1.47 cfs @ 11.94 hrs, Volume= 0.064 af, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.86"

Area (sf)	CN	Description
9,137	65	Woods/grass comb., Fair, HSG B
13,616	98	Paved parking, HSG B
22,753	85	Weighted Average
9,137		40.16% Pervious Area
13,616		59.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	238	0.0100	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"

Summary for Subcatchment PR-2: DA NORTH

Runoff = 0.03 cfs @ 11.94 hrs, Volume= 0.002 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.86"

Area (sf)	CN	Description
2,571	61	>75% Grass cover, Good, HSG B
2,571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	10	0.0600	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"

Summary for Subcatchment PR-3: DA EAST OFF-SITE TO CREEK

Runoff = 0.07 cfs @ 12.11 hrs, Volume= 0.008 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.86"

Area (sf)	CN	Description
12,913	61	>75% Grass cover, Good, HSG B
12,913		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	28	0.0860	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
9.0	84	0.0200	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"
13.6	112	Total			

Summary for Reach 1R: (new Reach)

Inflow Area = 0.878 ac, 35.61% Impervious, Inflow Depth = 0.19" for 2-Year event
Inflow = 0.08 cfs @ 12.11 hrs, Volume= 0.014 af
Outflow = 0.08 cfs @ 12.11 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs

Summary for Pond P-1: RAINGARDEN

Inflow Area = 0.522 ac, 59.84% Impervious, Inflow Depth = 1.47" for 2-Year event
Inflow = 1.47 cfs @ 11.94 hrs, Volume= 0.064 af
Outflow = 0.02 cfs @ 18.58 hrs, Volume= 0.042 af, Atten= 99%, Lag= 398.5 min
Discarded = 0.01 cfs @ 18.58 hrs, Volume= 0.038 af
Primary = 0.01 cfs @ 18.58 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 827.60' @ 18.58 hrs Surf.Area= 2,589 sf Storage= 2,063 cf

Plug-Flow detention time= 1,011.1 min calculated for 0.042 af (66% of inflow)
Center-of-Mass det. time= 903.1 min (1,728.7 - 825.6)

Volume	Invert	Avail.Storage	Storage Description
#1	826.75'	6,191 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
826.75	2,110	175.5	0	0	2,110
827.00	2,244	180.8	544	544	2,267
828.00	2,818	201.9	2,526	3,070	2,937
828.55	3,150	213.0	1,640	4,710	3,321
829.00	3,433	222.0	1,481	6,191	3,648

Device	Routing	Invert	Outlet Devices
#1	Primary	828.75'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	826.75'	**0.200 in/hr Exfiltration over Surface area**
#3	Device 5	827.55'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 5	828.66'	**40.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

#5	Primary	827.55'	**6.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 827.55' / 827.35' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 18.58 hrs HW=827.60' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.01 cfs @ 18.58 hrs HW=827.60' (Free Discharge)
├**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**5=Culvert** (Controls 0.01 cfs)
  ├**3=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.77 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Subcatchment PR-1: DA TO RAINGARDEN

Runoff = 2.62 cfs @ 11.94 hrs, Volume= 0.117 af, Depth= 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=4.26"

Area (sf)	CN	Description
9,137	65	Woods/grass comb., Fair, HSG B
13,616	98	Paved parking, HSG B
22,753	85	Weighted Average
9,137		40.16% Pervious Area
13,616		59.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	238	0.0100	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"

Summary for Subcatchment PR-2: DA NORTH

Runoff = 0.11 cfs @ 11.92 hrs, Volume= 0.005 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=4.26"

Area (sf)	CN	Description
2,571	61	>75% Grass cover, Good, HSG B
2,571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	10	0.0600	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"

Summary for Subcatchment PR-3: DA EAST OFF-SITE TO CREEK

Runoff = 0.33 cfs @ 12.08 hrs, Volume= 0.023 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=4.26"

Area (sf)	CN	Description
12,913	61	>75% Grass cover, Good, HSG B
12,913		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	28	0.0860	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
9.0	84	0.0200	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"
13.6	112	Total			

Summary for Reach 1R: (new Reach)

Inflow Area = 0.878 ac, 35.61% Impervious, Inflow Depth = 1.13" for 10-Year event
Inflow = 0.52 cfs @ 12.10 hrs, Volume= 0.083 af
Outflow = 0.52 cfs @ 12.10 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs

Summary for Pond P-1: RAINGARDEN

Inflow Area = 0.522 ac, 59.84% Impervious, Inflow Depth = 2.69" for 10-Year event
Inflow = 2.62 cfs @ 11.94 hrs, Volume= 0.117 af
Outflow = 0.23 cfs @ 12.39 hrs, Volume= 0.094 af, Atten= 91%, Lag= 27.2 min
Discarded = 0.01 cfs @ 12.39 hrs, Volume= 0.040 af
Primary = 0.22 cfs @ 12.39 hrs, Volume= 0.055 af

Routing by Stor-Ind method, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 827.84' @ 12.39 hrs Surf.Area= 2,729 sf Storage= 2,676 cf

Plug-Flow detention time= 532.6 min calculated for 0.094 af (81% of inflow)
Center-of-Mass det. time= 453.7 min (1,262.1 - 808.4)

Volume	Invert	Avail.Storage	Storage Description
#1	826.75'	6,191 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
826.75	2,110	175.5	0	0	2,110
827.00	2,244	180.8	544	544	2,267
828.00	2,818	201.9	2,526	3,070	2,937
828.55	3,150	213.0	1,640	4,710	3,321
829.00	3,433	222.0	1,481	6,191	3,648

Device	Routing	Invert	Outlet Devices
#1	Primary	828.75'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	826.75'	**0.200 in/hr Exfiltration over Surface area**
#3	Device 5	827.55'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 5	828.66'	**40.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

#5	Primary	827.55'	**6.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 827.55' / 827.35' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 12.39 hrs HW=827.84' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.22 cfs @ 12.39 hrs HW=827.84' (Free Discharge)
├**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**5=Culvert** (Controls 0.22 cfs)
  ├**3=Orifice/Grate** (Orifice Controls 0.22 cfs @ 1.85 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Subcatchment PR-1: DA TO RAINGARDEN

Runoff = 5.17 cfs @ 11.94 hrs, Volume= 0.242 af, Depth= 5.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.32"

Area (sf)	CN	Description
9,137	65	Woods/grass comb., Fair, HSG B
13,616	98	Paved parking, HSG B
22,753	85	Weighted Average
9,137		40.16% Pervious Area
13,616		59.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	238	0.0100	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"

Summary for Subcatchment PR-2: DA NORTH

Runoff = 0.35 cfs @ 11.91 hrs, Volume= 0.014 af, Depth= 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.32"

Area (sf)	CN	Description
2,571	61	>75% Grass cover, Good, HSG B
2,571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	10	0.0600	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"

Summary for Subcatchment PR-3: DA EAST OFF-SITE TO CREEK

Runoff = 1.16 cfs @ 12.06 hrs, Volume= 0.073 af, Depth= 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.32"

Area (sf)	CN	Description
12,913	61	>75% Grass cover, Good, HSG B
12,913		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	28	0.0860	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
9.0	84	0.0200	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"
13.6	112	Total			

Summary for Reach 1R: (new Reach)

Inflow Area = 0.878 ac, 35.61% Impervious, Inflow Depth = 3.60" for 100-Year event
Inflow = 2.11 cfs @ 12.06 hrs, Volume= 0.263 af
Outflow = 2.11 cfs @ 12.06 hrs, Volume= 0.263 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs

Summary for Pond P-1: RAINGARDEN

Inflow Area = 0.522 ac, 59.84% Impervious, Inflow Depth = 5.56" for 100-Year event
Inflow = 5.17 cfs @ 11.94 hrs, Volume= 0.242 af
Outflow = 0.92 cfs @ 12.09 hrs, Volume= 0.219 af, Atten= 82%, Lag= 9.4 min
Discarded = 0.02 cfs @ 12.09 hrs, Volume= 0.042 af
Primary = 0.91 cfs @ 12.09 hrs, Volume= 0.176 af

Routing by Stor-Ind method, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 828.72' @ 12.09 hrs Surf.Area= 3,255 sf Storage= 5,259 cf

Plug-Flow detention time= 281.3 min calculated for 0.218 af (90% of inflow)
Center-of-Mass det. time= 233.1 min (1,021.0 - 787.9)

Volume	Invert	Avail.Storage	Storage Description
#1	826.75'	6,191 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
826.75	2,110	175.5	0	0	2,110
827.00	2,244	180.8	544	544	2,267
828.00	2,818	201.9	2,526	3,070	2,937
828.55	3,150	213.0	1,640	4,710	3,321
829.00	3,433	222.0	1,481	6,191	3,648

Device	Routing	Invert	Outlet Devices
#1	Primary	828.75'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	826.75'	**0.200 in/hr Exfiltration over Surface area**
#3	Device 5	827.55'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 5	828.66'	**40.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

#5	Primary	827.55'	**6.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 827.55' / 827.35' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.02 cfs @ 12.09 hrs HW=828.72' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.90 cfs @ 12.09 hrs HW=828.72' (Free Discharge)
├**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**5=Culvert** (Inlet Controls 0.90 cfs @ 4.61 fps)
  ├**3=Orifice/Grate** (Passes < 0.90 cfs potential flow)
  └**4=Orifice/Grate** (Passes < 0.45 cfs potential flow)

Summary for Subcatchment PR-1: DA TO RAINGARDEN

Runoff = 1.34 cfs @ 11.94 hrs, Volume= 0.058 af, Depth= 1.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr Custom Rainfall=2.70"

Area (sf)	CN	Description
9,137	65	Woods/grass comb., Fair, HSG B
13,616	98	Paved parking, HSG B
22,753	85	Weighted Average
9,137		40.16% Pervious Area
13,616		59.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	238	0.0100	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"

Summary for Subcatchment PR-2: DA NORTH

Runoff = 0.02 cfs @ 11.94 hrs, Volume= 0.001 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr Custom Rainfall=2.70"

Area (sf)	CN	Description
2,571	61	>75% Grass cover, Good, HSG B
2,571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	10	0.0600	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"

Summary for Subcatchment PR-3: DA EAST OFF-SITE TO CREEK

Runoff = 0.05 cfs @ 12.11 hrs, Volume= 0.006 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Type II 24-hr Custom Rainfall=2.70"

Area (sf)	CN	Description
12,913	61	>75% Grass cover, Good, HSG B
12,913		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	28	0.0860	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
9.0	84	0.0200	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"
13.6	112	Total			

Summary for Reach 1R: (new Reach)

Inflow Area = 0.878 ac, 35.61% Impervious, Inflow Depth = 0.11" for Custom event
Inflow = 0.06 cfs @ 12.11 hrs, Volume= 0.008 af
Outflow = 0.06 cfs @ 12.11 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs

Summary for Pond P-1: RAINGARDEN

Inflow Area = 0.522 ac, 59.84% Impervious, Inflow Depth = 1.34" for Custom event
Inflow = 1.34 cfs @ 11.94 hrs, Volume= 0.058 af
Outflow = 0.01 cfs @ 24.00 hrs, Volume= 0.037 af, Atten= 99%, Lag= 723.5 min
Discarded = 0.01 cfs @ 24.00 hrs, Volume= 0.037 af
Primary = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 2.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 827.56' @ 24.00 hrs Surf.Area= 2,567 sf Storage= 1,966 cf

Plug-Flow detention time= 1,083.3 min calculated for 0.037 af (64% of inflow)
Center-of-Mass det. time= 971.2 min (1,799.5 - 828.3)

Volume	Invert	Avail.Storage	Storage Description
#1	826.75'	6,191 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
826.75	2,110	175.5	0	0	2,110
827.00	2,244	180.8	544	544	2,267
828.00	2,818	201.9	2,526	3,070	2,937
828.55	3,150	213.0	1,640	4,710	3,321
829.00	3,433	222.0	1,481	6,191	3,648

Device	Routing	Invert	Outlet Devices
#1	Primary	828.75'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	826.75'	**0.200 in/hr Exfiltration over Surface area**
#3	Device 5	827.55'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 5	828.66'	**40.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

#5	Primary	827.55'	**6.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 827.55' / 827.35' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 24.00 hrs HW=827.56' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

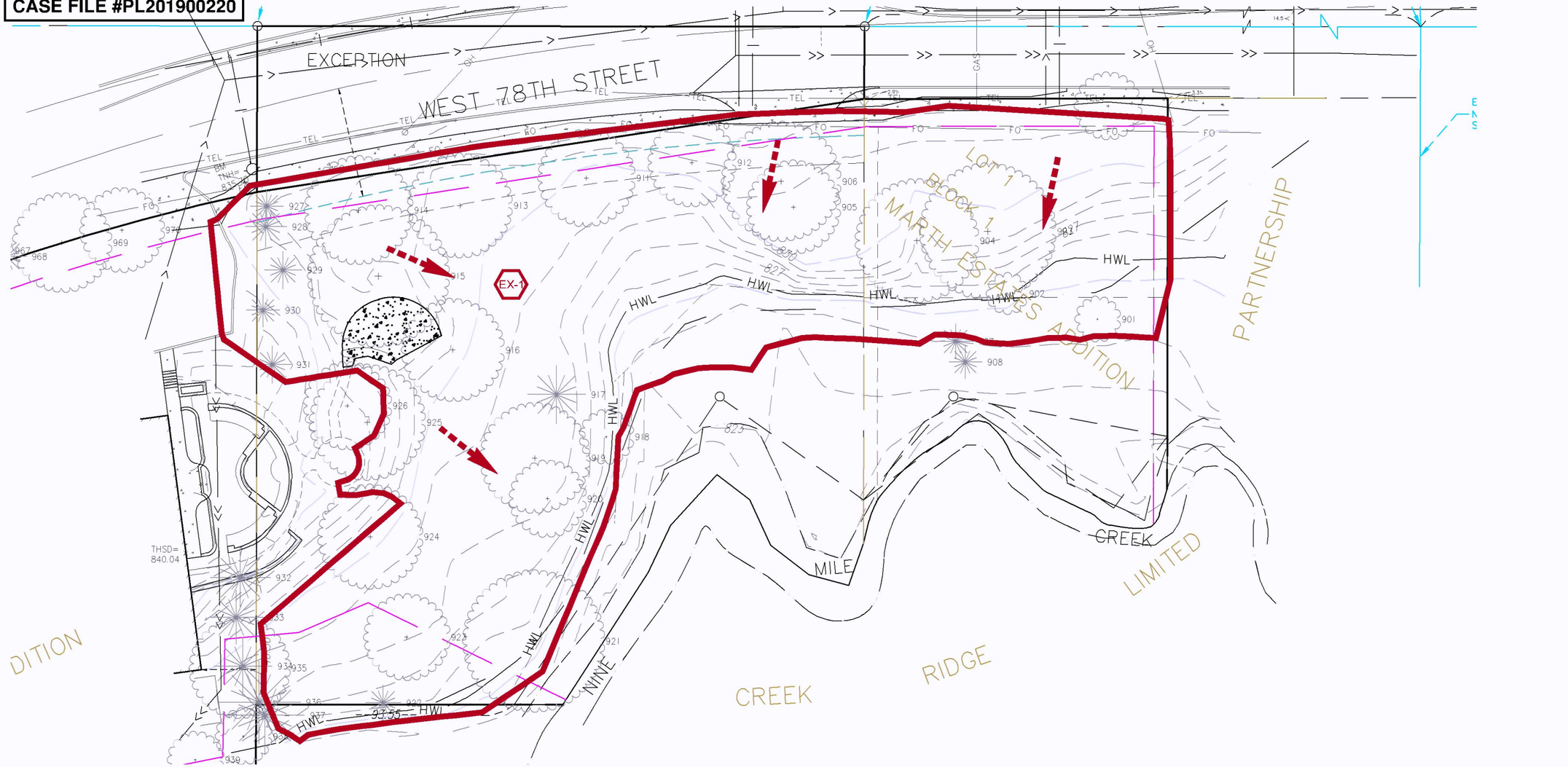
Primary OutFlow Max=0.00 cfs @ 24.00 hrs HW=827.56' (Free Discharge)
├**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**5=Culvert** (Barrel Controls 0.00 cfs @ 0.55 fps)
  ├**3=Orifice/Grate** (Passes 0.00 cfs of 0.00 cfs potential flow)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

CASE FILE #PL201900220

Figures

Existing & Proposed Drainage Exhibit

CASE FILE #PL201900220



LEGEND

- SUBCATCHMENT
- INFILTRATION BASIN
- SITE DISCHARGE

0 40 80

SCALE IN FEET

CREEKVIEW EAST PARKING LOT

PROJECT ADDRESS

FRAUENSHUH

7101 WEST 7TH STREET
MINNEAPOLIS, MN 55439

LOUCKS

PLANNING
CIVIL ENGINEERING
LAND SURVEYING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL

7200 Hemlock Lane, Suite 300
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763.424.5505
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CADD QUALIFICATION

SUBMITTAL/REVISIONS

11/20/2019 WATERSHED SUBMITTAL

PROFESSIONAL SIGNATURE

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

NOT FOR CONSTRUCTION

Vicki J. Van Dell - PE

License No.	41352
Date	10/22/19

QUALITY CONTROL

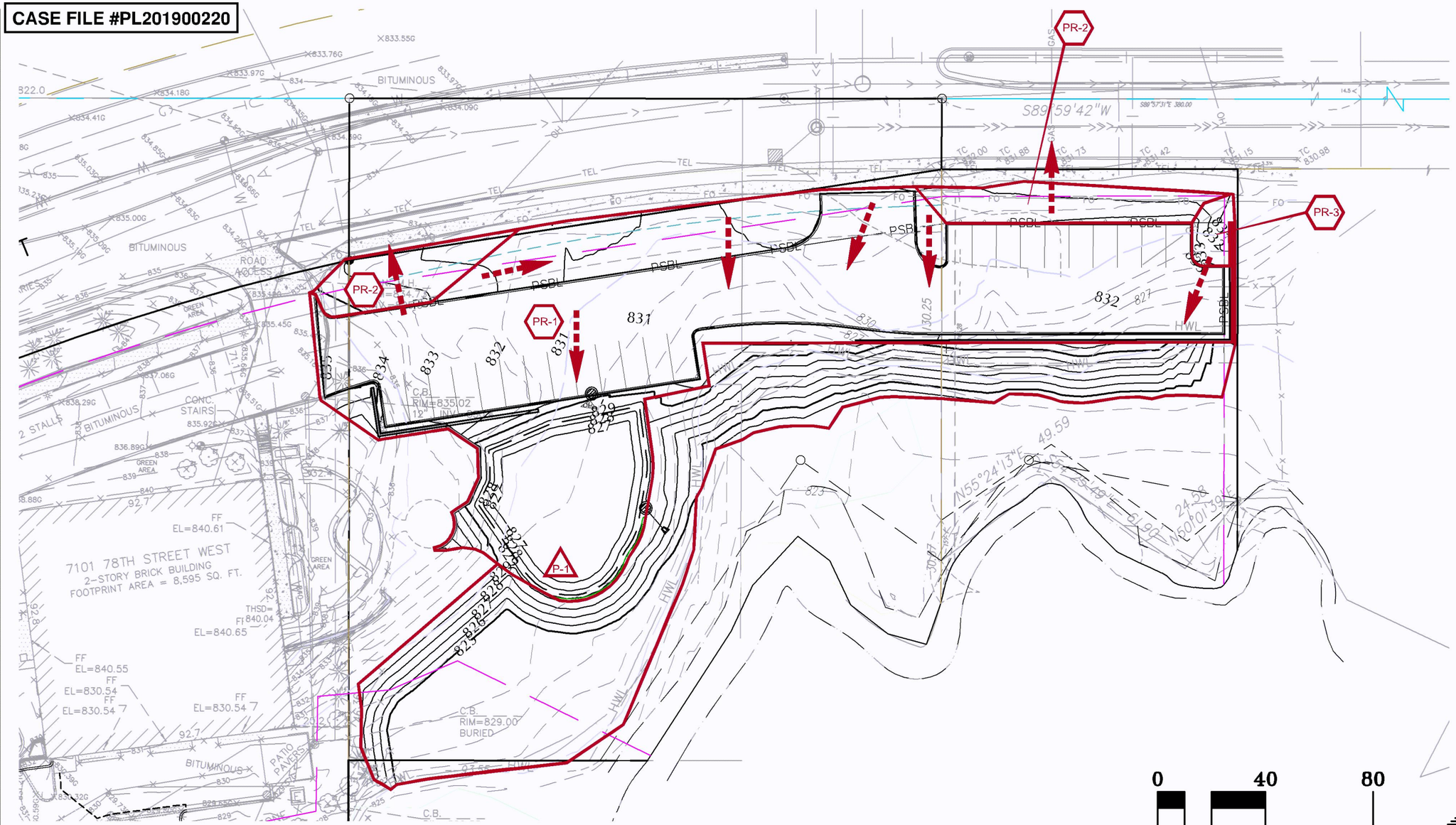
Loucks Project No.	14004.D
Project Lead	VJV
Drawn By	JBT
Checked By	VJV
Review Date	10/22/19

SHEET INDEX

EXISTING DRAINAGE AREA MAP

H1-1

CASE FILE #PL201900220



0 40 80

SCALE IN FEET

LEGEND

- SUBCATCHMENT
- INFILTRATION BASIN
- SITE DISCHARGE

CREEKVIEW EAST PARKING LOT

PROJECT ADDRESS

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SUBMITTAL/REVISIONS

11/20/2019 WATERSHED SUBMITTAL

PROFESSIONAL SIGNATURE

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

NOT FOR CONSTRUCTION

Vicki J. Van Dell - PE

License No.	41352
Date	10/22/19

QUALITY CONTROL

Loucks Project No.	14004.D
Project Lead	VJV
Drawn By	JBT
Checked By	VJV
Review Date	10/22/19

SHEET INDEX

PROPOSED DRAINAGE AREA MAP

H2-1

Plotted: 11/19/2019 4:46 PM W:\2014\14004\CADD DATA\CIVIL_dwg Sheet Files\14004.DH2-1 PROPOSED DRAINAGE MAP

CASE FILE #PL201900220

Project Information

Calculator Version:	Version 3: January 2017
Project Name:	Creeview
User Name / Company Name:	Loucks
Date:	7/24/18
Project Description:	
Construction Permit?:	Yes

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55439
Annual Rainfall (inches):	30.9
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land		0.55			0.55
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed					0
			Impervious Area (acres)		0.31
				Total Area (acres)	0.86

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land		0.55			0.55
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed					0
			Impervious Area (acres)		0.31
				Total Area (acres)	0.86

CASE FILE #PL201900220

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	1238	ft3
Volume removed by BMPs towards performance goal:	1238	ft^3
Percent volume removed towards performance goal	**100**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	0.7207	acre-ft
Annual runoff volume removed by BMPs:	0.6704	acre-ft
Percent annual runoff volume removed:	**93**	**%**
Post development annual particulate P load:	0.324	lbs
Annual particulate P removed by BMPs:	0.301	lbs
Post development annual dissolved P load:	0.265	lbs
Annual dissolved P removed by BMPs:	0.246	lbs
Percent annual total phosphorus removed:	**93**	**%**
Post development annual TSS load:	106.8	lbs
Annual TSS removed by BMPs:	99.4	lbs
Percent annual TSS removed:	**93**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Bioretention basin (w/o underdrain)	2104	1238	1238	0	100

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Bioretention basin (w/o underdrain)	0.7207	0	0.6704	0.0503	93

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Bioretention basin (w/o underdrain)	0.3235	0	0.3009	0.0226	93

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Bioretention basin (w/o underdrain)	0.2647	0	0.2462	0.0185	93

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Bioretention basin (w/o underdrain)	106.84	0	99.38	7.4600000000	93

BMP Schematic

CASE FILE #PL201900220

CreekView Parking Lot Addition

P8 Urban Catchment Model, Version 3.5 Run Date 11/20/19

Case New_Case.p8c FirstDate 01/01/83 Precip(in) 405.5

Title Startup Case LastDate 12/31/95 Rain(in) 370.66

PrecFile Msp5095.pcp Events 1035 Snow(in) 34.87

PartFile nurp50.p8p TotalHrs 113760 TotalYrs 12.98

Case Title Startup Case

Case Data File New_Case.p8c

Path C:\P8_UserFiles\

Case Notes: simple startup case

one device (wet pond)

one watershed

Storm Data File Msp5095.pcp

Particle File nurp50.p8p

Air Temp File File msp_4889.tem

Time Steps Per Hour 4

Minimum Inter-Event Time (hrs) 10

Maximum Continuity Error % 2

Rainfall Breakpoint (inches) 0.8

Precipitation Scale Factor 1

Air Temp Offset (deg-F) 0

Loops Thru Storm File 1

Simulation Dates

Start 6/1/1980

CASE FILE #PL201900220

Keep	1/1/1983
Stop	1/1/9999

Max Snowfall Temperature (deg-f)	32.0
SnowMelt Temperature (deg-f)	32.0
Snowmelt Coef (in/degF-Day)	0.06
Soil Freeze Temp (deg-F)	32.0
Snowmelt Abstraction Factor	1.00
Evapo-Trans. Calibration Factor	1.00
Growing Season Start Month	5
Growing Season End Month	10

5-Day Antecedent Rainfall + Runoff (inches)

CN Antecedent Moisture Condition	AMC-II	AMC-III
Growing Season	1.40	2.10
NonGrowing Season	0.50	1.10

Watershed Data

Watershed Name	PR-1
Runoff to Device	INF BASIN
Infiltration to Device	
Watershed Area	0.522
SCS Curve Number (Pervious)	65
Scale Factor for Pervious Runoff	1
Indirectly Connected Imperv Frac	0
UnSwept Impervious Fraction	0.5984
UnSwept Depression Storage (inch	0.02
UnSwept Imperv. Runoff Coefficie	1
UnSwept Scale Factor for Particl	1

CASE FILE #PL201900220

Swept Impervious Fraction	0
Swept Depression Storage (inches	0.02
Swept Imperv. Runoff Coefficient	1
Swept Scale Factor for Particle	1
Sweeping Frequency	0
Sweeping Efficiency	1
Sweeping Start Date (MMDD)	101
Sweeping Stop Date (MMDD)	1231

Device Data	
Device Name	INF BASIN
Device Type	INF_BASIN
Infiltration Outlet	
Normal Outlet	
Spillway Outlet	
Particle Removal Scale Factor	1
Bottom Elevation (ft)	826.75
Bottom Area (acres)	0.048
Permanent Pool Area (acres)	
Permanent Pool Volume (ac-ft)	
Perm Pool Infilt Rate (in/hr)	
Flood Pool Area (acres)	0.059
Flood Pool Volume (ac-ft)	0.045
Flood Pool Infilt Rate (in/hr)	0.2
Infilt Basin Void Fraction (%)	100
Detention Pond Outlet Parameters	
Outlet Type	
Outlet Orifice Diameter (in)	
Orifice Discharge Coef	

CASE FILE #PL201900220

Outlet Weir Length (ft)

Weir Discharge Coef

Perforated Riser Height (ft)

Number of Holes in Riser

Holes Diameter

Flood Pool Drain Time (hrs)

Swale Parameters

Length of Flow Path (ft)

Slope of Flow Path %

Bottom Width (ft)

Side Slope (ft-v/ft-h)

Maximum Depth of Flow (ft)

Mannings n Constant

Hydraulic Model

Pipe, Splitter, Aquifer Parameter

Hydraulic Res. Time (hrs)

Particle Data

Particle File nurp50.p8p

Particle Class	P0%	P10%	P30%	P50%	P80%
Filtration Efficiency	90	100	100	100	100
Settling Velocity (ft/	0	0.03	0.3	1.5	15
First Order Decay Rate	0	0	0	0	0
2nd Order Decay (1/day	0	0	0	0	0
Impervious Runoff Conc	1	0	0	0	0
Pervious Runoff Conc (	1	100	100	100	200
Pervious Conc Exponent	0	1	1	1	1
Accum. Rate (lbs-ac-da	0	1.75	1.75	1.75	3.5
Particle Removal Rate	0	0.25	0.25	0.25	0.25

CASE FILE #PL201900220

Washoff Coefficient	0	20	20	20	20
Washoff Exponent	0	2	2	2	2
Sweeper Efficiency	0	0	0	5	15

Water Quality Component Data

Component Name	TSS	TP	TKN	CU	PB	ZN	HC

Water Quality Criteria (ppm)

Level 1	5	0.025	2	2	0.02	5	0.1
Level 2	10	0.05	1	0.0048	0.014	0.0362	0.5
Level 3	20	0.1	0.5	0.02	0.15	0.38	1

Content Scale Factor	1	1	1	1	1	1	1

Particle Composition (mg/kg)

P0%	0	99000	600000	13600	2000	64000	250000
P10%	1000000	3850	15000	340	180	1600	22500
P30%	1000000	3850	15000	340	180	1600	22500
P50%	1000000	3850	15000	340	180	1600	22500
P80%	1000000	0	0	340	180	0	22500