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PRELIMINARY STORMWATER MANAGEMENT PLAN

FOR

KASOTA AVENUE TRAILER STORAGE

KASOTA AVENUE & HIGHWAY 280

SAINT PAUL, MN

PREPARED BY:

EMILY CASTANIAS

CHAD AYERS, PE

08/09/2019

PROJECT INTRODUCTION

The proposed project is a development of an existing site on the north-west corner of Kasota Avenue and Highway 280 in Saint Paul. The redevelopment will includes the addition of a parking lot for trailer storage as well as the addition of a rate control basin. The project is within the jurisdiction of the Mississippi Watershed Management Organization (MWMO). It is the intent of the project to meet the stormwater management requirement of the City of City of Saint Paul and the the construction of a rate control basin and a proprietary filtration device.

EXISTING CONDITIONS

The existing 1.67-acre site is undeveloped. The Geotechnical Report prepared by AET shows soils onsite to be primarily silty sands which may be classified as HSG type B soils. The soils on-site are largely contaminated. The north end of the site drains uncontrolled to the west where it runs along the adjacent railroad and enters an existing wetland basin south of the site. The southern end of the drains into an existing stormwater pond before discharging into the wetland south of the site. The site ultimately discharges into the Mississippi River approximately 1.75 miles away.

PROPOSED CONDITIONS

The proposed site includes the addition of 1.058 acres of impervious for the proposed parking lot. The majority of the site is captured and discharged into a rate control basin at the southwest end of the site. The rate control basin discharges into a proprietary device before discharging into the existing wetland south of the site. The western edge of the site runs off uncontrolled to the west where it runs along the adjacent railroad and enters an existing wetland basin south of the site.

RATE CONTROL AND WATER QUALITY

The City of Saint Paul requires post development discharge rates not exceed predevelopment discharge rates for the 2-, 10-, 100-year 24-hour rainfall events for all discharge points from the site. The City of Saint Paul also requires that runoff from a 5.9-inch Type II 24-hour event not exceed 1.64 cubic feet per second per acre of disturbed area. HydroCAD was used to model the existing and proposed site runoff. For the model, a curve number of 61 and 98 were used for the pervious and impervious areas respectively. The results of the analysis are below. Detailed calculations may be found in the appendices.

Due to contaminated soils infiltration and sand filtration with underdrain on site was not feasible. In order to meet MPCA water quality requirements a proprietary filtration will be installed to treat water discharging from the rate control basin. The City of Saint Paul and the MWMO do not specify water quality requirements.

Existing Drainage Areas Information

Existing DAs	Total Area [sf]	Impervious Area [sf]	Pervious Area [sf]	Tc [min]
CN	-	98	61	-
3S, On-Site UC Runoff	25539	0	25539	10
1S, On-Site to Pond	47072	0	47072	10
4S, Off-Site UC Runoff	2786	0	2786	7
2S, Off-Site to Pond	24964	8375	16589	7

Proposed Drainage Area Information

Proposed DAs	Total Area [sf]	Impervious Area [sf]	Pervious Area [sf]	Tc [min]
CN	-	98	61	-
8S, On-Site UC Runoff	8484	0	8484	7
6S, On-Site To Pond	64108	44865	19243	7
5S, Off-Site from Street	14214	8375	5839	7
7S, Off-Site To Pond	13629	1226	12403	7

$$Q_{Max}(cfs) = 1.64\ (cfs/ac) * Site\ Area\ (ac) + Offsite\ Flow\ (cfs)$$

$$Q_{Max}(cfs) = 1.64\ (cfs/ac) * 1.668\ (ac) + 2.88(cfs) = 5.62\ cfs$$

Maximum Rate of Runoff (cfs)

Storm Event	Total Existing	Total Proposed
2-year	1.07	0.95
10-year	3.72	2.73
100-year	8.14	7.89
Saint Paul 100-year	6.39	**5.55**

Proposed Rate Control Basin Details

Max Depth	4-ft
Area	0.15-ac
Max Volume	0.448-af
100-year Depth	2-ft
100-year volume	8080-af

Emergency Overflow

In the event of a clog in the system or a rainfall event larger than the design events water will overflow from the rate control basin at an elevation of 883-ft. Water will overflow into Kasota Avenue where it will either enter the adjacent storm sewer and be directed into the wetland to the south, or continue to flow west down Kasota Avenue.

Stormwater System Operations & Maintenance

If required by the LGU, indicate an operations & maintenance agreement will be prepared for the project.

Erosion & Sediment Control

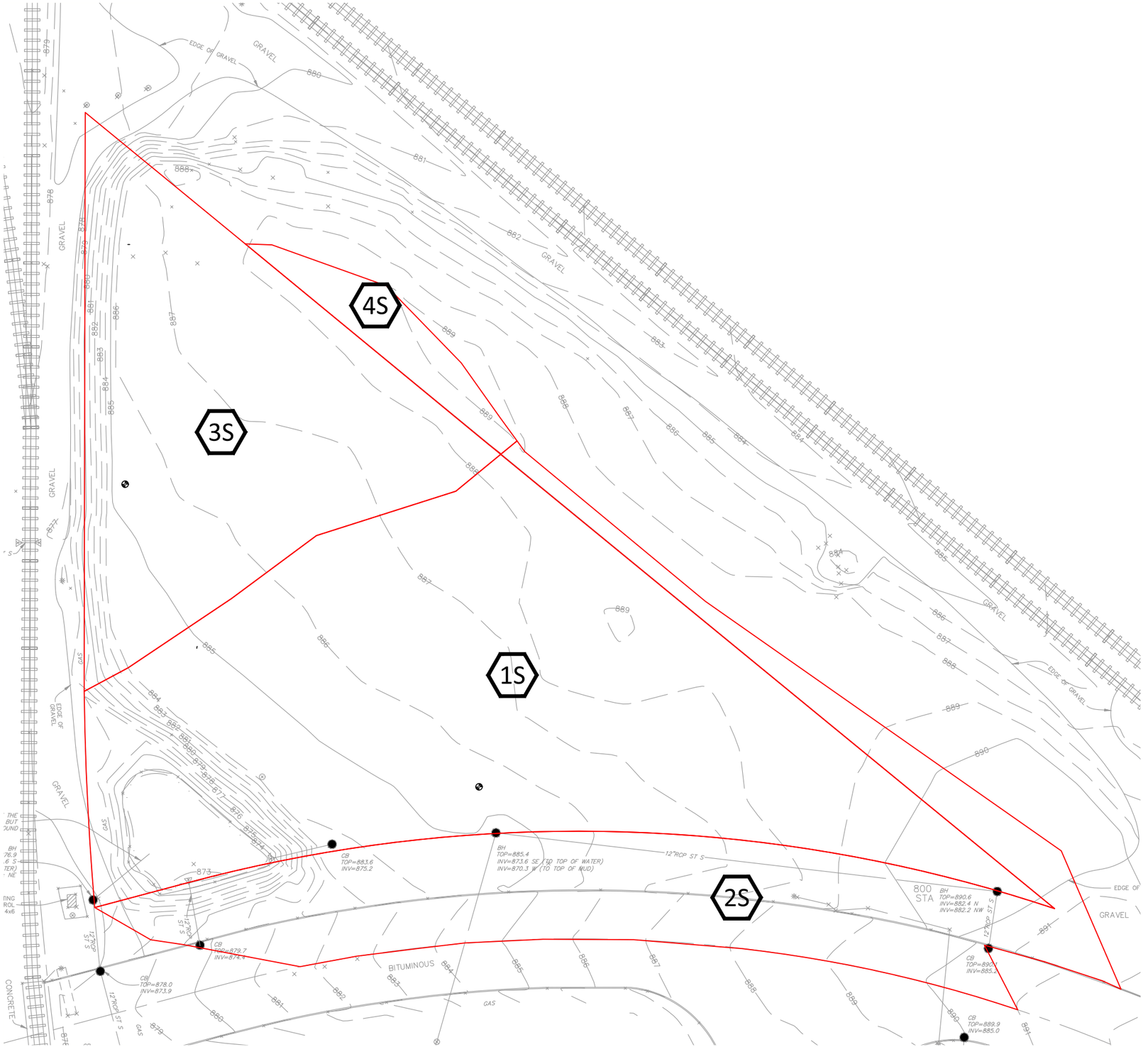
A comprehensive Stormwater Pollution Prevention Plan (SWPPP) meeting the requirements of the 2018 MPCA NPDES permit will be developed as a part of the proposed plans.

Summary

The proposed Kasota Avenue Trailer Storage project will meet the requirements of the City of Saint Paul, and the MPCA through construction of a rate control basin and a proprietary filtration device. These BMPs will provide the required rate control and water quality improvements prior to discharging stormwater runoff from the site to downstream receiving waters.

If you have any questions, comments, or additional information regarding this report, please contact me at CAyers@sambatek.com or 763.259.6697

APPENDIX A – DRAINAGE MAPS



LEGEND

- XX — LINK
- XX — POND
- XX — REACH
- XX — SUB-CATCHMENT

NORTH

0 50

SCALE IN FEET

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Client

VENTURE PASS PARTNERS

Project

RHON INDUSTRIES TRAILER STORAGE

Location

ST PAUL, MN

Certification

Summary

Approved: CA Drawn: EC

Revision History

No.	Date	By	Submittal / Rev.

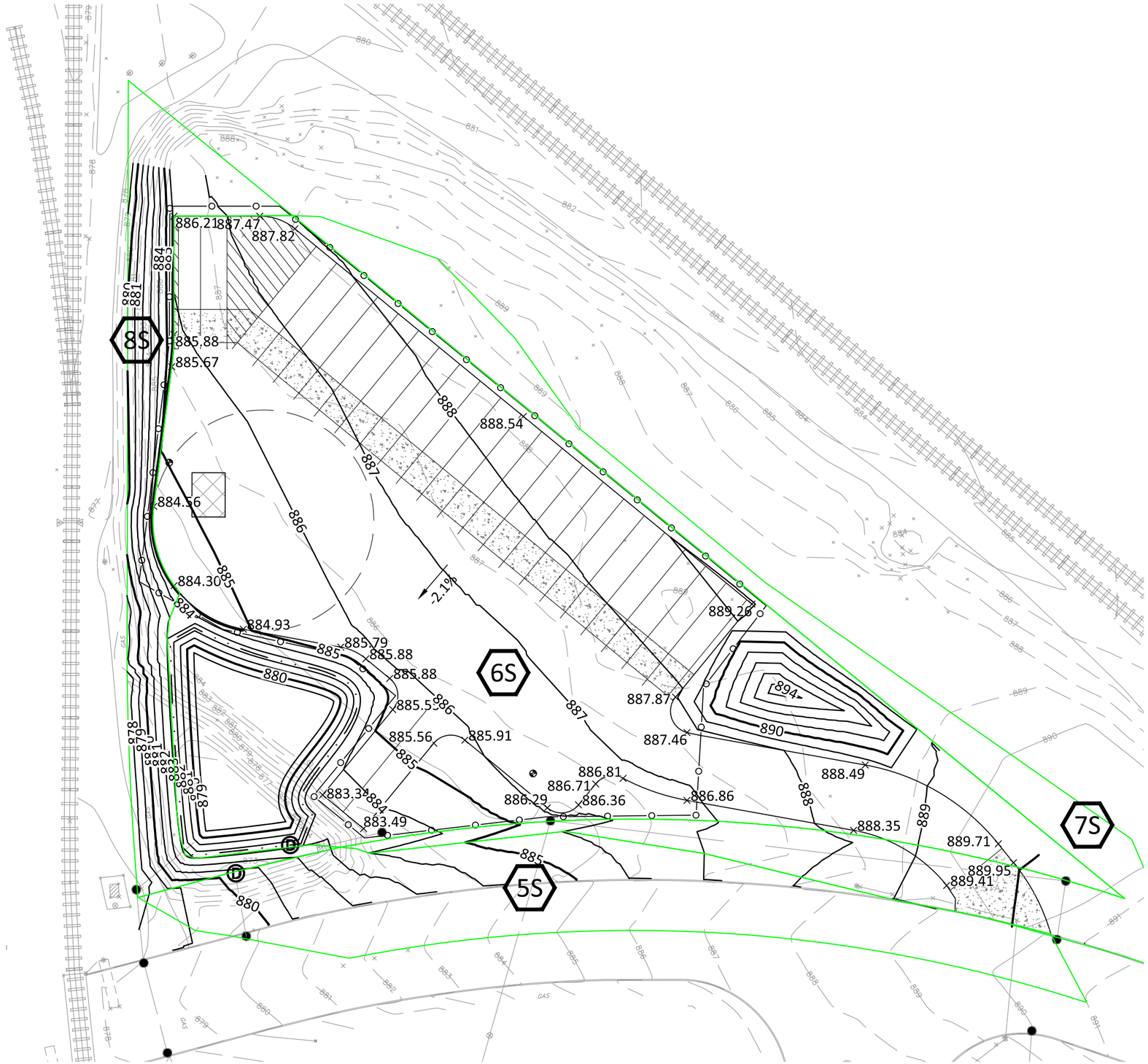
Sheet Title

EXISTING DRAINAGE MAP

Sheet No. Revision

1/2

Project No. 21625



LEGEND

- XX — LINK
- XX — POND
- XX — REACH
- XX — SUB-CATCHMENT

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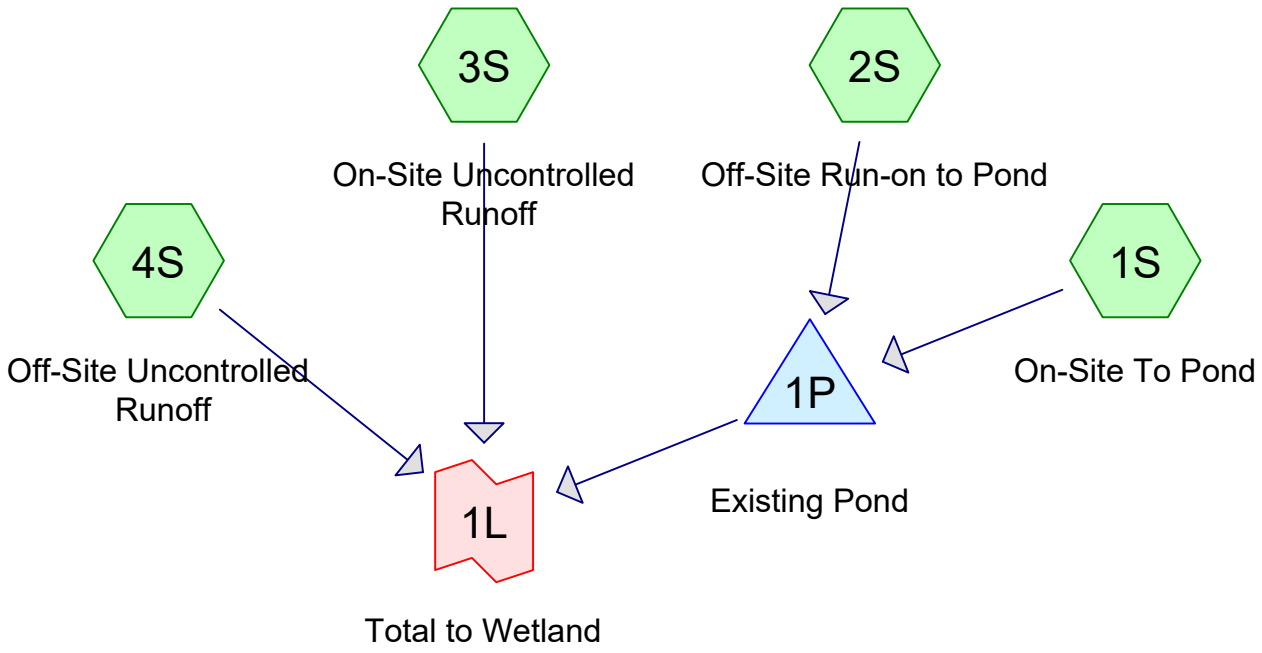
PROPOSED DRAINAGE MAP

Sheet No. Revision

2/2

Project No. 21625

APPENDIX B – HYDROCAD MODELS



Subcat Reach Pond Link

Routing Diagram for 21625_Stormwater_08082019
Prepared by {enter your company name here}, Printed 8/9/2019

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.112	61	>75% Grass cover, Good, HSG B (1S, 2S, 3S, 4S)
0.192	98	Paved parking, HSG B (2S)
2.304	**64**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
2.304	HSG B	1S, 2S, 3S, 4S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.304		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	2.112	0.000	0.000	0.000	2.112	>75% Grass cover, Good	1S, 2S, 3S, 4S
0.000	0.192	0.000	0.000	0.000	0.192	Paved parking	2S
0.000	**2.304**	**0.000**	**0.000**	**0.000**	**2.304**	**TOTAL AREA**	

Pipe Listing (selected 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	1P	871.90	871.90	30.0	0.0000	0.011	12.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: On-Site To Pond Runoff Area=47,072 sf 0.00% Impervious Runoff Depth=0.30"
Tc=10.0 min CN=61 Runoff=0.28 cfs 0.027 af

Subcatchment2S: Off-Site Run-on to Pond Runoff Area=24,964 sf 33.55% Impervious Runoff Depth=0.74"
Tc=7.0 min CN=73 Runoff=0.72 cfs 0.035 af

Subcatchment3S: On-Site Uncontrolled Runoff Area=25,539 sf 0.00% Impervious Runoff Depth=0.30"
Tc=10.0 min CN=61 Runoff=0.15 cfs 0.014 af

Subcatchment4S: Off-Site Uncontrolled Runoff Area=2,786 sf 0.00% Impervious Runoff Depth=0.30"
Tc=7.0 min CN=61 Runoff=0.02 cfs 0.002 af

Pond 1P: Existing Pond Peak Elev=873.81' Storage=18 cf Inflow=0.92 cfs 0.062 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0000 '/' Outflow=0.92 cfs 0.062 af

Link 1L: Total to Wetland Inflow=1.07 cfs 0.078 af
Primary=1.07 cfs 0.078 af

Total Runoff Area = 2.304 ac Runoff Volume = 0.078 af Average Runoff Depth = 0.41"
91.66% Pervious = 2.112 ac 8.34% Impervious = 0.192 ac

Summary for Subcatchment 1S: On-Site To Pond

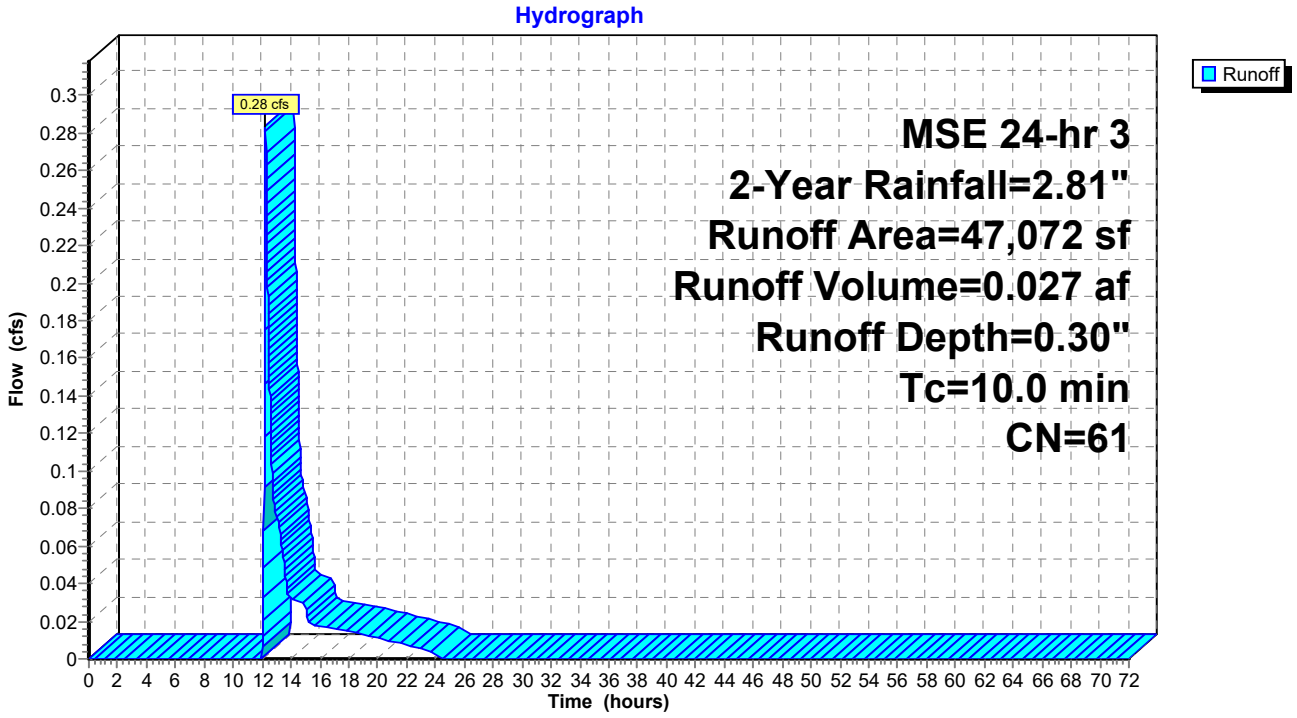
Runoff = 0.28 cfs @ 12.22 hrs, Volume= 0.027 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

Area (sf)	CN	Description
47,072	61	>75% Grass cover, Good, HSG B
47,072		100.00% Pervious Area

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

Subcatchment 1S: On-Site To Pond



Summary for Subcatchment 2S: Off-Site Run-on to Pond

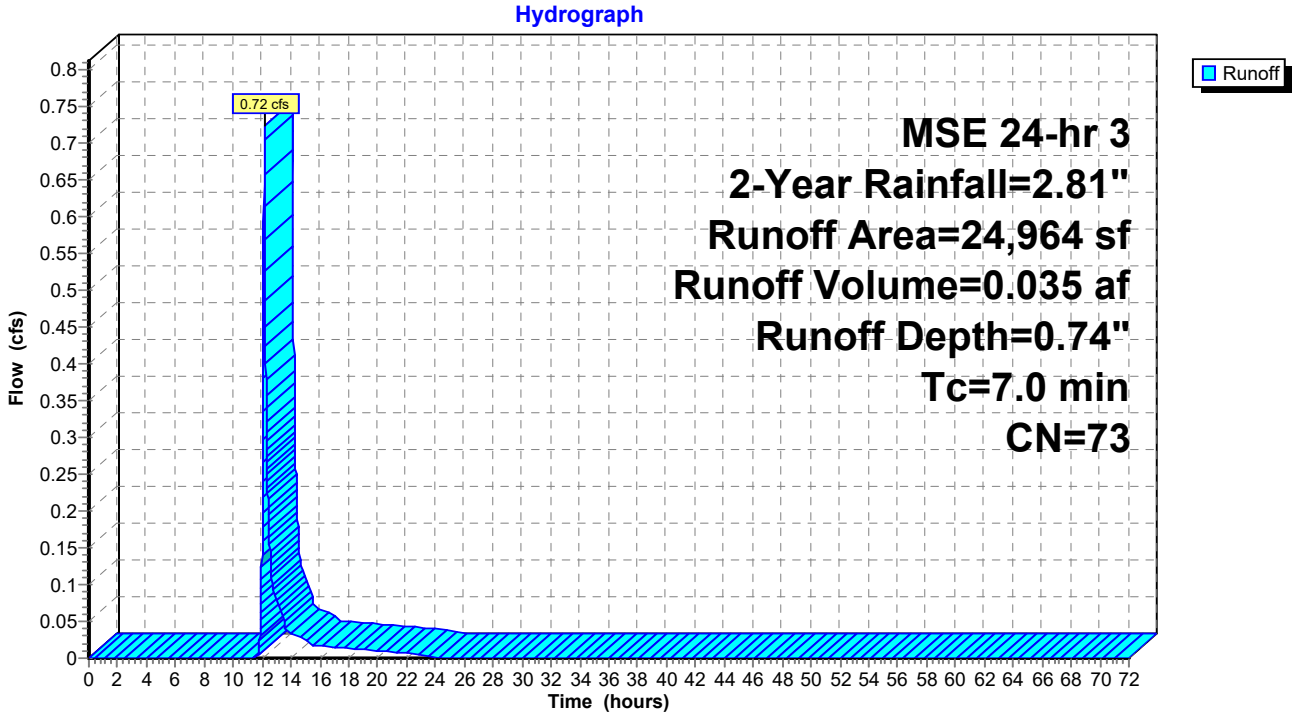
Runoff = 0.72 cfs @ 12.15 hrs, Volume= 0.035 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

Area (sf)	CN	Description
16,589	61	>75% Grass cover, Good, HSG B
8,375	98	Paved parking, HSG B
24,964	73	Weighted Average
16,589		66.45% Pervious Area
8,375		33.55% Impervious Area

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

Subcatchment 2S: Off-Site Run-on to Pond



Summary for Subcatchment 3S: On-Site Uncontrolled Runoff

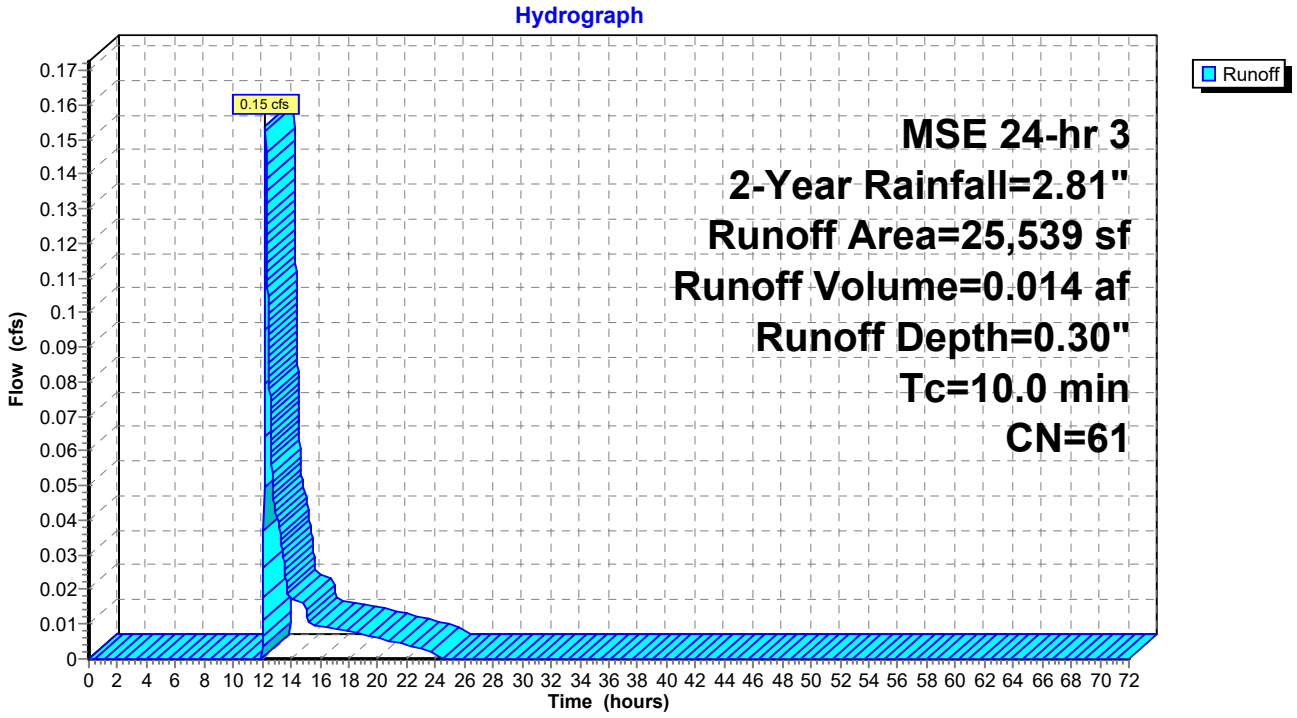
Runoff = 0.15 cfs @ 12.22 hrs, Volume= 0.014 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

Area (sf)	CN	Description
25,539	61	>75% Grass cover, Good, HSG B
25,539		100.00% Pervious Area

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

Subcatchment 3S: On-Site Uncontrolled Runoff



Summary for Subcatchment 4S: Off-Site Uncontrolled Runoff

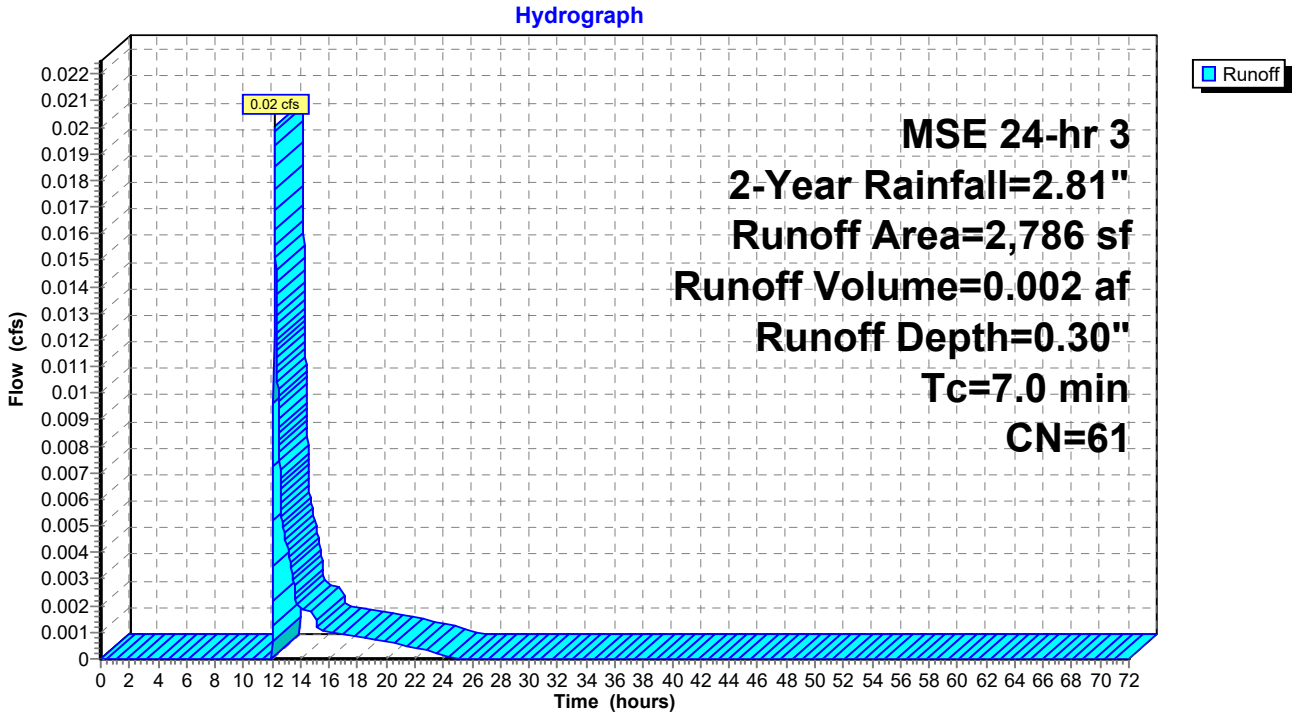
Runoff = 0.02 cfs @ 12.17 hrs, Volume= 0.002 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

Area (sf)	CN	Description
2,786	61	>75% Grass cover, Good, HSG B
2,786		100.00% Pervious Area

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

Subcatchment 4S: Off-Site Uncontrolled Runoff



Summary for Pond 1P: Existing Pond

Inflow Area = 1.654 ac, 11.63% Impervious, Inflow Depth = 0.45" for 2-Year event
Inflow = 0.92 cfs @ 12.17 hrs, Volume= 0.062 af
Outflow = 0.92 cfs @ 12.17 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.4 min
Primary = 0.92 cfs @ 12.17 hrs, Volume= 0.062 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 873.81' @ 12.17 hrs Surf.Area= 2,476 sf Storage= 18 cf

Plug-Flow detention time= 0.3 min calculated for 0.062 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (859.8 - 859.5)

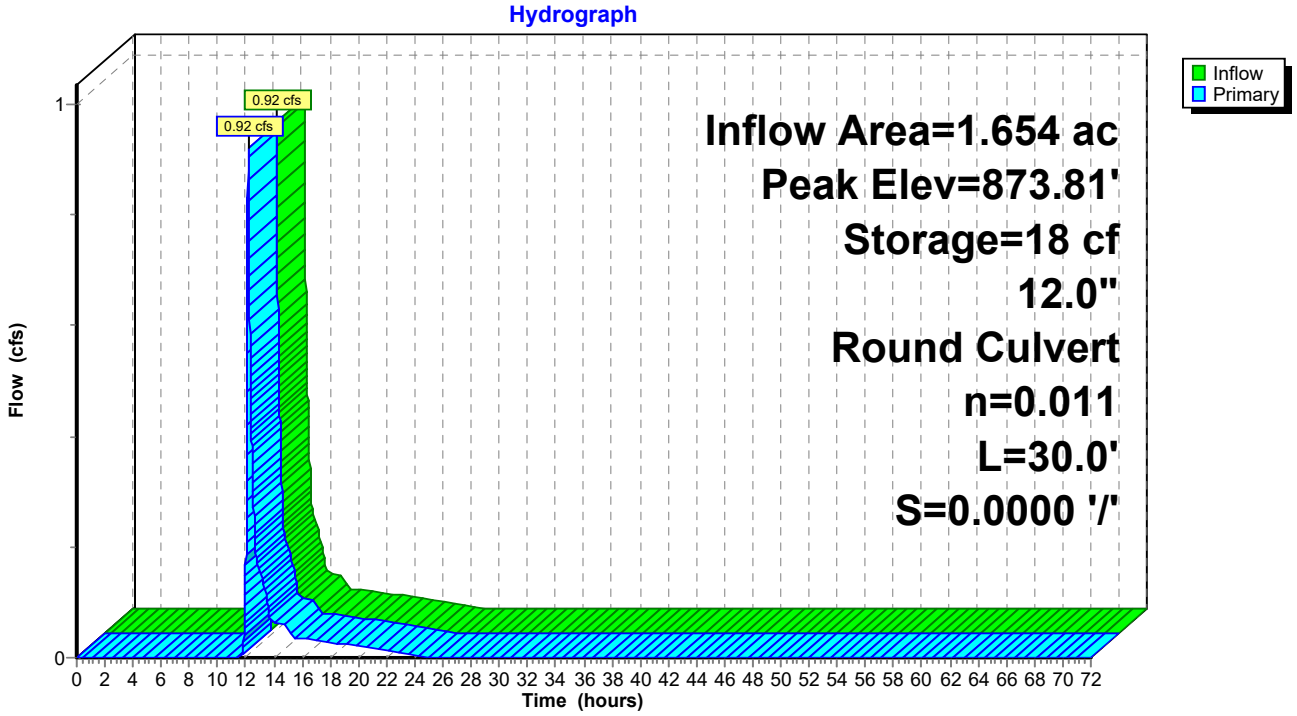
Volume	Invert	Avail.Storage	Storage Description
#1	873.80'	10,998 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
873.80	2,472	0	0
876.00	3,710	6,800	6,800
877.00	4,686	4,198	10,998

Device	Routing	Invert	Outlet Devices
#1	Primary	871.90'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 871.90' / 871.90' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=4.07 cfs @ 12.17 hrs HW=873.81' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 4.07 cfs @ 5.18 fps)

Pond 1P: Existing Pond

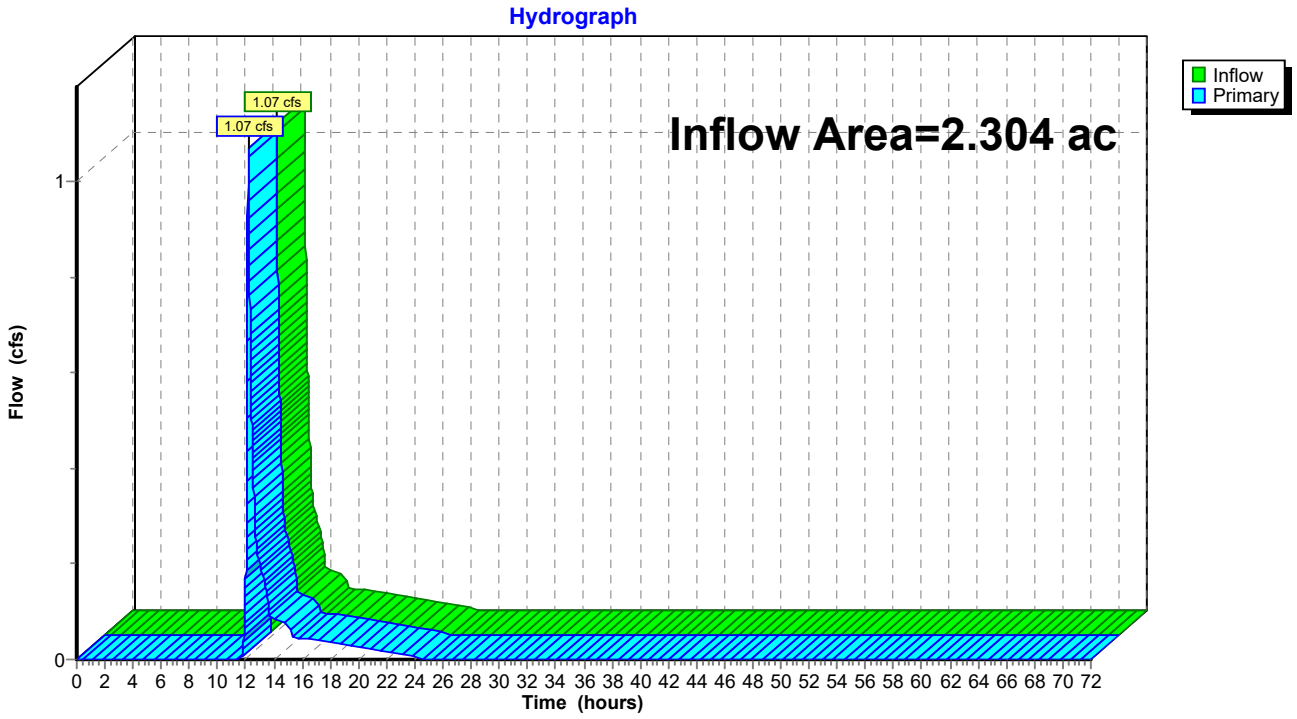


Summary for Link 1L: Total to Wetland

Inflow Area = 2.304 ac, 8.34% Impervious, Inflow Depth = 0.41" for 2-Year event
Inflow = 1.07 cfs @ 12.18 hrs, Volume= 0.078 af
Primary = 1.07 cfs @ 12.18 hrs, Volume= 0.078 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Total to Wetland



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: On-Site To Pond Runoff Area=47,072 sf 0.00% Impervious Runoff Depth=0.91"
Tc=10.0 min CN=61 Runoff=1.36 cfs 0.082 af

Subcatchment2S: Off-Site Run-on to Pond Runoff Area=24,964 sf 33.55% Impervious Runoff Depth=1.67"
Tc=7.0 min CN=73 Runoff=1.70 cfs 0.080 af

Subcatchment3S: On-Site Uncontrolled Runoff Area=25,539 sf 0.00% Impervious Runoff Depth=0.91"
Tc=10.0 min CN=61 Runoff=0.74 cfs 0.045 af

Subcatchment4S: Off-Site Uncontrolled Runoff Area=2,786 sf 0.00% Impervious Runoff Depth=0.91"
Tc=7.0 min CN=61 Runoff=0.09 cfs 0.005 af

Pond 1P: Existing Pond Peak Elev=873.82' Storage=56 cf Inflow=2.93 cfs 0.162 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0000 '/' Outflow=2.92 cfs 0.162 af

Link 1L: Total to Wetland Inflow=3.72 cfs 0.211 af
Primary=3.72 cfs 0.211 af

Total Runoff Area = 2.304 ac Runoff Volume = 0.211 af Average Runoff Depth = 1.10"
91.66% Pervious = 2.112 ac 8.34% Impervious = 0.192 ac

Summary for Subcatchment 1S: On-Site To Pond

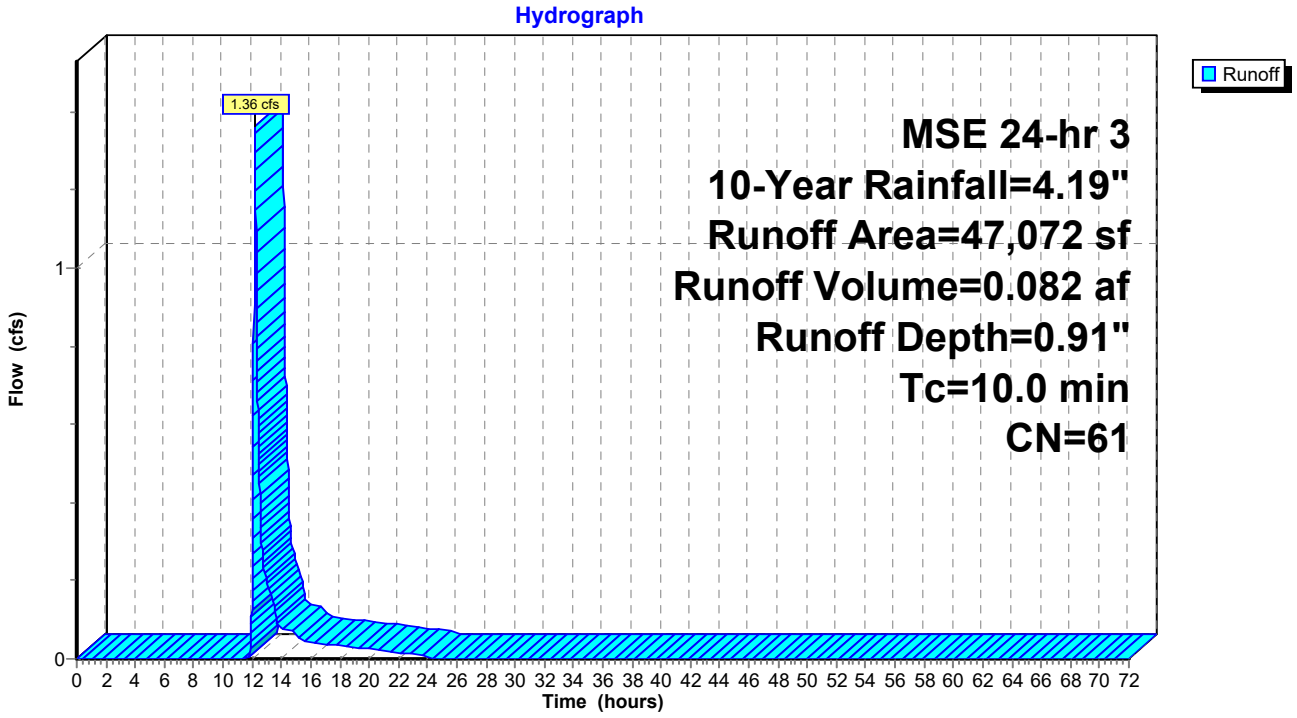
Runoff = 1.36 cfs @ 12.19 hrs, Volume= 0.082 af, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.19"

Area (sf)	CN	Description
47,072	61	>75% Grass cover, Good, HSG B
47,072		100.00% Pervious Area

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

Subcatchment 1S: On-Site To Pond



Summary for Subcatchment 2S: Off-Site Run-on to Pond

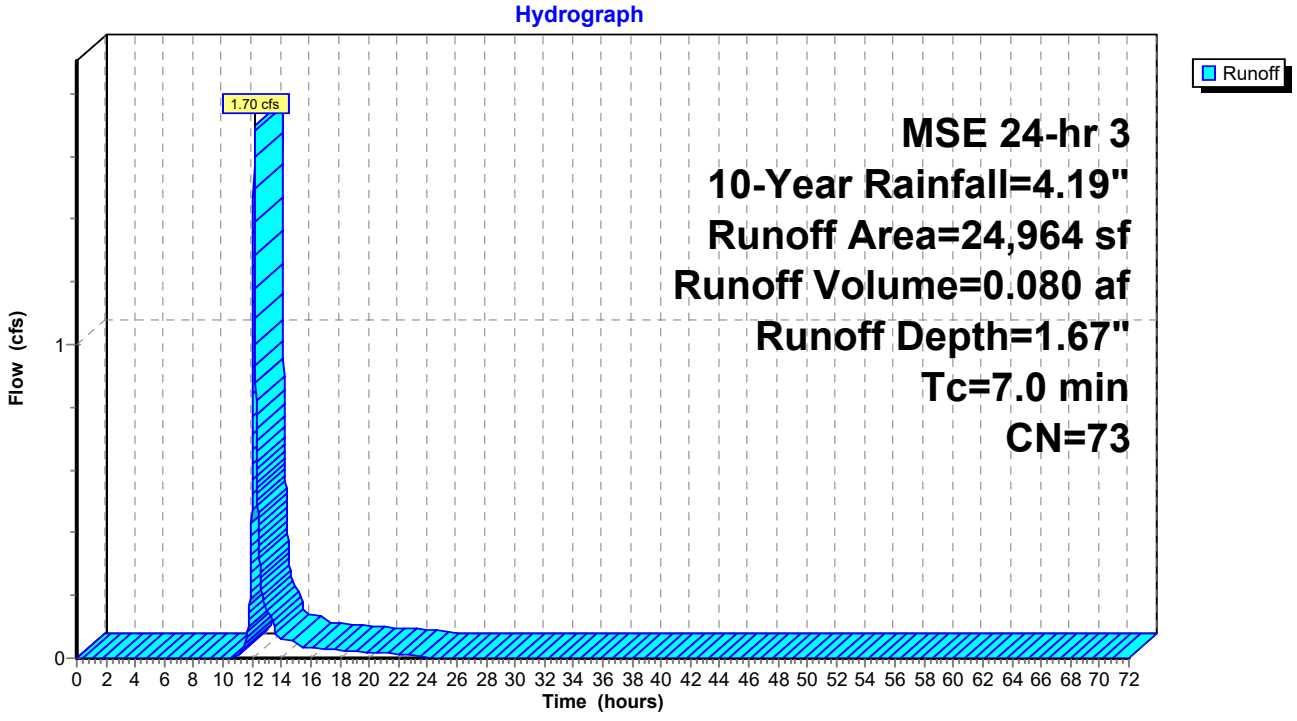
Runoff = 1.70 cfs @ 12.15 hrs, Volume= 0.080 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.19"

Area (sf)	CN	Description
16,589	61	>75% Grass cover, Good, HSG B
8,375	98	Paved parking, HSG B
24,964	73	Weighted Average
16,589		66.45% Pervious Area
8,375		33.55% Impervious Area

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

Subcatchment 2S: Off-Site Run-on to Pond



Summary for Subcatchment 3S: On-Site Uncontrolled Runoff

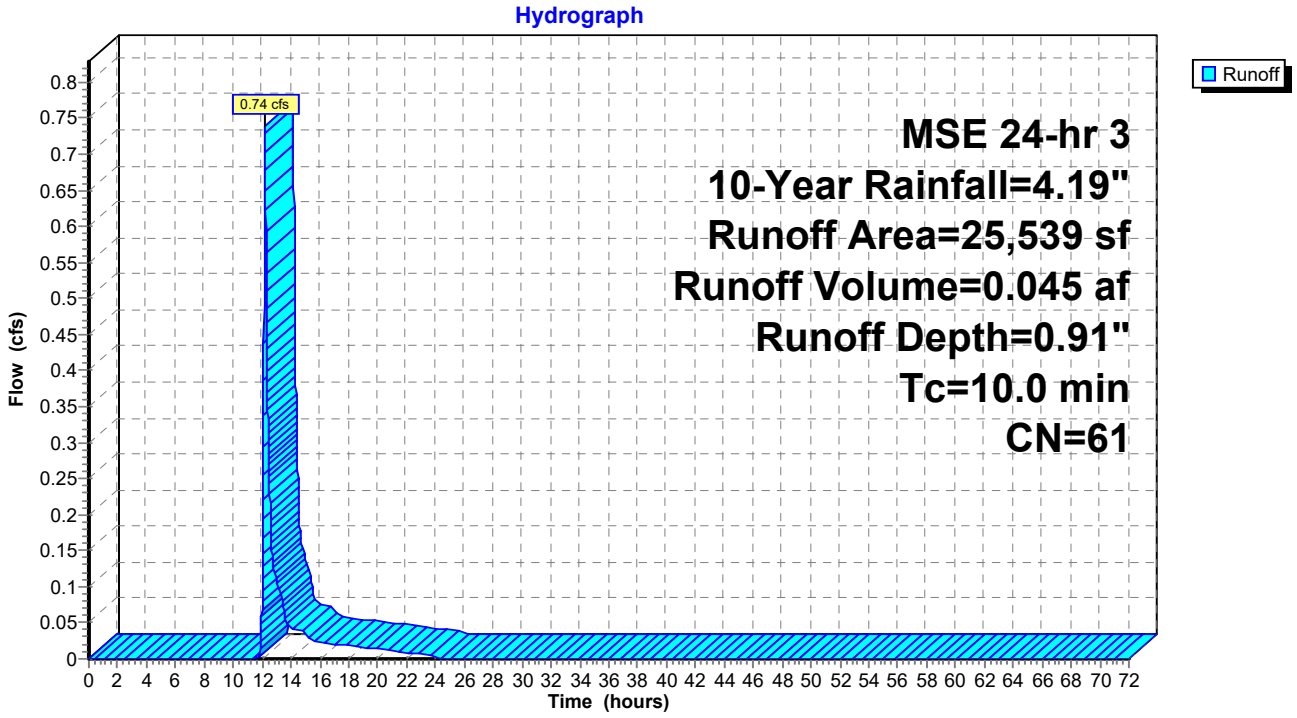
Runoff = 0.74 cfs @ 12.19 hrs, Volume= 0.045 af, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.19"

Area (sf)	CN	Description
25,539	61	>75% Grass cover, Good, HSG B
25,539		100.00% Pervious Area

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

Subcatchment 3S: On-Site Uncontrolled Runoff



Summary for Subcatchment 4S: Off-Site Uncontrolled Runoff

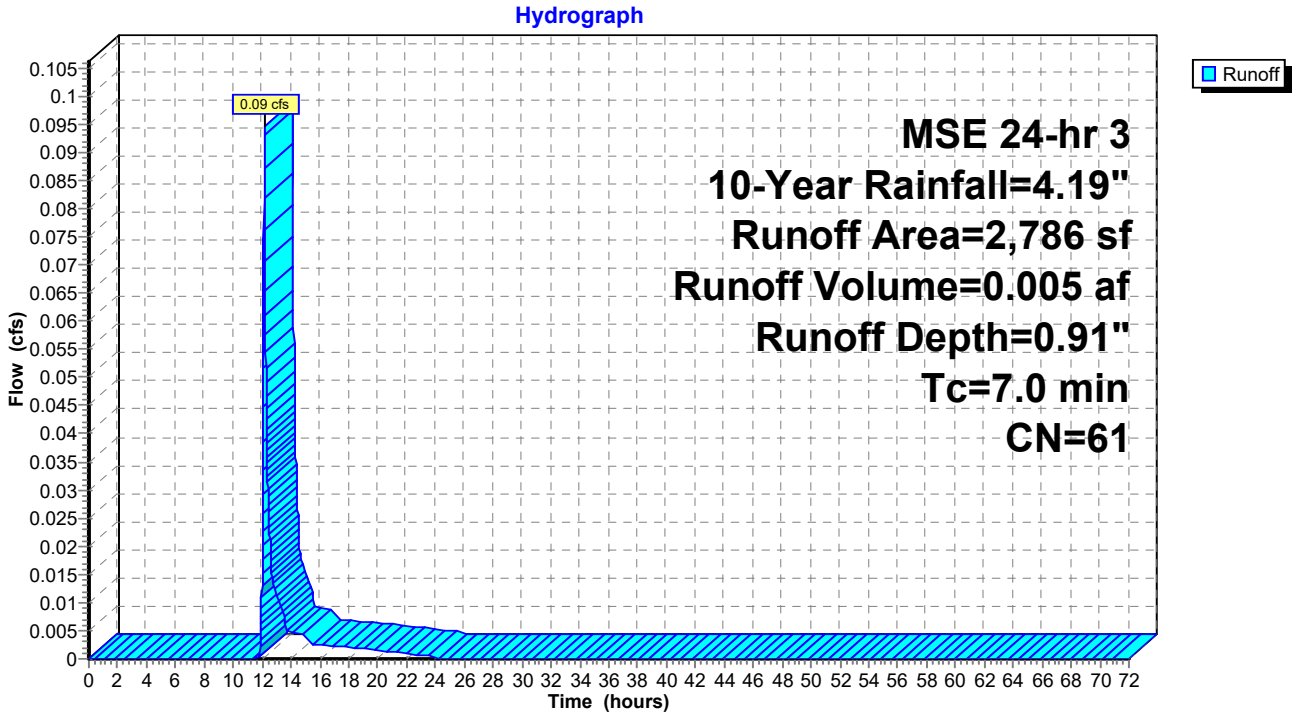
Runoff = 0.09 cfs @ 12.15 hrs, Volume= 0.005 af, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.19"

Area (sf)	CN	Description
2,786	61	>75% Grass cover, Good, HSG B
2,786		100.00% Pervious Area

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

Subcatchment 4S: Off-Site Uncontrolled Runoff



Summary for Pond 1P: Existing Pond

Inflow Area = 1.654 ac, 11.63% Impervious, Inflow Depth = 1.17" for 10-Year event
Inflow = 2.93 cfs @ 12.16 hrs, Volume= 0.162 af
Outflow = 2.92 cfs @ 12.17 hrs, Volume= 0.162 af, Atten= 0%, Lag= 0.3 min
Primary = 2.92 cfs @ 12.17 hrs, Volume= 0.162 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 873.82' @ 12.17 hrs Surf.Area= 2,485 sf Storage= 56 cf

Plug-Flow detention time= 0.3 min calculated for 0.162 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (835.7 - 835.4)

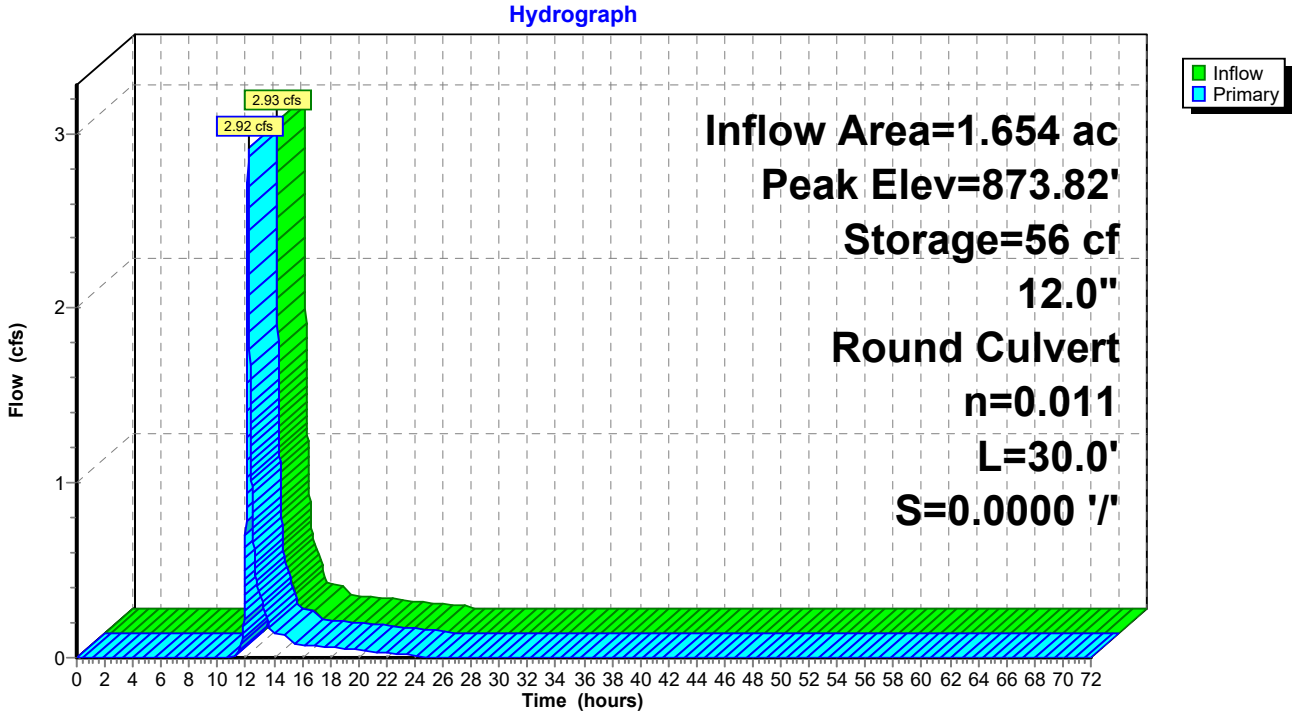
Volume	Invert	Avail.Storage	Storage Description
#1	873.80'	10,998 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
873.80	2,472	0	0
876.00	3,710	6,800	6,800
877.00	4,686	4,198	10,998

Device	Routing	Invert	Outlet Devices
#1	Primary	871.90'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 871.90' / 871.90' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=4.11 cfs @ 12.17 hrs HW=873.82' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 4.11 cfs @ 5.23 fps)

Pond 1P: Existing Pond

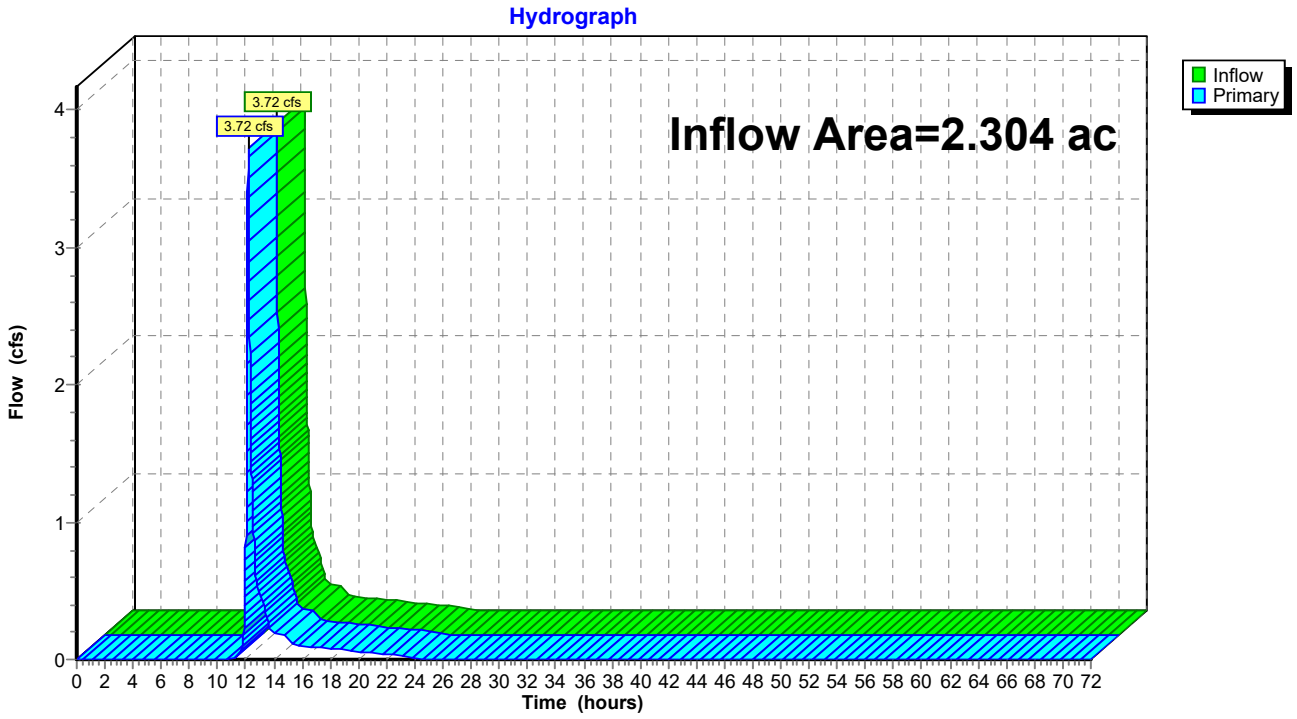


Summary for Link 1L: Total to Wetland

Inflow Area = 2.304 ac, 8.34% Impervious, Inflow Depth = 1.10" for 10-Year event
Inflow = 3.72 cfs @ 12.17 hrs, Volume= 0.211 af
Primary = 3.72 cfs @ 12.17 hrs, Volume= 0.211 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Total to Wetland



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: On-Site To Pond Runoff Area=47,072 sf 0.00% Impervious Runoff Depth=2.96"
Tc=10.0 min CN=61 Runoff=4.96 cfs 0.267 af

Subcatchment2S: Off-Site Run-on to Pond Runoff Area=24,964 sf 33.55% Impervious Runoff Depth=4.25"
Tc=7.0 min CN=73 Runoff=4.30 cfs 0.203 af

Subcatchment3S: On-Site Uncontrolled Runoff Area=25,539 sf 0.00% Impervious Runoff Depth=2.96"
Tc=10.0 min CN=61 Runoff=2.69 cfs 0.145 af

Subcatchment4S: Off-Site Uncontrolled Runoff Area=2,786 sf 0.00% Impervious Runoff Depth=2.96"
Tc=7.0 min CN=61 Runoff=0.34 cfs 0.016 af

Pond 1P: Existing Pond Peak Elev=874.51' Storage=1,909 cf Inflow=8.97 cfs 0.470 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0000 '/' Outflow=5.43 cfs 0.470 af

Link 1L: Total to Wetland Inflow=8.14 cfs 0.630 af
Primary=8.14 cfs 0.630 af

Total Runoff Area = 2.304 ac Runoff Volume = 0.630 af Average Runoff Depth = 3.28"
91.66% Pervious = 2.112 ac 8.34% Impervious = 0.192 ac

Summary for Subcatchment 1S: On-Site To Pond

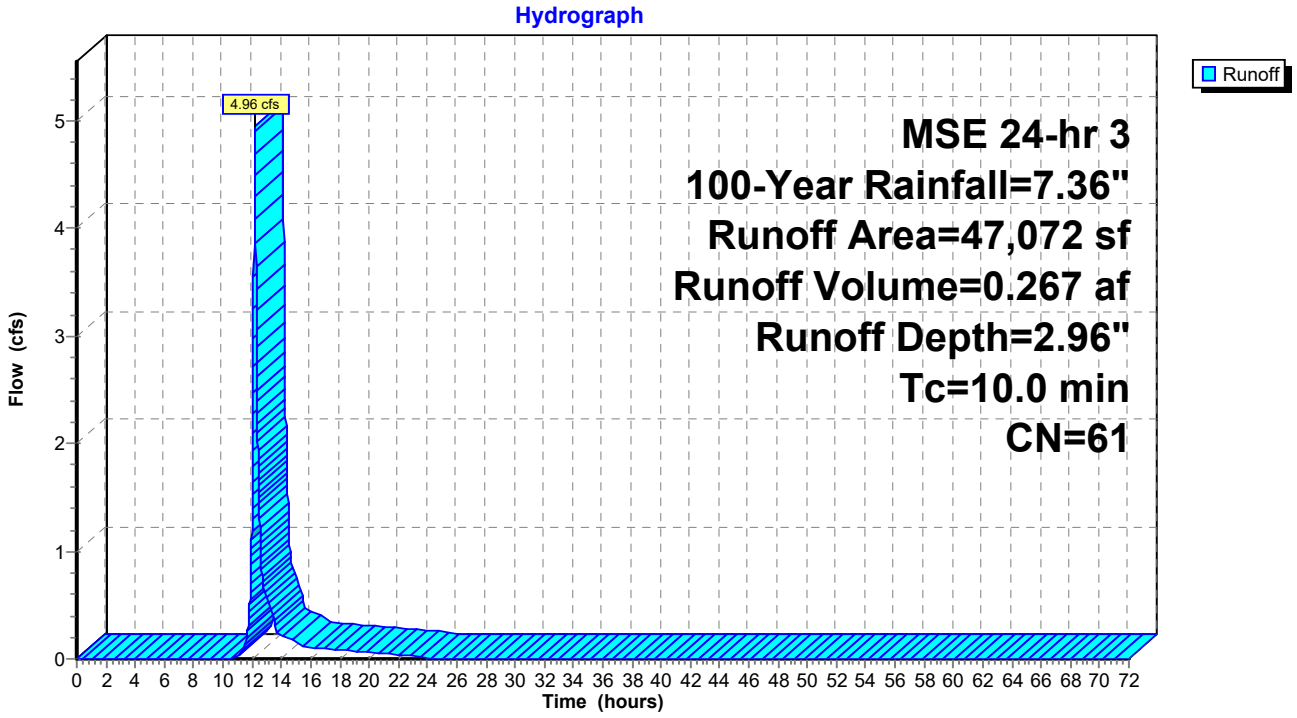
Runoff = 4.96 cfs @ 12.18 hrs, Volume= 0.267 af, Depth= 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.36"

Area (sf)	CN	Description
47,072	61	>75% Grass cover, Good, HSG B
47,072		100.00% Pervious Area

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

Subcatchment 1S: On-Site To Pond



Summary for Subcatchment 2S: Off-Site Run-on to Pond

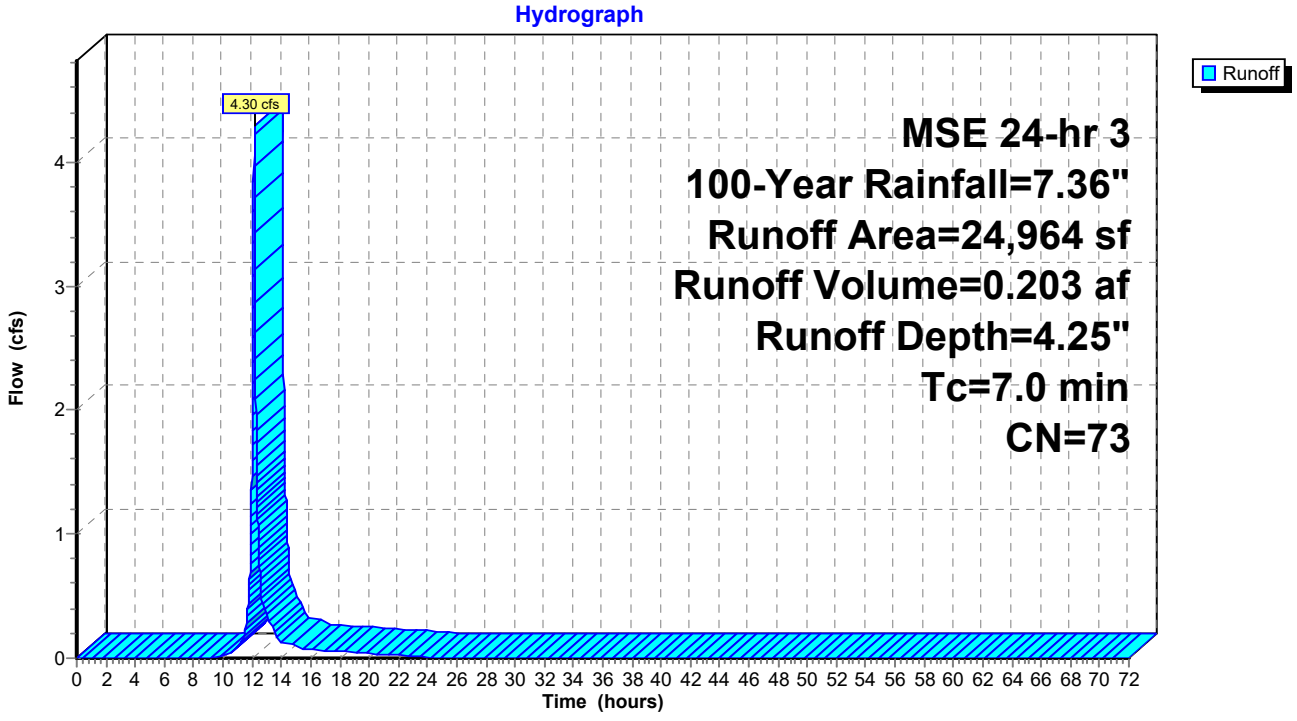
Runoff = 4.30 cfs @ 12.14 hrs, Volume= 0.203 af, Depth= 4.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.36"

Area (sf)	CN	Description
16,589	61	>75% Grass cover, Good, HSG B
8,375	98	Paved parking, HSG B
24,964	73	Weighted Average
16,589		66.45% Pervious Area
8,375		33.55% Impervious Area

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

Subcatchment 2S: Off-Site Run-on to Pond



Summary for Subcatchment 3S: On-Site Uncontrolled Runoff

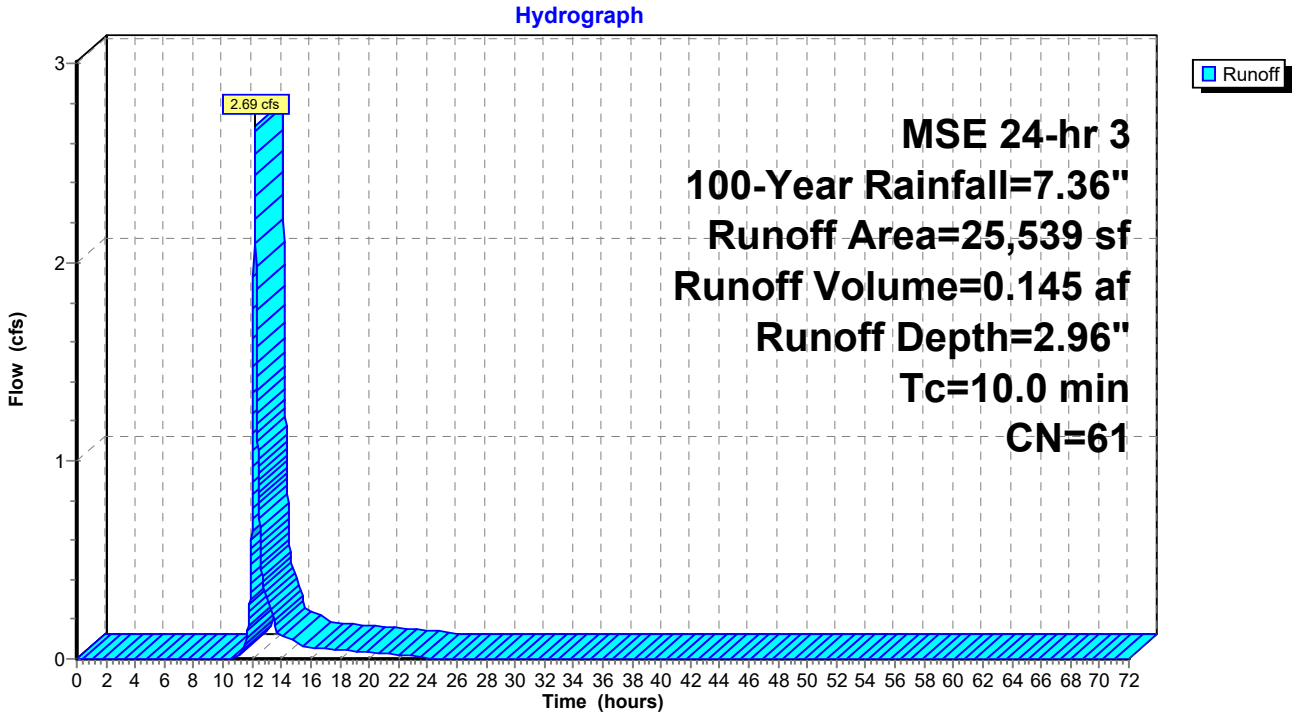
Runoff = 2.69 cfs @ 12.18 hrs, Volume= 0.145 af, Depth= 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.36"

Area (sf)	CN	Description
25,539	61	>75% Grass cover, Good, HSG B
25,539		100.00% Pervious Area

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

Subcatchment 3S: On-Site Uncontrolled Runoff



Summary for Subcatchment 4S: Off-Site Uncontrolled Runoff

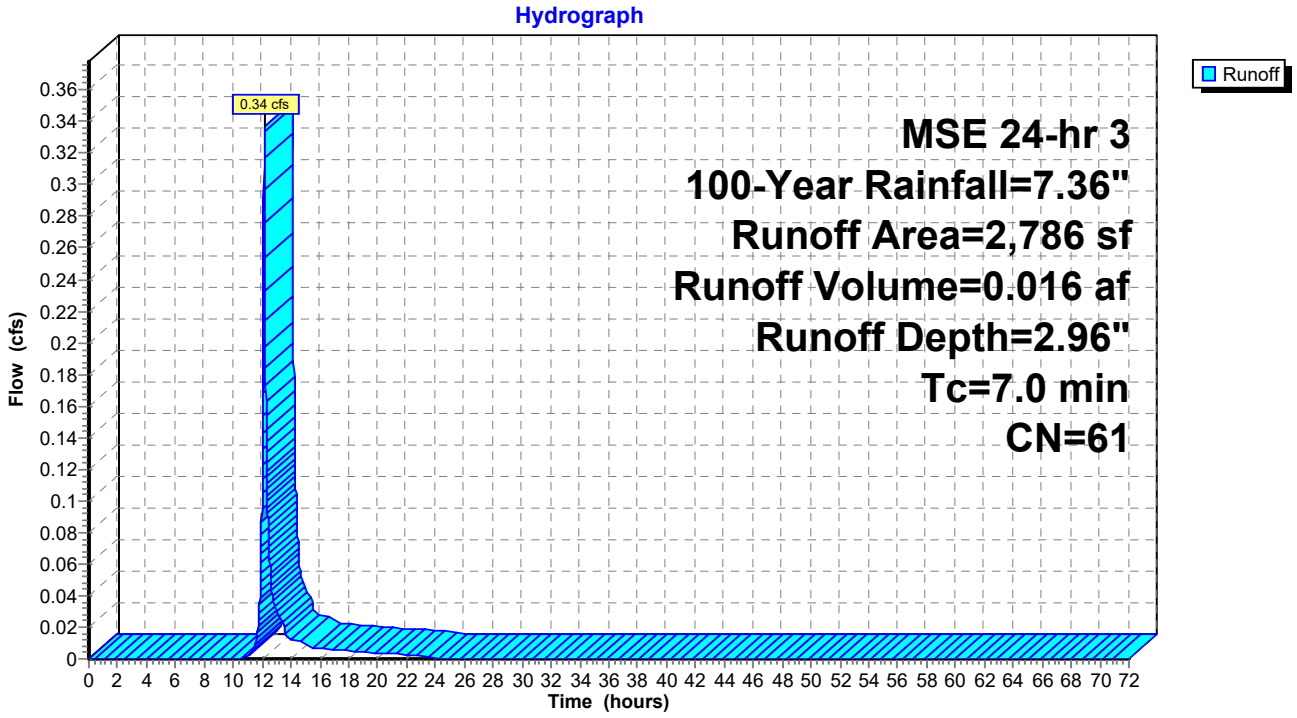
Runoff = 0.34 cfs @ 12.15 hrs, Volume= 0.016 af, Depth= 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.36"

Area (sf)	CN	Description
2,786	61	>75% Grass cover, Good, HSG B
2,786		100.00% Pervious Area

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

Subcatchment 4S: Off-Site Uncontrolled Runoff



Summary for Pond 1P: Existing Pond

Inflow Area = 1.654 ac, 11.63% Impervious, Inflow Depth = 3.41" for 100-Year event
Inflow = 8.97 cfs @ 12.16 hrs, Volume= 0.470 af
Outflow = 5.43 cfs @ 12.27 hrs, Volume= 0.470 af, Atten= 39%, Lag= 6.4 min
Primary = 5.43 cfs @ 12.27 hrs, Volume= 0.470 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 874.51' @ 12.27 hrs Surf.Area= 2,874 sf Storage= 1,909 cf

Plug-Flow detention time= 1.8 min calculated for 0.470 af (100% of inflow)
Center-of-Mass det. time= 1.8 min (814.6 - 812.8)

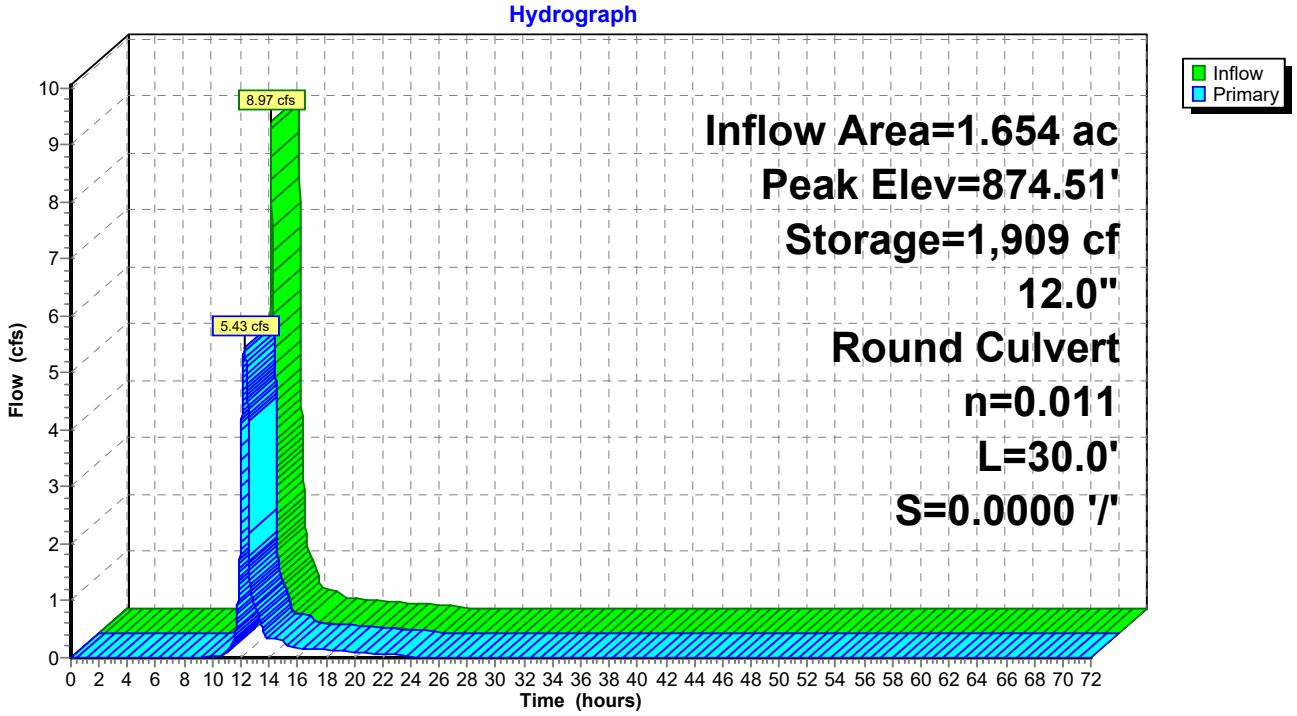
Volume	Invert	Avail.Storage	Storage Description
#1	873.80'	10,998 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
873.80	2,472	0	0
876.00	3,710	6,800	6,800
877.00	4,686	4,198	10,998

Device	Routing	Invert	Outlet Devices
#1	Primary	871.90'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 871.90' / 871.90' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=5.43 cfs @ 12.27 hrs HW=874.51' (Free Discharge)
1=Culvert (Barrel Controls 5.43 cfs @ 6.91 fps)

Pond 1P: Existing Pond

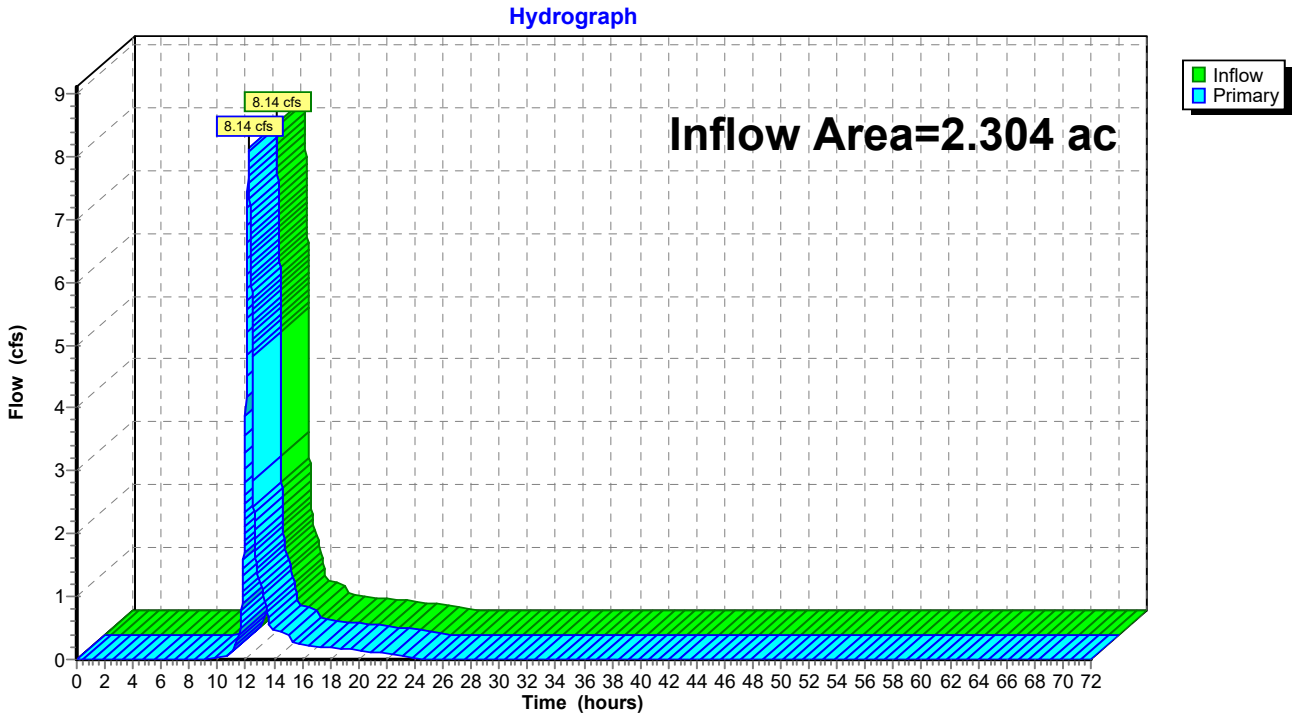


Summary for Link 1L: Total to Wetland

Inflow Area = 2.304 ac, 8.34% Impervious, Inflow Depth = 3.28" for 100-Year event
Inflow = 8.14 cfs @ 12.19 hrs, Volume= 0.630 af
Primary = 8.14 cfs @ 12.19 hrs, Volume= 0.630 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Total to Wetland



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: On-Site To Pond Runoff Area=47,072 sf 0.00% Impervious Runoff Depth=1.94"
Tc=10.0 min CN=61 Runoff=3.18 cfs 0.175 af

Subcatchment2S: Off-Site Run-on to Pond Runoff Area=24,964 sf 33.55% Impervious Runoff Depth=3.01"
Tc=7.0 min CN=73 Runoff=3.07 cfs 0.144 af

Subcatchment3S: On-Site Uncontrolled Runoff Area=25,539 sf 0.00% Impervious Runoff Depth=1.94"
Tc=10.0 min CN=61 Runoff=1.72 cfs 0.095 af

Subcatchment4S: Off-Site Uncontrolled Runoff Area=2,786 sf 0.00% Impervious Runoff Depth=1.94"
Tc=7.0 min CN=61 Runoff=0.22 cfs 0.010 af

Pond 1P: Existing Pond Peak Elev=874.03' Storage=593 cf Inflow=6.03 cfs 0.318 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0000 '/' Outflow=4.55 cfs 0.318 af

Link 1L: Total to Wetland Inflow=6.39 cfs 0.423 af
Primary=6.39 cfs 0.423 af

Total Runoff Area = 2.304 ac Runoff Volume = 0.423 af Average Runoff Depth = 2.20"
91.66% Pervious = 2.112 ac 8.34% Impervious = 0.192 ac

Summary for Subcatchment 1S: On-Site To Pond

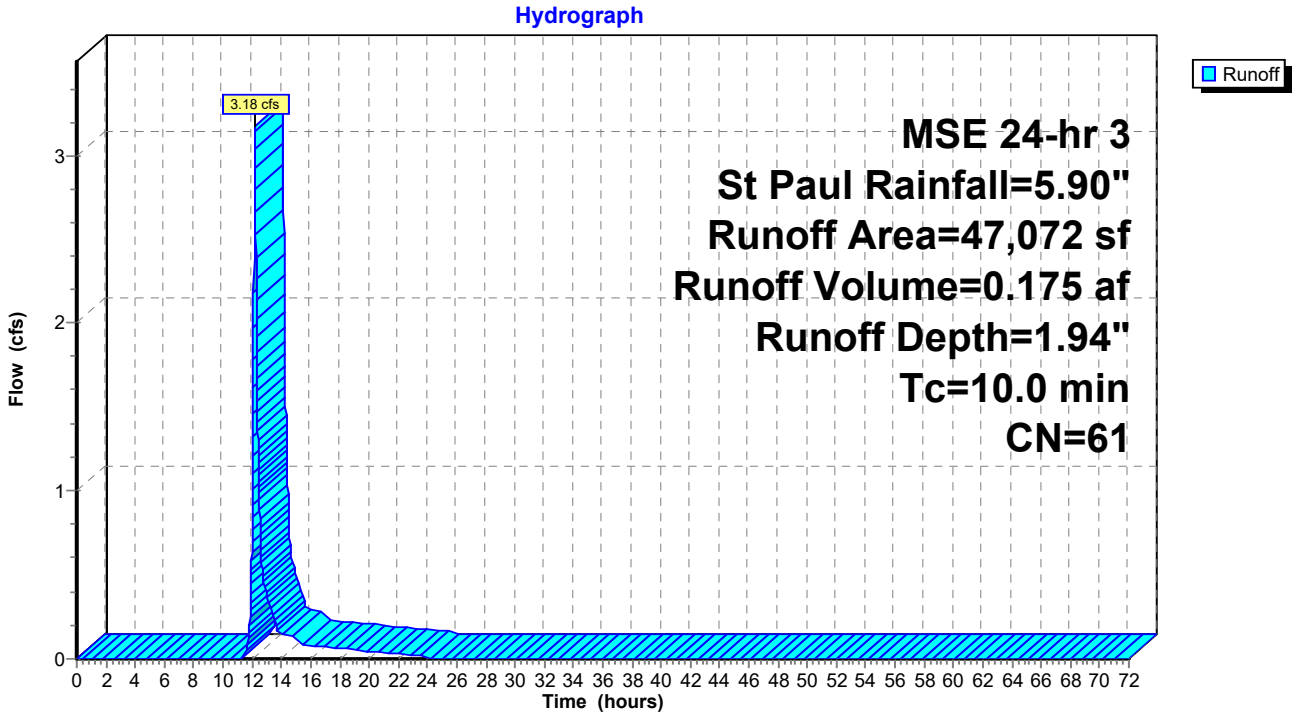
Runoff = 3.18 cfs @ 12.18 hrs, Volume= 0.175 af, Depth= 1.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 St Paul Rainfall=5.90"

Area (sf)	CN	Description
47,072	61	>75% Grass cover, Good, HSG B
47,072		100.00% Pervious Area

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

Subcatchment 1S: On-Site To Pond



Summary for Subcatchment 2S: Off-Site Run-on to Pond

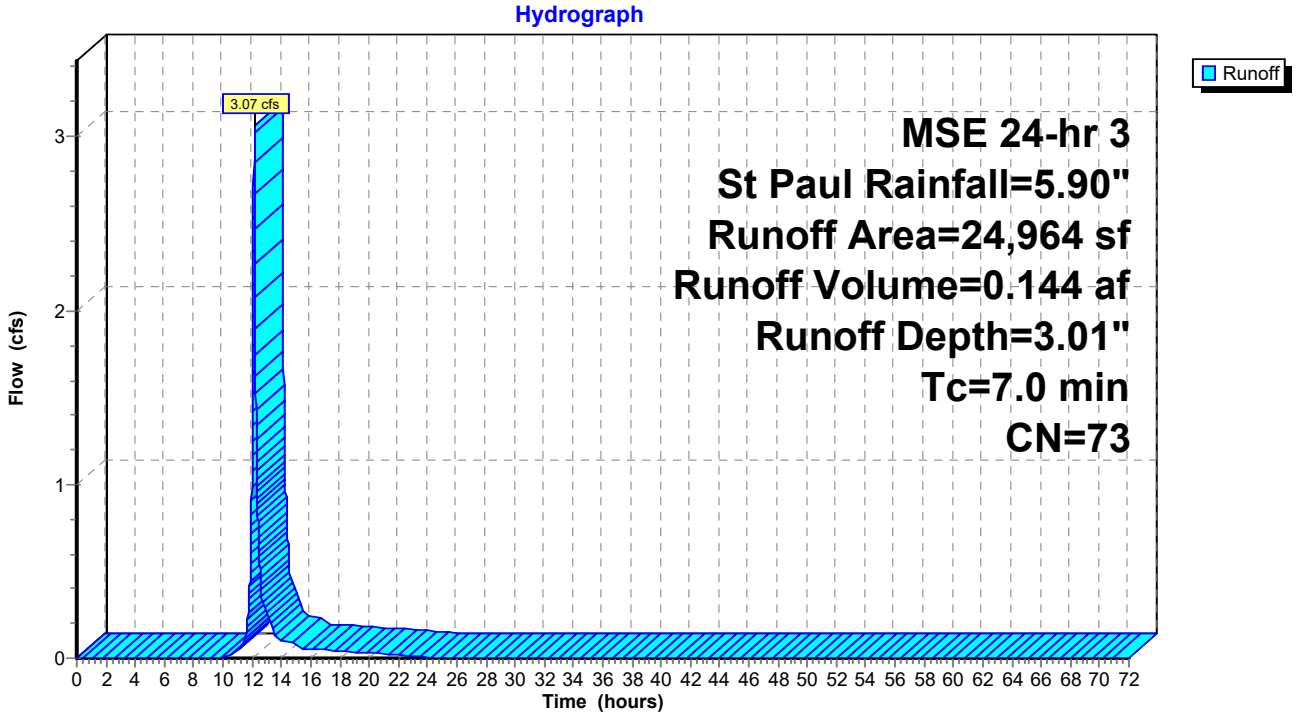
Runoff = 3.07 cfs @ 12.14 hrs, Volume= 0.144 af, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 St Paul Rainfall=5.90"

Area (sf)	CN	Description
16,589	61	>75% Grass cover, Good, HSG B
8,375	98	Paved parking, HSG B
24,964	73	Weighted Average
16,589		66.45% Pervious Area
8,375		33.55% Impervious Area

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

Subcatchment 2S: Off-Site Run-on to Pond



Summary for Subcatchment 3S: On-Site Uncontrolled Runoff

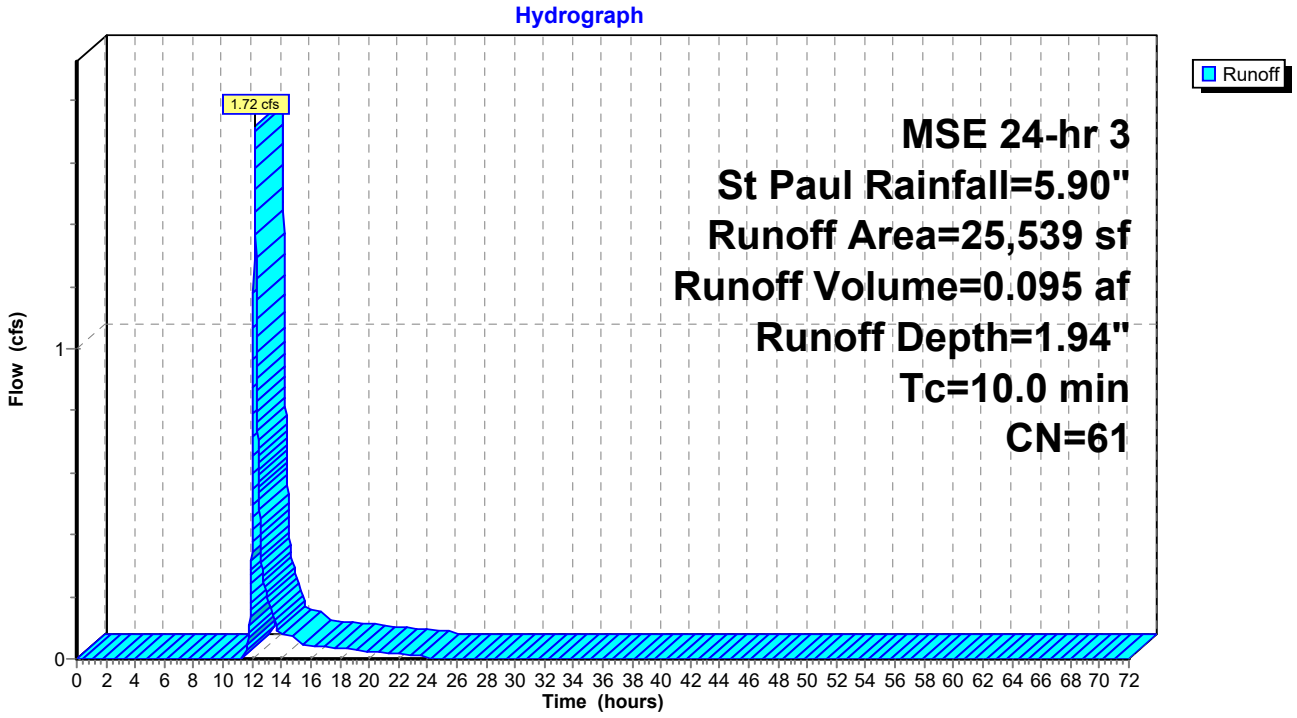
Runoff = 1.72 cfs @ 12.18 hrs, Volume= 0.095 af, Depth= 1.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 St Paul Rainfall=5.90"

Area (sf)	CN	Description
25,539	61	>75% Grass cover, Good, HSG B
25,539		100.00% Pervious Area

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

Subcatchment 3S: On-Site Uncontrolled Runoff



Summary for Subcatchment 4S: Off-Site Uncontrolled Runoff

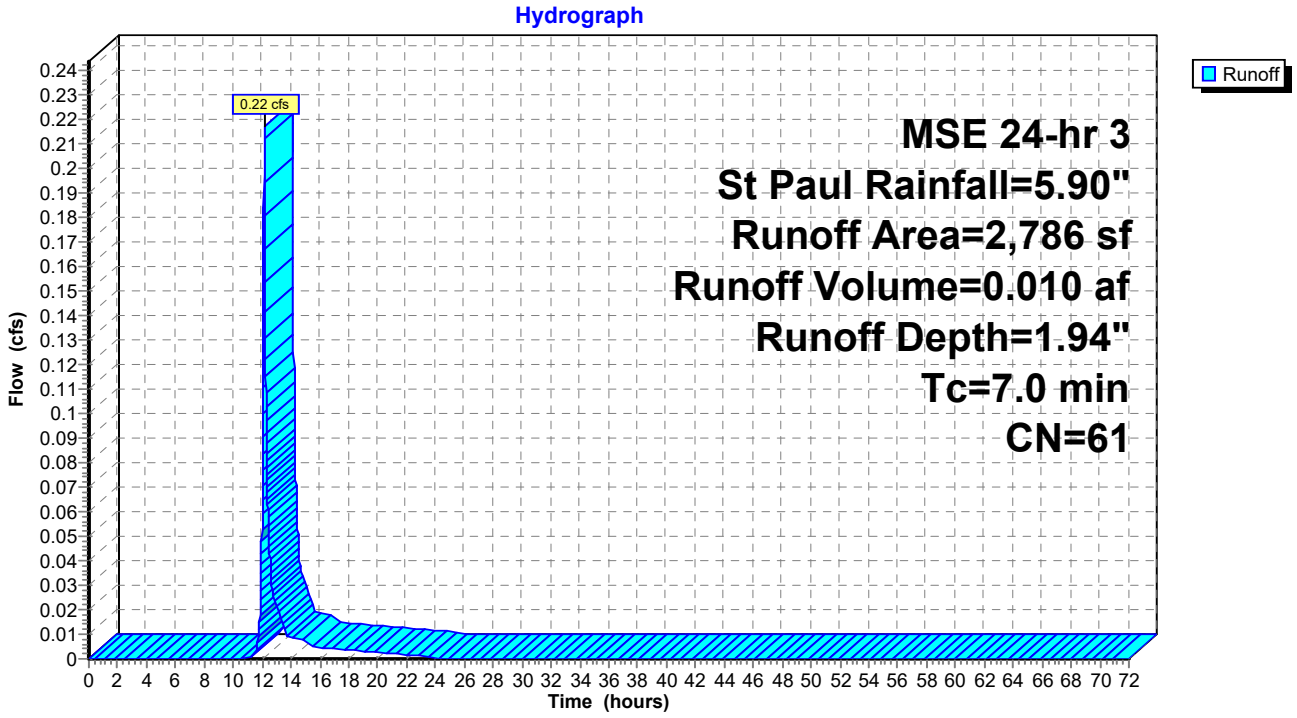
Runoff = 0.22 cfs @ 12.15 hrs, Volume= 0.010 af, Depth= 1.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 St Paul Rainfall=5.90"

Area (sf)	CN	Description
2,786	61	>75% Grass cover, Good, HSG B
2,786		100.00% Pervious Area

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

Subcatchment 4S: Off-Site Uncontrolled Runoff



Summary for Pond 1P: Existing Pond

Inflow Area = 1.654 ac, 11.63% Impervious, Inflow Depth = 2.31" for St Paul event
Inflow = 6.03 cfs @ 12.16 hrs, Volume= 0.318 af
Outflow = 4.55 cfs @ 12.23 hrs, Volume= 0.318 af, Atten= 25%, Lag= 4.2 min
Primary = 4.55 cfs @ 12.23 hrs, Volume= 0.318 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 874.03' @ 12.23 hrs Surf.Area= 2,603 sf Storage= 593 cf

Plug-Flow detention time= 0.7 min calculated for 0.318 af (100% of inflow)
Center-of-Mass det. time= 0.7 min (821.3 - 820.7)

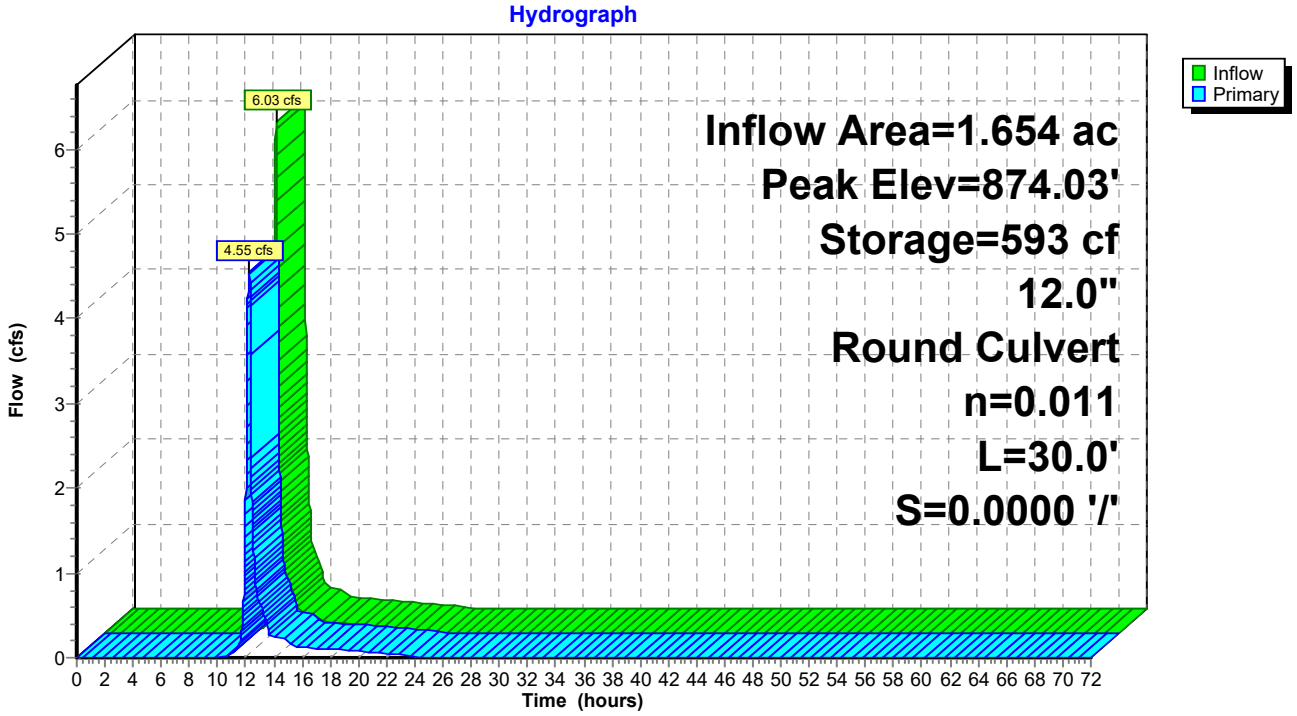
Volume	Invert	Avail.Storage	Storage Description
#1	873.80'	10,998 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
873.80	2,472	0	0
876.00	3,710	6,800	6,800
877.00	4,686	4,198	10,998

Device	Routing	Invert	Outlet Devices
#1	Primary	871.90'	**12.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 871.90' / 871.90' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=4.55 cfs @ 12.23 hrs HW=874.03' (Free Discharge)
↑**1=Culvert** (Barrel Controls 4.55 cfs @ 5.79 fps)

Pond 1P: Existing Pond

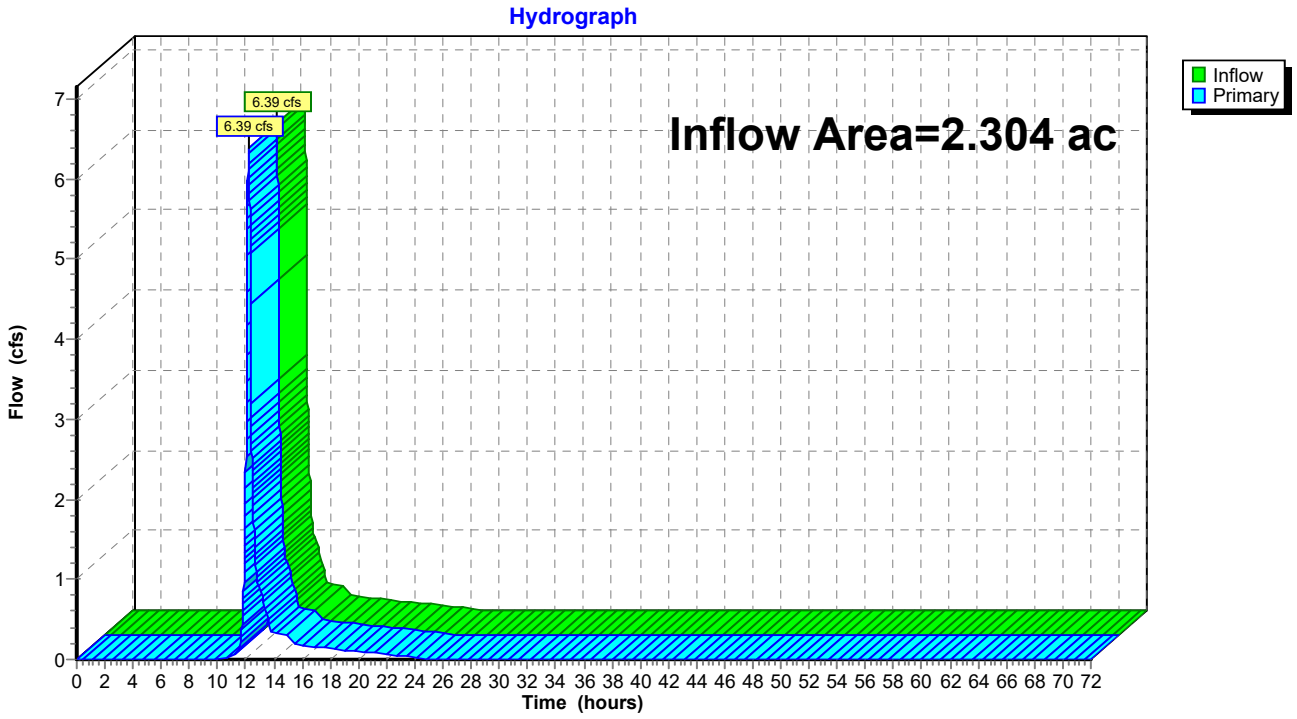


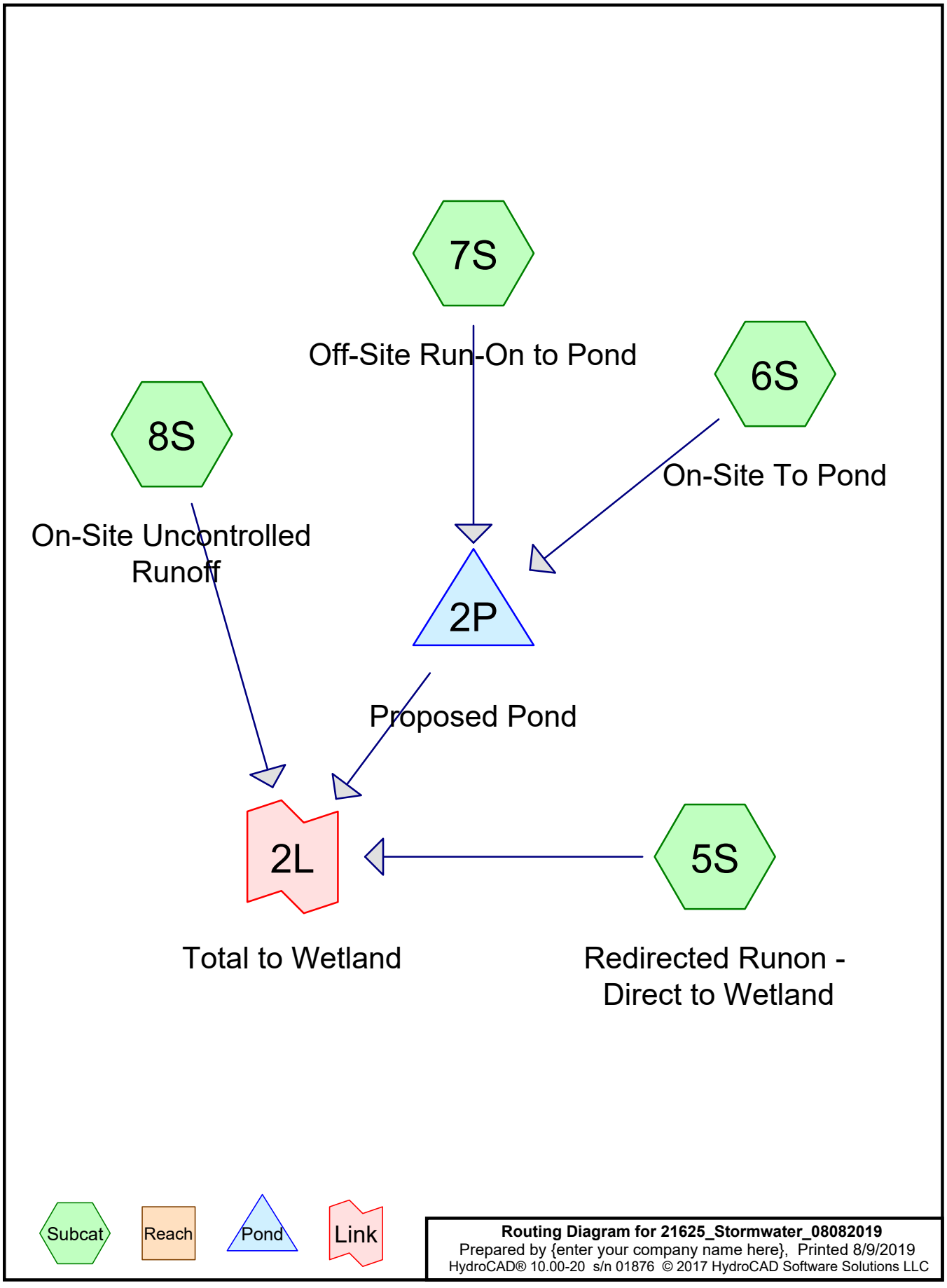
Summary for Link 1L: Total to Wetland

Inflow Area = 2.304 ac, 8.34% Impervious, Inflow Depth = 2.20" for St Paul event
Inflow = 6.39 cfs @ 12.19 hrs, Volume= 0.423 af
Primary = 6.39 cfs @ 12.19 hrs, Volume= 0.423 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Total to Wetland





Routing Diagram for 21625_Stormwater_08082019
Prepared by {enter your company name here}, Printed 8/9/2019
HydroCAD® 10.00-20 s/n 01876 © 2017 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.624	61	>75% Grass cover, Good, HSG B (5S, 6S, 7S, 8S)
0.662	98	Paved parking, HSG B (5S, 6S, 7S)
2.286	**72**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
2.286	HSG B	5S, 6S, 7S, 8S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.286		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	1.624	0.000	0.000	0.000	1.624	>75% Grass cover, Good	5S, 6S, 7S, 8S
0.000	0.662	0.000	0.000	0.000	0.662	Paved parking	5S, 6S, 7S
0.000	**2.286**	**0.000**	**0.000**	**0.000**	**2.286**	**TOTAL AREA**	

Pipe Listing (selected 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	2P	873.00	872.85	20.0	0.0075	0.011	12.0	0.0	0.0
2	2P	879.00	878.97	3.0	0.0100	0.013	12.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment5S: Redirected Runon - Runoff Area=13,714 sf 61.07% Impervious Runoff Depth=1.36"
Tc=7.0 min CN=84 Runoff=0.76 cfs 0.036 af

Subcatchment6S: On-Site To Pond Runoff Area=64,108 sf 30.02% Impervious Runoff Depth=0.70"
Tc=7.0 min CN=72 Runoff=1.72 cfs 0.086 af

Subcatchment7S: Off-Site Run-On to Pond Runoff Area=13,269 sf 9.24% Impervious Runoff Depth=0.39"
Tc=7.0 min CN=64 Runoff=0.16 cfs 0.010 af

Subcatchment8S: On-Site Uncontrolled Runoff Area=8,484 sf 0.00% Impervious Runoff Depth=0.30"
Tc=7.0 min CN=61 Runoff=0.06 cfs 0.005 af

Pond 2P: Proposed Pond Peak Elev=879.40' Storage=1,352 cf Inflow=1.88 cfs 0.095 af
Outflow=0.45 cfs 0.095 af

Link 2L: Total to Wetland Inflow=0.95 cfs 0.136 af
Primary=0.95 cfs 0.136 af

Total Runoff Area = 2.286 ac Runoff Volume = 0.136 af Average Runoff Depth = 0.71"
71.03% Pervious = 1.624 ac 28.97% Impervious = 0.662 ac

Summary for Subcatchment 5S: Redirected Runon - Direct to Wetland

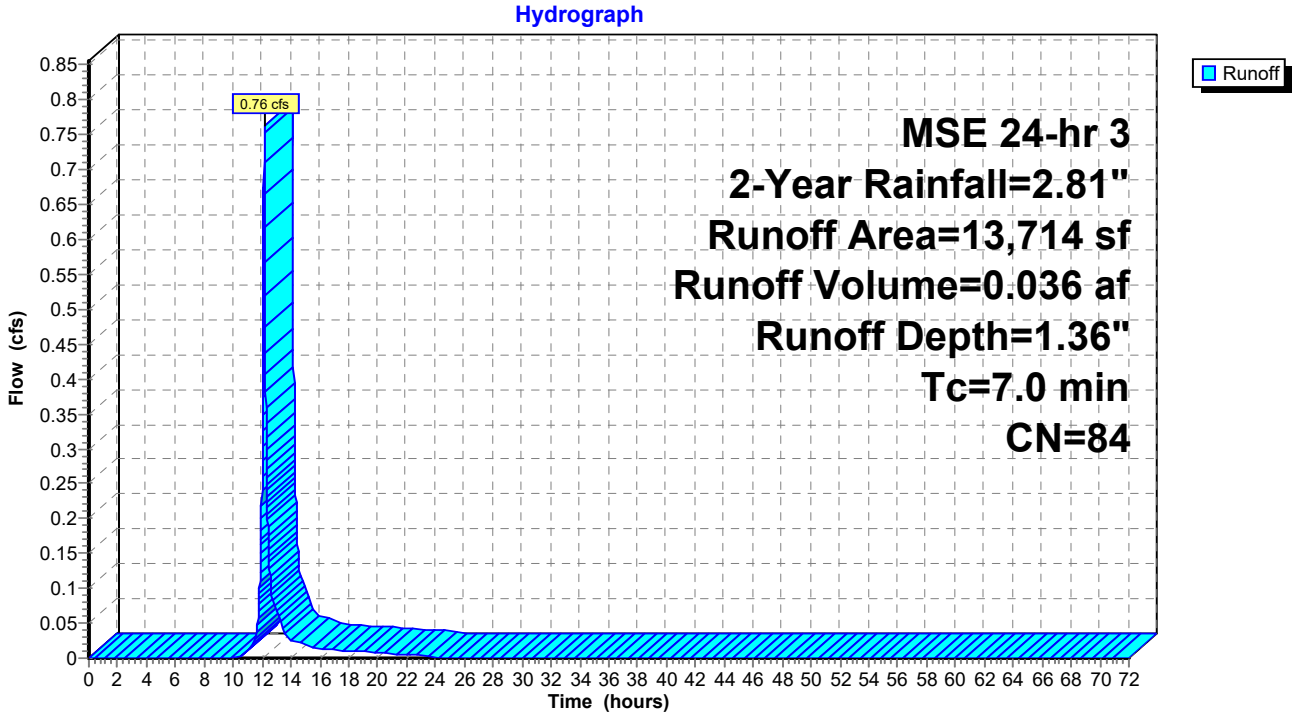
Runoff = 0.76 cfs @ 12.15 hrs, Volume= 0.036 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

Area (sf)	CN	Description
8,375	98	Paved parking, HSG B
5,339	61	>75% Grass cover, Good, HSG B
13,714	84	Weighted Average
5,339		38.93% Pervious Area
8,375		61.07% Impervious Area

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

Subcatchment 5S: Redirected Runon - Direct to Wetland



Summary for Subcatchment 6S: On-Site To Pond

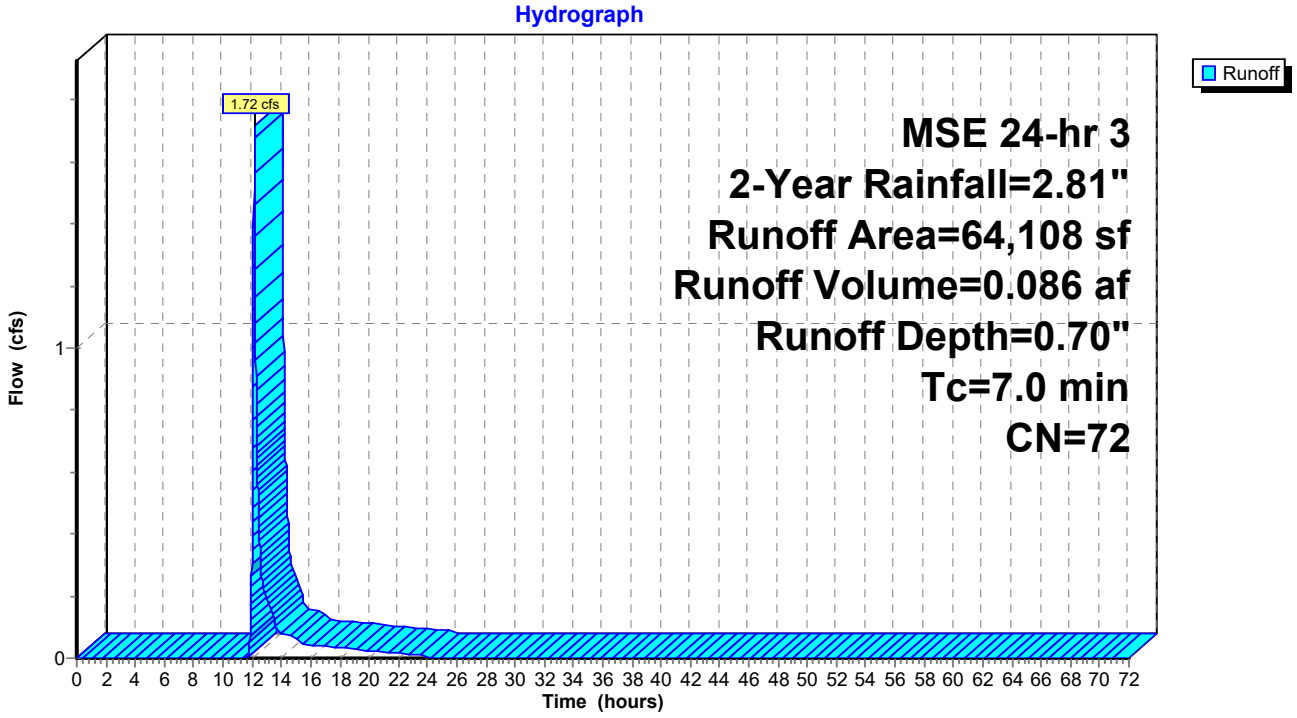
Runoff = 1.72 cfs @ 12.15 hrs, Volume= 0.086 af, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

Area (sf)	CN	Description
44,865	61	>75% Grass cover, Good, HSG B
19,243	98	Paved parking, HSG B
64,108	72	Weighted Average
44,865		69.98% Pervious Area
19,243		30.02% Impervious Area

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

Subcatchment 6S: On-Site To Pond



Summary for Subcatchment 7S: Off-Site Run-On to Pond

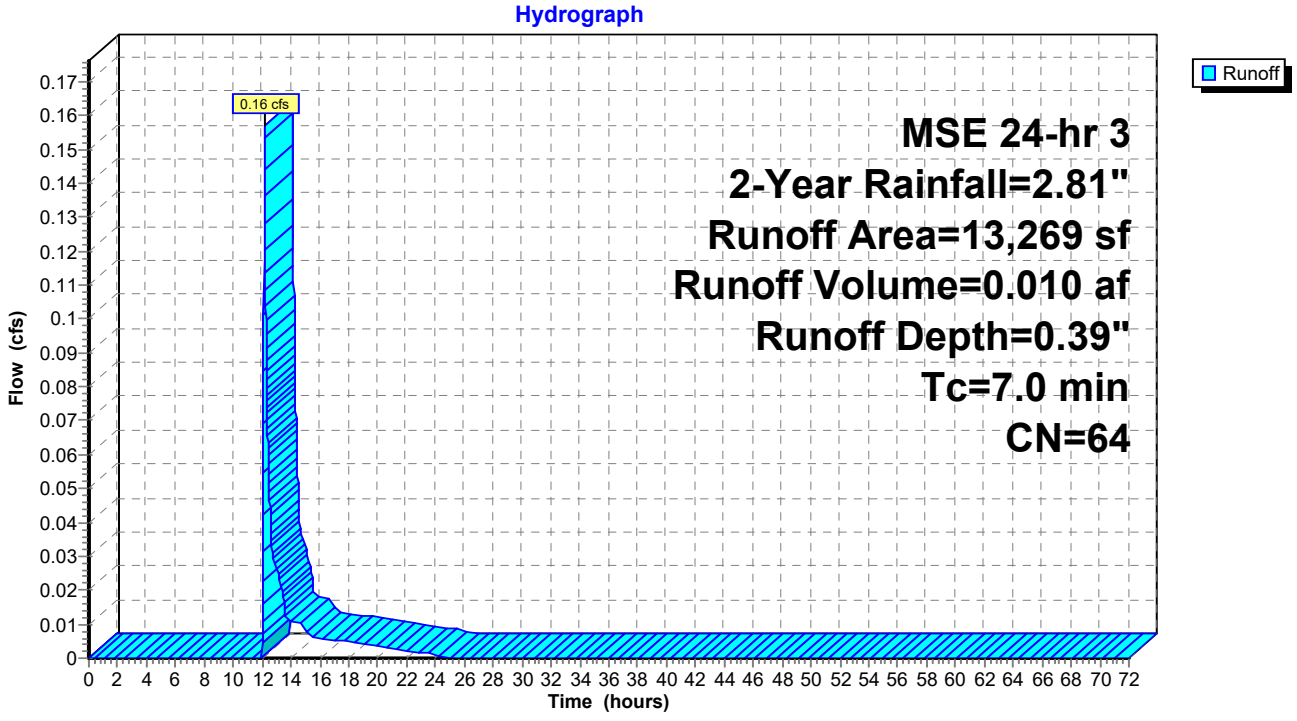
Runoff = 0.16 cfs @ 12.16 hrs, Volume= 0.010 af, Depth= 0.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

Area (sf)	CN	Description
12,043	61	>75% Grass cover, Good, HSG B
1,226	98	Paved parking, HSG B
13,269	64	Weighted Average
12,043		90.76% Pervious Area
1,226		9.24% Impervious Area

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

Subcatchment 7S: Off-Site Run-On to Pond



Summary for Subcatchment 8S: On-Site Uncontrolled Runoff

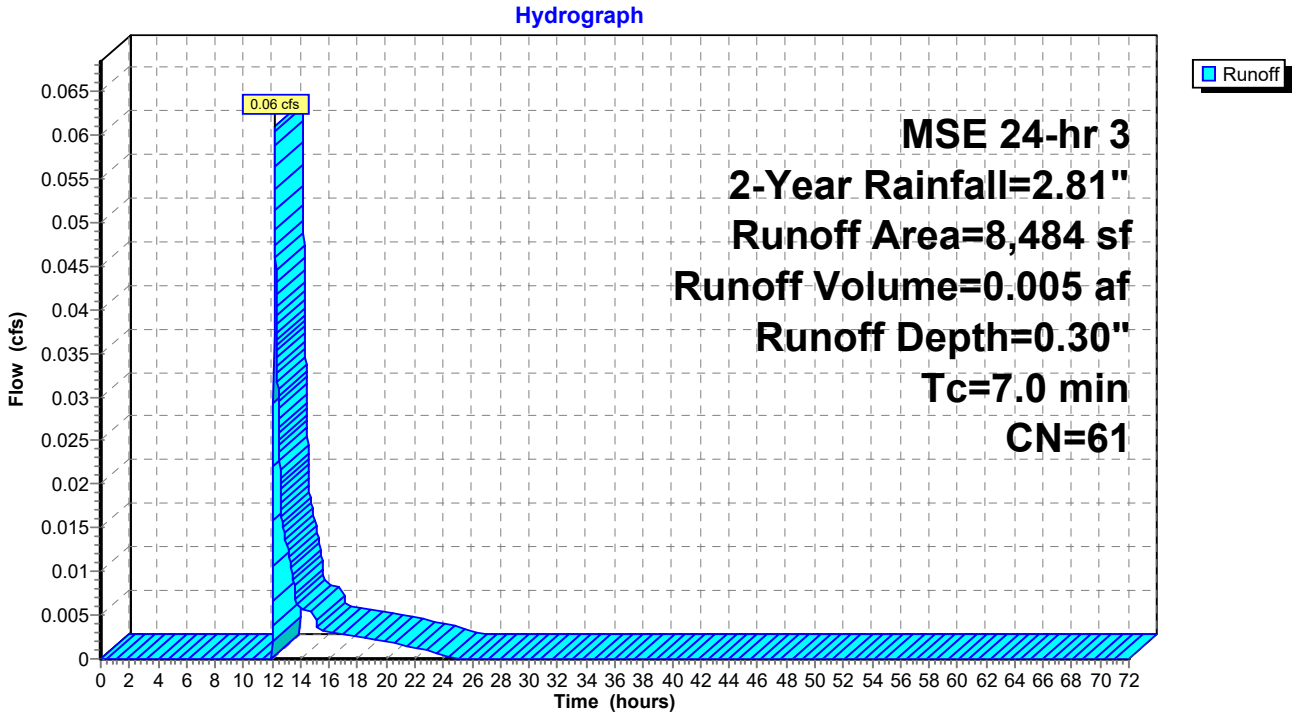
Runoff = 0.06 cfs @ 12.17 hrs, Volume= 0.005 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

Area (sf)	CN	Description
8,484	61	>75% Grass cover, Good, HSG B
8,484		100.00% Pervious Area

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

Subcatchment 8S: On-Site Uncontrolled Runoff



Summary for Pond 2P: Proposed Pond

Inflow Area = 1.776 ac, 26.45% Impervious, Inflow Depth = 0.64" for 2-Year event
Inflow = 1.88 cfs @ 12.15 hrs, Volume= 0.095 af
Outflow = 0.45 cfs @ 12.50 hrs, Volume= 0.095 af, Atten= 76%, Lag= 20.6 min
Primary = 0.45 cfs @ 12.50 hrs, Volume= 0.095 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 879.40' @ 12.50 hrs Surf.Area= 3,536 sf Storage= 1,352 cf
Flood Elev= 881.00' Surf.Area= 4,883 sf Storage= 8,080 cf

Plug-Flow detention time= 104.5 min calculated for 0.095 af (100% of inflow)
Center-of-Mass det. time= 104.8 min (949.2 - 844.4)

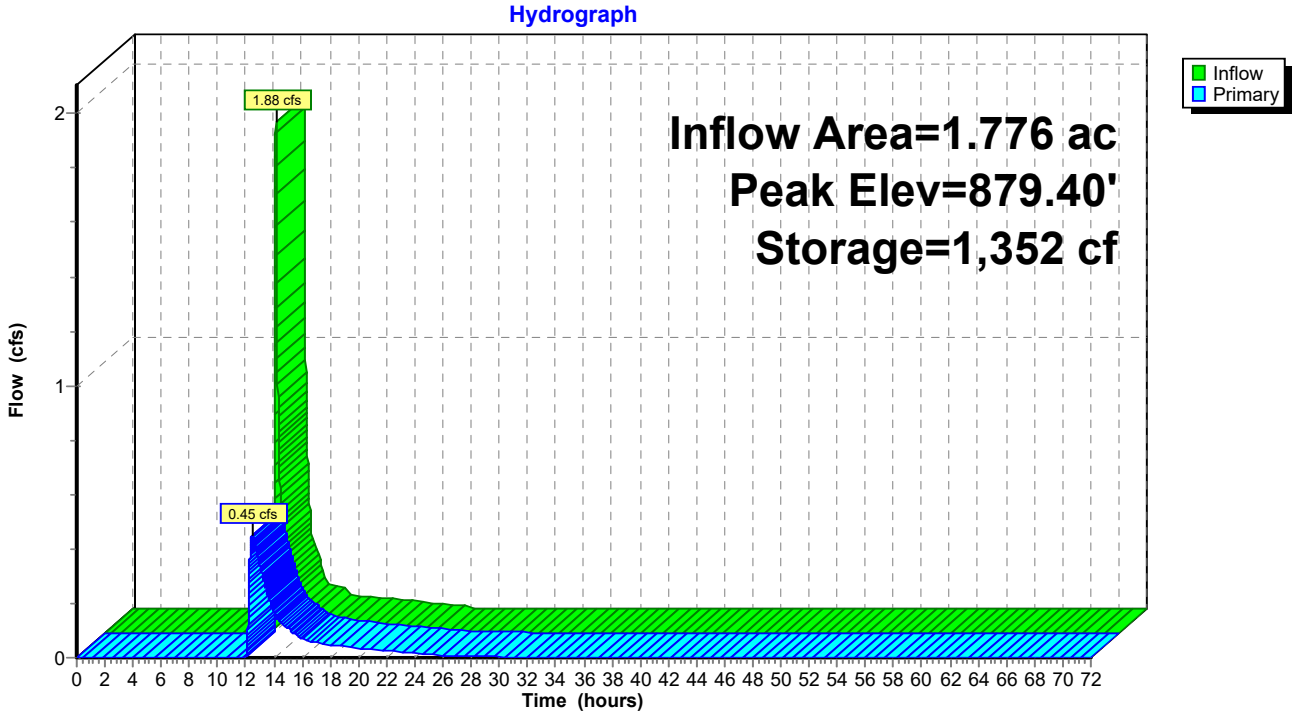
Volume	Invert	Avail.Storage	Storage Description
#1	879.00'	19,532 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
879.00	3,197	0	0
883.00	6,569	19,532	19,532

Device	Routing	Invert	Outlet Devices
#1	Primary	873.00'	**12.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 873.00' / 872.85' S= 0.0075 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	879.00'	**12.0" Round Culvert** L= 3.0' Ke= 0.500 Inlet / Outlet Invert= 879.00' / 878.97' S= 0.0100 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=0.45 cfs @ 12.50 hrs HW=879.40' (Free Discharge)
↑**1=Culvert** (Passes 0.45 cfs of 9.19 cfs potential flow)
↑**2=Culvert** (Barrel Controls 0.45 cfs @ 2.25 fps)

Pond 2P: Proposed Pond

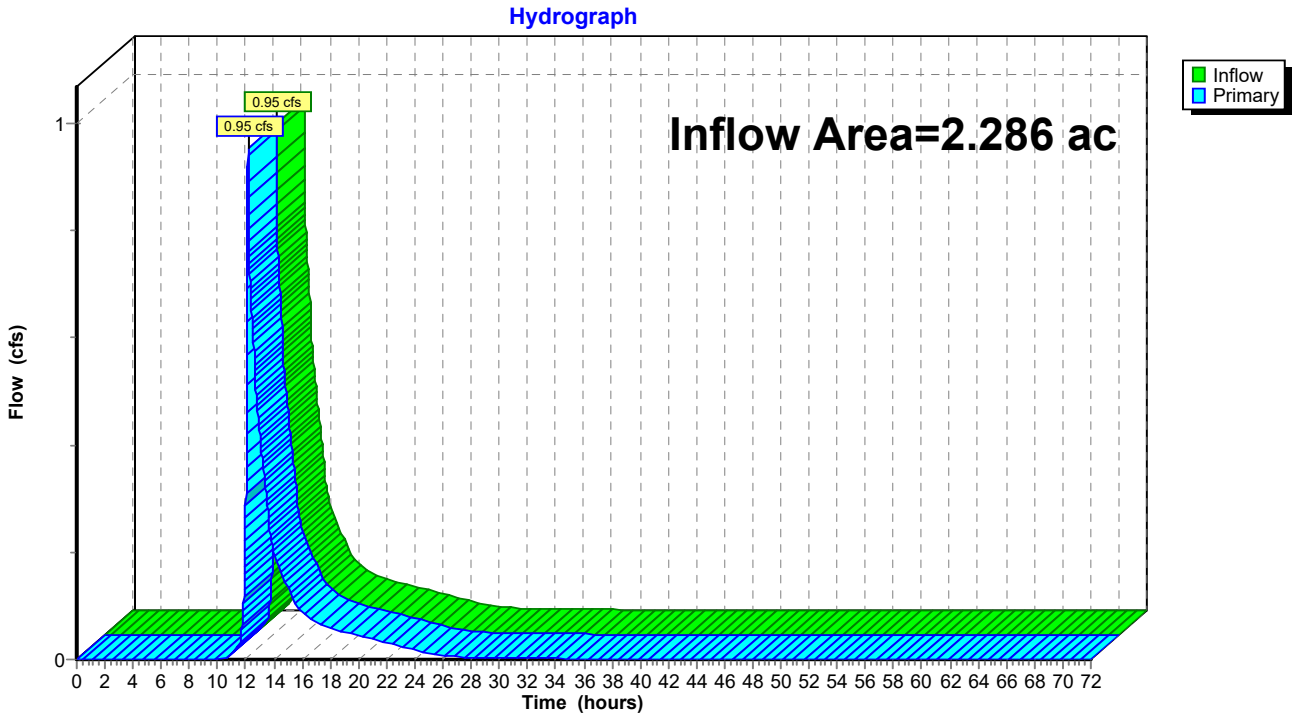


Summary for Link 2L: Total to Wetland

Inflow Area = 2.286 ac, 28.97% Impervious, Inflow Depth = 0.71" for 2-Year event
Inflow = 0.95 cfs @ 12.16 hrs, Volume= 0.136 af
Primary = 0.95 cfs @ 12.16 hrs, Volume= 0.136 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 2L: Total to Wetland



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment5S: Redirected Runon - Runoff Area=13,714 sf 61.07% Impervious Runoff Depth=2.54"
Tc=7.0 min CN=84 Runoff=1.41 cfs 0.067 af

Subcatchment6S: On-Site To Pond Runoff Area=64,108 sf 30.02% Impervious Runoff Depth=1.59"
Tc=7.0 min CN=72 Runoff=4.17 cfs 0.196 af

Subcatchment7S: Off-Site Run-On to Pond Runoff Area=13,269 sf 9.24% Impervious Runoff Depth=1.08"
Tc=7.0 min CN=64 Runoff=0.56 cfs 0.027 af

Subcatchment8S: On-Site Uncontrolled Runoff Area=8,484 sf 0.00% Impervious Runoff Depth=0.91"
Tc=7.0 min CN=61 Runoff=0.29 cfs 0.015 af

Pond 2P: Proposed Pond Peak Elev=879.86' Storage=3,043 cf Inflow=4.72 cfs 0.223 af
Outflow=1.68 cfs 0.223 af

Link 2L: Total to Wetland Inflow=2.73 cfs 0.304 af
Primary=2.73 cfs 0.304 af

Total Runoff Area = 2.286 ac Runoff Volume = 0.304 af Average Runoff Depth = 1.60"
71.03% Pervious = 1.624 ac 28.97% Impervious = 0.662 ac

Summary for Subcatchment 5S: Redirected Runon - Direct to Wetland

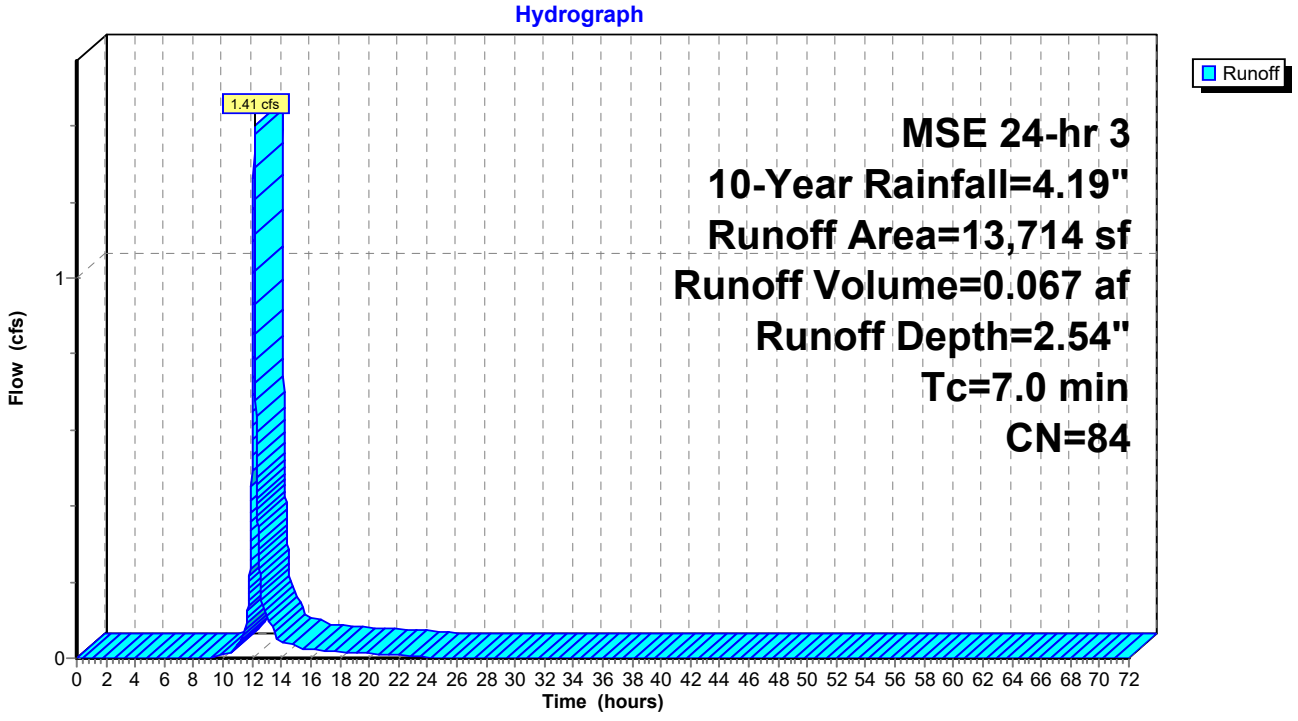
Runoff = 1.41 cfs @ 12.14 hrs, Volume= 0.067 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.19"

Area (sf)	CN	Description
8,375	98	Paved parking, HSG B
5,339	61	>75% Grass cover, Good, HSG B
13,714	84	Weighted Average
5,339		38.93% Pervious Area
8,375		61.07% Impervious Area

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

Subcatchment 5S: Redirected Runon - Direct to Wetland



Summary for Subcatchment 6S: On-Site To Pond

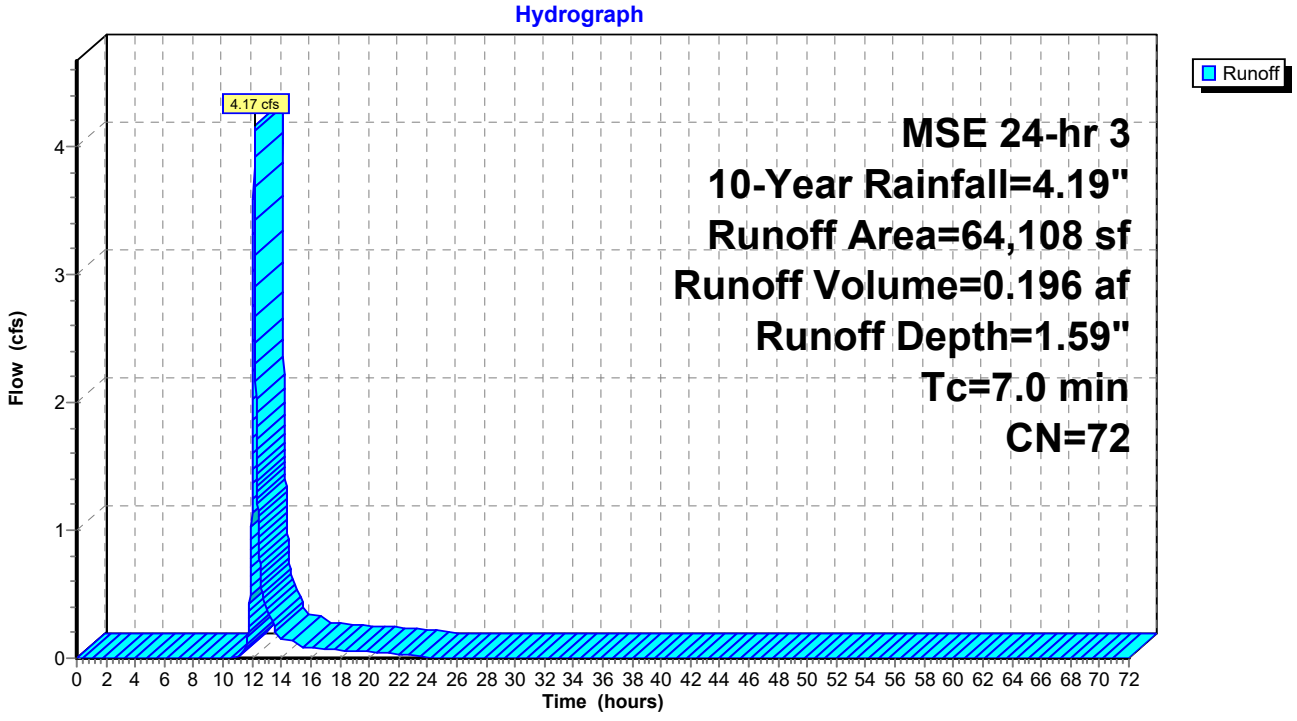
Runoff = 4.17 cfs @ 12.15 hrs, Volume= 0.196 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.19"

Area (sf)	CN	Description
44,865	61	>75% Grass cover, Good, HSG B
19,243	98	Paved parking, HSG B
64,108	72	Weighted Average
44,865		69.98% Pervious Area
19,243		30.02% Impervious Area

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

Subcatchment 6S: On-Site To Pond



Summary for Subcatchment 7S: Off-Site Run-On to Pond

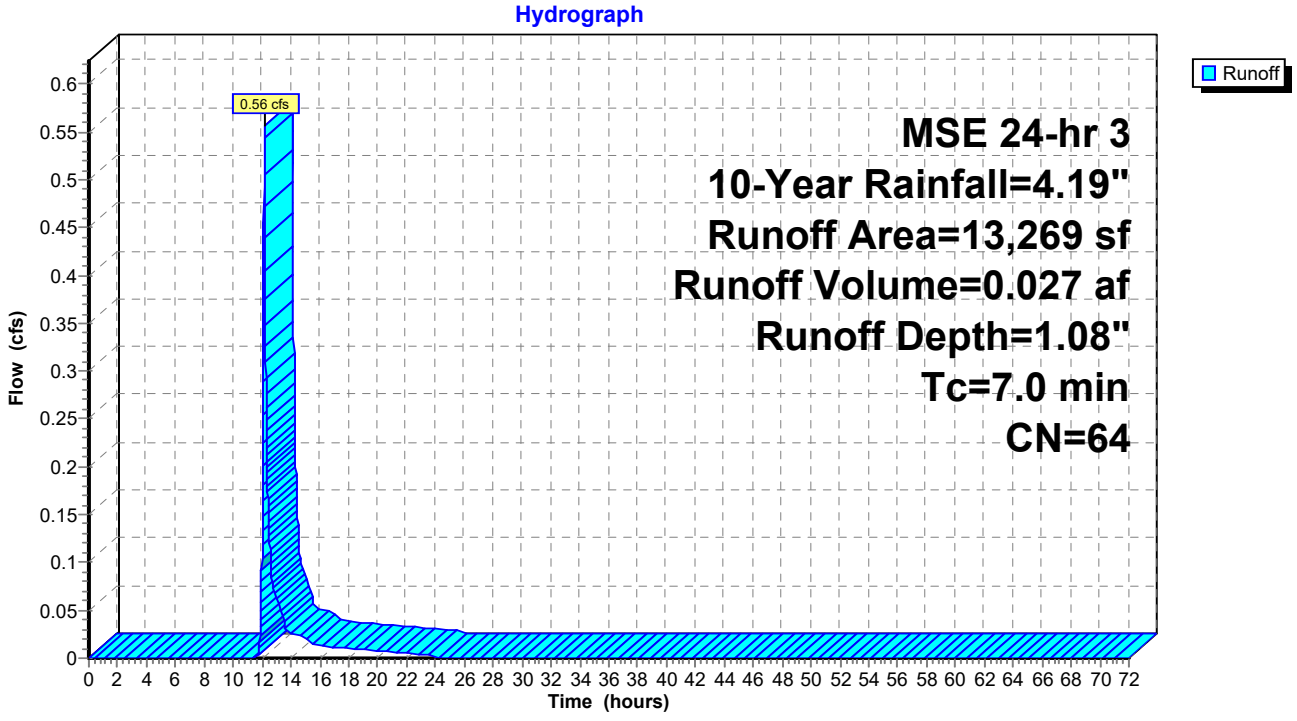
Runoff = 0.56 cfs @ 12.15 hrs, Volume= 0.027 af, Depth= 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.19"

Area (sf)	CN	Description
12,043	61	>75% Grass cover, Good, HSG B
1,226	98	Paved parking, HSG B
13,269	64	Weighted Average
12,043		90.76% Pervious Area
1,226		9.24% Impervious Area

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

Subcatchment 7S: Off-Site Run-On to Pond



Summary for Subcatchment 8S: On-Site Uncontrolled Runoff

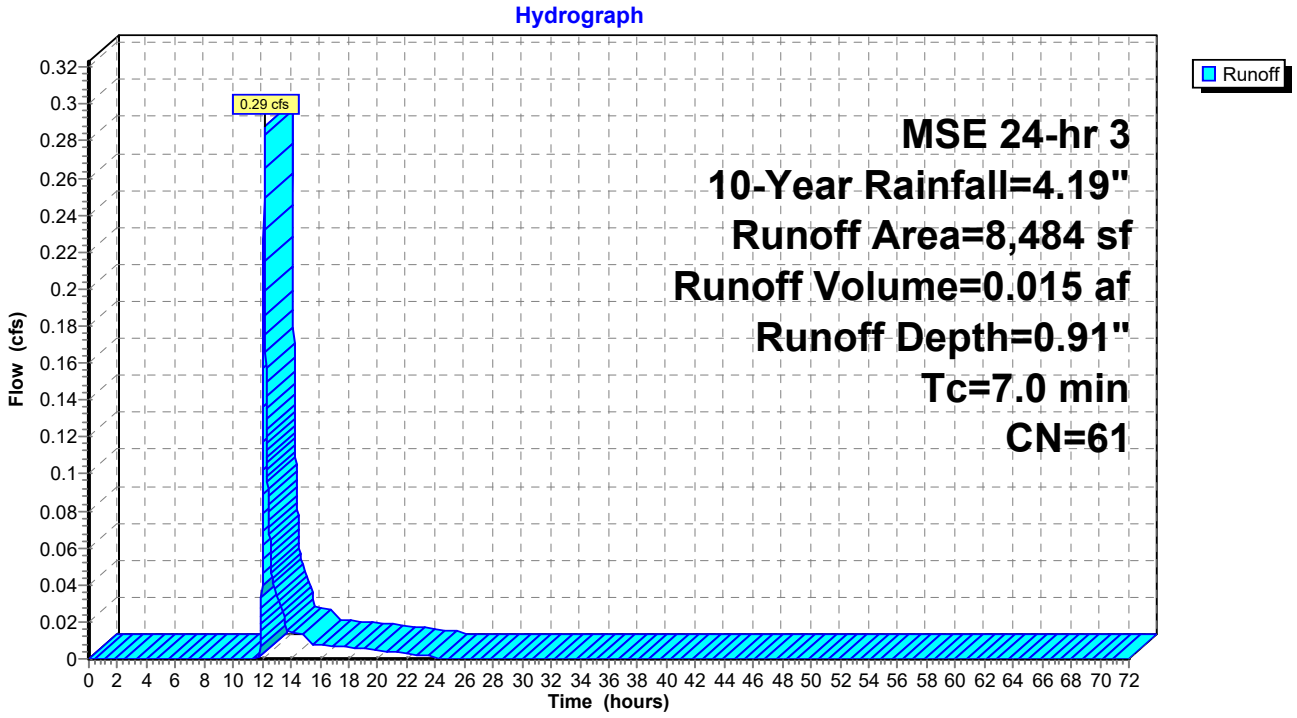
Runoff = 0.29 cfs @ 12.15 hrs, Volume= 0.015 af, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.19"

Area (sf)	CN	Description
8,484	61	>75% Grass cover, Good, HSG B
8,484		100.00% Pervious Area

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

Subcatchment 8S: On-Site Uncontrolled Runoff



Summary for Pond 2P: Proposed Pond

Inflow Area = 1.776 ac, 26.45% Impervious, Inflow Depth = 1.51" for 10-Year event
Inflow = 4.72 cfs @ 12.15 hrs, Volume= 0.223 af
Outflow = 1.68 cfs @ 12.32 hrs, Volume= 0.223 af, Atten= 64%, Lag= 10.6 min
Primary = 1.68 cfs @ 12.32 hrs, Volume= 0.223 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 879.86' @ 12.32 hrs Surf.Area= 3,918 sf Storage= 3,043 cf
Flood Elev= 881.00' Surf.Area= 4,883 sf Storage= 8,080 cf

Plug-Flow detention time= 66.7 min calculated for 0.223 af (100% of inflow)
Center-of-Mass det. time= 67.0 min (891.1 - 824.1)

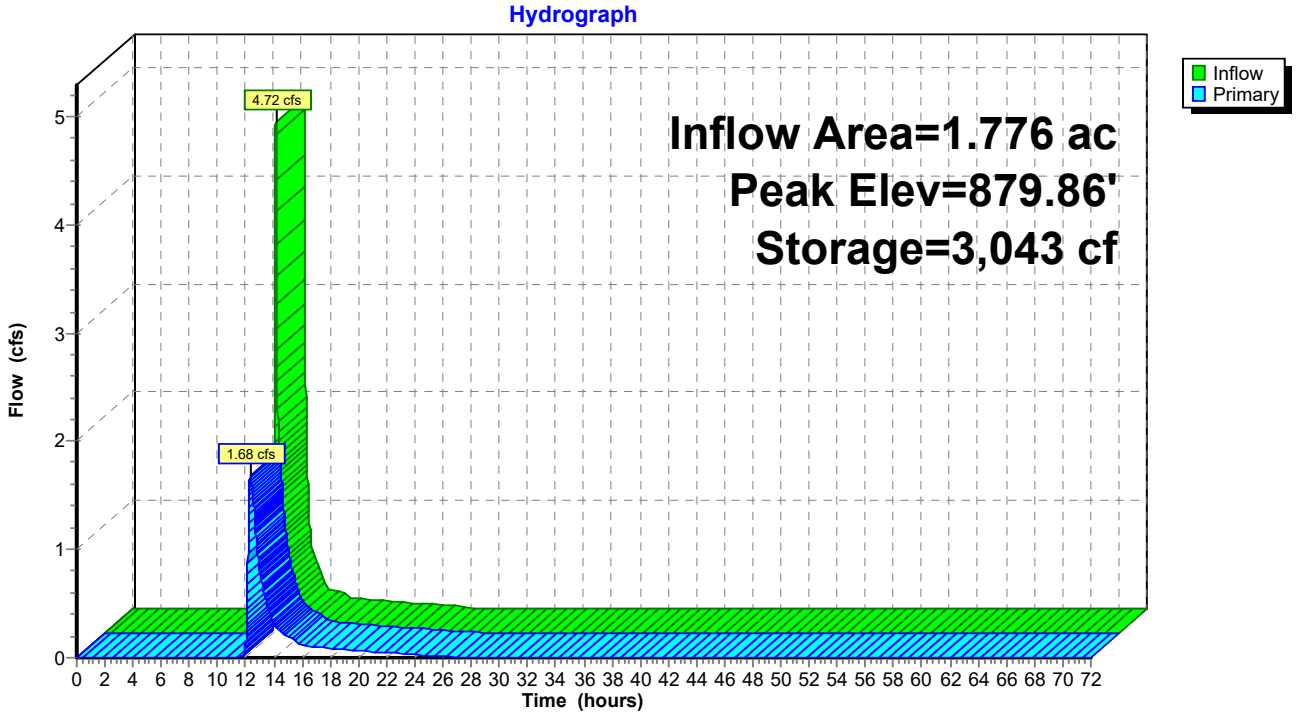
Volume	Invert	Avail.Storage	Storage Description
#1	879.00'	19,532 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
879.00	3,197	0	0
883.00	6,569	19,532	19,532

Device	Routing	Invert	Outlet Devices
#1	Primary	873.00'	**12.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 873.00' / 872.85' S= 0.0075 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	879.00'	**12.0" Round Culvert** L= 3.0' Ke= 0.500 Inlet / Outlet Invert= 879.00' / 878.97' S= 0.0100 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=1.68 cfs @ 12.32 hrs HW=879.86' (Free Discharge)
↑**1=Culvert** (Passes 1.68 cfs of 9.53 cfs potential flow)
↑**2=Culvert** (Barrel Controls 1.68 cfs @ 3.15 fps)

Pond 2P: Proposed Pond

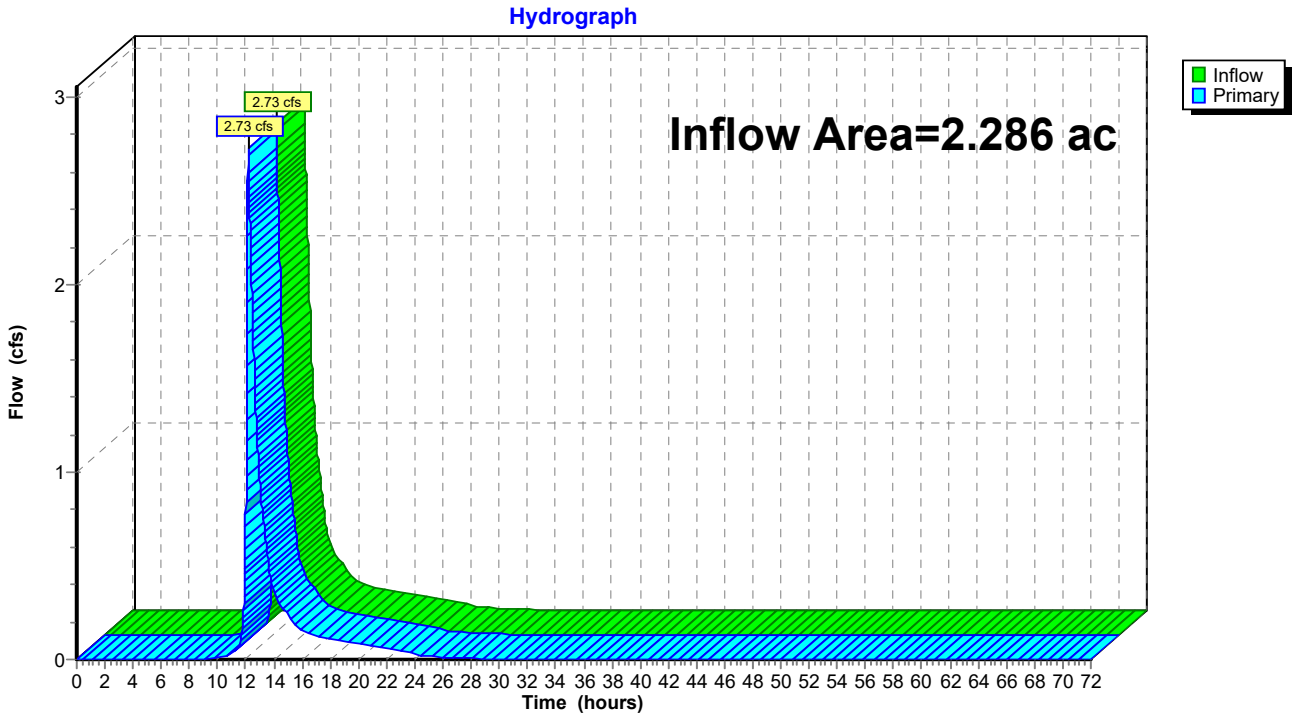


Summary for Link 2L: Total to Wetland

Inflow Area = 2.286 ac, 28.97% Impervious, Inflow Depth = 1.60" for 10-Year event
Inflow = 2.73 cfs @ 12.17 hrs, Volume= 0.304 af
Primary = 2.73 cfs @ 12.17 hrs, Volume= 0.304 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 2L: Total to Wetland



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment5S: Redirected Runon - Runoff Area=13,714 sf 61.07% Impervious Runoff Depth=5.48"
Tc=7.0 min CN=84 Runoff=2.92 cfs 0.144 af

Subcatchment6S: On-Site To Pond Runoff Area=64,108 sf 30.02% Impervious Runoff Depth=4.14"
Tc=7.0 min CN=72 Runoff=10.78 cfs 0.507 af

Subcatchment7S: Off-Site Run-On to Pond Runoff Area=13,269 sf 9.24% Impervious Runoff Depth=3.28"
Tc=7.0 min CN=64 Runoff=1.78 cfs 0.083 af

Subcatchment8S: On-Site Uncontrolled Runoff Area=8,484 sf 0.00% Impervious Runoff Depth=2.96"
Tc=7.0 min CN=61 Runoff=1.03 cfs 0.048 af

Pond 2P: Proposed Pond Peak Elev=881.00' Storage=8,074 cf Inflow=12.56 cfs 0.591 af
Outflow=4.63 cfs 0.591 af

Link 2L: Total to Wetland Inflow=7.89 cfs 0.783 af
Primary=7.89 cfs 0.783 af

Total Runoff Area = 2.286 ac Runoff Volume = 0.783 af Average Runoff Depth = 4.11"
71.03% Pervious = 1.624 ac 28.97% Impervious = 0.662 ac

Summary for Subcatchment 5S: Redirected Runon - Direct to Wetland

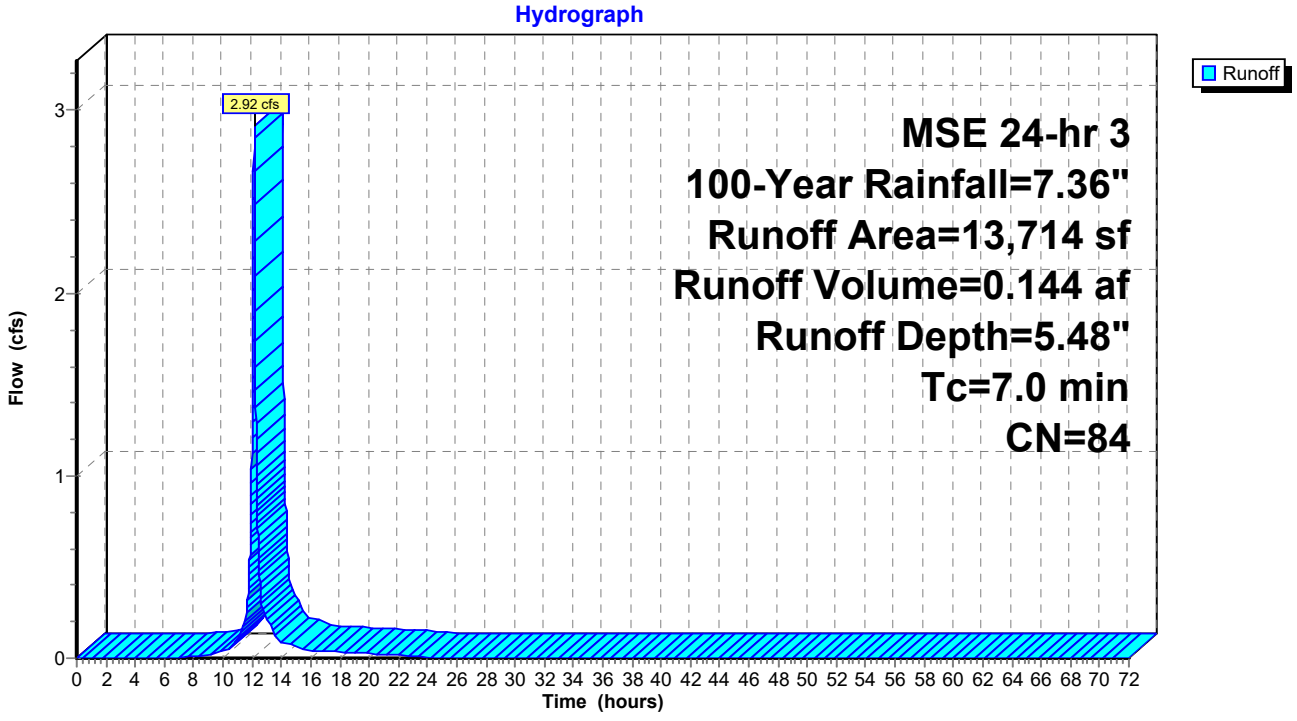
Runoff = 2.92 cfs @ 12.14 hrs, Volume= 0.144 af, Depth= 5.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.36"

Area (sf)	CN	Description
8,375	98	Paved parking, HSG B
5,339	61	>75% Grass cover, Good, HSG B
13,714	84	Weighted Average
5,339		38.93% Pervious Area
8,375		61.07% Impervious Area

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

Subcatchment 5S: Redirected Runon - Direct to Wetland



Summary for Subcatchment 6S: On-Site To Pond

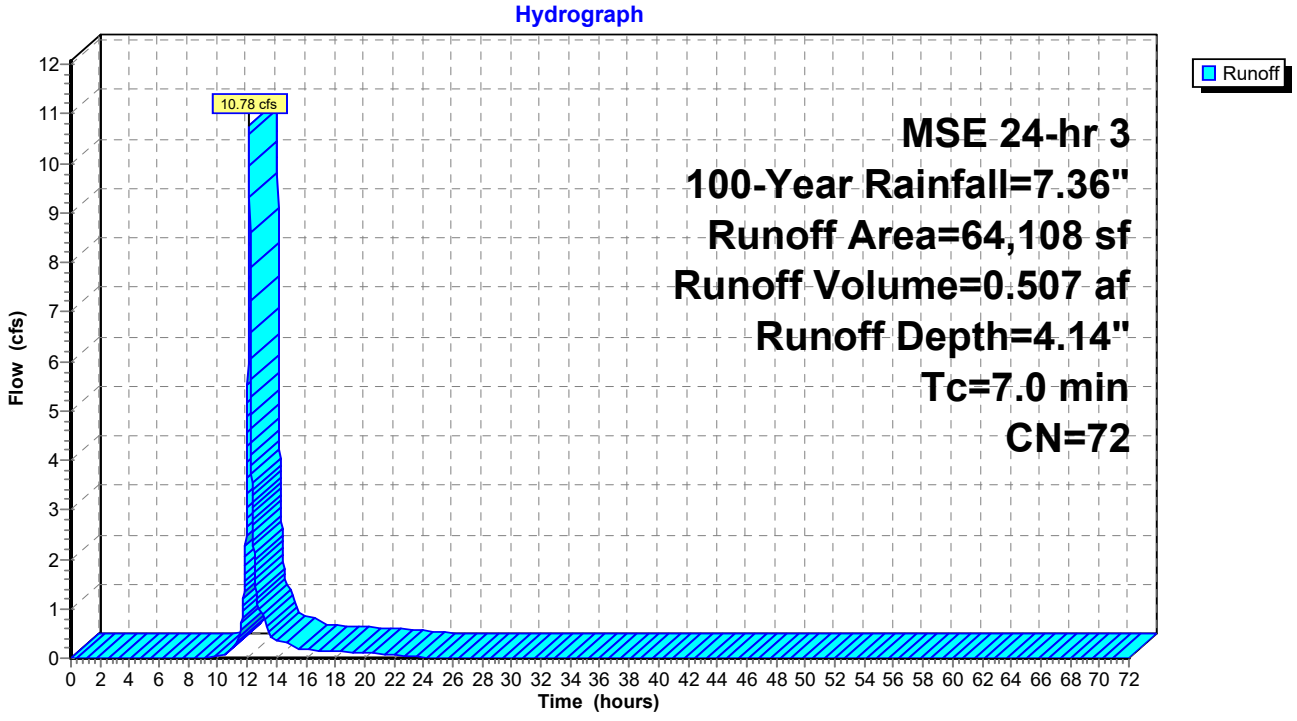
Runoff = 10.78 cfs @ 12.14 hrs, Volume= 0.507 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.36"

Area (sf)	CN	Description
44,865	61	>75% Grass cover, Good, HSG B
19,243	98	Paved parking, HSG B
64,108	72	Weighted Average
44,865		69.98% Pervious Area
19,243		30.02% Impervious Area

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

Subcatchment 6S: On-Site To Pond



Summary for Subcatchment 7S: Off-Site Run-On to Pond

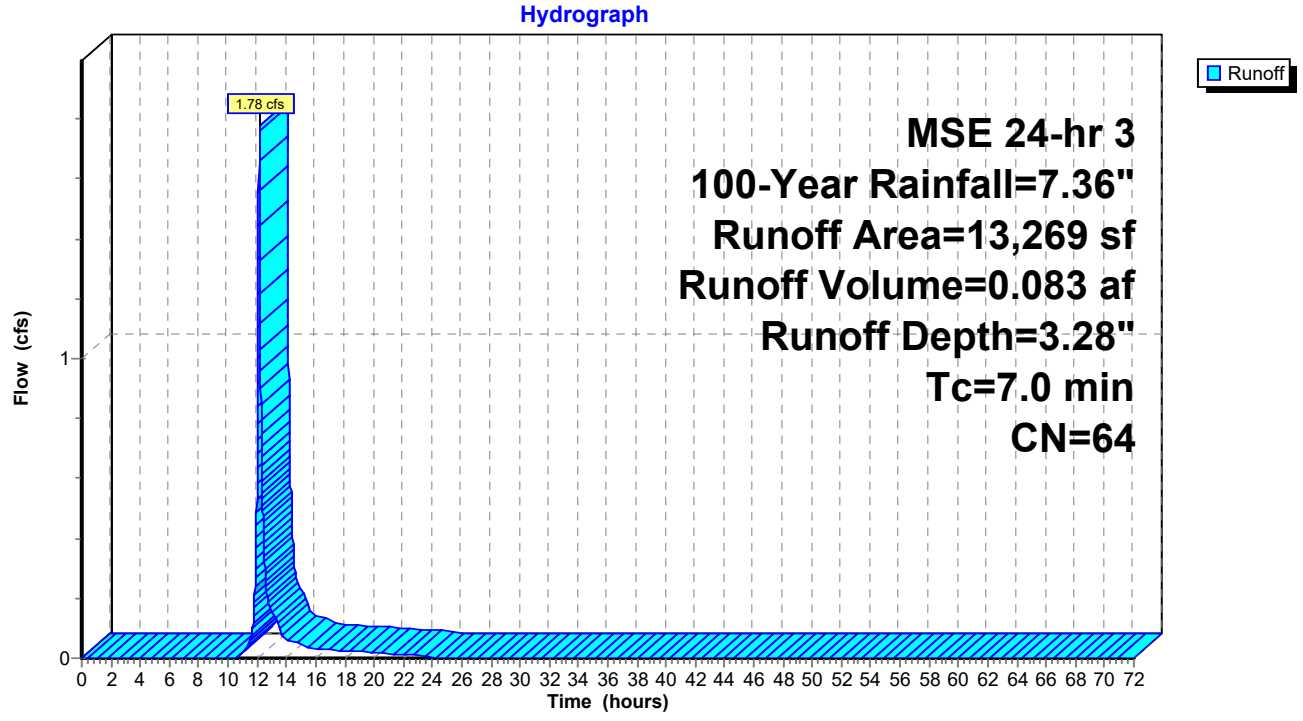
Runoff = 1.78 cfs @ 12.15 hrs, Volume= 0.083 af, Depth= 3.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.36"

Area (sf)	CN	Description
12,043	61	>75% Grass cover, Good, HSG B
1,226	98	Paved parking, HSG B
13,269	64	Weighted Average
12,043		90.76% Pervious Area
1,226		9.24% Impervious Area

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

Subcatchment 7S: Off-Site Run-On to Pond



Summary for Subcatchment 8S: On-Site Uncontrolled Runoff

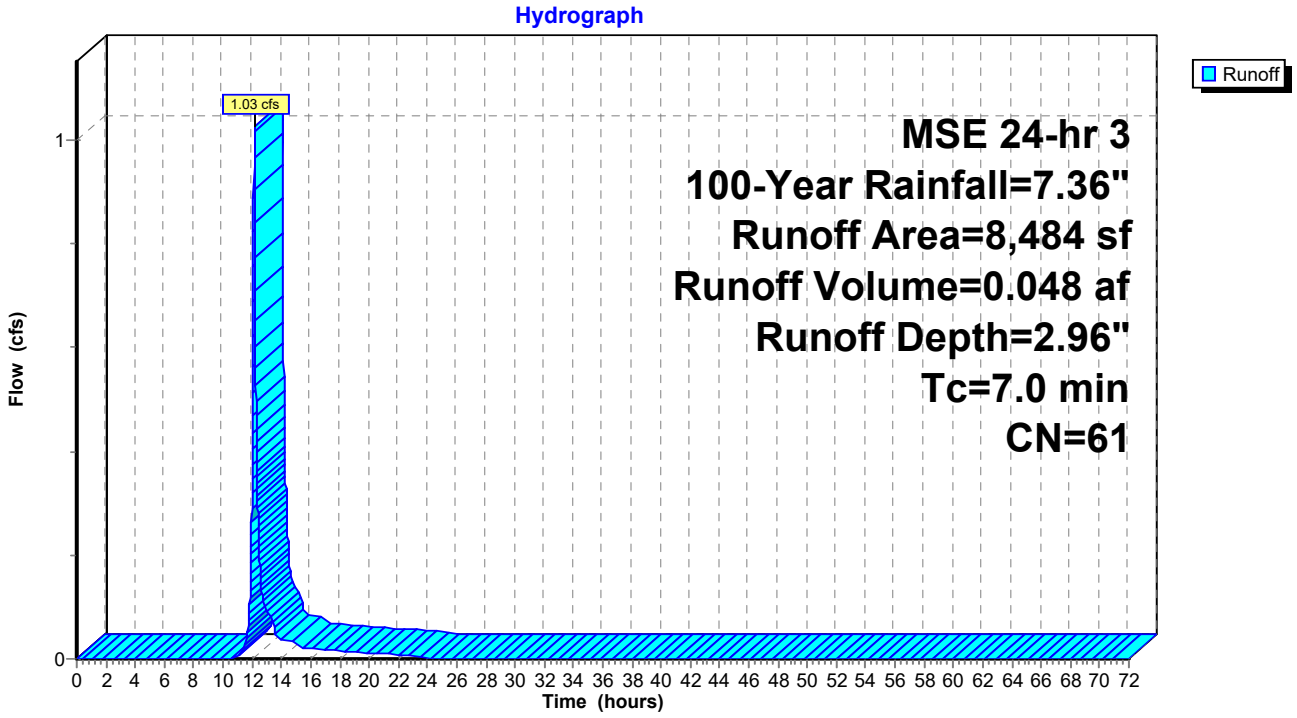
Runoff = 1.03 cfs @ 12.15 hrs, Volume= 0.048 af, Depth= 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=7.36"

Area (sf)	CN	Description
8,484	61	>75% Grass cover, Good, HSG B
8,484		100.00% Pervious Area

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

Subcatchment 8S: On-Site Uncontrolled Runoff



Summary for Pond 2P: Proposed Pond

Inflow Area = 1.776 ac, 26.45% Impervious, Inflow Depth = 3.99" for 100-Year event
Inflow = 12.56 cfs @ 12.14 hrs, Volume= 0.591 af
Outflow = 4.63 cfs @ 12.30 hrs, Volume= 0.591 af, Atten= 63%, Lag= 9.2 min
Primary = 4.63 cfs @ 12.30 hrs, Volume= 0.591 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 881.00' @ 12.30 hrs Surf.Area= 4,882 sf Storage= 8,074 cf
Flood Elev= 881.00' Surf.Area= 4,883 sf Storage= 8,080 cf

Plug-Flow detention time= 45.3 min calculated for 0.591 af (100% of inflow)
Center-of-Mass det. time= 45.2 min (849.1 - 803.9)

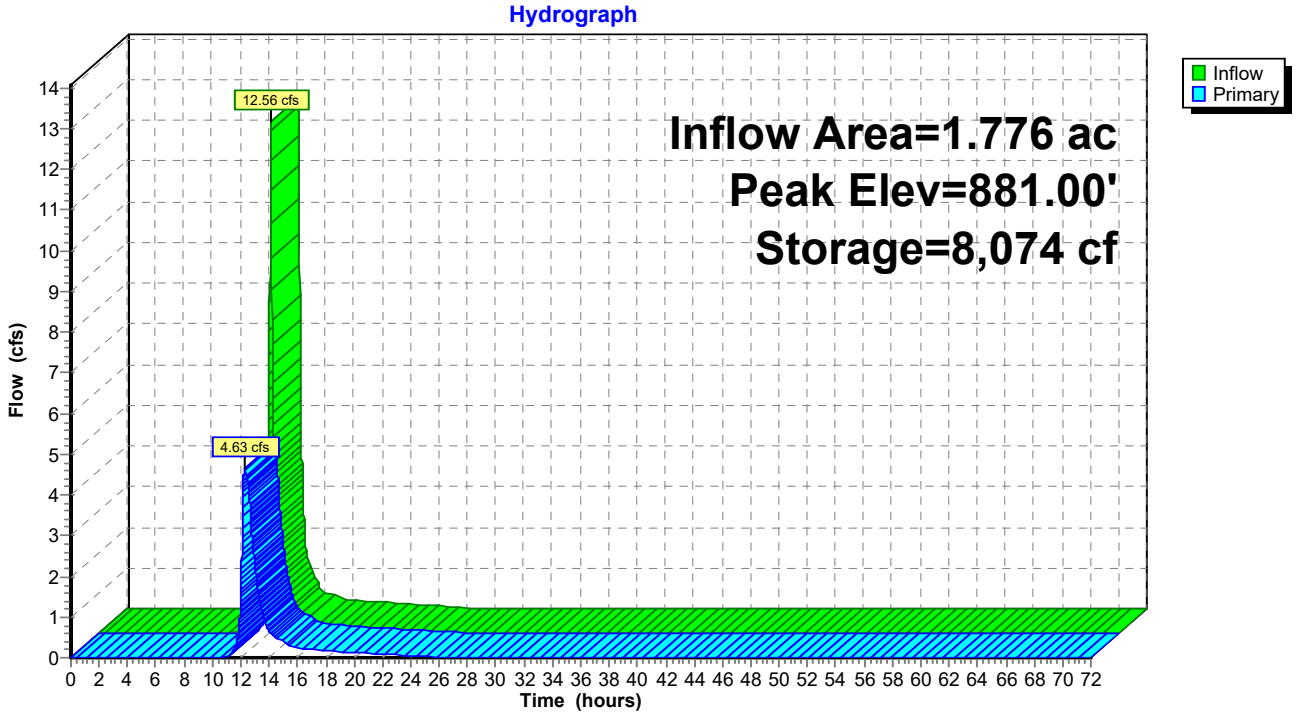
Volume	Invert	Avail.Storage	Storage Description
#1	879.00'	19,532 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
879.00	3,197	0	0
883.00	6,569	19,532	19,532

Device	Routing	Invert	Outlet Devices
#1	Primary	873.00'	**12.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 873.00' / 872.85' S= 0.0075 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	879.00'	**12.0" Round Culvert** L= 3.0' Ke= 0.500 Inlet / Outlet Invert= 879.00' / 878.97' S= 0.0100 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=4.63 cfs @ 12.30 hrs HW=881.00' (Free Discharge)
↑**1=Culvert** (Passes 4.63 cfs of 10.36 cfs potential flow)
↑**2=Culvert** (Inlet Controls 4.63 cfs @ 5.89 fps)

Pond 2P: Proposed Pond

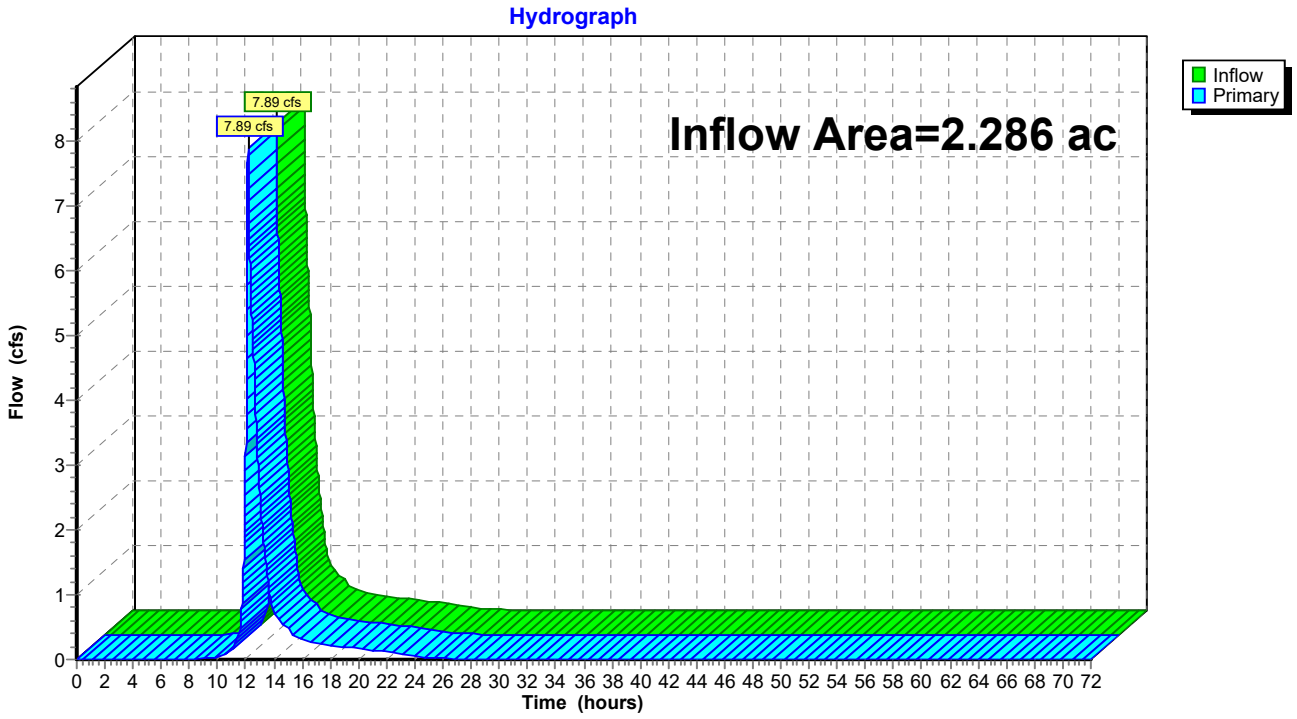


Summary for Link 2L: Total to Wetland

Inflow Area = 2.286 ac, 28.97% Impervious, Inflow Depth = 4.11" for 100-Year event
Inflow = 7.89 cfs @ 12.16 hrs, Volume= 0.783 af
Primary = 7.89 cfs @ 12.16 hrs, Volume= 0.783 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 2L: Total to Wetland



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment5S: Redirected Runon - Runoff Area=13,714 sf 61.07% Impervious Runoff Depth=4.10"
Tc=7.0 min CN=84 Runoff=2.22 cfs 0.108 af

Subcatchment6S: On-Site To Pond Runoff Area=64,108 sf 30.02% Impervious Runoff Depth=2.91"
Tc=7.0 min CN=72 Runoff=7.64 cfs 0.357 af

Subcatchment7S: Off-Site Run-On to Pond Runoff Area=13,269 sf 9.24% Impervious Runoff Depth=2.19"
Tc=7.0 min CN=64 Runoff=1.18 cfs 0.056 af

Subcatchment8S: On-Site Uncontrolled Runoff Area=8,484 sf 0.00% Impervious Runoff Depth=1.94"
Tc=7.0 min CN=61 Runoff=0.66 cfs 0.031 af

Pond 2P: Proposed Pond Peak Elev=880.46' Storage=5,577 cf Inflow=8.82 cfs 0.413 af
Outflow=3.50 cfs 0.413 af

Link 2L: Total to Wetland Inflow=5.55 cfs 0.552 af
Primary=5.55 cfs 0.552 af

Total Runoff Area = 2.286 ac Runoff Volume = 0.552 af Average Runoff Depth = 2.90"
71.03% Pervious = 1.624 ac 28.97% Impervious = 0.662 ac

Summary for Subcatchment 5S: Redirected Runon - Direct to Wetland

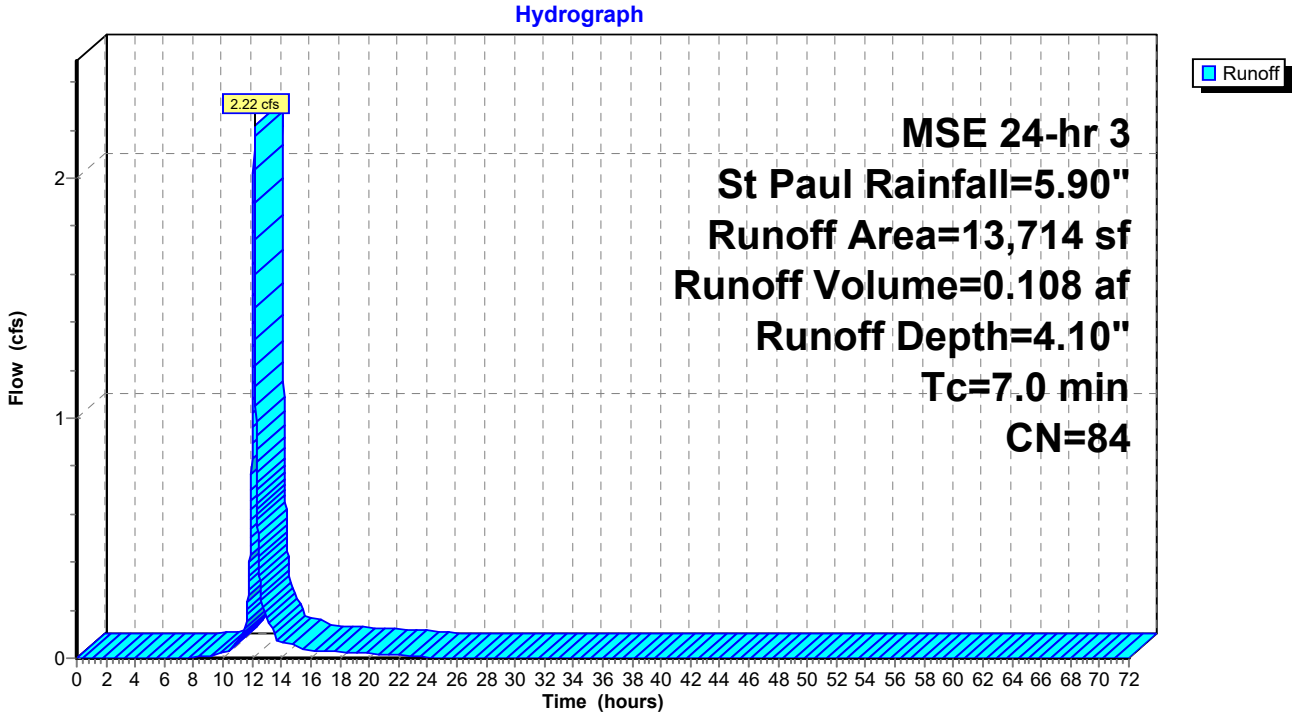
Runoff = 2.22 cfs @ 12.14 hrs, Volume= 0.108 af, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 St Paul Rainfall=5.90"

Area (sf)	CN	Description
8,375	98	Paved parking, HSG B
5,339	61	>75% Grass cover, Good, HSG B
13,714	84	Weighted Average
5,339		38.93% Pervious Area
8,375		61.07% Impervious Area

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

Subcatchment 5S: Redirected Runon - Direct to Wetland



Summary for Subcatchment 6S: On-Site To Pond

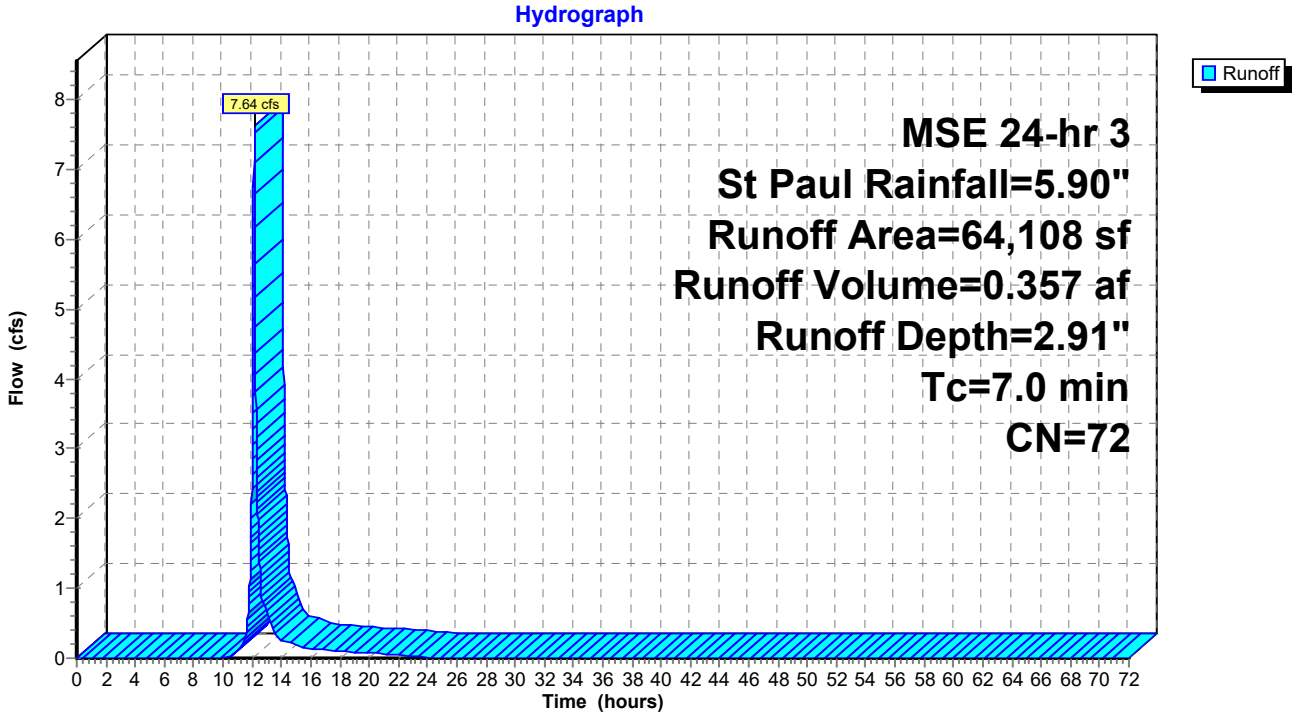
Runoff = 7.64 cfs @ 12.14 hrs, Volume= 0.357 af, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 St Paul Rainfall=5.90"

Area (sf)	CN	Description
44,865	61	>75% Grass cover, Good, HSG B
19,243	98	Paved parking, HSG B
64,108	72	Weighted Average
44,865		69.98% Pervious Area
19,243		30.02% Impervious Area

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

Subcatchment 6S: On-Site To Pond



Summary for Subcatchment 7S: Off-Site Run-On to Pond

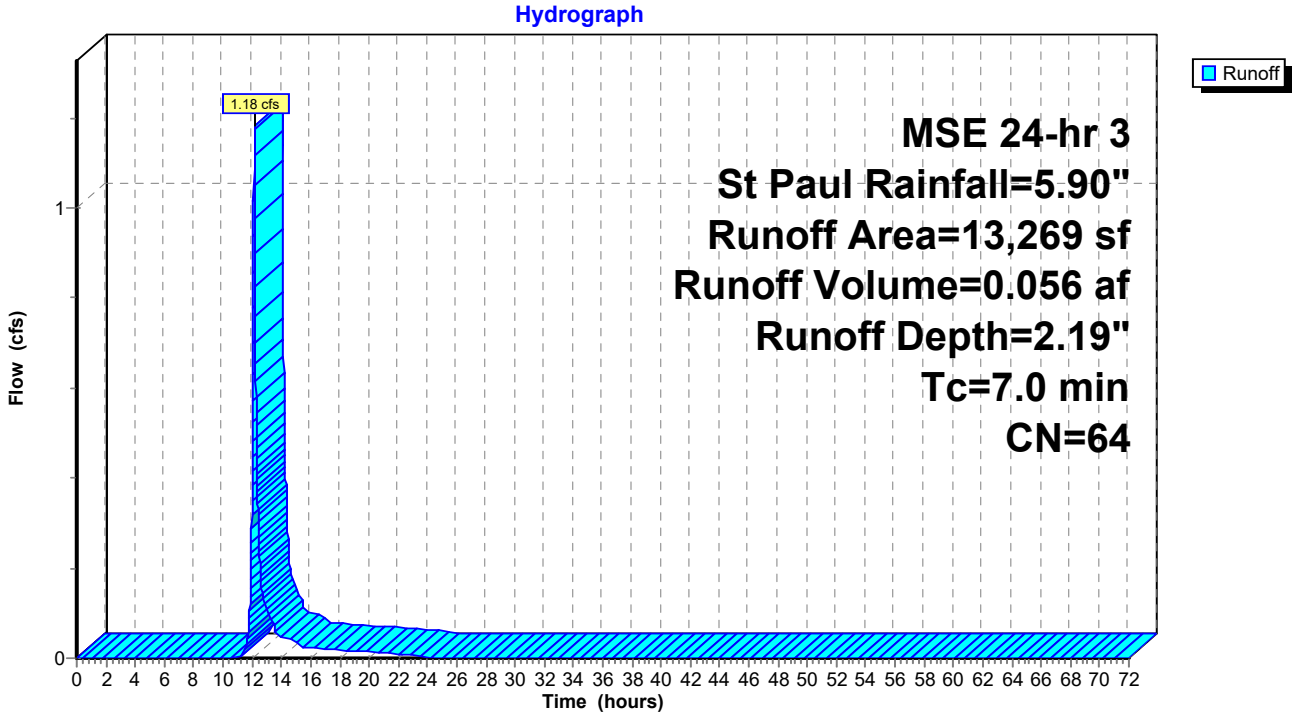
Runoff = 1.18 cfs @ 12.15 hrs, Volume= 0.056 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 St Paul Rainfall=5.90"

Area (sf)	CN	Description
12,043	61	>75% Grass cover, Good, HSG B
1,226	98	Paved parking, HSG B
13,269	64	Weighted Average
12,043		90.76% Pervious Area
1,226		9.24% Impervious Area

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

Subcatchment 7S: Off-Site Run-On to Pond



Summary for Subcatchment 8S: On-Site Uncontrolled Runoff

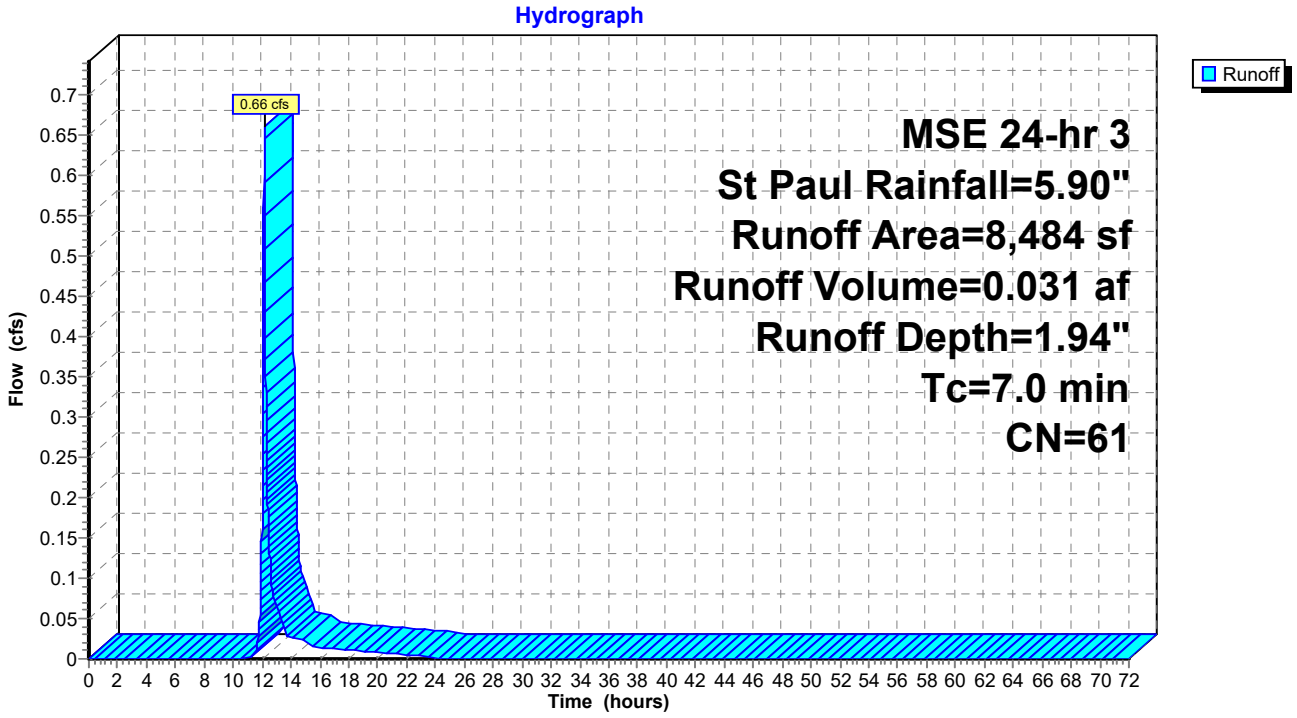
Runoff = 0.66 cfs @ 12.15 hrs, Volume= 0.031 af, Depth= 1.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 St Paul Rainfall=5.90"

Area (sf)	CN	Description
8,484	61	>75% Grass cover, Good, HSG B
8,484		100.00% Pervious Area

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

Subcatchment 8S: On-Site Uncontrolled Runoff



Summary for Pond 2P: Proposed Pond

Inflow Area = 1.776 ac, 26.45% Impervious, Inflow Depth = 2.79" for St Paul event
Inflow = 8.82 cfs @ 12.15 hrs, Volume= 0.413 af
Outflow = 3.50 cfs @ 12.29 hrs, Volume= 0.413 af, Atten= 60%, Lag= 8.6 min
Primary = 3.50 cfs @ 12.29 hrs, Volume= 0.413 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 880.46' @ 12.29 hrs Surf.Area= 4,430 sf Storage= 5,577 cf
Flood Elev= 881.00' Surf.Area= 4,883 sf Storage= 8,080 cf

Plug-Flow detention time= 51.0 min calculated for 0.413 af (100% of inflow)
Center-of-Mass det. time= 50.9 min (862.0 - 811.1)

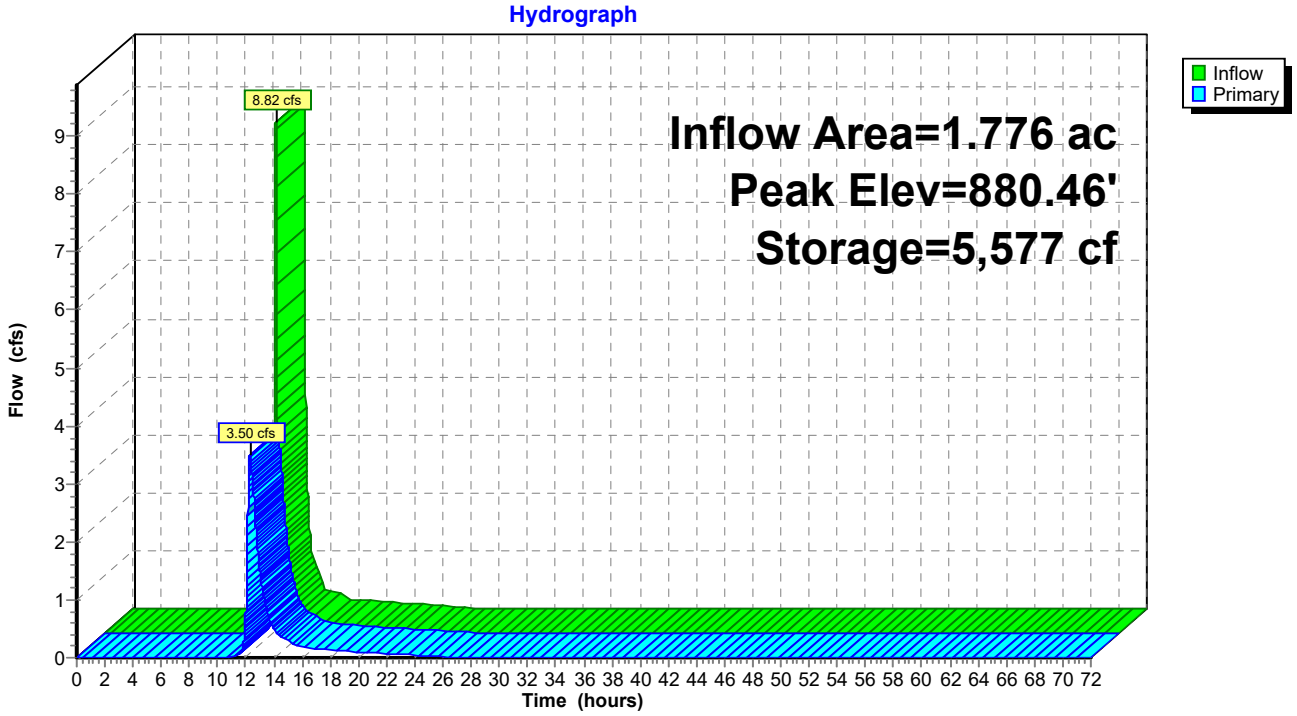
Volume	Invert	Avail.Storage	Storage Description
#1	879.00'	19,532 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
879.00	3,197	0	0
883.00	6,569	19,532	19,532

Device	Routing	Invert	Outlet Devices
#1	Primary	873.00'	**12.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 873.00' / 872.85' S= 0.0075 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	879.00'	**12.0" Round Culvert** L= 3.0' Ke= 0.500 Inlet / Outlet Invert= 879.00' / 878.97' S= 0.0100 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=3.50 cfs @ 12.29 hrs HW=880.46' (Free Discharge)
↑**1=Culvert** (Passes 3.50 cfs of 9.98 cfs potential flow)
↑**2=Culvert** (Barrel Controls 3.50 cfs @ 4.46 fps)

Pond 2P: Proposed Pond

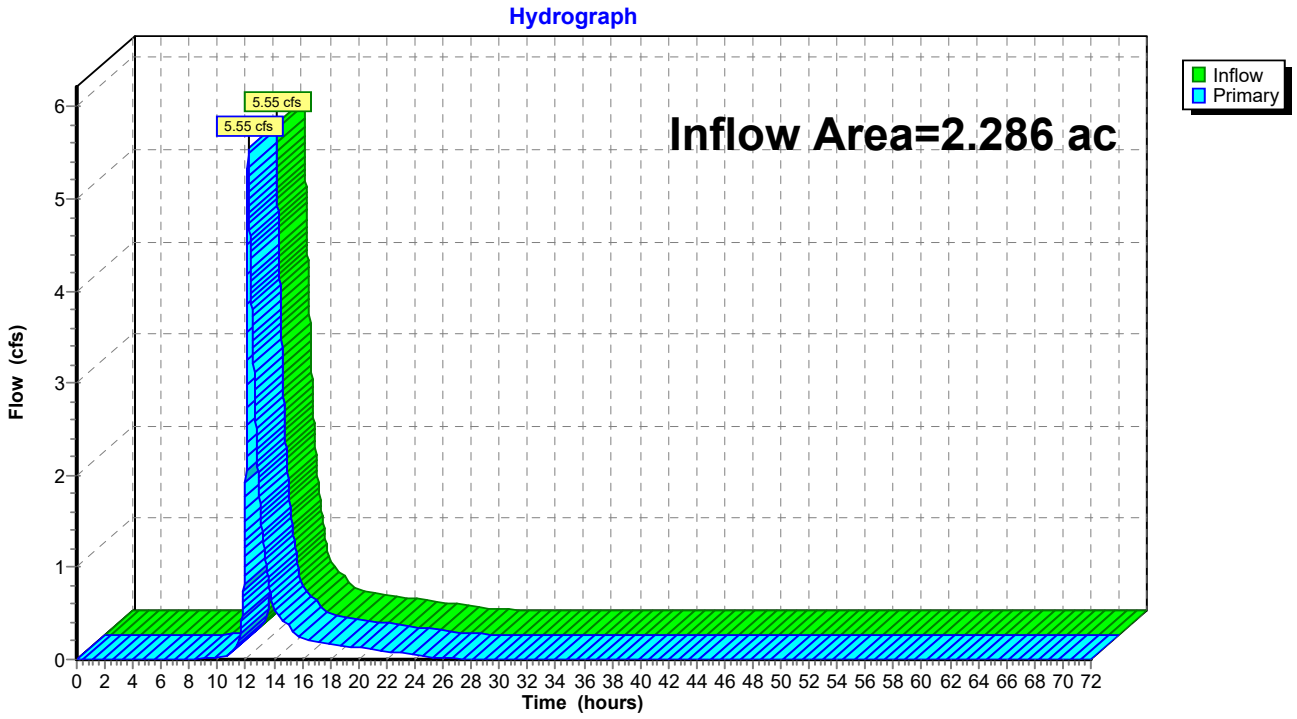


Summary for Link 2L: Total to Wetland

Inflow Area = 2.286 ac, 28.97% Impervious, Inflow Depth = 2.90" for St Paul event
Inflow = 5.55 cfs @ 12.16 hrs, Volume= 0.552 af
Primary = 5.55 cfs @ 12.16 hrs, Volume= 0.552 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 2L: Total to Wetland



APPENDIX C – GEOTECHNICAL REPORT

Geotechnical Evaluation Report

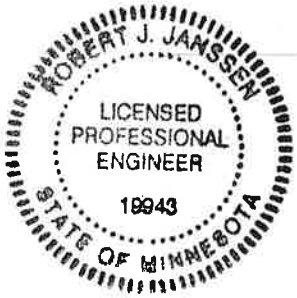
Proposed Pavements
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
St. Paul, Minnesota

Prepared for

Venture Pass Partners, LLC or assigns and Mason Holdings III, LLC or assigns

Professional Certification:
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.

Robert J. Janssen, PE
President - Principal Engineer
License Number: 19943
June 21, 2019



Project B1905336

Braun Intertec Corporation

BRAUN INTERTEC
The Science You Build On.

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The Science You Build On.

Braun Intertec Corporation
11001 Hampshire Avenue S
Minneapolis, MN 55438

Phone: 952.995.2000
Fax: 952.995.2020
Web: braunintertec.com

June 21, 2019

Project B1905336

Mr. Randy Rauwerdink
Venture Pass Partners, LLC or assigns
and Mason Holdings III, LLC or assigns
19620 Waterford Court
Shorewood, MN 55331

Re: Geotechnical Evaluation
Proposed Pavements
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
St. Paul, Minnesota

Dear Mr. Rauwerdink:

We are pleased to present this Geotechnical Evaluation Report for the proposed parking lot at in the northwest quadrant of Kasota Avenue and Highway 280 in St. Paul, Minnesota.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Belick Pha at 612.750.2148 (bpha@braunintertec.com) or Bob Janssen at 612.865.8786 (bjanssen@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION

Belick Pha, EIT
Staff Engineer

Robert J. Janssen, PE
President - Principal Engineer

c: Mr. Jerry Mullin, Landmark Environmental
Mr. Chad Ayers, Sambatek

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Appendix

A. Introduction

A.1. Project Description

This Geotechnical Evaluation Report addresses the proposed design and construction of a new trailer parking lot located at the junction of MN 280 and Kasota Avenue in Saint Paul, Minnesota. The project will include the construction of a bituminous paved parking lot for semi-truck trailers. Table 1 provides project details.

Table 1. Site Aspects and Grading Description

Aspect	Description
Pavement type(s)	Bituminous or concrete with concrete dolly pads
Assumed pavement loads	Heavy-duty: 150,000 ESALs*
Grade changes	2 (provided)

*Equivalent 43,000-lb multi-axle loads based on 15 semitrailers per day for a 20-year design life.

The figure below shows an illustration of the proposed site layout.

Figure 1. Site Layout

Figure provided by Google Earth© dated June 2019. Approximate property line denoted in solid red lines.

A.2. Site Conditions and History

Currently, the site exists as undeveloped property. The surface is generally populated with vegetation including grass and trees with no structures currently existing on site. Generally, the site is flat, increasing in elevation from the southwest to northeast.

Correspondences with Venture Pass Partners, LLC indicated the site had previously been used as a landfill. No further documents were provided about the site's use history, except for those mentioned in section A.4.

A.3. Purpose

The purpose of our evaluation was to characterize subsurface geologic conditions at selected exploration locations, evaluate their impact and provide recommendations for use in the design and construction of the proposed parking lot.

A.4. Background Information and Reference Documents

We reviewed the following information:

- Topographic map and Concept Plan 4 prepared by Sambatek, Inc.
- Previous geotechnical report prepared by Braun Intertec (Project No. BAAX-95-849) and dated January 15, 1996. As part of that evaluation, 6 soil borings were performed on this site. The approximate locations of those borings are shown on the sketch and those boring logs are included with this report.
- Communications with Venture Pass Partners, LLC regarding test pit locations and scheduling.
- Discussions with you, along with the Civil Engineers with Sambatek and the Environmental consultants with Landmark to discuss design details.

In addition to the provided sources, we have used several publicly available sources of information.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses and/or recommendations.

A.5. Scope of Services

We performed our scope of services for the project in accordance with our Proposal to Venture Park Pass, LLC, dated May 17, 2019. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.

- Landmark Environmental (Landmark) selected the new test pit locations. We acquired the surface elevations and locations with Landmark GPS technology using the Universal Transverse Mercator (UTM) coordinate system NAD83/UTM 15T. The attached Sketch shows the approximate locations of the test pits, along with the locations of the previously performed soil borings.

- Performing 8 test pits, denoted as TP-1 to TP-8, to nominal depths of 5 feet below grade across the site.

- Preparing this report containing a test pit location sketch, logs of test pits, a summary of the soils encountered, and recommendations for pavement subgrade preparation and the design and pavements.

Our scope of services did not include environmental services or testing. Environmental testing and services were provided by Landmark Environmental (Landmark). When the test pits were excavated, an environmental scientist was present from Landmark.

B. Results

B.1. Geologic Overview

We based the geologic origins used in this report on the soil types and available common knowledge of the geological history of the site.

B.2. Test Pit and Previous Boring Results

We performed 6 soil borings at this site in 1995. Borings ST-1 to ST-6 are in the area of the proposed parking lot footprint. The borings were extended to nominal depths of 25 1/2 to 80 feet. Logs of the previous borings are included in the Appendix.

Table 2 provides a summary of the test pits and previous soil boring results, in the general order we encountered the strata. Please refer to the Log of Test Pits and Boring sheets in the Appendix for additional details. The Descriptive Terminology sheet in the Appendix includes definitions of abbreviations used in Table 2.

Table 2. Subsurface Profile Summary*

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Topsoil Fill	SM		▪ Predominantly SM. ▪ Generally black. ▪ Topsoil fill not present at all borings and was measured to be less than 1 foot when observed. ▪ Moisture condition generally moist.
Fill	SM, CL, OL, PT	Weight of hammer to 39 blows per foot (BPF)	▪ General penetration resistance of 4 to 15 BPF. ▪ Intermixed layers of dark brown, dark gray, and black. ▪ Moisture condition generally moist to wet. ▪ Thicknesses at soil boring locations varied from 16 to 22 feet. ▪ Highly variable, soils intermixed; layers of organic clay and peat observed in Boring ST-1. ▪ Existing fill contained variable amounts of gravel and debris, including glass, bricks, metal, concrete and bituminous. ▪ Possible cobbles and boulders.
Swamp deposits	OL	1 to 4 BPF	▪ A 3-foot layer was observed in Boring ST-5. ▪ Generally black. ▪ Moisture condition generally wet. ▪ Swamp deposits not observed in test pits.
Alluvial	CL	4 BPF	▪ Moisture condition generally wet. ▪ Only observed beneath the fill in Borings ST-3/ST-3A and ST-6. ▪ Alluvial soils not observed in test pits.
Glacial deposits	SP, SP-SM, SM	2 to 58 BPF	▪ Intermixed layers of glacial outwash and till. ▪ Variable amounts of gravel; may contain cobbles. ▪ Moisture condition generally wet. ▪ Glacial deposits not observed in test pits.
	SC, CL, ML	4 to 20 BPF	
Bedrock	Shale	17 to 44 BPF	▪ Top of bedrock observed at depth of 80 feet. ▪ Generally bluish gray. ▪ Bedrock not observed in test pits.

*Abbreviations defined in the attached Descriptive Terminology sheet.

B.3. Groundwater

While excavating the test pits, water was observed seeping into 3 of the test pits. Table 3 summarizes the depths where we observed groundwater while excavating test pits. Table 3 also summarizes groundwater observed while advancing previous soil borings. The attached Log of Test Pits and Log of Borings in the Appendix also include this information and additional details.

Table 3. Groundwater Summary

Location	Measured or Estimated Depth to Groundwater (ft)
TP-1	Not observed in test pit to 5 feet
TP-2	Not observed in test pit to 5 1/2 feet
TP-3	Not observed in test pit to 5 feet
TP-4	2
TP-5	Not observed in test pit to 5 feet
TP-6	Not observed in test pit to 5 feet
TP-7	1.1/2
TP-8	1 1/2
ST-1	Not observed in boring to 25.5 feet
ST-2/ST-2A	19 1/2
ST-3/ST-3A	Not observed in boring to 80 feet
ST-4	16
ST-5	18
ST-6	21.2

Groundwater observed in test pits were relatively shallow and likely due to perched water conditions. Precipitation or seasonal changes, such as thawing, will increase perched water conditions in sand seams in the fill.

Based on the available data, it appears that at the time those borings were performed, the hydrostatic water level will be below excavations for the proposed parking lot.

C. Recommendations

C.1. Site Grading and Subgrade Preparation

C.1.a. Existing Fill

As indicated by the soil borings and test pit data, the on-site soils consist of significant amounts of fill materials consisting of variable soils types which are intermixed with miscellaneous debris and organic soils, and the penetration resistances recorded in the soil borings indicate that some of the fill is very soft or loose. Ideally, and to reduce risks of long-term differential settlement, all or a significant portion of the existing fill would have to be removed from beneath the proposed pavements. However, because of the environmental concerns associated with the removal of the existing fill and considering that some risk of long-term settlements associated with pavements can typically be tolerated, the significant costs associated with the removal of significant amounts of the existing fill can likely not be tolerated. As such, the recommendations we are providing in this report assumes that the risk of long-term differential settlement to the pavements can be tolerated. Within this report, we will provide design and earthwork recommendations to reduce risks associated with adverse amounts of long-term settlement.

As discussed in more detail in the following sections, our recommendations include the removal of the surficial topsoil, scarifying and compacting the in place soils prior to placement of fill or pavement areas, removing any exposed large-sized or compressible debris, and placement of geogrid beneath the recommended pavement designs.

C.1.b. Reuse of On-Site Soils

With the exception of the topsoil and unsuitable debris, assuming that the soils are acceptable per the Response Action Plan (RAP) that is being prepared by Landmark, it is our opinion that much of the excavated soils on site will be suitable to be reused for subgrade fill material. Any on-site soils with an organic content greater that 3 percent, or debris or boulders larger than 4 inches in diameter should be considered unsuitable for use as pavement fill material. Those materials should be placed in a green area or hauled off site. Furthermore, much of the soils on this site are moisture sensitive, and it is likely that some moisture conditioning (wetting or drying) will be necessary to reuse the on-site soils as compacted backfill.

C.1.c. Excavated Slopes

Based on the borings, we anticipate on-site soils in excavations will consist of silty sands intermixed with clay. These soils are typically considered Type B Soil under OSHA (Occupational Safety and Health

Administration) guidelines. OSHA guidelines indicate unsupported excavations in Type B soils should have a gradient no steeper than 1H:1V. Slopes constructed in this manner may still exhibit surface sloughing. OSHA requires an engineer to evaluate slopes or excavations over 20 feet in depth.

An OSHA-approved qualified person should review the soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." This document states excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

C.1.d. Excavation Dewatering

We recommend removing groundwater from the excavations. Project planning should include temporary sumps and pumps for excavations in low-permeability soils, such as clays. If it is necessary to pump water from excavations, that work should be done in accordance with the RAP.

C.1.e. Pavement and Exterior Slab Subgrade Preparation

We recommend the following steps for pavement and exterior slab subgrade preparation, understanding the site will have a grade change of 2 feet or less. Note that project planning may need to require additional subcuts to limit frost heave.

1. Strip unsuitable soils consisting of surficial vegetation and soils with an organic content greater than 3 percent any existing structures and pavements that exists within2 feet of the surface of the proposed pavement subgrade. At depths greater than 2 feet, assuming the surficial organic materials are removed and the underlying soils can be stabilized as addressed below, the existing soils can remain in place.

2. Have a geotechnical representative observe the excavated subgrade to evaluate if additional subgrade improvements are necessary.

3. Prior to placement of fill or the pavement materials, Scarify the exposed soils to a depth of 10 inches, moisture condition the soils to near optimum moisture content and then compact the soils to the relative densities indicated in Table 5.

4. Place pavement engineered fill to grade and compact in accordance with Section C.1.g. to bottom of pavement.

5. Proofroll the pavement or exterior slab subgrade as described in Section C.1.f.

Along with the earthwork correction recommendations previously provided and because much of the existing fill that will be left in place beneath the pavement areas are very soft/loose and contain organic soils and debris, to improve long-term pavement performance of the pavement, we recommend incorporating biaxial geogrid at the interface of the prepared subgrade and aggregate base layer.

C.1.f. Pavement Subgrade Proofroll

After preparing the subgrade as described above and prior to the placement of the geogrid and aggregate base, we recommend proofrolling the subgrade soils with a fully loaded tandem-axle truck. We also recommend having a geotechnical representative observe the proofroll. Areas that fail the proofroll likely indicate soft or weak areas that will require additional soil correction work to support pavements.

The contractor should correct areas that display excessive yielding or rutting during the proofroll, as determined by the geotechnical representative. Possible options for subgrade correction include moisture conditioning and recompaction, subcutting and replacement with soil or crushed aggregate, chemical stabilization and/or geotextiles. We recommend performing a second proofroll after the aggregate base material is in place, and prior to placing bituminous or concrete pavement.

C.1.g. Engineered Fill Materials and Compaction

The engineered fill materials placed in proposed pavement areas should consist of on-site soils as addressed previously in Section C.1.b or imported soils consisting of soils classified as sands or clays with an organic content less than 3 percent containing a plastic index less than 25 percent. We recommend placing an aggregate base below the pavement to provide a suitable subgrade for pavement, reduce faulting and help dissipate loads.

Table 4 provides recommended subgrade relative compaction of fill based on depth and location.

Table 4. Compaction Recommendations Summary

Reference	Relative Compaction, percent (ASTM D698 – Standard Proctor)	Moisture Content Variance from Optimum, percentage points	
		< 12% Passing #200 Sieve (typically SP, SP-SM)	> 12% Passing #200 Sieve (typically CL, SC, ML, SM)
Within 3 feet of pavement subgrade	100	±2	-1 to +2
More than 3 feet below pavement subgrade	95	±3	±3
Below landscaped surfaces	90	±5	±4

*Increase compaction requirement to meet compaction required for structure supported by this engineered fill.

The project documents should not allow the contractor to use frozen material as engineered fill or to place engineered fill on frozen material. Frost should not penetrate under foundations during construction.

We recommend performing density tests in engineered fill to evaluate if the contractors are effectively compacting the soil and meeting project requirements.

C.2. Pavements and Exterior Slabs

C.2.a. Design Sections

Based on the previous year's average load and estimated average daily traffic, provided by Venture Pass Partners, LLC., and test pit observations, we recommend pavement design assume an R-value of 12. We based the concrete pavement designs on a modulus of subgrade reaction (k) of 75 pci.

Note the contractor may need to perform limited removal of unsuitable or less suitable soils to achieve this value.

Table 5 provides recommended pavement sections, based on the soils support and traffic loads.

Table 5. Recommended Bituminous and Concrete Pavement Sections

	Component Thicknesses (inches)	
	Heavy-duty	
Material Component	Bituminous[a]	Concrete
Bituminous Wear	2	—
Bituminous Non-wear	2	—
Bituminous Non-wear	2	—
Concrete	—	6
Aggregate Base	8	6
Geotextile Grid	Yes (see Section C.2.e)	No

C.2.b. Aggregate Base Materials

We recommend specifying crushed aggregate base meeting the requirements of Minnesota Department of Transportation (MnDOT) Specification 3138 for Class 5.

Table 6 shows recommended Minnesota Department of Transportation (MnDOT) Class 5 and Class 6 base aggregate gradations. Gradation recommendations assume base aggregate will contain less than 25 percent, by weight, recycled aggregate.

Table 6. MnDOT Class 5 and 6 Aggregate*

Base Aggregate**	% passing 1 1/2" Sieve	% passing 3/4" Sieve	% passing 3/8" Sieve	% passing #4 Sieve	% passing #10 Sieve	% passing #40 Sieve	% passing #200 Sieve
Class 5	100	70 - 100	45 - 90	35 - 80	20 - 65	10 - 35	3.0 - 10.0
Class 6	100	70 - 100	45 - 85	35 - 70	20 - 55	10 - 30	3.0 - 7.0

*Gradations based on Minnesota Department of Transportation (MnDOT) 2018 Standard Specification for Construction section 3138.
**Percent passing value should be total percent passing by weight.

We recommend that the aggregate base be compacted to a minimum of 100 percent of its maximum standard Proctor dry density at a moisture content within 1 percentage point of its optimum moisture content.

C.2.c. Bituminous Pavement Materials

We recommend that the bituminous wear and base courses meet the requirements of Minnesota Department of Transportation Specification 2360, Type SP. We recommend the aggregate gradations for the asphalt mixes meet Gradation B for the non-wear and wear courses. We recommend that the light- and heavy-duty bituminous mixes incorporate Traffic Level 3. With that, we recommend using the following mix designations for heavy- duty pavements:

- Heavy-duty Non-Wear: SPNWB330E; Asphalt Binder Grade PG 58H-28 (PG 64-28)
- Heavy-duty Wear: SPWEB340E; Asphalt Binder Grade PG 58H-28 (PG 64-28)

We recommend that the bituminous pavement be compacted to an average density of at least 92 percent (per the core method) of the maximum theoretical Rice density, with no core test result being less than 90 percent and no core test result being greater than 97 percent.

C.2.d. Concrete Pavement Materials

We assumed the concrete pavement sections in Table 5 will have edge support. We recommend placing an aggregate base below the pavement to provide a suitable subgrade for concrete placement, reduce faulting and help dissipate loads. Appropriate mix designs, panel sizing, jointing, doweling, and edge reinforcement are critical to performance of rigid pavements.

We recommend specifying concrete for pavements that has a minimum 28-day compressive strength of 4,000 psi, and a modulus of rupture (M_r) of at least 600 psi. We also recommend Type I cement meeting the requirements of ASTM C 150. We recommend specifying 5 to 7 percent entrained air for exposed concrete to provide resistance to freeze-thaw deterioration. We also recommend using a water/cement ratio of 0.45 or less for concrete exposed to deicers.

C.2.e. Geotextile Grid

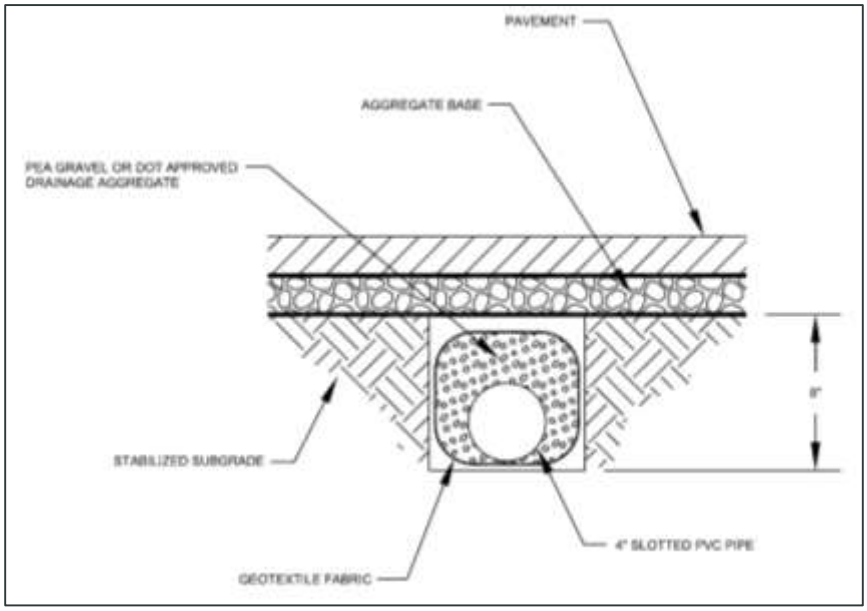
We recommend placing Tensar® Biaxial Geogrid BX1200 or equivalent directly below the aggregate base layer.

C.2.f. Subgrade Drainage

We recommend installing plastic perforated drainpipes throughout pavement areas at low points and about catch basins. The drainpipes should be placed in small trenches extended at least 8 inches below the aggregate base material. A cross-section illustration of a drainage trench is shown below in Figure 2. We recommend installing the draintile at a pitch of no less than 1/4 percent. We recommend routing the draintile to nearby storm sewer or other suitable outlet.

We suggest that we work with the civil engineer to determine the spacing of drainpipes.

Figure 2. Draintile Illustration



C.2.g. Performance and Maintenance

We based the above pavement designs on a 20-year performance life for bituminous and a 20-year life for concrete. This is the amount of time before we anticipate the pavement will require reconstruction. This performance life assumes routine maintenance, such as seal coating and crack sealing. The actual pavement life will vary depending on variations in weather, traffic conditions and maintenance.

It is common to place the non-wear course of bituminous and then delay placement of wear course. For this situation, we recommend evaluating if the reduced pavement section will have sufficient structure to support construction traffic.

Many conditions affect the overall performance of the exterior slabs and pavements. Some of these conditions include the environment, loading conditions and the level of ongoing maintenance. With regard to bituminous pavements in particular, it is common to have thermal cracking develop within the first one to two years of placement, and continue throughout the life of the pavement. We recommend developing a regular maintenance plan for filling cracks in exterior slabs and pavements to lessen the potential impacts for cold weather distress due to frost heave or warm weather distress due to wetting and softening of the subgrade.

C.3. Utilities

C.3.a. Subgrade Stabilization

For exterior utilities, we anticipate the soils at typical invert elevations will generally be suitable for utility support. However, if construction encounters unfavorable conditions such as soft clay, organic soils, perched water or large debris within 2 feet of invert grades, the unsuitable soils should be removed and replaced with sand or crushed rock to prepare a proper subgrade for pipe support. Project design and construction should not place utilities within the 1H:1V oversizing of foundations.

C.3.b. Corrosion Potential

Based on our experience, the soils encountered by the borings are moderately corrosive to metallic conduits, but only marginally corrosive to concrete. We recommend specifying non-corrosive materials or providing corrosion protection, unless project planning chooses to perform additional tests to demonstrate the soils are not corrosive.

D. Procedures

D.1. Exploratory Test Pits

Frattalone excavated the test pits with a Bobcat E85 backhoe, under the direction and observation of our staff, Landmark, and Venture Pass Partners, Inc. We prepared Test Pit Logs by visually examining the sidewalls of the test pits and classifying the materials brought to the surface by the backhoe bucket. We measured strata boundary depths with a steel tape and generally rounded to the nearest 1/2-foot.

D.2. Exploration Logs

D.2.a. Log of Test Pit and Previous Boring Sheets

The Appendix includes Log of Test Pit sheets as well as Logs of Borings from previous projects. The logs classify and describe the geologic materials exposed in the sidewalls and bottoms of the pits, present the results of laboratory tests performed on bulk samples obtained from them, and depict groundwater measurements.

D.2.b. Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed for the project, and (4) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

D.3. Material Classification and Testing

D.3.a. Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

D.3.b. Laboratory Testing

The exploration logs in the Appendix note the results of the laboratory tests performed on geologic material samples. We performed the tests in general accordance with ASTM or AASHTO procedures.

D.4. Groundwater Measurements

While excavating the test pits and at the termination depths, our field personnel observed the sides and bottoms of the excavation for evidence of groundwater seepage and/or accumulation.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

We developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and

thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work, or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

E.1.b. Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

E.2. Continuity of Professional Responsibility

E.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

E.2.b. Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

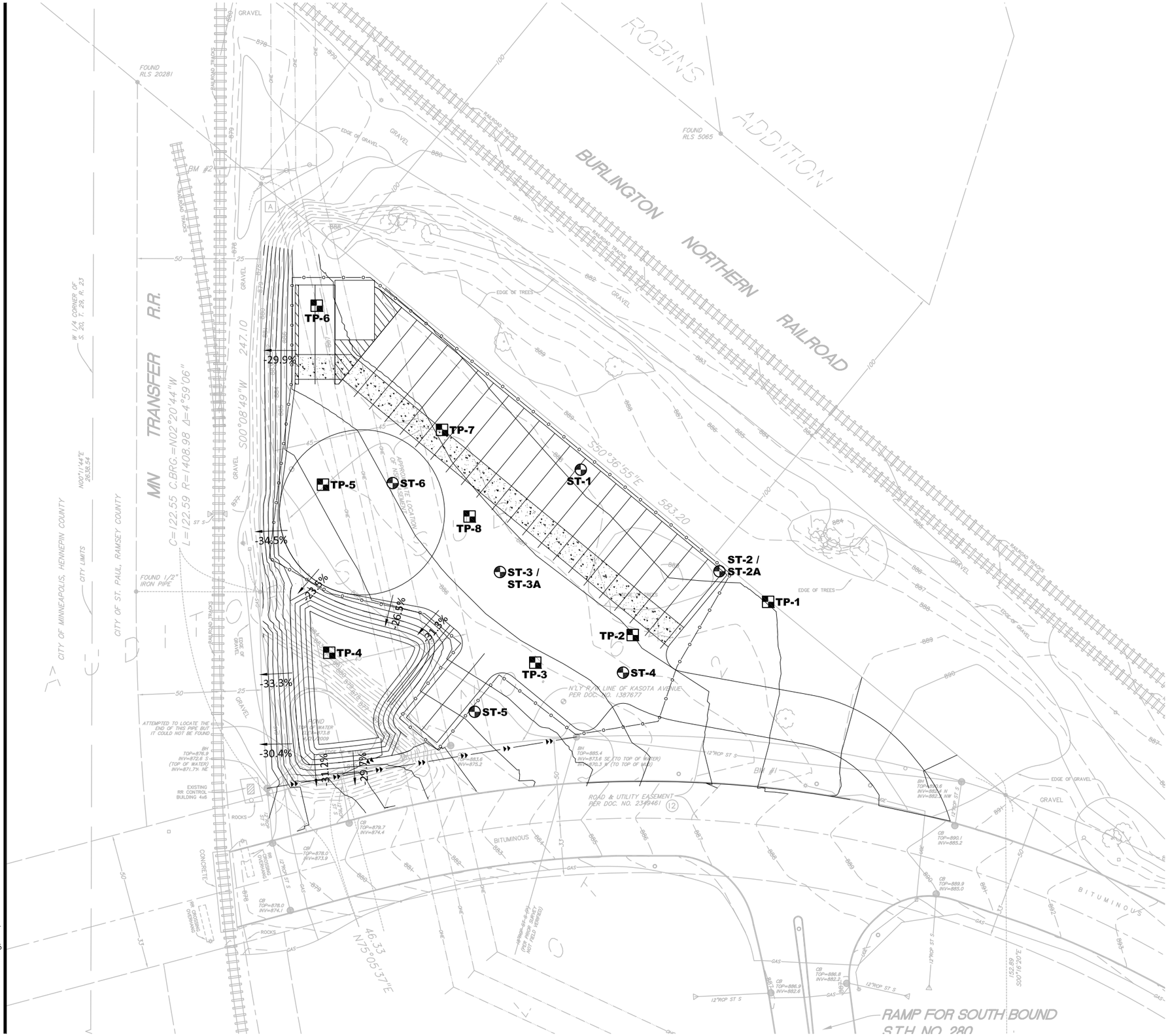
E.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix



DENOTES APPROXIMATE LOCATION OF TEST PIT

DENOTES APPROXIMATE LOCATION OF PREVIOUSLY COMPLETED SOIL BORING

30' 0 60'

SCALE: 1" = 60'

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Minneapolis, MN 55438
952.995.2000
braunintertec.com

Base Drawing Provided By

Sambatek

Drawing Information

Project No:	B1905336
Drawing No:	B1905336
Drawn By:	BJB
Date Drawn:	6/14/19
Checked By:	BP
Last Modified:	6/14/19

Project Information

280 Trailer Storage

Kasota Avenue, west of Highway 280

Saint Paul, Minnesota

Test Pit and Soil Boring Location Sketch

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LOG OF TEST PIT

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1905336
Geotechnical Evaluation
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
Saint Paul, Minnesota

TEST PIT: **TP-1**

LOCATION: Coordinate datum uses NAD83/UTM Zone 15N. Elevations estimated from Concept 4 plans, CP-4, prepared by Sambatek. See attached sketch.

NORTHING: 4980523	EASTING: 483893.0		
EXCAVATOR: Frattalone	LOGGED BY: B. Pha	START DATE: 05/30/19	END DATE: 05/30/19
SURFACE ELEVATION: 889.0 ft	RIG: Excavator	METHOD:	SURFACING: Grass	WEATHER: Cloudy

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
888.2		SILTY SAND (SM), fine to medium sand, trace Gravel, black, moist (TOPSOIL)					Soil consisted of approximately 5 to 10 percent debris
0.8		FILL: SILTY SAND (SM), fine to medium sand, with Gravel, and debris, dark brown to dark gray, moist, debris includes glass, brick, plastic, wooden beams, and wood chips *Soil dark gray and contained odor below 2 1/2 feet*					
884.0			5				
5.0		END OF TEST PIT Test pit then backfilled with spoils					Water not observed with 5.0 feet of tooling in the ground while drilling.
			10				

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LOG OF TEST PIT

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1905336
Geotechnical Evaluation
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
Saint Paul, Minnesota

TEST PIT: **TP-2**

LOCATION: Coordinate datum uses NAD83/UTM Zone 15N. Elevations estimated from Concept 4 plans, CP-4, prepared by Sambatek. See attached sketch.

NORTHING: 4980517	EASTING: 483868.0		
EXCAVATOR: Frattalone	LOGGED BY: B. Pha	START DATE: 05/30/19	END DATE: 05/30/19
SURFACE ELEVATION: 887.0 ft	RIG: Excavator	METHOD:	SURFACING: Grass	WEATHER: Cloudy

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
886.6		SILTY SAND (SM), fine to medium sand, with Gravel, and roots, black, moist (TOPSOIL)					Soil consisted of approximately 5 to 10 percent debris
0.4		FILL: SILTY SAND (SM), fine to medium sand, with Gravel, and debris, dark brown to dark gray, moist, debris includes glass, brick, plastic, rubber, wood chips, wooden beams, and cinders					
		Soil dark gray and contained odor below 4 feet					
		5					
881.5							
5.5		END OF TEST PIT					Water not observed with 5.5 feet of tooling in the ground while drilling.
		Test pit then backfilled with spoils					
		10					

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LOG OF TEST PIT

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1905336
Geotechnical Evaluation
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
Saint Paul, Minnesota

TEST PIT: **TP-3**

LOCATION: Coordinate datum uses NAD83/UTM Zone 15N. Elevations estimated from Concept 4 plans, CP-4, prepared by Sambatek. See attached sketch.

NORTHING:	4980512	EASTING:	483850.0		
EXCAVATOR:	Frattalone	LOGGED BY:	B. Pha	START DATE:	05/30/19
END DATE:	05/30/19	SURFACE ELEVATION:	886.0 ft	RIG:	Excavator
METHOD:		SURFACING:	Grass	WEATHER:	Cloudy

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
885.5		SILTY SAND (SM), fine to medium sand, with Gravel, and roots, black, moist (TOPSOIL)					Soil consisted of approximately 5 to 10 percent debris
0.5		FILL: SILTY SAND (SM), fine to medium sand, with Gravel, and debris, dark brown to dark gray, moist, debris includes glass, brick, plastic, rubber chips, rubber hoses, wood chips, wooden beams, cinders, and concrete					*8-inch thick concrete slabs greater than 20"x20" encountered
		Soil dark gray and contained odor below 3 feet					
881.0			5				
5.0		END OF TEST PIT					Water not observed with 5.0 feet of tooling in the ground while drilling.
		Test pit then backfilled with spoils					
			10				

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LOG OF TEST PIT

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1905336
Geotechnical Evaluation
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
Saint Paul, Minnesota

TEST PIT: **TP-4**

LOCATION: Coordinate datum uses NAD83/UTM Zone 15N. Elevations estimated from Concept 4 plans, CP-4, prepared by Sambatek. See attached sketch.

NORTHING: 4980514	EASTING: 483812.0		
EXCAVATOR: Frattalone	LOGGED BY: B. Pha	START DATE: 05/30/19	END DATE: 05/30/19
SURFACE ELEVATION: 884.0 ft	RIG: Excavator	METHOD:	SURFACING: Grass	WEATHER: Mostly cloudy

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
883.0		SILTY SAND (SM), with Gravel, and roots, trace debris, black, moist, debris includes glass and plastic (TOPSOIL)					Soil consisted of approximately 5 to 10 percent debris
1.0	▽	FILL: SILTY SAND (SM), fine to medium sand, with Gravel, and Clay seams, with debris, dark brown to dark gray, moist to wet, debris includes glass, brick, plastic, rubber, metal pipes and nails, wood, and cinders *Soil dark gray and contained odor below 3 feet*					
879.0							
5.0		END OF TEST PIT Test pit then backfilled with spoils	5				Water observed at 2.0 feet with 5.0 feet of tooling in the ground while drilling. Water observed likely perched.
			10				

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LOG OF TEST PIT

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1905336
Geotechnical Evaluation
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
Saint Paul, Minnesota

TEST PIT: **TP-5**

LOCATION: Coordinate datum uses NAD83/UTM Zone 15N. Elevations estimated from Concept 4 plans, CP-4, prepared by Sambatek. See attached sketch.

NORTHING: 4980545	EASTING: 483811.0		
EXCAVATOR: Frattalone	LOGGED BY: B. Pha	START DATE: 05/30/19	END DATE: 05/30/19
SURFACE ELEVATION: 886.0 ft	RIG: Excavator	METHOD:	SURFACING: Grass	WEATHER: Mostly cloudy

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
		FILL: SILTY SAND (SM), fine to medium sand, with Gravel, and debris, dark brown to dark gray, moist, debris includes glass, brick, plastic, rubber, metal, concrete, wood chips, wooden beams, and cinders					Soil consisted of approximately 5 to 10 percent debris
		Soil dark gray and contained odor below 3 1/2 feet					
881.0							
5.0		END OF TEST PIT	5				Water not observed with 5.0 feet of tooling in the ground while drilling.
		Test pit then backfilled with spoils					
			10				

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LOG OF TEST PIT

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1905336
Geotechnical Evaluation
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
Saint Paul, Minnesota

TEST PIT: **TP-6**

LOCATION: Coordinate datum uses NAD83/UTM Zone 15N. Elevations estimated from Concept 4 plans, CP-4, prepared by Sambatek. See attached sketch.

NORTHING: 4980578	EASTING: 483810.0		
EXCAVATOR: Frattalone	LOGGED BY: B. Pha	START DATE: 05/30/19	END DATE: 05/30/19
SURFACE ELEVATION: 887.0 ft	RIG: Excavator	METHOD:	SURFACING: Grass	WEATHER: Mostly cloudy

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
		FILL: SILTY SAND (SM), fine to medium sand, with Gravel, roots, and debris, dark brown to dark gray, moist, debris includes glass, brick, plastic, rubber, metal, concrete, wood chips, wooden beams, and cinders					Soil consisted of approximately 5 to 10 percent debris
		Soil dark gray and contained odor below 3 feet					
882.0							
5.0		END OF TEST PIT	5				Water not observed with 5.0 feet of tooling in the ground while drilling.
		Test pit then backfilled with spoils					
			10				

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LOG OF TEST PIT

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1905336
Geotechnical Evaluation
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
Saint Paul, Minnesota

TEST PIT: **TP-7**

LOCATION: Coordinate datum uses NAD83/UTM Zone 15N. Elevations estimated from Concept 4 plans, CP-4, prepared by Sambatek. See attached sketch.

NORTHING: 4980555	EASTING: 483833.0		
EXCAVATOR: Frattalone	LOGGED BY: B. Pha	START DATE: 05/30/19	END DATE: 05/30/19
SURFACE ELEVATION: 887.0 ft	RIG: Excavator	METHOD:	SURFACING: Grass	WEATHER: Mostly cloudy

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
886.4		SILTY SAND (SM), fine to medium sand, with Gravel, and roots, black, moist (TOPSOIL)					Soil consisted of approximately 5 to 10 percent debris
0.6	▽	FILL: SILTY SAND (SM), fine to medium sand, with Gravel, and debris, brown to dark gray, moist to wet, debris includes glass, brick, plastic, rubber, metal, concrete, and wood chips					
		Soil dark gray and contained odor below 3 feet					
882.0							
5.0		END OF TEST PIT					Water observed at 1.5 feet with 5.0 feet of tooling in the ground while drilling.
		Test pit then backfilled with spoils					Water observed likely perched.
			5				
			10				

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LOG OF TEST PIT

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B1905336
Geotechnical Evaluation
280 Trailer Storage
Kasota Avenue and Hwy 280 South Entrance Ramp
Saint Paul, Minnesota

TEST PIT: **TP-8**

LOCATION: Coordinate datum uses NAD83/UTM Zone 15N. Elevations estimated from Concept 4 plans, CP-4, prepared by Sambatek. See attached sketch.

NORTHING: 4980539	EASTING: 483838.0		
EXCAVATOR: Frattalone	LOGGED BY: B. Pha	START DATE: 05/30/19	END DATE: 05/30/19
SURFACE ELEVATION: 886.0 ft	RIG: Excavator	METHOD:	SURFACING: Grass	WEATHER: Mostly cloudy

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
885.0		SILTY SAND (SM), fine to medium sand, with Gravel, and roots, black, moist (TOPSOIL)					Soil consisted of approximately 5 to 10 percent debris
1.0	▽	FILL: SILTY SAND (SM), with Gravel, and debris, contains seams of Poorly Graded Sand, dark brown to dark gray, moist to wet, debris includes glass, bricks, plastic, rubber, metal, concrete, and wood *Soil dark gray and contained odor below 3 feet*					
881.0			5				
5.0		END OF TEST PIT Test pit then backfilled with spoils					Water observed at 1.5 feet with 5.0 feet of tooling in the ground while drilling. Water observed likely perched.
			10				

LOG OF BORING

PROJECT: **BABX-95-849** **PRELIMINARY GEOTECHNICAL EVALUATION** **Proposed Manufacturing Building** **Northwest of Kasota Avenue & Minnesota Highway 280** **St. Paul, Minnesota**	BORING: **ST-1** LOCATION: See attached sketch.
DRILLER: M. Rowland — METHOD: 3 1/4" HSA	DATE: 10/31/95 — SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
98.2	0.0	FILL	FILL: Silty Sand mixed with glass, concrete, Gravel, brick, wood, cinders, paper and peat, black and dark brown, moist to wet.	4		Strong fuel odor.
				8		
				10		
				3		
				5		
84.2	14.0	FILL	FILL: Organic Clay mixed with glass, black and gray, wet.	2		
82.2	16.0	FILL	FILL: Peat mixed with Organic Clay and Silt with a trace of glass, black and gray, wet.	5		
				7		
76.2	22.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brow, wet, medium to rather stiff. (Glacial Till)	7		
72.7	25.5			9		
			END OF BORING. Water not observed with 24' of hollow-stem auger in the ground. Boring grouted to the surface.			Elevation Reference: Top of catch basin on north side of Kasota Avenue east of the southbound highway 280 entrance ramp. Elevation assumed to be 100.0.

LOG OF BORING

PROJECT:	BORING: ST-2
BABX-95-849 **PRELIMINARY GEOTECHNICAL EVALUATION** **Proposed Manufacturing Building** **Northwest of Kasota Avenue & Minnesota Highway 280** **St. Paul, Minnesota**	LOCATION: **See attached sketch.**
DRILLER: M. Niesen — METHOD: 3 1/4" HSA	DATE: 10/30/95 — SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
98.2	0.0	FILL	FILL: Silty Sand mixed with brick rubble, wood, metal, Organic Clay and glass, black and dark brown, moist to 10' then wet.	9 14 6 10 13 19 10 10 4 5 2 4 1 5 WH 6 4 8		
80.2	18.0	CL	SANDY LEAN CLAY, with a trace of Gravel and seams and layers of Sand, brown, wet, rather soft to very stiff. (Glacial Till)	4 6 5 17 12 17	▼ ▽	
72.2	26.0		END OF BORING. Water down 22 1/2' with 24' of hollow-stem auger in the ground. Water down 19 1/2' with cave-in at 21 1/2'. Boring then grouted to surface.			

LOG OF BORING

PROJECT: BABX-95-849 PRELIMINARY GEOTECHNICAL EVALUATION Proposed Manufacturing Building Northwest of Kasota Avenue & Minnesota Highway 280 St. Paul, Minnesota	BORING: ST-2A LOCATION: Same as Boring ST-2 - redrilled.
DRILLER: M. Niesen — METHOD: 3 1/4" HSA	DATE: 12/21/95 — SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
98.2	0.0	FILL	FILL: Silty Sand mixed with brick rubble, wood, metal, Organic Clay and glass, black and dark brown, moist to 10' then wet.			
80.2	18.0	CL	SANDY LEAN CLAY, with a trace of Gravel and seams and layers of Sand, brown, wet, rather soft to very stiff. (Glacial Till)	20		
72.2	26.0	SC	CLAYEY SAND, with a trace of Gravel, brown, wet, very stiff. (Glacial Till)			
70.2	28.0	SC	CLAYEY SAND, with a trace of Gravel, grayish brown, wet, medium. (Glacial Till)	8		
66.2	32.0					

LOG OF BORING

PROJECT: BABX-95-849 PRELIMINARY GEOTECHNICAL EVALUATION Proposed Manufacturing Building Northwest of Kasota Avenue & Minnesota Highway 280 St. Paul, Minnesota	BORING: ST-2A (cont.) LOCATION: Same as Boring ST-2 - redrilled.
DRILLER: M. Niesen — METHOD: 3 1/4" HSA	DATE: 12/21/95 — SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
		SP	POORLY GRADED SAND, mostly medium-grained, brown, waterbearing, very loose. (Glacial Outwash)	3		
60.2	38.0	SP	POORLY GRADED SAND, fine- to coarse-grained, with fine to coarse Gravel, brown, waterbearing, medium dense. (Glacial Outwash)	20		
				24		
50.2	48.0	SP	POORLY GRADED SAND, mostly fine- to medium-grained, with a trace of fine to coarse Gravel, brown, waterbearing, medium dense. (Glacial Outwash)	12		
				14		
39.2	59.0	SC	CLAYEY SAND, with a trace of fine to coarse Gravel, brown, wet, hard. (Glacial Till)	32		
34.2	64.0		(Continued on next page)			

LOG OF BORING

PROJECT: **BABX-95-849** **PRELIMINARY GEOTECHNICAL EVALUATION** **Proposed Manufacturing Building** **Northwest of Kasota Avenue & Minnesota Highway 280** **St. Paul, Minnesota**	BORING: **ST-2A (cont.)** LOCATION: **Same as Boring ST-2 - redrilled.**
DRILLER: M. Niesen METHOD: 3 1/4" HSA	DATE: 12/21/95 SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
		SC	(Continued from previous page) CLAYEY SAND, brown, wet, hard. (Glacial Till)	42		
27.7	70.5			58		
			END OF BORING. Boring immediately grouted to the surface.			

LOG OF BORING

PROJECT: BABX-95-849 PRELIMINARY GEOTECHNICAL EVALUATION Proposed Manufacturing Building Northwest of Kasota Avenue & Minnesota Highway 280 St. Paul, Minnesota	BORING: ST-3 LOCATION: See attached sketch.

DRILLER: M. Rowland	METHOD: 3 1/4" HSA	DATE: 10/31/95	SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
97.2	0.0	FILL	FILL: Sandy Lean Clay mixed with Peat, Gravel, glass, concrete and brick debris, black, moist to wet.	2		
				8		
				6		OC = 9% MC = 40%
				3		
				4		
				3		
				39		
77.2	20.0			4		
		CL	LEAN CLAY, gray, wet, rather soft. (Alluvium)			
75.2	22.0					
		CL	SANDY LEAN CLAY, with seams and layers of Sand and a trace of Gravel, brown, wet, stiff. (Glacial Till)	14		
71.7	25.5					
			END OF BORING. Water not observed with 24' of hollow-stem auger in the ground. Boring grouted to surface.			

LOG OF BORING

PROJECT: **BABX-95-849** **PRELIMINARY GEOTECHNICAL EVALUATION** **Proposed Manufacturing Building** **Northwest of Kasota Avenue & Minnesota Highway 280** **St. Paul, Minnesota**	BORING: **ST-3A** LOCATION: **Same as Boring ST-3 - redrilled.**
DRILLER: M. Niesen — METHOD: 3 1/4" HSA	DATE: 12/21/95 — SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
97.2	0.0	FILL	FILL: Sandy Lean Clay mixed with Peat, Gravel, glass, concrete and brick debris, black, moist to wet. (Redrilled, augered to 25-foot depth.)			
77.2	20.0	CL	LEAN CLAY, gray, wet, rather soft. (Alluvium)			
75.2	22.0	CL	SANDY LEAN CLAY, with seams and layers of Sand and a trace of Gravel, brown, wet, stiff. (Glacial Till)			
72.2	25.0	CL	SANDY LEAN CLAY, with a trace of Gravel and layers of Sand, brown, wet, rather stiff. (Glacial Till)	9		
69.2	28.0	SC	CLAYEY SAND, with a trace of fine to medium Gravel, brown, wet, stiff. (Glacial Till)	16		
65.2	32.0		(Continued on next page)			

LOG OF BORING

PROJECT: BABX-95-849 PRELIMINARY GEOTECHNICAL EVALUATION Proposed Manufacturing Building Northwest of Kasota Avenue & Minnesota Highway 280 St. Paul, Minnesota	BORING: ST-3A (cont.) LOCATION: Same as Boring ST-3 - redrilled.
DRILLER: M. Niesen — METHOD: 3 1/4" HSA	DATE: 12/21/95 — SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
64.2	33.0	SC	(Continued from previous page) CLAYEY SAND, with a trace of fine to medium Gravel, brown, wet, stiff. (Glacial Till)			
		CL	SANDY LEAN CLAY, with a trace of fine to medium Gravel, brown, wet, medium to stiff. (Glacial Till)	8		
				13		
53.2	44.0					
		SP	POORLY GRADED SAND, mostly fine- to medium-grained, brown, waterbearing, very loose to medium dense. (Glacial Outwash)	2		
				16		
44.2	53.0					
		SP	POORLY GRADED SAND, mostly fine- to medium-grained, with a trace of Gravel and layers of Clayey Sand, brown, waterbearing, medium dense. (Glacial Outwash)	25		
39.2	58.0					
		CL	LEAN CLAY, Shale, bluish gray, moist, very stiff to hard. (Bedrock)	17		
33.2	64.0		(Continued on next page)			

LOG OF BORING

PROJECT: **BABX-95-849** **PRELIMINARY GEOTECHNICAL EVALUATION** **Proposed Manufacturing Building** **Northwest of Kasota Avenue & Minnesota Highway 280** **St. Paul, Minnesota**	BORING: **ST-3A (cont.)** LOCATION: **Same as Boring ST-3 - redrilled.**
DRILLER: M. Niesen METHOD: 3 1/4" HSA	DATE: 12/21/95 SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
		CL	(Continued from previous page) LEAN CLAY, Shale, bluish gray, moist, very stiff to hard. (Bedrock)	40		
				30		
				42		
17.2	80.0			44		
			END OF BORING. Boring immediately grouted to surface.			

LOG OF BORING

PROJECT: **BABX-95-849** **PRELIMINARY GEOTECHNICAL EVALUATION** **Proposed Manufacturing Building** **Northwest of Kasota Avenue & Minnesota Highway 280** **St. Paul, Minnesota**	BORING: **ST-4** LOCATION: **Drilled 5' north of staked location. See attached sketch.**
DRILLER: M. Niesen — METHOD: 3 1/4" HSA	DATE: 10/30/95 — SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
97.4	0.0	FILL	FILL: Silty Sand mixed with Gravel, wood, paper, glass and metal debris, black and dark brown, moist to 14' then wet.	15		Strong fuel odor.
				5		
				2	▼	
80.4	17.0	CL	SANDY LEAN CLAY, with a trace of Gravel, brown, wet, rather soft to rather stiff. (Glacial Till)	4		
				6		
71.9	25.5			12		
			END OF BORING. Water not observed with 24' of hollow-stem auger in the ground. Water down 16' with cave-in at 23'. Boring then grouted to the surface.			

LOG OF BORING

PROJECT: **BABX-95-849** **PRELIMINARY GEOTECHNICAL EVALUATION** **Proposed Manufacturing Building** **Northwest of Kasota Avenue & Minnesota Highway 280** **St. Paul, Minnesota**	BORING: **ST-5** LOCATION: **See attached sketch.**

DRILLER: M. Niesen	METHOD: 3 1/4" HSA	DATE: 10/30/95	SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
96.5	0.0	FILL	FILL: Silty Sand mixed with Organic Clay, glass, concrete, Gravel, brick, wood, paper and a trace of coal, black and dark brown, moist to wet.	5 8 6 7 9 16 27 30 11 7 5 5 1 2 3 6		
80.5	16.0	OL	ORGANIC CLAY, black, wet. (Swamp Deposit)	4 2 1	▽ ▼	
77.5	19.0	CL	SANDY LEAN CLAY, with a trace of Gravel, and seams and layers of Sand, wet, rather soft to very stiff. (Glacial Till)	5 4 7 14 29		
70.5	26.0		END OF BORING. Water down 16 1/2' with 24' of hollow-stem auger in the ground. Water down 18' immediately after withdrawal of auger with cave-in at 23'.*			Boring then grouted to the surface.

LOG OF BORING

PROJECT: **BABX-95-849** **PRELIMINARY GEOTECHNICAL EVALUATION** **Proposed Manufacturing Building** **Northwest of Kasota Avenue & Minnesota Highway 280** **St. Paul, Minnesota**	BORING: **ST-6** LOCATION: See attached sketch.

DRILLER: M. Rowland	METHOD: 3 1/4" HSA	DATE: 10/31/95	SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials	BPF	WL	Tests or Notes
96.2	0.0	FILL	FILL: Mixed Silty Sand, Clayey Sand, Organic Clay, Peat, glass, concrete, Gravel, wood, metal and brick rubble, black, moist to wet.	5 4 9 8 3 3 5 13 11 12 16 15 10 8 5 4 5 7 3 2 4 4	▽	
74.2	22.0	ML	SILT, with a trace of shells, gray, wet, very loose. (Alluvium)	4 4		
72.2	24.0	SM	SILTY SAND, mostly fine-grained, with a trace of Gravel, gray, waterbearing, medium dense. (Glacial Till)	14 16		
70.2	26.0		END OF BORING. Water down 21.2' with 24' of hollow-stem auger in the ground. Boring grouted to the surface.			

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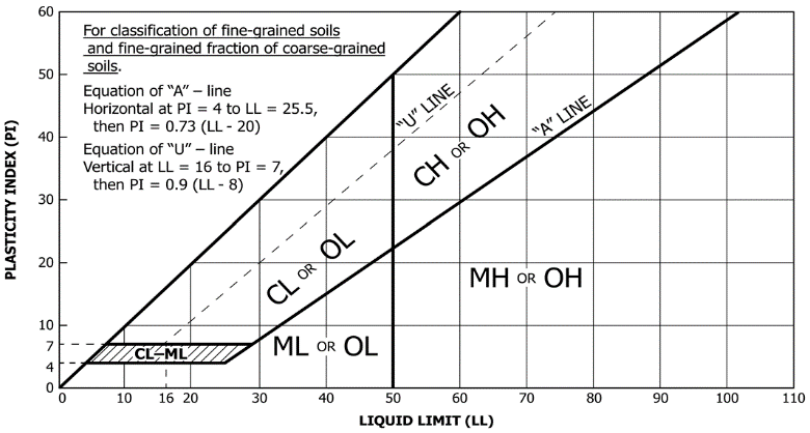
Descriptive Terminology of Soil

Based on Standards ASTM D2487/2488
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines[C])	$C_u \geq 4$ and $1 \leq C_c \leq 3$[D]	GW	Well-graded gravel[E]
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$)[D]	GP	Poorly graded gravel[E]
		Gravels with Fines (More than 12% fines[C])	Fines classify as ML or MH	GM	Silty gravel[E F G]
			Fines Classify as CL or CH	GC	Clayey gravel[E F G]
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines[H])	$C_u \geq 6$ and $1 \leq C_c \leq 3$[D]	SW	Well-graded sand[I]
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$)[D]	SP	Poorly graded sand[J]
		Sands with Fines (More than 12% fines[H])	Fines classify as ML or MH	SM	Silty sand[F G I]
			Fines classify as CL or CH	SC	Clayey sand[F G I]
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K L M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OL	Organic clay[K L M N] / Organic silt[K L M O]
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OH	Organic clay[K L M P] / Organic silt[K L M Q]
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:
   GW-GM well-graded gravel with silt
   GW-GC well-graded gravel with clay
   GP-GM poorly graded gravel with silt
   GP-GC poorly graded gravel with clay
D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:
   SW-SM well-graded sand with silt
   SW-SC well-graded sand with clay
   SP-SM poorly graded sand with silt
   SP-SC poorly graded sand with clay
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
N. PI ≥ 4 and plots on or above "A" line.
O. PI < 4 or plots below "A" line.
P. PI plots on or above "A" line.
Q. PI plots below "A" line.



Particle Size Identification

Boulders..... over 12"
Cobbles..... 3" to 12"
Gravel
  Coarse..... 3/4" to 3" (19.00 mm to 75.00 mm)
  Fine..... No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
  Coarse..... No. 10 to No. 4 (2.00 mm to 4.75 mm)
  Medium..... No. 40 to No. 10 (0.425 mm to 2.00 mm)
  Fine..... No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt..... No. 200 (0.075 mm) to .005 mm
Clay..... < .005 mm

Relative Proportions[L, M]

trace..... 0 to 5%
little..... 6 to 14%
with..... ≥ 15%

Inclusion Thicknesses

lens..... 0 to 1/8"
seam..... 1/8" to 1"
layer..... over 1"

Apparent Relative Density of Cohesionless Soils

Very loose ..... 0 to 4 BPF
Loose ..... 5 to 10 BPF
Medium dense..... 11 to 30 BPF
Dense..... 31 to 50 BPF
Very dense..... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft	0 to 1 BPF	< 0.25 tsf
Soft	2 to 4 BPF	0.25 to 0.5 tsf
Medium	5 to 8 BPF	0.5 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

Blows/N-value: Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

Recovery: Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

WOH: Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WOR: Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (▽), at the end of drilling (▼), or at some time after drilling (▼).

Laboratory Tests

DD	Dry density, pcf	**OC**	Organic content, %	**LL**	Liquid limit
WD	Wet density, pcf	**q_p**	Pocket penetrometer strength, tsf	**PL**	Plastic limit
P200	% Passing #200 sieve	**MC**	Moisture content, %	**PI**	Plasticity index
		q_U	Unconfined compression test, tsf		

3/2019