

PRINCIPALS

Steven J. Thompson, P.L.S.
Brian J. Johnson, P.E.
Steven J. Penkava, P.E.
John H. Schulte V, P.E.
Scott A. Tuchtenhagen, P.L.S.

Established 1945

Drainage Memorandum
Preliminary Plat
Metcon Addition
Mankato
Prepared by: John H. Schulte V, PE

August 13, 2026

Introduction

Metcon intends to construct a new commercial / industrial subdivision off Adam Avenue Mankato. The project will include a new cul-de-sac from Adams Avenue, a right turn lane on Adams Avenue, sanitary sewer and water main extensions, and a wet stormwater treatment basin.

Basis of Design

The modeling that follows in this report was performed utilizing HydroCAD software. Pipes were sized utilizing State Plumbing Code and/or Rational Method Design and Manning's Equation. Rainfall was modeling with Atlas 14 Rainfall events.

Onsite soils per the Web Soil Survey and on-site borings show Hydric Type C/D clay soils. Infiltration as a method of stormwater treatment is therefore unavailable. Filtration was considered as an alternate method of treatment but a wet stormwater pond was selected to eliminate the costs of importing filtration viable materials as none exist on site, and to reduce the footprint required of the treatment basin. A filtration system would have required a higher outflow elevation to make room for the filtration materials, reducing the dry storage elevations available and thus increasing the overall basin footprint.

Existing Conditions

The site is bounded by Adams Avenue on the north, agricultural ground and a farm site to the east, CSAH 12 on the west and Madison Avenue to the south. The existing site is undeveloped and is maintained as agricultural row crop.

General surface water flows through the site east to west, with three wetlands scattered across the site. The site in general is very flat, with the three very shallow wetland basins providing almost no surface water storage. The eventual site discharge point is a centerline culvert under CSAH 12 near Madison Avenue discharging east to west.

Required Treatment

This site is greater than 1 acre and is thus required to provide stormwater treatment per the NPDES Construction Stormwater Permit with its associated 1" infiltration goal; a 1.1" Water Quality Volume requirement, and discharge rates controlled to not exceed existing conditions.

Below is a table of the requirements:

Platted Area:	14.47 acres
Proposed Impervious Surface:	10.56 acres
1" Infiltration Goal:	$10.56 \text{ acres} \times 1" = 38333 \text{ cf}$
1.1" Water Quality Volume:	$10.56 \text{ acres} \times 1.1" = 42166 \text{ cf}$
Basin Watershed Area:	15.03 acres
Wet Pond Wet Storage Volume:	$15.03 \text{ acres} \times 1800 \text{ cf / acre} = 27054 \text{ cf}$

Discussion of Proposed Improvements

The development of this site initially includes construction of Ponderosa Court and its associated roadway and utility infrastructure, the addition of a turn lane to Adams Avenue, and construction of the subdivision's wet stormwater pond. Future development will include the full buildout of the site's commercial and industrial lots. Right of Way for Evergreen Drive is being dedicated with this project, but there are currently no plans to construct that roadway.

Conveyance of stormwater flows to the wet stormwater pond is achieved via swales on the southeast and west sides of the development, while storm sewer will be constructed within Ponderosa Court.

Discussion of Proposed Stormwater Treatment

The wet stormwater pond is designed to treat the entire subdivision and a small portion of the farm site to the southeast that drains into the site. The area of Evergreen Drive is considered industrial development for the purposes of this design since there are currently no plans to construct it as a roadway.

The wet stormwater pond is designed to provide at least 1800 cf of wet volume per acre drained, to provide a Water Quality Volume of at least 1.1" of volume over the new impervious surface areas that discharges no faster than 5.66 cfs per acre of Water Quality Volume, and to not discharge faster than existing conditions to CSAH 12. Since infiltration is not viable at this site, that goal is not met. A summary of the requirements and design is below:

	Required	Designed
Wet Volume	27054 cf	113212 cf
1.1" Water Quality Volume	42166 cf	46520 cf
Water Quality Volume Rate	6.91 cfs	3.30 cfs
2-year Discharge Rate	9.68 cfs	6.73 cfs
10-year Discharge Rate	23.98 cfs	11.06 cfs
100-year Discharge Rate	47.27 cfs	16.14 cfs

Other Pertinent Pond Data:

Pond Bottom Elevation	1007
Normal Water Level Elevation	1011
Water Quality Volume Elevation	1011.85
High Water Level	1014.51
Emergency Overflow Elevation	1015.5
Top of Bank Elevation	1016
Minimum FFE Draining to Basin	1016.75

Summary

In summary, the site's proposed wet stormwater pond provides the required treatment and attenuation that reduces flows leaving the site to less than existing.

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.



John H. Schulte V Date: 8/13/26

License No. 44639

Attachments:

Watershed Map
Calculations
Web Soil Survey
HydroCAD Model
Geotechnical Report

WATERSHED MAP

METCON ADDITION

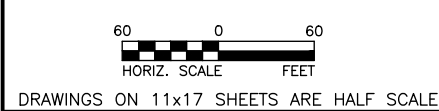
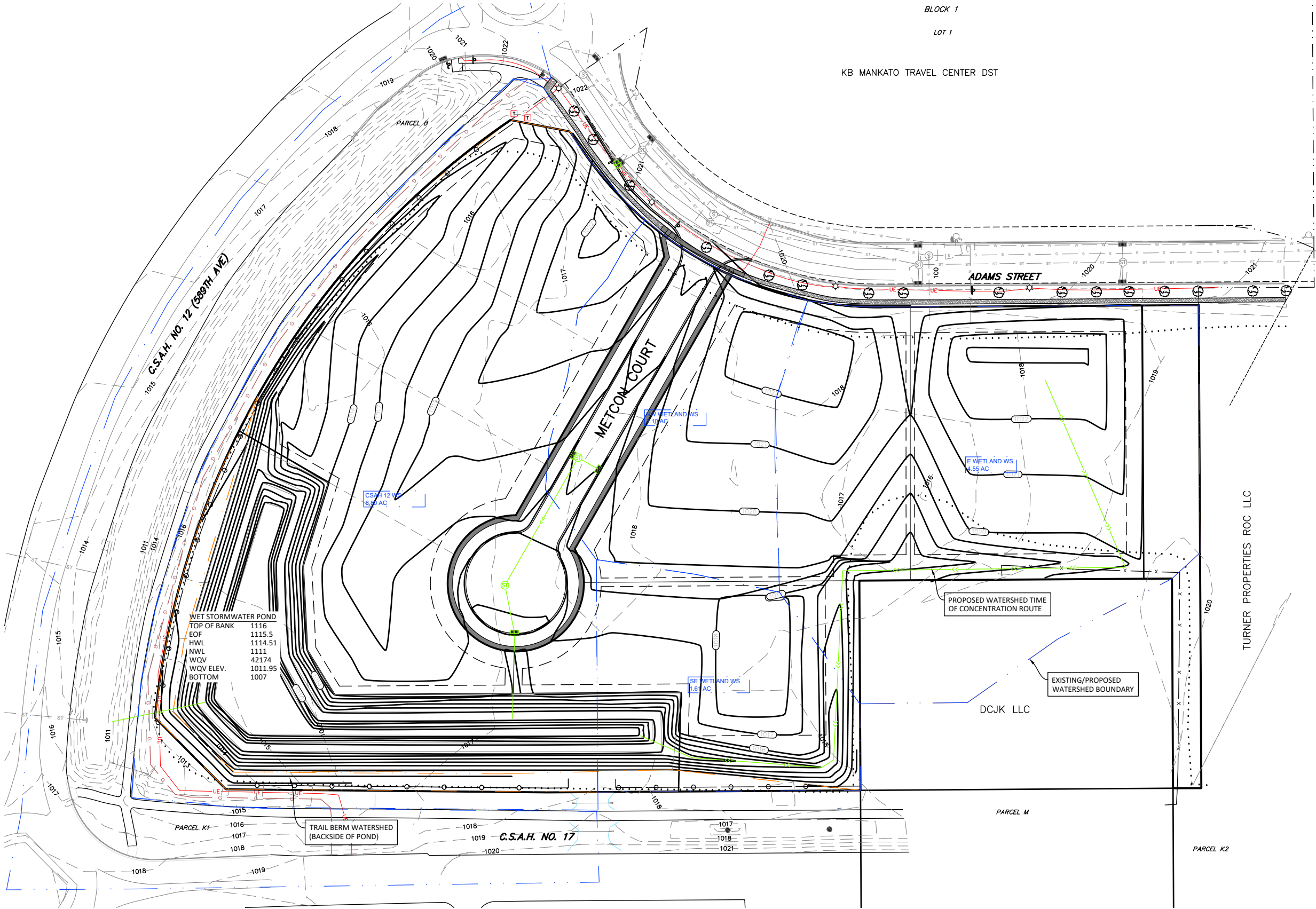
BLOCK 1

LOT 1

KB MANKATO TRAVEL CENTER DST



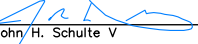
- LEGEND**
- W = Water Main
 - S = Sanitary Sewer
 - ST = Storm Sewer
 - G = Gas Main
 - UT = Underground Telephone
 - OT = Overhead Telephone
 - FO = Fiber-Optics
 - UE = Underground Electric
 - OE = Overhead Electric
 - UTV = Underground TV
 - JLM = Judicial Landmark
 - X = Chain Link Fence
 - Control Access
 - Sign
 - Stop Sign
 - Light Pole
 - Flood Lights
 - Power Pole
 - Guy Anchor
 - Fire hydrant
 - Water Main Valve
 - Culvert
 - Catch Basin & Catch Basin Numbers
 - Manholes & Manhole Numbers
 - 1272 = Elevation Contour Line
 - 1271.23 = Spot Elevation
 - RM1270.89 = Rim Elevation
 - FL1262.34 = FlowLine Elevation
 - Deciduous Tree
 - Coniferous Tree
 - Bush



REV.	BY	DATE	REVISION DESCRIPTION

 **JONES HAUGH SMITH**
Engineers + Surveyors
415 West North Street Owatonna, MN 56045-4598

DESIGNED: JHS
DRAWN: JHS
CHECKED: BJ
Date: 7/28/26
DWG: 25-1234PP

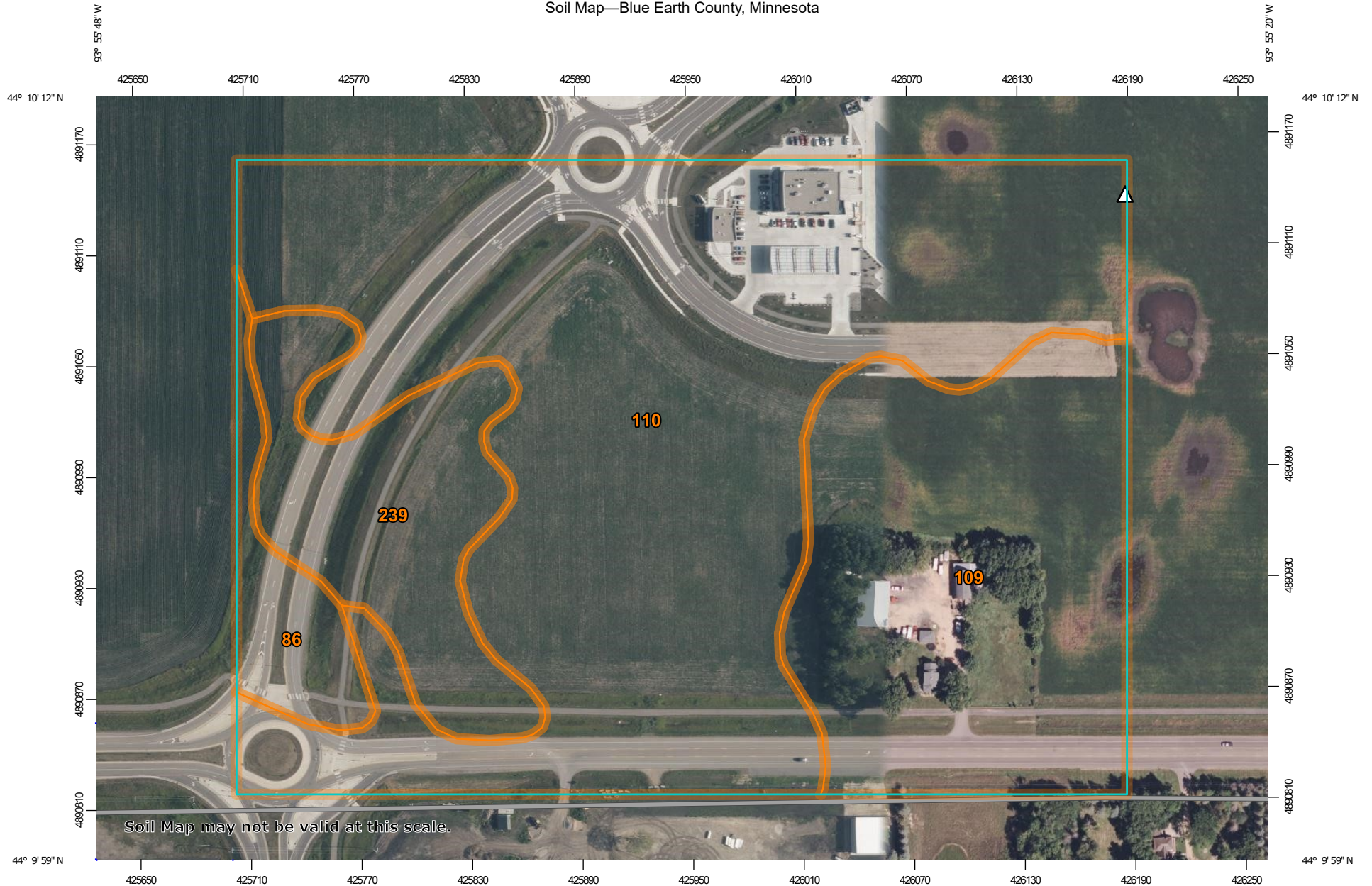
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

John H. Schulte V
License No. 44639 Date: 7/28/26

PRELIMINARY PLAT
METCON ADDITION
PART OF SW1/4 SECTION 11-T108N-R26W
WATERSHEDS MAP

SHEET
1
OF
1

WEB SOIL SURVEY

Soil Map—Blue Earth County, Minnesota



Soil Map may not be valid at this scale.

Map Scale: 1:2,910 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

7/20/2026
Page 1 of 3

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Blue Earth County, Minnesota

Survey Area Data: Version 23, Sep 9, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 30, 2020—Aug 8, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
86	Canisteo clay loam, 0 to 2 percent slopes	1.7	4.1%
109	Cordova clay loam, 0 to 2 percent slopes	10.2	24.7%
110	Marna silty clay loam, 0 to 2 percent slopes	24.6	59.7%
239	Le Sueur loam, 1 to 3 percent slopes	4.7	11.5%
Totals for Area of Interest		41.2	100.0%

CALCULATIONS

25-1243

MSE 24-hr 3 100-Year Rainfall=7.41"

Prepared by Jones Haugh & Smith Inc

Printed 8/13/2026

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Stage-Area-Storage for Pond 23P: Metcon Addn Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
1,011.00	47,057	0	1,011.52	50,800	25,443
1,011.01	47,129	471	1,011.53	50,872	25,951
1,011.02	47,201	943	1,011.54	50,944	26,460
1,011.03	47,273	1,415	1,011.55	51,016	26,970
1,011.04	47,345	1,888	1,011.56	51,088	27,481
1,011.05	47,417	2,362	1,011.57	51,160	27,992
1,011.06	47,489	2,836	1,011.58	51,232	28,504
1,011.07	47,561	3,312	1,011.59	51,304	29,016
1,011.08	47,633	3,788	1,011.60	51,376	29,530
1,011.09	47,705	4,264	1,011.61	51,448	30,044
1,011.10	47,777	4,742	1,011.62	51,520	30,559
1,011.11	47,849	5,220	1,011.63	51,592	31,074
1,011.12	47,921	5,699	1,011.64	51,664	31,591
1,011.13	47,993	6,178	1,011.65	51,736	32,108
1,011.14	48,065	6,659	1,011.66	51,808	32,625
1,011.15	48,137	7,140	1,011.67	51,880	33,144
1,011.16	48,209	7,621	1,011.68	51,952	33,663
1,011.17	48,281	8,104	1,011.69	52,023	34,183
1,011.18	48,353	8,587	1,011.70	52,095	34,703
1,011.19	48,425	9,071	1,011.71	52,167	35,225
1,011.20	48,497	9,555	1,011.72	52,239	35,747
1,011.21	48,569	10,041	1,011.73	52,311	36,269
1,011.22	48,641	10,527	1,011.74	52,383	36,793
1,011.23	48,712	11,013	1,011.75	52,455	37,317
1,011.24	48,784	11,501	1,011.76	52,527	37,842
1,011.25	48,856	11,989	1,011.77	52,599	38,368
1,011.26	48,928	12,478	1,011.78	52,671	38,894
1,011.27	49,000	12,968	1,011.79	52,743	39,421
1,011.28	49,072	13,458	1,011.80	52,815	39,949
1,011.29	49,144	13,949	1,011.81	52,887	40,477
1,011.30	49,216	14,441	1,011.82	52,959	41,007
1,011.31	49,288	14,934	1,011.83	53,031	41,537
1,011.32	49,360	15,427	1,011.84	53,103	42,067
1,011.33	49,432	15,921	1,011.85	53,175	42,599
1,011.34	49,504	16,415	1,011.86	53,247	43,131
1,011.35	49,576	16,911	1,011.87	53,319	43,664
1,011.36	49,648	17,407	1,011.88	53,391	44,197
1,011.37	49,720	17,904	1,011.89	53,463	44,731
1,011.38	49,792	18,401	1,011.90	53,535	45,266
1,011.39	49,864	18,900	1,011.91	53,607	45,802
1,011.40	49,936	19,399	1,011.92	53,679	46,339
1,011.41	50,008	19,898	1,011.93	53,751	46,876
1,011.42	50,080	20,399	1,011.94	53,823	47,414
1,011.43	50,152	20,900	1,011.95	53,895	47,952
1,011.44	50,224	21,402	1,011.96	53,967	48,491
1,011.45	50,296	21,904	1,011.97	54,039	49,031
1,011.46	50,368	22,408	1,011.98	54,111	49,572
1,011.47	50,440	22,912	1,011.99	54,183	50,114
1,011.48	50,512	23,417	1,012.00	54,255	50,656
1,011.49	50,584	23,922	1,012.01	54,327	51,199
1,011.50	50,656	24,428	1,012.02	54,399	51,742
1,011.51	50,728	24,935	1,012.03	54,471	52,287

Rec'd
Went
$$\frac{53247}{43540} \times 5.44 =$$

6.91 cfs

25-1243

MSE 24-hr 3 100-Year Rainfall=7.41"

Prepared by Jones Haugh & Smith Inc

Printed 8/13/2026

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Hydrograph for Pond 23P: Metcon Addn Pond (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
10.20	3.28	21,447	1,011.44	0.98
10.25	3.32	21,862	1,011.45	1.01
10.30	3.36	22,277	1,011.46	1.05
10.35	3.39	22,691	1,011.47	1.09
10.40	3.42	23,106	1,011.47	1.12
10.45	3.45	23,519	1,011.48	1.16
10.50	3.49	23,932	1,011.49	1.20
10.55	3.64	24,355	1,011.50	1.23
10.60	4.21	24,835	1,011.51	1.28
10.65	4.87	25,417	1,011.52	1.34
10.70	5.41	26,096	1,011.53	1.40
10.75	5.84	26,850	1,011.55	1.47
10.80	6.26	27,666	1,011.56	1.55
10.85	6.65	28,541	1,011.58	1.64
10.90	7.06	29,471	1,011.60	1.73
10.95	7.45	30,456	1,011.62	1.84
11.00	7.86	31,493	1,011.64	1.95
11.05	8.25	32,581	1,011.66	2.07
11.10	8.67	33,721	1,011.68	2.19
11.15	9.08	34,912	1,011.70	2.33
11.20	9.51	36,153	1,011.73	2.47
11.25	9.92	37,443	1,011.75	2.62
11.30	10.35	38,781	1,011.78	2.78
11.35	10.77	40,167	1,011.80	2.95
11.40	11.21	41,599	1,011.83	3.12
11.45	11.63	43,076	1,011.86	3.30
11.50	12.07	44,597	1,011.89	3.49
11.55	12.83	46,192	1,011.92	3.69
11.60	14.89	48,001	1,011.95	3.92
11.65	17.45	50,180	1,011.99	4.20
11.70	20.48	52,808	1,012.04	4.54
11.75	23.73	55,935	1,012.10	4.94
11.80	28.24	59,681	1,012.16	5.41
11.85	33.33	64,199	1,012.25	5.96
11.90	40.07	69,676	1,012.34	6.58
11.95	49.14	76,463	1,012.46	7.22
12.00	66.76	85,531	1,012.62	7.92
12.05	89.43	98,079	1,012.83	8.84
12.10	123.37	115,547	1,013.11	9.87
12.15	146.53	137,968	1,013.47	10.90
12.20	121.52	160,051	1,013.80	11.79
12.25	83.00	176,281	1,014.04	12.39
12.30	59.48	186,841	1,014.19	12.75
12.35	45.97	194,015	1,014.29	12.99
12.40	37.07	199,135	1,014.37	13.16
12.45	30.78	202,862	1,014.42	13.28
12.50	25.98	205,573	1,014.46	13.36
12.55	22.20	207,498	1,014.48	13.42
12.60	18.75	208,763	1,014.50	13.46
12.65	15.96	209,462	1,014.51	13.48
12.70	14.42	209,768	1,014.51	13.49
12.75	13.57	209,858	1,014.51	13.50

vs 6.91 cfs ✓

25-1243

MSE 24-hr 3 2-Year Rainfall=2.92"

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Printed 7/14/2026

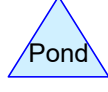
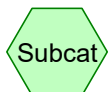
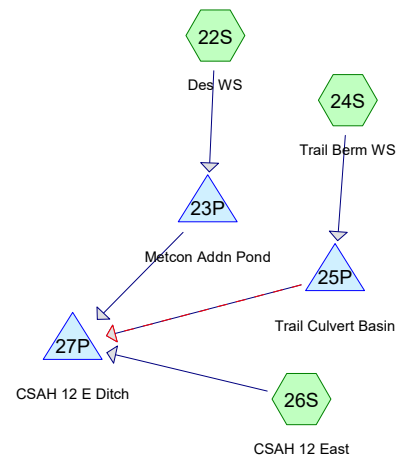
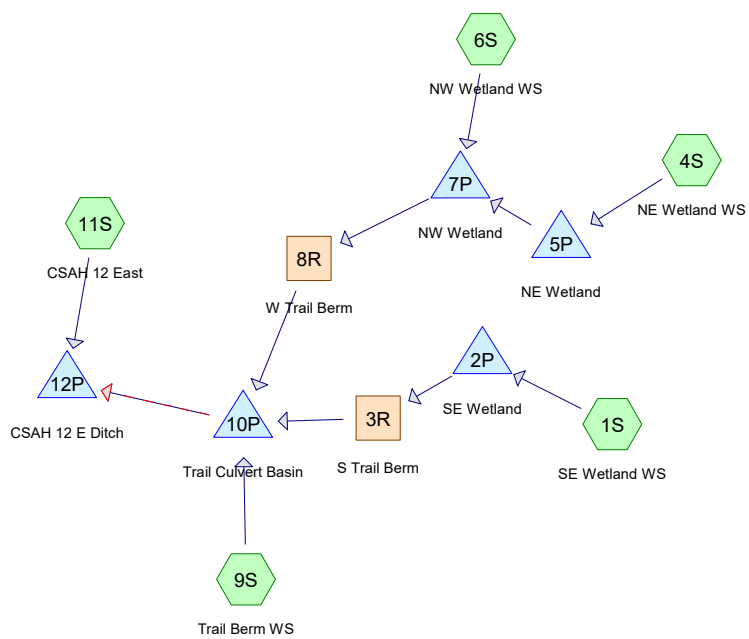
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Hydrograph for Pond 3P: (new Pond) (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
10.20	0.73	3,521	1,011.08	0.04
10.25	0.75	3,647	1,011.09	0.04
10.30	0.76	3,775	1,011.09	0.04
10.35	0.77	3,906	1,011.09	0.04
10.40	0.79	4,038	1,011.10	0.05
10.45	0.80	4,173	1,011.10	0.05
10.50	0.82	4,309	1,011.10	0.05
10.55	0.86	4,450	1,011.11	0.06
10.60	1.00	4,607	1,011.11	0.06
10.65	1.17	4,790	1,011.11	0.07
10.70	1.31	5,001	1,011.12	0.08
10.75	1.43	5,234	1,011.12	0.08
10.80	1.55	5,486	1,011.13	0.09
10.85	1.67	5,759	1,011.14	0.10
10.90	1.79	6,051	1,011.14	0.11
10.95	1.91	6,364	1,011.15	0.12
11.00	2.04	6,696	1,011.16	0.13
11.05	2.16	7,048	1,011.17	0.15
11.10	2.30	7,421	1,011.18	0.17
11.15	2.43	7,816	1,011.19	0.18
11.20	2.57	8,232	1,011.20	0.20
11.25	2.71	8,669	1,011.21	0.22
11.30	2.86	9,129	1,011.22	0.25
11.35	3.01	9,611	1,011.23	0.28
11.40	3.17	10,115	1,011.24	0.30
11.45	3.32	10,641	1,011.25	0.33
11.50	3.48	11,190	1,011.26	0.37
11.55	3.74	11,770	1,011.28	0.40
11.60	4.39	12,425	1,011.29	0.45
11.65	5.20	13,203	1,011.31	0.50
11.70	6.18	14,131	1,011.33	0.57
11.75	7.26	15,231	1,011.36	0.65
11.80	8.77	16,546	1,011.39	0.76
11.85	10.50	18,130	1,011.42	0.90
11.90	12.84	20,052	1,011.46	1.08
11.95	16.02	22,433	1,011.52	1.33
12.00	22.22	25,604	1,011.59	1.68
12.05	30.40	29,991	1,011.68	2.29
12.10	42.91	36,120	1,011.81	3.01
12.15	51.89	44,012	1,011.98	4.11
12.20	43.52	51,760	1,012.14	5.21
12.25	29.97	57,367	1,012.25	5.98
12.30	21.63	60,894	1,012.32	6.43
12.35	16.82	63,172	1,012.36	6.70
12.40	13.62	64,690	1,012.39	6.87
12.45	11.35	65,690	1,012.41	6.98
12.50	9.60	66,314	1,012.42	7.04
12.55	8.22	66,648	1,012.43	7.07
12.60	6.95	66,739	1,012.43	7.08
12.65	5.92	66,624	1,012.43	7.07
12.70	5.36	66,369	1,012.43	7.04
12.75	5.04	66,040	1,012.42	7.01

✓
vs 4.2

HYDROCAD MODEL



Routing Diagram for 25-1243

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25-1243

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MSE 24-hr 3 2-Year Rainfall=2.92"

Printed 8/13/2026

Page 2

Summary for Subcatchment 1S: SE Wetland WS

Runoff = 2.96 cfs @ 12.40 hrs, Volume= 0.257 af, Depth> 1.91"
 Routed to Pond 2P : SE Wetland

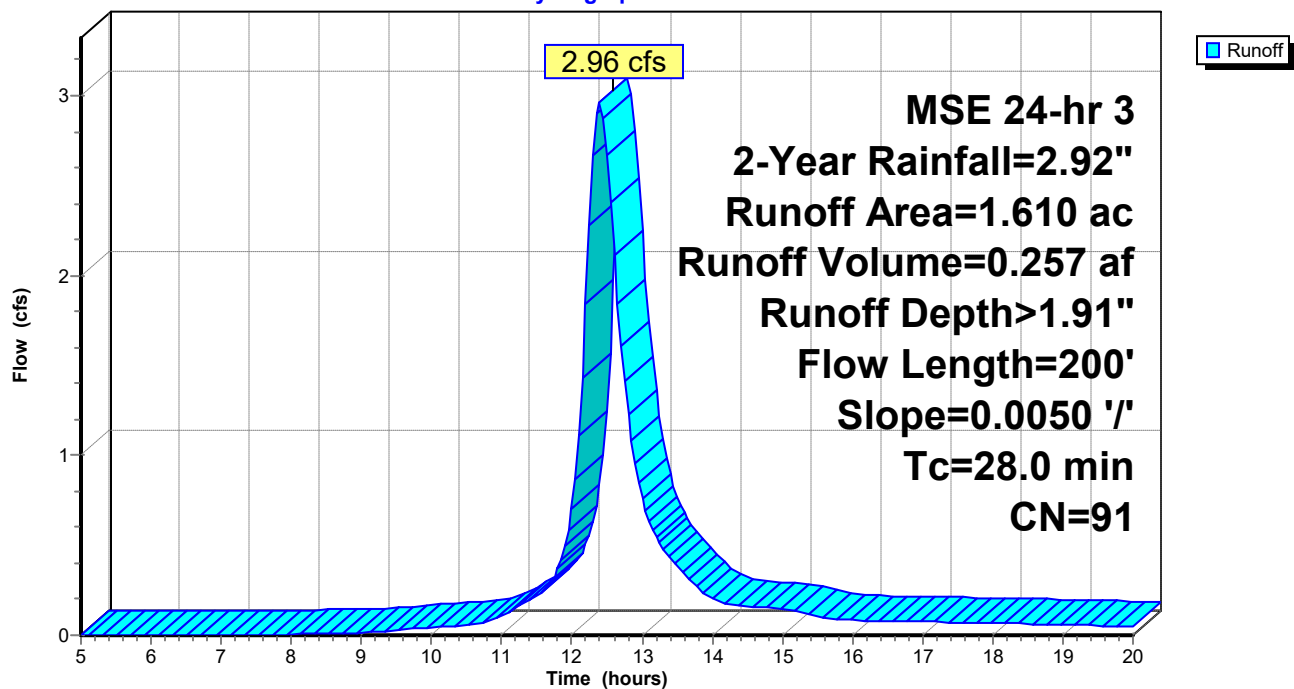
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 2-Year Rainfall=2.92"

Area (ac)	CN	Description
1.610	91	Row crops, straight row, Poor, HSG D
1.610		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	200	0.0050	0.12		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 4.40"

Subcatchment 1S: SE Wetland WS

Hydrograph



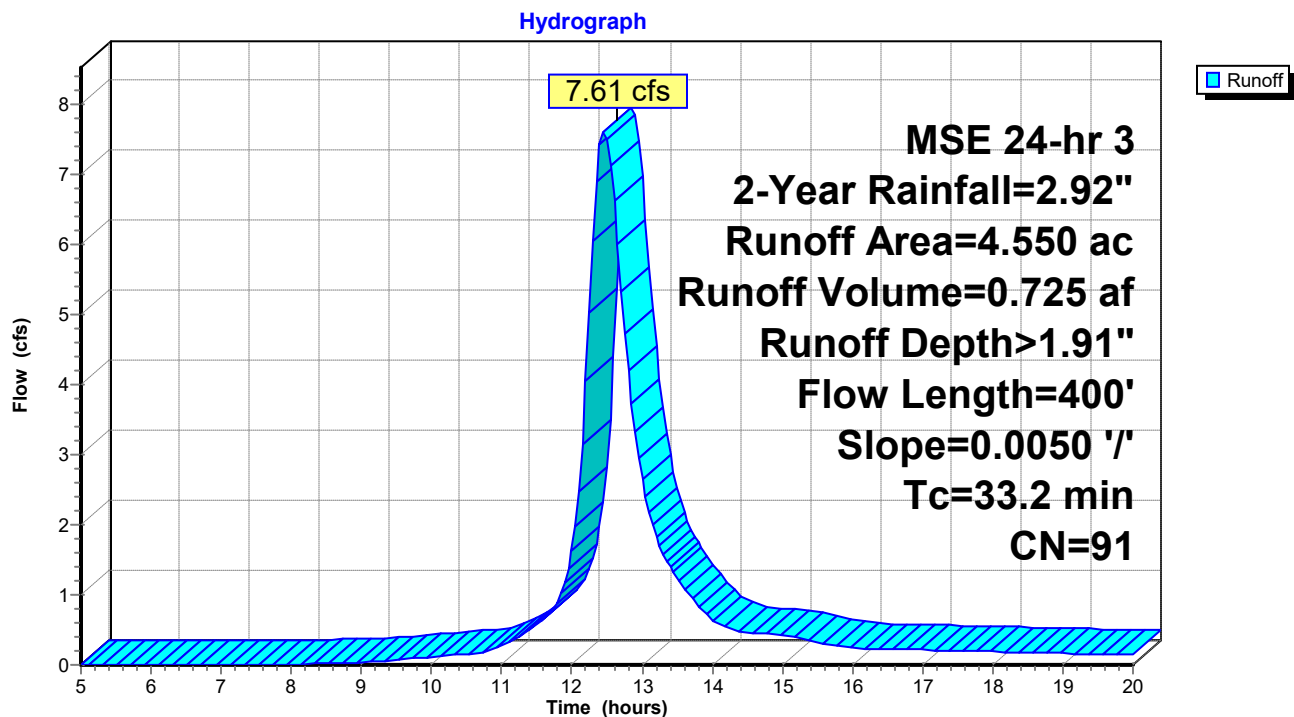
Summary for Subcatchment 4S: NE Wetland WS

Runoff = 7.61 cfs @ 12.46 hrs, Volume= 0.725 af, Depth> 1.91"
 Routed to Pond 5P : NE Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 2-Year Rainfall=2.92"

Area (ac)	CN	Description
4.190	91	Row crops, straight row, Poor, HSG D
0.360	86	Farmsteads, HSG D
4.550	91	Weighted Average
4.550		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	200	0.0050	0.12		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 4.40"
5.2	200	0.0050	0.64		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
33.2	400	Total			

Subcatchment 4S: NE Wetland WS

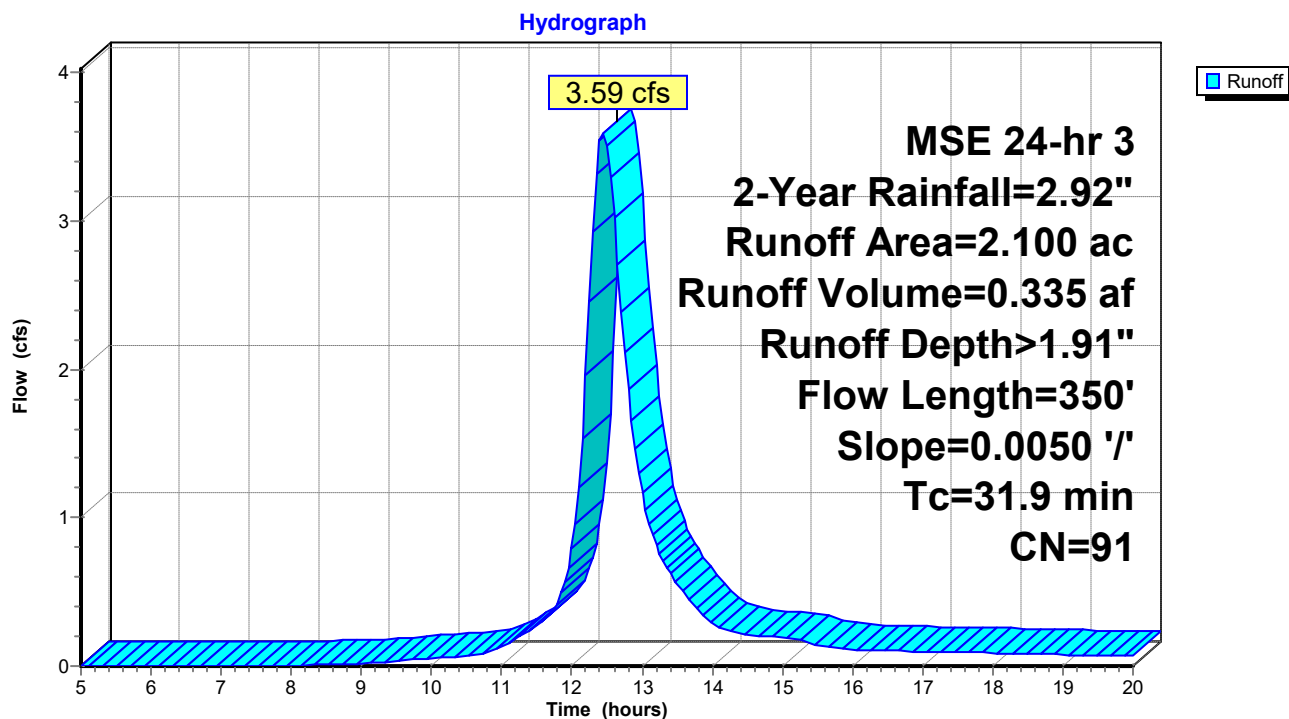
Summary for Subcatchment 6S: NW Wetland WS

Runoff = 3.59 cfs @ 12.44 hrs, Volume= 0.335 af, Depth> 1.91"
 Routed to Pond 7P : NW Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 2-Year Rainfall=2.92"

Area (ac)	CN	Description
2.100	91	Row crops, straight row, Poor, HSG D
2.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	200	0.0050	0.12		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 4.40"
3.9	150	0.0050	0.64		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
31.9	350	Total			

Subcatchment 6S: NW Wetland WS

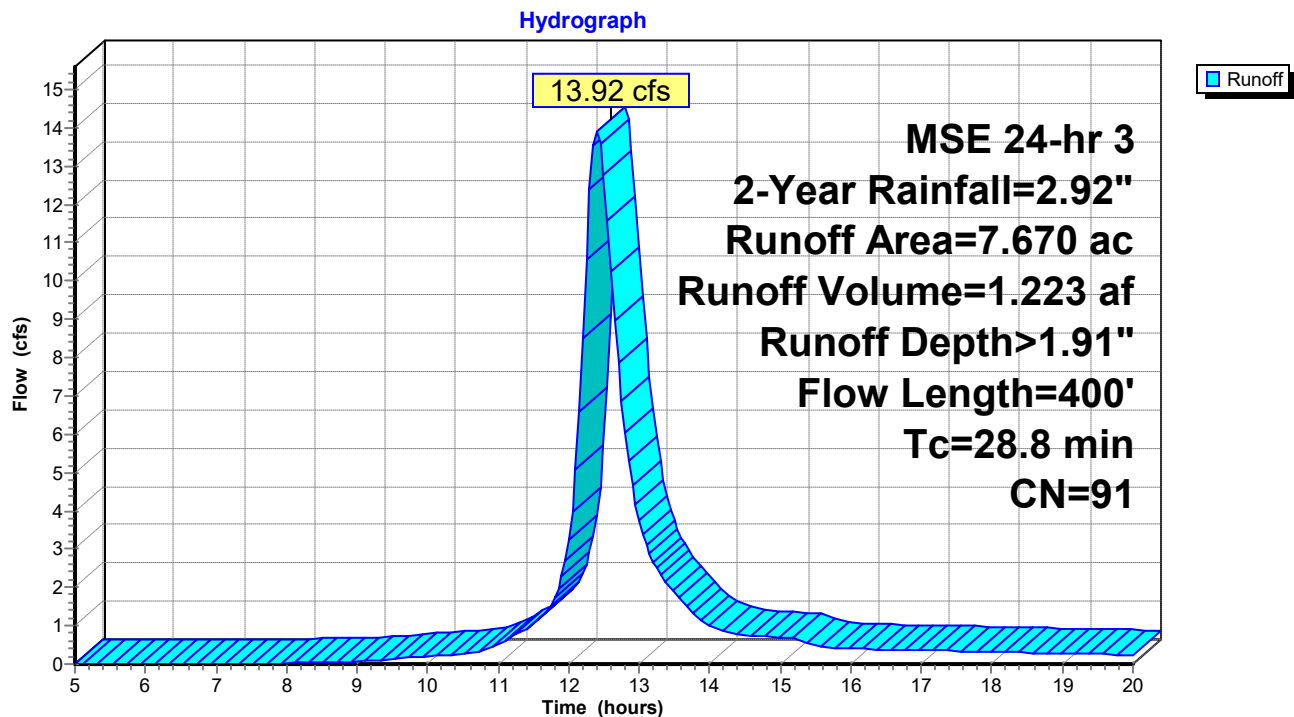
Summary for Subcatchment 9S: Trail Berm WS

Runoff = 13.92 cfs @ 12.40 hrs, Volume= 1.223 af, Depth> 1.91"
 Routed to Pond 10P : Trail Culvert Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 2-Year Rainfall=2.92"

Area (ac)	CN	Description
7.670	91	Row crops, straight row, Poor, HSG D
7.670		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	200	0.0050	0.27		Sheet Flow, Cultivated: Residue<=20% n= 0.060 P2= 4.40"
16.6	200	0.0005	0.20		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
28.8	400	Total			

Subcatchment 9S: Trail Berm WS

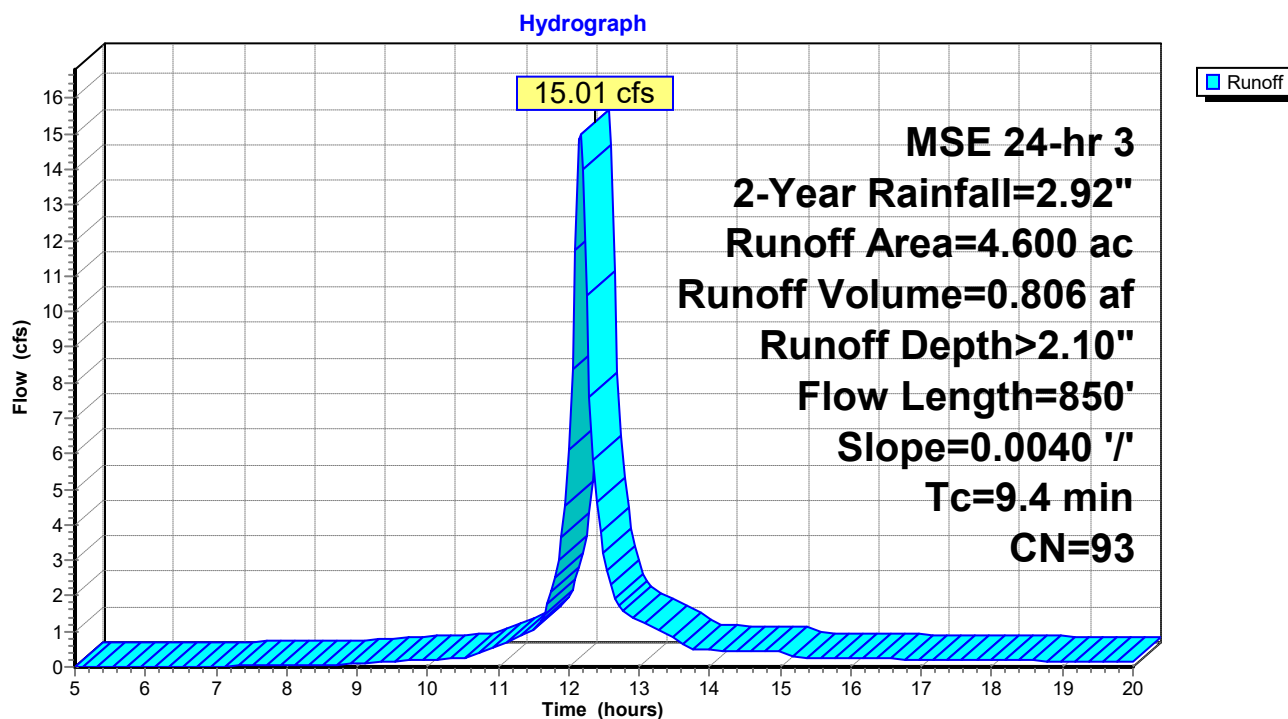
Summary for Subcatchment 11S: CSAH 12 East

Runoff = 15.01 cfs @ 12.16 hrs, Volume= 0.806 af, Depth> 2.10"
 Routed to Pond 12P : CSAH 12 E Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 2-Year Rainfall=2.92"

Area (ac)	CN	Description
4.600	93	Paved roads w/open ditches, 50% imp, HSG D
2.300		50.00% Pervious Area
2.300		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
2.4	450	0.0040	3.12	100.00	Trap/Vee/Rect Channel Flow, Bot.W=7.00' D=2.00' Z= 6.0 & 3.0 ' Top.W=25.00' n= 0.035 Earth, dense weeds
9.4	850	Total			

Subcatchment 11S: CSAH 12 East

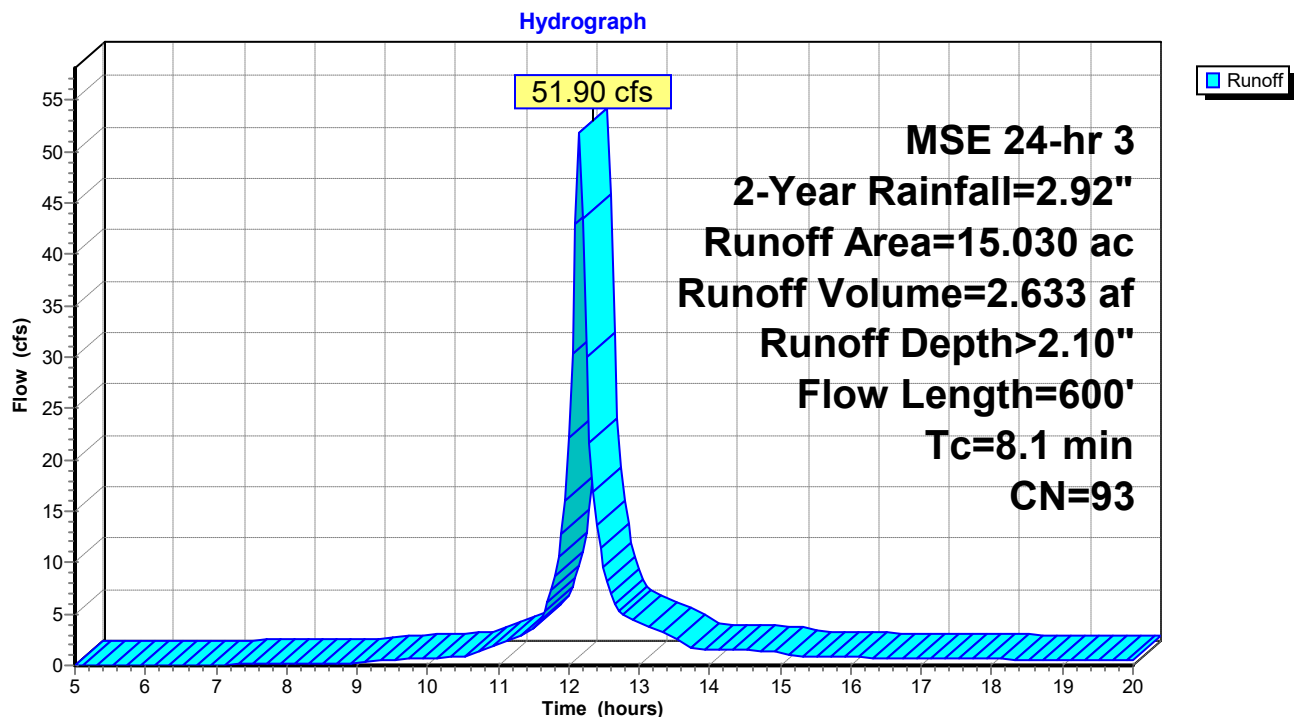
Summary for Subcatchment 22S: Des WS

Runoff = 51.90 cfs @ 12.15 hrs, Volume= 2.633 af, Depth> 2.10"
 Routed to Pond 23P : Metcon Addn Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 2-Year Rainfall=2.92"

Area (ac)	CN	Description
14.670	93	Urban industrial, 72% imp, HSG D
0.360	86	Farmsteads, HSG D
15.030	93	Weighted Average
4.468		29.72% Pervious Area
10.562		70.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	200	0.0200	1.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 4.40"
6.3	400	0.0050	1.06		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
8.1	600	Total			

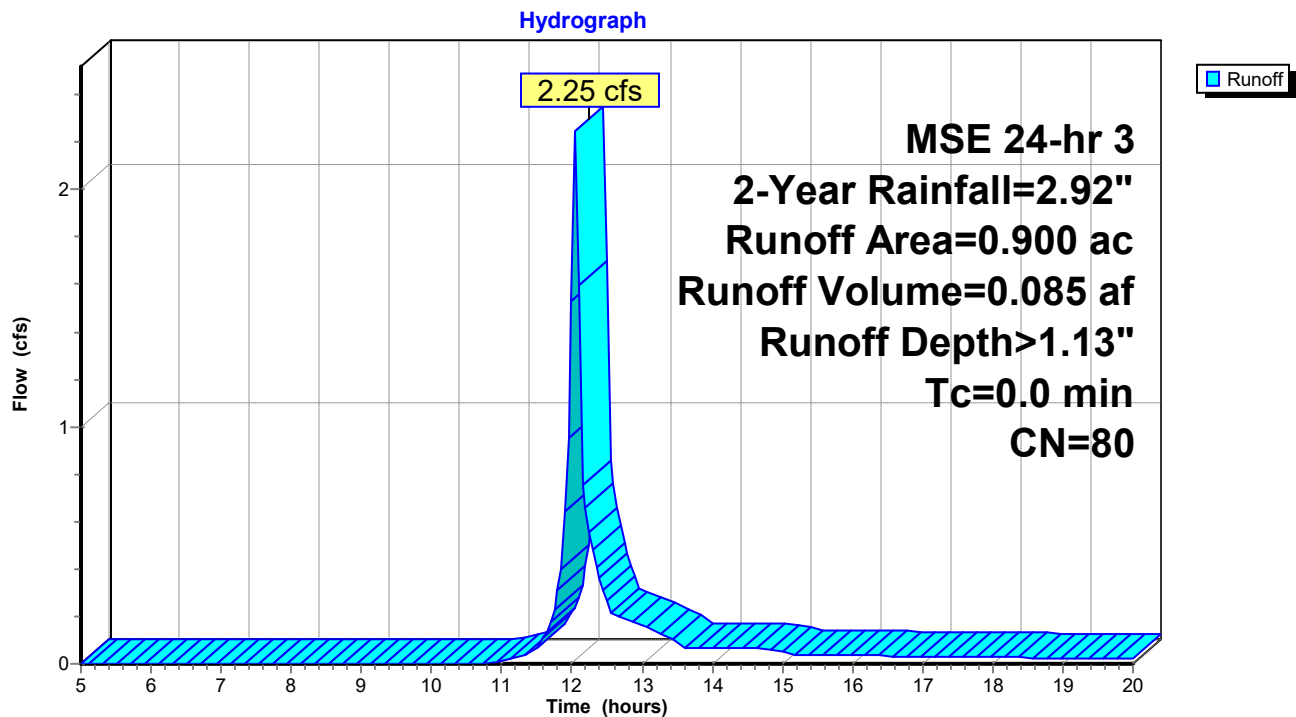
Subcatchment 22S: Des WS

Summary for Subcatchment 24S: Trail Berm WS

Runoff = 2.25 cfs @ 12.05 hrs, Volume= 0.085 af, Depth> 1.13"
 Routed to Pond 25P : Trail Culvert Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 2-Year Rainfall=2.92"

Area (ac)	CN	Description
0.900	80	>75% Grass cover, Good, HSG D
0.900		100.00% Pervious Area

Subcatchment 24S: Trail Berm WS

25-1243

Prepared by Jones Haugh & Smith Inc

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MSE 24-hr 3 2-Year Rainfall=2.92"

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Summary for Subcatchment 26S: CSAH 12 East

Runoff = 15.01 cfs @ 12.16 hrs, Volume= 0.806 af, Depth> 2.10"
 Routed to Pond 27P : CSAH 12 E Ditch

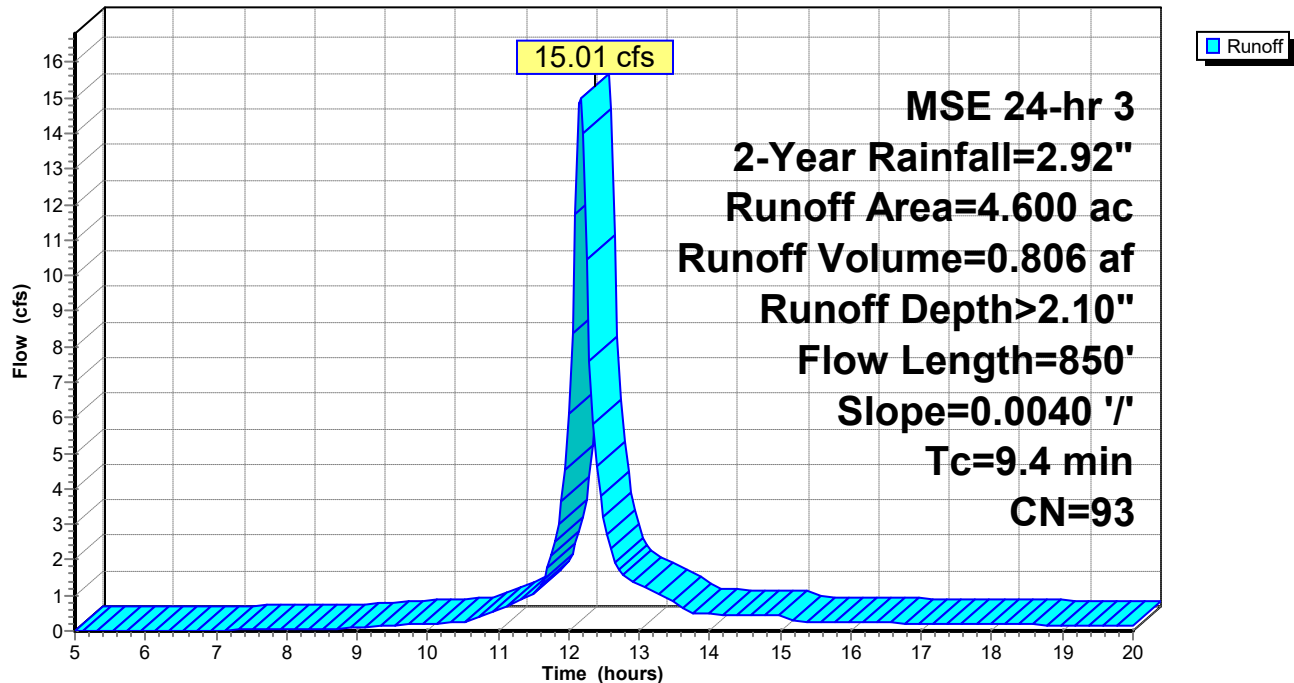
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 2-Year Rainfall=2.92"

Area (ac)	CN	Description
4.600	93	Paved roads w/open ditches, 50% imp, HSG D
2.300		50.00% Pervious Area
2.300		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
2.4	450	0.0040	3.12	100.00	Trap/Vee/Rect Channel Flow, Bot.W=7.00' D=2.00' Z= 6.0 & 3.0 ' /' Top.W=25.00' n= 0.035 Earth, dense weeds
9.4	850	Total			

Subcatchment 26S: CSAH 12 East

Hydrograph



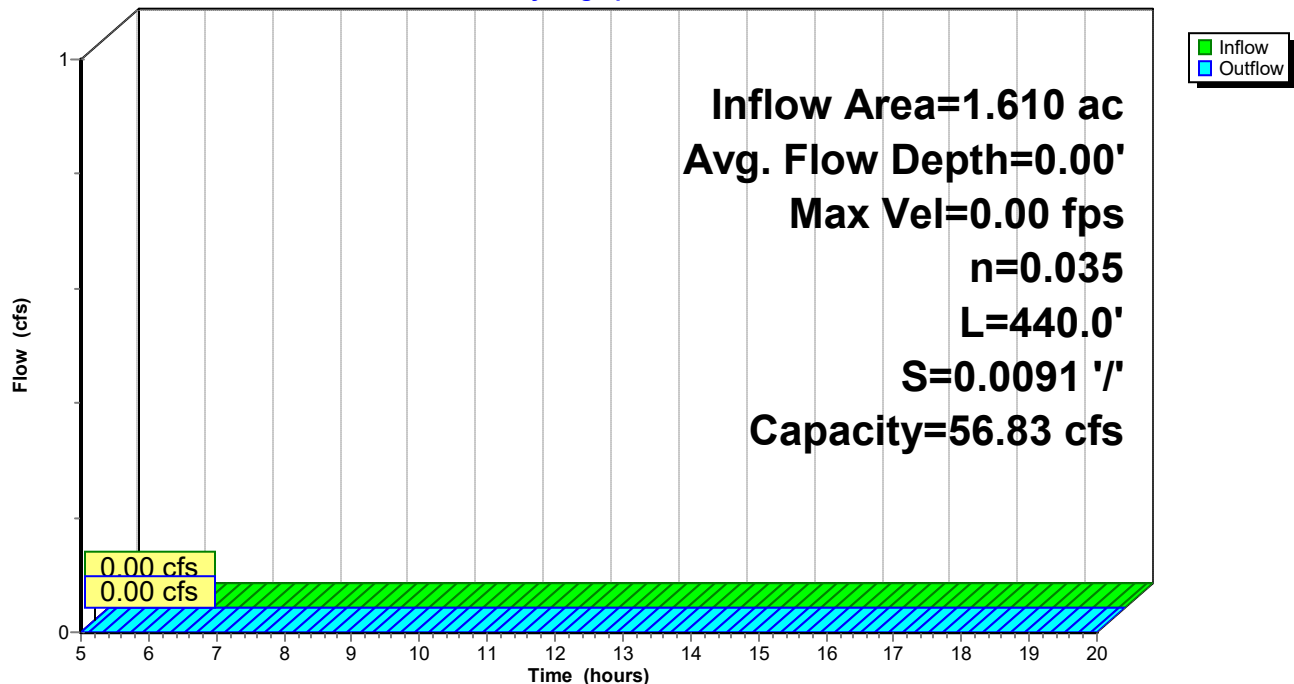
Summary for Reach 3R: S Trail Berm

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Routed to Pond 10P : Trail Culvert Basin

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
 Avg. Velocity= 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 5.00 hrs
 Average Depth at Peak Storage= 0.00'
 Bank-Full Depth= 1.00' Flow Area= 18.0 sf, Capacity= 56.83 cfs

10.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 6.0 10.0 '/' Top Width= 26.00'
 Length= 440.0' Slope= 0.0091 '/'
 Inlet Invert= 1,016.00', Outlet Invert= 1,012.00'

**Reach 3R: S Trail Berm****Hydrograph**

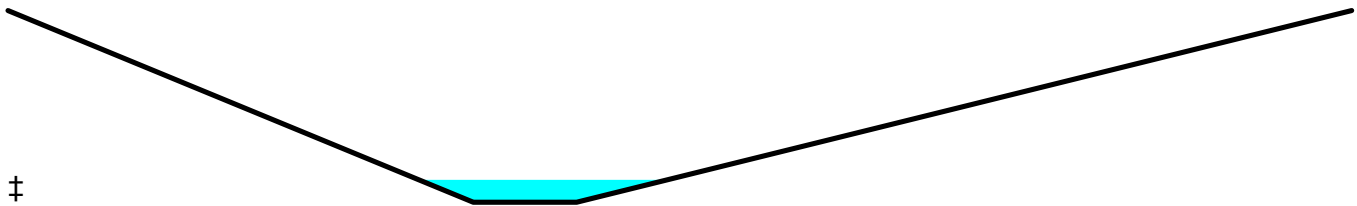
Summary for Reach 8R: W Trail Berm

Inflow Area = 6.650 ac, 0.00% Impervious, Inflow Depth > 0.55" for 2-Year event
 Inflow = 3.48 cfs @ 12.51 hrs, Volume= 0.303 af
 Outflow = 3.11 cfs @ 12.80 hrs, Volume= 0.299 af, Atten= 11%, Lag= 17.5 min
 Routed to Pond 10P : Trail Culvert Basin

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Max. Velocity= 1.30 fps, Min. Travel Time= 9.9 min
 Avg. Velocity= 0.60 fps, Avg. Travel Time= 21.4 min

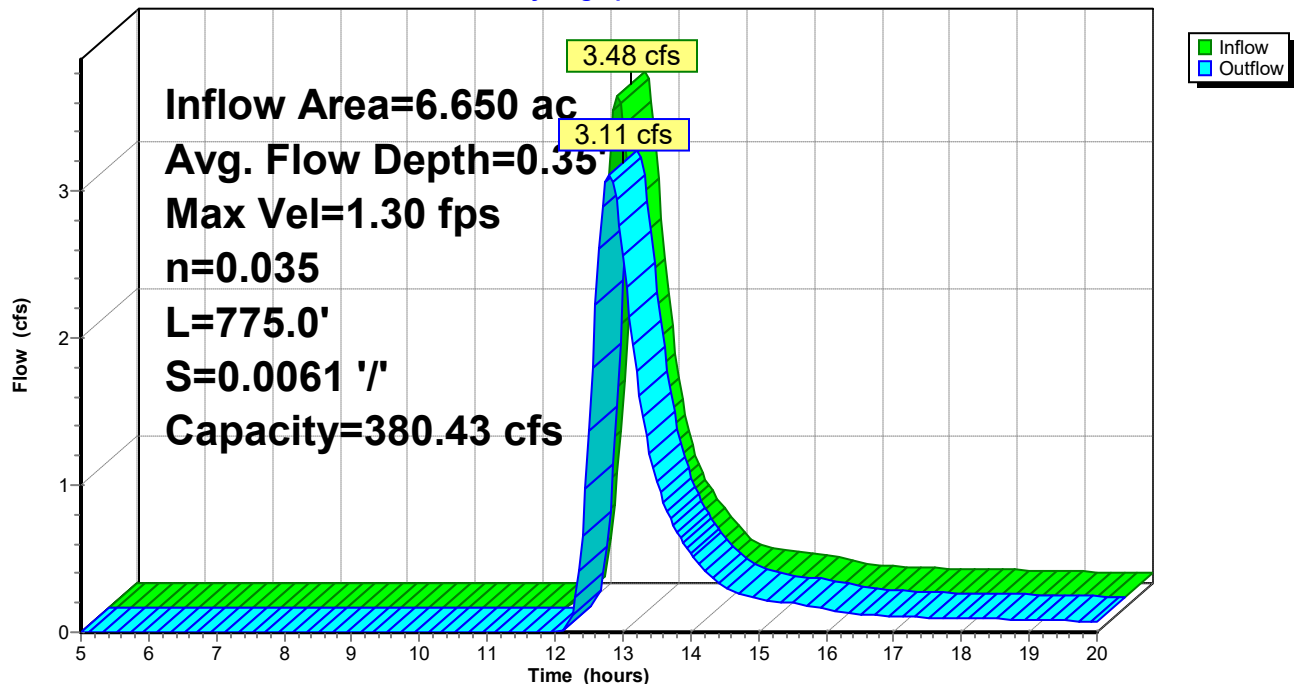
Peak Storage= 1,855 cf @ 12.63 hrs
 Average Depth at Peak Storage= 0.35' , Surface Width= 9.62'
 Bank-Full Depth= 3.00' Flow Area= 84.0 sf, Capacity= 380.43 cfs

4.00' x 3.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 6.0 10.0 ' / ' Top Width= 52.00'
 Length= 775.0' Slope= 0.0061 ' / '
 Inlet Invert= 1,016.70', Outlet Invert= 1,012.00'



Reach 8R: W Trail Berm

Hydrograph



Summary for Pond 2P: SE Wetland

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth > 1.91" for 2-Year event
 Inflow = 2.96 cfs @ 12.40 hrs, Volume= 0.257 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Routed to Reach 3R : S Trail Berm

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,017.78' @ 20.00 hrs Surf.Area= 41,990 sf Storage= 11,182 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,017.25'	22,174 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

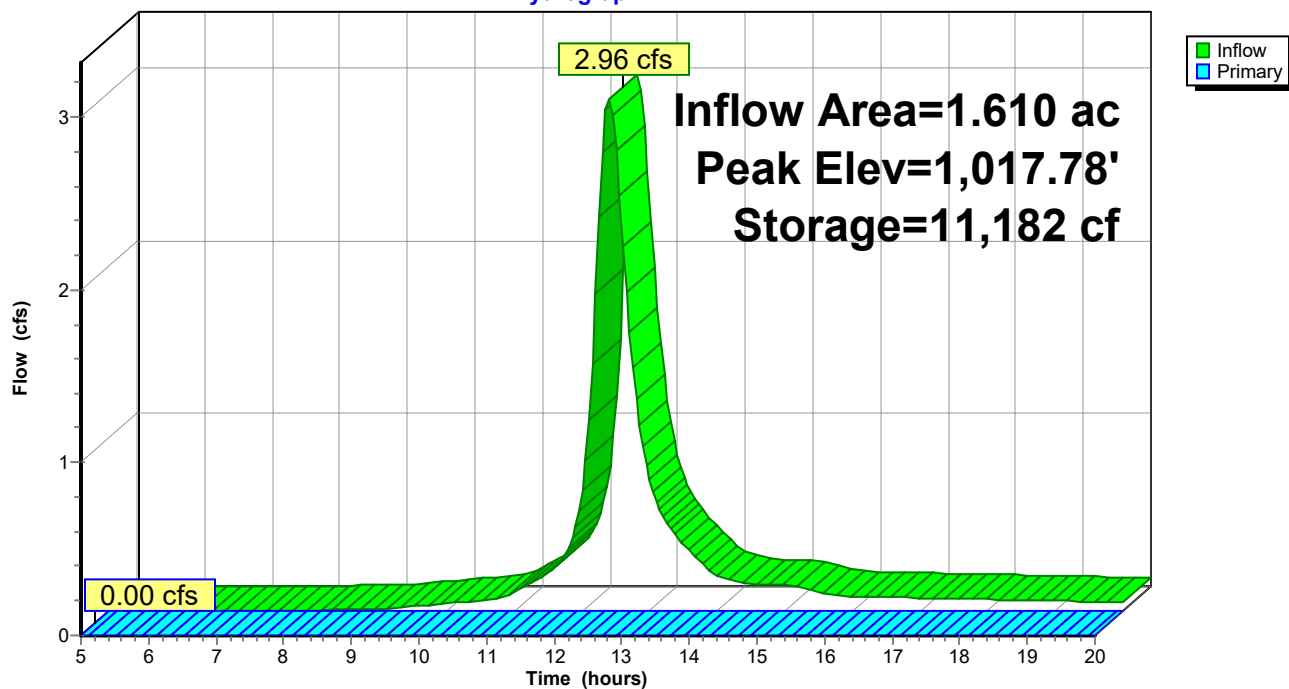
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,017.25	0	0	0
1,018.00	59,130	22,174	22,174

Device	Routing	Invert	Outlet Devices
#1	Primary	1,017.90'	100.0' long + 100.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,017.25' (Free Discharge)
 ↑1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 2P: SE Wetland

Hydrograph



Summary for Pond 5P: NE Wetland

Inflow Area = 4.550 ac, 0.00% Impervious, Inflow Depth > 1.91" for 2-Year event
 Inflow = 7.61 cfs @ 12.46 hrs, Volume= 0.725 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Routed to Pond 7P : NW Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,017.48' @ 20.00 hrs Surf.Area= 51,399 sf Storage= 31,557 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,016.00'	65,093 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,016.00	0	0	0
1,017.00	25,742	12,871	12,871
1,018.00	78,702	52,222	65,093

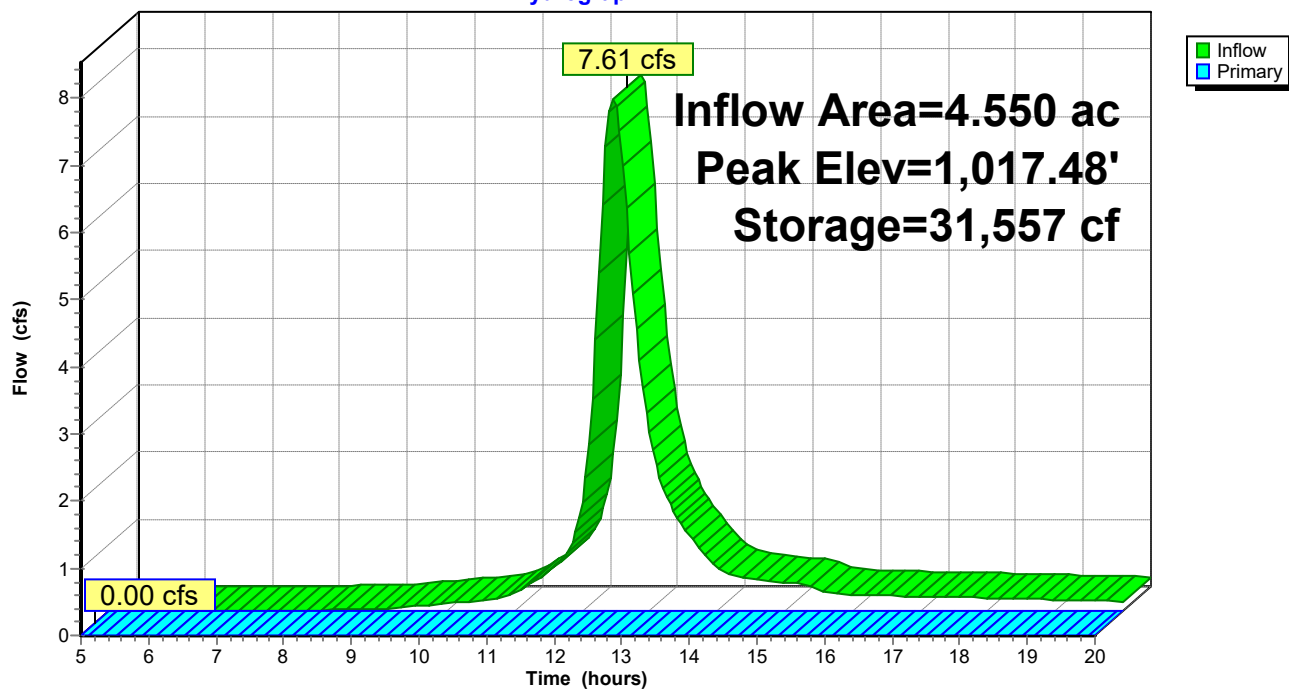
Device	Routing	Invert	Outlet Devices
#1	Primary	1,017.56'	75.0' long + 100.0 ' /' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,016.00' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: NE Wetland

Hydrograph



Summary for Pond 7P: NW Wetland

Inflow Area = 6.650 ac, 0.00% Impervious, Inflow Depth > 0.60" for 2-Year event
 Inflow = 3.59 cfs @ 12.44 hrs, Volume= 0.335 af
 Outflow = 3.48 cfs @ 12.51 hrs, Volume= 0.303 af, Atten= 3%, Lag= 3.9 min
 Primary = 3.48 cfs @ 12.51 hrs, Volume= 0.303 af
 Routed to Reach 8R : W Trail Berm

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,017.23' @ 12.51 hrs Surf.Area= 20,885 sf Storage= 2,362 cf

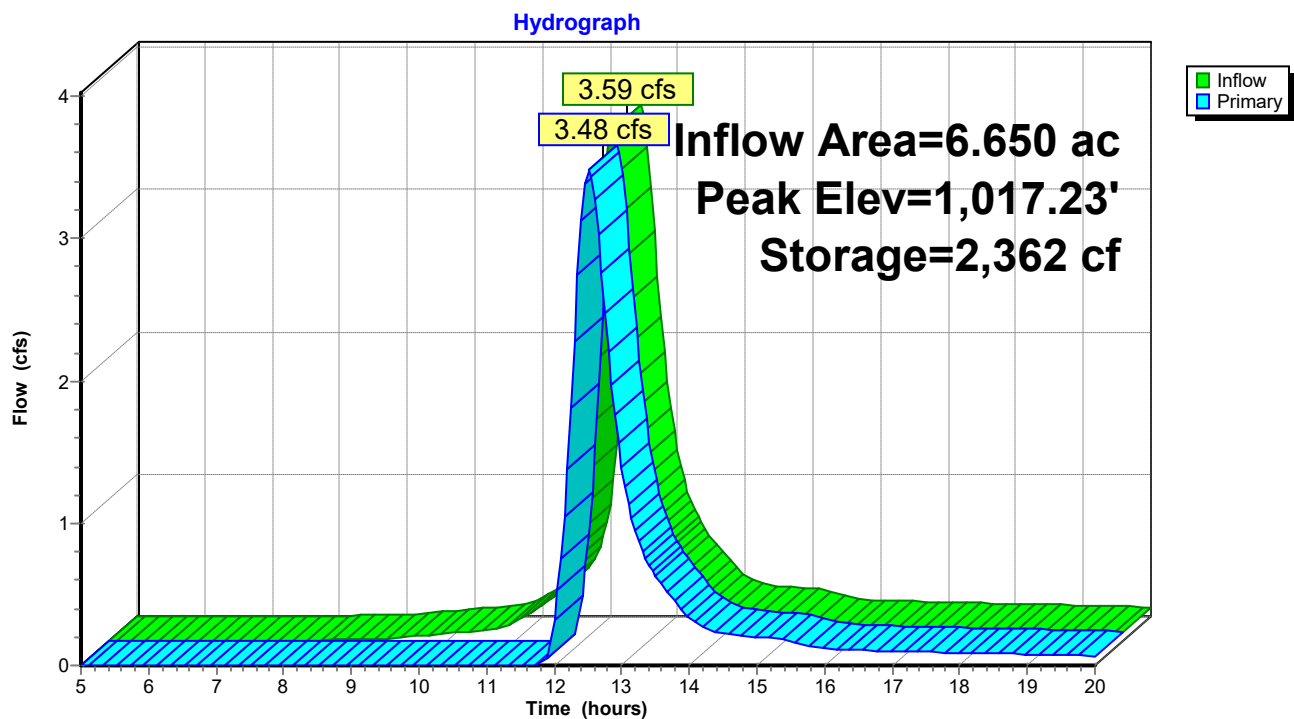
Plug-Flow detention time= 45.5 min calculated for 0.302 af (90% of inflow)
 Center-of-Mass det. time= 18.3 min (808.8 - 790.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,017.00'	46,162 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,017.00	0	0	0
1,018.00	92,324	46,162	46,162

Device	Routing	Invert	Outlet Devices
#1	Primary	1,017.17'	100.0' long + 100.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=3.46 cfs @ 12.51 hrs HW=1,017.23' (Free Discharge)
 ↑1=Broad-Crested Rectangular Weir (Weir Controls 3.46 cfs @ 0.58 fps)

Pond 7P: NW Wetland

Summary for Pond 10P: Trail Culvert Basin

Inflow Area = 15.930 ac, 0.00% Impervious, Inflow Depth > 1.15" for 2-Year event
 Inflow = 14.64 cfs @ 12.43 hrs, Volume= 1.522 af
 Outflow = 9.68 cfs @ 12.77 hrs, Volume= 1.520 af, Atten= 34%, Lag= 20.9 min
 Primary = 4.03 cfs @ 12.77 hrs, Volume= 1.323 af
 Routed to Pond 12P : CSAH 12 E Ditch
 Secondary = 5.65 cfs @ 12.77 hrs, Volume= 0.197 af
 Routed to Pond 12P : CSAH 12 E Ditch

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,014.61' @ 12.77 hrs Surf.Area= 23,929 sf Storage= 18,489 cf

Plug-Flow detention time= 34.2 min calculated for 1.520 af (100% of inflow)
 Center-of-Mass det. time= 33.7 min (829.6 - 795.9)

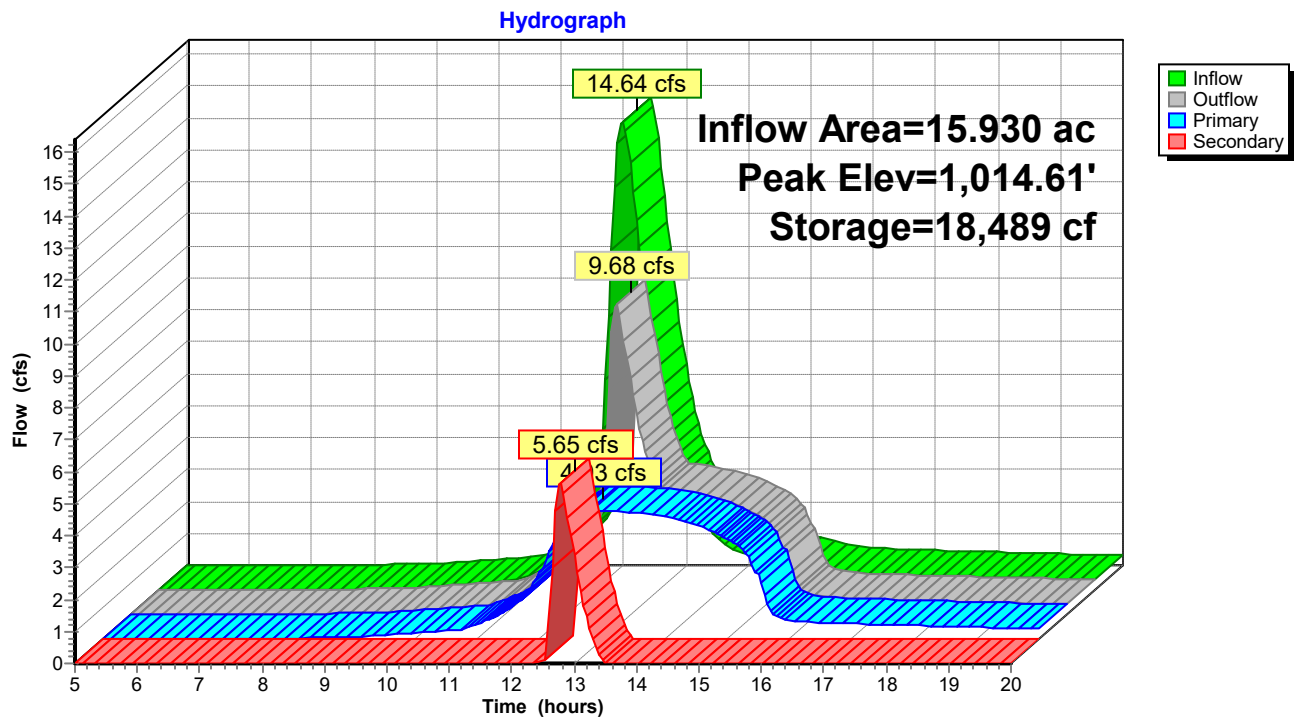
Volume	Invert	Avail.Storage	Storage Description
#1	1,011.30'	29,601 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,011.30	0	0	0
1,013.00	1,763	1,499	1,499
1,014.00	11,053	6,408	7,907
1,015.00	32,336	21,695	29,601

Device	Routing	Invert	Outlet Devices
#1	Primary	1,011.30'	12.0" Round Culvert L= 42.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,011.30' / 1,011.00' S= 0.0071 ' / ' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Secondary	1,014.50'	50.0' long + 100.0 ' /' SideZ x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=4.03 cfs @ 12.77 hrs HW=1,014.60' (Free Discharge)
 ↑1=Culvert (Barrel Controls 4.03 cfs @ 5.13 fps)

Secondary OutFlow Max=5.47 cfs @ 12.77 hrs HW=1,014.60' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 5.47 cfs @ 0.87 fps)

Pond 10P: Trail Culvert Basin

Summary for Pond 12P: CSAH 12 E Ditch

Inflow Area = 20.530 ac, 11.20% Impervious, Inflow Depth > 1.36" for 2-Year event
 Inflow = 17.83 cfs @ 12.17 hrs, Volume= 2.326 af
 Outflow = 8.60 cfs @ 13.01 hrs, Volume= 2.312 af, Atten= 52%, Lag= 50.6 min
 Primary = 8.60 cfs @ 13.01 hrs, Volume= 2.312 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,011.42' @ 13.01 hrs Surf.Area= 21,148 sf Storage= 16,510 cf

Plug-Flow detention time= 27.1 min calculated for 2.304 af (99% of inflow)
 Center-of-Mass det. time= 24.8 min (832.3 - 807.5)

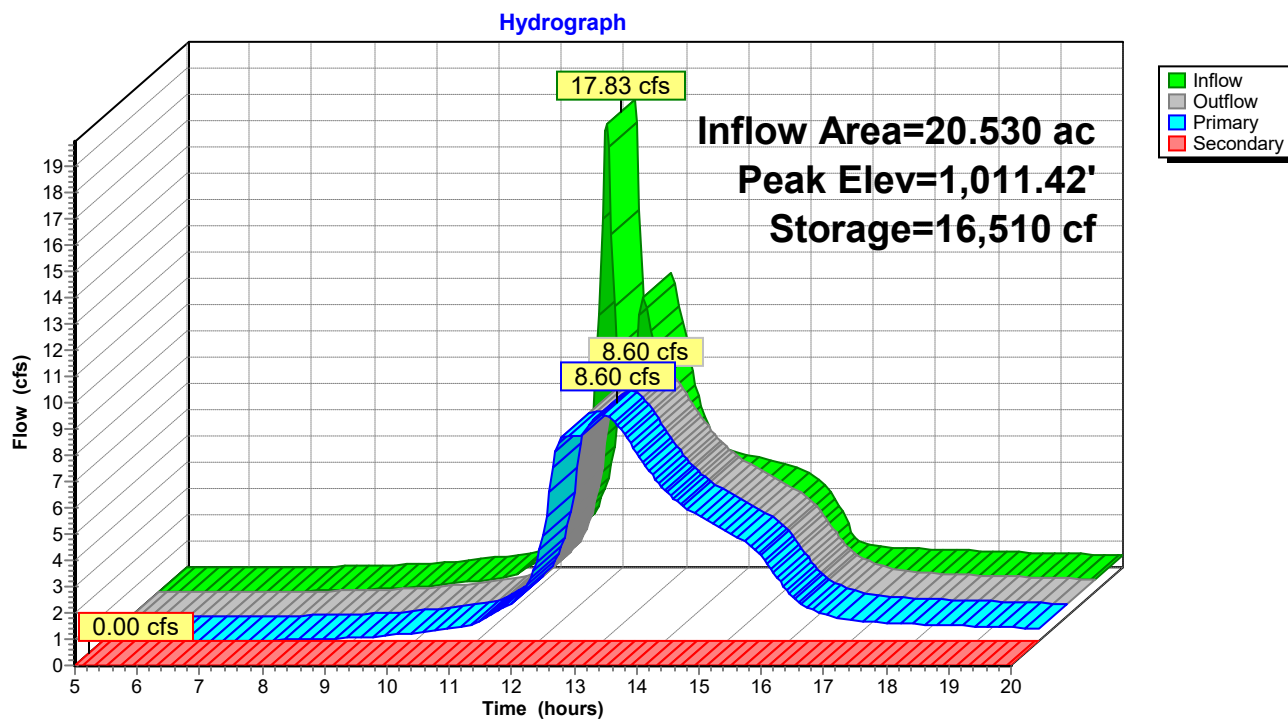
Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	152,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	0	0	0
1,011.00	17,095	8,548	8,548
1,012.00	26,827	21,961	30,509
1,013.00	37,445	32,136	62,645
1,014.00	38,000	37,723	100,367
1,015.00	66,462	52,231	152,598

Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	28.0" W x 18.0" H, R=14.7"/40.7" Pipe Arch Culvert L= 148.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.60' S= 0.0027 ' /' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 2.76 sf
#2	Secondary	1,013.70'	10.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=8.60 cfs @ 13.01 hrs HW=1,011.42' (Free Discharge)
 ↑1=Culvert (Barrel Controls 8.60 cfs @ 3.93 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,010.00' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 12P: CSAH 12 E Ditch

Summary for Pond 23P: Metcon Addn Pond

Inflow Area = 15.030 ac, 70.28% Impervious, Inflow Depth > 2.10" for 2-Year event
 Inflow = 51.90 cfs @ 12.15 hrs, Volume= 2.633 af
 Outflow = 6.45 cfs @ 12.62 hrs, Volume= 2.118 af, Atten= 88%, Lag= 28.4 min
 Primary = 6.45 cfs @ 12.62 hrs, Volume= 2.118 af
 Routed to Pond 27P : CSAH 12 E Ditch

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,012.32' @ 12.62 hrs Surf.Area= 56,574 sf Storage= 68,509 cf

Plug-Flow detention time= 164.7 min calculated for 2.118 af (80% of inflow)
 Center-of-Mass det. time= 121.1 min (885.7 - 764.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,011.00'	325,258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

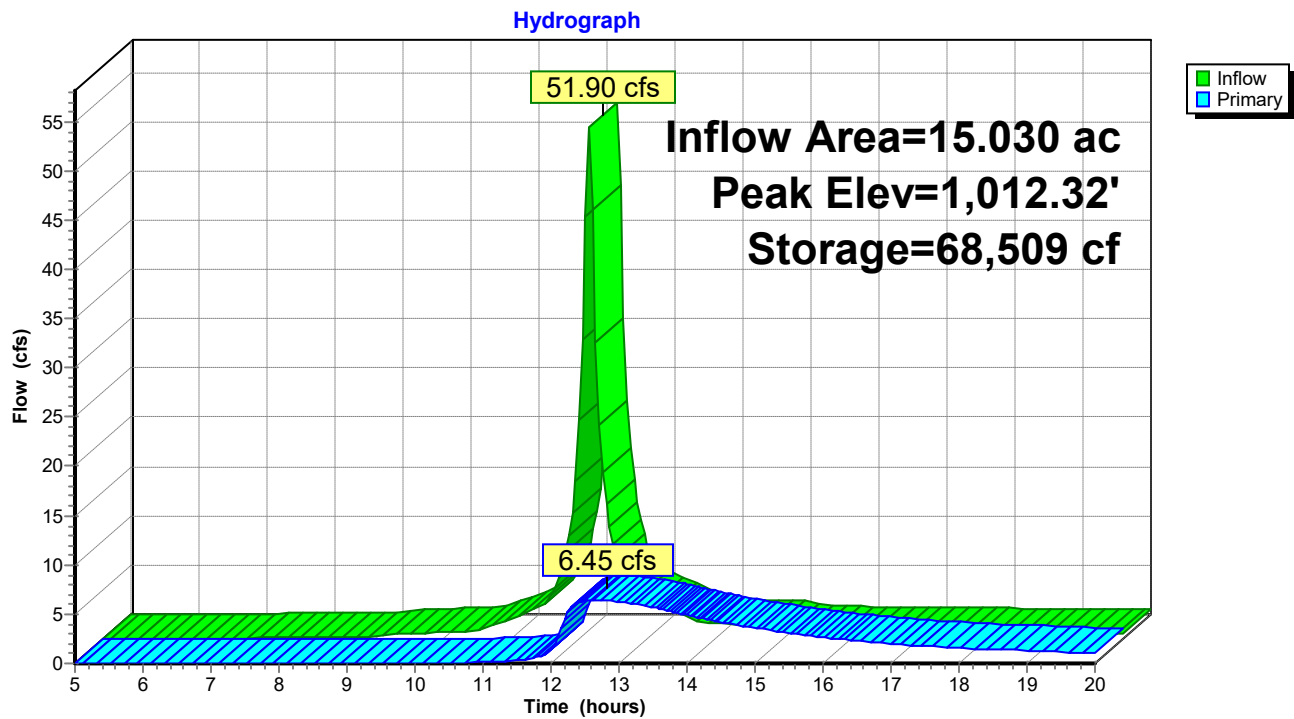
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,011.00	47,057	0	0
1,016.00	83,046	325,258	325,258

Device	Routing	Invert	Outlet Devices
#1	Primary	1,011.00'	18.0" Round Culvert L= 100.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,011.00' / 1,010.00' S= 0.0100 ' / ' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	1,008.00'	18.0" Round Culvert L= 30.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,008.00' / 1,008.00' S= 0.0000 ' / ' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=6.45 cfs @ 12.62 hrs HW=1,012.32' (Free Discharge)

↑ **1=Culvert** (Inlet Controls 6.45 cfs @ 3.91 fps)

↑ **2=Culvert** (Passes 6.45 cfs of 9.78 cfs potential flow)

Pond 23P: Metcon Addn Pond

Summary for Pond 25P: Trail Culvert Basin

Inflow Area = 0.900 ac, 0.00% Impervious, Inflow Depth > 1.13" for 2-Year event
 Inflow = 2.25 cfs @ 12.05 hrs, Volume= 0.085 af
 Outflow = 1.54 cfs @ 12.11 hrs, Volume= 0.085 af, Atten= 32%, Lag= 3.3 min
 Primary = 1.54 cfs @ 12.11 hrs, Volume= 0.085 af
 Routed to Pond 27P : CSAH 12 E Ditch
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Routed to Pond 27P : CSAH 12 E Ditch

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,012.26' @ 12.11 hrs Surf.Area= 993 sf Storage= 476 cf

Plug-Flow detention time= 4.5 min calculated for 0.085 af (100% of inflow)
 Center-of-Mass det. time= 3.9 min (792.4 - 788.4)

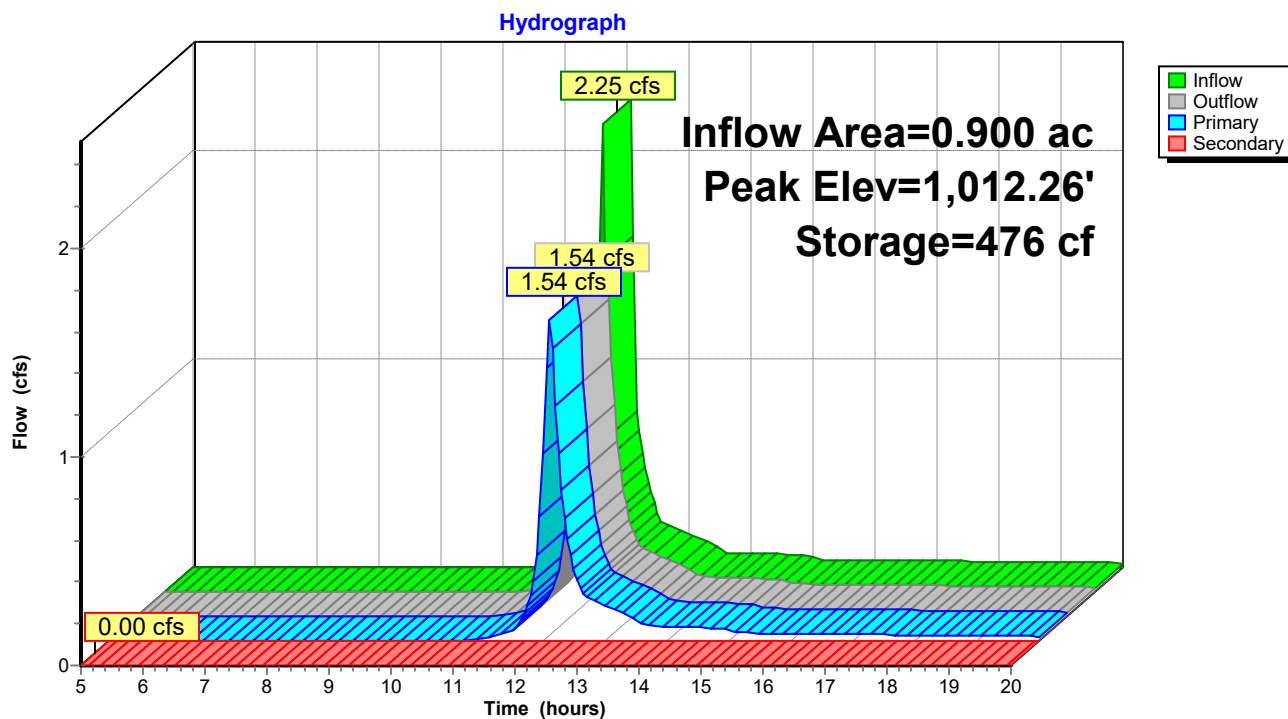
Volume	Invert	Avail.Storage	Storage Description
#1	1,011.30'	12,717 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,011.30	0	0	0
1,013.00	1,763	1,499	1,499
1,014.00	5,033	3,398	4,897
1,015.00	10,608	7,821	12,717

Device	Routing	Invert	Outlet Devices
#1	Primary	1,011.30'	12.0" Round Culvert L= 42.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,011.30' / 1,011.00' S= 0.0071 ' / ' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Secondary	1,014.50'	50.0' long + 100.0 ' /' SideZ x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=1.52 cfs @ 12.11 hrs HW=1,012.25' (Free Discharge)
 ↑1=Culvert (Barrel Controls 1.52 cfs @ 2.54 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,011.30' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 25P: Trail Culvert Basin

Summary for Pond 27P: CSAH 12 E Ditch

Inflow Area = 20.530 ac, 62.65% Impervious, Inflow Depth > 1.76" for 2-Year event
 Inflow = 20.20 cfs @ 12.17 hrs, Volume= 3.009 af
 Outflow = 8.94 cfs @ 12.61 hrs, Volume= 2.970 af, Atten= 56%, Lag= 26.1 min
 Primary = 8.94 cfs @ 12.61 hrs, Volume= 2.970 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,011.46' @ 12.61 hrs Surf.Area= 21,602 sf Storage= 17,509 cf

Plug-Flow detention time= 27.3 min calculated for 2.970 af (99% of inflow)
 Center-of-Mass det. time= 22.9 min (873.8 - 850.9)

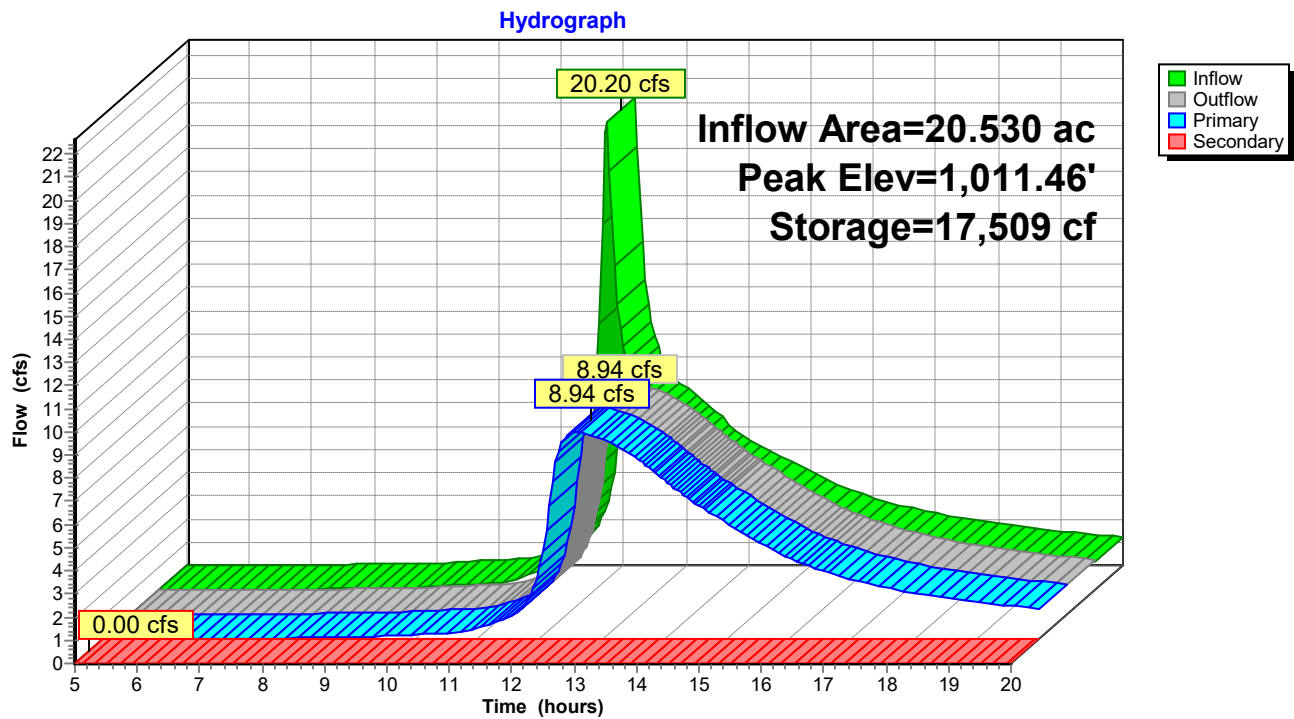
Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	152,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	0	0	0
1,011.00	17,095	8,548	8,548
1,012.00	26,827	21,961	30,509
1,013.00	37,445	32,136	62,645
1,014.00	38,000	37,723	100,367
1,015.00	66,462	52,231	152,598

Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	28.0" W x 18.0" H, R=14.7"/40.7" Pipe Arch Culvert L= 148.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.60' S= 0.0027 ' /' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 2.76 sf
#2	Secondary	1,013.70'	10.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=8.94 cfs @ 12.61 hrs HW=1,011.46' (Free Discharge)
 ↑1=Culvert (Barrel Controls 8.94 cfs @ 3.97 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,010.00' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 27P: CSAH 12 E Ditch

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MSE 24-hr 3 10-Year Rainfall=4.38"

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Summary for Subcatchment 1S: SE Wetland WS

Runoff = 4.92 cfs @ 12.39 hrs, Volume= 0.437 af, Depth> 3.25"
 Routed to Pond 2P : SE Wetland

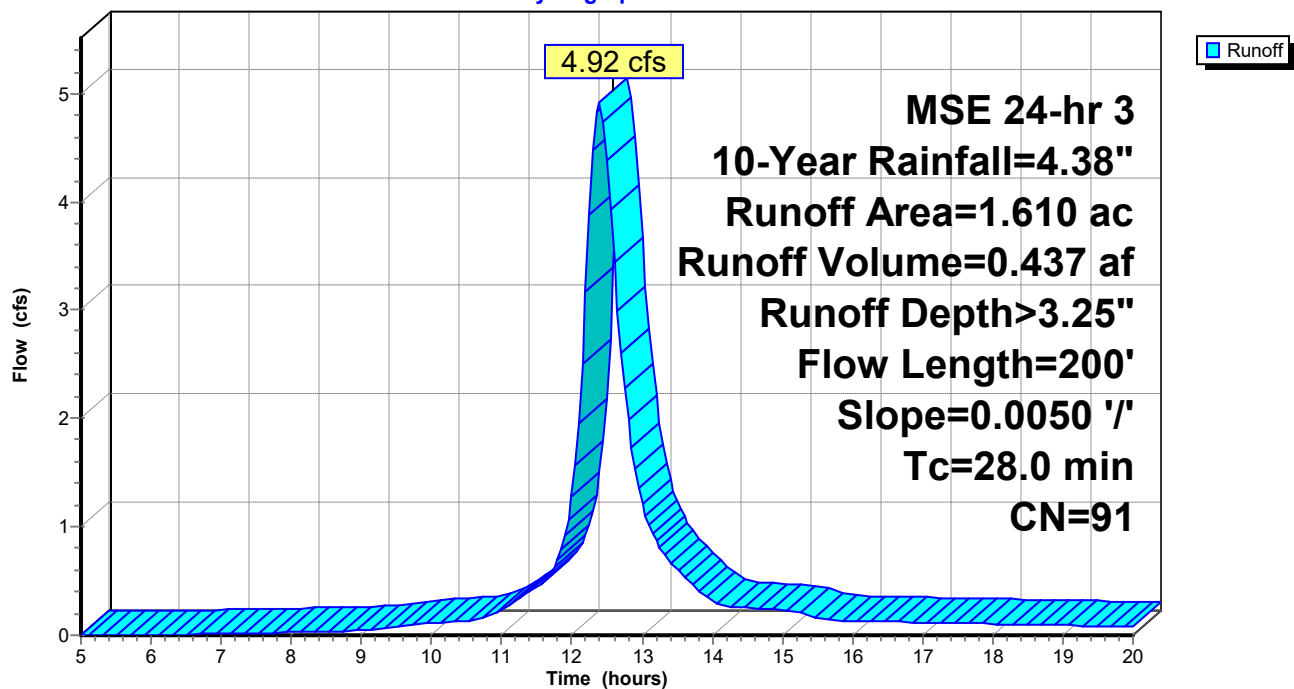
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.38"

Area (ac)	CN	Description
1.610	91	Row crops, straight row, Poor, HSG D
1.610		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	200	0.0050	0.12		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 4.40"

Subcatchment 1S: SE Wetland WS

Hydrograph



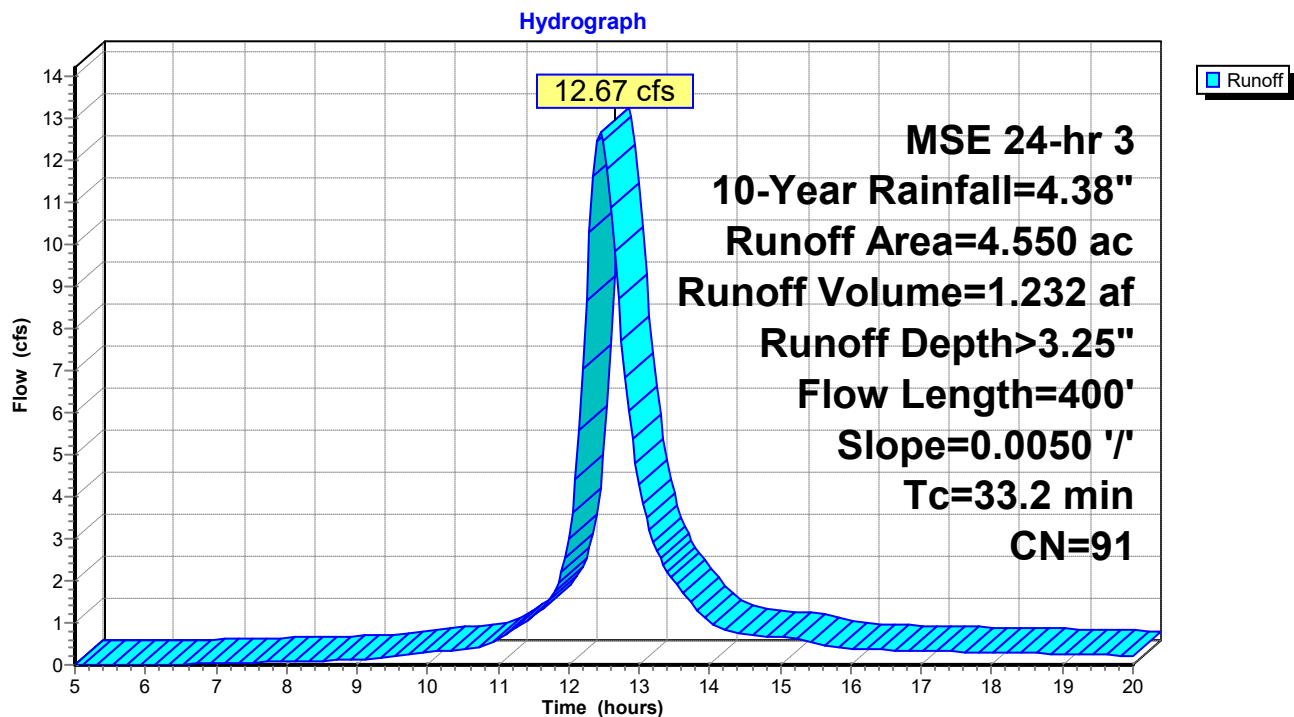
Summary for Subcatchment 4S: NE Wetland WS

Runoff = 12.67 cfs @ 12.45 hrs, Volume= 1.232 af, Depth> 3.25"
 Routed to Pond 5P : NE Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.38"

Area (ac)	CN	Description
4.190	91	Row crops, straight row, Poor, HSG D
0.360	86	Farmsteads, HSG D
4.550	91	Weighted Average
4.550		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	200	0.0050	0.12		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 4.40"
5.2	200	0.0050	0.64		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
33.2	400	Total			

Subcatchment 4S: NE Wetland WS

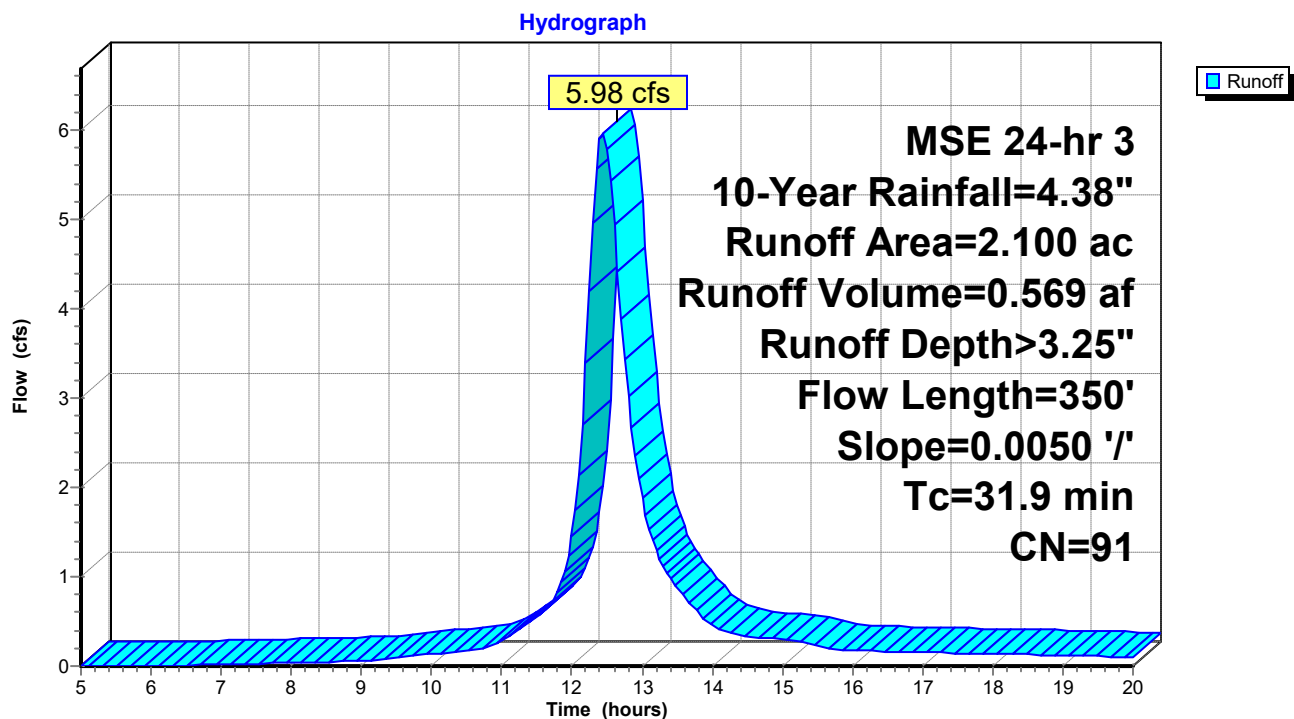
Summary for Subcatchment 6S: NW Wetland WS

Runoff = 5.98 cfs @ 12.44 hrs, Volume= 0.569 af, Depth> 3.25"
 Routed to Pond 7P : NW Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.38"

Area (ac)	CN	Description
2.100	91	Row crops, straight row, Poor, HSG D
2.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	200	0.0050	0.12		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 4.40"
3.9	150	0.0050	0.64		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
31.9	350	Total			

Subcatchment 6S: NW Wetland WS

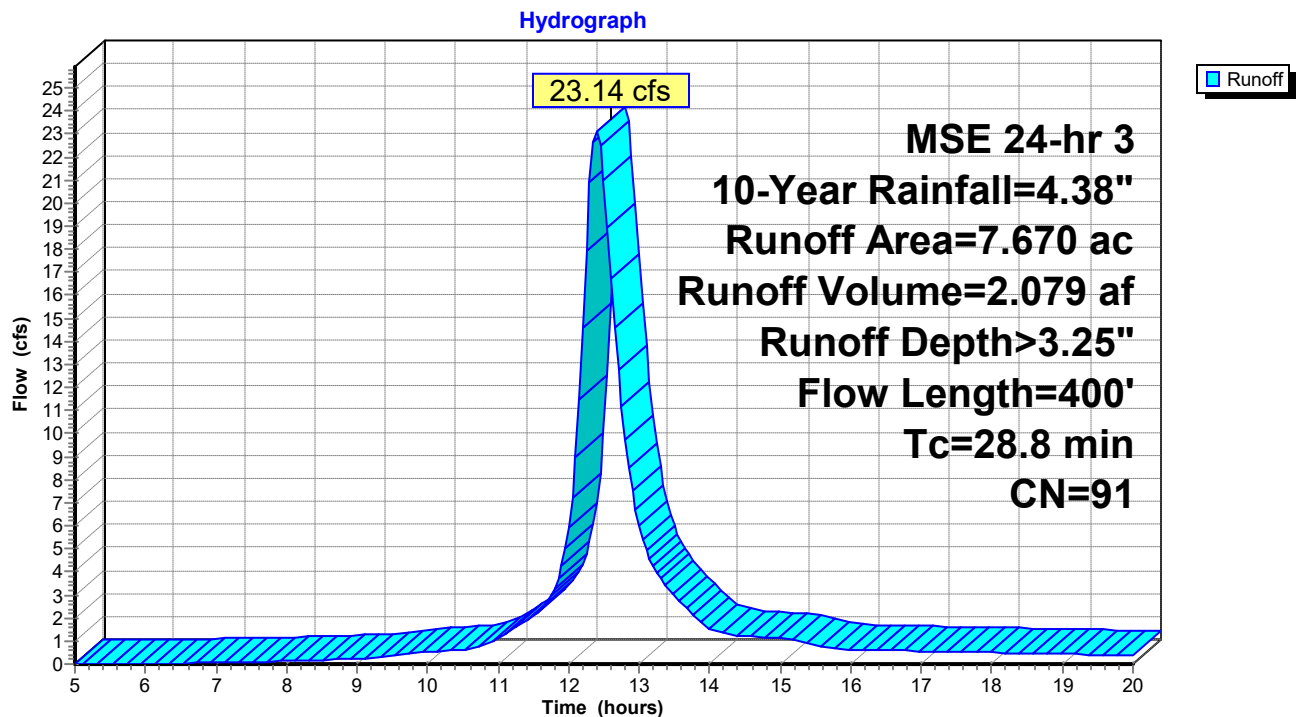
Summary for Subcatchment 9S: Trail Berm WS

Runoff = 23.14 cfs @ 12.40 hrs, Volume= 2.079 af, Depth> 3.25"
 Routed to Pond 10P : Trail Culvert Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.38"

Area (ac)	CN	Description
7.670	91	Row crops, straight row, Poor, HSG D
7.670		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	200	0.0050	0.27		Sheet Flow, Cultivated: Residue<=20% n= 0.060 P2= 4.40"
16.6	200	0.0005	0.20		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
28.8	400	Total			

Subcatchment 9S: Trail Berm WS

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MSE 24-hr 3 10-Year Rainfall=4.38"

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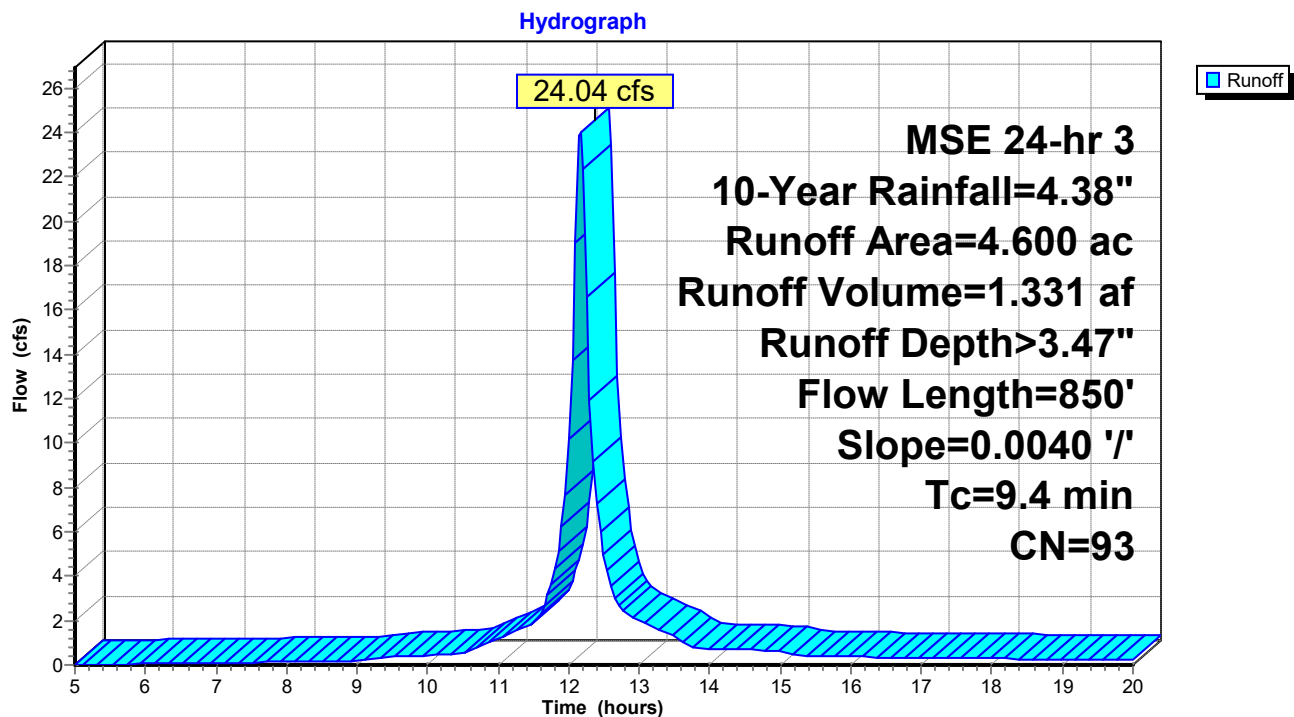
Summary for Subcatchment 11S: CSAH 12 East

Runoff = 24.04 cfs @ 12.16 hrs, Volume= 1.331 af, Depth> 3.47"
 Routed to Pond 12P : CSAH 12 E Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.38"

Area (ac)	CN	Description
4.600	93	Paved roads w/open ditches, 50% imp, HSG D
2.300		50.00% Pervious Area
2.300		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
2.4	450	0.0040	3.12	100.00	Trap/Vee/Rect Channel Flow, Bot.W=7.00' D=2.00' Z= 6.0 & 3.0 ' Top.W=25.00' n= 0.035 Earth, dense weeds
9.4	850	Total			

Subcatchment 11S: CSAH 12 East

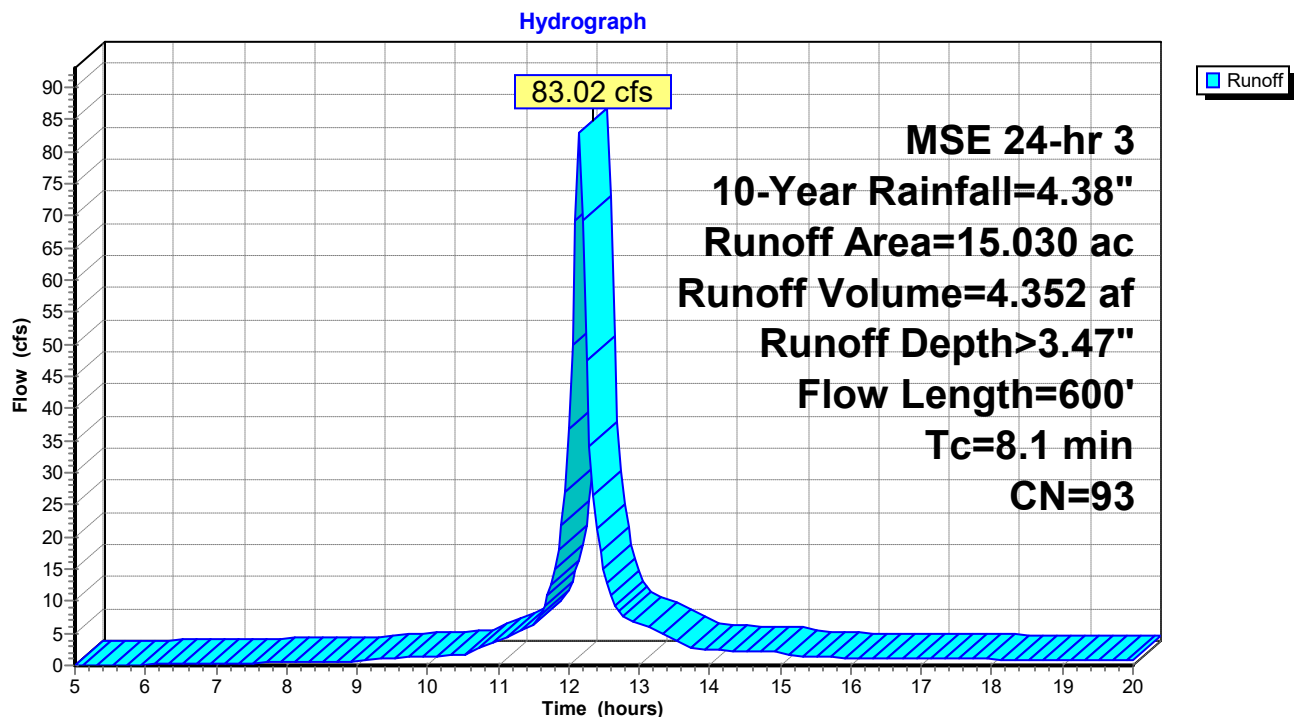
Summary for Subcatchment 22S: Des WS

Runoff = 83.02 cfs @ 12.15 hrs, Volume= 4.352 af, Depth> 3.47"
 Routed to Pond 23P : Metcon Addn Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.38"

Area (ac)	CN	Description
14.670	93	Urban industrial, 72% imp, HSG D
0.360	86	Farmsteads, HSG D
15.030	93	Weighted Average
4.468		29.72% Pervious Area
10.562		70.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	200	0.0200	1.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 4.40"
6.3	400	0.0050	1.06		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
8.1	600	Total			

Subcatchment 22S: Des WS

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MSE 24-hr 3 10-Year Rainfall=4.38"

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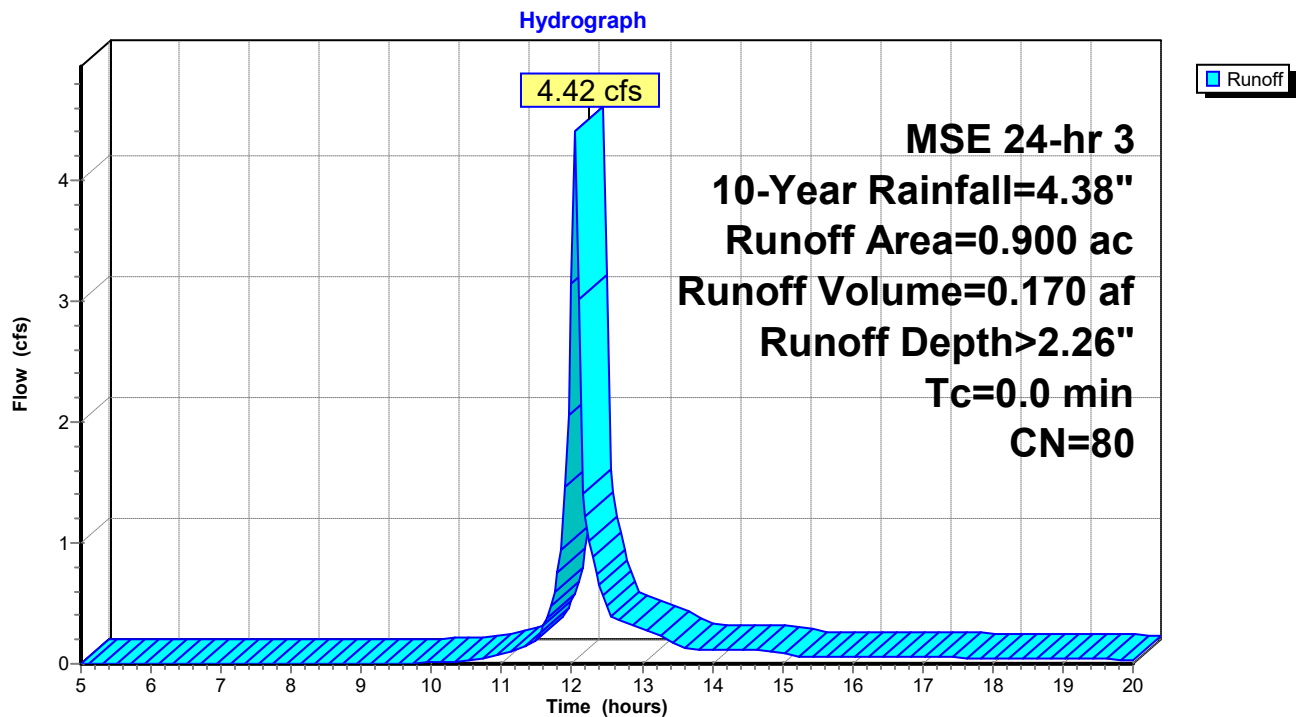
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Summary for Subcatchment 24S: Trail Berm WS

Runoff = 4.42 cfs @ 12.05 hrs, Volume= 0.170 af, Depth> 2.26"
Routed to Pond 25P : Trail Culvert Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.38"

Area (ac)	CN	Description
0.900	80	>75% Grass cover, Good, HSG D
0.900		100.00% Pervious Area

Subcatchment 24S: Trail Berm WS

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MSE 24-hr 3 10-Year Rainfall=4.38"

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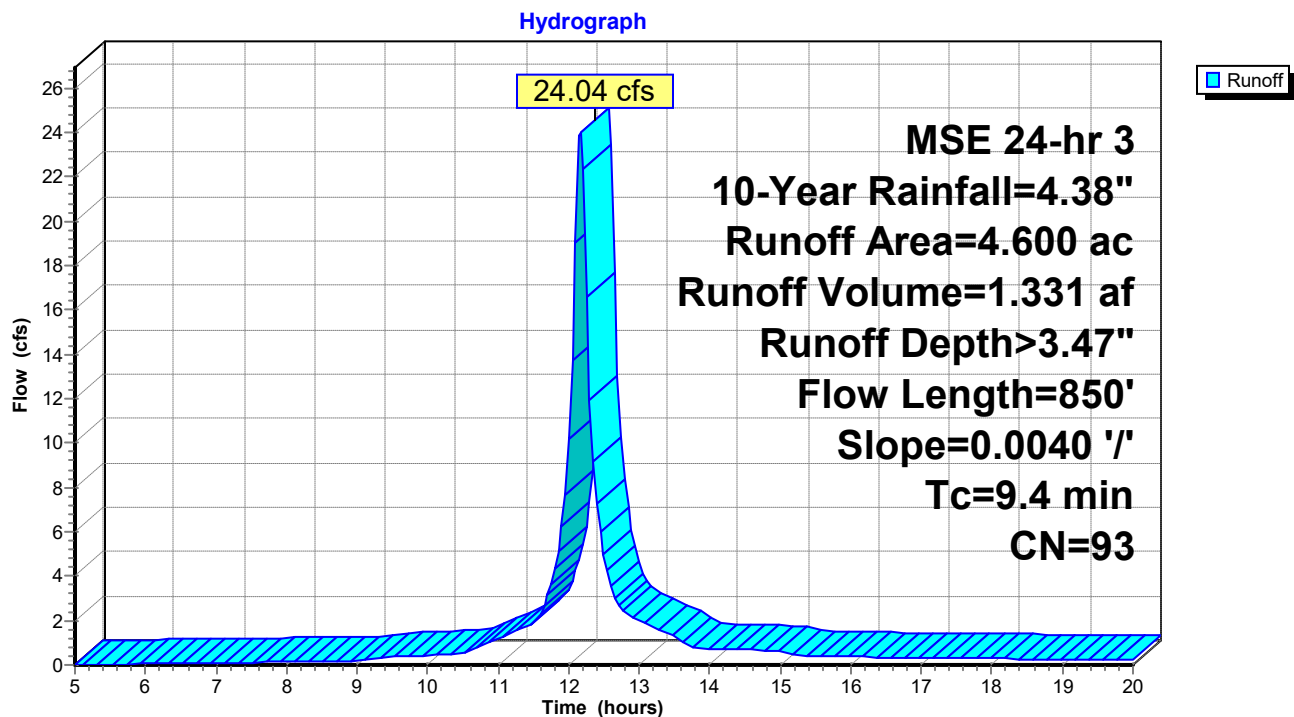
Summary for Subcatchment 26S: CSAH 12 East

Runoff = 24.04 cfs @ 12.16 hrs, Volume= 1.331 af, Depth> 3.47"
 Routed to Pond 27P : CSAH 12 E Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.38"

Area (ac)	CN	Description
4.600	93	Paved roads w/open ditches, 50% imp, HSG D
2.300		50.00% Pervious Area
2.300		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
2.4	450	0.0040	3.12	100.00	Trap/Vee/Rect Channel Flow, Bot.W=7.00' D=2.00' Z= 6.0 & 3.0 ' Top.W=25.00' n= 0.035 Earth, dense weeds
9.4	850	Total			

Subcatchment 26S: CSAH 12 East

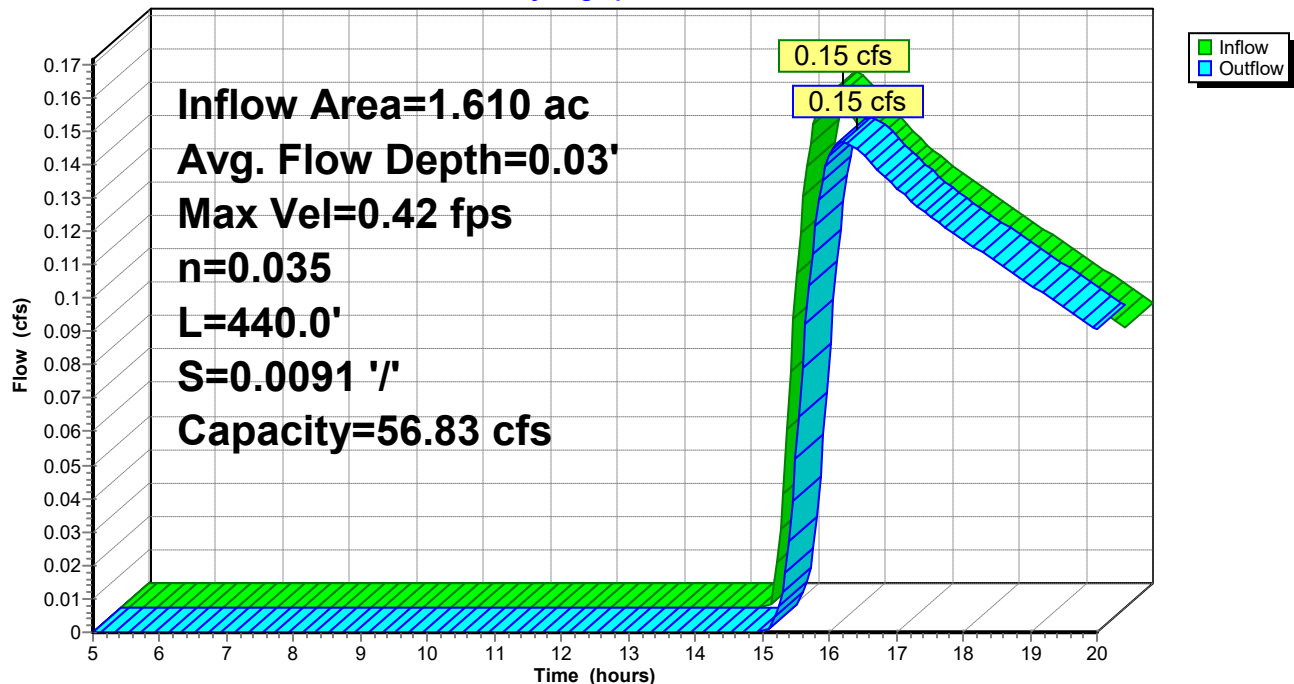
Summary for Reach 3R: S Trail Berm

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth > 0.37" for 10-Year event
 Inflow = 0.15 cfs @ 15.57 hrs, Volume= 0.049 af
 Outflow = 0.15 cfs @ 16.20 hrs, Volume= 0.044 af, Atten= 4%, Lag= 37.9 min
 Routed to Pond 10P : Trail Culvert Basin

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Max. Velocity= 0.42 fps, Min. Travel Time= 17.4 min
 Avg. Velocity= 0.37 fps, Avg. Travel Time= 20.0 min

Peak Storage= 153 cf @ 15.91 hrs
 Average Depth at Peak Storage= 0.03' , Surface Width= 10.54'
 Bank-Full Depth= 1.00' Flow Area= 18.0 sf, Capacity= 56.83 cfs

10.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 6.0 10.0 ' ' Top Width= 26.00'
 Length= 440.0' Slope= 0.0091 ' /'
 Inlet Invert= 1,016.00', Outlet Invert= 1,012.00'

**Reach 3R: S Trail Berm****Hydrograph**

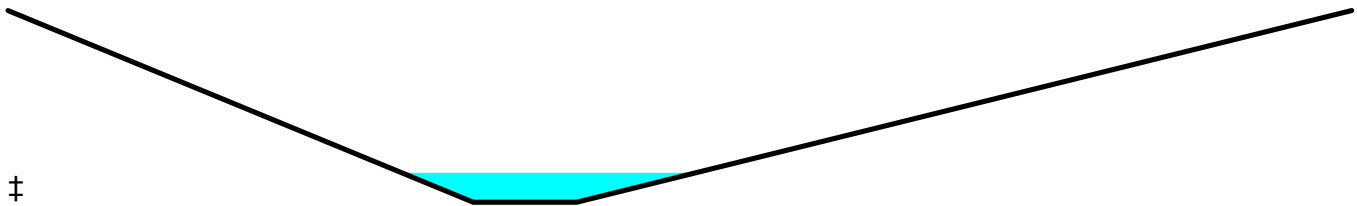
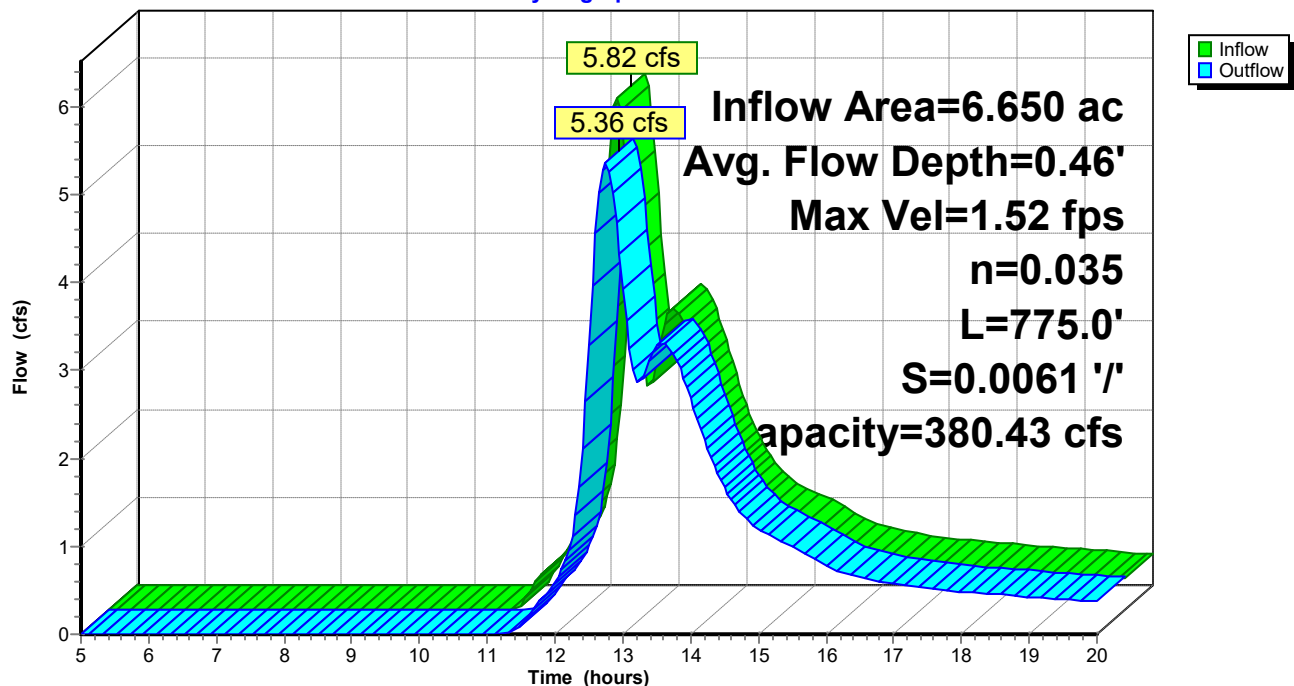
Summary for Reach 8R: W Trail Berm

Inflow Area = 6.650 ac, 0.00% Impervious, Inflow Depth > 1.69" for 10-Year event
 Inflow = 5.82 cfs @ 12.50 hrs, Volume= 0.937 af
 Outflow = 5.36 cfs @ 12.75 hrs, Volume= 0.923 af, Atten= 8%, Lag= 14.9 min
 Routed to Pond 10P : Trail Culvert Basin

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Max. Velocity= 1.52 fps, Min. Travel Time= 8.5 min
 Avg. Velocity= 0.91 fps, Avg. Travel Time= 14.2 min

Peak Storage= 2,749 cf @ 12.60 hrs
 Average Depth at Peak Storage= 0.46' , Surface Width= 11.38'
 Bank-Full Depth= 3.00' Flow Area= 84.0 sf, Capacity= 380.43 cfs

4.00' x 3.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 6.0 10.0 '/' Top Width= 52.00'
 Length= 775.0' Slope= 0.0061 '/'
 Inlet Invert= 1,016.70', Outlet Invert= 1,012.00'

**Reach 8R: W Trail Berm****Hydrograph**

Summary for Pond 2P: SE Wetland

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth > 3.25" for 10-Year event
 Inflow = 4.92 cfs @ 12.39 hrs, Volume= 0.437 af
 Outflow = 0.15 cfs @ 15.57 hrs, Volume= 0.049 af, Atten= 97%, Lag= 191.0 min
 Primary = 0.15 cfs @ 15.57 hrs, Volume= 0.049 af
 Routed to Reach 3R : S Trail Berm

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,017.91' @ 15.57 hrs Surf.Area= 51,771 sf Storage= 16,998 cf

Plug-Flow detention time= 397.6 min calculated for 0.049 af (11% of inflow)
 Center-of-Mass det. time= 257.7 min (1,035.9 - 778.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,017.25'	22,174 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

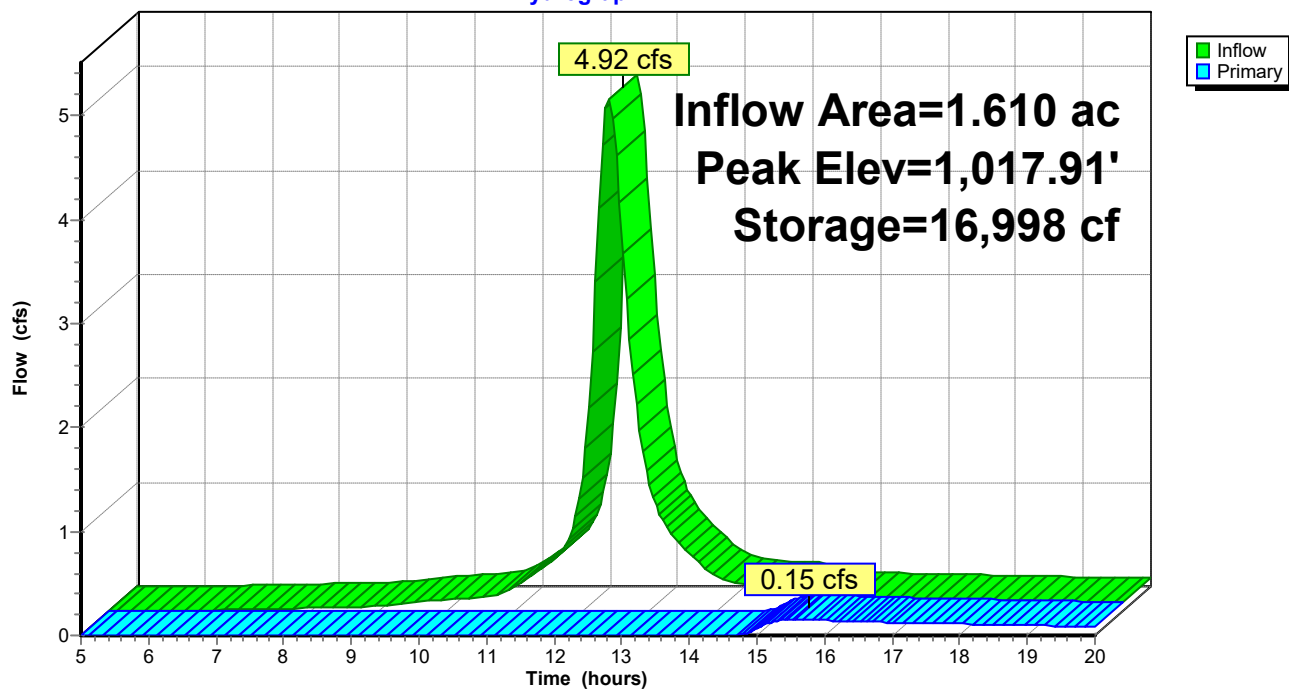
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,017.25	0	0	0
1,018.00	59,130	22,174	22,174

Device	Routing	Invert	Outlet Devices
#1	Primary	1,017.90'	100.0' long + 100.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.14 cfs @ 15.57 hrs HW=1,017.91' (Free Discharge)
 ↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 0.14 cfs @ 0.20 fps)

Pond 2P: SE Wetland

Hydrograph



Summary for Pond 5P: NE Wetland

Inflow Area = 4.550 ac, 0.00% Impervious, Inflow Depth > 3.25" for 10-Year event
 Inflow = 12.67 cfs @ 12.45 hrs, Volume= 1.232 af
 Outflow = 2.36 cfs @ 13.36 hrs, Volume= 0.404 af, Atten= 81%, Lag= 54.3 min
 Primary = 2.36 cfs @ 13.36 hrs, Volume= 0.404 af
 Routed to Pond 7P : NW Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,017.61' @ 13.36 hrs Surf.Area= 58,140 sf Storage= 38,528 cf

Plug-Flow detention time= 204.5 min calculated for 0.404 af (33% of inflow)
 Center-of-Mass det. time= 123.8 min (906.3 - 782.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,016.00'	65,093 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,016.00	0	0	0
1,017.00	25,742	12,871	12,871
1,018.00	78,702	52,222	65,093

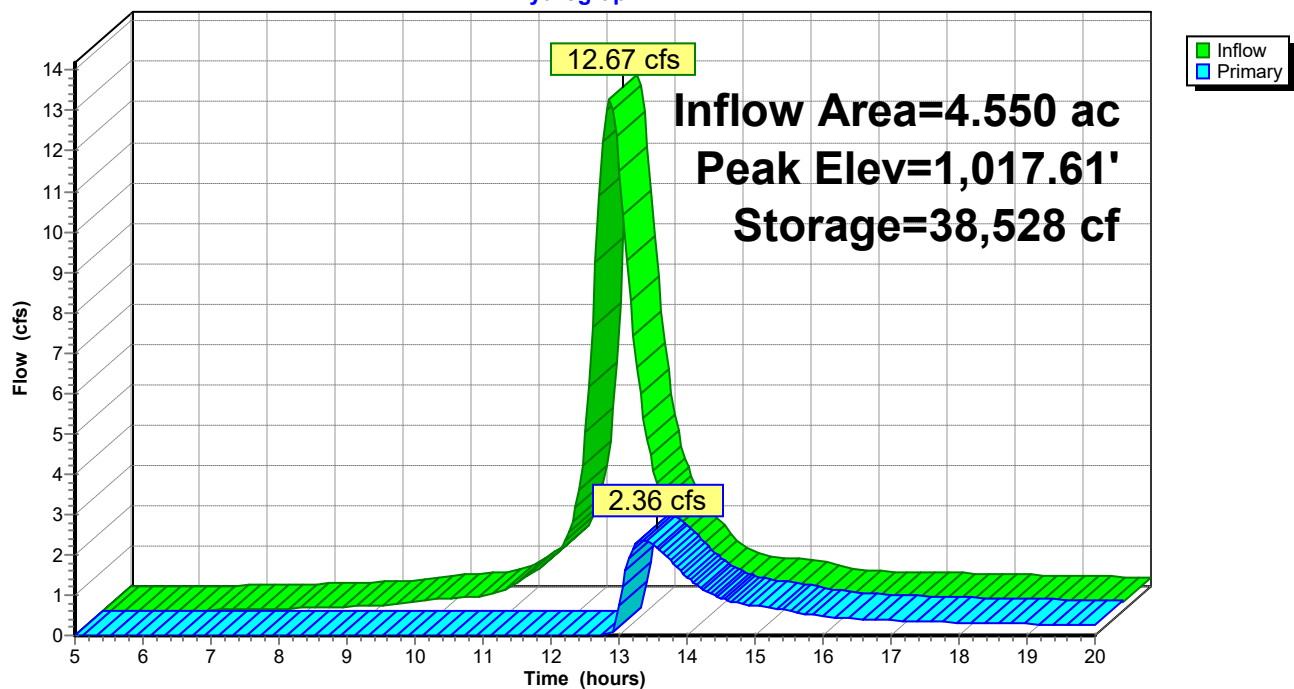
Device	Routing	Invert	Outlet Devices
#1	Primary	1,017.56'	75.0' long + 100.0 ' /' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.32 cfs @ 13.36 hrs HW=1,017.61' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 2.32 cfs @ 0.56 fps)

Pond 5P: NE Wetland

Hydrograph



Summary for Pond 7P: NW Wetland

Inflow Area = 6.650 ac, 0.00% Impervious, Inflow Depth > 1.75" for 10-Year event
 Inflow = 5.98 cfs @ 12.44 hrs, Volume= 0.972 af
 Outflow = 5.82 cfs @ 12.50 hrs, Volume= 0.937 af, Atten= 3%, Lag= 3.5 min
 Primary = 5.82 cfs @ 12.50 hrs, Volume= 0.937 af
 Routed to Reach 8R : W Trail Berm

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,017.25' @ 12.50 hrs Surf.Area= 22,937 sf Storage= 2,849 cf

Plug-Flow detention time= 24.4 min calculated for 0.937 af (96% of inflow)
 Center-of-Mass det. time= 12.3 min (845.5 - 833.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,017.00'	46,162 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

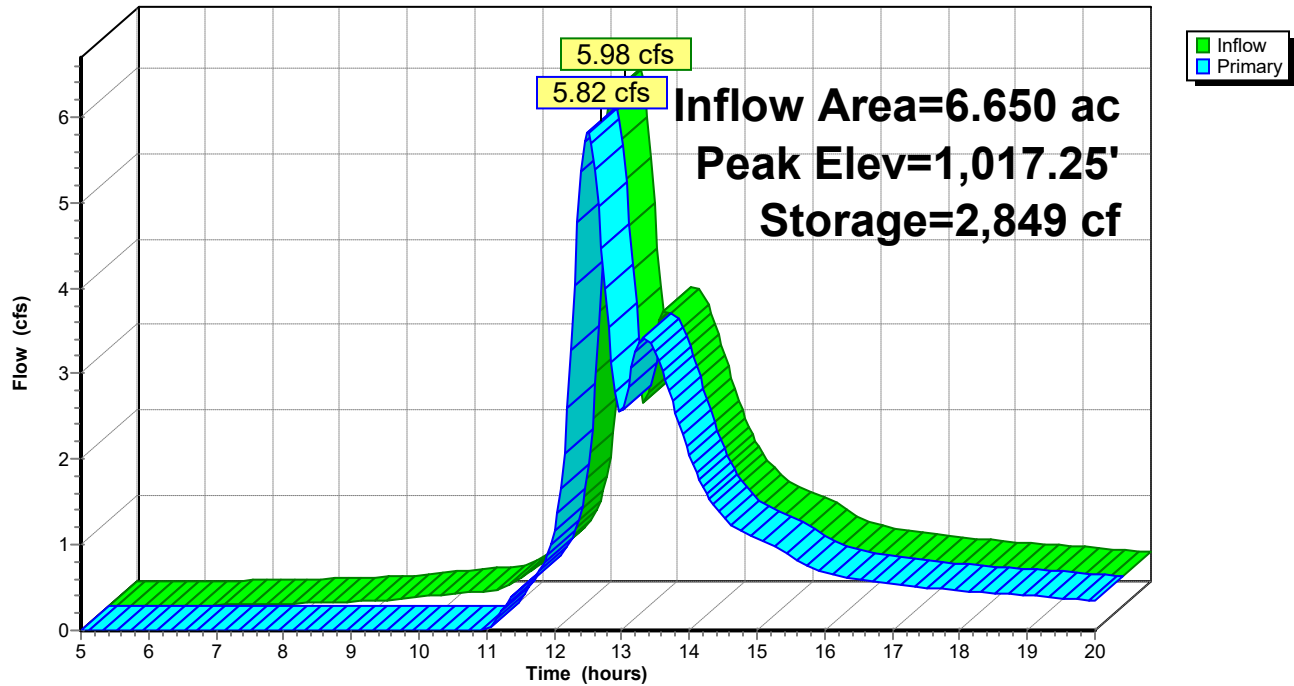
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,017.00	0	0	0
1,018.00	92,324	46,162	46,162

Device	Routing	Invert	Outlet Devices
#1	Primary	1,017.17'	100.0' long + 100.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.81 cfs @ 12.50 hrs HW=1,017.25' (Free Discharge)
 ↑1=**Broad-Crested Rectangular Weir** (Weir Controls 5.81 cfs @ 0.69 fps)

Pond 7P: NW Wetland

Hydrograph



Summary for Pond 10P: Trail Culvert Basin

Inflow Area = 15.930 ac, 0.00% Impervious, Inflow Depth > 2.30" for 10-Year event
 Inflow = 25.33 cfs @ 12.42 hrs, Volume= 3.047 af
 Outflow = 23.98 cfs @ 12.52 hrs, Volume= 3.042 af, Atten= 5%, Lag= 6.2 min
 Primary = 4.12 cfs @ 12.52 hrs, Volume= 2.057 af
 Routed to Pond 12P : CSAH 12 E Ditch
 Secondary = 19.87 cfs @ 12.52 hrs, Volume= 0.985 af
 Routed to Pond 12P : CSAH 12 E Ditch

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,014.72' @ 12.52 hrs Surf.Area= 26,395 sf Storage= 21,404 cf

Plug-Flow detention time= 29.3 min calculated for 3.032 af (99% of inflow)
 Center-of-Mass det. time= 28.6 min (836.3 - 807.7)

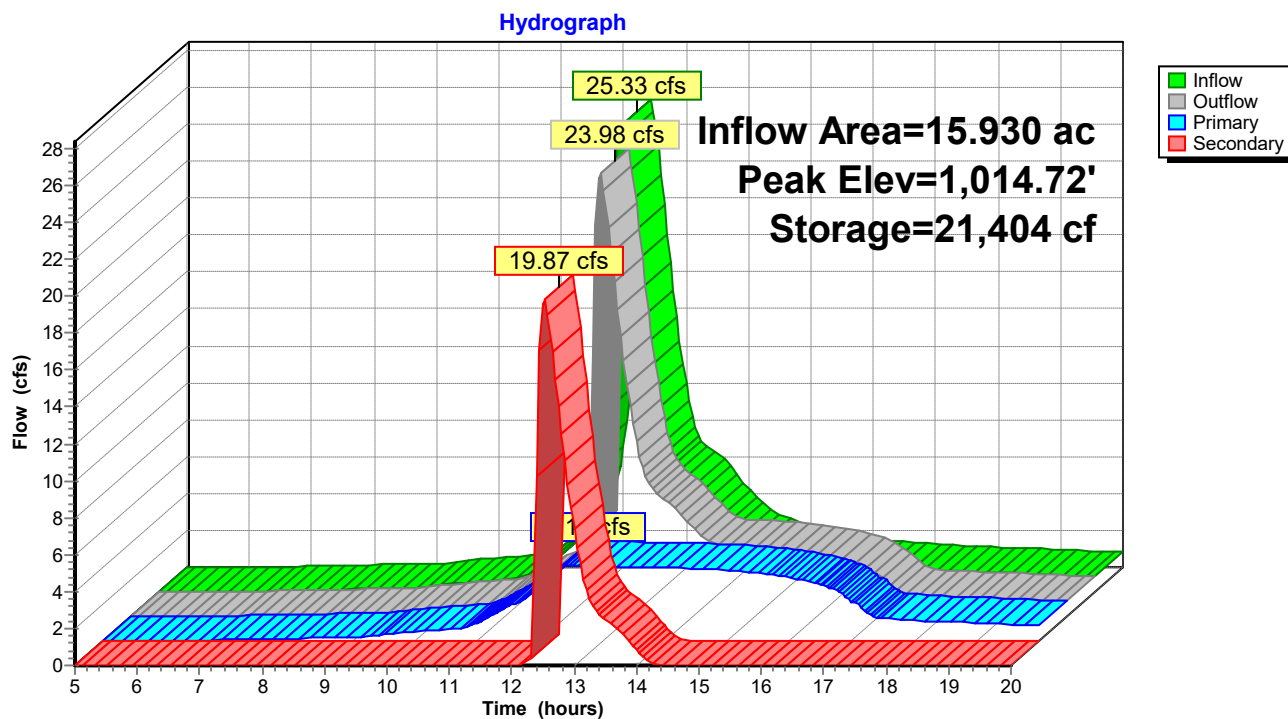
Volume	Invert	Avail.Storage	Storage Description
#1	1,011.30'	29,601 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,011.30	0	0	0
1,013.00	1,763	1,499	1,499
1,014.00	11,053	6,408	7,907
1,015.00	32,336	21,695	29,601

Device	Routing	Invert	Outlet Devices
#1	Primary	1,011.30'	12.0" Round Culvert L= 42.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,011.30' / 1,011.00' S= 0.0071 ' / Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Secondary	1,014.50'	50.0' long + 100.0 ' / SideZ x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=4.12 cfs @ 12.52 hrs HW=1,014.72' (Free Discharge)
 ↑ **1=Culvert** (Barrel Controls 4.12 cfs @ 5.24 fps)

Secondary OutFlow Max=19.43 cfs @ 12.52 hrs HW=1,014.72' (Free Discharge)
 ↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 19.43 cfs @ 1.24 fps)

Pond 10P: Trail Culvert Basin

Summary for Pond 12P: CSAH 12 E Ditch

Inflow Area = 20.530 ac, 11.20% Impervious, Inflow Depth > 2.56" for 10-Year event
 Inflow = 28.72 cfs @ 12.51 hrs, Volume= 4.373 af
 Outflow = 13.68 cfs @ 12.99 hrs, Volume= 4.340 af, Atten= 52%, Lag= 29.0 min
 Primary = 13.68 cfs @ 12.99 hrs, Volume= 4.340 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,012.49' @ 12.99 hrs Surf.Area= 31,981 sf Storage= 44,780 cf

Plug-Flow detention time= 36.8 min calculated for 4.340 af (99% of inflow)
 Center-of-Mass det. time= 34.0 min (846.1 - 812.1)

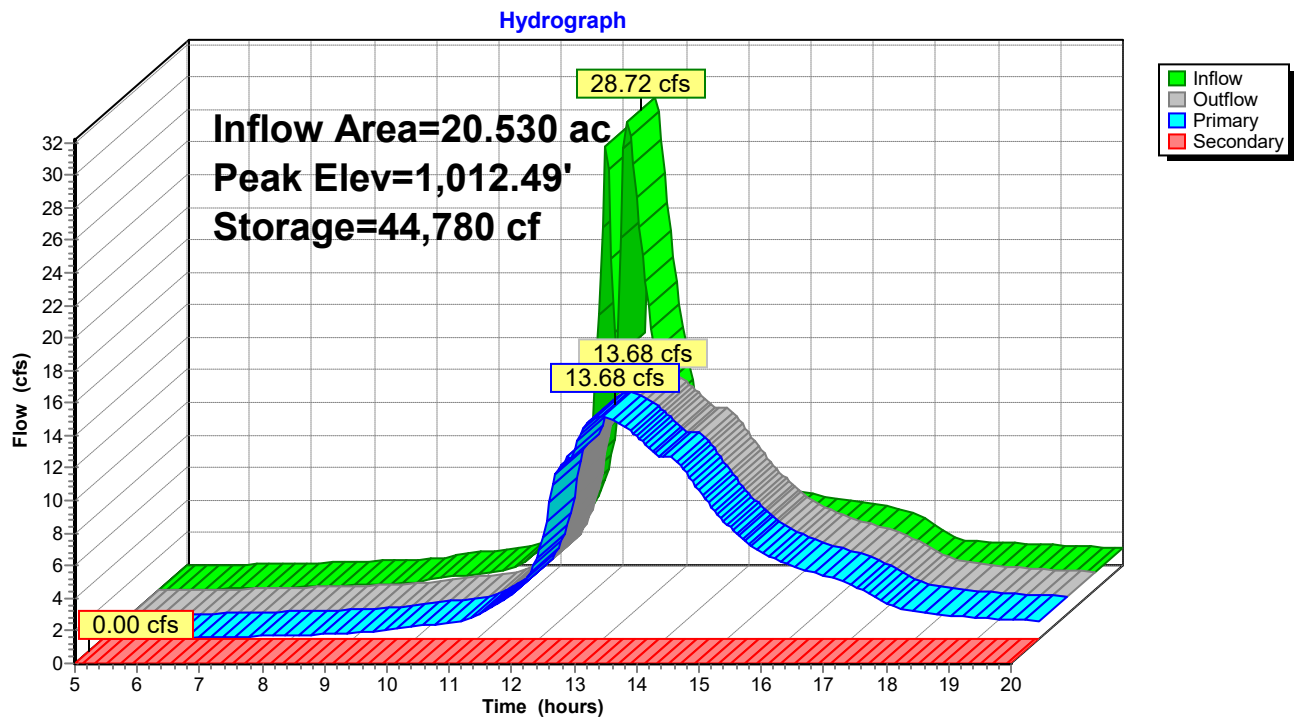
Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	152,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	0	0	0
1,011.00	17,095	8,548	8,548
1,012.00	26,827	21,961	30,509
1,013.00	37,445	32,136	62,645
1,014.00	38,000	37,723	100,367
1,015.00	66,462	52,231	152,598

Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	28.0" W x 18.0" H, R=14.7"/40.7" Pipe Arch Culvert L= 148.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.60' S= 0.0027 ' S= 0.0027 ' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 2.76 sf
#2	Secondary	1,013.70'	10.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=13.67 cfs @ 12.99 hrs HW=1,012.48' (Free Discharge)
 ↑1=Culvert (Barrel Controls 13.67 cfs @ 4.96 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,010.00' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 12P: CSAH 12 E Ditch

Summary for Pond 23P: Metcon Addn Pond

Inflow Area = 15.030 ac, 70.28% Impervious, Inflow Depth > 3.47" for 10-Year event
 Inflow = 83.02 cfs @ 12.15 hrs, Volume= 4.352 af
 Outflow = 9.75 cfs @ 12.64 hrs, Volume= 3.697 af, Atten= 88%, Lag= 29.2 min
 Primary = 9.75 cfs @ 12.64 hrs, Volume= 3.697 af
 Routed to Pond 27P : CSAH 12 E Ditch

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,013.07' @ 12.64 hrs Surf.Area= 61,990 sf Storage= 113,121 cf

Plug-Flow detention time= 165.0 min calculated for 3.685 af (85% of inflow)
 Center-of-Mass det. time= 127.4 min (883.2 - 755.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,011.00'	325,258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,011.00	47,057	0	0
1,016.00	83,046	325,258	325,258

Device	Routing	Invert	Outlet Devices
#1	Primary	1,011.00'	18.0" Round Culvert L= 100.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,011.00' / 1,010.00' S= 0.0100 ' / ' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	1,008.00'	18.0" Round Culvert L= 30.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,008.00' / 1,008.00' S= 0.0000 ' / ' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=9.75 cfs @ 12.64 hrs HW=1,013.07' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 9.75 cfs @ 5.52 fps)

↑ **2=Culvert** (Passes 9.75 cfs of 12.25 cfs potential flow)

25-1243

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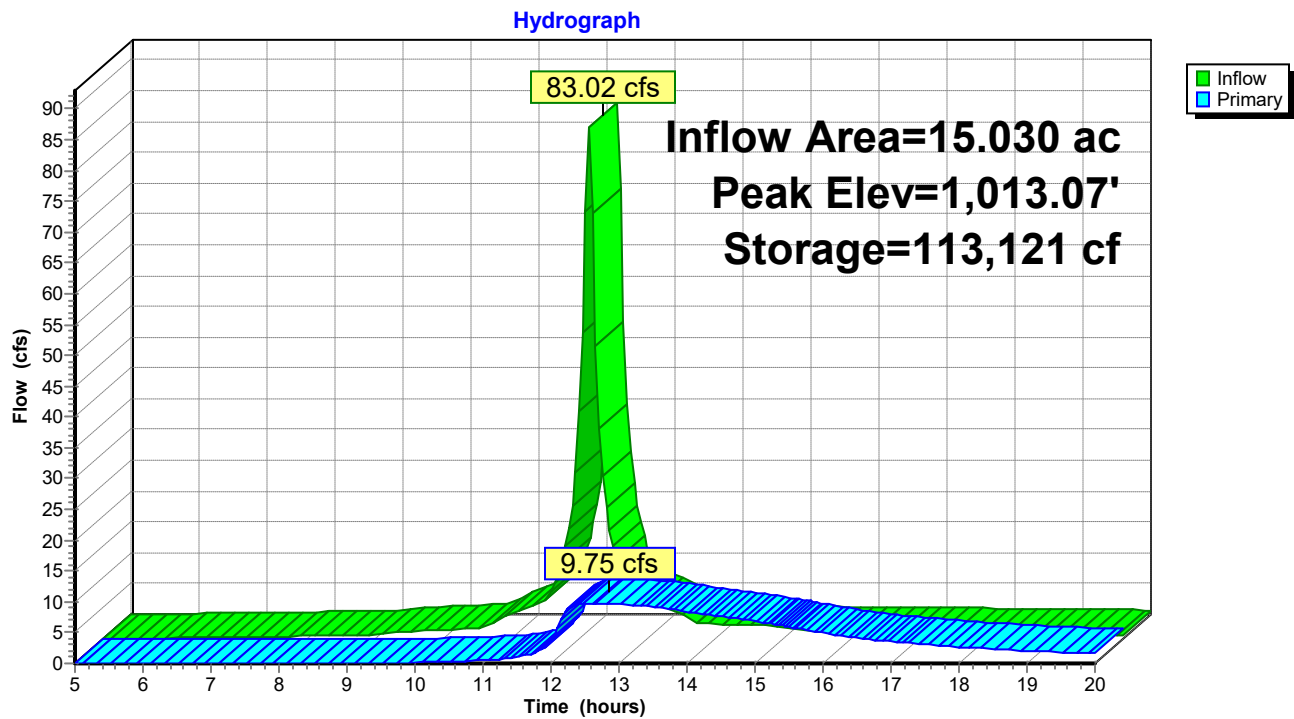
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MSE 24-hr 3 10-Year Rainfall=4.38"

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Pond 23P: Metcon Addn Pond



Summary for Pond 25P: Trail Culvert Basin

Inflow Area = 0.900 ac, 0.00% Impervious, Inflow Depth > 2.26" for 10-Year event
 Inflow = 4.42 cfs @ 12.05 hrs, Volume= 0.170 af
 Outflow = 2.29 cfs @ 12.12 hrs, Volume= 0.170 af, Atten= 48%, Lag= 4.5 min
 Primary = 2.29 cfs @ 12.12 hrs, Volume= 0.170 af
 Routed to Pond 27P : CSAH 12 E Ditch
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Routed to Pond 27P : CSAH 12 E Ditch

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,012.84' @ 12.12 hrs Surf.Area= 1,600 sf Storage= 1,235 cf

Plug-Flow detention time= 5.5 min calculated for 0.169 af (100% of inflow)
 Center-of-Mass det. time= 5.0 min (782.0 - 777.0)

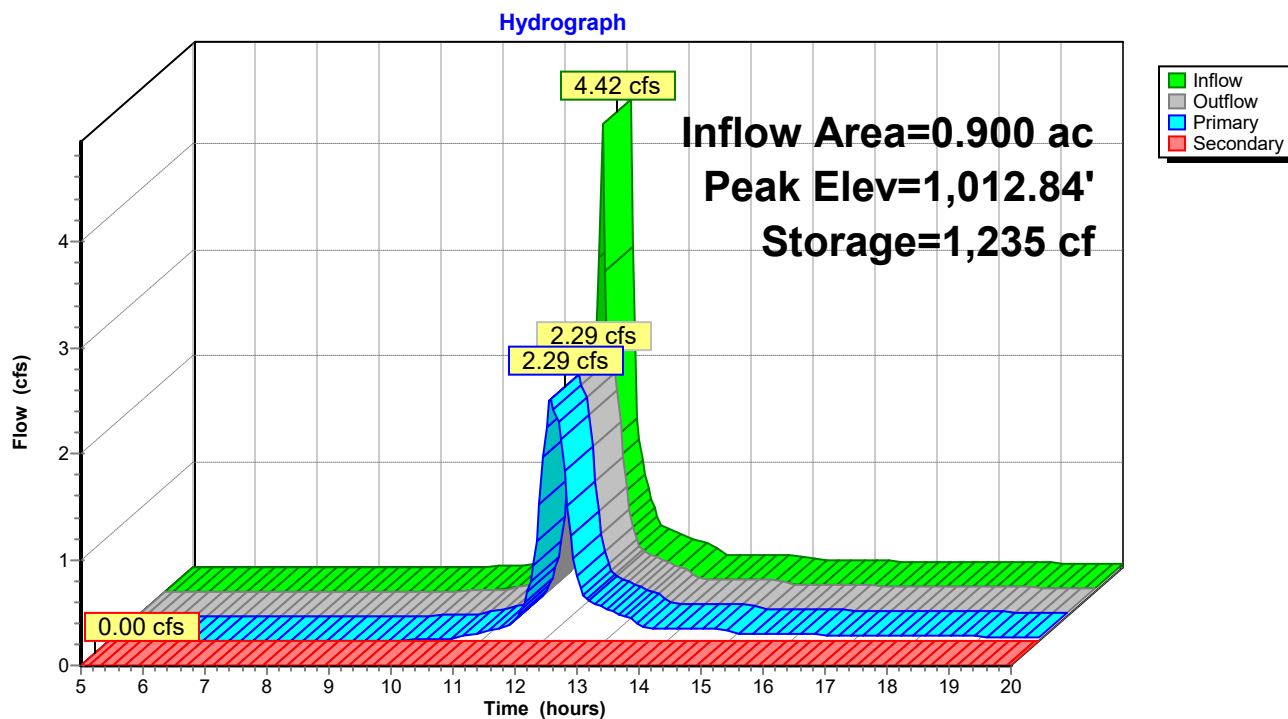
Volume	Invert	Avail.Storage	Storage Description
#1	1,011.30'	12,717 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,011.30	0	0	0
1,013.00	1,763	1,499	1,499
1,014.00	5,033	3,398	4,897
1,015.00	10,608	7,821	12,717

Device	Routing	Invert	Outlet Devices
#1	Primary	1,011.30'	12.0" Round Culvert L= 42.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,011.30' / 1,011.00' S= 0.0071 ' / ' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Secondary	1,014.50'	50.0' long + 100.0 ' /' SideZ x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=2.26 cfs @ 12.12 hrs HW=1,012.82' (Free Discharge)
 ↑1=Culvert (Barrel Controls 2.26 cfs @ 2.88 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,011.30' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 25P: Trail Culvert Basin

Summary for Pond 27P: CSAH 12 E Ditch

Inflow Area = 20.530 ac, 62.65% Impervious, Inflow Depth > 3.04" for 10-Year event
 Inflow = 33.76 cfs @ 12.17 hrs, Volume= 5.198 af
 Outflow = 12.04 cfs @ 12.95 hrs, Volume= 5.134 af, Atten= 64%, Lag= 47.0 min
 Primary = 12.04 cfs @ 12.95 hrs, Volume= 5.134 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,012.17' @ 12.95 hrs Surf.Area= 28,677 sf Storage= 35,343 cf

Plug-Flow detention time= 36.6 min calculated for 5.134 af (99% of inflow)
 Center-of-Mass det. time= 32.3 min (879.9 - 847.5)

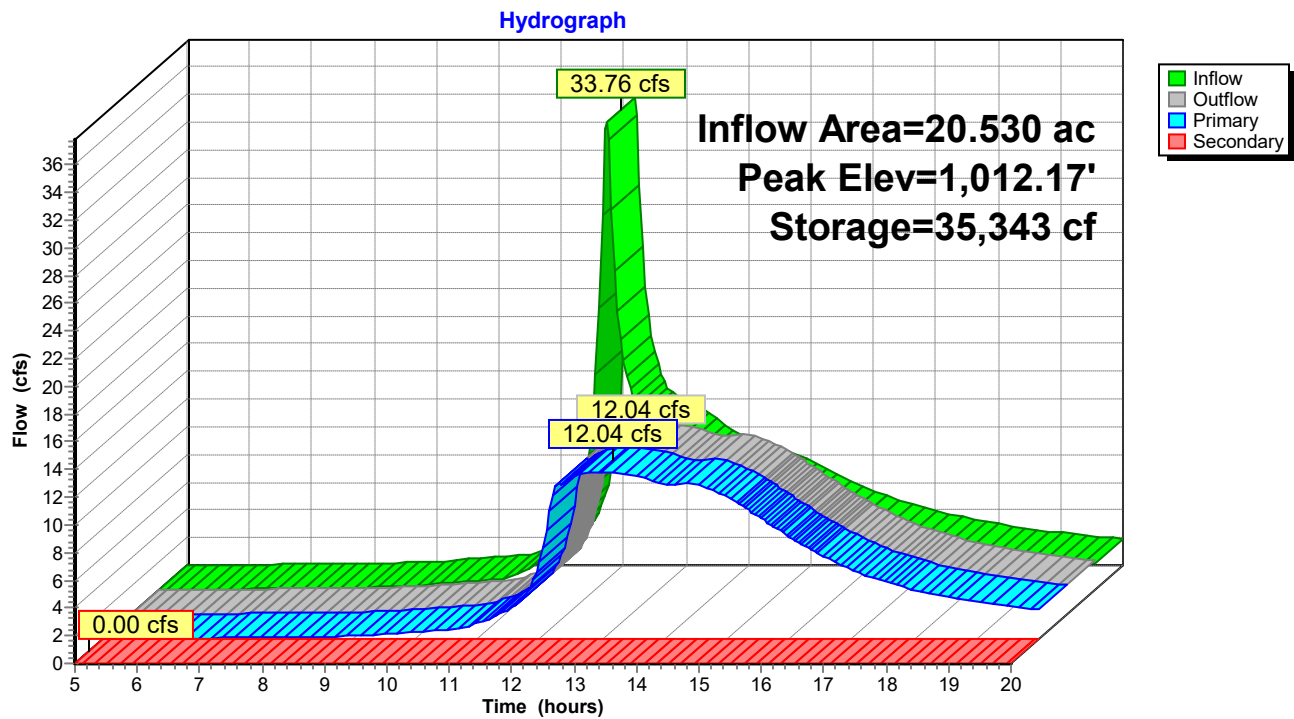
Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	152,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	0	0	0
1,011.00	17,095	8,548	8,548
1,012.00	26,827	21,961	30,509
1,013.00	37,445	32,136	62,645
1,014.00	38,000	37,723	100,367
1,015.00	66,462	52,231	152,598

Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	28.0" W x 18.0" H, R=14.7"/40.7" Pipe Arch Culvert L= 148.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.60' S= 0.0027 ' S= 0.0027 ' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 2.76 sf
#2	Secondary	1,013.70'	10.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=12.04 cfs @ 12.95 hrs HW=1,012.17' (Free Discharge)
 ↑1=Culvert (Barrel Controls 12.04 cfs @ 4.36 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,010.00' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 27P: CSAH 12 E Ditch

Summary for Subcatchment 1S: SE Wetland WS

Runoff = 8.95 cfs @ 12.39 hrs, Volume= 0.821 af, Depth> 6.12"
 Routed to Pond 2P : SE Wetland

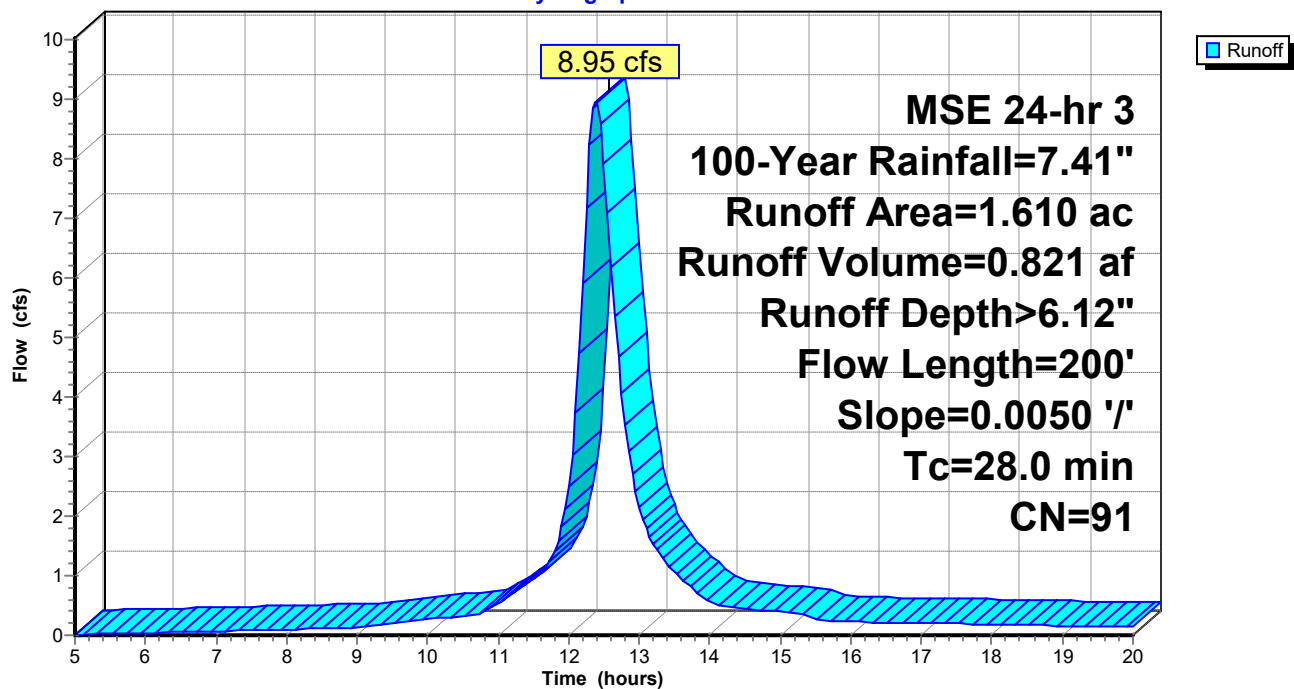
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.41"

Area (ac)	CN	Description
1.610	91	Row crops, straight row, Poor, HSG D
1.610		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	200	0.0050	0.12		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 4.40"

Subcatchment 1S: SE Wetland WS

Hydrograph



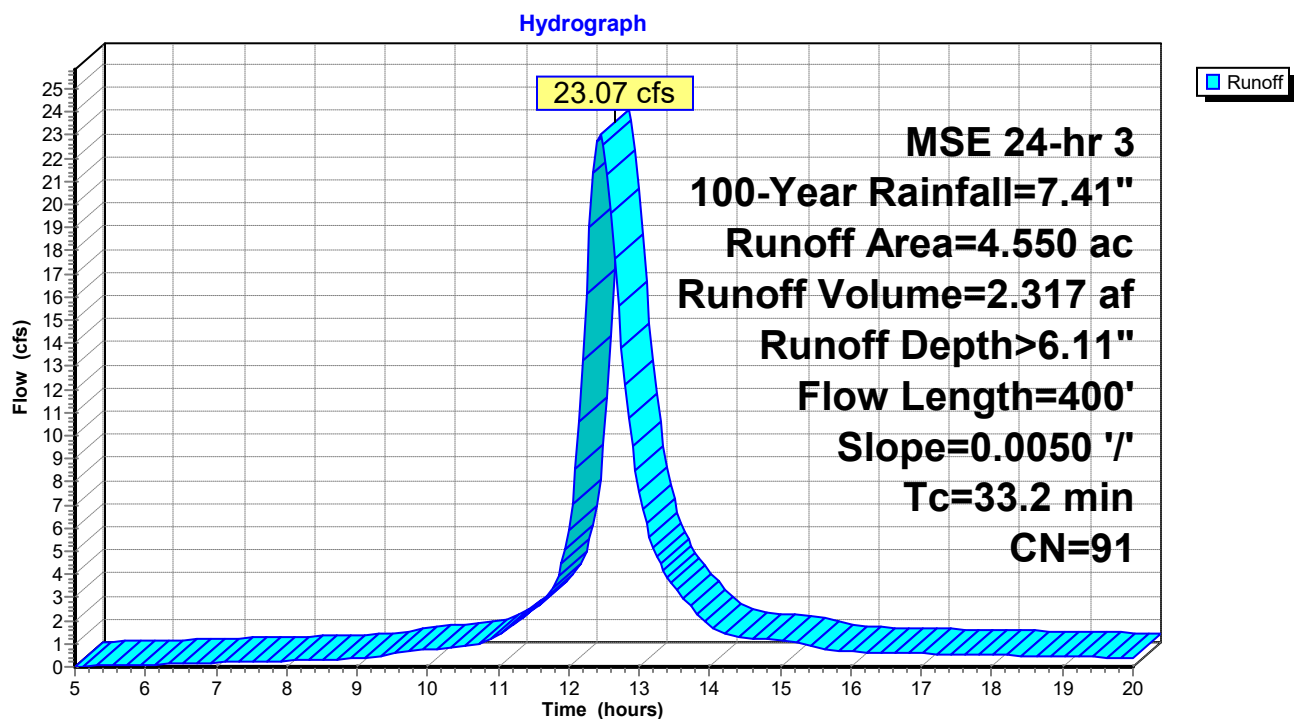
Summary for Subcatchment 4S: NE Wetland WS

Runoff = 23.07 cfs @ 12.45 hrs, Volume= 2.317 af, Depth> 6.11"
 Routed to Pond 5P : NE Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.41"

Area (ac)	CN	Description
4.190	91	Row crops, straight row, Poor, HSG D
0.360	86	Farmsteads, HSG D
4.550	91	Weighted Average
4.550		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	200	0.0050	0.12		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 4.40"
5.2	200	0.0050	0.64		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
33.2	400	Total			

Subcatchment 4S: NE Wetland WS

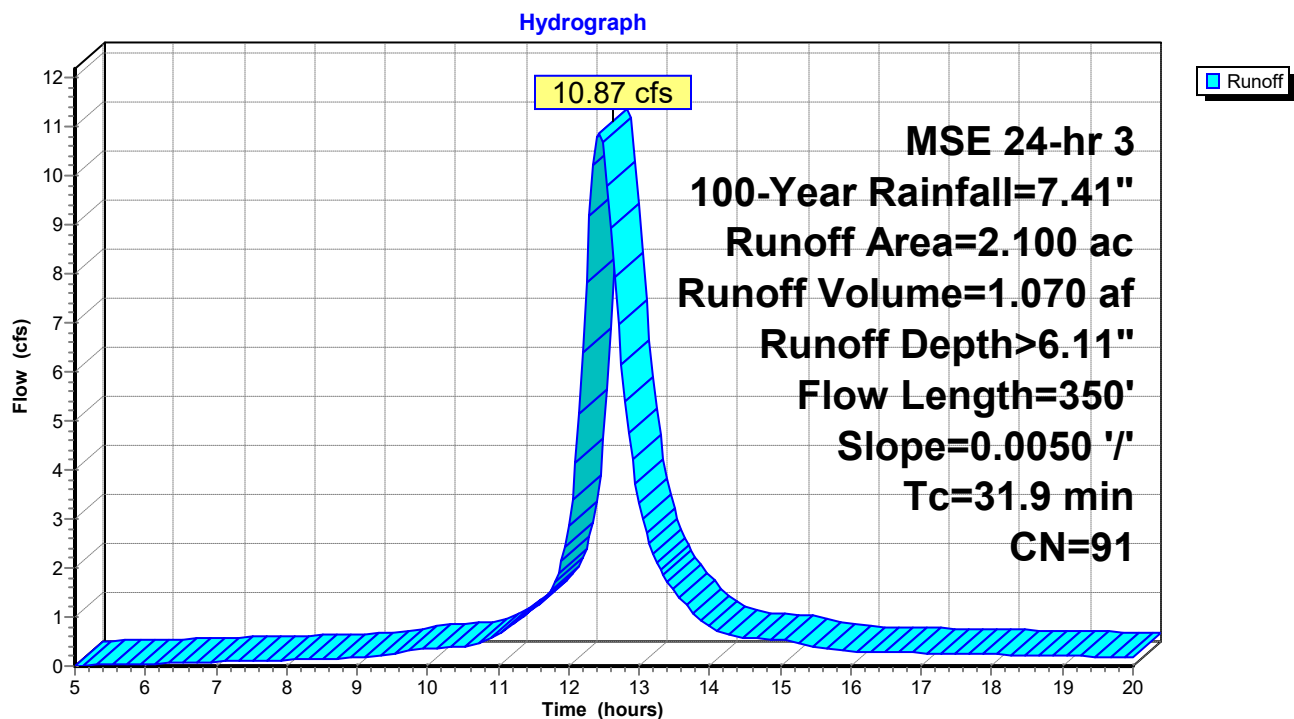
Summary for Subcatchment 6S: NW Wetland WS

Runoff = 10.87 cfs @ 12.43 hrs, Volume= 1.070 af, Depth> 6.11"
 Routed to Pond 7P : NW Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.41"

Area (ac)	CN	Description
2.100	91	Row crops, straight row, Poor, HSG D
2.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	200	0.0050	0.12		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 4.40"
3.9	150	0.0050	0.64		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
31.9	350	Total			

Subcatchment 6S: NW Wetland WS

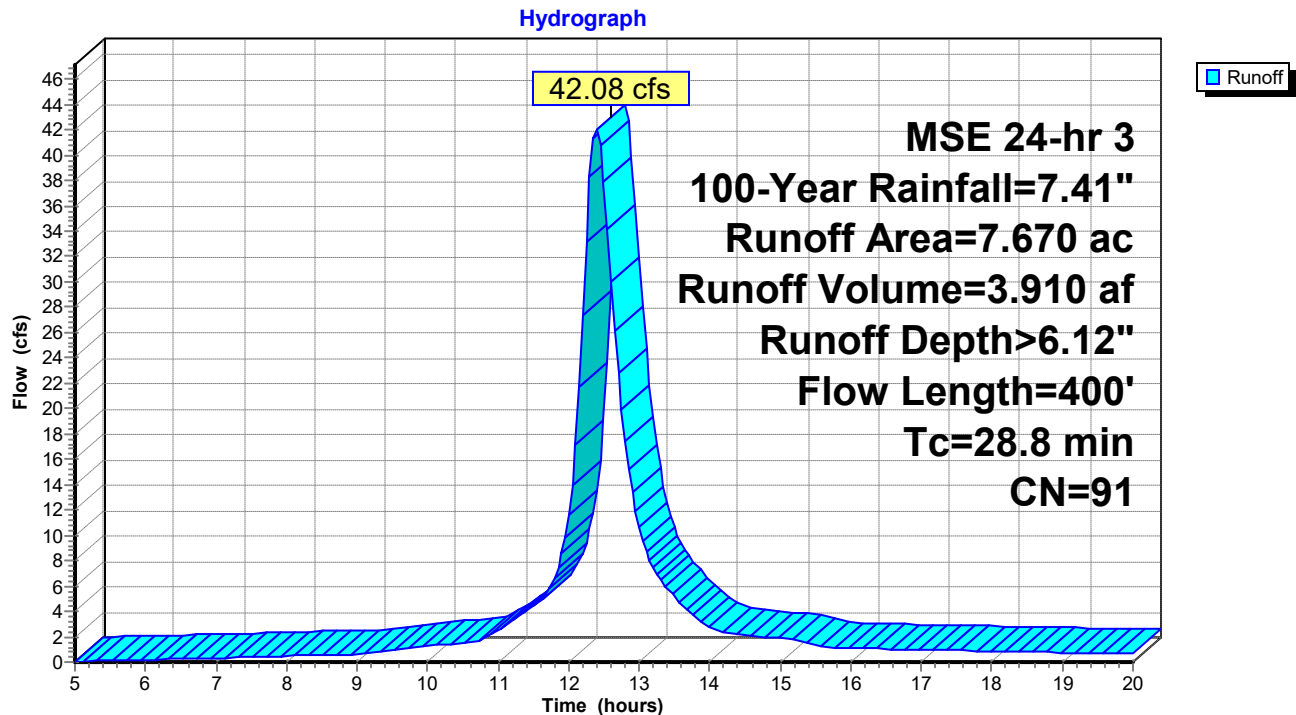
Summary for Subcatchment 9S: Trail Berm WS

Runoff = 42.08 cfs @ 12.39 hrs, Volume= 3.910 af, Depth> 6.12"
 Routed to Pond 10P : Trail Culvert Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.41"

Area (ac)	CN	Description
7.670	91	Row crops, straight row, Poor, HSG D
7.670		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	200	0.0050	0.27		Sheet Flow, Cultivated: Residue<=20% n= 0.060 P2= 4.40"
16.6	200	0.0005	0.20		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
28.8	400	Total			

Subcatchment 9S: Trail Berm WS

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MSE 24-hr 3 100-Year Rainfall=7.41"

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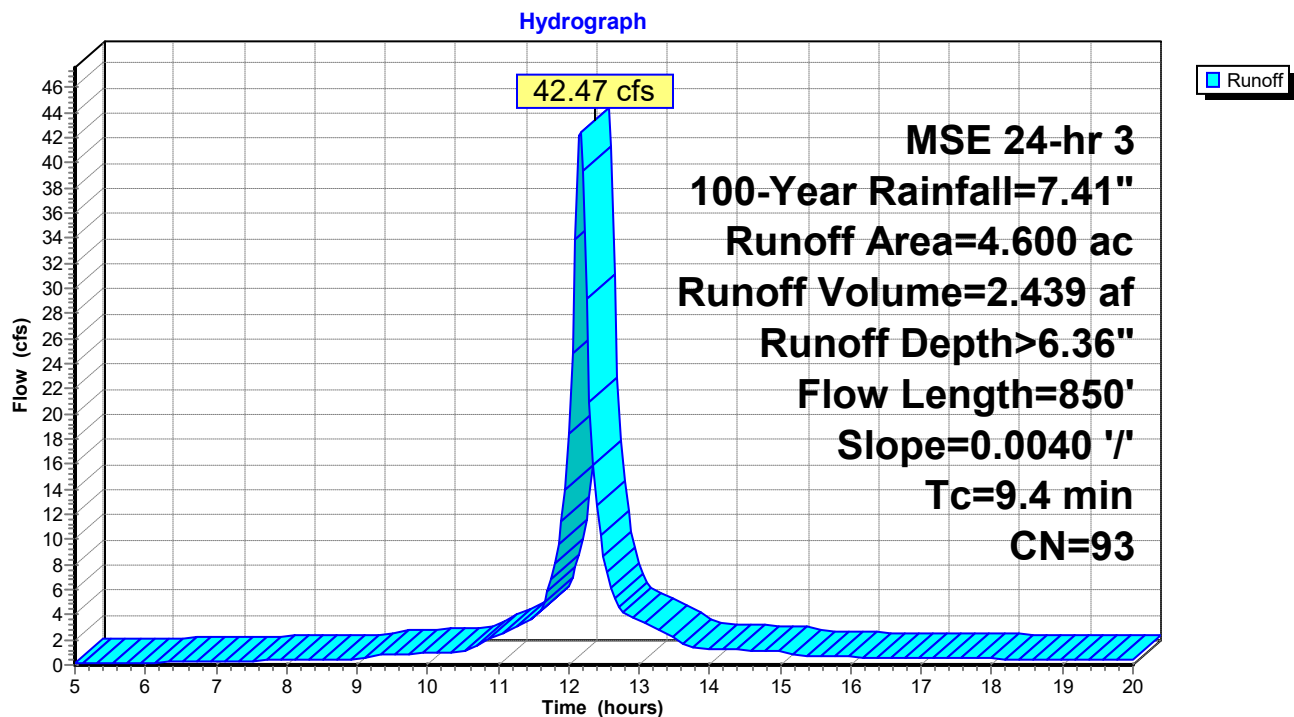
Summary for Subcatchment 11S: CSAH 12 East

Runoff = 42.47 cfs @ 12.16 hrs, Volume= 2.439 af, Depth> 6.36"
 Routed to Pond 12P : CSAH 12 E Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.41"

Area (ac)	CN	Description
4.600	93	Paved roads w/open ditches, 50% imp, HSG D
2.300		50.00% Pervious Area
2.300		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
2.4	450	0.0040	3.12	100.00	Trap/Vee/Rect Channel Flow, Bot.W=7.00' D=2.00' Z= 6.0 & 3.0 ' Top.W=25.00' n= 0.035 Earth, dense weeds
9.4	850	Total			

Subcatchment 11S: CSAH 12 East

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MSE 24-hr 3 100-Year Rainfall=7.41"

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Summary for Subcatchment 22S: Des WS

Runoff = 146.54 cfs @ 12.15 hrs, Volume= 7.970 af, Depth> 6.36"
 Routed to Pond 23P : Metcon Addn Pond

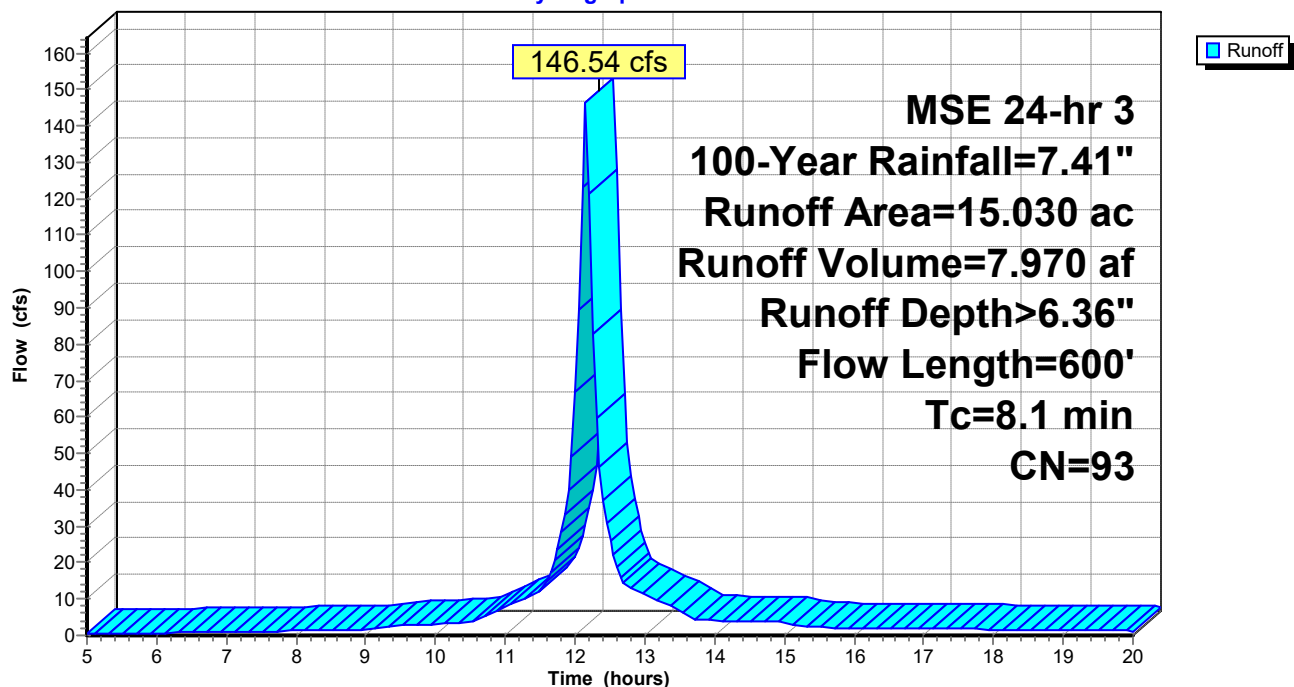
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.41"

Area (ac)	CN	Description
14.670	93	Urban industrial, 72% imp, HSG D
0.360	86	Farmsteads, HSG D
15.030	93	Weighted Average
4.468		29.72% Pervious Area
10.562		70.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	200	0.0200	1.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 4.40"
6.3	400	0.0050	1.06		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
8.1	600	Total			

Subcatchment 22S: Des WS

Hydrograph



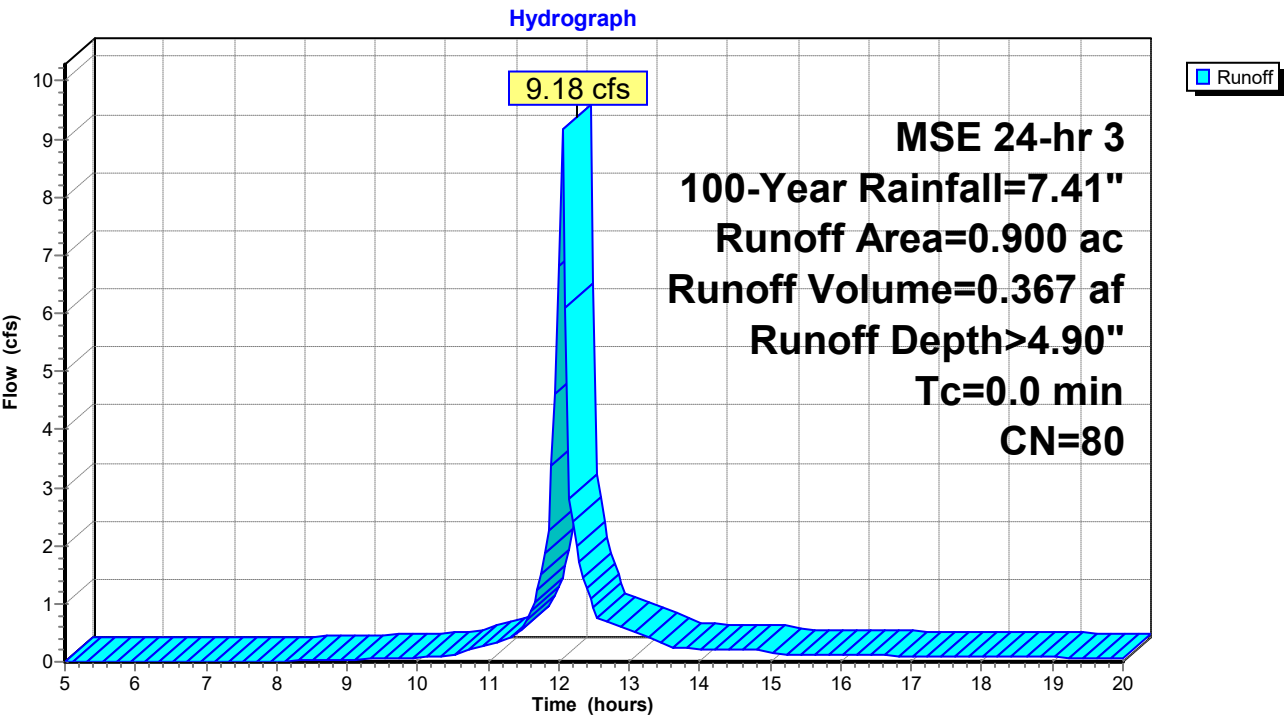
Summary for Subcatchment 24S: Trail Berm WS

Runoff = 9.18 cfs @ 12.05 hrs, Volume= 0.367 af, Depth> 4.90"
Routed to Pond 25P : Trail Culvert Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.41"

Area (ac)	CN	Description
0.900	80	>75% Grass cover, Good, HSG D
0.900		100.00% Pervious Area

Subcatchment 24S: Trail Berm WS



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MSE 24-hr 3 100-Year Rainfall=7.41"

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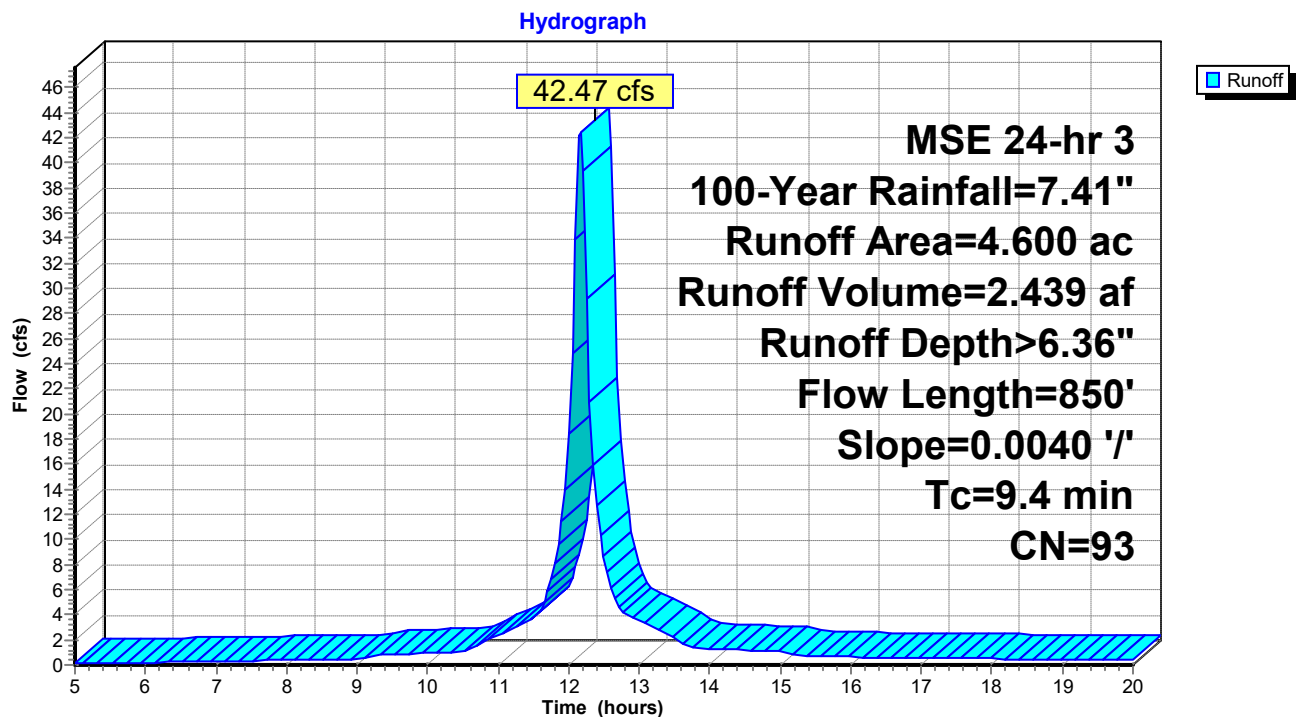
Summary for Subcatchment 26S: CSAH 12 East

Runoff = 42.47 cfs @ 12.16 hrs, Volume= 2.439 af, Depth> 6.36"
 Routed to Pond 27P : CSAH 12 E Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.41"

Area (ac)	CN	Description
4.600	93	Paved roads w/open ditches, 50% imp, HSG D
2.300		50.00% Pervious Area
2.300		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
3.5	200	0.0040	0.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
2.4	450	0.0040	3.12	100.00	Trap/Vee/Rect Channel Flow, Bot.W=7.00' D=2.00' Z= 6.0 & 3.0 ' Top.W=25.00' n= 0.035 Earth, dense weeds
9.4	850	Total			

Subcatchment 26S: CSAH 12 East

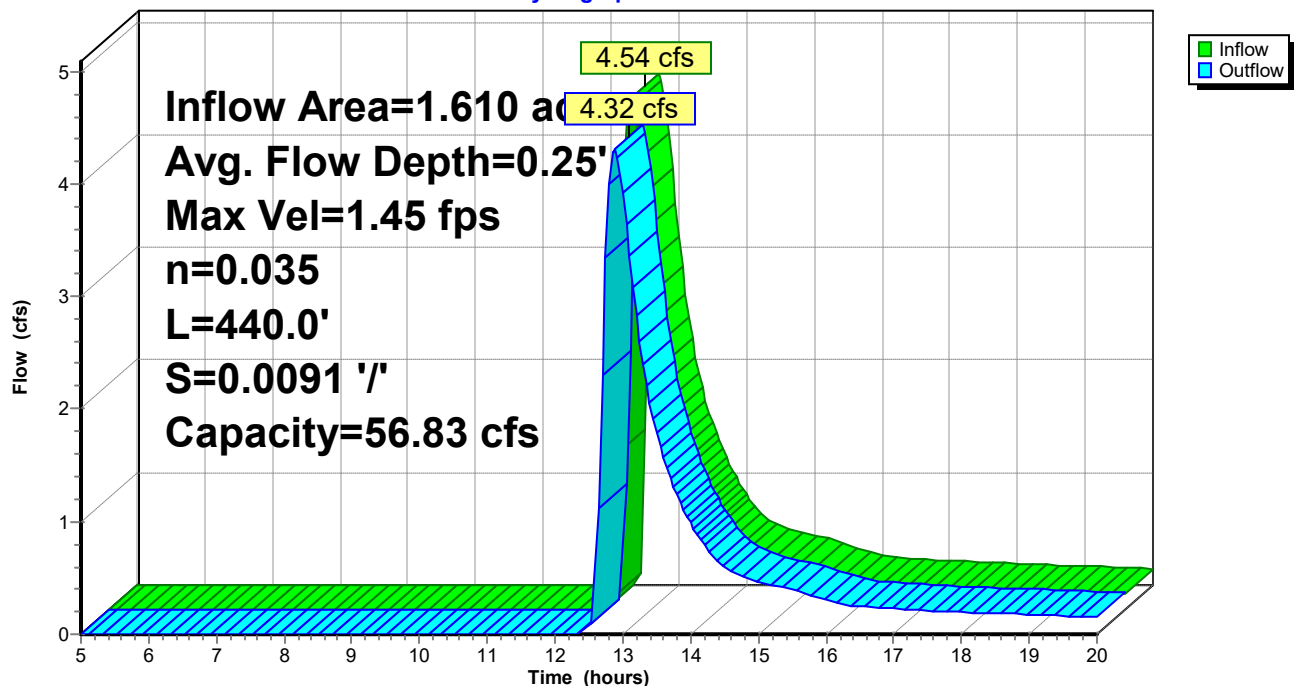
Summary for Reach 3R: S Trail Berm

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth > 3.21" for 100-Year event
 Inflow = 4.54 cfs @ 12.71 hrs, Volume= 0.431 af
 Outflow = 4.32 cfs @ 12.88 hrs, Volume= 0.426 af, Atten= 5%, Lag= 9.9 min
 Routed to Pond 10P : Trail Culvert Basin

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Max. Velocity= 1.45 fps, Min. Travel Time= 5.1 min
 Avg. Velocity= 0.65 fps, Avg. Travel Time= 11.4 min

Peak Storage= 1,319 cf @ 12.79 hrs
 Average Depth at Peak Storage= 0.25' , Surface Width= 14.00'
 Bank-Full Depth= 1.00' Flow Area= 18.0 sf, Capacity= 56.83 cfs

10.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 6.0 10.0 ' ' Top Width= 26.00'
 Length= 440.0' Slope= 0.0091 ' / '
 Inlet Invert= 1,016.00', Outlet Invert= 1,012.00'

**Reach 3R: S Trail Berm****Hydrograph**

Summary for Reach 8R: W Trail Berm

Inflow Area = 6.650 ac, 0.00% Impervious, Inflow Depth > 4.53" for 100-Year event
 Inflow = 24.95 cfs @ 12.67 hrs, Volume= 2.513 af
 Outflow = 23.66 cfs @ 12.85 hrs, Volume= 2.494 af, Atten= 5%, Lag= 10.8 min
 Routed to Pond 10P : Trail Culvert Basin

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 2.24 fps, Min. Travel Time= 5.8 min

Avg. Velocity= 1.04 fps, Avg. Travel Time= 12.5 min

Peak Storage= 8,194 cf @ 12.75 hrs

Average Depth at Peak Storage= 0.93' , Surface Width= 18.82'

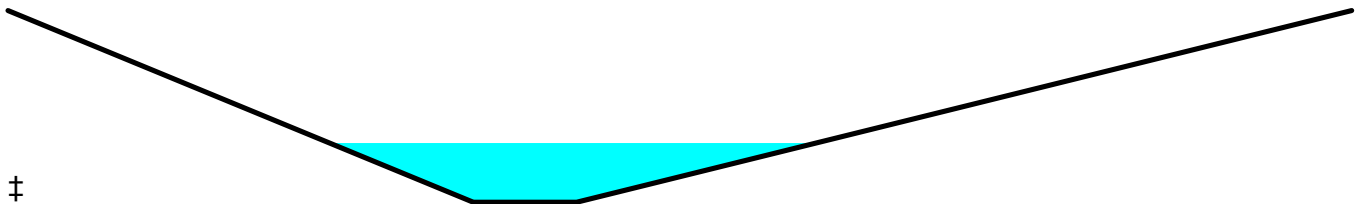
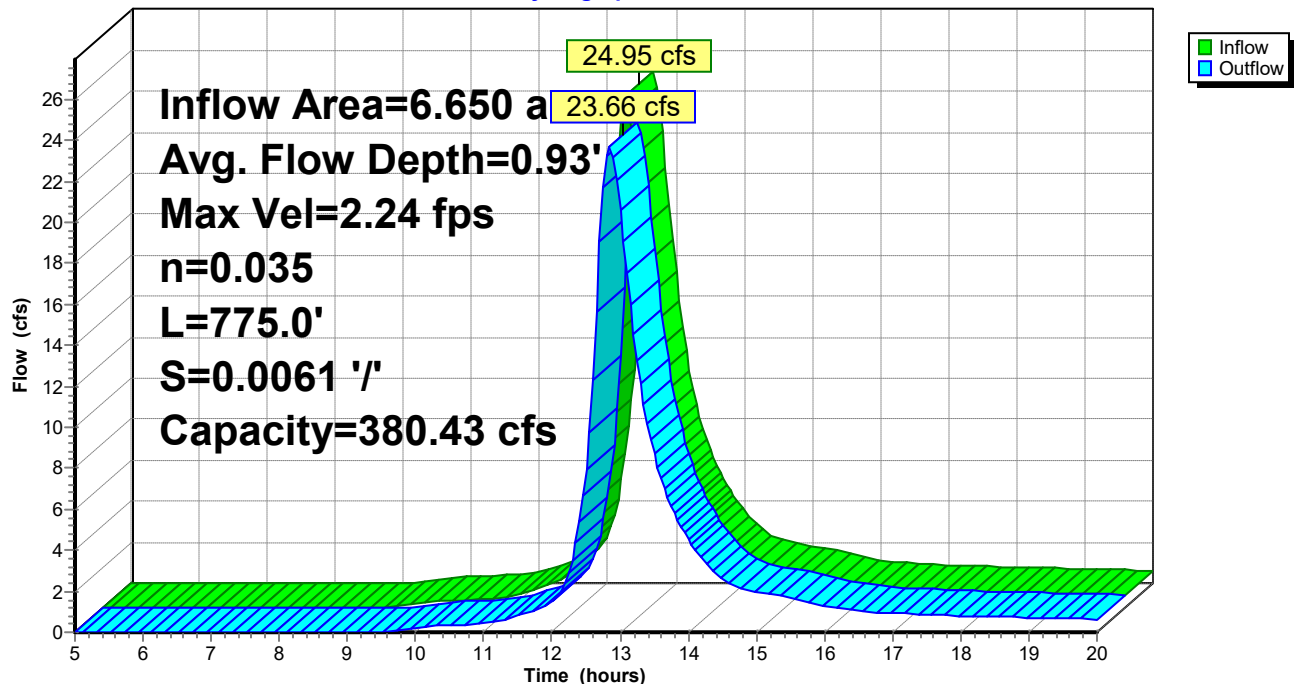
Bank-Full Depth= 3.00' Flow Area= 84.0 sf, Capacity= 380.43 cfs

4.00' x 3.00' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 6.0 10.0 ' / ' Top Width= 52.00'

Length= 775.0' Slope= 0.0061 ' / '

Inlet Invert= 1,016.70', Outlet Invert= 1,012.00'

**Reach 8R: W Trail Berm****Hydrograph**

Summary for Pond 2P: SE Wetland

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth > 6.12" for 100-Year event
 Inflow = 8.95 cfs @ 12.39 hrs, Volume= 0.821 af
 Outflow = 4.54 cfs @ 12.71 hrs, Volume= 0.431 af, Atten= 49%, Lag= 19.7 min
 Primary = 4.54 cfs @ 12.71 hrs, Volume= 0.431 af
 Routed to Reach 3R : S Trail Berm

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,017.97' @ 12.71 hrs Surf.Area= 56,519 sf Storage= 20,259 cf

Plug-Flow detention time= 142.0 min calculated for 0.429 af (52% of inflow)
 Center-of-Mass det. time= 77.1 min (844.6 - 767.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,017.25'	22,174 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

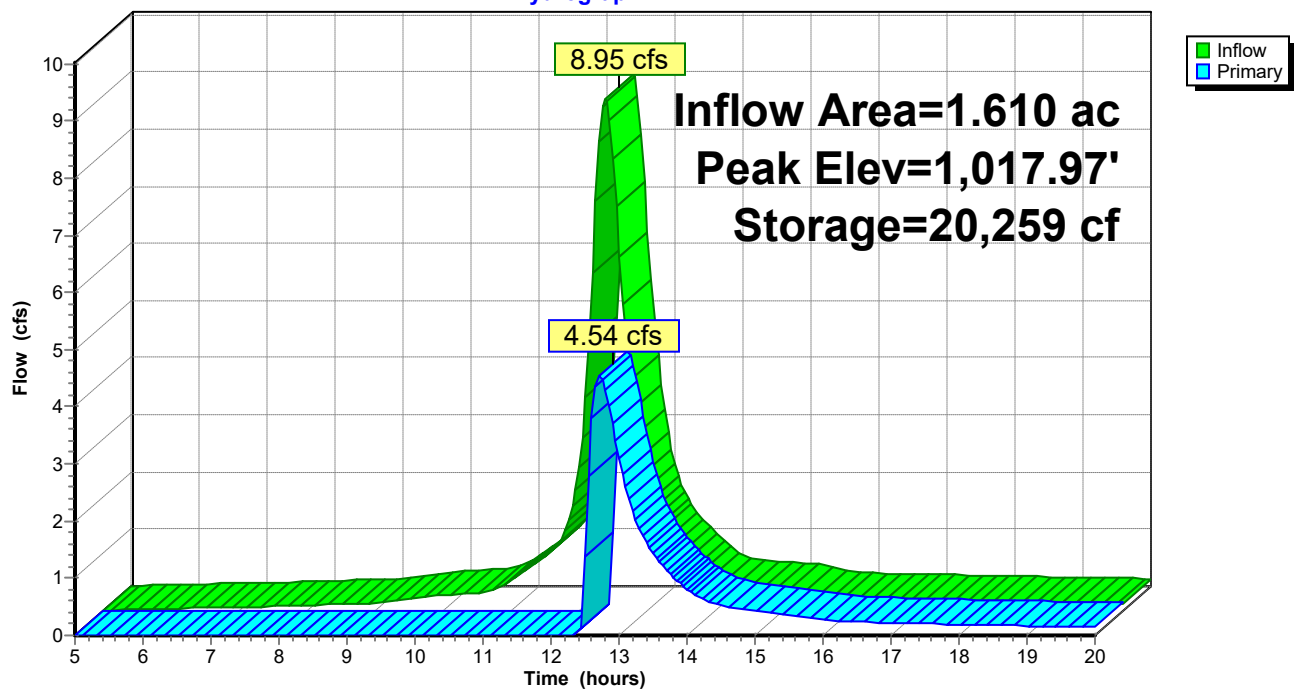
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,017.25	0	0	0
1,018.00	59,130	22,174	22,174

Device	Routing	Invert	Outlet Devices
#1	Primary	1,017.90'	100.0' long + 100.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.51 cfs @ 12.71 hrs HW=1,017.97' (Free Discharge)
 ↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 4.51 cfs @ 0.63 fps)

Pond 2P: SE Wetland

Hydrograph



Summary for Pond 5P: NE Wetland

Inflow Area = 4.550 ac, 0.00% Impervious, Inflow Depth > 6.11" for 100-Year event
 Inflow = 23.07 cfs @ 12.45 hrs, Volume= 2.317 af
 Outflow = 17.30 cfs @ 12.66 hrs, Volume= 1.480 af, Atten= 25%, Lag= 13.1 min
 Primary = 17.30 cfs @ 12.66 hrs, Volume= 1.480 af
 Routed to Pond 7P : NW Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,017.74' @ 12.66 hrs Surf.Area= 65,030 sf Storage= 46,541 cf

Plug-Flow detention time= 116.2 min calculated for 1.480 af (64% of inflow)
 Center-of-Mass det. time= 59.8 min (831.5 - 771.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,016.00'	65,093 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,016.00	0	0	0
1,017.00	25,742	12,871	12,871
1,018.00	78,702	52,222	65,093

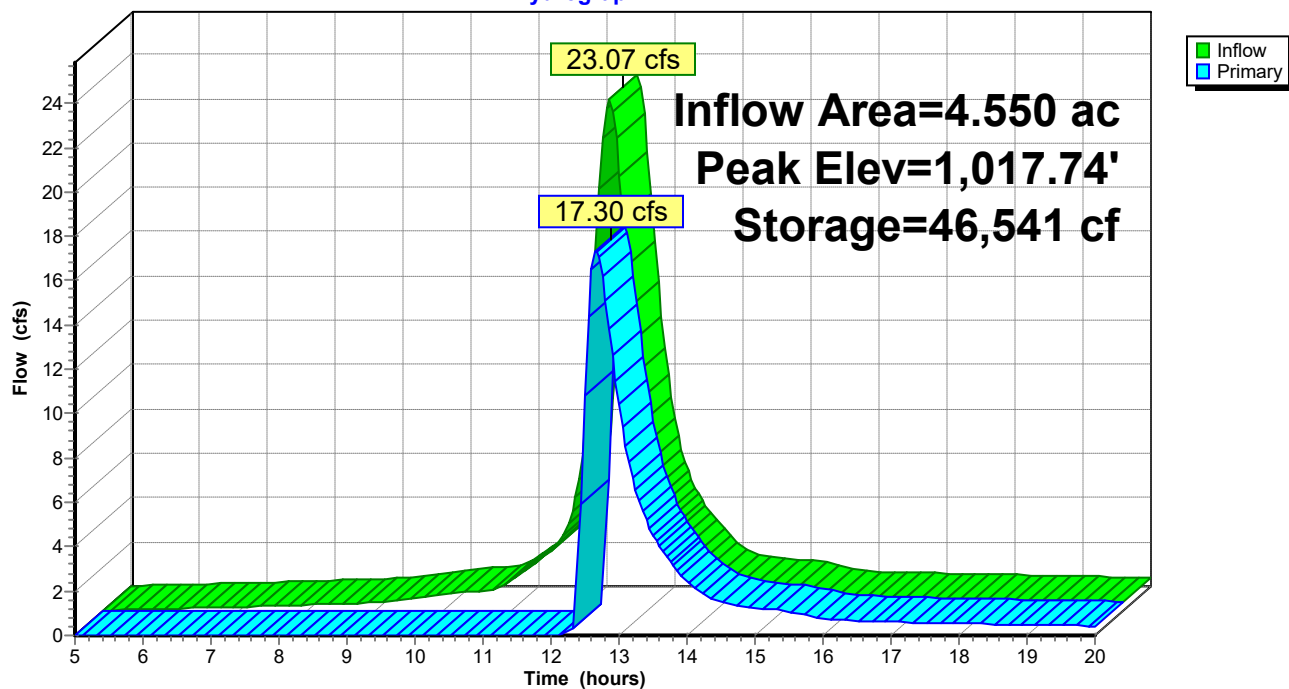
Device	Routing	Invert	Outlet Devices
#1	Primary	1,017.56'	75.0' long + 100.0 ' /' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=17.19 cfs @ 12.66 hrs HW=1,017.74' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 17.19 cfs @ 1.02 fps)

Pond 5P: NE Wetland

Hydrograph



Summary for Pond 7P: NW Wetland

Inflow Area = 6.650 ac, 0.00% Impervious, Inflow Depth > 4.60" for 100-Year event
 Inflow = 25.51 cfs @ 12.62 hrs, Volume= 2.550 af
 Outflow = 24.95 cfs @ 12.67 hrs, Volume= 2.513 af, Atten= 2%, Lag= 3.1 min
 Primary = 24.95 cfs @ 12.67 hrs, Volume= 2.513 af
 Routed to Reach 8R : W Trail Berm

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,017.37' @ 12.67 hrs Surf.Area= 33,765 sf Storage= 6,174 cf

Plug-Flow detention time= 13.2 min calculated for 2.504 af (98% of inflow)
 Center-of-Mass det. time= 7.7 min (813.7 - 806.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,017.00'	46,162 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

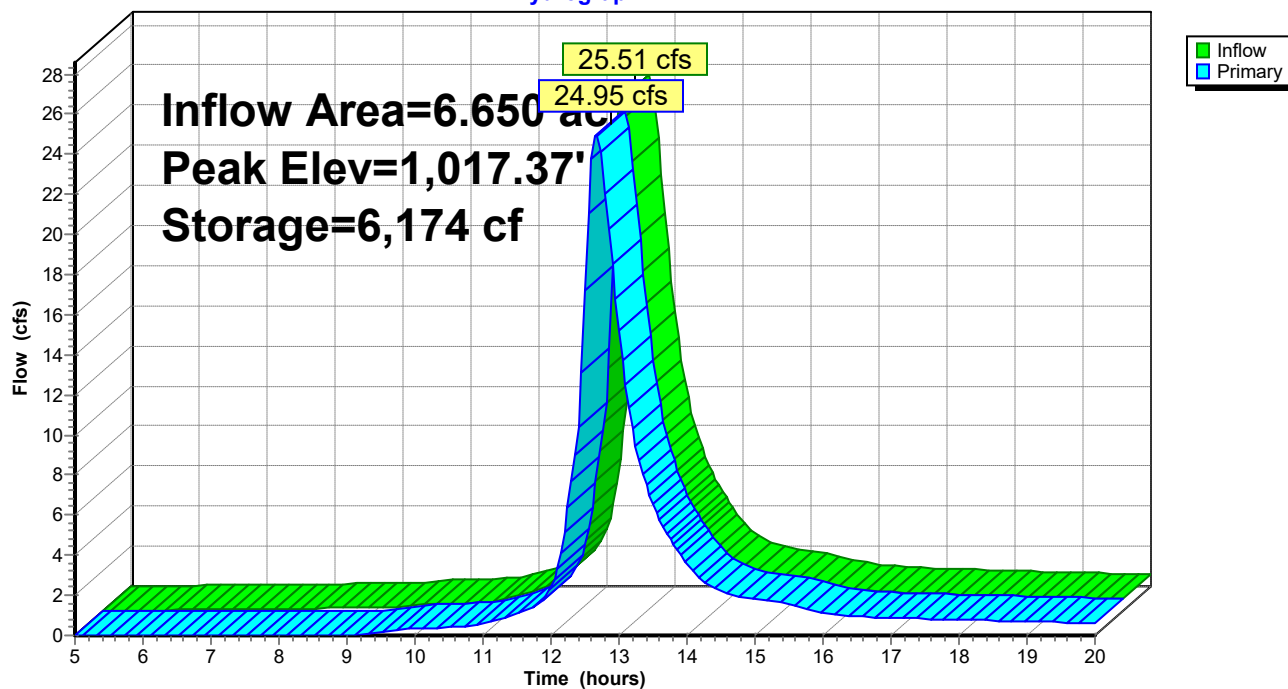
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,017.00	0	0	0
1,018.00	92,324	46,162	46,162

Device	Routing	Invert	Outlet Devices
#1	Primary	1,017.17'	100.0' long + 100.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=24.78 cfs @ 12.67 hrs HW=1,017.36' (Free Discharge)
 ↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 24.78 cfs @ 1.06 fps)

Pond 7P: NW Wetland

Hydrograph



Summary for Pond 10P: Trail Culvert Basin

Inflow Area = 15.930 ac, 0.00% Impervious, Inflow Depth > 5.14" for 100-Year event
 Inflow = 47.66 cfs @ 12.42 hrs, Volume= 6.830 af
 Outflow = 47.27 cfs @ 12.46 hrs, Volume= 6.820 af, Atten= 1%, Lag= 2.2 min
 Primary = 4.20 cfs @ 12.46 hrs, Volume= 2.869 af
 Routed to Pond 12P : CSAH 12 E Ditch
 Secondary = 43.07 cfs @ 12.46 hrs, Volume= 3.951 af
 Routed to Pond 12P : CSAH 12 E Ditch

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,014.84' @ 12.46 hrs Surf.Area= 28,827 sf Storage= 24,559 cf

Plug-Flow detention time= 20.8 min calculated for 6.820 af (100% of inflow)
 Center-of-Mass det. time= 20.2 min (814.5 - 794.4)

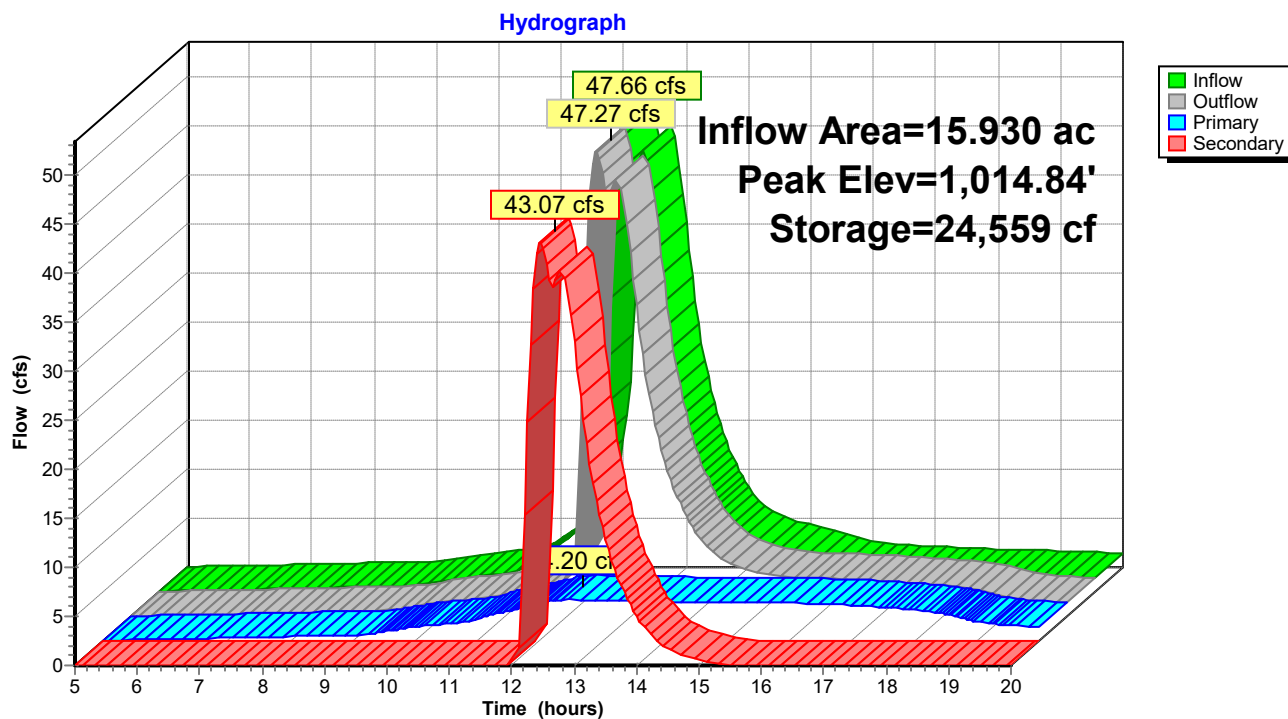
Volume	Invert	Avail.Storage	Storage Description
#1	1,011.30'	29,601 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,011.30	0	0	0
1,013.00	1,763	1,499	1,499
1,014.00	11,053	6,408	7,907
1,015.00	32,336	21,695	29,601

Device	Routing	Invert	Outlet Devices
#1	Primary	1,011.30'	12.0" Round Culvert L= 42.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,011.30' / 1,011.00' S= 0.0071 ' / ' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Secondary	1,014.50'	50.0' long + 100.0 ' /' SideZ x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=4.20 cfs @ 12.46 hrs HW=1,014.83' (Free Discharge)
 ↑ **1=Culvert** (Barrel Controls 4.20 cfs @ 5.35 fps)

Secondary OutFlow Max=42.81 cfs @ 12.46 hrs HW=1,014.83' (Free Discharge)
 ↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 42.81 cfs @ 1.53 fps)

Pond 10P: Trail Culvert Basin

Summary for Pond 12P: CSAH 12 E Ditch

Inflow Area = 20.530 ac, 11.20% Impervious, Inflow Depth > 5.41" for 100-Year event
 Inflow = 58.81 cfs @ 12.38 hrs, Volume= 9.258 af
 Outflow = 39.07 cfs @ 13.03 hrs, Volume= 9.195 af, Atten= 34%, Lag= 38.7 min
 Primary = 21.06 cfs @ 13.03 hrs, Volume= 8.092 af
 Secondary = 18.01 cfs @ 13.03 hrs, Volume= 1.103 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 1,014.39' @ 13.03 hrs Surf.Area= 48,961 sf Storage= 117,112 cf

Plug-Flow detention time= 51.3 min calculated for 9.195 af (99% of inflow)

Center-of-Mass det. time= 48.6 min (845.5 - 796.9)

Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	152,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	0	0	0
1,011.00	17,095	8,548	8,548
1,012.00	26,827	21,961	30,509
1,013.00	37,445	32,136	62,645
1,014.00	38,000	37,723	100,367
1,015.00	66,462	52,231	152,598

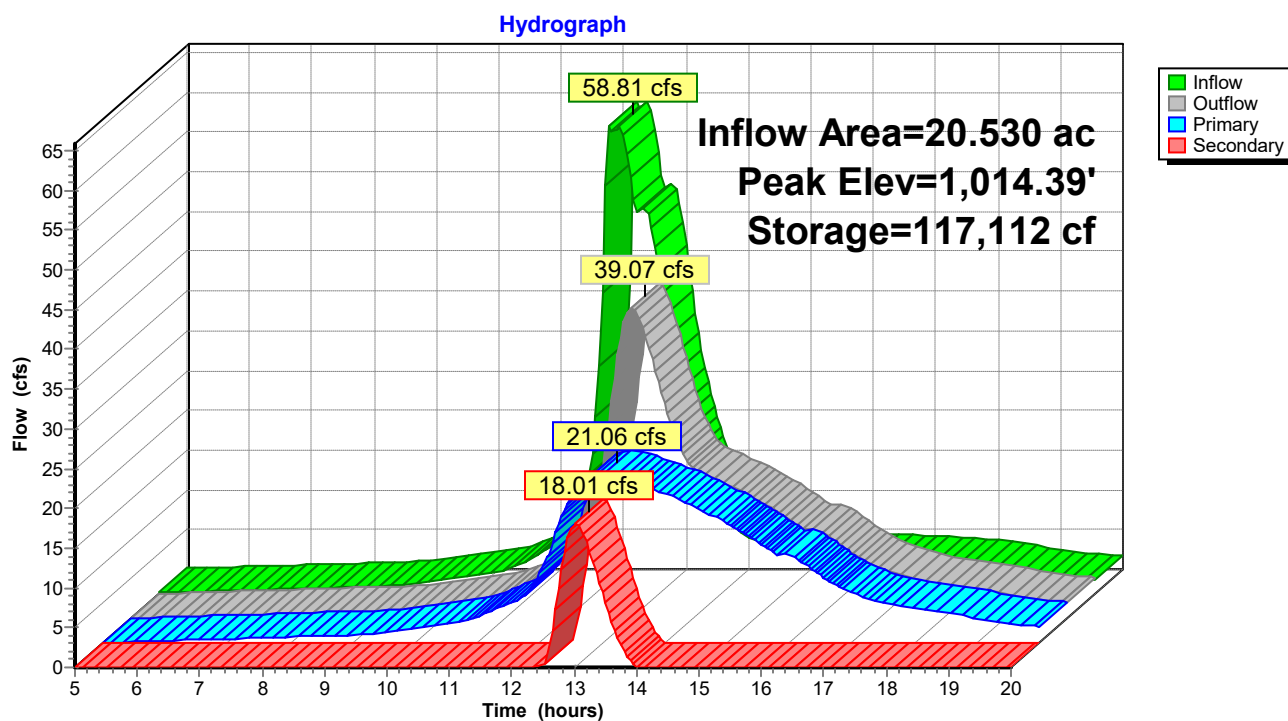
Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	28.0" W x 18.0" H, R=14.7"/40.7" Pipe Arch Culvert L= 148.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.60' S= 0.0027 ' /' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 2.76 sf
#2	Secondary	1,013.70'	10.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=21.06 cfs @ 13.03 hrs HW=1,014.38' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 21.06 cfs @ 7.63 fps)

Secondary OutFlow Max=17.94 cfs @ 13.03 hrs HW=1,014.38' (Free Discharge)

↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 17.94 cfs @ 2.62 fps)

Pond 12P: CSAH 12 E Ditch

Summary for Pond 23P: Metcon Addn Pond

Inflow Area = 15.030 ac, 70.28% Impervious, Inflow Depth > 6.36" for 100-Year event
 Inflow = 146.54 cfs @ 12.15 hrs, Volume= 7.970 af
 Outflow = 13.50 cfs @ 12.76 hrs, Volume= 6.895 af, Atten= 91%, Lag= 36.6 min
 Primary = 13.50 cfs @ 12.76 hrs, Volume= 6.895 af
 Routed to Pond 27P : CSAH 12 E Ditch

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,014.51' @ 12.76 hrs Surf.Area= 72,356 sf Storage= 209,859 cf

Plug-Flow detention time= 189.9 min calculated for 6.894 af (87% of inflow)
 Center-of-Mass det. time= 153.5 min (900.0 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,011.00'	325,258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,011.00	47,057	0	0
1,016.00	83,046	325,258	325,258

Device	Routing	Invert	Outlet Devices
#1	Primary	1,011.00'	18.0" Round Culvert L= 100.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,011.00' / 1,010.00' S= 0.0100 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	1,008.00'	18.0" Round Culvert L= 30.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,008.00' / 1,008.00' S= 0.0000 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=13.50 cfs @ 12.76 hrs HW=1,014.51' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 13.50 cfs @ 7.64 fps)

↑ **2=Culvert** (Passes 13.50 cfs of 15.95 cfs potential flow)

25-1243

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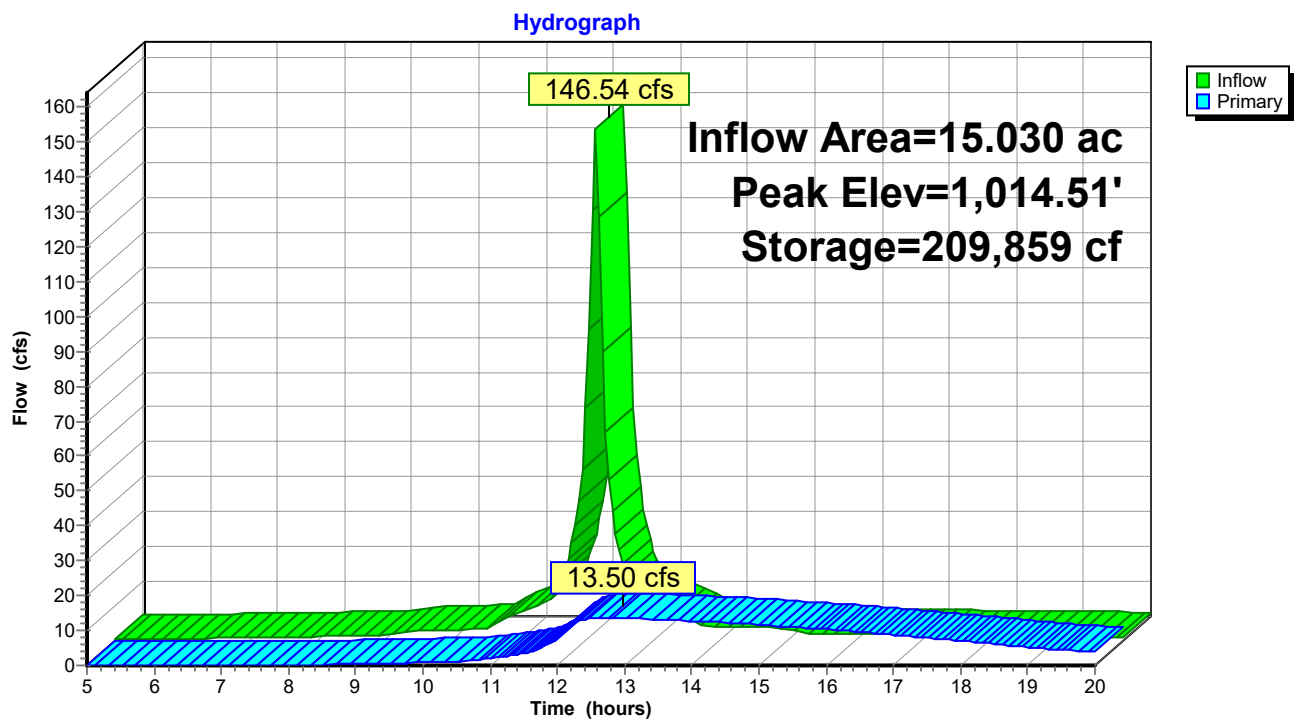
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MSE 24-hr 3 100-Year Rainfall=7.41"

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Pond 23P: Metcon Addn Pond



Summary for Pond 25P: Trail Culvert Basin

Inflow Area = 0.900 ac, 0.00% Impervious, Inflow Depth > 4.90" for 100-Year event
 Inflow = 9.18 cfs @ 12.05 hrs, Volume= 0.367 af
 Outflow = 3.28 cfs @ 12.16 hrs, Volume= 0.367 af, Atten= 64%, Lag= 6.6 min
 Primary = 3.28 cfs @ 12.16 hrs, Volume= 0.367 af
 Routed to Pond 27P : CSAH 12 E Ditch
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Routed to Pond 27P : CSAH 12 E Ditch

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,013.72' @ 12.16 hrs Surf.Area= 4,123 sf Storage= 3,623 cf

Plug-Flow detention time= 9.0 min calculated for 0.367 af (100% of inflow)
 Center-of-Mass det. time= 8.6 min (772.7 - 764.1)

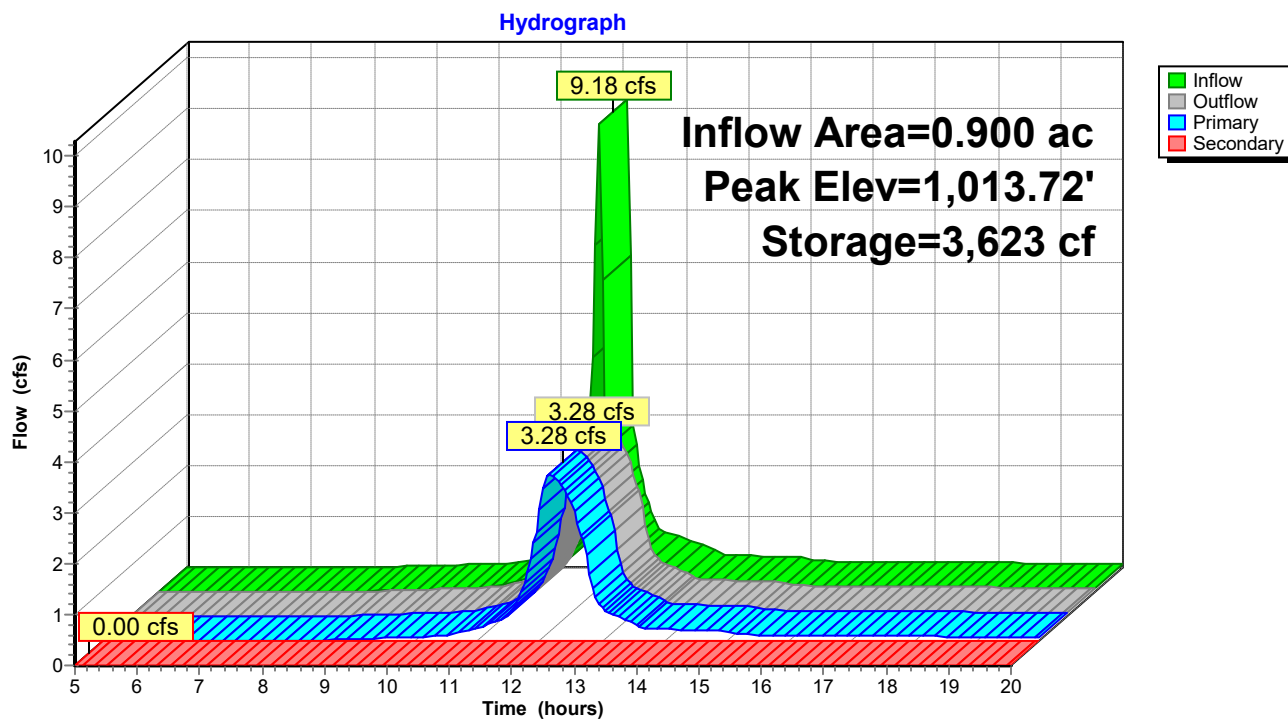
Volume	Invert	Avail.Storage	Storage Description
#1	1,011.30'	12,717 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,011.30	0	0	0
1,013.00	1,763	1,499	1,499
1,014.00	5,033	3,398	4,897
1,015.00	10,608	7,821	12,717

Device	Routing	Invert	Outlet Devices
#1	Primary	1,011.30'	12.0" Round Culvert L= 42.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,011.30' / 1,011.00' S= 0.0071 ' / ' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Secondary	1,014.50'	50.0' long + 100.0 ' /' SideZ x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=3.27 cfs @ 12.16 hrs HW=1,013.72' (Free Discharge)
 ↑1=Culvert (Barrel Controls 3.27 cfs @ 4.16 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,011.30' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 25P: Trail Culvert Basin

Summary for Pond 27P: CSAH 12 E Ditch

Inflow Area = 20.530 ac, 62.65% Impervious, Inflow Depth > 5.67" for 100-Year event
 Inflow = 56.91 cfs @ 12.17 hrs, Volume= 9.700 af
 Outflow = 17.07 cfs @ 13.14 hrs, Volume= 9.497 af, Atten= 70%, Lag= 58.6 min
 Primary = 17.07 cfs @ 13.14 hrs, Volume= 9.497 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,013.26' @ 13.14 hrs Surf.Area= 37,588 sf Storage= 72,305 cf

Plug-Flow detention time= 53.4 min calculated for 9.465 af (98% of inflow)
 Center-of-Mass det. time= 46.3 min (903.1 - 856.9)

Volume	Invert	Avail.Storage	Storage Description
#1	1,010.00'	152,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,010.00	0	0	0
1,011.00	17,095	8,548	8,548
1,012.00	26,827	21,961	30,509
1,013.00	37,445	32,136	62,645
1,014.00	38,000	37,723	100,367
1,015.00	66,462	52,231	152,598

Device	Routing	Invert	Outlet Devices
#1	Primary	1,010.00'	28.0" W x 18.0" H, R=14.7"/40.7" Pipe Arch Culvert L= 148.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,010.00' / 1,009.60' S= 0.0027 ' /' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 2.76 sf
#2	Secondary	1,013.70'	10.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=17.07 cfs @ 13.14 hrs HW=1,013.26' (Free Discharge)
 ↑1=Culvert (Barrel Controls 17.07 cfs @ 6.19 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,010.02' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

25-1243

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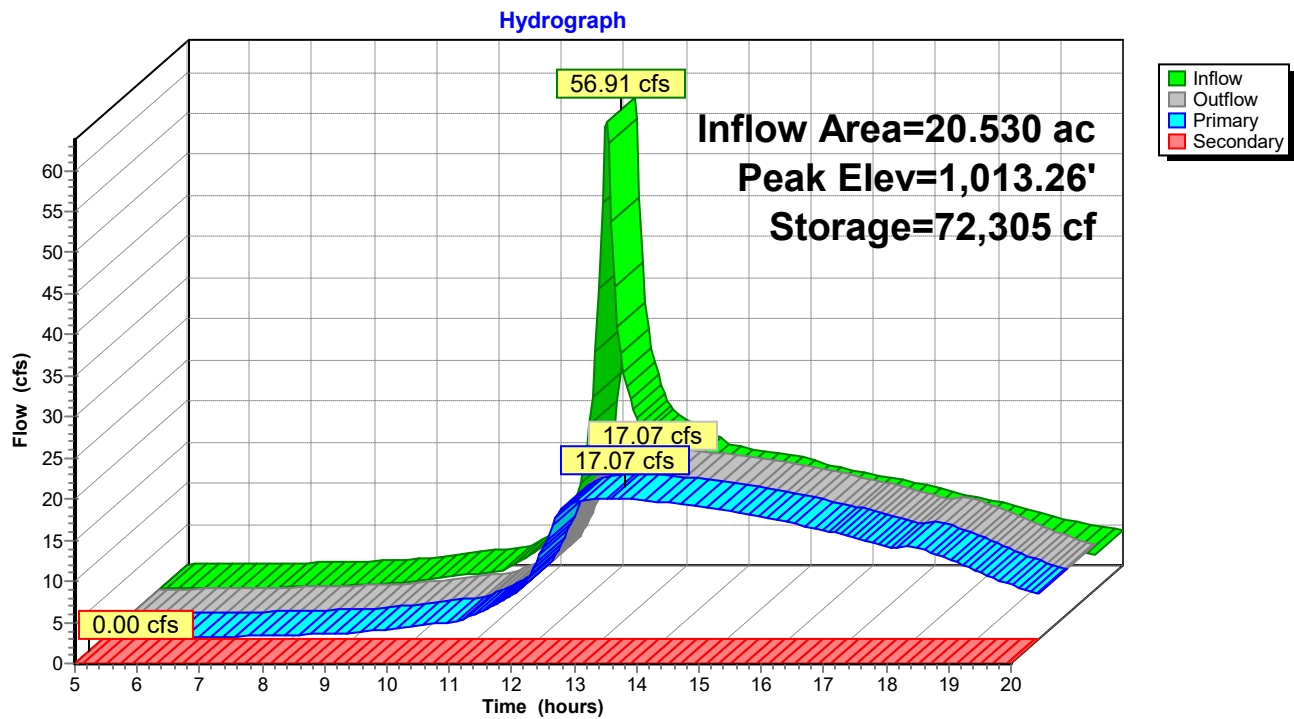
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MSE 24-hr 3 100-Year Rainfall=7.41"

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Pond 27P: CSAH 12 E Ditch



GEOTECHNICAL REPORT

Geotechnical Evaluation Report

Met-Con Mankato Office and Site Development

East of County Highway 12 between Adams Street and Madison Avenue
Mankato, Minnesota

Prepared for

Met-Con Companies, Inc.

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.

Philip E. Bailey, PE
Associate Director, Senior Engineer
License Number: 47539
February 3, 2026

Braun Intertec Corporation

Project B2508847

February 3, 2026

Project B2508847

Scott Brown
Met-Con Companies, Inc.
PO Box 427
15760 Acorn Trail
Faribault, MN 55021

Re: Geotechnical Evaluation
Met-Con Mankato Office and Site Development
East of County Highway 12 between Adams Street and Madison Avenue
Mankato, Minnesota

Dear Mr. Brown:

We are pleased to present this geotechnical evaluation report for the Met-Con Mankato Office and Site Development project at the above referenced site.

Thank you for making Braun Intertec Corporation (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 Philip Bailey at 507.995.2788 or pbailey@braunintertec.com.

Sincerely,
Braun Intertec Corporation

Philip E. Bailey, PE
Associate Director, Senior Engineer

Brandon K. Wright, PE
Senior Manager, Senior Engineer

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DRAFT



1.0 Introduction

1.1 Project Description

This geotechnical evaluation report addresses the proposed design and construction of the proposed office building and site grading, located in the southeast quadrant of the intersection of County State Aid Highway 12 and Adams Street in Mankato, Minnesota. The project will include the construction of a single-story office building with multiple rental units within a 1.9-acre parcel (Lot 6). The proposed office building will be steel framed with sheet-metal and stone siding. Civil improvements will include concrete pavement, a gravel surfaced storage yard, detention pond, and a patio.

In addition to the development of Lot 6, we also understand Met-Con has purchased an additional five adjoining lots and intends to develop them in the future. We assume similar single-story, slab-on-grade, steel-framed, office- or warehouse-type buildings will be constructed on the five adjoining lots.

Table 1-1 and Table 1-2 summarize the provided and assumed project details used to prepare this report.

Table 1-1. Building Description

Aspect	Descriptions
Below grade levels	None (Provided)
Above grade levels	1 (Provided)
Lowest level floor elevation (feet)	1018 (Assumed)
Column loads (kips)	150 (Assumed)
Wall loads (kips/foot)	8 (Assumed)
Nature of construction	Single-story, slab-on-grade, steel-framed, office- or warehouse-type buildings (Provided)
Cuts or fills for buildings	1 to 3 feet of fill (Assumed)
Tolerable building settlements	1 inch total, ½ inch differential (Assumed)

Table 1-2. Site Aspects and Grading Description

Aspect	Descriptions
Pavement type(s)	Bituminous or concrete for parking and drive areas and aggregate surfacing for yard storage
Assumed pavement loads	Light-duty: 50,000 ESALs* for car parking
	Medium-duty: 100,000 ESALs* for main drive areas
Grade changes	Up to 3 feet of fill in pavement areas (Assumed)

*Equivalent 18,000-lb single axle loads based on 20-year design for bituminous and 35-year design for concrete.



Figure 1-1 below shows an illustration of the proposed development area.



Figure 1-1. Site Development Area

Figure provided by Met-Con Companies, Inc. not dated.



Figure 1-2 below shows an illustration of the proposed site layout within Lot 6.

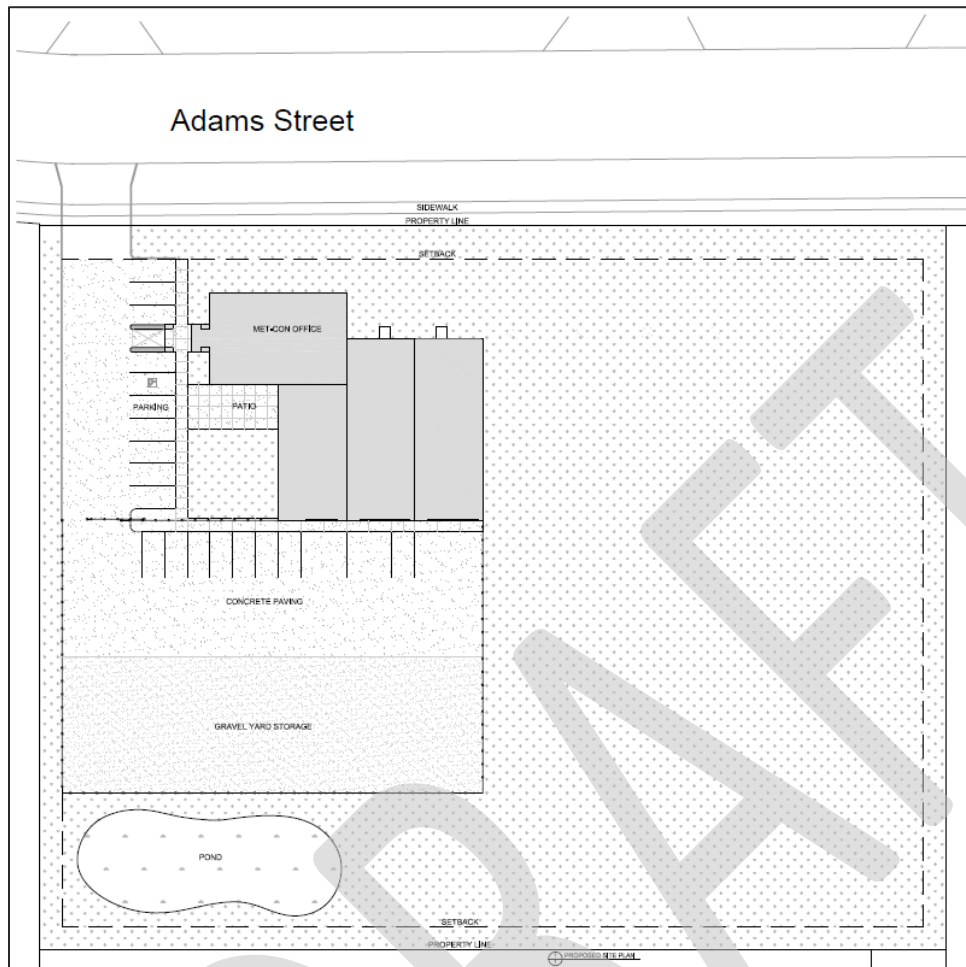


Figure 1-2. Site Layout

Figure provided by Met-Con Companies, Inc. dated June 26, 2025.

1.2 Site Conditions and History

Currently, the site exists as undeveloped agricultural fields. The project area is bounded by Adams Street on the north, County State Aid Highway (CSAH 12) on the west, Madison Avenue on the South and an existing farm and agricultural fields on the east.

Current grades range from about 1012 to 1018 feet with site slopes generally downward to the southeast.

Historically, the development area has remained as agricultural land. As shown in Figure 1-3 below, you will note the current site conditions.



Figure 1-3. Aerial Photograph of the Site in 2025

Figure obtained from Google Earth™ dated May 5, 2025.

1.3 Purpose

The purpose of our geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations, evaluate their impact on the project, and provide geotechnical recommendations for the design and construction of the proposed office building, pavements, and site development of Lots 1 to 5.

1.4 Background Information and Reference Documents

We reviewed the following information:

- Topographic data obtained from MnTOPO.
- Site Layout Plan prepared by Met-Con Companies, Inc. dated June 26, 2025.
- Surficial Geology Map of Blue Earth County, prepared by the University of Minnesota, Minnesota Geological Survey. The map is denoted as Atlas C-26, Part A, Plate 3, dated 2012.
- Google Earth aerial imagery with dates ranging from April 27, 1991 to May 5, 2025.
- Communications with Mr. Scott Brown of Met-Con Companies, Inc. regarding the proposed development.



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.

1.5 Scope of Services

We performed our scope of services for the project in accordance with our Proposal Mr. Scott Brown of Met-Con Companies, Inc., dated and authorized on September 30, 2025. 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.
- Staking and clearing the exploration location of underground utilities. We selected and we staked the new exploration locations. We acquired the surface elevations and locations with GPS technology. The Soil Boring Location Sketch included in the Appendix shows the approximate locations of the borings.
- Performing 24 standard penetration test (SPT) borings, denoted as ST-1 to ST-24, to nominal depths of 5 to 20 feet below grade across the site.
- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.
- Perform engineering analysis including settlement and bearing capacity for spread footing foundations and pavement analysis for pavement design.
- Preparing this report containing a boring location sketch, logs of soil borings, a summary of the soils encountered, results of laboratory tests, and recommendations for structure and pavement subgrade preparation and the design of foundations, floor slabs, exterior slabs, utilities, stormwater improvements, and pavements.

2.0 Results

2.1 Geologic Overview

We based the geologic origins used in this report on the soil types, in-situ and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.



2.2 Boring Results

Table 2-1 provides a summary of the soil boring results, in the general order we encountered the strata. Please refer to the Log of Boring sheets in the [Appendix](#) for additional details. The Descriptive Terminology sheets in the [Appendix](#) include definitions of abbreviations used in the table below.

Table 2-1. Subsurface Profile Summary

Strata	Soil Type -ASTM Classification	Range of Penetration Resistances	Commentary and Details
Topsoil	OL, CL, SM, SC	--	- Thickesses at boring locations varied from 1 to 3 1/2 feet. - Slightly organic to organic. - Dark brown to black. - Moisture condition generally moist to wet.
Glaciolacustrine	CL, SC, ML, OL	3 to 9 blows per foot (BPF)	- Primarily lean clay with varying sand contents but also silt and organic clay. - Encountered to depths of about 4 to 11 feet. - Locally slightly organic to organic. - General penetration resistance of 3 to 6 BPF indicating the cohesionless silts and sands were very loose to loose in relative density and the cohesive clays were soft to stiff in consistency. - Brown, gray, dark gray and black in color. - Moisture condition generally moist.
Glacial deposits	SP-SC	5 to 9 BPF	- Primarily till composed of lean clay with varying sand contents but also outwash composed of sand with silt. - Possible cobbles and boulders. - Variable amounts of gravel and may contain cobbles and boulders.
	CL, SC	3 to 16 BPF	- Locally slightly organic. - General penetration resistance of 3 to 7 BPF, indicating the glacial soils were generally soft to medium in consistency and loose in relative density. - Moisture condition generally moist to wet.

2.3 Groundwater

Table 2-3 summarizes the depths where we observed groundwater; the attached Log of Boring sheets in the [Appendix](#) also include this information and additional details. We did not observe groundwater while performing the remainder of our borings. Groundwater may take days or longer to reach equilibrium in the boreholes and we immediately backfilled the boreholes, in accordance with our scope of work. Given the coloration of soils and experience with projects in the area, we anticipate that perched groundwater will likely be encountered at depths of 4 to 8 feet. In addition, glacial till (composed of sandy lean clay) frequently



contains isolated pockets and seams of water-bearing sands and gravels. These water-bearing layers are generally limited to extent but can produce a sudden influx of water when encountered during drilling operations or in excavations. If the project team identifies a need for more accurate determination of groundwater depth, we can install piezometers. Project planning should anticipate seasonal and annual fluctuations of groundwater.

Table 2-2. Groundwater Summary

Locations	Surface Elevation	Measured or Estimated Depth to Groundwater (ft)	Corresponding Groundwater Elevation (ft)
ST-2	1015.4	10	1005 1/2
ST-3	1016.2	10	1006 1/2
ST-4	1014.5	10	1004 1/2
ST-5	1017.1	12	1005 1/2
ST-15	1016.4	7 1/2	1009
ST-20	1016.9	10	1007

2.4 Laboratory Test Results

The boring logs show the results of laboratory testing we performed, next to the tested sample depth. The Appendix contains the results of these tests. The laboratory tests were completed in accordance with the current standards as specified by the American Society for Testing and Materials (ASTM).

The moisture content tests (ASTM D 2216) performed on select soil samples indicated a moisture content of 17 to 40 percent moisture by weight. The tests on the select soil samples indicate that the clay-laden soils are near to well above their estimated optimum moisture contents.

Sieve analysis tests (ASTM D 422) performed on select soil samples indicated 11 to 41 percent particles, by weight, passing the #200 sieve.

Liquid limits determined for the select soil samples ranged from 38 to 48; plastic limits ranged from 13 to 21. These results indicate that the select soil samples are classified as lean clay (CL) or silt.

We performed organic content tests (ASTM D2974) on selected samples to determine the reusability of the material for structure support and pavement design. The organic content of the selected material tested ranged from 4 to 6 percent, indicating the samples tested were slightly organic to organic.



3.0 Recommendations

3.1 Design and Construction Discussion

Based on the results of our exploration, field and laboratory tests and our understanding of the proposed project, it is our opinion that the site is suitable for the proposed project, with the following geotechnical design and construction considerations.

3.1.1 Building Subgrade Preparation

All borings encountered topsoil at the surface that was between about 1 to 3 1/2 feet in thickness that is unsuitable for use as subgrade material as well as structural fill and will need to be removed from all building and pavement areas.

Portions of the glacial clays and clayey sands present throughout the site are soft, slightly organic to organic, and are considered compressible. If these soils are left in place below the proposed building footprints, there is an elevated risk of post-construction settlement, and the soils cannot be directly relied upon to support the proposed building foundations. Therefore, we recommend removing soft clays with penetration test values less 4 BPF during mass grading and soft clays with penetration test values less than 5 below foundations and replacing them with compacted granular structural fill as described in [Table 3-2](#). Additionally, to allow for fill-induced consolidation to occur prior to placement of foundations, we recommend grade raises be completed prior to foundation construction.

3.1.2 Reuse of On-Site Soils

The majority of the on-site glacial clay soils tested were several percentage points to well above their estimated optimum moisture content, particularly in the upper 5 to 10 feet of the soil profile. Should these soils be selected for use as engineered fill, they will likely need to be moisture conditioned (dried) to achieve compaction. In our opinion, these materials are suitable for reuse if the contractor performs scarifying of these materials and are placed in the locations shown in [Table 3-2](#). To reduce settlement and facilitate construction, we do not recommend the onsite clayey soils be re-used as structural fill directly below foundations. Additionally, the silt and organic soils present on the site will be highly moisture sensitive, difficult to compact and provide limited support, thus we do not recommend reusing them outside of green spaces. Granular material used as soil correction backfill will need to be imported. Soils with more than 2-percent organic content should not be considered suitable for reuse as structural fill.

To achieve the proper moisture content within the on-site soils, the soils should be dried during the summer months. If the contractor performs site grading in the spring or fall, on-site drying of these soils may not prove feasible and require importing drier soils. If project constraints do not allow the time, or ideal weather conditions, the overly wet soil may need to be replaced with suitable material. We recommend discussing the reuse of these materials and required import quantities with potential contractors at the bidding stages of the project.



3.1.3 Groundwater

Perched water conditions will likely be present during construction. It is possible to encounter sand pockets and seams within the glacial clays and excavations may experience a sudden influx of groundwater. Temporary dewatering measures such as sumps pits should be anticipated during construction in clay areas as well as potential reconnection of disturbed field tile around the construction limits. Where clay soils are encountered in excavation bottoms, we recommend including provisions for placement of 4 to 6 inches of crushed aggregate in foundation excavations to provide a construction platform and a medium for removal of any accumulating water during construction.

3.1.4 Construction Disturbance

The contractor should note the on-site, clayey soils are highly susceptible to disturbance, due to repeated construction traffic. Disturbance of these soils may cause areas that were previously prepared, or that were suitable for pavement or structure support, to become unstable and require moisture conditioning and compaction. Subcutting and replacing the disturbed material with crushed, coarse gravel, free of fines is also an alternative. The contractor should use means and methods to limit disturbance of the soils.

If significant rainfall is anticipated during construction, the site should be graded to intercept surface water flow into the area and drain water from the area to an appropriate collection point. After grading, the soil surface should be compacted with a smooth drum roller to attempt to lower infiltration. After the rain, construction traffic should be limited until the surface has dried somewhat, to prevent traffic from mixing water that has accumulated at the surface into lower portions of the soil.

3.1.5 Frost Heave Mitigation

The soils encountered on the site are generally susceptible to frost heave. If heaving of exterior slabs and sidewalks is unacceptable, consideration should also be given to incorporating a granular subbase into these sections. A granular subbase enhances subgrade drainage, reduces the potential for subgrades to become saturated and heave upon freezing, and reduces the effects of subgrade strength loss upon thawing.

3.1.6 Pavement

In preparation of pavement subgrades, the project team should anticipate removal of topsoils within 3 feet of the pavements and some areas of unstable clayey or silty soils. If required, the contractor should perform scarification, drying and recompaction, as outlined in Section 3.2.7. Depending on the time of year and weather conditions, scarification, drying, and recompaction efforts may require multiple iterations to stabilize pavement subgrades.

To improve long-term pavement performance, the project team should consider a pavement design that incorporates non-frost-susceptible sand in paved areas. Incorporation of the sand into the pavement section will reduce the impact of the frost heave and subsequent thaw-weakening of the soils beneath the pavement. The sand will also provide better drainage throughout the year. Sand will not only increase the life of the pavement but will likely reduce reconstruction cost at the end of the pavement life. If the pavement design incorporates a sand subgrade, it could then decrease the aggregate base thickness.



3.2 Site Grading and Subgrade Preparation

3.2.1 Building Subgrade Excavations

We recommend removing unsuitable materials from below the proposed buildings and their oversize areas. We define unsuitable materials as topsoil, existing fill, frozen materials, slightly organic to organic soils, existing utilities, draisile, vegetation, and soft/loose soils with penetration test values less than 4 BPF. Table 3-1 shows the anticipated excavation depths and bottom elevations for each of the borings.

Table 3-1. Building Excavation Depths

Location	Approximate Surface Elevation (ft)	Anticipated Excavation Depth (ft)**	Anticipated Bottom Elevation* (ft)
ST-1	1017.0	2	1015
ST-2	1015.4	7	1008
ST-3	1016.2	7	1009
ST-4	1014.5	5	1009 1/2
ST-5	1017.1	7	1010
ST-11	1014	7	1007
ST-12	1015.4	1	1014 1/2
ST-14	1016.5	1	1015 1/2
ST-15	1016.4	6	1010
ST-17	1013.4	1 1/2	1011 1/2
ST-18	1014.9	4	1010 1/2
ST-20	1016.9	10	1006 1/2
ST-21	1017.6	2	1015 1/2
ST-23	1015.4	1 1/2	1014
ST-24	1015.1	1	1014

*Rounded down to the nearest 1/2-foot.

**In addition to removals depths noted above, we recommend removing any soft to medium soils with penetration test values less than 6 BPF within 1/2 of a column width below column pads and a full footing width below continuous foundations and replacing them with select structural fill.

Excavation depths will vary between the borings. Portions of the excavations may also extend deeper than indicated by the borings. A geotechnical representative should observe the excavations to make the necessary field judgments regarding the suitability of the exposed soils.

The contractor should use equipment and techniques to minimize soil disturbance. If soils become disturbed or are wet, we recommend excavation and replacement.



3.2.2 Excavation Oversizing

When removing unsuitable materials below structures or pavements, we recommend the excavation extend outward and downward at a slope of 1H:1V (horizontal:vertical) or flatter. See [Figure 3-1](#) for an illustration of excavation oversized.

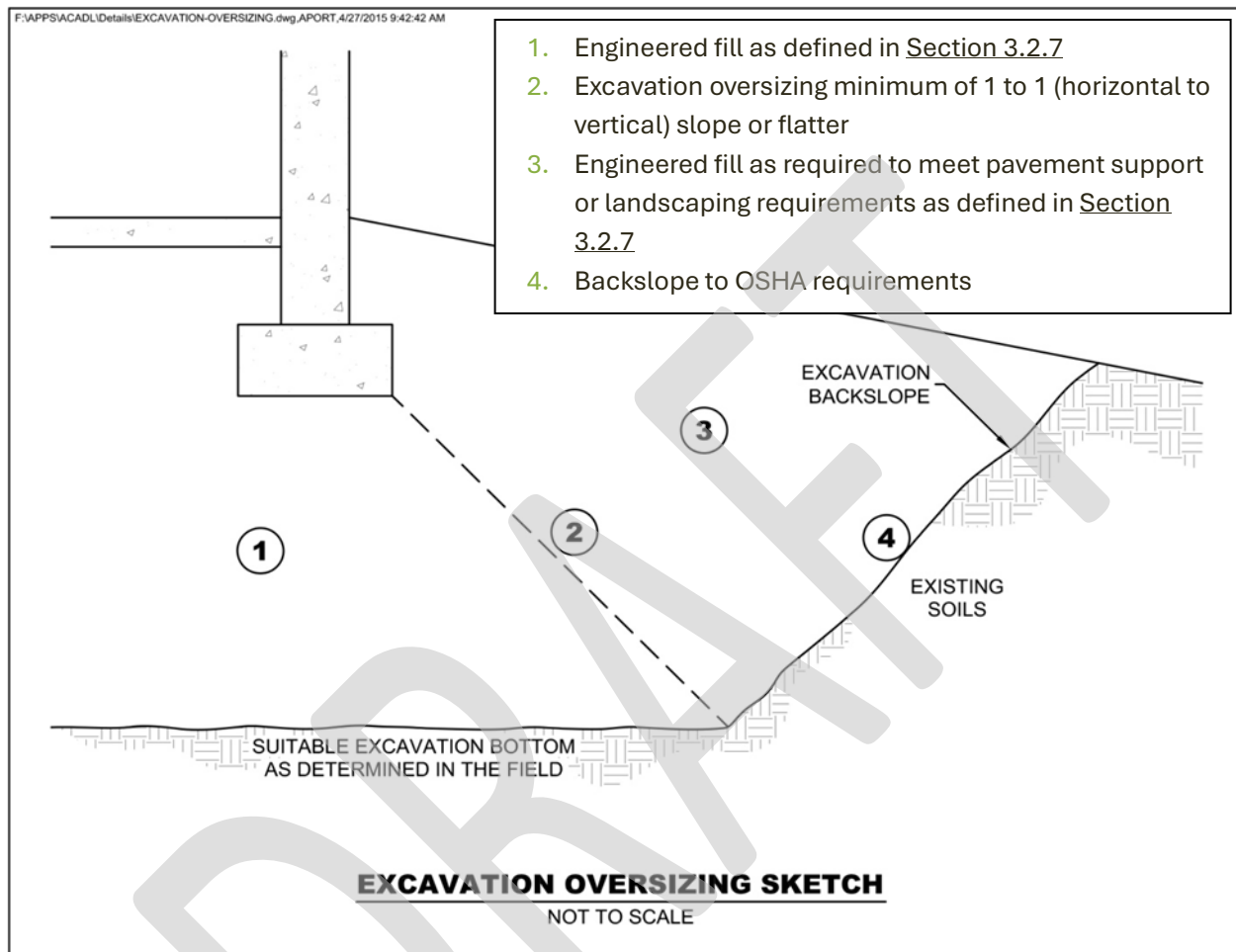


Figure 3-1. Generalized Illustration of Oversizing

3.2.3 Excavated Slopes

Based on the borings, we anticipate on-site soils in excavations will consist of soft to medium glacial clays and loose glacial sands and silts. These soils are typically considered Type C Soil under OSHA (Occupational Safety and Health Administration) guidelines. OSHA guidelines indicate unsupported excavations in Type C soils should have a gradient no steeper than 1 1/2H: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 that excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

3.2.4 Excavation Dewatering

We recommend removing surface of water or groundwater from the excavations. Project planning should include temporary sumps and pumps for excavations in low-permeability soils, such as clays.

3.2.5 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 3 feet or less. Note that project planning may require additional subcuts to limit frost heave.

1. Strip unsuitable soils consisting of topsoil, organic soils, vegetation, existing fill, and pavements from the area, within 3 feet of the pavement subgrade.
2. Subcut to allow for placement of the pavement and exterior slab section.
3. Have a geotechnical representative observe the excavated subgrade to evaluate if additional subgrade improvements are necessary.
4. Slope subgrade soils to areas of sand or drain tile to allow the removal of accumulating water.
5. Scarify, moisture condition and surface compact the subgrade with at least three passes of a large roller with a minimum drum diameter of 3 1/2 feet. It should be noted that multiple iterations of moisture conditioning may be required based on the high moisture content of the soils tested.
6. If overly soft or wet soils are encountered after the required removals that do not allow for placement of engineered fill, or if weather conditions do not allow for adequate drying and recompaction of engineered fill, we recommend performing subgrade stabilization that consists of either:
 - a. Subexcavating below the existing subgrade soils to allow for placement of a minimum of 24 inches of clean, sand subbase to bridge the softer soils.
 - b. Place geogrid reinforcement (Tensar NX750 or equivalent) on the surface of the clay subgrade in correction areas and place a thicker section of aggregate base. It should be noted that where stabilization is necessary, it may be necessary in localized areas to place a second layer of geogrid reinforcement approximately 6 to 8 inches below the top of aggregate base. We recommend initially constructing a test strip to evaluate the need for a second layer of geogrid.

Ultimately, the method and thickness of stabilization will have to be based on test sections placed within the pavement areas and will be dependent on what is needed to meet the requirements of a proofroll.



7. Place pavement engineered fill to grade and compact in accordance with [Section 3.2.7](#) to bottom of pavement and exterior slab section. See [Section 3.5](#) for additional considerations related to frost heave.
8. Proofroll the pavement or exterior slab subgrade as described in [Section 3.2.6](#).

To improve long-term pavement performance, we recommend incorporating 12 to 18 inches of sand subbase engineered fill in paved areas, in addition to the recommendations above, as a sand subbase. Note, we recommend sloping subgrade soils to promote drainage and removal of accumulated water.

3.2.6 Pavement Subgrade Proofroll

After preparing the subgrade as described above and prior to the placement of the 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.

3.2.7 Engineered Fill Materials and Compaction

[Table 3-2](#) below contains our recommendations for engineered fill materials.

Table 3-2. Engineered Fill Materials*

Locations To Be Used	Engineered Fill Classification	Possible Soil Type Descriptions	Gradation	Additional Requirements
- Mass grading - Below interior slabs	Structural fill	SP, SP-SM, SM, SC, CL (excluding ML)	100% passing 2-inch sieve	< 2% Organic Content (OC) - Liquid Limit (LL) < 50%
Non-frost-susceptible	- Free draining - Non-frost-susceptible fill	GP, GW, SP, SW	100% passing 1-inch sieve < 50% passing #40 sieve < 5% passing #200 sieve	< 2% OC
- Soil Corrections below foundations - Deep Structural Fill (>10 feet of fill)	- Deep sand fill - Select structural fill	SP, SP-SM	100% passing 1-inch sieve < 12% passing #200 sieve	< 2% OC
Pavements	Pavement fill	SP, SP-SM, SM, SC, CL (excluding ML)	100% passing 3-inch sieve	< 3% OC - PI < 20%



Locations To Be Used	Engineered Fill Classification	Possible Soil Type Descriptions	Gradation	Additional Requirements
Below landscaped surfaces, where subsidence is not a concern	Non-structural fill	Any Soil Type	100% passing 6-inch sieve	< 10% OC

* More select soils comprised of coarse sands with < 5% passing #200 sieve may be needed to accommodate work occurring in periods of wet or freezing weather.

If there is a need for deeper soil correction work or if there is a need for large grade raises that will require more than 10 feet of compacted fill below the lowest floor grades, we recommend placing sand fill (less than 12 percent passing the #200 sieve) as structural fill at depths deeper than 10 feet. If only clay fill is used to fill building pads where more than 10 feet of fill is needed, a construction delay of at least 3 to 12 months may be needed, depending on the final depths of clay fill used. As an alternative, on lots where deep fills are needed, deep sand fill could be used to initially fill the excavations below these house pads. The deep sand fill should be placed in thin compacted lifts, up to an elevation of 10 feet or less from the finished lowest floor grades. On-site clay fill can then be used to complete construction of the building pads. If the alternative method of filling the building pads partially with deep sand fill is used, a construction delay would not be needed. Any sand fill needed for deeper fill will need to be imported to the site.

We recommend spreading engineered fill in loose lifts of approximately 8 to 10 inches thick. We recommend compacting engineered fill in accordance with the criteria presented below in Table 3-3. The project documents should specify relative compaction of engineered fill, based on the structure located above the engineered fill, and vertical proximity to that structure.

Table 3-3. Compaction Recommendations Summary

Reference	Relative Compaction, percent (ASTM D698 – Standard Proctor) (ASTM D1557 – Modified Proctor)	Moisture Content Variance from Optimum, percentage points	
		< 12% Passing #200 Sieve (typically SP, SP-SM)	> 12% Passing #200 Sieve (typically CL, SC, SM)
Below foundations and oversizing zones and mass grading	98	±3	-1 to +3
Below interior slabs	5	±3	-1 to +3
Within 3 feet of pavement subgrade	100	±3	-2 to +1
More than 3 feet below pavement subgrade	95	±3	-1 to +3
Below landscaped surfaces	90	±6	±5

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.

3.2.8 Special Inspections of Soils

We recommend including the site grading and placement of engineered fill within the building pad under the requirements of Special Inspections, as provided in Chapter 17 of the International Building Code, which is part of the Minnesota State Building Code. Special Inspection requires observation of soil conditions below engineered fill or footings, evaluations to determine if excavations extend to the anticipated soils, and if engineered fill materials meet requirements for engineered fill and compaction condition of engineered fill. A licensed geotechnical engineer should direct the Special Inspections of site grading and engineered fill placement. The purpose of these Special Inspections is to evaluate whether the work is in accordance with the approved geotechnical report for the project. Special Inspections should include evaluation of the subgrade, observing preparation of the subgrade (surface compaction or dewatering, excavation oversizing, placement procedures, and materials used for engineered fill, etc.) and compaction testing of the engineered fill.

3.3 Spread Footings

We assume the foundation subgrade will consist of native soils with penetration test values of at least 6 BPF or compacted engineered fill soils. We recommend including an allowance for subcutting soft, wet soils below the footings due to groundwater and replacing with at least 4 to 6 inches of clear, crushed gravel free of fines.



Table 3-4 below contains our recommended parameters for foundation design. Given the limited information available for development of Lots 1 through 5, these recommendations should be considered preliminary, and we recommend additional exploration and evaluation be performed once further development information is available.

Table 3-4. Recommended Spread Footing Design Parameters

Item	Description
Maximum net allowable bearing pressure (psf)	1,500 (for Lot 6 based on subgrade improvement recommended here within)
Minimum factor of safety for bearing capacity failure	3.0
Minimum embedment below final exterior grade for heated structures (inches)	42
Minimum embedment below final exterior grade for unheated structures or for footings not protected from freezing temperatures during construction (inches)	60
Total estimated settlement (inches)	1*
Differential settlement (inches)	Typically, about 2/3 of total settlement**

* If the site is raised more than 3 feet, a time delay is recommended to allow the soft soils time to consolidate.

** Actual differential settlement amounts will depend on final loads and foundation layout. We can evaluate differential settlement based on final foundation plans and loadings.

3.4 Interior Slabs

3.4.1 Subgrade Modulus

The anticipated floor subgrade is engineered clay fill. We recommend using a modulus of subgrade reaction, k , of 100 pounds per square inch per inch of deflection (pci) to design the slabs. If the slab design requires placing 6 inches of compacted crushed aggregate base immediately below the slab, the slab design may increase the k -value by 50 pci. We recommend that the aggregate base materials be free of bituminous. In addition to improving the modulus of subgrade reaction, an aggregate base facilitates construction activities and is less weather sensitive.

3.4.2 Moisture Vapor Protection

Excess transmission of water vapor could cause floor dampness, certain types of floor bonding agents to separate, or mold to form under floor coverings. If project planning includes using floor coverings or coatings, we recommend placing a vapor retarder or vapor barrier immediately beneath the slab. We also recommend consulting with floor covering manufacturers regarding the appropriate type, use and installation of the vapor retarder or barrier to preserve warranty assurances.



3.5 Frost Protection

3.5.1 General

Clayey and silty soils will underlie exterior slabs, as well as pavements. We consider clayey and silty soils to be moderately to highly frost susceptible. Soils of this type can retain moisture and heave upon freezing. In general, this characteristic is not an issue unless these soils become saturated, due to surface runoff or infiltration, or are excessively wet in-situ. Once frozen, unfavorable amounts of general and isolated heaving of the soils and the surface structures supported on them could develop. This type of heaving could affect design drainage patterns and the performance of exterior slabs and pavements, as well as any isolated exterior footings and piers.

Note that general runoff and infiltration from precipitation are not the only sources of water that can saturate subgrade soils and contribute to frost heave. Roof drainage and irrigation of landscaped areas in close proximity to exterior slabs, pavements, and isolated footings and piers, contribute as well.

3.5.2 Frost Heave Mitigation

To address most of the heave related issues, we recommend setting general site grades and grades for exterior surface features to direct surface drainage away from buildings, across large, paved areas and away from walkways. Such grading will limit the potential for saturation of the subgrade and subsequent heaving. General grades should also have enough “slope” to tolerate potential larger areas of heave, which may not fully settle after thawing.

Even small amounts of frost-related differential movement at walkway joints or cracks can create tripping hazards. Project planning can explore several subgrade improvement options to address this condition.

One of the more conservative subgrade improvement options to mitigate potential heave is removing any frost-susceptible soils present below the exterior slab areas down to a minimum depth of 4 feet below subgrade elevations. We recommend filling the resulting excavation with non-frost-susceptible fill. We recommend providing drainage at the base of the subcut, as well as gradual transitions from this subcut (3H:1V or flatter gradient). We also recommend sloping the bottom of the excavation toward one or more collection points to remove any water entering the engineered fill. This approach will not be effective in controlling frost heave without removing the water.

An important geometric aspect of the excavation and replacement approach described above is sloping the banks of the excavations to create a more gradual transition between the unexcavated soils considered frost susceptible and the engineered fill in the excavated area, which is not frost susceptible. The slope allows attenuation of differential movement that may occur along the excavation boundary. We recommend slopes that are 3H:1V, or flatter, along transitions between frost-susceptible and non-frost-susceptible soils.

Figure 3-2 shows an illustration summarizing some of the recommendations.

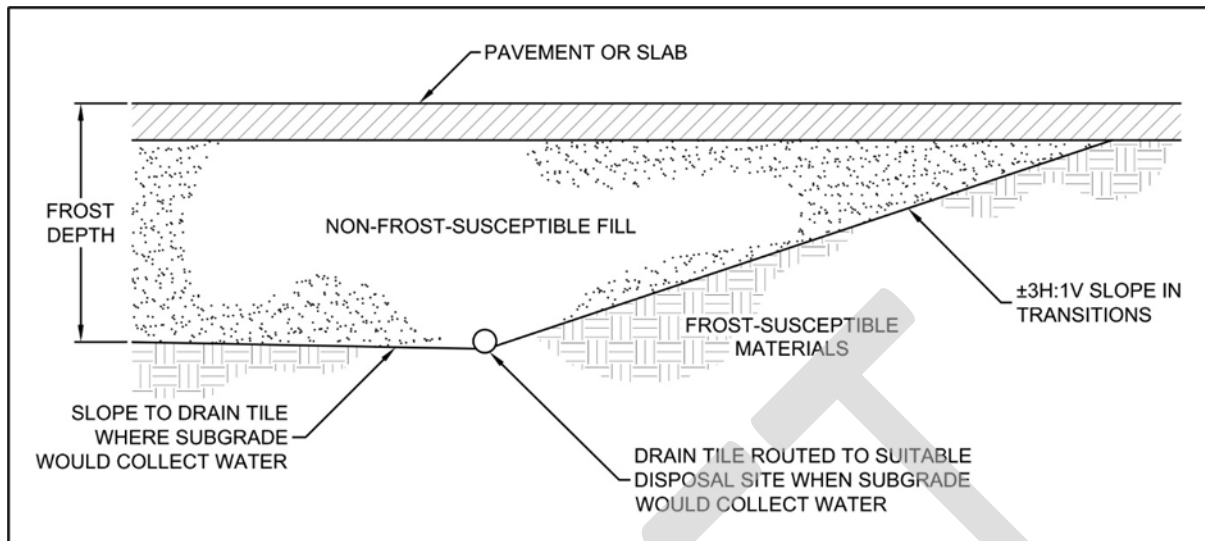


Figure 3-2. Frost Protection Geometry Illustration

Another option is to limit frost heave in critical areas, such as doorways and entrances, via frost-depth footings or localized excavations with sloped transitions between frost-susceptible and non-frost-susceptible soils, as described above.

Over the life of slabs and pavements, cracks will develop, and joints will open up, which will expose the subgrade and allow water to enter from the surface and either saturate or perch atop the subgrade soils. This water intrusion increases the potential for frost heave or moisture-related distress near the crack or joint. Therefore, we recommend implementing a detailed maintenance program to seal and/or fill any cracks and joints. The maintenance program should give special attention to areas where dissimilar materials abut one another, where construction joints occur and where shrinkage cracks develop.

3.6 Pavements and Exterior Slabs

3.6.1 Design Sections

Our scope of services for this project did not include laboratory tests on subgrade soils to determine an R-value for pavement design. Based on our experience with similar clayey soils anticipated at the pavement subgrade elevation, we recommend pavement design assume an R-value of 10. Note the contractor may need to perform limited removal of unsuitable or less suitable soils or mechanical or chemical stabilization to achieve this value. [Table 3-6](#) provides recommended pavement sections, based on the soils support and traffic loads.

We based the concrete pavement designs on a modulus of subgrade reaction (k) of 75 pci.



Table 3-5. Recommended Bituminous and Concrete Pavement Sections

Use	Light Duty Bituminous	Medium Duty Bituminous	Light Duty Concrete	Medium Duty Concrete
Minimum asphalt thickness (inches)	3 ½	4	---	---
Minimum concrete thickness (inches)	---	---	5	6
Minimum aggregate base thickness (inches)	6	8	4	4
Minimum granular subbase	12	18	12	18

3.6.2 Concrete Pavements

We assumed the concrete pavement sections in [Table 3-6](#) 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 you contact your civil engineer to determine the final design or consult with us for guidance on these items.

3.6.3 Bituminous Pavement Materials

Appropriate mix designs are critical to the performance of flexible pavements. We can provide recommendations for pavement material selection during final pavement design.

3.6.4 Subgrade Drainage

We recommend installing perforated drainpipes throughout pavement areas at low points, around catch basins, and behind curb in landscaped areas. We also recommend installing drainpipes along pavement and exterior slab edges where exterior grades promote drainage toward those edge areas. The contractor should place drainpipes in small trenches, extended at least 8 inches below the granular subbase layer, or below the aggregate base material where no subbase is present.

3.6.5 Performance and Maintenance

We based the above pavement designs on a 20-year performance life for bituminous and a 35-year life for concrete. This is the amount of time before we anticipate the pavement will require reconstruction. This performance 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 few 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.

3.7 Utilities

3.7.1 Subgrade Stabilization

Earthwork activities associated with utility installations located inside the building area should adhere to the recommendations in [Section 3.2](#).

For exterior utilities, we anticipate the soils at typical invert elevations will be suitable for utility support. However, if construction encounters unfavorable conditions such as soft clay, organic soils or perched water at invert grades, the unsuitable soils may require some additional subcutting and replacement 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.

3.7.2 Corrosion Potential

Based on our experience, the soils encountered in 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.

3.8 Equipment Support

The recommendations included in the report may not be applicable to equipment used for the construction and maintenance of this project. We recommend evaluating subgrade conditions in areas of shoring, scaffolding, cranes, pumps, lifts, and other construction equipment prior to mobilization to determine if the exposed materials are suitable for equipment support or require some form of subgrade improvement. We also recommend project planning consider the effect that loads applied by such equipment may have on structures they bear on or surcharge – including pavements, buried utilities, below-grade walls, etc. We can assist you in this evaluation.



4.0 Procedures

4.1 Penetration Test Borings

We drilled the penetration test borings with a flotation tire-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D6151 taking penetration test samples at 2 1/2- or 5-foot intervals in general accordance with ASTM D1586. The boring logs show the actual sample intervals and corresponding depths.

We sealed penetration test boreholes meeting the Minnesota Department of Health (MDH) Environmental Borehole criteria with an MDH-approved grout. We will forward a sealing record (or sealing records) for those boreholes to the MDH Well Management Section.

4.2 Exploration Logs

4.2.1 Log of Boring Sheets

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials and present the results of penetration resistance performed. The logs also present the results of laboratory tests performed on penetration test samples, and groundwater measurements. The Appendix also includes a Fence Diagram intended to provide a summarized cross-sectional view of the soil profile across the site.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

4.2.2 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 testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past .



4.3 Material Classification and Testing

4.3.1 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.

4.3.2 Laboratory Testing

The exploration logs in the [Appendix](#) note most of the results of the laboratory tests performed on geologic material samples. We performed the tests in general accordance with ASTM procedures.

4.4 Groundwater Measurements

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes, as noted on the boring logs.

5.0 Qualifications

5.1 Variations in Subsurface Conditions

5.1.1 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.

5.1.2 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.



5.2 Continuity of Professional Responsibility

5.2.1 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.

5.2.2 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.

5.3 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.

5.4 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

Soil Boring Location Sketch

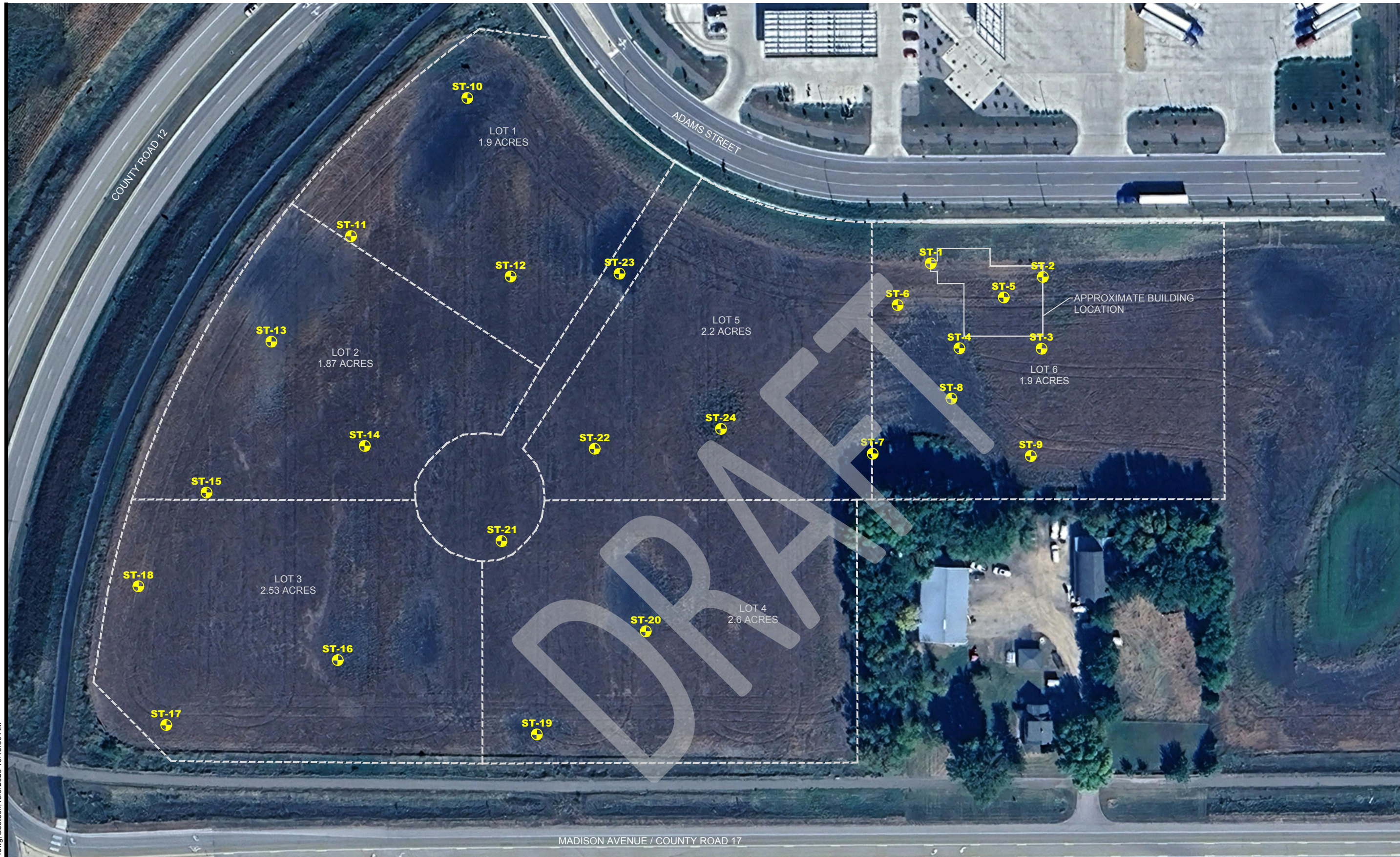
Fence Diagram

Log of Boring Sheets ST-1 to ST-24

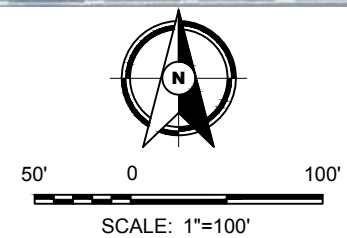
Descriptive Terminology of Soil

DRAFT

F:\2025\B2508847\CAD\B2508847.dwg, Geotech, 10/9/2025 10:13:59 AM



● DENOTES APPROXIMATE LOCATION OF
STANDARD PENETRATION TEST BORING



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North Mankato, MN 56003
507.594.3000
braunintertec.com

Drawing Information

Project No:
B2508847

Drawing No:
B2508847

Drawn By: MMH
Date Drawn: 10/9/25
Checked By: IB
Last Modified: 10/9/25

Project Information

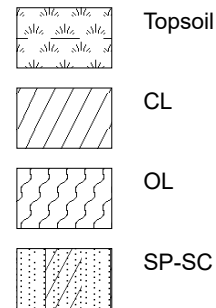
Met-Con Mankato Office
and Site Development

East of County Highway
12 Between Adams
Street and Madison
Avenue

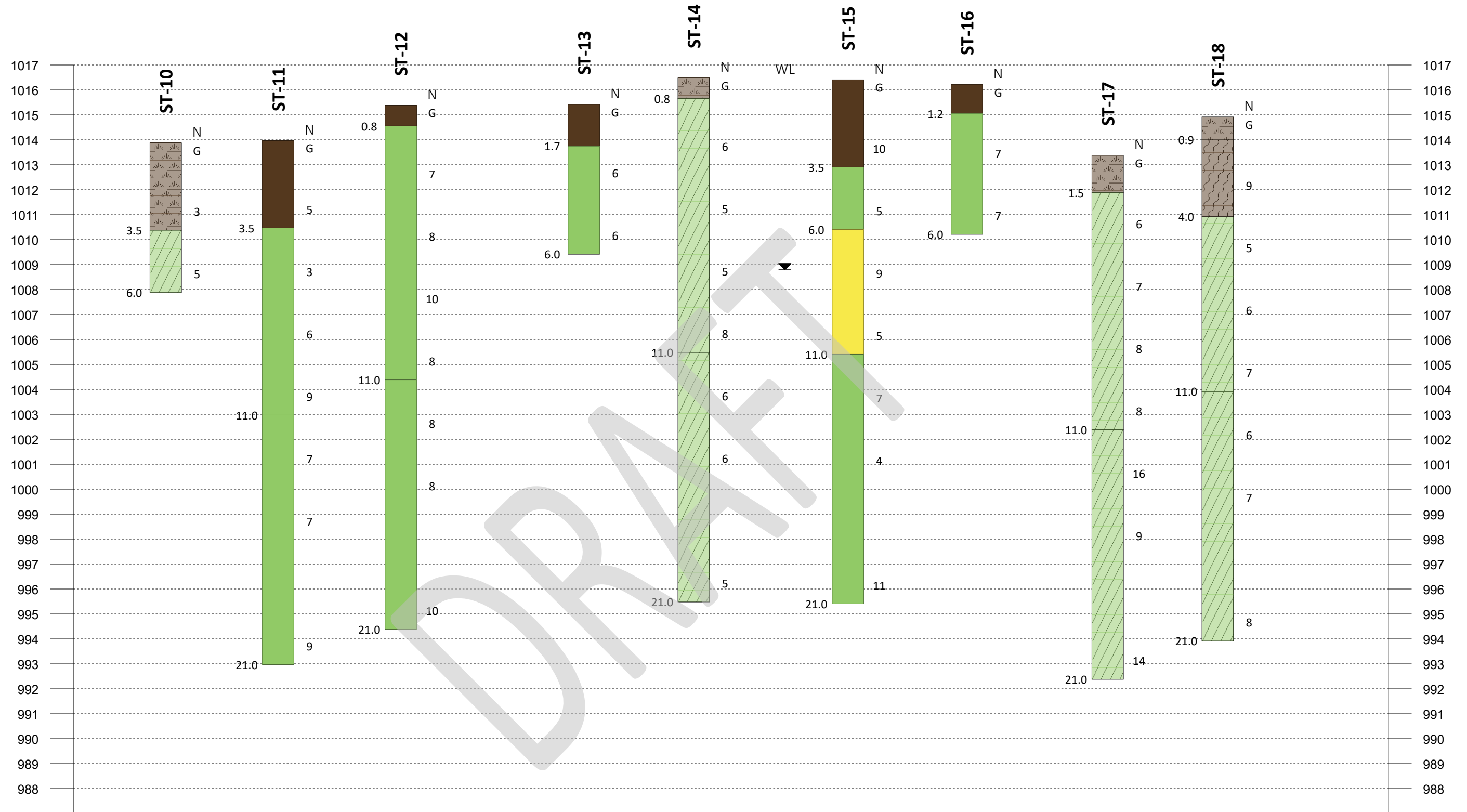
Mankato, Minnesota

**Soil Boring
Location Sketch**

Legend Key



987.00
↓



ST-10 to ST-18

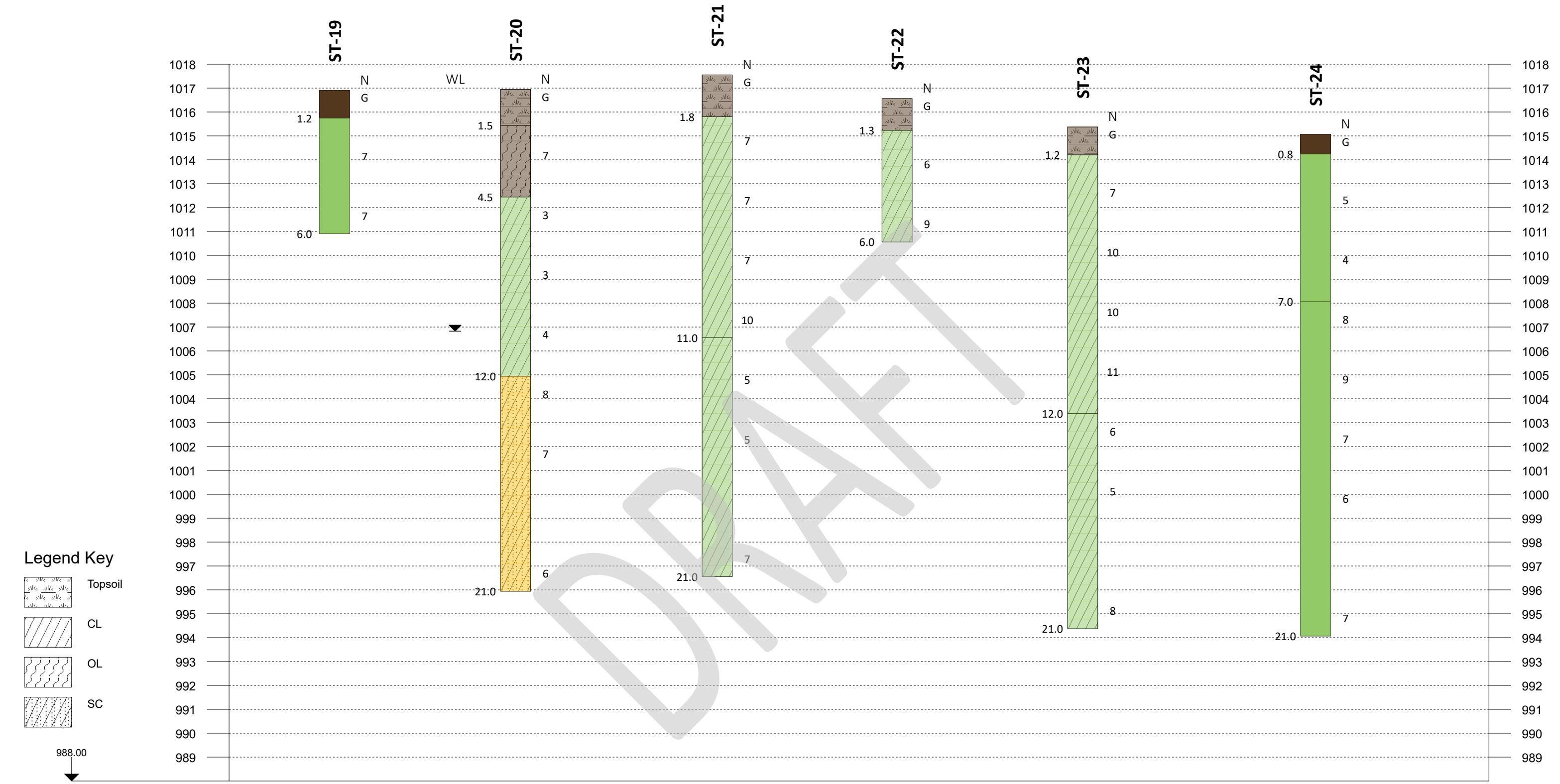
Fence Diagram

Geotechnical Evaluation

Met-Con Mankato Office and Site Development

E of Cty Hwy 12 between Adams St and Madison Ave

Mankato, Minnesota



LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-01		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 217080.3	EASTING: 589641.5	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/06/25	END DATE: 10/06/25			
SURFACE ELEVATION: 1017.0 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 50°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1015.0		CLAYEY SAND (SC), fine to medium-grained, slightly organic, black, moist (TOPSOIL)					
2.0		SANDY LEAN CLAY (CL), trace Gravel, gray, moist, soft to medium (GLACIAL TILL)		2-3-4 (7) 8"		27	
			5	1-2-2 (4) 10"			
				1-2-3 (5) 8"		27	
			10	1-2-5 (7) 12"			
				1-3-4 (7) 10"			
			15	2-3-5 (8) 14"		24	
				1-2-3 (5) 16"			
996.0		END OF BORING					Water not observed while drilling.
21.0		Boring then backfilled with bentonite grout					Water not observed immediately after withdrawal of auger.

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-02		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 217065.8	EASTING: 589761.1	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/06/25	END DATE: 10/06/25			
SURFACE ELEVATION: 1015.4 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 50°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1014.1		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, moist (TOPSOIL)					
1.3		LEAN CLAY (CL), light gray, moist, soft (GLACIAL LAKE)		1-2-2 (4) 6"		27	
1011.4		CLAYEY SAND (SC), trace Gravel, gray, moist, soft (GLACIAL LAKE)	5	1-1-2 (3) 10"			
1008.4		SANDY SILT (ML), brown, moist, loose (GLACIAL LAKE)		2-3-3 (6) 10"		28	LL=38, PL=25, PI=13
1006.4		SANDY LEAN CLAY (CL), trace Gravel, gray, moist, medium (GLACIAL TILL)	10	1-3-4 (7) 12"		36	
				2-3-4 (7) 0"			No recovery
			15	1-1-4 (5) 0"			No recovery
			20	3-4-4 (8) 16"			
994.4		END OF BORING					Water observed at 10.0 feet while drilling.
21.0		Boring then backfilled with bentonite grout					Water observed at 10.0 feet immediately after withdrawal of auger.

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-03		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216989.3	EASTING: 589759.7	
DRILLER: E. Rislov		LOGGED BY: I. Breitlow		START DATE: 10/06/25	END DATE: 10/06/25		
SURFACE ELEVATION: 1016.2 ft		RIG: 8505	METHOD: 3 1/4" HSA		SURFACING: Farm Field	WEATHER: Clear, 50°s	
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1014.9		SILTY SAND (SM), slightly organic, black, moist (TOPSOIL)					
1.3		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black to gray, moist, soft to medium (GLACIAL LAKE)		1-2-3 (5) 6"		30	OC=5%
1012.2		SANDY LEAN CLAY (CL), trace Gravel, brown to gray, moist, soft to medium (GLACIAL TILL)		1-1-2 (3) 10"		26	
4.0				1-2-4 (6) 12"			
				2-4-4 (8) 0"			No recovery
				2-2-5 (7) 14"			
				1-2-3 (5) 0"			No recovery
				1-2-3 (5) 0"			No recovery
995.2		END OF BORING					Water observed at 10.0 feet while drilling.
21.0		Boring then backfilled with bentonite grout					Water observed at 10.0 feet immediately after withdrawal of auger.

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-04		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216989.8	EASTING: 589672.0	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/06/25	END DATE: 10/06/25			
SURFACE ELEVATION: 1014.5 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 50°s			

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1013.3		CLAYEY SAND (SC), fine to medium-grained, slightly organic, black, moist (TOPSOIL)					
1.2		SANDY LEAN CLAY (CL), trace Gravel, brown to gray, moist, soft to medium (GLACIAL TILL)		1-1-2 (3) 0"			No recovery
			5	1-2-2 (4) 12"		23	
				1-1-3 (4) 10"		26	
			10	1-2-3 (5) 3"		27	
		Wet and dark gray at 10 feet		2-3-3 (6) 0"			No recovery
			15	1-2-3 (5) 4"			
			20	1-2-4 (6) 6"			
993.5		END OF BORING					Water observed at 10.0 feet while drilling.
21.0		Boring then backfilled with bentonite grout					Water observed at 10.0 feet immediately after withdrawal of auger.

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-05		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 217043.9	EASTING: 589719.3	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/06/25	END DATE: 10/06/25			
SURFACE ELEVATION: 1017.1 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 50°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1016.1		CLAYEY SAND (SC), fine to medium-grained, slightly organic, black, moist (TOPSOIL)					
1.0		LEAN CLAY (CL), trace Sand, light gray to brown, moist, soft (GLACIAL LAKE)		1-1-2 (3) 6"		30	LL=38, PL=21, PI=17
			5	1-1-2 (3) 3"		28	
1010.1		SANDY SILT (ML), brown, moist, loose (GLACIAL LAKE)		2-3-4 (7) 12"		40	LL=45, PL=27, PI=18
7.0			10	1-3-4 (7) 8"		40	
1006.1		SANDY LEAN CLAY (CL), gray, moist, medium to stiff (GLACIAL TILL)		2-4-5 (9) 12"		23	
11.0		Silt seams and sand seams present	15	2-2-4 (6) 3"			
			20	3-3-4 (7) 0"			No recovery
996.1		END OF BORING					Water observed at 20.0 feet while drilling.
21.0		Boring then backfilled with bentonite grout					Water observed at 12.0 feet immediately after withdrawal of auger.

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-06		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 217035.8	EASTING: 589606.2	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/06/25	END DATE: 10/06/25			
SURFACE ELEVATION: 1015.8 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 50°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1014.9		CLAYEY SAND (SC), fine to medium-grained, slightly organic, black, moist (TOPSOIL)					
0.9		SANDY LEAN CLAY (CL), trace Gravel, brown to gray, moist, medium (GLACIAL TILL)		2-2-3 (5) 6"		24	
			5	1-3-5 (8) 12"		25	
		Sand seam from 7 to 8 feet		1-2-4 (6) 6"		27	
			10	1-2-3 (5) 12"			
1004.8		END OF BORING					Water not observed while drilling.
11.0		Boring then backfilled with auger cuttings					
			15				
			20				

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-07			
					LOCATION: Captured with RTK GPS.			
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)			
					NORTHING: 216877.4	EASTING: 589579.5		
DRILLER: E. Rislov		LOGGED BY: I. Breitlow		START DATE: 10/06/25	END DATE: 10/06/25			
SURFACE ELEVATION: 1014.8 ft		RIG: 8505	METHOD: 3 1/4" HSA		SURFACING: Farm Field	WEATHER: Clear, 50°s		
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)		Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1013.8		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, moist (TOPSOIL)						
1.0		SANDY LEAN CLAY (CL), trace Gravel, light gray to brown, moist, soft to stiff (GLACIAL TILL)			2-2-3 (5) 6"			
				5	1-1-3 (4) 8"		28	
					1-3-4 (7) 10"			
				10	1-3-6 (9) 12"			
1003.8		END OF BORING						Water not observed while drilling.
11.0		Boring then backfilled with auger cuttings						
				15				
				20				

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-08		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216936.0	EASTING: 589663.5	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/06/25	END DATE: 10/06/25			
SURFACE ELEVATION: 1014.3 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 50°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1012.3		CLAYEY SAND (SC), fine to medium-grained, slightly organic, black, moist (TOPSOIL)					
2.0		SANDY LEAN CLAY (CL), trace Gravel, black to gray, moist, soft to medium (GLACIAL TILL)		1-2-3 (5) 2"			
			5	1-1-2 (3) 8"		17	
				1-2-3 (5) 12"			
1003.3			10	1-2-3 (5) 12"			
11.0		END OF BORING					Water not observed while drilling.
		Boring then backfilled with auger cuttings					
			15				
			20				

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-09		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216874.9	EASTING: 589748.2	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/06/25	END DATE: 10/06/25			
SURFACE ELEVATION: 1015.8 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 50°s			

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1014.8		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, moist (TOPSOIL)					
1.0		SANDY LEAN CLAY (CL), trace Gravel, gray to brown, moist, soft to medium (GLACIAL TILL)		1-2-2 (4) 6"		26	
			5	1-3-3 (6) 10"		28	
1008.8		LEAN CLAY (CL), trace Sand, brown, moist, medium (GLACIAL TILL)		2-3-4 (7) 14"		38	LL=48, PL=27, PI=21
1006.8		SANDY LEAN CLAY (CL), with Gravel, brown, moist, medium (GLACIAL TILL)	10	1-3-5 (8) 12"		19	
1004.8		END OF BORING					Water not observed while drilling.
11.0		Boring then backfilled with auger cuttings					
			15				
			20				

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-10		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 217256.5	EASTING: 589147.2	
DRILLER: E. Rislov			LOGGED BY: I. Breitlow		START DATE: 10/08/25	END DATE: 10/08/25	
SURFACE ELEVATION: 1013.9 ft		RIG: 8505	METHOD: 3 1/4" HSA		SURFACING: Farm Field	WEATHER: Clear, 50°s	
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
1010.4		 SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, moist (TOPSOIL)		1-1-2 (3) 4"		22	
3.5		 SANDY LEAN CLAY (CL), with Gravel, dark gray to brown, moist, medium (GLACIAL TILL)		1-2-3 (5) 8"		31	
1007.9		END OF BORING					Water not observed while drilling.
6.0		Boring then backfilled with auger cuttings					

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-11		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 217109.3	EASTING: 589023.2	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/07/25	END DATE: 10/07/25			
SURFACE ELEVATION: 1014.0 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 60°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1010.5		SANDY ORGANIC CLAY (OL), trace Gravel, black, dry to moist (TOPSOIL)		2-2-3 (5) 4"		25	OC=6%
3.5		SANDY LEAN CLAY (CL), trace Gravel, gray to brown, moist, soft to stiff (GLACIAL TILL)	5	1-1-2 (3) 10"		26	
				1-2-4 (6) 12"		25	
1003.0		SANDY LEAN CLAY (CL), trace Gravel, dark gray, moist, medium to stiff (GLACIAL TILL)	10	2-3-6 (9) 14"			
11.0				2-3-4 (7) 14"		22	
			15	2-3-4 (7) 16"			
			20	1-4-5 (9) 16"			
993.0		END OF BORING					Water not observed while drilling.
21.0		Boring then backfilled with bentonite grout					

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-12		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 217066.3	EASTING: 589193.4	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/07/25	END DATE: 10/07/25			
SURFACE ELEVATION: 1015.4 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 60°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1014.6 0.8		SANDY ORGANIC CLAY (OL), black, moist to dry (TOPSOIL)					No recovery
		SANDY LEAN CLAY (CL), trace Gravel, brown to gray, moist, medium to stiff (GLACIAL TILL)		2-3-4 (7) 0"			
				2-3-5 (8) 10"		20	
				1-4-6 (10) 12"			
				2-3-5 (8) 10"			
1004.4 11.0		SANDY LEAN CLAY (CL), trace Gravel, dark gray, moist, medium to stiff (GLACIAL TILL)		1-4-4 (8) 14"		23	
				1-3-5 (8) 10"			
				3-4-6 (10) 16"			
994.4 21.0		END OF BORING					Water not observed while drilling.
		Boring then backfilled with bentonite grout					

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-13				
					LOCATION: Captured with RTK GPS.				
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)				
					NORTHING: 216996.8	EASTING: 588938.2			
DRILLER: E. Rislov		LOGGED BY: I. Breitlow		START DATE: 10/08/25	END DATE: 10/08/25				
SURFACE ELEVATION: 1015.4 ft		RIG: 8505	METHOD: 3 1/4" HSA		SURFACING: Farm Field		WEATHER: Clear, 60°s		
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)			Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1013.7		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, moist (TOPSOIL)							
1.7		SANDY LEAN CLAY (CL), trace Gravel, dark gray to brown, moist, medium (GLACIAL TILL)				2-3-3 (6) 3"		25	
1009.4					5	2-2-4 (6) 2"			
6.0		END OF BORING							Water not observed while drilling.
		Boring then backfilled with auger cuttings							
					10				
					15				
					20				

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-14		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216885.6	EASTING: 589037.8	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/07/25	END DATE: 10/07/25			
SURFACE ELEVATION: 1016.5 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 50°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1015.7 0.8		SANDY ORGANIC CLAY (OL), trace Gravel, black, dry to moist (TOPSOIL)					
		SANDY LEAN CLAY (CL), trace Gravel, light gray to brown, moist, medium to stiff (GLACIAL TILL)		2-2-4 (6) 6"		24	
			5	1-1-4 (5) 10"		22	
		Brown at 7 feet		1-2-3 (5) 12"		24	
			10	1-3-5 (8) 10"			
1005.5 11.0		SANDY LEAN CLAY (CL), trace Gravel, dark gray, moist, medium (GLACIAL TILL)		1-1-5 (6) 14"		23	
			15	2-2-4 (6) 18"			
			20	1-1-4 (5) 14"			
995.5 21.0		END OF BORING					Water not observed while drilling.
		Boring then backfilled with bentonite grout					

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-15		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216836.0	EASTING: 588869.0	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/07/25	END DATE: 10/07/25			
SURFACE ELEVATION: 1016.4 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 60°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1012.9		SANDY ORGANIC CLAY (OL), trace Gravel, black, dry to moist (TOPSOIL)		5-5-5 (10) 0"			No recovery
3.5		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black to gray, moist, medium (GLACIAL LAKE)	5	2-2-3 (5) 5"		24	OC=4%
1010.4		POORLY GRADED SAND with CLAY (SP-SC), fine to coarse-grained, trace Gravel, brown, moist to wet, loose (GLACIAL OUTWASH)		1-3-6 (9) 8"		22	P200=11%
6.0			10	1-2-3 (5) 6"		23	
1005.4		SANDY LEAN CLAY (CL), trace Gravel, gray, moist, soft to stiff (GLACIAL TILL)		1-2-5 (7) 12"			
11.0			15	1-2-2 (4) 10"		27	
			20	2-4-7 (11) 14"			
995.4		END OF BORING					Water observed at 7.5 feet while drilling.
21.0		Boring then backfilled with bentonite grout					Water observed at 7.5 feet immediately after withdrawal of auger.

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-16		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216657.4	EASTING: 589009.0	
DRILLER: E. Rislov		LOGGED BY: I. Breitlow		START DATE: 10/08/25	END DATE: 10/08/25		
SURFACE ELEVATION: 1016.2 ft		RIG: 8505	METHOD: 3 1/4" HSA		SURFACING: Farm Field	WEATHER: Clear, 60°s	
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1015.0 1.2		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, dry to moist (TOPSOIL)	Hand				
		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black to brown, moist, medium (GLACIAL TILL)	3-3-4 (7) 0"				No recovery
1010.2 6.0		END OF BORING	5 3-3-4 (7) 2"				Water not observed while drilling.
		Boring then backfilled with auger cuttings					
			10				
			15				
			20				

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-17		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216588.1	EASTING: 588826.0	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/07/25	END DATE: 10/07/25			
SURFACE ELEVATION: 1013.4 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 60°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1011.9		SILTY SAND (SM), trace Gravel, slightly organic, black, dry to moist (TOPSOIL)					
1.5		SANDY LEAN CLAY (CL), trace Gravel, light gray to brown, moist, medium (GLACIAL TILL)		2-2-4 (6) 8"		23	
			5	1-3-4 (7) 10"		22	
				1-4-4 (8) 10"			
			10	1-4-4 (8) 14"			
1002.4		SANDY LEAN CLAY (CL), trace Gravel, dark gray, moist, stiff to very stiff (GLACIAL TILL)		7-7-9 (16) 0"			No recovery
11.0			15	3-4-5 (9) 10"		23	
			20	2-6-8 (14) 12"			
992.4		END OF BORING					Water not observed while drilling.
21.0		Boring then backfilled with bentonite grout					

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-18		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216736.0	EASTING: 588796.3	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/07/25	END DATE: 10/08/25			
SURFACE ELEVATION: 1014.9 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 60°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1014.0		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, moist (TOPSOIL)					
0.9		SANDY ORGANIC CLAY (OL), trace Gravel, black, moist, stiff (GLACIAL LAKE)		3-4-5 (9) 6"		22	OC=6%
1010.9		SANDY LEAN CLAY (CL), trace Gravel, light gray to brown, moist, medium (GLACIAL TILL)	5	1-2-3 (5) 8"		30	
4.0				2-2-4 (6) 10"		30	
		Silt seams		1-2-5 (7) 14"			
1003.9		SANDY LEAN CLAY (CL), trace Gravel, dark gray, moist, medium (GLACIAL TILL)	10	2-2-4 (6) 14"			
11.0				1-3-4 (7) 14"			
			15	2-3-5 (8) 12"		25	
993.9		END OF BORING	20				Water not observed while drilling.
21.0		Boring then backfilled with bentonite grout					

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-19		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216578.2	EASTING: 589221.4	
DRILLER: E. Rislov		LOGGED BY: I. Breitlow		START DATE: 10/08/25	END DATE: 10/08/25		
SURFACE ELEVATION: 1016.9 ft	RIG: 8505	METHOD: 3 1/4" HSA		SURFACING: Farm Field	WEATHER: Clear, 60°s		
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1015.7		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, dry to moist (TOPSOIL)	Hand				
1.2		SANDY LEAN CLAY (CL), trace Gravel, light gray to brown, moist, medium (GLACIAL TILL)	3-3-4 (7) 6"		23		
1010.9			5	1-3-4 (7) 10"	25		
6.0		END OF BORING					Water not observed while drilling.
		Boring then backfilled with auger cuttings					
			10				
			15				
			20				

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-20		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216688.0	EASTING: 589337.6	
DRILLER: E. Rislov		LOGGED BY: I. Breitlow		START DATE: 10/08/25	END DATE: 10/08/25		
SURFACE ELEVATION: 1016.9 ft		RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field		WEATHER: Clear, 60°s	
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1015.4		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, dry to moist (TOPSOIL)	Hand				
1.5		ORGANIC CLAY (OL), trace Gravel, black to gray, moist, soft to medium (GLACIAL LAKE)		2-3-4 (7) 4"		22	
1012.4		SANDY LEAN CLAY (CL), with Gravel, slightly organic, brown, moist, soft (GLACIAL TILL)	5	1-1-2 (3) 8"		28	OC=2%
4.5				1-1-2 (3) 10"			
			10	1-2-2 (4) 10"		27	
1004.9		CLAYEY SAND (SC), medium-grained, brown to gray, moist to wet, loose (GLACIAL TILL)		1-3-5 (8) 12"			
12.0			15	1-3-4 (7) 8"		29	P200=41%
			20	2-3-3 (6) 12"			
995.9		END OF BORING					Water observed at 10.0 feet while drilling.
21.0		Boring then backfilled with bentonite grout					Water observed at 10.0 feet immediately after withdrawal of auger.

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-21		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216784.3	EASTING: 589183.8	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/08/25	END DATE: 10/08/25			
SURFACE ELEVATION: 1017.6 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 60°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1015.8		SILTY SAND (SM), fine to medium-grained, slightly organic, black, dry to moist (TOPSOIL)					
1.8		SANDY LEAN CLAY (CL), trace Gravel, light gray to brown, moist, medium to stiff (GLACIAL TILL)		2-3-4 (7) 8"		22	
			5	1-3-4 (7) 10"			
				1-2-5 (7) 10"			
1006.6			10	1-3-7 (10) 12"		22	
11.0		SANDY LEAN CLAY (CL), trace Gravel, dark gray, moist, medium (GLACIAL TILL)		1-2-3 (5) 14"		23	
			15	2-2-3 (5) 12"			
			20	2-4-3 (7) 14"			
996.6		END OF BORING					Water not observed while drilling.
21.0		Boring then backfilled with bentonite grout					

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-23		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 217069.3	EASTING: 589309.6	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/07/25	END DATE: 10/07/25			
SURFACE ELEVATION: 1015.4 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 60°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1014.2 1.2		CLAYEY SAND (SC), trace Gravel, organic, black, moist (TOPSOIL)					
		SANDY LEAN CLAY (CL), trace Gravel, light gray to brown, moist, medium to stiff (GLACIAL TILL)		1-2-5 (7) 10"		23	
			5	2-4-6 (10) 12"			
				3-4-6 (10) 10"			
			10	4-4-7 (11) 10"			
1003.4 12.0		SANDY LEAN CLAY (CL), trace Gravel, dark gray, moist, medium (GLACIAL TILL)		1-3-3 (6) 16"		24	
			15	1-2-3 (5) 12"			
			20	1-3-5 (8) 12"			
994.4 21.0		END OF BORING					Water not observed while drilling.
		Boring then backfilled with bentonite grout					

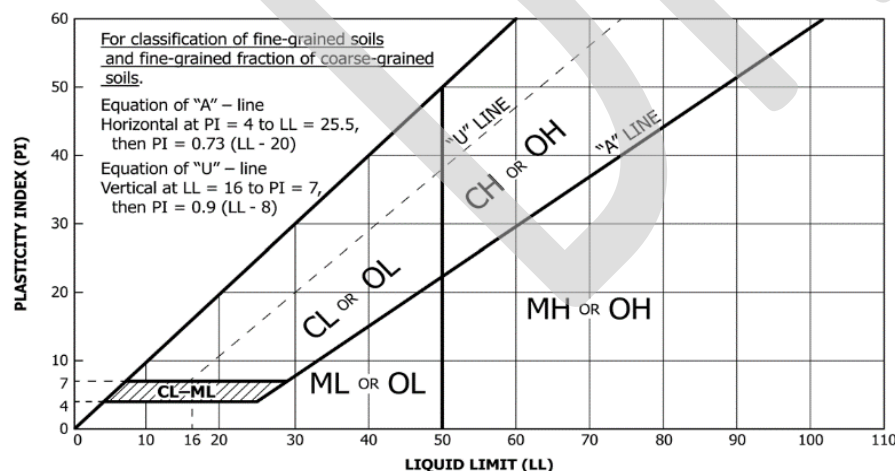
LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508847 Geotechnical Evaluation Met-Con Mankato Office and Site Development E of Cty Hwy 12 between Adams St and Madison Ave Mankato, Minnesota					BORING: ST-24		
					LOCATION: Captured with RTK GPS.		
					DATUM: NAD 1983 HARN Adj MN Blue Earth (US Feet)		
					NORTHING: 216903.7	EASTING: 589417.6	
DRILLER: E. Rislov	LOGGED BY: I. Breitlow		START DATE: 10/07/25	END DATE: 10/07/25			
SURFACE ELEVATION: 1015.1 ft	RIG: 8505	METHOD: 3 1/4" HSA	SURFACING: Farm Field	WEATHER: Clear, 60°s			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
1014.2 0.8		SANDY LEAN CLAY (CL), trace Gravel, slightly organic, black, moist (TOPSOIL)					
		SANDY LEAN CLAY (CL), trace Gravel, light gray, moist, soft to medium (GLACIAL LAKE)		1-2-3 (5) 4"			
				1-1-3 (4) 12"		29	
1008.1 7.0		SANDY LEAN CLAY (CL), trace Gravel, dark brown to dark gray, moist, medium to stiff (GLACIAL TILL)		2-3-5 (8) 10"			
				2-3-6 (9) 6"			
				1-2-5 (7) 14"			
				2-2-4 (6) 12"			
							
				2-3-4 (7) 14"			
994.1 21.0		END OF BORING					Water not observed while drilling.
		Boring then backfilled with bentonite grout					

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 ^{EFG}
			Fines Classify as CL or CH	GC	Clayey gravel ^{EFG}
	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 ^I
		Sands with Fines (More than 12% fines ^H)	Fines classify as ML or MH	SM	Silty sand ^{FGI}
			Fines classify as CL or CH	SC	Clayey sand ^{FGI}
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 ^{KLM}
			PI < 4 or plots below "A" line ^J	ML	Silt ^{KLM}
		Organic	Liquid Limit – oven dried <0.75	OL	Organic clay ^{KLMN}
			Liquid Limit – not dried <0.75		Organic silt ^{KLM O}
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay ^{KLM}
			PI plots below "A" line	MH	Elastic silt ^{KLM}
		Organic	Liquid Limit – oven dried <0.75	OH	Organic clay ^{KLM P}
			Liquid Limit – not dried <0.75		Organic silt ^{KLM 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 $\geq 15\%$ 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 $\geq 15\%$ 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 $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.
- M. If soil contains $\geq 30\%$ 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.



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

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..... $\geq 15\%$

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 ().

Sample Symbols

	Standard Penetration Test		Rock Core
	Modified California (MC)		Thinwall (TW)/Shelby Tube (SH)
	Auger		Texas Cone Penetrometer
	Grab Sample		Dynamic Cone Penetrometer