Mahler Aggregate Mine Expansion

Hanover, MN

DRAINAGE ANALYSIS

Prepared for:

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September 16, 2019
Revised 12/02/2019

CESD Project # 00722

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NARRATIVE

PROPOSED PROJECT:

The project proposes the expansion of a gravel mining and crushing operation located in Hanover, MN on 130 acres of additional land. The operation will include sand and gravel mining, a wash plant, concrete recycling, and drainage and erosion control as required by the City of Hanover.

The project proposes to collect the surface storm water runoff for the project site and convey storm water to a storm water management basin to contain and treat the surface runoff.

SITE LOCATION:

The site is located on the east side of River Road NE between the extension of 15th Street NE on the north boundary line and the section line between Erin St. and 10th St. on the south boundary line in the City of Hanover, MN. The property extends east to the Crow River.

The project is in the W 1/2 of Section 30, Township 120, Range 23, and SE 1/4 of Section 25, Township 120, Range 24, Wright County, MN. Access to the site can be achieved from 15th Street NE.

REQUIREMENTS:

Stormwater management design for the project is subject to review by the City of Hanover. The significant requirements are water quality treatment in accordance with the National Pollutant Discharge Elimination System (NPDES) permit.

The attached storm water runoff and ponding calculations are based on the Soil Conservation Service Synthetic Unit Hydrograph Method incorporated into the software program HydroCad 10.00.

EXISTING SITE CONDITIONS:

The existing expansion site is primarily agricultural cropland. Existing residential homes are adjacent to the site to the west. There is a mining operation to the north, cropland to the south and the Crow River to the east.

Drainage for the existing property is by surface drainage. The main portion of the property drainage flows to a low area southwest of the current gravel pit. Larger storms would drain into the pit area. The northwest portion of the expansion area drains to the haul road ditch and is conveyed west to a low area in the southeast quadrant of 15th St. and River Rd. This low area is drained by a culvert under River Rd. The southwest portion of the expansion area drains to the residential area to the west. The south area drains southeast to the Crow River. The east area has a steep slope that drains east to the Crow River. Existing topography elevation change of the property ranges from minimal to significant with surface slopes from 1% to 35%.

Existing Conditions Drainage Area Map DA 1 and associated HydroCAD calculation model printouts for the existing condition can be found in attached Appendix A.

PROPOSED SITE CONDITIONS:

The proposed project will result in the expansion of the gravel mining and crushing operations. The project will maintain the current alignment of the haul road. The project will include a 3 acre stormwater management basin southeast of the current gravel pit area that will serve as infiltration and sufficient storage within the mining end use condition for a hundred year storm event.

The northwest drainage area to the existing low area that drains off-site will remain. The southwest and south drainage areas that drain off-site will be rerouted to the gravel pit area.

Proposed Operating Condition Drainage Area Map DA 2, Proposed End Use Condition Drainage Area Map DA 3, and associated HydroCAD calculation model printouts can be found in attached Appendix B.

SOILS DATA:

Soils for this analysis have been determined to be hydrologic Group A soils. Group A soils are defined as having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands, and have a high rate of water transmission.

Soil analysis has been completed on the property by Haugo Geotechnical Services with soil borings and laboratory analysis. Boring and test pit logs can be found attached in Appendix C.

RUNOFF RATE CALCULATIONS:

Calculations have been generated using HydroCAD 10.00 for runoff rate analysis based on Atlas 14 rainfall data. Refer to attachments of Exhibit A and Exhibit B for drainage area plans and hydrographs for the 2 year (2.81") storm event, 10 year (4.18") storm event, 100 year (6.93") storm event, and 100 year 10 day (7.35") snow melt event.

Individual subcatchment areas have been identified and runoff rates have been calculated in the HydroCAD model. A storm water management basin is proposed. The basin size and volume capacity has been designed to contain the storm water runoff from the gravel pit operation and the improvements necessary for the end use condition. The site runoff rates are then tabulated for both the existing condition and proposed condition. Results indicate the proposed condition runoff rates are less than existing condition runoff rates.

The following table summarizes the calculation model results for comparison of storm water runoff rate of existing conditions to proposed end use conditions.

CALCULATION SUMMARY

Item	Subcatchment Area	2 yr (2.81") Runoff Rate (cfs)	10 yr (4.18") Runoff Rate (cfs)	100 yr (6.93") Runoff Rate (cfs)	10 day(7.35") Snowmelt (cfs)
Existing Condition	SW Area 1S Area=18.5 ac.	15.20	37.49	90.71	0.57
Existing Condition	Culvert 3P Area=43.4 ac.	4.80	6.96	20.42	1.34
Existing Condition	South Area 5S Area=18.6 ac.	10.34	25.75	62.96	0.57
Existing Condition	River 6R Area=104.5 ac.	23.01	61.17	154.50	1.03

Existing Total Runoff	Total=185 ac.	53.35	131.37	328.59	3.51

Operations Condition	1S Rerouted to Area 41S	0	0	0	0
Operations Condition	Culvert 3P Area=9.0 ac.	1.99	3.47	5.30	0.28
Operations Condition	5S Rerouted to Area 41S	0	0	0	0
Operations Condition	River 6R Area=176.1 ac.	18.04	47.97	121.15	0.81
Operations Total Runoff	Total=185 ac.	20.03	51.44	126.45	1.09

End Use Condition	Culvert 3P Area=9.0 ac.	1.99	3.47	5.30	0.28
End Use Condition	River 6R Area=176.1 ac.	18.04	47.97	121.15	0.81
End Use Total Runoff	Total=185 ac.	20.03	51.44	126.45	1.09

WATER QUALITY:

Water quality is to conform with City of Hanover requirements. Pretreatment of the storm water is provided by a pretreatment basin before discharging to the infiltration basin. Since there is no runoff leaving the excavated mining or reclamation area for a 100-year precipitation event, water quality requirements are satisfied.

SUMMARY:

The project improvements and drainage analysis herein propose to satisfy the City of Hanover for storm water management.

CERTIFICATION:

I hereby certify that this 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.

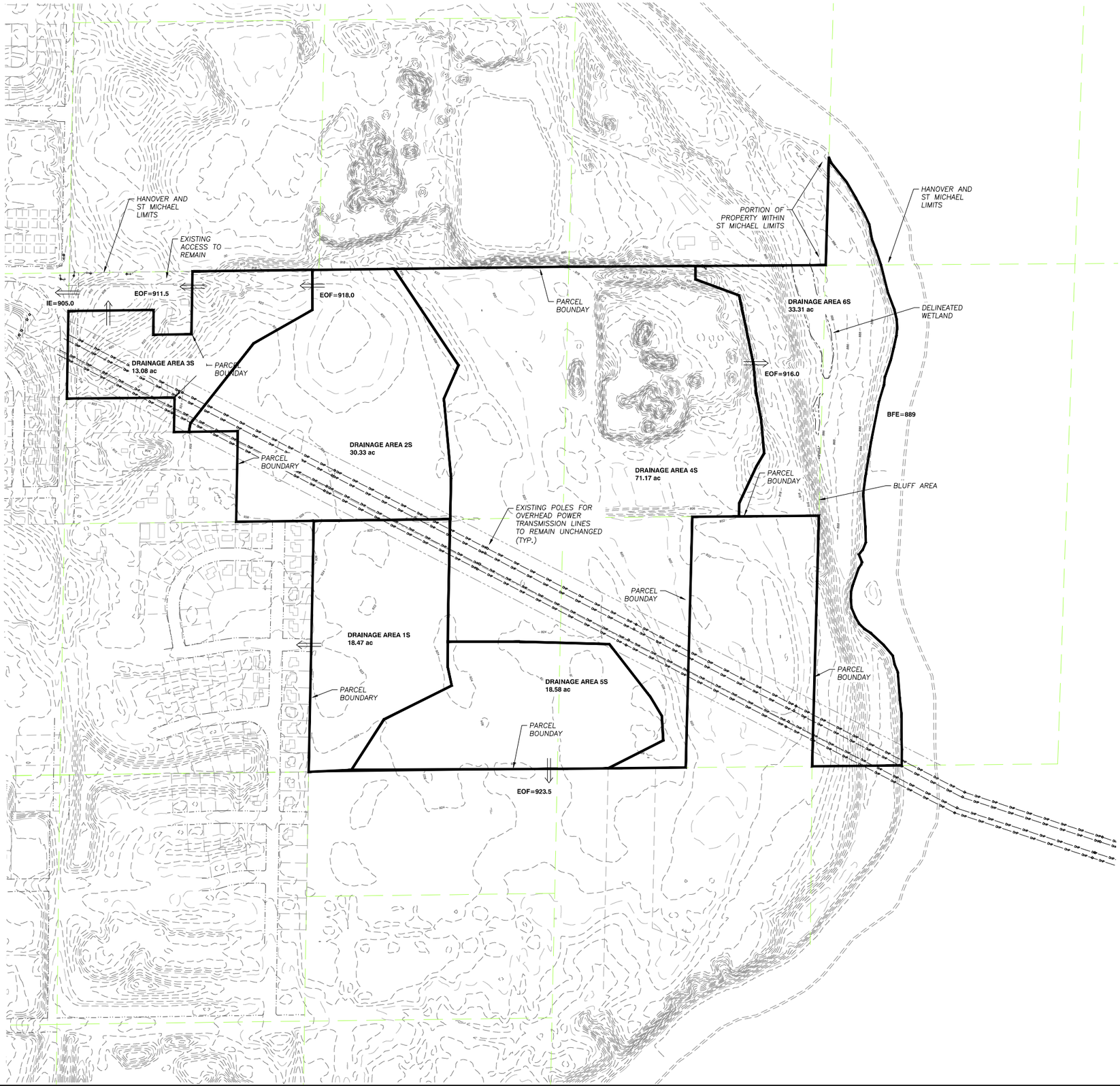
12/2/2019

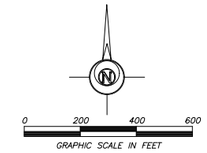
Scott Dahlke, P.E.
Reg. No. 24348

Date

APPENDIX A

Existing Conditions Drainage Calculations





EXISTING P.I.D. #S

108-500-303-200	HANOVER
108-500-254-200	HANOVER
108-500-254-400	HANOVER
108-500-303-300	HANOVER
114-800-302-400	ST MICHAEL

APPROXIMATE GROSS AREA

184.9 ACRES

FEHN

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Albertville, MN 55301

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MAHLER AGGREGATE MINE EXPANSION

SE Quad 15th Street and River Road
Hanover, MN 55341

EXISTING CONDITIONS
DRAINAGE AREA PLAN

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.

Date: 9/16/19 Reg. No. 24348

PREPARED BY: CIVIL ENGINEERING SITE DESIGN

118 East Broadway St.
PO Box 566
Monticello, MN 55362
Phone: 763-314-0929
www.civilsd.com

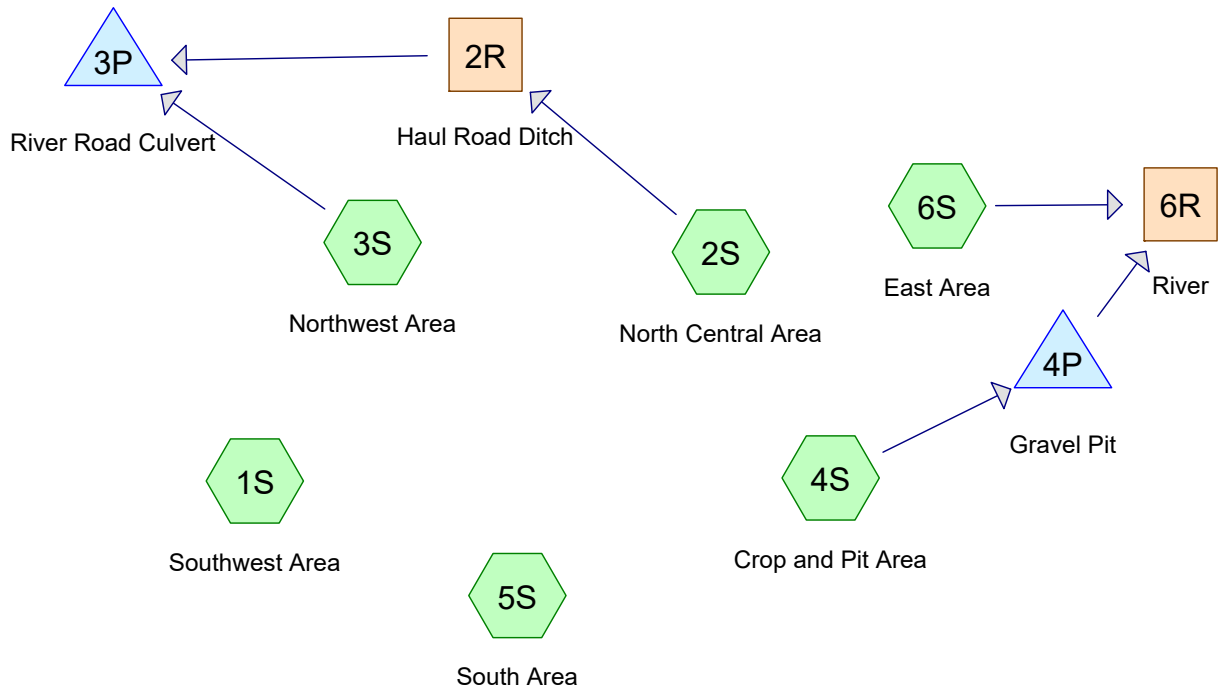
REVISIONS

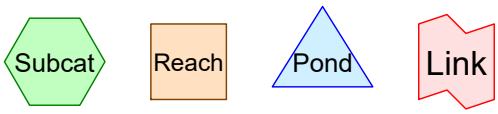
DATE	09/16/19
DRAWN BY	SD
DESIGNED BY	SD
CHECKED BY	SD

FILE NO. 00722

DA1

Existing Conditions
Drainage Area Plan





Routing Diagram for 00722 Ex
Prepared by CESD, Printed 11/29/2019
HydroCAD® 10.00-20 s/n 01607 © 2017 HydroCAD Software Solutions LLC

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Southwest Area Runoff Area=18.470 ac 0.00% Impervious Runoff Depth=0.70"
Tc=15.0 min CN=72 Runoff=15.20 cfs 46,764 cf

Subcatchment 2S: North Central Area Runoff Area=30.330 ac 0.00% Impervious Runoff Depth=0.70"
Tc=15.0 min CN=72 Runoff=24.97 cfs 76,792 cf

Subcatchment 3S: Northwest Area Runoff Area=13.080 ac 0.00% Impervious Runoff Depth=0.70"
Tc=18.0 min CN=72 Runoff=9.74 cfs 33,117 cf

Subcatchment 4S: Crop and Pit Area Runoff Area=71.170 ac 0.00% Impervious Runoff Depth=0.49"
Tc=45.0 min CN=67 Runoff=19.43 cfs 127,459 cf

Subcatchment 5S: South Area Runoff Area=18.580 ac 0.00% Impervious Runoff Depth=0.70"
Tc=30.0 min CN=72 Runoff=10.34 cfs 47,043 cf

Subcatchment 6S: East Area Runoff Area=33.310 ac 0.00% Impervious Runoff Depth=0.61"
Tc=15.0 min CN=70 Runoff=23.01 cfs 73,916 cf

Reach 2R: Haul Road Ditch Avg. Flow Depth=0.37' Max Vel=3.25 fps Inflow=24.97 cfs 76,792 cf
n=0.030 L=500.0' S=0.0280 '/' Capacity=210.69 cfs Outflow=24.17 cfs 76,792 cf

Reach 6R: River Inflow=23.01 cfs 73,916 cf
Outflow=23.01 cfs 73,916 cf

Pond 3P: River Road Culvert Peak Elev=907.14' Storage=1.089 af Inflow=33.86 cfs 109,910 cf
Outflow=4.80 cfs 109,923 cf

Pond 4P: Gravel Pit Peak Elev=896.37' Storage=2.926 af Inflow=19.43 cfs 127,459 cf
Outflow=0.00 cfs 0 cf

Total Runoff Area = 8,055,986 sf Runoff Volume = 405,091 cf Average Runoff Depth = 0.60"
100.00% Pervious = 8,055,986 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1S: Southwest Area

Runoff = 15.20 cfs @ 12.25 hrs, Volume= 46,764 cf, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	18.470	72	Row crops, straight row
	18.470	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5					**Direct Entry,**
10.5	0	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 2S: North Central Area

Runoff = 24.97 cfs @ 12.25 hrs, Volume= 76,792 cf, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	30.330	72	Row crops, straight row
	30.330	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**
10.0	0	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 3S: Northwest Area

Runoff = 9.74 cfs @ 12.30 hrs, Volume= 33,117 cf, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	13.080	72	Pasture/grassland/range
	13.080	72	100.00% Pervious Area

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

Summary for Subcatchment 4S: Crop and Pit Area

Runoff = 19.43 cfs @ 12.75 hrs, Volume= 127,459 cf, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	71.170	67	Pasture/grassland/range, Fair, HSG B
	71.170	67	100.00% Pervious Area

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

Summary for Subcatchment 5S: South Area

Runoff = 10.34 cfs @ 12.47 hrs, Volume= 47,043 cf, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	18.580	72	Row crops, straight row
	18.580	72	100.00% Pervious Area

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

Summary for Subcatchment 6S: East Area

Runoff = 23.01 cfs @ 12.26 hrs, Volume= 73,916 cf, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	33.310	70	Woods
	33.310	70	100.00% Pervious Area

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

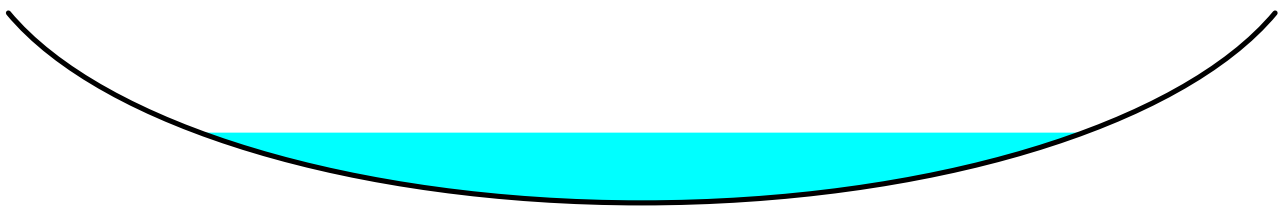
Summary for Reach 2R: Haul Road Ditch

Inflow Area = 1,321,175 sf, 0.00% Impervious, Inflow Depth = 0.70" for 2-Year event
Inflow = 24.97 cfs @ 12.25 hrs, Volume= 76,792 cf
Outflow = 24.17 cfs @ 12.29 hrs, Volume= 76,792 cf, Atten= 3%, Lag= 2.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.25 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.01 fps, Avg. Travel Time= 8.2 min

Peak Storage= 3,720 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.00' Flow Area= 33.3 sf, Capacity= 210.69 cfs

50.00' x 1.00' deep Parabolic Channel, n= 0.030 Earth, dense weeds
Length= 500.0' Slope= 0.0280 '/'
Inlet Invert= 918.00', Outlet Invert= 904.00'



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Summary for Reach 6R: River

Inflow Area = 4,551,149 sf, 0.00% Impervious, Inflow Depth = 0.19" for 2-Year event
Inflow = 23.01 cfs @ 12.26 hrs, Volume= 73,916 cf
Outflow = 23.01 cfs @ 12.26 hrs, Volume= 73,916 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 1,890,940 sf, 0.00% Impervious, Inflow Depth = 0.70" for 2-Year event
Inflow = 33.86 cfs @ 12.29 hrs, Volume= 109,910 cf
Outflow = 4.80 cfs @ 13.43 hrs, Volume= 109,923 cf, Atten= 86%, Lag= 68.2 min
Primary = 4.80 cfs @ 13.43 hrs, Volume= 109,923 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 907.14' @ 13.43 hrs Surf.Area= 0.880 ac Storage= 1.089 af

Plug-Flow detention time= 114.5 min calculated for 109,900 cf (100% of inflow)
Center-of-Mass det. time= 114.8 min (967.9 - 853.1)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.80 cfs @ 13.43 hrs HW=907.14' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.80 cfs @ 6.11 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: Gravel Pit

Inflow Area = 3,100,165 sf, 0.00% Impervious, Inflow Depth = 0.49" for 2-Year event
Inflow = 19.43 cfs @ 12.75 hrs, Volume= 127,459 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 896.37' @ 26.51 hrs Surf.Area= 2.218 ac Storage= 2.926 af

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	894.00'	49.235 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
894.00	0.127	0.000	0.000
896.00	2.023	2.150	2.150
898.00	3.087	5.110	7.260
900.00	4.320	7.407	14.667
902.00	5.048	9.368	24.035
904.00	6.226	11.274	35.309
906.00	7.700	13.926	49.235

Device	Routing	Invert	Outlet Devices
#1	Primary	916.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=894.00' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Southwest Area Runoff Area=18.470 ac 0.00% Impervious Runoff Depth=1.59"
Tc=15.0 min CN=72 Runoff=37.49 cfs 106,440 cf

Subcatchment 2S: North Central Area Runoff Area=30.330 ac 0.00% Impervious Runoff Depth=1.59"
Tc=15.0 min CN=72 Runoff=61.57 cfs 174,788 cf

Subcatchment 3S: Northwest Area Runoff Area=13.080 ac 0.00% Impervious Runoff Depth=1.59"
Tc=18.0 min CN=72 Runoff=24.03 cfs 75,378 cf

Subcatchment 4S: Crop and Pit Area Runoff Area=71.170 ac 0.00% Impervious Runoff Depth=1.26"
Tc=45.0 min CN=67 Runoff=58.53 cfs 324,753 cf

Subcatchment 5S: South Area Runoff Area=18.580 ac 0.00% Impervious Runoff Depth=1.59"
Tc=30.0 min CN=72 Runoff=25.75 cfs 107,074 cf

Subcatchment 6S: East Area Runoff Area=33.310 ac 0.00% Impervious Runoff Depth=1.45"
Tc=15.0 min CN=70 Runoff=61.17 cfs 175,469 cf

Reach 2R: Haul Road Ditch Avg. Flow Depth=0.56' Max Vel=4.31 fps Inflow=61.57 cfs 174,788 cf
n=0.030 L=500.0' S=0.0280 '/' Capacity=210.69 cfs Outflow=60.49 cfs 174,788 cf

Reach 6R: River Inflow=61.17 cfs 175,469 cf
Outflow=61.17 cfs 175,469 cf

Pond 3P: River Road Culvert Peak Elev=908.96' Storage=3.163 af Inflow=84.39 cfs 250,166 cf
Outflow=6.96 cfs 250,178 cf

Pond 4P: Gravel Pit Peak Elev=898.06' Storage=7.455 af Inflow=58.53 cfs 324,753 cf
Outflow=0.00 cfs 0 cf

Total Runoff Area = 8,055,986 sf Runoff Volume = 963,902 cf Average Runoff Depth = 1.44"
100.00% Pervious = 8,055,986 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1S: Southwest Area

Runoff = 37.49 cfs @ 12.24 hrs, Volume= 106,440 cf, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	18.470	72	Row crops, straight row
	18.470	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5					**Direct Entry,**
10.5	0	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 2S: North Central Area

Runoff = 61.57 cfs @ 12.24 hrs, Volume= 174,788 cf, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	30.330	72	Row crops, straight row
	30.330	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**
10.0	0	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 3S: Northwest Area

Runoff = 24.03 cfs @ 12.28 hrs, Volume= 75,378 cf, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	13.080	72	Pasture/grassland/range
	13.080	72	100.00% Pervious Area

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

Summary for Subcatchment 4S: Crop and Pit Area

Runoff = 58.53 cfs @ 12.65 hrs, Volume= 324,753 cf, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	71.170	67	Pasture/grassland/range, Fair, HSG B
	71.170	67	100.00% Pervious Area

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

Summary for Subcatchment 5S: South Area

Runoff = 25.75 cfs @ 12.44 hrs, Volume= 107,074 cf, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	18.580	72	Row crops, straight row
	18.580	72	100.00% Pervious Area

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

Summary for Subcatchment 6S: East Area

Runoff = 61.17 cfs @ 12.25 hrs, Volume= 175,469 cf, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	33.310	70	Woods
	33.310	70	100.00% Pervious Area

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

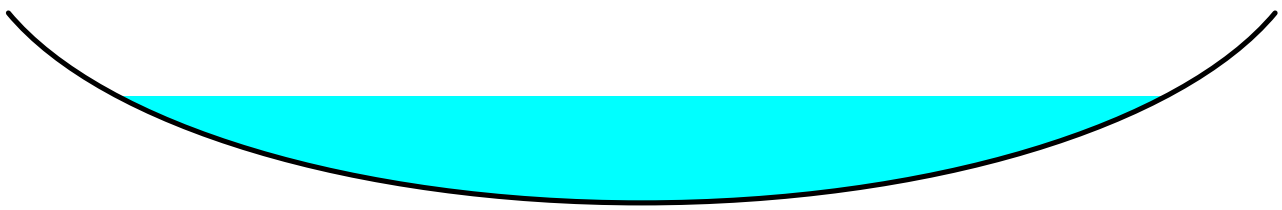
Summary for Reach 2R: Haul Road Ditch

Inflow Area = 1,321,175 sf, 0.00% Impervious, Inflow Depth = 1.59" for 10-Year event
Inflow = 61.57 cfs @ 12.24 hrs, Volume= 174,788 cf
Outflow = 60.49 cfs @ 12.27 hrs, Volume= 174,788 cf, Atten= 2%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.31 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.23 fps, Avg. Travel Time= 6.7 min

Peak Storage= 7,023 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.56'
Bank-Full Depth= 1.00' Flow Area= 33.3 sf, Capacity= 210.69 cfs

50.00' x 1.00' deep Parabolic Channel, n= 0.030 Earth, dense weeds
Length= 500.0' Slope= 0.0280 '/'
Inlet Invert= 918.00', Outlet Invert= 904.00'



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Summary for Reach 6R: River

Inflow Area = 4,551,149 sf, 0.00% Impervious, Inflow Depth = 0.46" for 10-Year event
Inflow = 61.17 cfs @ 12.25 hrs, Volume= 175,469 cf
Outflow = 61.17 cfs @ 12.25 hrs, Volume= 175,469 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 1,890,940 sf, 0.00% Impervious, Inflow Depth = 1.59" for 10-Year event
Inflow = 84.39 cfs @ 12.27 hrs, Volume= 250,166 cf
Outflow = 6.96 cfs @ 13.69 hrs, Volume= 250,178 cf, Atten= 92%, Lag= 85.1 min
Primary = 6.96 cfs @ 13.69 hrs, Volume= 250,178 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 908.96' @ 13.69 hrs Surf.Area= 1.400 ac Storage= 3.163 af

Plug-Flow detention time= 228.9 min calculated for 250,152 cf (100% of inflow)
Center-of-Mass det. time= 229.0 min (1,061.8 - 832.8)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.96 cfs @ 13.69 hrs HW=908.96' (Free Discharge)
└─**1=Culvert** (Barrel Controls 6.96 cfs @ 8.86 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: Gravel Pit

Inflow Area = 3,100,165 sf, 0.00% Impervious, Inflow Depth = 1.26" for 10-Year event
Inflow = 58.53 cfs @ 12.65 hrs, Volume= 324,753 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 898.06' @ 26.51 hrs Surf.Area= 3.126 ac Storage= 7.455 af

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	894.00'	49.235 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
894.00	0.127	0.000	0.000
896.00	2.023	2.150	2.150
898.00	3.087	5.110	7.260
900.00	4.320	7.407	14.667
902.00	5.048	9.368	24.035
904.00	6.226	11.274	35.309
906.00	7.700	13.926	49.235

Device	Routing	Invert	Outlet Devices
#1	Primary	916.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=894.00' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Southwest Area Runoff Area=18.470 ac 0.00% Impervious Runoff Depth=3.77"
Tc=15.0 min CN=72 Runoff=90.71 cfs 252,729 cf

Subcatchment 2S: North Central Area Runoff Area=30.330 ac 0.00% Impervious Runoff Depth=3.77"
Tc=15.0 min CN=72 Runoff=148.95 cfs 415,013 cf

Subcatchment 3S: Northwest Area Runoff Area=13.080 ac 0.00% Impervious Runoff Depth=3.77"
Tc=18.0 min CN=72 Runoff=58.30 cfs 178,977 cf

Subcatchment 4S: Crop and Pit Area Runoff Area=71.170 ac 0.00% Impervious Runoff Depth=3.25"
Tc=45.0 min CN=67 Runoff=162.10 cfs 839,953 cf

Subcatchment 5S: South Area Runoff Area=18.580 ac 0.00% Impervious Runoff Depth=3.77"
Tc=30.0 min CN=72 Runoff=62.96 cfs 254,235 cf

Subcatchment 6S: East Area Runoff Area=33.310 ac 0.00% Impervious Runoff Depth=3.56"
Tc=15.0 min CN=70 Runoff=154.50 cfs 430,494 cf

Reach 2R: Haul Road Ditch Avg. Flow Depth=0.85' Max Vel=5.66 fps Inflow=148.95 cfs 415,013 cf
n=0.030 L=500.0' S=0.0280 '/' Capacity=210.69 cfs Outflow=147.54 cfs 415,013 cf

Reach 6R: River Inflow=154.50 cfs 430,494 cf
Outflow=154.50 cfs 430,494 cf

Pond 3P: River Road Culvert Peak Elev=911.86' Storage=8.160 af Inflow=205.51 cfs 593,989 cf
Outflow=20.42 cfs 594,000 cf

Pond 4P: Gravel Pit Peak Elev=901.02' Storage=19.283 af Inflow=162.10 cfs 839,953 cf
Outflow=0.00 cfs 0 cf

Total Runoff Area = 8,055,986 sf Runoff Volume = 2,371,401 cf Average Runoff Depth = 3.53"
100.00% Pervious = 8,055,986 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1S: Southwest Area

Runoff = 90.71 cfs @ 12.23 hrs, Volume= 252,729 cf, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	18.470	72	Row crops, straight row
	18.470	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5					**Direct Entry,**
10.5	0	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 2S: North Central Area

Runoff = 148.95 cfs @ 12.23 hrs, Volume= 415,013 cf, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	30.330	72	Row crops, straight row
	30.330	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**
10.0	0	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 3S: Northwest Area

Runoff = 58.30 cfs @ 12.27 hrs, Volume= 178,977 cf, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	13.080	72	Pasture/grassland/range
	13.080	72	100.00% Pervious Area

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

Summary for Subcatchment 4S: Crop and Pit Area

Runoff = 162.10 cfs @ 12.65 hrs, Volume= 839,953 cf, Depth= 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	71.170	67	Pasture/grassland/range, Fair, HSG B
	71.170	67	100.00% Pervious Area

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

Summary for Subcatchment 5S: South Area

Runoff = 62.96 cfs @ 12.43 hrs, Volume= 254,235 cf, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	18.580	72	Row crops, straight row
	18.580	72	100.00% Pervious Area

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

Summary for Subcatchment 6S: East Area

Runoff = 154.50 cfs @ 12.23 hrs, Volume= 430,494 cf, Depth= 3.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	33.310	70	Woods
	33.310	70	100.00% Pervious Area

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

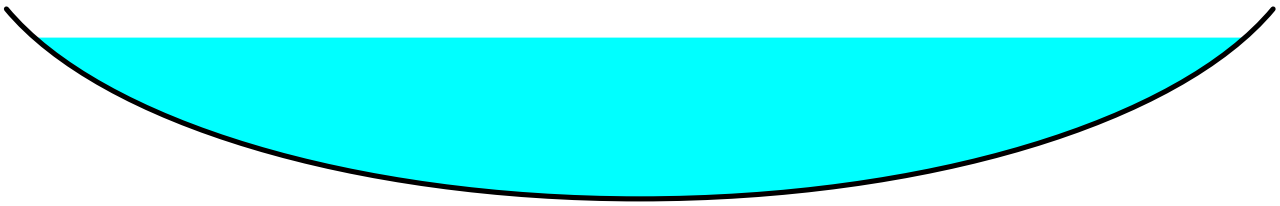
Summary for Reach 2R: Haul Road Ditch

Inflow Area = 1,321,175 sf, 0.00% Impervious, Inflow Depth = 3.77" for 100-Year event
Inflow = 148.95 cfs @ 12.23 hrs, Volume= 415,013 cf
Outflow = 147.54 cfs @ 12.25 hrs, Volume= 415,013 cf, Atten= 1%, Lag= 1.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.66 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.52 fps, Avg. Travel Time= 5.5 min

Peak Storage= 13,022 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.85'
Bank-Full Depth= 1.00' Flow Area= 33.3 sf, Capacity= 210.69 cfs

50.00' x 1.00' deep Parabolic Channel, n= 0.030 Earth, dense weeds
Length= 500.0' Slope= 0.0280 '/'
Inlet Invert= 918.00', Outlet Invert= 904.00'



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Summary for Reach 6R: River

Inflow Area = 4,551,149 sf, 0.00% Impervious, Inflow Depth = 1.14" for 100-Year event
Inflow = 154.50 cfs @ 12.23 hrs, Volume= 430,494 cf
Outflow = 154.50 cfs @ 12.23 hrs, Volume= 430,494 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 1,890,940 sf, 0.00% Impervious, Inflow Depth = 3.77" for 100-Year event
Inflow = 205.51 cfs @ 12.26 hrs, Volume= 593,989 cf
Outflow = 20.42 cfs @ 13.37 hrs, Volume= 594,000 cf, Atten= 90%, Lag= 66.9 min
Primary = 20.42 cfs @ 13.37 hrs, Volume= 594,000 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 911.86' @ 13.37 hrs Surf.Area= 1.954 ac Storage= 8.160 af

Plug-Flow detention time= 387.4 min calculated for 593,938 cf (100% of inflow)
Center-of-Mass det. time= 387.5 min (1,201.8 - 814.2)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=20.42 cfs @ 13.37 hrs HW=911.86' (Free Discharge)
└─**1=Culvert** (Barrel Controls 9.44 cfs @ 12.01 fps)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 10.99 cfs @ 1.53 fps)

Summary for Pond 4P: Gravel Pit

Inflow Area = 3,100,165 sf, 0.00% Impervious, Inflow Depth = 3.25" for 100-Year event
Inflow = 162.10 cfs @ 12.65 hrs, Volume= 839,953 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 901.02' @ 26.51 hrs Surf.Area= 4.693 ac Storage= 19.283 af

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	894.00'	49.235 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
894.00	0.127	0.000	0.000
896.00	2.023	2.150	2.150
898.00	3.087	5.110	7.260
900.00	4.320	7.407	14.667
902.00	5.048	9.368	24.035
904.00	6.226	11.274	35.309
906.00	7.700	13.926	49.235

Device	Routing	Invert	Outlet Devices
#1	Primary	916.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=894.00' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-480.00 hrs, dt=0.10 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Southwest Area Runoff Area=18.470 ac 0.00% Impervious Runoff Depth=7.11"
Tc=15.0 min AMC Adjusted CN=98 Runoff=0.57 cfs 476,741 cf

Subcatchment 2S: North Central Area Runoff Area=30.330 ac 0.00% Impervious Runoff Depth=7.11"
Tc=15.0 min AMC Adjusted CN=98 Runoff=0.94 cfs 782,867 cf

Subcatchment 3S: Northwest Area Runoff Area=13.080 ac 0.00% Impervious Runoff Depth=7.11"
Tc=18.0 min AMC Adjusted CN=98 Runoff=0.40 cfs 337,616 cf

Subcatchment 4S: Crop and Pit Area Runoff Area=71.170 ac 0.00% Impervious Runoff Depth=7.11"
Tc=45.0 min AMC Adjusted CN=98 Runoff=2.20 cfs 1,837,015 cf

Subcatchment 5S: South Area Runoff Area=18.580 ac 0.00% Impervious Runoff Depth=7.11"
Tc=30.0 min AMC Adjusted CN=98 Runoff=0.57 cfs 479,580 cf

Subcatchment 6S: East Area Runoff Area=33.310 ac 0.00% Impervious Runoff Depth=7.11"
Tc=15.0 min AMC Adjusted CN=98 Runoff=1.03 cfs 859,786 cf

Reach 2R: Haul Road Ditch Avg. Flow Depth=0.08' Max Vel=1.20 fps Inflow=0.94 cfs 782,867 cf
n=0.030 L=500.0' S=0.0280 '/' Capacity=210.69 cfs Outflow=0.94 cfs 782,867 cf

Reach 6R: River Inflow=1.03 cfs 859,786 cf
Outflow=1.03 cfs 859,786 cf

Pond 3P: River Road Culvert Peak Elev=905.61' Storage=0.103 af Inflow=1.34 cfs 1,120,483 cf
Outflow=1.34 cfs 1,120,484 cf

Pond 4P: Gravel Pit Peak Elev=905.04' Storage=42.172 af Inflow=2.20 cfs 1,837,015 cf
Outflow=0.00 cfs 0 cf

Total Runoff Area = 8,055,986 sf Runoff Volume = 4,773,605 cf Average Runoff Depth = 7.11"
100.00% Pervious = 8,055,986 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1S: Southwest Area

Runoff = 0.57 cfs @ 239.90 hrs, Volume= 476,741 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	18.470	72		Row crops, straight row
	18.470	72	98	Weighted Average, AMC Adjusted
	18.470	72	98	100.00% Pervious Area, AMC Adjusted

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5					**Direct Entry,**
10.5	0	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 2S: North Central Area

Runoff = 0.94 cfs @ 239.90 hrs, Volume= 782,867 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	30.330	72		Row crops, straight row
	30.330	72	98	Weighted Average, AMC Adjusted
	30.330	72	98	100.00% Pervious Area, AMC Adjusted

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**
10.0	0	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 3S: Northwest Area

Runoff = 0.40 cfs @ 239.90 hrs, Volume= 337,616 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	13.080	72		Pasture/grassland/range
	13.080	72	98	Weighted Average, AMC Adjusted
	13.080	72	98	100.00% Pervious Area, AMC Adjusted

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

Summary for Subcatchment 4S: Crop and Pit Area

Runoff = 2.20 cfs @ 240.00 hrs, Volume= 1,837,015 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	71.170	67		Pasture/grassland/range, Fair, HSG B
	71.170	67	98	Weighted Average, AMC Adjusted
	71.170	67	98	100.00% Pervious Area, AMC Adjusted

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

Summary for Subcatchment 5S: South Area

Runoff = 0.57 cfs @ 240.00 hrs, Volume= 479,580 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	18.580	72		Row crops, straight row
	18.580	72	98	Weighted Average, AMC Adjusted
	18.580	72	98	100.00% Pervious Area, AMC Adjusted

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

Summary for Subcatchment 6S: East Area

Runoff = 1.03 cfs @ 239.90 hrs, Volume= 859,786 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	33.310	70		Woods
	33.310	70	98	Weighted Average, AMC Adjusted
	33.310	70	98	100.00% Pervious Area, AMC Adjusted

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

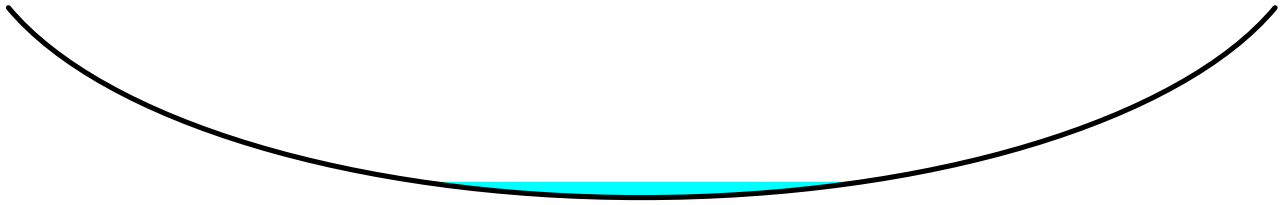
Summary for Reach 2R: Haul Road Ditch

Inflow Area = 1,321,175 sf, 0.00% Impervious, Inflow Depth = 7.11" for 100-Year 10-Day event
Inflow = 0.94 cfs @ 239.90 hrs, Volume= 782,867 cf
Outflow = 0.94 cfs @ 239.90 hrs, Volume= 782,867 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Max. Velocity= 1.20 fps, Min. Travel Time= 7.0 min
Avg. Velocity = 1.17 fps, Avg. Travel Time= 7.1 min

Peak Storage= 391 cf @ 239.90 hrs
Average Depth at Peak Storage= 0.08'
Bank-Full Depth= 1.00' Flow Area= 33.3 sf, Capacity= 210.69 cfs

50.00' x 1.00' deep Parabolic Channel, n= 0.030 Earth, dense weeds
Length= 500.0' Slope= 0.0280 '/'
Inlet Invert= 918.00', Outlet Invert= 904.00'



‡

Summary for Reach 6R: River

Inflow Area = 4,551,149 sf, 0.00% Impervious, Inflow Depth = 2.27" for 100-Year 10-Day event
Inflow = 1.03 cfs @ 239.90 hrs, Volume= 859,786 cf
Outflow = 1.03 cfs @ 239.90 hrs, Volume= 859,786 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 1,890,940 sf, 0.00% Impervious, Inflow Depth = 7.11" for 100-Year 10-Day event
Inflow = 1.34 cfs @ 239.90 hrs, Volume= 1,120,483 cf
Outflow = 1.34 cfs @ 239.90 hrs, Volume= 1,120,484 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.34 cfs @ 239.90 hrs, Volume= 1,120,484 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Peak Elev= 905.61' @ 239.90 hrs Surf.Area= 0.335 ac Storage= 0.103 af

Plug-Flow detention time= 55.5 min calculated for 1,120,250 cf (100% of inflow)
Center-of-Mass det. time= 55.6 min (7,484.9 - 7,429.3)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=1.34 cfs @ 239.90 hrs HW=905.61' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.34 cfs @ 3.79 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: Gravel Pit

Inflow Area = 3,100,165 sf, 0.00% Impervious, Inflow Depth = 7.11" for 100-Year 10-Day event
Inflow = 2.20 cfs @ 240.00 hrs, Volume= 1,837,015 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Peak Elev= 905.04' @ 242.60 hrs Surf.Area= 6.991 ac Storage= 42.172 af

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	894.00'	49.235 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

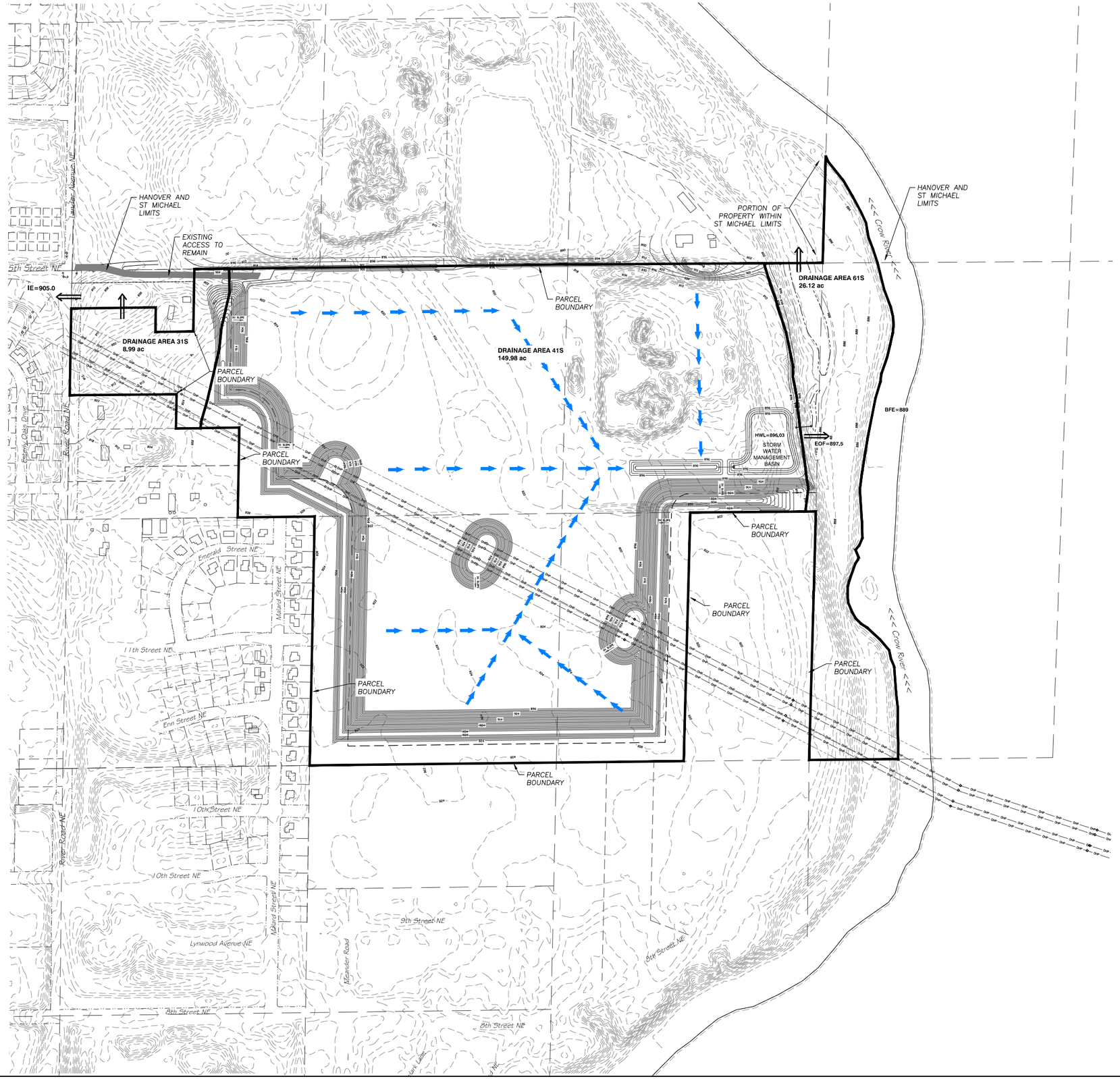
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
894.00	0.127	0.000	0.000
896.00	2.023	2.150	2.150
898.00	3.087	5.110	7.260
900.00	4.320	7.407	14.667
902.00	5.048	9.368	24.035
904.00	6.226	11.274	35.309
906.00	7.700	13.926	49.235

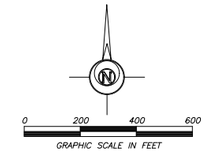
Device	Routing	Invert	Outlet Devices
#1	Primary	916.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=894.00' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

APPENDIX B

Proposed Conditions Drainage Calculations





EXISTING P.I.D. #S

108-500-303-200	HANOVER
108-500-254-200	HANOVER
108-500-254-400	HANOVER
108-500-303-300	HANOVER
114-800-302-400	ST MICHAEL

APPROXIMATE GROSS AREA

184.9 ACRES

EXCAVATION ELEVATION DATA

EXCAVATED BOTTOM ELEV 896.0
WATER TABLE ELEV 886.0

FEHN

Fehn Companies, Inc.
5050 Barthel Industrial Dr.
Albertville, MN 55301

Gary Fehn
612-282-6542
gfehn@fehncompanies.com

MAHLER AGGREGATE MINE EXPANSION

SE Quad 15th Street and River Road
Hanover, MN 55341

OPERATIONS CONDITION
DRAINAGE AREA PLAN

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.

Date: 12/02/19 Reg. No. 24348

PREPARED BY: CIVIL ENGINEERING SITE DESIGN
118 East Broadway St.
PO Box 566
Monticello, MN 55362
Phone: 763-314-0929
www.civilesd.com

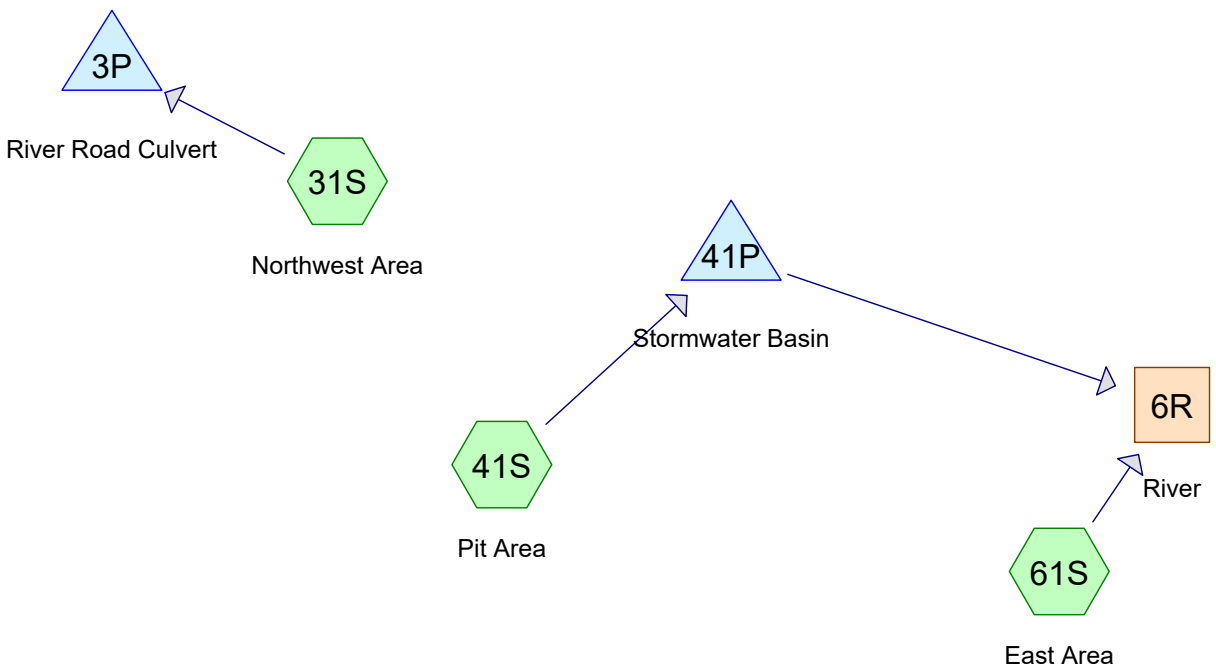
REVISIONS
12/02/2019 END USE CONTOUR MODIFICATIONS

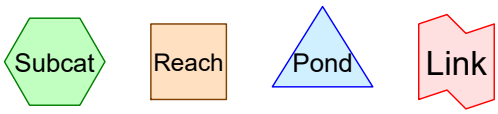
DATE	12/02/19
DRAWN BY	SD
DESIGNED BY	SD
CHECKED BY	SD

FILE NO. 00722

DA2

Operations Condition
Drainage Area Plan





Routing Diagram for 00722 Pro-operations
Prepared by CESD, Printed 11/29/2019
HydroCAD® 10.00-20 s/n 01607 © 2017 HydroCAD Software Solutions LLC

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 31S: Northwest Area Runoff Area=8.990 ac 0.00% Impervious Runoff Depth=0.70"
Tc=18.0 min CN=72 Runoff=6.69 cfs 22,762 cf

Subcatchment 41S: Pit Area Runoff Area=149.980 ac 0.00% Impervious Runoff Depth=0.49"
Tc=45.0 min CN=67 Runoff=40.94 cfs 268,601 cf

Subcatchment 61S: East Area Runoff Area=26.120 ac 0.00% Impervious Runoff Depth=0.61"
Tc=15.0 min CN=70 Runoff=18.04 cfs 57,961 cf

Reach 6R: River Inflow=18.04 cfs 57,961 cf
Outflow=18.04 cfs 57,961 cf

Pond 3P: River Road Culvert Peak Elev=905.79' Storage=0.171 af Inflow=6.69 cfs 22,762 cf
Outflow=1.99 cfs 22,775 cf

Pond 41P: Stormwater Basin Peak Elev=892.43' Storage=4.564 af Inflow=40.94 cfs 268,601 cf
Discarded=1.76 cfs 268,613 cf Primary=0.00 cfs 0 cf Outflow=1.76 cfs 268,613 cf

Total Runoff Area = 8,062,520 sf Runoff Volume = 349,323 cf Average Runoff Depth = 0.52"
100.00% Pervious = 8,062,520 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 31S: Northwest Area

Runoff = 6.69 cfs @ 12.30 hrs, Volume= 22,762 cf, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	8.990	72	Pasture/grassland/range
	8.990	72	100.00% Pervious Area

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

Summary for Subcatchment 41S: Pit Area

Runoff = 40.94 cfs @ 12.75 hrs, Volume= 268,601 cf, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	149.980	67	Pasture/grassland/range, Fair, HSG B
	149.980	67	100.00% Pervious Area

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

Summary for Subcatchment 61S: East Area

Runoff = 18.04 cfs @ 12.26 hrs, Volume= 57,961 cf, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	26.120	70	Woods
	26.120	70	100.00% Pervious Area

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

Summary for Reach 6R: River

Inflow Area = 7,670,916 sf, 0.00% Impervious, Inflow Depth = 0.09" for 2-Year event
Inflow = 18.04 cfs @ 12.26 hrs, Volume= 57,961 cf
Outflow = 18.04 cfs @ 12.26 hrs, Volume= 57,961 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 391,604 sf, 0.00% Impervious, Inflow Depth = 0.70" for 2-Year event
Inflow = 6.69 cfs @ 12.30 hrs, Volume= 22,762 cf
Outflow = 1.99 cfs @ 12.77 hrs, Volume= 22,775 cf, Atten= 70%, Lag= 28.4 min
Primary = 1.99 cfs @ 12.77 hrs, Volume= 22,775 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 905.79' @ 12.77 hrs Surf.Area= 0.431 ac Storage= 0.171 af

Plug-Flow detention time= 54.4 min calculated for 22,761 cf (100% of inflow)
Center-of-Mass det. time= 56.1 min (907.7 - 851.7)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=1.99 cfs @ 12.77 hrs HW=905.79' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.99 cfs @ 4.10 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 41P: Stormwater Basin

Inflow Area = 6,533,129 sf, 0.00% Impervious, Inflow Depth = 0.49" for 2-Year event
Inflow = 40.94 cfs @ 12.75 hrs, Volume= 268,601 cf
Outflow = 1.76 cfs @ 21.44 hrs, Volume= 268,613 cf, Atten= 96%, Lag= 521.7 min
Discarded = 1.76 cfs @ 21.44 hrs, Volume= 268,613 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 892.43' @ 21.44 hrs Surf.Area= 2.177 ac Storage= 4.564 af

Plug-Flow detention time= 1,201.6 min calculated for 268,585 cf (100% of inflow)
Center-of-Mass det. time= 1,201.7 min (2,094.7 - 893.0)

Volume	Invert	Avail.Storage	Storage Description
#1	890.00'	227.895 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
890.00	1.590	0.000	0.000	1.590
892.00	2.070	3.649	3.649	2.072
894.00	2.590	4.650	8.300	2.595
895.90	3.130	5.426	13.726	3.138
896.00	104.000	4.172	17.898	104.008
898.00	106.000	209.997	227.895	106.038

Device	Routing	Invert	Outlet Devices
#1	Primary	889.00'	**18.0" Round Culvert** L= 77.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 889.00' / 885.50' S= 0.0455 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf
#2	Device 1	896.50'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	897.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Discarded	890.00'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=1.76 cfs @ 21.44 hrs HW=892.43' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 1.76 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=890.00' TW=0.00' (Dynamic Tailwater)
├─**1=Culvert** (Passes 0.00 cfs of 4.26 cfs potential flow)
│ └─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 31S: Northwest Area Runoff Area=8.990 ac 0.00% Impervious Runoff Depth=1.59"
Tc=18.0 min CN=72 Runoff=16.52 cfs 51,808 cf

Subcatchment 41S: Pit Area Runoff Area=149.980 ac 0.00% Impervious Runoff Depth=1.26"
Tc=45.0 min CN=67 Runoff=123.34 cfs 684,368 cf

Subcatchment 61S: East Area Runoff Area=26.120 ac 0.00% Impervious Runoff Depth=1.45"
Tc=15.0 min CN=70 Runoff=47.97 cfs 137,594 cf

Reach 6R: River Inflow=47.97 cfs 137,594 cf
Outflow=47.97 cfs 137,594 cf

Pond 3P: River Road Culvert Peak Elev=906.36' Storage=0.489 af Inflow=16.52 cfs 51,808 cf
Outflow=3.47 cfs 51,821 cf

Pond 41P: Stormwater Basin Peak Elev=895.78' Storage=13.346 af Inflow=123.34 cfs 684,368 cf
Discarded=2.50 cfs 611,022 cf Primary=0.00 cfs 0 cf Outflow=2.50 cfs 611,022 cf

Total Runoff Area = 8,062,520 sf Runoff Volume = 873,770 cf Average Runoff Depth = 1.30"
100.00% Pervious = 8,062,520 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 31S: Northwest Area

Runoff = 16.52 cfs @ 12.28 hrs, Volume= 51,808 cf, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	8.990	72	Pasture/grassland/range
	8.990	72	100.00% Pervious Area

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

Summary for Subcatchment 41S: Pit Area

Runoff = 123.34 cfs @ 12.65 hrs, Volume= 684,368 cf, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	149.980	67	Pasture/grassland/range, Fair, HSG B
	149.980	67	100.00% Pervious Area

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

Summary for Subcatchment 61S: East Area

Runoff = 47.97 cfs @ 12.25 hrs, Volume= 137,594 cf, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	26.120	70	Woods
	26.120	70	100.00% Pervious Area

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

Summary for Reach 6R: River

Inflow Area = 7,670,916 sf, 0.00% Impervious, Inflow Depth = 0.22" for 10-Year event
Inflow = 47.97 cfs @ 12.25 hrs, Volume= 137,594 cf
Outflow = 47.97 cfs @ 12.25 hrs, Volume= 137,594 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 391,604 sf, 0.00% Impervious, Inflow Depth = 1.59" for 10-Year event
Inflow = 16.52 cfs @ 12.28 hrs, Volume= 51,808 cf
Outflow = 3.47 cfs @ 12.86 hrs, Volume= 51,821 cf, Atten= 79%, Lag= 34.4 min
Primary = 3.47 cfs @ 12.86 hrs, Volume= 51,821 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 906.36' @ 12.86 hrs Surf.Area= 0.651 ac Storage= 0.489 af

Plug-Flow detention time= 74.2 min calculated for 51,805 cf (100% of inflow)
Center-of-Mass det. time= 75.0 min (907.2 - 832.2)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=3.47 cfs @ 12.86 hrs HW=906.36' (Free Discharge)
└─**1=Culvert** (Barrel Controls 3.47 cfs @ 4.42 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 41P: Stormwater Basin

Inflow Area = 6,533,129 sf, 0.00% Impervious, Inflow Depth = 1.26" for 10-Year event
Inflow = 123.34 cfs @ 12.65 hrs, Volume= 684,368 cf
Outflow = 2.50 cfs @ 22.82 hrs, Volume= 611,022 cf, Atten= 98%, Lag= 609.8 min
Discarded = 2.50 cfs @ 22.82 hrs, Volume= 611,022 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 895.78' @ 22.82 hrs Surf.Area= 3.094 ac Storage= 13.346 af

Plug-Flow detention time= 2,205.8 min calculated for 611,022 cf (89% of inflow)
Center-of-Mass det. time= 2,158.8 min (3,026.7 - 867.9)

Volume	Invert	Avail.Storage	Storage Description
#1	890.00'	227.895 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
890.00	1.590	0.000	0.000	1.590
892.00	2.070	3.649	3.649	2.072
894.00	2.590	4.650	8.300	2.595
895.90	3.130	5.426	13.726	3.138
896.00	104.000	4.172	17.898	104.008
898.00	106.000	209.997	227.895	106.038

Device	Routing	Invert	Outlet Devices
#1	Primary	889.00'	**18.0" Round Culvert** L= 77.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 889.00' / 885.50' S= 0.0455 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf
#2	Device 1	896.50'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	897.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Discarded	890.00'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=2.50 cfs @ 22.82 hrs HW=895.78' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 2.50 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=890.00' TW=0.00' (Dynamic Tailwater)
├─**1=Culvert** (Passes 0.00 cfs of 4.26 cfs potential flow)
│ └─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 31S: Northwest Area Runoff Area=8.990 ac 0.00% Impervious Runoff Depth=3.77"
Tc=18.0 min CN=72 Runoff=40.07 cfs 123,012 cf

Subcatchment 41S: Pit Area Runoff Area=149.980 ac 0.00% Impervious Runoff Depth=3.25"
Tc=45.0 min CN=67 Runoff=341.60 cfs 1,770,074 cf

Subcatchment 61S: East Area Runoff Area=26.120 ac 0.00% Impervious Runoff Depth=3.56"
Tc=15.0 min CN=70 Runoff=121.15 cfs 337,572 cf

Reach 6R: River Inflow=121.15 cfs 337,572 cf
Outflow=121.15 cfs 337,572 cf

Pond 3P: River Road Culvert Peak Elev=907.51' Storage=1.425 af Inflow=40.07 cfs 123,012 cf
Outflow=5.30 cfs 123,025 cf

Pond 41P: Stormwater Basin Peak Elev=896.03' Storage=21.042 af Inflow=341.60 cfs 1,770,074 cf
Discarded=83.92 cfs 1,683,870 cf Primary=0.00 cfs 0 cf Outflow=83.92 cfs 1,683,870 cf

Total Runoff Area = 8,062,520 sf Runoff Volume = 2,230,658 cf Average Runoff Depth = 3.32"
100.00% Pervious = 8,062,520 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 31S: Northwest Area

Runoff = 40.07 cfs @ 12.27 hrs, Volume= 123,012 cf, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	8.990	72	Pasture/grassland/range
	8.990	72	100.00% Pervious Area

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

Summary for Subcatchment 41S: Pit Area

Runoff = 341.60 cfs @ 12.65 hrs, Volume= 1,770,074 cf, Depth= 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	149.980	67	Pasture/grassland/range, Fair, HSG B
	149.980	67	100.00% Pervious Area

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

Summary for Subcatchment 61S: East Area

Runoff = 121.15 cfs @ 12.23 hrs, Volume= 337,572 cf, Depth= 3.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	26.120	70	Woods
	26.120	70	100.00% Pervious Area

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

Summary for Reach 6R: River

Inflow Area = 7,670,916 sf, 0.00% Impervious, Inflow Depth = 0.53" for 100-Year event
Inflow = 121.15 cfs @ 12.23 hrs, Volume= 337,572 cf
Outflow = 121.15 cfs @ 12.23 hrs, Volume= 337,572 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 391,604 sf, 0.00% Impervious, Inflow Depth = 3.77" for 100-Year event
Inflow = 40.07 cfs @ 12.27 hrs, Volume= 123,012 cf
Outflow = 5.30 cfs @ 13.12 hrs, Volume= 123,025 cf, Atten= 87%, Lag= 50.7 min
Primary = 5.30 cfs @ 13.12 hrs, Volume= 123,025 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 907.51' @ 13.12 hrs Surf.Area= 0.986 ac Storage= 1.425 af

Plug-Flow detention time= 131.4 min calculated for 123,000 cf (100% of inflow)
Center-of-Mass det. time= 131.7 min (945.9 - 814.2)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.30 cfs @ 13.12 hrs HW=907.51' (Free Discharge)
└─**1=Culvert** (Barrel Controls 5.30 cfs @ 6.75 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 41P: Stormwater Basin

Inflow Area = 6,533,129 sf, 0.00% Impervious, Inflow Depth = 3.25" for 100-Year event
Inflow = 341.60 cfs @ 12.65 hrs, Volume= 1,770,074 cf
Outflow = 83.92 cfs @ 13.68 hrs, Volume= 1,683,870 cf, Atten= 75%, Lag= 61.7 min
Discarded = 83.92 cfs @ 13.68 hrs, Volume= 1,683,870 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 896.03' @ 13.68 hrs Surf.Area= 104.030 ac Storage= 21.042 af

Plug-Flow detention time= 873.1 min calculated for 1,683,870 cf (95% of inflow)
Center-of-Mass det. time= 848.5 min (1,695.5 - 847.0)

Volume	Invert	Avail.Storage	Storage Description
#1	890.00'	227.895 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
890.00	1.590	0.000	0.000	1.590
892.00	2.070	3.649	3.649	2.072
894.00	2.590	4.650	8.300	2.595
895.90	3.130	5.426	13.726	3.138
896.00	104.000	4.172	17.898	104.008
898.00	106.000	209.997	227.895	106.038

Device	Routing	Invert	Outlet Devices
#1	Primary	889.00'	**18.0" Round Culvert** L= 77.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 889.00' / 885.50' S= 0.0455 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf
#2	Device 1	896.50'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	897.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Discarded	890.00'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=83.92 cfs @ 13.68 hrs HW=896.03' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 83.92 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=890.00' TW=0.00' (Dynamic Tailwater)
├─**1=Culvert** (Passes 0.00 cfs of 4.26 cfs potential flow)
│ └─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-480.00 hrs, dt=0.10 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 31S: Northwest Area Runoff Area=8.990 ac 0.00% Impervious Runoff Depth=7.11"
Tc=18.0 min AMC Adjusted CN=98 Runoff=0.28 cfs 232,047 cf

Subcatchment 41S: Pit Area Runoff Area=149.980 ac 0.00% Impervious Runoff Depth=7.11"
Tc=45.0 min AMC Adjusted CN=98 Runoff=4.63 cfs 3,871,230 cf

Subcatchment 61S: East Area Runoff Area=26.120 ac 0.00% Impervious Runoff Depth=7.11"
Tc=15.0 min AMC Adjusted CN=98 Runoff=0.81 cfs 674,200 cf

Reach 6R: River Inflow=0.81 cfs 674,200 cf
Outflow=0.81 cfs 674,200 cf

Pond 3P: River Road Culvert Peak Elev=905.26' Storage=0.018 af Inflow=0.28 cfs 232,047 cf
Outflow=0.28 cfs 232,047 cf

Pond 41P: Stormwater Basin Peak Elev=895.91' Storage=13.758 af Inflow=4.63 cfs 3,871,230 cf
Discarded=4.63 cfs 3,871,233 cf Primary=0.00 cfs 0 cf Outflow=4.63 cfs 3,871,233 cf

Total Runoff Area = 8,062,520 sf Runoff Volume = 4,777,477 cf Average Runoff Depth = 7.11"
100.00% Pervious = 8,062,520 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 31S: Northwest Area

Runoff = 0.28 cfs @ 239.90 hrs, Volume= 232,047 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	8.990	72		Pasture/grassland/range
	8.990	72	98	Weighted Average, AMC Adjusted
	8.990	72	98	100.00% Pervious Area, AMC Adjusted

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

Summary for Subcatchment 41S: Pit Area

Runoff = 4.63 cfs @ 240.00 hrs, Volume= 3,871,230 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	149.980	67		Pasture/grassland/range, Fair, HSG B
	149.980	67	98	Weighted Average, AMC Adjusted
	149.980	67	98	100.00% Pervious Area, AMC Adjusted

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

Summary for Subcatchment 61S: East Area

Runoff = 0.81 cfs @ 239.90 hrs, Volume= 674,200 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	26.120	70		Woods
	26.120	70	98	Weighted Average, AMC Adjusted
	26.120	70	98	100.00% Pervious Area, AMC Adjusted

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

Summary for Reach 6R: River

Inflow Area = 7,670,916 sf, 0.00% Impervious, Inflow Depth = 1.05" for 100-Year 10-Day event
Inflow = 0.81 cfs @ 239.90 hrs, Volume= 674,200 cf
Outflow = 0.81 cfs @ 239.90 hrs, Volume= 674,200 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 391,604 sf, 0.00% Impervious, Inflow Depth = 7.11" for 100-Year 10-Day event
Inflow = 0.28 cfs @ 239.90 hrs, Volume= 232,047 cf
Outflow = 0.28 cfs @ 239.90 hrs, Volume= 232,047 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.28 cfs @ 239.90 hrs, Volume= 232,047 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Peak Elev= 905.26' @ 239.90 hrs Surf.Area= 0.141 ac Storage= 0.018 af

Plug-Flow detention time= 47.4 min calculated for 231,998 cf (100% of inflow)
Center-of-Mass det. time= 47.4 min (7,473.8 - 7,426.4)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.28 cfs @ 239.90 hrs HW=905.26' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.28 cfs @ 1.73 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 41P: Stormwater Basin

Inflow Area = 6,533,129 sf, 0.00% Impervious, Inflow Depth = 7.11" for 100-Year 10-Day event
Inflow = 4.63 cfs @ 240.00 hrs, Volume= 3,871,230 cf
Outflow = 4.63 cfs @ 240.00 hrs, Volume= 3,871,233 cf, Atten= 0%, Lag= 0.0 min
Discarded = 4.63 cfs @ 240.00 hrs, Volume= 3,871,233 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Peak Elev= 895.91' @ 240.00 hrs Surf.Area= 5.737 ac Storage= 13.758 af

Plug-Flow detention time= 2,243.6 min calculated for 3,870,427 cf (100% of inflow)
Center-of-Mass det. time= 2,244.3 min (9,695.7 - 7,451.4)

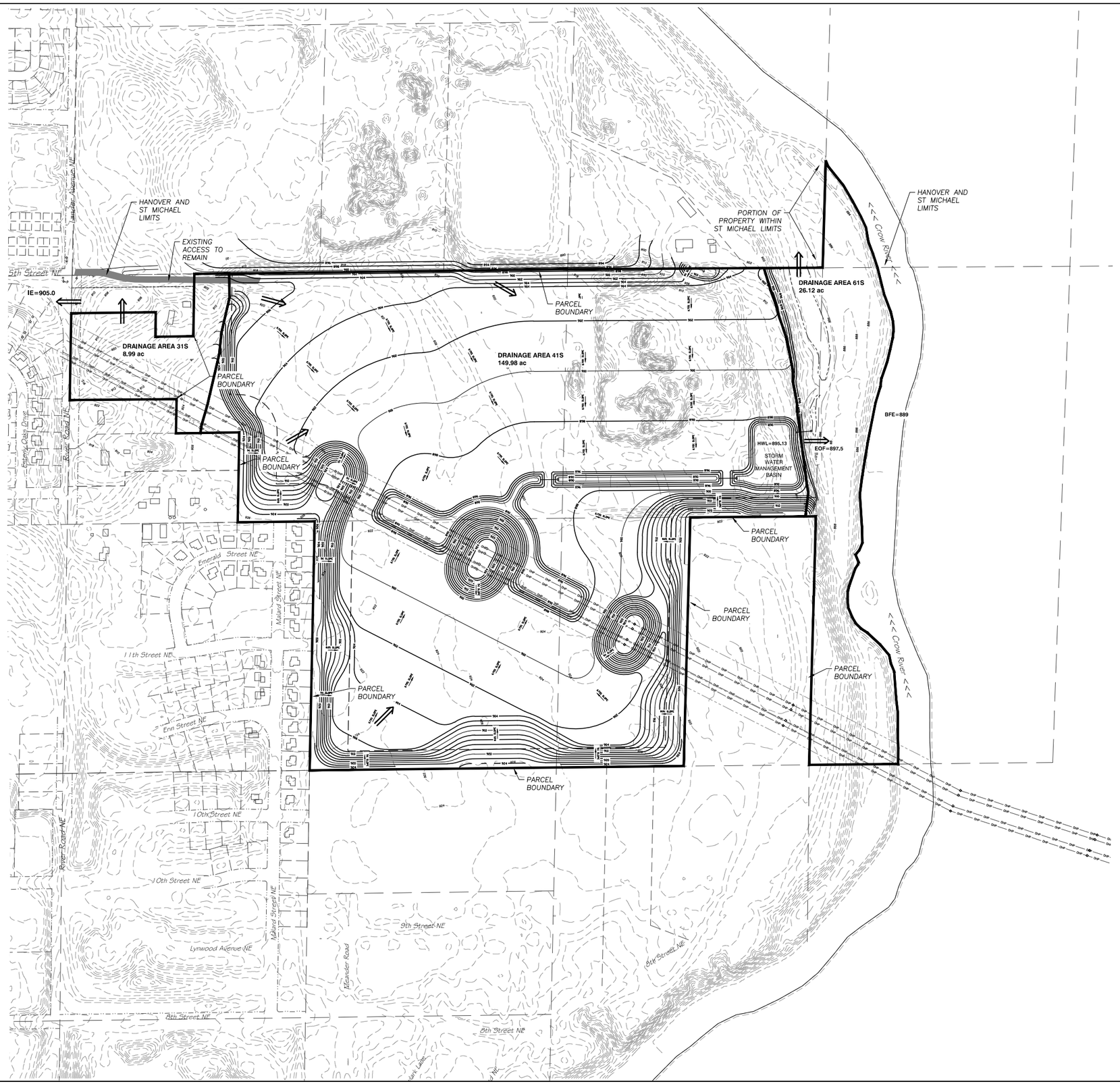
Volume	Invert	Avail.Storage	Storage Description
#1	890.00'	227.895 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
890.00	1.590	0.000	0.000	1.590
892.00	2.070	3.649	3.649	2.072
894.00	2.590	4.650	8.300	2.595
895.90	3.130	5.426	13.726	3.138
896.00	104.000	4.172	17.898	104.008
898.00	106.000	209.997	227.895	106.038

Device	Routing	Invert	Outlet Devices
#1	Primary	889.00'	**18.0" Round Culvert** L= 77.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 889.00' / 885.50' S= 0.0455 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf
#2	Device 1	896.50'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	897.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Discarded	890.00'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=4.63 cfs @ 240.00 hrs HW=895.91' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 4.63 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=890.00' TW=0.00' (Dynamic Tailwater)
├─**1=Culvert** (Passes 0.00 cfs of 4.26 cfs potential flow)
│ └─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)



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GRAPHIC SCALE IN FEET

EXISTING P.I.D. #S

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108-500-254-200	HANOVER
108-500-254-400	HANOVER
108-500-303-300	HANOVER
114-800-302-400	ST MICHAEL

APPROXIMATE GROSS AREA

184.9 ACRES

EXCAVATION ELEVATION DATA

EXCAVATED BOTTOM ELEV 896.0
WATER TABLE ELEV 886.0

FEHN

Fehn Companies, Inc.
5050 Barthel Industrial Dr.
Albertville, MN 55301

Gary Fehn
612-282-6542
gfehn@fehncompanies.com

MAHLER AGGREGATE MINE EXPANSION

SE Quad 15th Street and River Road
Hanover, MN 55341

END USE
DRAINAGE AREA PLAN

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.

Date: 12/02/19 Reg. No. 24348

PREPARED BY: CIVIL ENGINEERING SITE DESIGN

118 East Broadway St.
PO Box 566
Montrose, MN 55363
Phone: 763-314-0929
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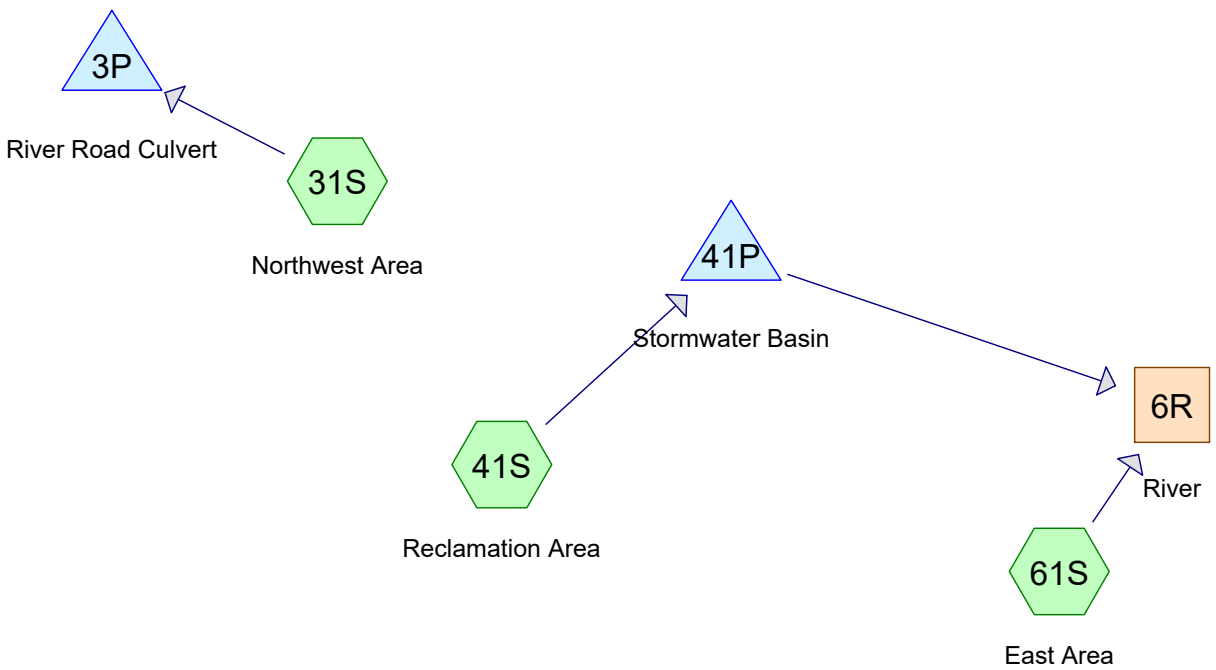
REVISIONS
12/02/2019 END USE CONTOUR MODIFICATIONS

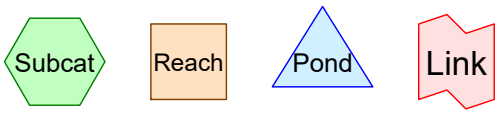
DATE 09/16/19	
DRAWN BY SD	
DESIGNED BY SD	
CHECKED BY SD	

FILE NO. 00722

DA3

End Use
Drainage Area Plan





Routing Diagram for 00722 Pro-end use
Prepared by CESD, Printed 11/29/2019
HydroCAD® 10.00-20 s/n 01607 © 2017 HydroCAD Software Solutions LLC

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 31S: Northwest Area Runoff Area=8.990 ac 0.00% Impervious Runoff Depth=0.70"
Tc=18.0 min CN=72 Runoff=6.69 cfs 22,762 cf

Subcatchment 41S: Reclamation Area Runoff Area=149.980 ac 0.00% Impervious Runoff Depth=0.49"
Tc=45.0 min CN=67 Runoff=40.94 cfs 268,601 cf

Subcatchment 61S: East Area Runoff Area=26.120 ac 0.00% Impervious Runoff Depth=0.61"
Tc=15.0 min CN=70 Runoff=18.04 cfs 57,961 cf

Reach 6R: River Inflow=18.04 cfs 57,961 cf
Outflow=18.04 cfs 57,961 cf

Pond 3P: River Road Culvert Peak Elev=905.79' Storage=0.171 af Inflow=6.69 cfs 22,762 cf
Outflow=1.99 cfs 22,775 cf

Pond 41P: Stormwater Basin Peak Elev=890.69' Storage=3.363 af Inflow=40.94 cfs 268,601 cf
Discarded=4.13 cfs 268,627 cf Primary=0.00 cfs 0 cf Outflow=4.13 cfs 268,627 cf

Total Runoff Area = 8,062,520 sf Runoff Volume = 349,323 cf Average Runoff Depth = 0.52"
100.00% Pervious = 8,062,520 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 31S: Northwest Area

Runoff = 6.69 cfs @ 12.30 hrs, Volume= 22,762 cf, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	8.990	72	Pasture/grassland/range
	8.990	72	100.00% Pervious Area

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

Summary for Subcatchment 41S: Reclamation Area

Runoff = 40.94 cfs @ 12.75 hrs, Volume= 268,601 cf, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	149.980	67	Pasture/grassland/range, Fair, HSG B
	149.980	67	100.00% Pervious Area

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

Summary for Subcatchment 61S: East Area

Runoff = 18.04 cfs @ 12.26 hrs, Volume= 57,961 cf, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.81"

	Area (ac)	CN	Description
*	26.120	70	Woods
	26.120	70	100.00% Pervious Area

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

Summary for Reach 6R: River

Inflow Area = 7,670,916 sf, 0.00% Impervious, Inflow Depth = 0.09" for 2-Year event
Inflow = 18.04 cfs @ 12.26 hrs, Volume= 57,961 cf
Outflow = 18.04 cfs @ 12.26 hrs, Volume= 57,961 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 391,604 sf, 0.00% Impervious, Inflow Depth = 0.70" for 2-Year event
Inflow = 6.69 cfs @ 12.30 hrs, Volume= 22,762 cf
Outflow = 1.99 cfs @ 12.77 hrs, Volume= 22,775 cf, Atten= 70%, Lag= 28.4 min
Primary = 1.99 cfs @ 12.77 hrs, Volume= 22,775 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 905.79' @ 12.77 hrs Surf.Area= 0.431 ac Storage= 0.171 af

Plug-Flow detention time= 54.4 min calculated for 22,761 cf (100% of inflow)
Center-of-Mass det. time= 56.1 min (907.7 - 851.7)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=1.99 cfs @ 12.77 hrs HW=905.79' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.99 cfs @ 4.10 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 41P: Stormwater Basin

Inflow Area =	6,533,129 sf,	0.00% Impervious,	Inflow Depth =	0.49"	for 2-Year event
Inflow =	40.94 cfs @	12.75 hrs,	Volume=	268,601 cf	
Outflow =	4.13 cfs @	15.85 hrs,	Volume=	268,627 cf,	Atten= 90%, Lag= 185.9 min
Discarded =	4.13 cfs @	15.85 hrs,	Volume=	268,627 cf	
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 890.69' @ 15.85 hrs Surf.Area= 5.121 ac Storage= 3.363 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 390.9 min (1,283.9 - 893.0)

Volume	Invert	Avail.Storage	Storage Description
#1	890.00'	75.057 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
890.00	4.610	0.000	0.000	4.610
892.00	6.160	10.733	10.733	6.162
894.00	7.760	13.889	24.622	7.764
896.00	9.420	17.153	41.775	9.427
898.00	25.120	33.282	75.057	25.128

Device	Routing	Invert	Outlet Devices
#1	Primary	889.00'	**18.0" Round Culvert** L= 77.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 889.00' / 885.50' S= 0.0455 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.77 sf
#2	Device 1	896.50'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	897.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Discarded	890.00'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=4.13 cfs @ 15.85 hrs HW=890.69' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 4.13 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=890.00' TW=0.00' (Dynamic Tailwater)
├─**1=Culvert** (Passes 0.00 cfs of 4.26 cfs potential flow)
│ └─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 31S: Northwest Area Runoff Area=8.990 ac 0.00% Impervious Runoff Depth=1.59"
Tc=18.0 min CN=72 Runoff=16.52 cfs 51,808 cf

Subcatchment 41S: Reclamation Area Runoff Area=149.980 ac 0.00% Impervious Runoff Depth=1.26"
Tc=45.0 min CN=67 Runoff=123.34 cfs 684,368 cf

Subcatchment 61S: East Area Runoff Area=26.120 ac 0.00% Impervious Runoff Depth=1.45"
Tc=15.0 min CN=70 Runoff=47.97 cfs 137,594 cf

Reach 6R: River Inflow=47.97 cfs 137,594 cf
Outflow=47.97 cfs 137,594 cf

Pond 3P: River Road Culvert Peak Elev=906.36' Storage=0.489 af Inflow=16.52 cfs 51,808 cf
Outflow=3.47 cfs 51,821 cf

Pond 41P: Stormwater Basin Peak Elev=892.11' Storage=11.388 af Inflow=123.34 cfs 684,368 cf
Discarded=5.03 cfs 684,399 cf Primary=0.00 cfs 0 cf Outflow=5.03 cfs 684,399 cf

Total Runoff Area = 8,062,520 sf Runoff Volume = 873,770 cf Average Runoff Depth = 1.30"
100.00% Pervious = 8,062,520 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 31S: Northwest Area

Runoff = 16.52 cfs @ 12.28 hrs, Volume= 51,808 cf, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	8.990	72	Pasture/grassland/range
	8.990	72	100.00% Pervious Area

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

Summary for Subcatchment 41S: Reclamation Area

Runoff = 123.34 cfs @ 12.65 hrs, Volume= 684,368 cf, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	149.980	67	Pasture/grassland/range, Fair, HSG B
	149.980	67	100.00% Pervious Area

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

Summary for Subcatchment 61S: East Area

Runoff = 47.97 cfs @ 12.25 hrs, Volume= 137,594 cf, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.18"

	Area (ac)	CN	Description
*	26.120	70	Woods
	26.120	70	100.00% Pervious Area

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

Summary for Reach 6R: River

Inflow Area = 7,670,916 sf, 0.00% Impervious, Inflow Depth = 0.22" for 10-Year event
Inflow = 47.97 cfs @ 12.25 hrs, Volume= 137,594 cf
Outflow = 47.97 cfs @ 12.25 hrs, Volume= 137,594 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 391,604 sf, 0.00% Impervious, Inflow Depth = 1.59" for 10-Year event
Inflow = 16.52 cfs @ 12.28 hrs, Volume= 51,808 cf
Outflow = 3.47 cfs @ 12.86 hrs, Volume= 51,821 cf, Atten= 79%, Lag= 34.4 min
Primary = 3.47 cfs @ 12.86 hrs, Volume= 51,821 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 906.36' @ 12.86 hrs Surf.Area= 0.651 ac Storage= 0.489 af

Plug-Flow detention time= 74.2 min calculated for 51,805 cf (100% of inflow)
Center-of-Mass det. time= 75.0 min (907.2 - 832.2)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=3.47 cfs @ 12.86 hrs HW=906.36' (Free Discharge)
└─**1=Culvert** (Barrel Controls 3.47 cfs @ 4.42 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 41P: Stormwater Basin

Inflow Area = 6,533,129 sf, 0.00% Impervious, Inflow Depth = 1.26" for 10-Year event
Inflow = 123.34 cfs @ 12.65 hrs, Volume= 684,368 cf
Outflow = 5.03 cfs @ 19.45 hrs, Volume= 684,399 cf, Atten= 96%, Lag= 407.8 min
Discarded = 5.03 cfs @ 19.45 hrs, Volume= 684,399 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 892.11' @ 19.45 hrs Surf.Area= 6.240 ac Storage= 11.388 af

Plug-Flow detention time= 1,057.2 min calculated for 684,328 cf (100% of inflow)
Center-of-Mass det. time= 1,057.3 min (1,925.2 - 867.9)

Volume	Invert	Avail.Storage	Storage Description
#1	890.00'	75.057 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
890.00	4.610	0.000	0.000	4.610
892.00	6.160	10.733	10.733	6.162
894.00	7.760	13.889	24.622	7.764
896.00	9.420	17.153	41.775	9.427
898.00	25.120	33.282	75.057	25.128

Device	Routing	Invert	Outlet Devices
#1	Primary	889.00'	**18.0" Round Culvert** L= 77.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 889.00' / 885.50' S= 0.0455 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.77 sf
#2	Device 1	896.50'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	897.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Discarded	890.00'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=5.03 cfs @ 19.45 hrs HW=892.11' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 5.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=890.00' TW=0.00' (Dynamic Tailwater)
├─**1=Culvert** (Passes 0.00 cfs of 4.26 cfs potential flow)
│ └─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 31S: Northwest Area Runoff Area=8.990 ac 0.00% Impervious Runoff Depth=3.77"
Tc=18.0 min CN=72 Runoff=40.07 cfs 123,012 cf

Subcatchment 41S: Reclamation Area Runoff Area=149.980 ac 0.00% Impervious Runoff Depth=3.25"
Tc=45.0 min CN=67 Runoff=341.60 cfs 1,770,074 cf

Subcatchment 61S: East Area Runoff Area=26.120 ac 0.00% Impervious Runoff Depth=3.56"
Tc=15.0 min CN=70 Runoff=121.15 cfs 337,572 cf

Reach 6R: River Inflow=121.15 cfs 337,572 cf
Outflow=121.15 cfs 337,572 cf

Pond 3P: River Road Culvert Peak Elev=907.51' Storage=1.425 af Inflow=40.07 cfs 123,012 cf
Outflow=5.30 cfs 123,025 cf

Pond 41P: Stormwater Basin Peak Elev=895.13' Storage=33.902 af Inflow=341.60 cfs 1,770,074 cf
Discarded=7.00 cfs 1,706,705 cf Primary=0.00 cfs 0 cf Outflow=7.00 cfs 1,706,705 cf

Total Runoff Area = 8,062,520 sf Runoff Volume = 2,230,658 cf Average Runoff Depth = 3.32"
100.00% Pervious = 8,062,520 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 31S: Northwest Area

Runoff = 40.07 cfs @ 12.27 hrs, Volume= 123,012 cf, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	8.990	72	Pasture/grassland/range
	8.990	72	100.00% Pervious Area

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

Summary for Subcatchment 41S: Reclamation Area

Runoff = 341.60 cfs @ 12.65 hrs, Volume= 1,770,074 cf, Depth= 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	149.980	67	Pasture/grassland/range, Fair, HSG B
	149.980	67	100.00% Pervious Area

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

Summary for Subcatchment 61S: East Area

Runoff = 121.15 cfs @ 12.23 hrs, Volume= 337,572 cf, Depth= 3.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.93"

	Area (ac)	CN	Description
*	26.120	70	Woods
	26.120	70	100.00% Pervious Area

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

Summary for Reach 6R: River

Inflow Area = 7,670,916 sf, 0.00% Impervious, Inflow Depth = 0.53" for 100-Year event
Inflow = 121.15 cfs @ 12.23 hrs, Volume= 337,572 cf
Outflow = 121.15 cfs @ 12.23 hrs, Volume= 337,572 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 391,604 sf, 0.00% Impervious, Inflow Depth = 3.77" for 100-Year event
Inflow = 40.07 cfs @ 12.27 hrs, Volume= 123,012 cf
Outflow = 5.30 cfs @ 13.12 hrs, Volume= 123,025 cf, Atten= 87%, Lag= 50.7 min
Primary = 5.30 cfs @ 13.12 hrs, Volume= 123,025 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 907.51' @ 13.12 hrs Surf.Area= 0.986 ac Storage= 1.425 af

Plug-Flow detention time= 131.4 min calculated for 123,000 cf (100% of inflow)
Center-of-Mass det. time= 131.7 min (945.9 - 814.2)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.30 cfs @ 13.12 hrs HW=907.51' (Free Discharge)
└─**1=Culvert** (Barrel Controls 5.30 cfs @ 6.75 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 41P: Stormwater Basin

Inflow Area = 6,533,129 sf, 0.00% Impervious, Inflow Depth = 3.25" for 100-Year event
Inflow = 341.60 cfs @ 12.65 hrs, Volume= 1,770,074 cf
Outflow = 7.00 cfs @ 21.72 hrs, Volume= 1,706,705 cf, Atten= 98%, Lag= 544.1 min
Discarded = 7.00 cfs @ 21.72 hrs, Volume= 1,706,705 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 895.13' @ 21.72 hrs Surf.Area= 8.678 ac Storage= 33.902 af

Plug-Flow detention time= 2,157.2 min calculated for 1,706,705 cf (96% of inflow)
Center-of-Mass det. time= 2,138.2 min (2,985.3 - 847.0)

Volume	Invert	Avail.Storage	Storage Description
#1	890.00'	75.057 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
890.00	4.610	0.000	0.000	4.610
892.00	6.160	10.733	10.733	6.162
894.00	7.760	13.889	24.622	7.764
896.00	9.420	17.153	41.775	9.427
898.00	25.120	33.282	75.057	25.128

Device	Routing	Invert	Outlet Devices
#1	Primary	889.00'	**18.0" Round Culvert** L= 77.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 889.00' / 885.50' S= 0.0455 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.77 sf
#2	Device 1	896.50'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	897.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Discarded	890.00'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=7.00 cfs @ 21.72 hrs HW=895.13' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 7.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=890.00' TW=0.00' (Dynamic Tailwater)
├─**1=Culvert** (Passes 0.00 cfs of 4.26 cfs potential flow)
│ └─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-480.00 hrs, dt=0.10 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 31S: Northwest Area Runoff Area=8.990 ac 0.00% Impervious Runoff Depth=7.11"
Tc=18.0 min AMC Adjusted CN=98 Runoff=0.28 cfs 232,047 cf

Subcatchment 41S: Reclamation Area Runoff Area=149.980 ac 0.00% Impervious Runoff Depth=7.11"
Tc=45.0 min AMC Adjusted CN=98 Runoff=4.63 cfs 3,871,230 cf

Subcatchment 61S: East Area Runoff Area=26.120 ac 0.00% Impervious Runoff Depth=7.11"
Tc=15.0 min AMC Adjusted CN=98 Runoff=0.81 cfs 674,200 cf

Reach 6R: River Inflow=0.81 cfs 674,200 cf
Outflow=0.81 cfs 674,200 cf

Pond 3P: River Road Culvert Peak Elev=905.26' Storage=0.018 af Inflow=0.28 cfs 232,047 cf
Outflow=0.28 cfs 232,047 cf

Pond 41P: Stormwater Basin Peak Elev=891.30' Storage=6.647 af Inflow=4.63 cfs 3,871,230 cf
Discarded=4.51 cfs 3,871,614 cf Primary=0.00 cfs 0 cf Outflow=4.51 cfs 3,871,614 cf

Total Runoff Area = 8,062,520 sf Runoff Volume = 4,777,477 cf Average Runoff Depth = 7.11"
100.00% Pervious = 8,062,520 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 31S: Northwest Area

Runoff = 0.28 cfs @ 239.90 hrs, Volume= 232,047 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	8.990	72		Pasture/grassland/range
	8.990	72	98	Weighted Average, AMC Adjusted
	8.990	72	98	100.00% Pervious Area, AMC Adjusted

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

Summary for Subcatchment 41S: Reclamation Area

Runoff = 4.63 cfs @ 240.00 hrs, Volume= 3,871,230 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	149.980	67		Pasture/grassland/range, Fair, HSG B
	149.980	67	98	Weighted Average, AMC Adjusted
	149.980	67	98	100.00% Pervious Area, AMC Adjusted

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

Summary for Subcatchment 61S: East Area

Runoff = 0.81 cfs @ 239.90 hrs, Volume= 674,200 cf, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Constant Intensity 240.00 hrs 100-Year 10-Day Rainfall=7.35", AMC=4

	Area (ac)	CN	Adj	Description
*	26.120	70		Woods
	26.120	70	98	Weighted Average, AMC Adjusted
	26.120	70	98	100.00% Pervious Area, AMC Adjusted

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

Summary for Reach 6R: River

Inflow Area = 7,670,916 sf, 0.00% Impervious, Inflow Depth = 1.05" for 100-Year 10-Day event
Inflow = 0.81 cfs @ 239.90 hrs, Volume= 674,200 cf
Outflow = 0.81 cfs @ 239.90 hrs, Volume= 674,200 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs

Summary for Pond 3P: River Road Culvert

Inflow Area = 391,604 sf, 0.00% Impervious, Inflow Depth = 7.11" for 100-Year 10-Day event
Inflow = 0.28 cfs @ 239.90 hrs, Volume= 232,047 cf
Outflow = 0.28 cfs @ 239.90 hrs, Volume= 232,047 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.28 cfs @ 239.90 hrs, Volume= 232,047 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Peak Elev= 905.26' @ 239.90 hrs Surf.Area= 0.141 ac Storage= 0.018 af

Plug-Flow detention time= 47.4 min calculated for 231,998 cf (100% of inflow)
Center-of-Mass det. time= 47.4 min (7,473.8 - 7,426.4)

Volume	Invert	Avail.Storage	Storage Description
#1	905.00'	8.435 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
905.00	0.000	0.000	0.000
906.00	0.545	0.272	0.272
908.00	1.131	1.676	1.949
910.00	1.691	2.822	4.771
912.00	1.974	3.665	8.435

Device	Routing	Invert	Outlet Devices
#1	Primary	905.00'	**12.0" Round Culvert** L= 50.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 905.00' / 904.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Primary	911.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.28 cfs @ 239.90 hrs HW=905.26' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.28 cfs @ 1.73 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 41P: Stormwater Basin

Inflow Area = 6,533,129 sf, 0.00% Impervious, Inflow Depth = 7.11" for 100-Year 10-Day event
Inflow = 4.63 cfs @ 240.00 hrs, Volume= 3,871,230 cf
Outflow = 4.51 cfs @ 240.20 hrs, Volume= 3,871,614 cf, Atten= 2%, Lag= 12.0 min
Discarded = 4.51 cfs @ 240.20 hrs, Volume= 3,871,614 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-480.00 hrs, dt= 0.10 hrs
Peak Elev= 891.30' @ 240.20 hrs Surf.Area= 5.596 ac Storage= 6.647 af

Plug-Flow detention time= 695.1 min calculated for 3,870,808 cf (100% of inflow)
Center-of-Mass det. time= 695.9 min (8,147.3 - 7,451.4)

Volume	Invert	Avail.Storage	Storage Description
#1	890.00'	75.057 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
890.00	4.610	0.000	0.000	4.610
892.00	6.160	10.733	10.733	6.162
894.00	7.760	13.889	24.622	7.764
896.00	9.420	17.153	41.775	9.427
898.00	25.120	33.282	75.057	25.128

Device	Routing	Invert	Outlet Devices
#1	Primary	889.00'	**18.0" Round Culvert** L= 77.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 889.00' / 885.50' S= 0.0455 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.77 sf
#2	Device 1	896.50'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	897.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Discarded	890.00'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=4.51 cfs @ 240.20 hrs HW=891.30' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 4.51 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=890.00' TW=0.00' (Dynamic Tailwater)
├─**1=Culvert** (Passes 0.00 cfs of 4.26 cfs potential flow)
│ └─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

APPENDIX C

Soils Data

Legend

Approximate Soil Boring Location

Haugo GeoTechnical Services, LLC
2825 Cedar Avenue S.
Minneapolis, MN 55407

Soil Boring Location Sketch
Mahler Aggregate Mine Expansion
Hanover, Minnesota

Figure #: 1
Drawn By: RD
Date: 5/14/19
Scale: None
Project #: 19-0388

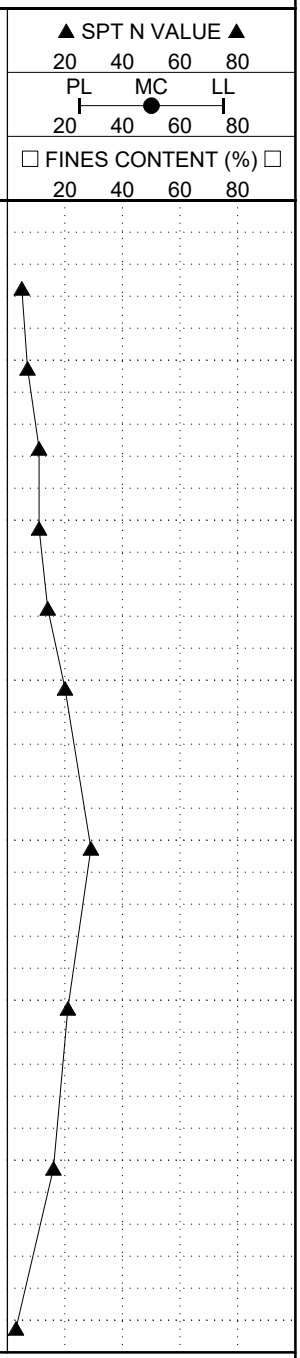
Haugo GTS
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959

BORING NUMBER SB-1

CLIENT Fehn Companies
PROJECT NAME Mahler Aggregate Mine Expansion
PROJECT NUMBER 19-0388
PROJECT LOCATION Hanover, MN
DATE STARTED 5/10/19 **COMPLETED** 5/10/19
GROUND ELEVATION 918.84 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING 35.00 ft / Elev 883.84 ft
LOGGED BY NA **CHECKED BY** PG
AT END OF DRILLING 31.70 ft / Elev 887.14 ft
NOTES Borehole grouted.
AFTER DRILLING --- Not Encountered with Cave-In Depth of 16 feet

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0		Silty Sand, trace Roots, brown, moist. (Topsoil)	AU 24				
		(SP-SM) Poorly Graded Sand with Silt, fine to medium grained, trace Gravel, brown, moist, loose to medium dense. (Glacial Outwash)	SS 25		2-3-2 (5)		
5			SS 26		2-2-5 (7)		
			SS 27		2-5-6 (11)		
10		(SP) Poorly Graded Sand, fine to coarse grained, with Gravel, brown, moist, medium dense. (Glacial Outwash)	SS 28		5-5-6 (11)		
			SS 29		3-6-8 (14)		
15			SS 30		6-10-10 (20)		
20			SS 31		9-14-15 (29)		
25		(SP) Poorly Graded Sand, fine grained, tan, moist, medium dense. (Glacial Outwash)	SS 32		7-10-11 (21)		
30		(SP) Poorly Graded Sand, fine to medium grained, brown, wet to waterbearing, medium dense to very loose. (Glacial Outwash)	SS 33		3-7-9 (16)		
35			SS 34		2-1-2 (3)		

Bottom of borehole at 36.0 feet.



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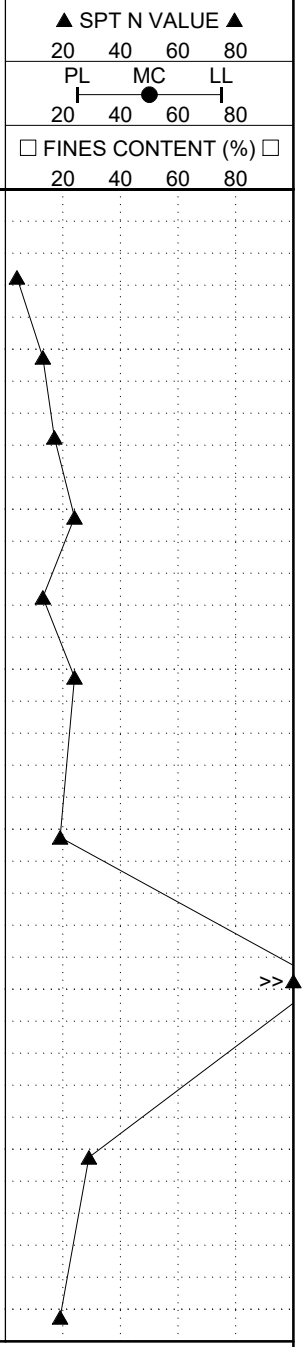
HAUGO GEOTECHNICAL SERVICES
Haugo GTS
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959

BORING NUMBER SB-2

CLIENT Fehn Companies
PROJECT NAME Mahler Aggregate Mine Expansion
PROJECT NUMBER 19-0388
PROJECT LOCATION Hanover, MN
DATE STARTED 5/10/19 **COMPLETED** 5/10/19
GROUND ELEVATION 920.01 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING 35.00 ft / Elev 885.01 ft
LOGGED BY NA **CHECKED BY** PG
AT END OF DRILLING 33.60 ft / Elev 886.41 ft
NOTES Borehole grouted.
AFTER DRILLING --- Not Encountered with Cave-In Depth of 14 feet

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0		Silty Sand, trace Organics, black, moist. (Topsoil)	AU 13				
		(SP-SM) Poorly Graded Sand with Silt, fine to medium grained, brown, moist, very loose. (Glacial Outwash)	SS 14		2-2-2 (4)		
5		(SP) Poorly Graded Sand, fine to coarse grained, trace to with Gravel, brown, moist to waterbearing, medium dense to very dense. (Glacial Outwash)	SS 15		4-6-7 (13)		
			SS 16		5-8-9 (17)		
10			SS 17		5-10-14 (24)		
			SS 18		6-6-7 (13)		
15			SS 19		14-15-9 (24)		
20			SS 20		3-10-9 (19)		
25			SS 21		50/6"		
30			SS 22		9-14-15 (29)		
35			SS 23		7-10-9 (19)		



Bottom of borehole at 36.0 feet.

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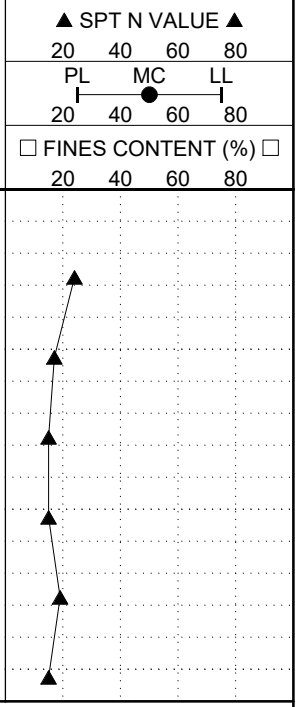
Haugo GTS
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959

BORING NUMBER SB-3

CLIENT Fehn Companies
PROJECT NAME Mahler Aggregate Mine Expansion
PROJECT NUMBER 19-0388
PROJECT LOCATION Hanover, MN
DATE STARTED 5/10/19 **COMPLETED** 5/10/19
GROUND ELEVATION 901.38 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING 14.50 ft / Elev 886.88 ft
LOGGED BY NA **CHECKED BY** PG
AT END OF DRILLING ---
NOTES
AFTER DRILLING --- Not Encountered with Cave-In Depth of 6 feet

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0		Poorly Graded Sand with Silt, fine to coarse grained, with Gravel, brown, moist. (FILL)	AU 6				
		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, light brown, moist, medium dense. (Glacial Outwash)	SS 7		6-12-12 (24)		
5			SS 8		5-8-9 (17)		
			SS 9		2-7-8 (15)		
10			SS 10		2-7-8 (15)		
		(SP) Poorly Graded Sand, fine to coarse grained, with Gravel, brown, moist to waterbearing, medium dense. (Glacial Outwash)	SS 11		4-9-10 (19)		
15			SS 12		4-6-9 (15)		



Bottom of borehole at 16.0 feet.

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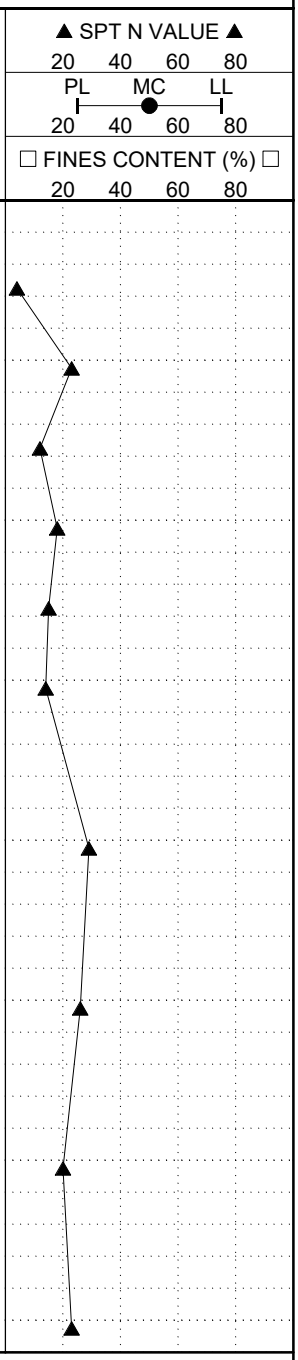
Haugo GTS
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959

BORING NUMBER SB-4

CLIENT Fehn Companies
PROJECT NAME Mahler Aggregate Mine Expansion
PROJECT NUMBER 19-0388
PROJECT LOCATION Hanover, MN
DATE STARTED 5/10/19 **COMPLETED** 5/10/19
GROUND ELEVATION 923.53 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING 35.00 ft / Elev 888.53 ft
LOGGED BY NA **CHECKED BY** PG
AT END OF DRILLING 34.70 ft / Elev 888.83 ft
NOTES Borehole grouted.
AFTER DRILLING --- Not Encountered with Cave-In Depth of 16 feet

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0	Silty Sand, trace Roots, dark brown, moist. (Topsoil)	AU 35				
	(SP-SM) Poorly Graded Sand with Silt, fine to medium grained, trace Gravel, brown, moist, very loose. (Glacial Outwash)	SS 36		2-2-2 (4)		
5	(SP) Poorly Graded Sand, fine to coarse grained, with Gravel, brown, moist, medium dense. (Glacial Outwash)	SS 37		5-11-12 (23)		
		SS 38		4-6-6 (12)		
10		SS 39		5-9-9 (18)		
		SS 40		4-8-7 (15)		
15		SS 41		4-6-8 (14)		
20	(SP) Poorly Graded Sand, mostly fine grained, trace Gravel, light brown, moist, medium dense. (Glacial Outwash)	SS 42		3-13-16 (29)		
25	(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, light brown, moist, medium dense. (Glacial Outwash)	SS 43		9-12-14 (26)		
30	(SP) Poorly Graded Sand, fine to coarse grained, with Gravel, brown, watebearing, medium dense. (Glacial Outwash)	SS 44		9-10-10 (20)		
35		SS 45		7-12-11 (23)		



Bottom of borehole at 36.0 feet.

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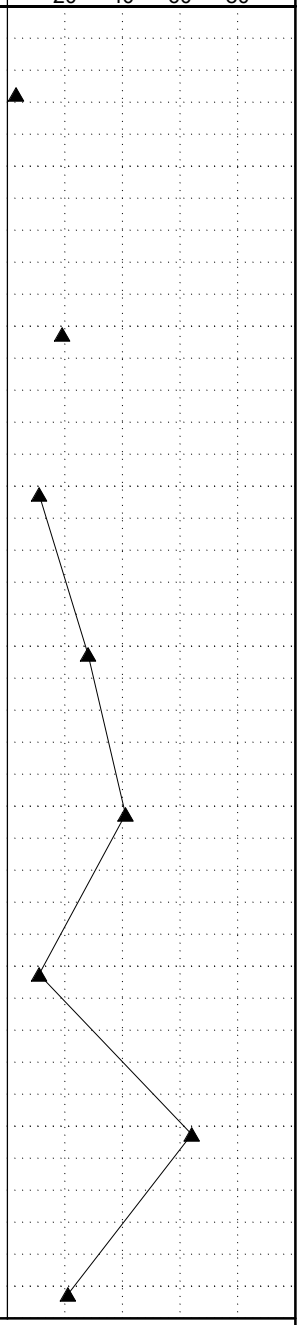
HAUGO GEOTECHNICAL SERVICES
Haugo GTS
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959

BORING NUMBER SB-5

CLIENT Fehn Companies
PROJECT NAME Mahler Aggregate Mine Expansion
PROJECT NUMBER 19-0388
PROJECT LOCATION Hanover, MN
DATE STARTED 5/10/19 **COMPLETED** 5/10/19
GROUND ELEVATION 925.13 ft **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING 40.00 ft / Elev 885.13 ft
LOGGED BY NA **CHECKED BY** PG
AT END OF DRILLING 39.50 ft / Elev 885.63 ft
NOTES Borehole grouted.
AFTER DRILLING --- Not Encountered with Cave-In Depth of 18 feet

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0		Silty Sand, dark brown to black, moist. (Topsoil)	AU 46				
		(SP-SM) Poorly Graded Sand with Silt, fine to medium grained, trace Gravel, brown, moist, very loose. (Glacial Outwash)	SS 47		3-2-1 (3)		
5			SS 48				
			SS 49				
10		(SP) Poorly Graded Sand, fine to coarse grained, with Gravel, brown, moist, medium dense to dense. (Glacial Outwash)	SS 50		2-9-10 (19)		
			SS 51				
15			SS 52		3-5-6 (11)		
20			SS 53		5-12-16 (28)		
25			SS 54		10-18-23 (41)		
30		(SP) Poorly Graded Sand, fine to medium grained, trace Gravel, with Sandy Lean Clay seam at about 40 feet, with Gravel layer at about 35 feet, brown, moist, medium dense. (Galcial Outwash)	SS 55		3-5-6 (11)		
35			SS 56		8-36-28 (64)		
40			SS 57		16-9-12 (21)		

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
☐ FINES CONTENT (%) ☐ 20 40 60 80



Bottom of borehole at 41.0 feet.

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Haugo GTS
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959

TEST PIT NUMBER TP-1

CLIENT Fehn Companies
PROJECT NAME Mahler Aggregate Mine Expansion
PROJECT NUMBER 19-0388
PROJECT LOCATION Hanover, MN
DATE STARTED 5/10/19 **COMPLETED** 5/10/19
GROUND ELEVATION 886.53 ft **TEST PIT SIZE** inches
EXCAVATION CONTRACTOR HGTS
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION 7.50 ft / Elev 879.03 ft
LOGGED BY NA **CHECKED BY** PG
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		(SM) Silty Sand, black to dark brown, moist.						
5		(SM) Silty Sand, brown, moist to wet.						

Bottom of test pit at 7.5 feet.

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Haugo GTS
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959

TEST PIT NUMBER TP-2

CLIENT Fehn Companies
PROJECT NAME Mahler Aggregate Mine Expansion
PROJECT NUMBER 19-0388
PROJECT LOCATION Hanover, MN
DATE STARTED 5/10/19 **COMPLETED** 5/10/19
GROUND ELEVATION 887.66 ft **TEST PIT SIZE** inches
EXCAVATION CONTRACTOR HGTS
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION 7.00 ft / Elev 880.66 ft
LOGGED BY NA **CHECKED BY** PG
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		(SM) Silty Sand, dark brown, wet.						
		(SM) Silty Sand, brown, waterbearing.						
5		(ML) Silt, light brown, wet.						

Bottom of test pit at 9.0 feet.

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Haugo GTS
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959

TEST PIT NUMBER TP-3

CLIENT Fehn Companies
PROJECT NAME Mahler Aggregate Mine Expansion
PROJECT NUMBER 19-0388
PROJECT LOCATION Hanover, MN
DATE STARTED 5/10/19 **COMPLETED** 5/10/19
GROUND ELEVATION 888.26 ft **TEST PIT SIZE** inches
EXCAVATION CONTRACTOR HGTS
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION 8.00 ft / Elev 880.26 ft
LOGGED BY NA **CHECKED BY** PG
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		(SM) Silty Sand, black to dark brown.						
5		(SP-SM) Poorly Graded Sand with Silt, fine to medium grained, brown, waterbearing.						
10								

Bottom of test pit at 10.0 feet.

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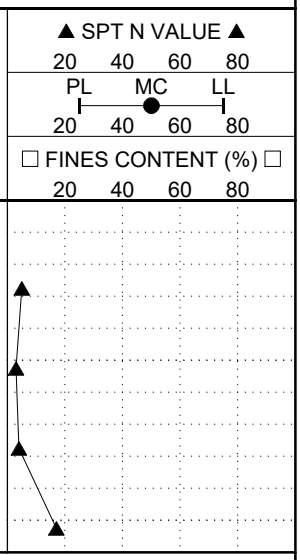
Haugo GTS
2825 Cedar Ave South
Minneapolis, MN 55407
Telephone: 612-729-2959

TEST PIT NUMBER TP-P2

CLIENT Fehn Companies
PROJECT NAME Mahler Aggregate Mine Expansion
PROJECT NUMBER 19-0388
PROJECT LOCATION Hanover, MN
DATE STARTED 5/10/19 **COMPLETED** 5/10/19
GROUND ELEVATION 888.87 ft **TEST PIT SIZE** 3 1/4 inches
EXCAVATION CONTRACTOR HGTS - 750
GROUND WATER LEVELS:
EXCAVATION METHOD Hollow Stem Auger/Split Spoon
AT TIME OF EXCAVATION 9.00 ft / Elev 879.87 ft
LOGGED BY NA **CHECKED BY** PG
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONT. (%)	NOTES
0		Silty Sand, trace Roots, dark brown, moist. (Topsoil)	AU 1				
			SS 2		2-2-3 (5)		
5		(SP-SM) Poorly Graded Sand with Silt, fine grained, dark brown to brown, wet, very loose to loose. (Alluvium)	SS 3		2-2-1 (3)		
		(SP-SM) Poorly Graded Sand with Silt, with Shells, brown, wet, very loose. (Alluvium)	SS 4		1-2-2 (4)		
10		(SP) Poorly Graded Sand, fine to coarse grained, with Gravel, brown, wet to waterbearing, medium dense. (Glacial Outwash)	SS 5		9-10-7 (17)		

Bottom of test pit at 11.0 feet.



GEOTECH BH PLOTS - GINT STD US LAB.GDT - 5/23/19 08:53 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\19-0388 MAHLER AGGREGATE MINE EXPANSION.GPJ

Infiltrameter Recording Chart

HAUGO GEOTECHNICAL SERVICES

Project Identification:	19-0388					**Constants**	**Area cm2**	**Depth of Liquid (cm)**	**Liquid Container Number**	**Marriotte Tube Volume**					
Test Location:	DRI-1 TP-2					**Inner Ring**	729	11.0	1	3000					
Elevation:			**Liquid Used:**	Water		**Annular Space**	2189	11.0	2	10000					
Tested By:	M. Swanson					**Liquid level maintained using:**		(X) Flow Valve ( ) Float Valve ( ) Mariotte Tubes							
Depth to water table:	N/A					**Penetration Depth of Outer Ring:** 3 inches									
					Flow Readings						**Inner Infiltration Rate**		**Ground Temperature**		**Remarks**	
Trial #	**Start / End**	**Date MM/DD/YY**	**Time HR:MIN**	**Elapsed Time Chg/(Total) Min**	**Inner Ring Reading cm**	**Inner Maroitte Tube Flow**	**Annular Space Reading cm**	**Annular Space Marriotte Tube Flow (ml)**	**Liquid Temp (F)**	**Inner Infiltration Rate (Inch/h)**	**Annular Infiltration Rate (Inch/h)**	**Ground Temp Depth (cm)**	**Temp at Depth (F)**	**Weather conditions Etc...**	**Hourly Inner Infiltration Rate (Inch/h)**
	Start Test	5/10/2019	11:05	0:15					63.0						
1	End Test	5/10/2019	11:20	0:15	n/a	3000	n/a	6000		6.48	4.32				
	Start Test	5/10/2019	11:20	0:15					63.0						
2	End Test	5/10/2019	11:35	0:30	n/a	3000	n/a	5000		6.48	3.60				6.26
	Start Test	5/10/2019	11:35	0:15					63.0						
3	End Test	5/10/2019	11:50	0:45	n/a	2800	n/a	3500		6.05	2.52				
	Start Test	5/10/2019	11:50	0:15					63.0						
4	End Test	5/10/2019	12:05	1:00	n/a	2800	n/a	3250		6.05	2.34				
	Start Test	5/10/2019	12:05	0:15					63.0						
5	End Test	5/10/2019	12:20	1:15	n/a	2500	n/a	3250		5.40	2.34				
	Start Test	5/10/2019	12:20	0:15					63.0						
6	End Test	5/10/2019	12:35	1:30	n/a	2500	n/a	3000		5.40	2.16				5.40
	Start Test	5/10/2019	12:35	0:15					63.0						
7	End Test	5/10/2019	12:50	1:45	n/a	2500	n/a	3000		5.40	2.16				
	Start Test	5/10/2019	13:05	0:15					63.0						
8	End Test	5/10/2019	13:20	2:00	n/a	2500	n/a	3000		5.40	2.16				
	Start Test			0:00					63.0						
9	End Test			2:00	n/a		n/a			0.00	0.00				
	Start Test			0:00					63.0						
10	End Test			2:00	n/a		n/a			0.00	0.00				
	Start Test			0:00					63.0						0.00
11	End Test			2:00	n/a		n/a			0.00	0.00				
	Start Test			0:00					63.0						
12	End Test			2:00	n/a		n/a			0.00	0.00				
	Start Test			0:00					63.0						
13	End Test			2:00	n/a		n/a			0.00	0.00				
	Start Test			0:00					63.0						
14	End Test			2:00	n/a		n/a			0.00	0.00				
	Start Test			0:00					63.0						0.00
15	End Test			2:00	n/a		n/a			0.00	0.00				
	Start Test			0:00					63.0						
16	End Test			2:00	n/a		n/a			0.00	0.00				
Final Results	**Start Test**	6/30/2015	**11:40**			**21600**		**30000**		**2.92**	**1.35**	**Total Infiltration in Inches (4 Hour Test)**			**11.67**
	End Test	6/30/2015	**14:40**	**3:00**											