Run-On and Run-Off Control Plan Update

Edgewater I-43 Ash Disposal Facility

Phase 3 Module 1
Phase 3 Module 2
Phase 4 Module 1
Contact Water Swale Module

Prepared for:

Wisconsin Power and Light Company
Edgewater Generating Station
3739 Lakeshore Drive
Sheboygan, Wisconsin 53081-7233

SCS ENGINEERS

25222259.00 | February 18, 2026

2830 Dairy Drive
Madison, WI 53718-6751
608-224-2830

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PE CERTIFICATION

2/18/2026

I, Phillip Gearing, hereby certify that I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A–E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A–E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 500 to 538, Wis. Adm. Code.

Specifically,

- This Run-On and Run-Off Control Plan Update was prepared by me or under my direct supervision and meets the requirements of 40 CFR 257.81(c) and NR 514.07(10)(b)

2/18/2026

(signature) (date)

Phillip E. Gearing

(printed or typed name)

License number E-45115

My license renewal date is July 31, 2026.

Pages or sheets covered by this seal:

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1.0 INTRODUCTION AND PROJECT SUMMARY

The I-43 facility includes a closed coal combustion residual (CCR) landfill, which consists of disposal Phase 1 and Phase 2 (License #2853), and an active CCR landfill (License #6078). The active CCR landfill currently consists of an existing CCR unit (Phase 3, Modules 1 and 2; and Phase 4, Module 1) and a new CCR unit (Contact Water Basin Module). The two landfills are located on the same property but are not contiguous. This plan pertains to the CCR units that are regulated under License #6078.

The active CCR landfill at I-43 includes the following modules, which are the subject of this Run-On and Run-Off Control Plan. These modules are listed below, along with their current status as it relates to the Run-On and Run-Off Control Plan:

- **Phase 3, Module 1** – This module has received some final cover over completed outer sideslope areas that will no longer receive additional CCR. This module has also received some intermediate cover in areas where future overlay of CCR will occur.

- **Phase 3, Module 2** – This module has received some intermediate cover and is currently being filled.

- **Phase 4, Module 1** – This module has received some final cover over completed outer sideslope areas that will no longer receive additional CCR. This module has also received some intermediate cover in areas where future overlay of CCR will occur.

- **Contact Water Swale (CWS) Module** – This module was constructed in 2025 and approved by the DNR for CCR placement in January 2026. Placement of CCR in this module is anticipated to begin in 2026.

Refer to **Figure 1** for the site location. **Figure 2** shows the run-on and run-off drainage areas.

SCS Engineers (SCS) has prepared this Run-on and Run-off Control Plan Update for the I-43 Ash Disposal Facility (ADF) in accordance with 40 CFR 257.81(c)(1) and NR 514.07(10)(b) as follows.

40 CFR 257.81(c)(4). *"The owner or operator of the CCR unit must prepare periodic run-on and run-off control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first subsequent plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed a periodic run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(3)."*

NR 514.07(10)(b)(4). *"Modification every 5 years from the date of the most recent plan approval or whenever there is a change in conditions that may substantially affect the written plan in effect. The modification shall be requested by the owner or operator in accordance with s. NR 514.04 (6) prior to the 5-year deadline."*

The initial Run-on and Run-off Control Plan was completed in 2016. Updates were made previously in 2021 and 2023 to meet federal and state requirements.

1.1 PLAN UPDATE

The following items have been updated in this plan update:

- Run-on and run-off controls associated with the CWS module construction and intermediate cover placement have been identified with this update.

2.0 RUN-ON AND RUN-OFF CONTROL PLAN

40 CFR 257.81(a). *"The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain:*

(1) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm."

NR 514.07(10)(b). *"A run−on and run−off control system plan that includes all of the following:*

(1) A run−on and run−off control system designed in accordance with the requirements under s. NR 504.12 (2)."

NR 504.12 (2). *"An existing or new CCR landfill or any lateral expansion of a CCR landfill shall be designed, constructed, operated, and maintained with a run−off and run−on control system in accordance with the requirements under s. NR 504.09 (1) (f) and (g) and all of the following:*

(a) A run−on control system shall prevent flow onto the active portion of the CCR landfill during the peak discharge from a 24−hour, 25−year storm."

The entire facility has run-on and run-off control in place, as approved by the DNR and further described below. Run-on is controlled by berms and swales around the perimeter of the landfill that divert storm water away from the landfill and ultimately to the detention basin on the north end of the property.

40 CFR 257.81(a)(2) *"A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm."*

NR 504.12(2)(b) *"A run−off control system from the active portion of the CCR landfill shall collect and control, at a minimum, the water volume resulting from a 24−hour, 25−year storm."*

Run-off from the active portions (contact water) of the existing and new CCR units at the facility is handled as leachate and is collected by a leachate collection system, which route the contact water to a composite-lined contact water basin. Water in the contact water basin is pumped through a force main to the sanitary sewer then on to the local waste water treatment facility for disposal. Per 40 CFR 257.81(b), this is consistent with the surface water requirements under 40 CFR 257.3-3.

Run-off from areas of the existing CCR units where intermediate/final cover is in place (which prevents contact with CCR) is diverted into the perimeter drainage swales, which drain to the on-site detention/sedimentation basin. Intermediate swales/berms, downslope flumes, and energy dissipaters on the final cover help minimize erosion of the final cover and divert water to the perimeter drainage system, and ultimately to the on-site detention/sedimentation basin. Per 40 CFR 257.81(b), this is consistent with the surface water requirements under 40 CFR 257.3-3.

2.1 DESIGN CRITERIA

The storm water features described above are designed to handle run-on and run-off from a 25-year, 24-hour storm event as required by 40 CFR 257.81(a)(1) and (2) and NR 504.12 (2)(a) and (b). Storm water run-off calculations were updated in 2025. The calculations were performed assuming a 25-year, 24-hour precipitation depth of 4.79 inches, based on National Oceanic and Atmospheric Administration (NOAA) Atlas 14 precipitation data published in April 2013. The detention basin and detention/sedimentation basin outlet structures are designed to safely pass run-off from a 100-year, 24-hour storm event.

2.2 DESIGN WITH CALCULATIONS

Storm water management design calculations (as described above) from the DNR approved Plan of Operation (2008), Plan of Operation Modification (2015) for Phase 3 and Phase 4 at the I-43 ADF, and CWS Module Plan of Operation Modification (2025) are contained in **Appendix A**, as required by 40 CFR 257.81(c)(1) and NR 514.07(10)(b)(2).

As described in **Section 2.1**, the calculations from the 2025 Plan of Operation Modification describe the storm water management design and provide calculations showing that the run-off control system will manage run-off during the peak discharge from a 25-year, 24-hour storm. Diversion berms, grading and swales (**Figure 2**) are in place to limit run-on into active portion of the CCR units during the peak discharge from a 25-year, 24-hour storm. The calculations from the 2024 Plan of Operation Modification describe the updated storm water management design features from the 2015 Plan of Operation Modification.

The contact water basin storage is maintained by the force main (installed 2019) that allows WPL to discharge contact water collected in the basin to the local sanitary sewer. The pumping of contact water into the force main allows for maintenance of water levels in the contact water basin and assists with providing sufficient water storage between storm events. Previous plan of operation modifications provided calculations for storage without the force main. The calculations were performed by or overseen by a professional engineer licensed in the State of Wisconsin.

Currently available design storm event data from National Oceanic and Atmospheric Administration NOAA Atlas 14, Volume 8, Version 2 and the design calculations described above were reviewed at the time of this update and the data does not substantially affect the results of design calculations provided in **Appendix A**.

2.3 CONSTRUCTION

Existing storm water management features were constructed to site specifications with construction oversight directed by a professional engineer licensed in the State of Wisconsin. Construction documentation reports for the storm water management features were prepared, submitted to the DNR, and approved by the DNR. Any future construction features will have been previously approved.

3.0 CERTIFICATIONS

40 CFR 257.81(c)(5). *"The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section."*

Mr. Phillip Gearing, PE, a licensed professional engineer in the State of Wisconsin, has overseen the preparation of this Run-on and Run-off Control Plan Update. A certification statement is provided on **page iii** of this plan.

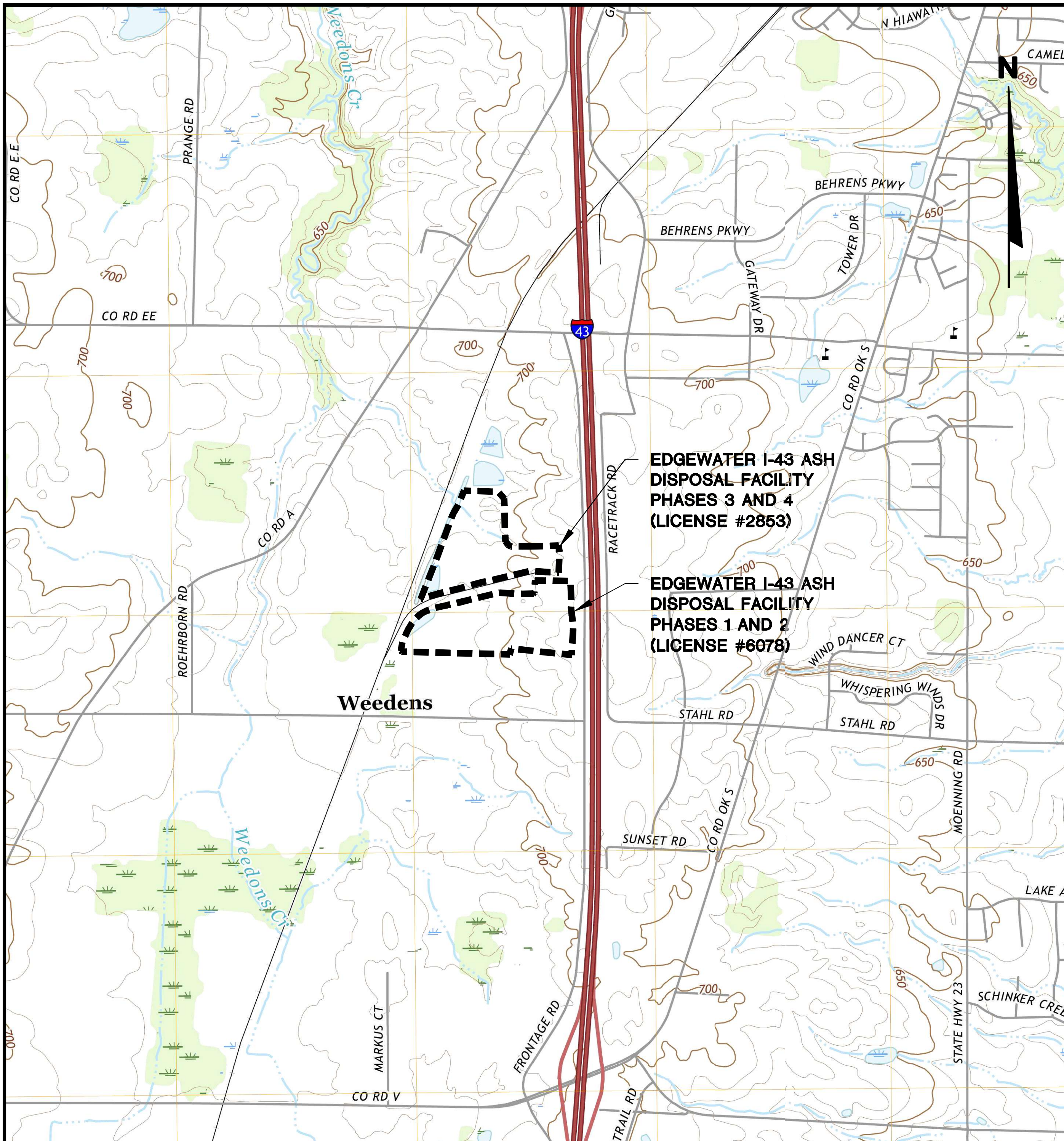
4.0 RECORDKEEPING AND PERIOD UPDATES

40 CFR257.81(d). *"The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in section 257.105(g), the notification requirements specified in section 257.106(g), and the internet requirements specified in section 257.107(g)."*

This Run-On and Run-Off Control Plan Update, and all additional periodic plans, will be placed in the facility's operating record and on Alliant Energy's CCR Rule Compliance Data and Information website, as well as all amendments. Periodic plans will be completed every 5 years per 40 CFR 257.81(c)(4) and NR 514.07(10)(b)(4).

Notification will be provided to State Director when this Run-On and Run-Off Control Plan Update, and all subsequent updates are available in the facility's operating record and on the facility's website per 40 CFR 257.105(g), 257.106(g), and 257.107(g) and NR 506.17(2) and (3).

Figures



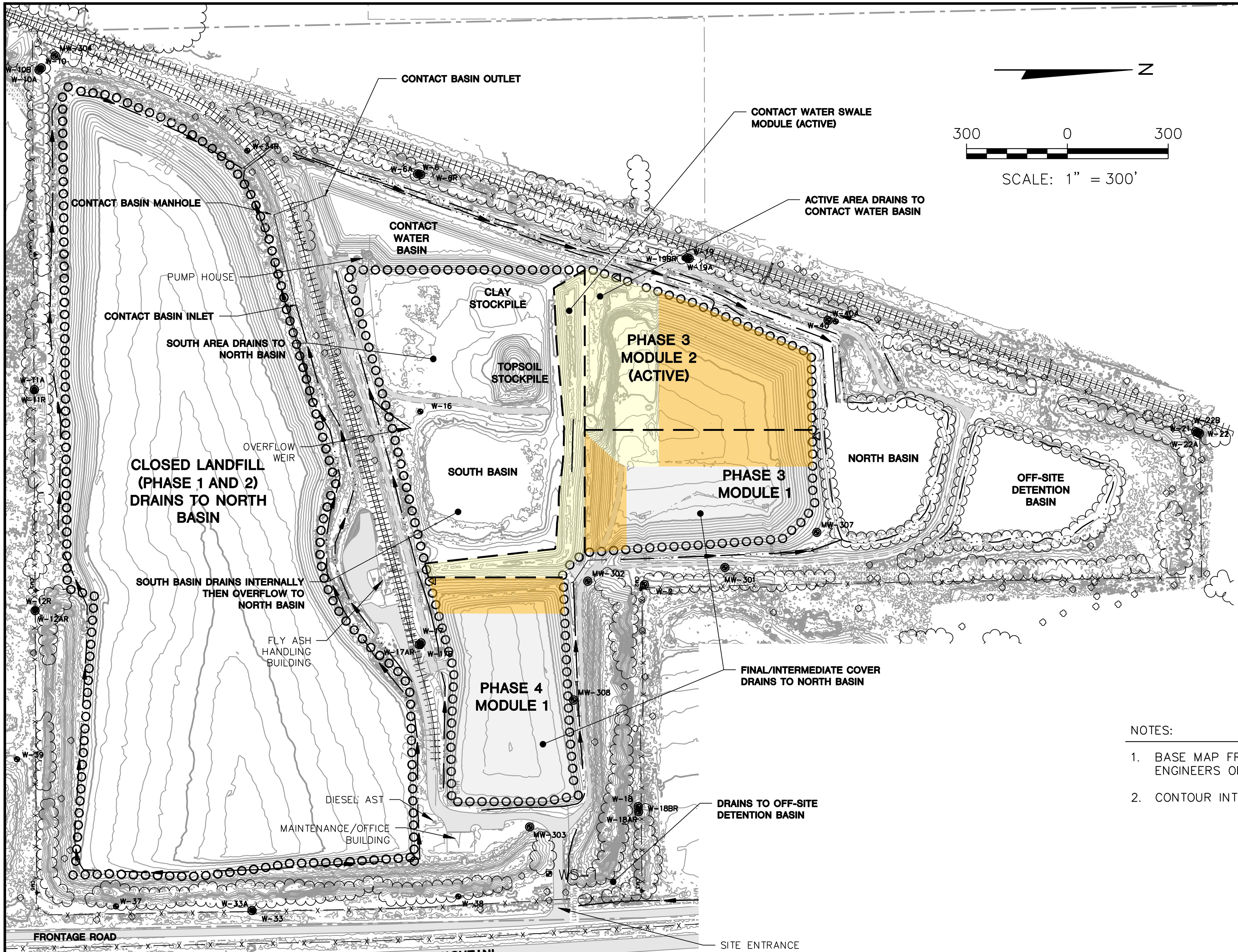
N

SHEBOYGAN HILLS QUADRANGLE
WISCONSIN–SHEBOYGAN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SCALE: 1" = 2,000'

CLIENT	WISCONSIN POWER AND LIGHT COMPANY EDGEWATER GENERATING STATION 3739 LAKESHORE DRIVE SHEBOYGAN, WI 53081	SITE	RUN–ON AND RUN–OFF CONTROL PLAN EDGEWATER I–43 ASH DISPOSAL FACILITY TOWN OF WILSON, WISCONSIN	SITE LOCATION MAP

PROJECT NO.	25224280.00	DRAWN BY:	AHB/RJG/RVG	ENGINEER	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718–6751 PHONE: (608) 224–2830	FIGURE
DRAWN:	08/09/2016	CHECKED BY:	RJG			1
REVISED:	01/20/2026	APPROVED BY:	PEG, 2/18/26			

I:\25224280.00\Drawings\Run-On Run-Off\Fig 1_Site Location Map.dwg, 1/20/2026 4:22:40 PM



LEGEND

- APPROXIMATE PROPERTY LINE
- LIMITS OF WASTE
- MODULE LIMITS
- GRADE (2' CONTOUR)
- 690 GRADE (10' CONTOUR)
- EDGE OF WATER
- SWALE
- WETLAND
- CULVERT
- MH MANHOLE
- W CONTACT WATER TRANSFER PIPE
- AB ABANDONED 3" DIA. HDPE PIPE
- FM CONTACT WATER FORCEMAIN
- E/I ELECTRIC/INSTRUMENTATION
- TREELINE/TREES
- PAVED ROAD
- UNPAVED ACCESS ROAD
- CONCRETE
- RAILROAD TRACKS
- FENCE
- UTILITY/LIGHT POLE
- CONTROL MONUMENT
- PIEZOMETER
- MONITORING WELL
- ACTIVE LANDFILL DRAINAGE AREA
- INTERMEDIATE COVER
- FINAL COVER AREA

NOTES:

1. BASE MAP FROM AERIAL TOPOGRAPHIC SURVEY BY SCS ENGINEERS ON OCTOBER 24, 2025.
2. CONTOUR INTERVAL IS 2 FEET.

PROJECT NO.	25224280.00	DRAWN BY:	AHB/RJG/RVG
DRAWN:	08/09/2016	CHECKED BY:	RJG
REVISED:	01/30/2026	APPROVED BY:	PEG, 2/18/26

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PHONE: (608) 224-2830

CLIENT: WISCONSIN POWER AND LIGHT COMPANY
EDGEWATER GENERATING STATION
3739 LAKESHORE DRIVE
SHEBOYGAN, WI 53081

SITE: RUN-ON AND RUN-OFF CONTROL PLAN
EDGEWATER I-43 ASH DISPOSAL FACILITY
TOWN OF WILSON, WISCONSIN

RUN-ON AND RUN-OFF CONTROL PLAN

FIGURE 2

I:\25224280.00\Drawings\Run-On Run-Off\Fig 2_Run on Run off Control Plan.dwg, 1/30/2026 12:08:13 PM

Appendix A

Drainage Design Calculations

2015 Plan of Operation Modification
Drainage Design Calculations

Storm Water Management Calculations

Purpose:
The purpose of the storm water runoff calculations is to demonstrate that the proposed landfill surface water management system design meets the requirements of the Wisconsin Administrative Code, 504.09.

Existing Features:
Currently Phase 1 and 2 of the landfill have final cover in place. The final cover includes a grass surface. Phase 3, Module 1 has been constructed and is full of ash but does not have final cover in place. Phase 4, Module 1 was constructed in the summer of 2014 and is accepting ash.

Surface water runoff from final cover areas discharges to an existing sedimentation basin at the north end of the landfill. Surface water runoff that comes in contact with ash discharges to the contact water basin located along the western side of the facility, which is managed separately from the non-contact runoff (refer to Section 2.7 of the Plan Modification report). An additional existing detention basin is located north of the landfill detention/sedimentation basin to treat off-site runon. Because the plan modification does not affect off-site runon or the existing detention basin, these storm water management calculations do not include modeling of these areas/features.

From the discharge of the existing detention/sedimentation basins, runoff ultimately discharges off-site via two culverts: 1) a 36-inch diameter culvert under the railroad tracks to the west of the site and 2) a 24-inch diameter culvert under the railroad tracks to the west of the site. The culverts are shown on **Figure F1**.

Approach:
Final Cover Soil Loss
The Universal Soil Loss Equation (USLE) was used to estimate soil loss along the final cover slopes. The USLE estimates the final cover soil erosion based on the erodibility of the soil, the rainfall and runoff erosivity, the slope steepness, cover management, and soil practice factors. A maximum soil loss of 3 tons per acre is considered acceptable.

Hydrograph Generation
To properly size the storm water management features, runoff hydrographs for the 25-year, 24-hour, and 100-year, 24-hour, storm events were developed. HydroCAD was used to model the storm water management system and develop the hydrographs using TR-20 methodologies. The model is designed to simulate the surface runoff response of a watershed to a precipitation event. Input parameters for the model include precipitation depth for the design storm event, contributing drainage areas, runoff curve numbers, time of concentration, and travel time.

The final cover watersheds are shown on **Figures F-1** and **F-2**.

Perimeter Ditch and Diversion Berm Sizing
Perimeter ditches and diversion berms were sized for the 25-year, 24-hour storm event using the Manning's equation to determine the depth of flow and velocity in the berm/ditch based on the berm/ditch geometry and peak flow in the berm/ditch (as determined by the Hydrograph Generation calculations). The drainage areas for the diversion berms are included in **Figure F2**.

Downslope Flume and Energy Dissipator Sizing
The downslope flume inlets were sized for the 25-year, 24-hour storm event using the orifice equation. The downslope flume pipes were sized based on the peak flow conditions in the pipe using Manning's

equation. Energy dissipators were sized using tables from the reference book "Hydraulic Design of Energy Dissipators for Culvert and Channels," US Department of Transportation, Federal Highway Administration, July 2006.

Culvert Sizing
The culverts were sized for the 25-year, 24-hour storm event using the HY-8 computer model developed by the US Department of Transportation, Federal Highway Administration. Culvert outlet protection was sized using guidance from the Wisconsin DOT Permissible Velocities for Riprap Lined Ditches, Procedure 13-30-10.

Sedimentation Basin Sizing
The sedimentation basin sizing process involved determining an appropriate ratio of surface area to flow rate that would allow particles to settle out during a design storm event. The sedimentation basins were sized for the 25-year, 24-hour storm event. The sedimentation basin emergency spillway were sized for the 100-year, 24-hour storm event.

A table presented in the "Erosion and Sediment Control Handbook" (Goldman, et. Al., 1986) provides the surface area-to-discharge ratio required to achieve settlement of the desired particle sizes.

The HydroCAD model was used in conjunction with accepted formulas and engineering calculations to evaluate the ability of the sedimentation basin to meet the requirements of NR 504.09.

Key Assumptions:

- Runoff curve numbers were based on tables presented in Urban Hydrology for Small Watersheds, and were assumed as follows

Cover Type	CN
Landfill final cover	79 – Open spaces (lawns, parks, etc) in fair condition with hydrologic soil group C
Sedimentation basin	98 – Water surface

- A Type II rainfall distribution was used, based on The NOAA Atlas 14, Precipitation Frequency Data Server for Sheboygan Falls, WI (page 4). The following precipitation depths were assumed.

Storm Event	Precipitation Depth (inches)
25-year, 24-hour	4.79
100-year, 24-hour	6.55

- Other assumptions are included with the calculations attached to this appendix.

Results:
The proposed landfill surface water management system design meets the requirements of the Wisconsin Administrative Code, 504.09. Further details are provided below.

Soil Loss
The USLE calculations indicate a minimal soil loss rate along the 3% and 4:1 final cover sideslopes. Although the calculations indicate no diversion berms are needed, berms have been designed upslope of the final cover slope transition. Experience has shown these transition points are sometimes more susceptible to erosion, so the added berms provide protection. Refer to the USLE Calculations section of this appendix for the detailed calculations.

Hydrograph Generation

The hydrograph modeling results for the 25-year and 100-year, 24-hour storm events are included the Hydrograph Generation section of this appendix.

Perimeter Ditch and Diversion Berm Sizing

The diversion berms will be constructed as shown on the plan set. The diversion berms will maintain a minimum 0.5 foot freeboard. Refer to the Diversion Berm and Ditch Sizing section of this appendix for the detailed calculations.

The perimeter ditches will be constructed as shown on the plan set. The perimeter ditches will contain the runoff from the 25-year, 24-hour storm event and maintain a minimum 0.5 foot of freeboard. Erosion matting will be used where ditch velocities exceed 5 feet per second. Refer to the Diversion Berm and Ditch Sizing section of this appendix for the detailed calculations.

Downslope Flume and Energy Dissipator Sizing

The downslope flumes will be constructed as shown on the plan set. The downslope flumes are designed to accommodate the surface water runoff from the final cover for a 25-year, 24-hour storm event. Energy dissipators at the bottom of the downslope flumes have been designed to handle the peak velocities, and additional riprap protection has been sized for the energy dissipator outlets. Refer to the Downslope Flume and Energy Dissipator Sizing section of this appendix for the detailed calculations.

Culvert Sizing

The culverts are designed to accommodate the flows from the perimeter ditches for the 25-year, 24-hour storm event. Riprap outlet protection has been sized based on the discharge rates and outlet velocities. Refer to the Culvert Sizing section of this appendix for the detailed calculations.

Sedimentation Basin Sizing

The outlet structure for the detention/sedimentation basin is sized to control runoff from the 25-year, 24-hour storm event, assuming the starting water elevation is at the bottom of the lowest outlet structure opening. The sedimentation basin is designed to settle out particles 0.01 microns and larger in diameter. Refer to the Sedimentation Basin Sizing section of this appendix for the detailed calculations. The emergency spillways have been designed to pass the 100-year, 24-hour storm event.

4

NOAA Atlas 14, Volume 8, Version 2
Location name: Sheboygan Falls, Wisconsin, US*
Latitude: 43.6942°, Longitude: -87.7645°
Elevation: 718 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.325** (0.258-0.409)	**0.388** (0.307-0.488)	**0.488** (0.385-0.615)	**0.568** (0.447-0.717)	**0.674** (0.514-0.858)	**0.753** (0.565-0.966)	**0.829** (0.607-1.07)	**0.903** (0.641-1.19)	**0.997** (0.688-1.33)	**1.06** (0.722-1.43)
10-min	**0.476** (0.377-0.599)	**0.568** (0.450-0.715)	**0.714** (0.564-0.900)	**0.832** (0.654-1.05)	**0.987** (0.753-1.26)	**1.10** (0.828-1.41)	**1.21** (0.889-1.57)	**1.32** (0.939-1.74)	**1.46** (1.01-1.94)	**1.56** (1.06-2.10)
15-min	**0.581** (0.460-0.730)	**0.693** (0.549-0.872)	**0.871** (0.688-1.10)	**1.01** (0.798-1.28)	**1.20** (0.918-1.53)	**1.34** (1.01-1.72)	**1.48** (1.08-1.92)	**1.61** (1.15-2.12)	**1.78** (1.23-2.37)	**1.90** (1.29-2.56)
30-min	**0.805** (0.638-1.01)	**0.963** (0.763-1.21)	**1.21** (0.959-1.53)	**1.41** (1.11-1.78)	**1.68** (1.28-2.13)	**1.87** (1.40-2.39)	**2.05** (1.50-2.66)	**2.23** (1.58-2.92)	**2.45** (1.69-3.26)	**2.60** (1.77-3.51)
60-min	**1.04** (0.823-1.31)	**1.24** (0.978-1.55)	**1.55** (1.23-1.96)	**1.81** (1.43-2.29)	**2.16** (1.66-2.76)	**2.43** (1.83-3.13)	**2.69** (1.98-3.50)	**2.96** (2.10-3.90)	**3.30** (2.28-4.41)	**3.56** (2.42-4.79)
2-hr	**1.27** (1.02-1.58)	**1.51** (1.21-1.87)	**1.89** (1.51-2.35)	**2.21** (1.76-2.75)	**2.65** (2.06-3.36)	**3.00** (2.28-3.82)	**3.34** (2.48-4.31)	**3.69** (2.65-4.83)	**4.16** (2.90-5.52)	**4.51** (3.08-6.04)
3-hr	**1.42** (1.15-1.75)	**1.67** (1.35-2.06)	**2.09** (1.69-2.58)	**2.45** (1.97-3.03)	**2.97** (2.33-3.75)	**3.38** (2.60-4.30)	**3.81** (2.85-4.90)	**4.25** (3.08-5.55)	**4.86** (3.41-6.44)	**5.34** (3.66-7.11)
6-hr	**1.69** (1.39-2.05)	**1.96** (1.61-2.39)	**2.45** (2.00-2.98)	**2.89** (2.35-3.52)	**3.54** (2.83-4.46)	**4.09** (3.19-5.17)	**4.67** (3.54-5.99)	**5.30** (3.88-6.90)	**6.19** (4.39-8.18)	**6.91** (4.77-9.15)
12-hr	**1.97** (1.64-2.36)	**2.27** (1.89-2.73)	**2.83** (2.34-3.40)	**3.35** (2.76-4.04)	**4.16** (3.38-5.21)	**4.85** (3.84-6.10)	**5.61** (4.31-7.15)	**6.44** (4.77-8.34)	**7.63** (5.46-10.0)	**8.60** (5.98-11.3)
24-hr	**2.26** (1.90-2.67)	**2.59** (2.18-3.07)	**3.23** (2.71-3.82)	**3.84** (3.20-4.56)	**4.79** (3.95-5.96)	**5.63** (4.51-7.01)	**6.55** (5.09-8.28)	**7.57** (5.66-9.73)	**9.04** (6.52-11.8)	**10.3** (7.18-13.4)
2-day	**2.57** (2.20-3.00)	**2.93** (2.50-3.42)	**3.63** (3.08-4.23)	**4.30** (3.63-5.04)	**5.37** (4.48-6.60)	**6.31** (5.12-7.79)	**7.36** (5.78-9.22)	**8.52** (6.43-10.9)	**10.2** (7.43-13.3)	**11.6** (8.18-15.1)
3-day	**2.82** (2.43-3.26)	**3.18** (2.73-3.67)	**3.87** (3.31-4.48)	**4.55** (3.88-5.29)	**5.65** (4.75-6.90)	**6.62** (5.41-8.11)	**7.70** (6.08-9.60)	**8.90** (6.76-11.3)	**10.7** (7.80-13.8)	**12.1** (8.58-15.7)
4-day	**3.03** (2.63-3.48)	**3.40** (2.93-3.90)	**4.10** (3.53-4.72)	**4.79** (4.11-5.54)	**5.91** (4.99-7.17)	**6.89** (5.66-8.40)	**7.99** (6.34-9.92)	**9.22** (7.02-11.7)	**11.0** (8.07-14.2)	**12.5** (8.86-16.1)
7-day	**3.55** (3.10-4.03)	**3.98** (3.48-4.53)	**4.80** (4.18-5.46)	**5.57** (4.82-6.36)	**6.77** (5.75-8.09)	**7.81** (6.46-9.39)	**8.95** (7.14-11.0)	**10.2** (7.81-12.8)	**12.0** (8.84-15.4)	**13.5** (9.62-17.3)
10-day	**4.01** (3.54-4.52)	**4.52** (3.98-5.10)	**5.43** (4.76-6.14)	**6.27** (5.47-7.11)	**7.54** (6.42-8.90)	**8.61** (7.14-10.3)	**9.77** (7.82-11.9)	**11.0** (8.46-13.7)	**12.8** (9.46-16.3)	**14.3** (10.2-18.2)
20-day	**5.45** (4.87-6.05)	**6.09** (5.44-6.77)	**7.20** (6.41-8.02)	**8.16** (7.21-9.12)	**9.54** (8.18-11.0)	**10.7** (8.91-12.4)	**11.8** (9.53-14.1)	**13.0** (10.1-16.0)	**14.7** (10.9-18.5)	**16.0** (11.6-20.4)
30-day	**6.71** (6.05-7.38)	**7.47** (6.73-8.23)	**8.74** (7.84-9.65)	**9.80** (8.74-10.9)	**11.3** (9.71-12.9)	**12.4** (10.4-14.4)	**13.6** (11.0-16.1)	**14.8** (11.5-17.9)	**16.4** (12.2-20.4)	**17.6** (12.7-22.2)
45-day	**8.35** (7.59-9.11)	**9.29** (8.44-10.1)	**10.8** (9.78-11.8)	**12.0** (10.8-13.2)	**13.7** (11.8-15.4)	**14.9** (12.6-17.0)	**16.1** (13.1-18.8)	**17.2** (13.4-20.7)	**18.7** (14.0-23.1)	**19.8** (14.4-24.9)
60-day	**9.78** (8.94-10.6)	**10.9** (9.96-11.8)	**12.7** (11.5-13.8)	**14.0** (12.7-15.3)	**15.8** (13.7-17.7)	**17.1** (14.5-19.4)	**18.3** (15.0-21.3)	**19.5** (15.2-23.3)	**20.9** (15.6-25.7)	**21.9** (15.9-27.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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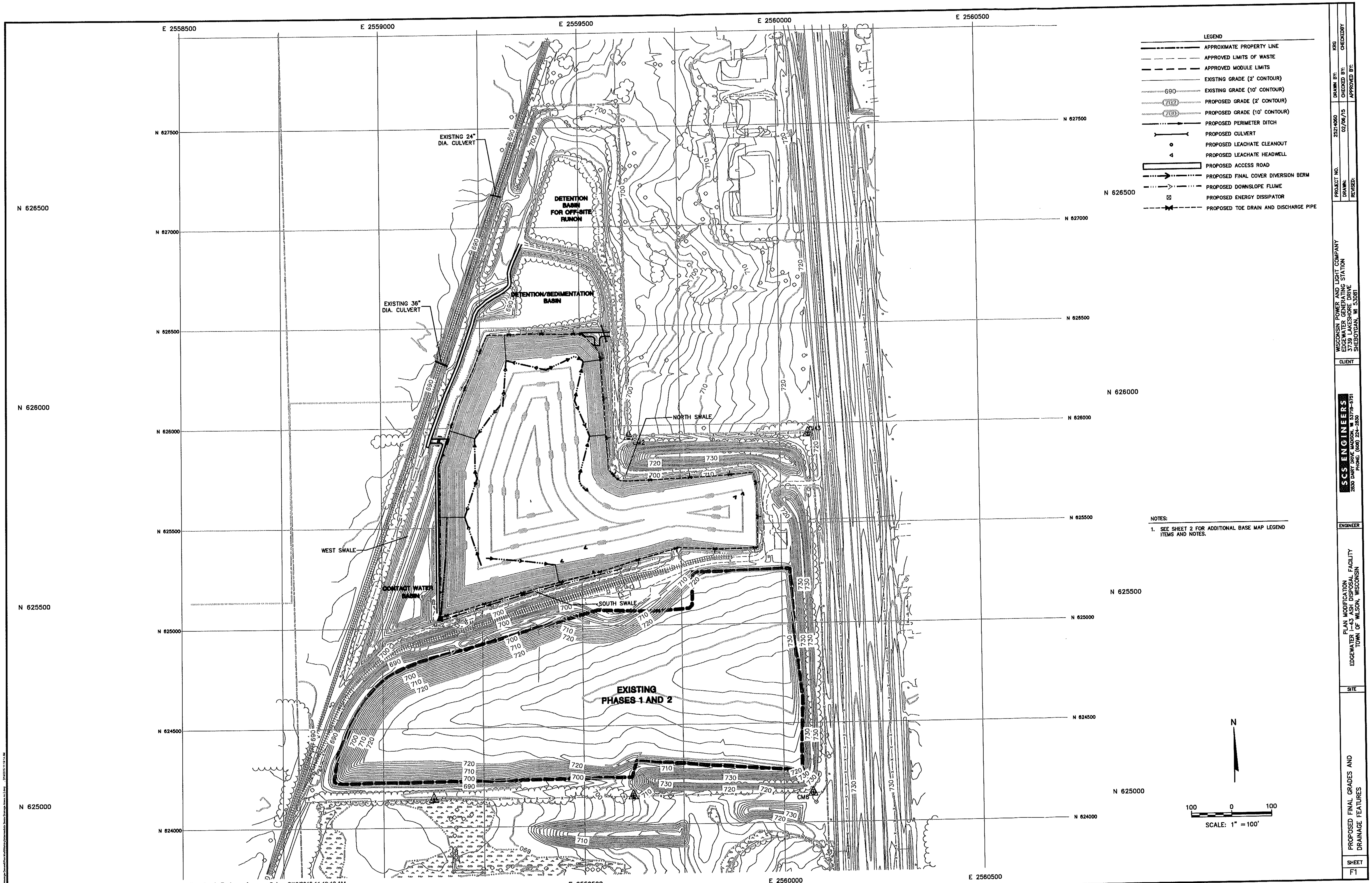

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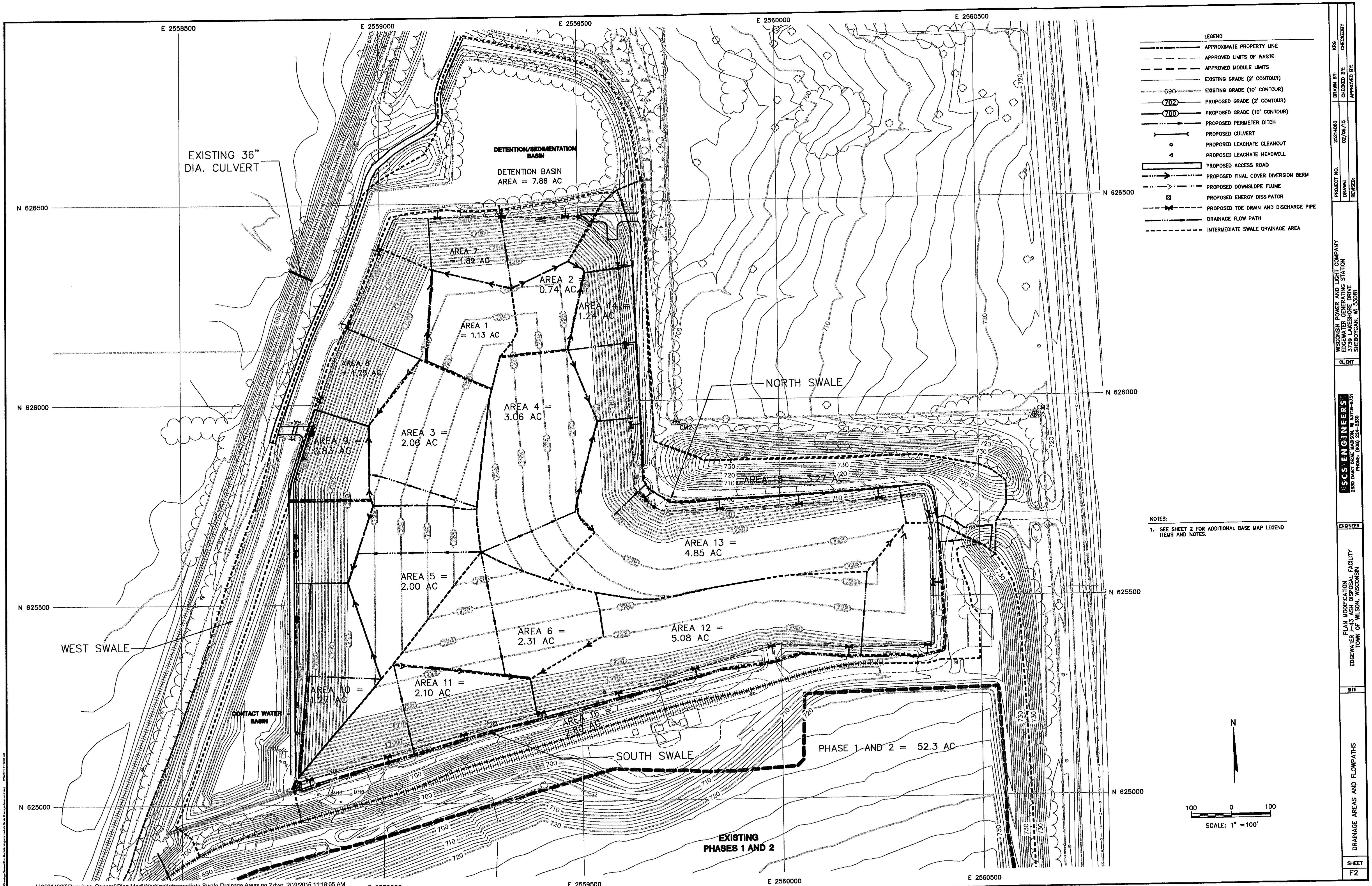

E 2558500
E 2559000
E 2559500
E 2560000
E 2560500
N 626500
N 626000
N 625500
N 625000
EXISTING 36" DIA. CULVERT
DETENTION/SEDIMENTATION BASIN
DETENTION BASIN AREA = 7.86 AC
AREA 7 = 1.89 AC
AREA 2 = 0.74 AC
AREA 14 = 1.24 AC
AREA 1 = 1.13 AC
AREA 8 = 1.75 AC
AREA 3 = 2.06 AC
AREA 4 = 3.06 AC
AREA 9 = 0.83 AC
NORTH SWALE
AREA 15 = 3.27 AC
AREA 13 = 4.85 AC
AREA 5 = 2.00 AC
AREA 6 = 2.31 AC
AREA 12 = 5.08 AC
WEST SWALE
AREA 10 = 1.27 AC
AREA 11 = 2.10 AC
CONTACT WATER BASIN
AREA 16 = 2.80 AC
SOUTH SWALE
PHASE 1 AND 2 = 52.3 AC
EXISTING PHASES 1 AND 2
CM2
CM3
MH3
MH5
LEGEND
APPROXIMATE PROPERTY LINE
APPROVED LIMITS OF WASTE
APPROVED MODULE LIMITS
EXISTING GRADE (2' CONTOUR)
690 EXISTING GRADE (10' CONTOUR)
702 PROPOSED GRADE (2' CONTOUR)
700 PROPOSED GRADE (10' CONTOUR)
PROPOSED PERIMETER DITCH
PROPOSED CULVERT
PROPOSED LEACHATE CLEANOUT
PROPOSED LEACHATE HEADWELL
PROPOSED ACCESS ROAD
PROPOSED FINAL COVER DIVERSION BERM
PROPOSED DOWNSLOPE FLUME
PROPOSED ENERGY DISSIPATOR
PROPOSED TOE DRAIN AND DISCHARGE PIPE
DRAINAGE FLOW PATH
INTERMEDIATE SWALE DRAINAGE AREA
NOTES:
1. SEE SHEET 2 FOR ADDITIONAL BASE MAP LEGEND ITEMS AND NOTES.
N
100 0 100
SCALE: 1" =100'
PROJECT NO. 25214060
DRAWN: 02/06/15
REVISED:
DRAWN BY: KRG
CHECKED BY: CHECKEDBY
APPROVED BY:
WISCONSIN POWER AND LIGHT COMPANY
EDGEWATER GENERATING STATION
3739 LAKESHORE DRIVE
SHEBOYGAN, WI 53081
CLIENT
SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830
ENGINEER
PLAN MODIFICATION
EDGEWATER I-43 ASH DISPOSAL FACILITY
TOWN OF WILSON, WISCONSIN
SITE
DRAINAGE AREAS AND FLOWPATHS
SHEET
F2
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USLE Calculation

		Sheet No.	1 of 6
		Calc. No.	
		Rev. No.	
Job No. 25214060	Job: I-43 Landfill Plan Modification	By: KRG	Date: 1/30/15
Client: Alient Energy	Subject: Soil Loss Along Final Cover	Chk'd:	Date:

Universal Soil Loss Equation (USLE) Calculation

Use USLE to estimate soil loss along the 3% final cover slope, with the goal of maintaining ≤ 3 ton/acre of soil loss along the final cover.

USLE Equation:

A = R * K * LS * C * P

where: A = Average annual soil loss, ton/acre
R = Rainfall and runoff erosivity index
K = Soil erodibility factor, tons/acre
LS = Slope length and steepness factor
C = Cover management factor
P = Practice factor

The LS factor is a function of the slope and flow length.

LS = L * S

where: L = Slope length factor = (l/72.6)^m
where: l = Slope length, feet
m = Slope-length exponent (m = 0.3 for slopes of 1% to 3%
m = 0.4 for slopes of 3.5% to 4.5%
m = 0.5 for slopes greater than 5%)

S = Slope steepness factor = (65.41s^2/(s^2 + 10,000)) + (4.56s/(SQRT(s^2 + 10,000))) + 0.065
where: s = Slope, in percent

The soil type chosen for selecting the appropriate K factor is an estimate of silt loam for the topsoil.

Data Entered		**Data Computed**	
Slope (%), s =	3	S =	0.26
l =	340	L =	1.6
m =	0.3	LS =	0.4

Calculate Average Annual Soil Loss, A:

R =	100	*
K =	0.42	*
LS =	0.4	
C =	0.004	*
P =	1.0	*

A = R * K * LS * C * P = 0.1 tons/acre

* See attached references for R, K, C, and P factors

Soil loss along the 3% slope of the final cover results in minimal soil loss.

Universal Soil Loss Equation (USLE) Calculation

Use USLE to estimate soil loss along the 4:1 final cover slope, with the goal of maintaining ≤ 3 ton/acre of soil loss along the final cover.

USLE Equation:

A = R * K * LS * C * P

where: A = Average annual soil loss, ton/acre
R = Rainfall and runoff erosivity index
K = Soil erodibility factor, tons/acre
LS = Slope length and steepness factor
C = Cover management factor
P = Practice factor

The LS factor is a function of the slope and flow length.

LS = L * S

where: L = Slope length factor = (l/72.6)^m
where: l = Slope length, feet
m = Slope-length exponent (m = 0.3 for slopes of 1% to 3%
m = 0.4 for slopes of 3.5% to 4.5%
m = 0.5 for slopes greater than 5%)

S = Slope steepness factor = (65.41s^2/(s^2 + 10,000)) + (4.56s/(SQRT(s^2 + 10,000))) + 0.065
where: s = Slope, in percent

The soil type chosen for selecting the appropriate K factor is an estimate of silt loam for the topsoil.

Data Entered		Data Computed	
Slope (%), s =	25	S =	5.02
l =	136	L =	1.4
m =	0.5	LS =	6.9

Calculate Average Annual Soil Loss, A:

R =	100	*
K =	0.42	*
LS =	6.9	
C =	0.004	*
P =	1.0	*

A = R * K * LS * C * P = 1.2 tons/acre

* See attached references for R, K, C, and P factors

Soil loss along the 4:1 slope of the final cover results in minimal soil loss.

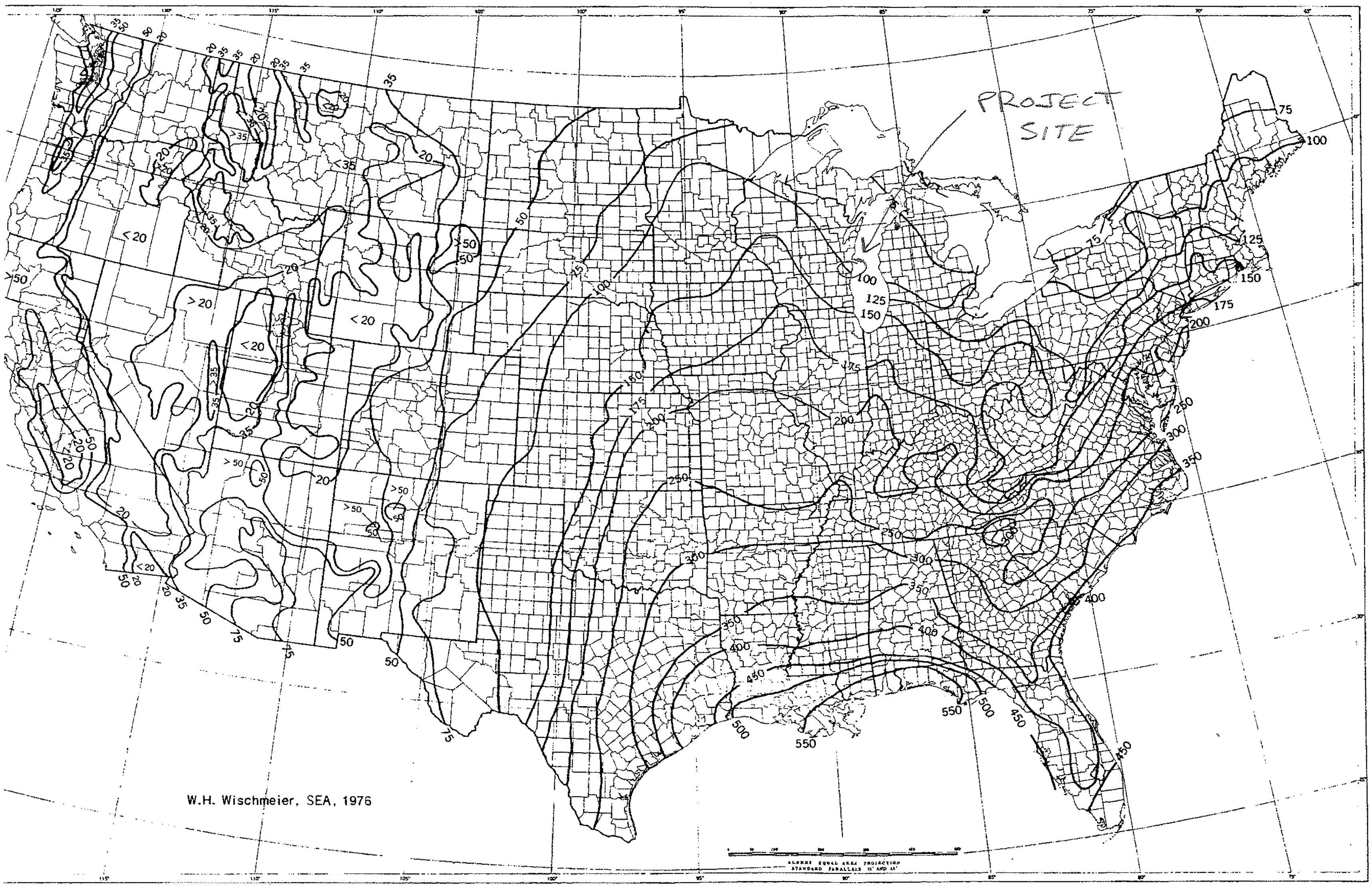

FIGURE 1.—Average annual values of the rainfall erosion index.

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soil in a unit plot, pinpoints differences in erosion according to differences in soil type. Long-term plot studies under natural rainfall have produced K values generalized in Table 5 for the USDA soil types.

TABLE 5. APPROXIMATE VALUES OF FACTOR K FOR USDA TEXTURAL CLASSES[11]

Texture class	Organic matter content		
	<0.5%	2%	4%
	K	K	K
Sand	0.05	0.03	0.02
Fine sand	.16	.14	.10
Very fine sand	.42	.36	.28
Loamy sand	.12	.10	.08
Loamy fine sand	.24	.20	.16
Loamy very fine sand	.44	.38	.30
Sandy loam	.27	.24	.19
Fine sandy loam	.35	.30	.24
Very fine sandy loam	.47	.41	.33
Loam	.38	.34	.29
Silt loam	.48	.42	.33
Silt	.60	.52	.42
Sandy clay loam	.27	.25	.21
Clay loam	.28	.25	.21
Silty clay loam	.37	.32	.26
Sandy clay	.14	.13	.12
Silty clay	.25	.23	.19
Clay		0.13-0.29	

The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, use the average of the two K values.

The evaluator must next consider the shape of the slope in terms of length and inclination. The appropriate LS factor is obtained from Table 6. A nonlinear slope may have to be evaluated as a series of segments, each with uniform gradient. Two or three segments should be sufficient for most engineered landfills, provided the segments are selected so that they are also of equal length (Table 6 can be used, with certain adjustments). Enter Table 6 with the total slope length and read LS values corresponding to the percent slope of each segment. For three segments, multiply the chart LS values for the upper, middle, and lower segments by 0.58, 1.06, and 1.37, respectively. The average of the three products is a good estimate of the

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TABLE 7. GENERALIZED VALUES OF FACTOR C FOR STATES EAST OF THE ROCKY MOUNTAINS[11]

Crop, rotation, and management	Productivity level	
	High	Mod.
	C value	
Base value: continuous fallow, tilled up and down slope	1.00	1.00
CORN		
C, RdR, fall TP, conv	0.54	0.62
C, RdR, spring TP, conv	.50	.59
C, RdL, fall TP, conv	.42	.52
C, RdR, wc seeding, spring TP, conv	.40	.49
C, RdL, standing, spring TP, conv	.38	.48
C-W-M-M, RdL, TP for C, disk for W	.039	.074
C-W-M-M-M, RdL, TP for C, disk for W	.032	.061
C, no-till pl in c-k sod, 95-80% rc	.017	.053
COTTON		
Cot, conv (Western Plains)	0.42	0.49
Cot, conv (South)	.34	.40
MEADOW		
Grass & Legume mix	0.004	0.01
Alfalfa, lespedeza or Sericia	.020	
Sweet clover	.025	
SORGHUM, GRAIN (Western Plains)		
RdL, spring TP, conv	0.43	0.53
No-till pl in shredded 70-50% rc	.11	.18
SOYBEANS		
B, RdL, spring TP, conv	0.48	0.54
C-B, TP annually, conv	.43	.51
B, no-till pl	.22	.28
C-B, no-till pl, fall shred C stalks	.18	.22
WHEAT		
W-F, fall TP after W	0.38	
W-F, stubble mulch, 500 lbs rc	.32	
W-F, stubble mulch, 1000 lbs rc	.21	

Abbreviations defined:

B - soybeans
C - corn
c-k - chemically killed
conv - conventional
cot - cotton
F - fallow
M - grass & legume hay
pl - plant
W - wheat
wc - winter cover

lbs rc - pounds of crop residue per acre remaining on surface after new crop seeding
% rc - percentage of soil surface covered by residue mulch after new crop seeding
70-50% rc - 70% cover for C values in first column; 50% for second column
RdR - residues (corn stover, straw, etc.) removed or burned
RdL - all residues left on field (on surface or incorporated)
TP - turn plowed (upper 5 or more inches of soil inverted, covering residues)

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are listed in Table 8. These values are based on rather limited field data, but P has a narrower range of possible values than the other five factors.

TABLE 8. VALUES OF FACTOR P[11]

Practice	Land slope (percent)				
	1.1-2	2.1-7	7.1-12	12.1-18	18.1-24
	(Factor P)				
Contouring (P_c)	0.60	0.50	0.60	0.80	0.90
Contour strip cropping (P_{sc})					
R-R-M-M[1]	0.30	0.25	0.30	0.40	0.45
R-W-M-M	0.30	0.25	0.30	0.40	0.45
R-R-W-M	0.45	0.38	0.45	0.60	0.68
R-W	0.52	0.44	0.52	0.70	0.90
R-O	0.60	0.50	0.60	0.80	0.90
Contour listing or ridge planting (P_{c1})	0.30	0.25	0.30	0.40	0.45
Contour terracing (P_t)[2]	[3] $0.6/\sqrt{n}$	$0.5/\sqrt{n}$	$0.6/\sqrt{n}$	$0.8/\sqrt{n}$	$0.9/\sqrt{n}$
No support practice	1.0	1.0	1.0	1.0	1.0

[1] R = rowcrop, W = fall-seeded grain, O = spring-seeded grain, M = meadow. The crops are grown in rotation and so arranged on the field that rowcrop strips are always separated by a meadow or winter-grain strip.

[2] These P_t values estimate the amount of soil eroded to the terrace channels and are used for conservation planning. For prediction of off-field sediment, the P_t values are multiplied by 0.2.

[3] n = number of approximately equal-length intervals into which the field slope is divided by the terraces. Tillage operations must be parallel to the terraces.

Example: An owner/operator proposes to close one section of his small landfill with a sandy clay subsoil cover having the surface configuration shown in Figure 21. The factor R has been established as 200 for this locality. The evaluator questions anticipated erosion along the steep side and assigns the following values to the other factors in the USLE after inspecting Tables 5 through 8:

$$K = 0.14 \quad LS = 8.3 \quad C = 1.00 \quad P = 0.90$$

The rate of erosion for the steep slope of the landfill is calculated as follows:

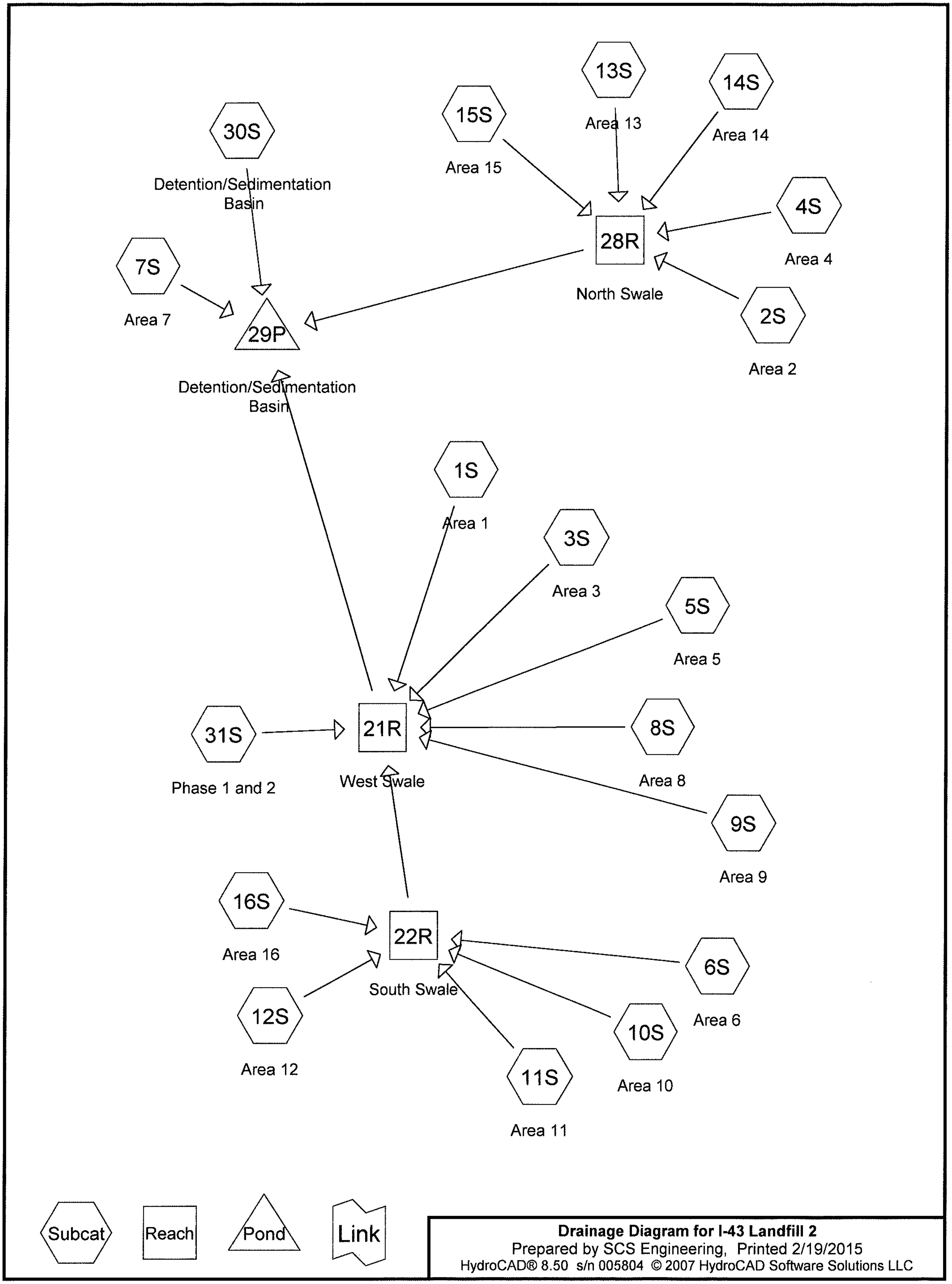
$$A = 200\ (0.14\ \text{tons/acre})\ (8.3)\ (1.00)\ (0.90) = 209\ \text{tons/acre}$$

This erosion not only exceeds a limit recommended by the permitting authority but also indicates a potential

Hydrograph Generation

- 25-year, 24-hour Storm Event
- 100-year, 24-hour Storm Event

25-year, 24-hour Storm


13S
14S
15S
30S
Area 13
Area 14
Detention/Sedimentation
Basin
Area 15
4S
28R
Area 4
7S
North Swale
2S
Area 7
29P
Area 2
Detention/Sedimentation
Basin
1S
Area 1
3S
Area 3
5S
Area 5
31S
21R
8S
Phase 1 and 2
West Swale
Area 8
9S
Area 9
16S
Area 16
22R
6S
12S
South Swale
Area 6
10S
Area 12
Area 10
11S
Area 11
Subcat
Reach
Pond
Link
Drainage Diagram for I-43 Landfill 2
Prepared by SCS Engineering, Printed 2/19/2015
HydroCAD® 8.50 s/n 005804 © 2007 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: Area 1

Runoff = 3.71 cfs @ 12.08 hrs, Volume= 0.227 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	1.130	79	
	1.130		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	78	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	223	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.8	401	Total			

Summary for Subcatchment 2S: Area 2

Runoff = 2.45 cfs @ 12.08 hrs, Volume= 0.149 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	0.740	79	
	0.740		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.0	70	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	196	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.5	366	Total			

Summary for Subcatchment 3S: Area 3

Runoff = 6.61 cfs @ 12.09 hrs, Volume= 0.414 af, Depth> 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	2.060	79	
	2.060		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.5	182	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	120	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.6	402	Total			

Summary for Subcatchment 4S: Area 4

Runoff = 9.76 cfs @ 12.09 hrs, Volume= 0.616 af, Depth> 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	3.060	79	
	3.060		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.1	155	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	232	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.8	487	Total			

Summary for Subcatchment 5S: Area 5

Runoff = 6.38 cfs @ 12.09 hrs, Volume= 0.402 af, Depth> 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	2.000	79	
	2.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.9	208	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	77	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.8	385	Total			

Summary for Subcatchment 6S: Area 6

Runoff = 7.37 cfs @ 12.09 hrs, Volume= 0.465 af, Depth> 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	2.310	79	
	2.310		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
3.0	215	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	62	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.8	377	Total			

Summary for Subcatchment 7S: Area 7

Runoff = 7.41 cfs @ 12.02 hrs, Volume= 0.381 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	1.890	79	
	1.890		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	65	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.7	144	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	209	Total			

Summary for Subcatchment 8S: Area 8

Runoff = 6.83 cfs @ 12.02 hrs, Volume= 0.353 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	1.750	79	
	1.750		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	67	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.6	136	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.4	203	Total			

Summary for Subcatchment 9S: Area 9

Runoff = 3.33 cfs @ 12.01 hrs, Volume= 0.167 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	0.830	79	
	0.830		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	60	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.7	145	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.7	205	Total			

Summary for Subcatchment 10S: Area 10

Runoff = 4.41 cfs @ 12.06 hrs, Volume= 0.256 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	1.270	79	
	1.270		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	82	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	96	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.1	242	0.0100	1.93	1.93	**Trap/Vee/Rect Channel Flow, Intermediate Swale on 4:1 Slope** Bot.W=0.00' D=0.50' Z= 4.0 '/' Top.W=4.00' n= 0.030
14.1	420	Total			

Summary for Subcatchment 11S: Area 11

Runoff = 7.24 cfs @ 12.06 hrs, Volume= 0.423 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	2.100	79	
	2.100		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.2	12	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	120	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.3	232	Total			

Summary for Subcatchment 12S: Area 12

Runoff = 14.68 cfs @ 12.13 hrs, Volume= 1.021 af, Depth> 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	5.080	79	
	5.080		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	163	0.0300	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.2	46	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.1	209	Total			

Summary for Subcatchment 13S: Area 13

Runoff = 15.91 cfs @ 12.08 hrs, Volume= 0.976 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	4.850	79	
	4.850		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.8	133	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	108	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.8	341	Total			

Summary for Subcatchment 14S: Area 14

Runoff = 4.97 cfs @ 12.01 hrs, Volume= 0.250 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	1.240	79	
	1.240		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	62	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	111	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.7	173	Total			

Summary for Subcatchment 15S: Area 15

[49] Hint: Tc<2dt may require smaller dt

Runoff = 15.87 cfs @ 11.95 hrs, Volume= 0.661 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	3.270	79	
	3.270		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	58	0.2700	0.27		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.6	145	0.0600	3.94		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.2	203	Total			

Summary for Subcatchment 16S: Area 16

Runoff = 10.90 cfs @ 12.03 hrs, Volume= 0.579 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	2.870	79	
	2.870		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	44	0.0100	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.4	55	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.3	99	Total			

Summary for Subcatchment 30S: Detention/Sedimentation Basin

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 60.20 cfs @ 11.89 hrs, Volume= 2.833 af, Depth> 4.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

Area (ac)	CN	Description
7.860	98	Water Surface
7.860		Impervious Area

Summary for Subcatchment 31S: Phase 1 and 2

Runoff = 121.30 cfs @ 12.23 hrs, Volume= 10.476 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.79"

	Area (ac)	CN	Description
*	52.300	79	Closed Landfill
	52.300		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0400	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.8	400	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.1	2,976	0.0120	4.10	55.37	**Channel Flow, Perimeter Swale** Area= 13.5 sf Perim= 16.3' r= 0.83' n= 0.035 Earth, dense weeds
28.9	3,476	Total			

Summary for Reach 21R: West Swale

[62] Warning: Exceeded Reach 22R OUTLET depth by 1.93' @ 12.40 hrs

Inflow Area = 73.700 ac, 0.00% Impervious, Inflow Depth > 2.40" for 25-yr event
Inflow = 167.13 cfs @ 12.24 hrs, Volume= 14.740 af
Outflow = 146.77 cfs @ 12.51 hrs, Volume= 14.486 af, Atten= 12%, Lag= 16.4 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.67 fps, Min. Travel Time= 9.8 min
Avg. Velocity = 0.98 fps, Avg. Travel Time= 26.7 min

Peak Storage= 86,617 cf @ 12.35 hrs, Average Depth at Peak Storage= 2.46'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 214.18 cfs

15.00' x 3.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 33.00'
Length= 1,570.0' Slope= 0.0013 '/'
Inlet Invert= 684.08', Outlet Invert= 682.00'

Summary for Reach 22R: South Swale

Inflow Area = 13.630 ac, 0.00% Impervious, Inflow Depth > 2.41" for 25-yr event
Inflow = 42.53 cfs @ 12.07 hrs, Volume= 2.743 af
Outflow = 35.46 cfs @ 12.29 hrs, Volume= 2.699 af, Atten= 17%, Lag= 13.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.03 fps, Min. Travel Time= 8.0 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 25.2 min

Peak Storage= 17,162 cf @ 12.16 hrs, Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 242.67 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 1,925.0' Slope= 0.0135 '/'
Inlet Invert= 710.00', Outlet Invert= 684.08'

Summary for Reach 28R: North Swale

Inflow Area =	13.160 ac,	0.00% Impervious,	Inflow Depth > 2.42"	for 25-yr event	
Inflow =	39.81 cfs @	12.00 hrs, Volume=	2.652 af		
Outflow =	35.67 cfs @	12.18 hrs, Volume=	2.620 af,	Atten= 10%,	Lag= 10.7 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.31 fps, Min. Travel Time= 6.0 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 19.0 min

Peak Storage= 12,884 cf @ 12.08 hrs, Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 609.75 cfs

10.00' x 3.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 31.00'
Length= 1,560.0' Slope= 0.0167 '/'
Inlet Invert= 708.00', Outlet Invert= 682.00'

100-year, 24-hour Storm

Summary for Subcatchment 1S: Area 1

Runoff = 5.86 cfs @ 12.08 hrs, Volume= 0.365 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	1.130	79	
	1.130		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	78	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	223	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.8	401	Total			

Summary for Subcatchment 2S: Area 2

Runoff = 3.88 cfs @ 12.07 hrs, Volume= 0.239 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	0.740	79	
	0.740		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.0	70	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	196	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.5	366	Total			

Summary for Subcatchment 3S: Area 3

Runoff = 10.45 cfs @ 12.09 hrs, Volume= 0.665 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	2.060	79	
	2.060		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.5	182	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	120	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.6	402	Total			

Summary for Subcatchment 4S: Area 4

Runoff = 15.43 cfs @ 12.09 hrs, Volume= 0.987 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	3.060	79	
	3.060		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.1	155	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	232	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.8	487	Total			

Summary for Subcatchment 5S: Area 5

Runoff = 10.09 cfs @ 12.09 hrs, Volume= 0.645 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	2.000	79	
	2.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.9	208	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	77	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.8	385	Total			

Summary for Subcatchment 6S: Area 6

Runoff = 11.65 cfs @ 12.09 hrs, Volume= 0.745 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	2.310	79	
	2.310		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
3.0	215	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	62	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.8	377	Total			

Summary for Subcatchment 7S: Area 7

Runoff = 11.66 cfs @ 12.02 hrs, Volume= 0.611 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	1.890	79	
	1.890		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	65	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.7	144	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	209	Total			

Summary for Subcatchment 8S: Area 8

Runoff = 10.75 cfs @ 12.02 hrs, Volume= 0.566 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	1.750	79	
	1.750		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	67	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.6	136	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.4	203	Total			

Summary for Subcatchment 9S: Area 9

Runoff = 5.23 cfs @ 12.01 hrs, Volume= 0.268 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	0.830	79	
	0.830		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	60	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.7	145	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.7	205	Total			

Summary for Subcatchment 10S: Area 10

Runoff = 6.96 cfs @ 12.06 hrs, Volume= 0.410 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	1.270	79	
	1.270		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	82	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	96	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.1	242	0.0100	1.93	1.93	**Trap/Vee/Rect Channel Flow, Intermediate Swale on 4:1 Slope** Bot.W=0.00' D=0.50' Z= 4.0 '/' Top.W=4.00' n= 0.030
14.1	420	Total			

Summary for Subcatchment 11S: Area 11

Runoff = 11.43 cfs @ 12.06 hrs, Volume= 0.678 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	2.100	79	
	2.100		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.2	12	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	120	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.3	232	Total			

Summary for Subcatchment 12S: Area 12

Runoff = 23.32 cfs @ 12.12 hrs, Volume= 1.638 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	5.080	79	
	5.080		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	163	0.0300	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.2	46	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.1	209	Total			

Summary for Subcatchment 13S: Area 13

Runoff = 25.14 cfs @ 12.08 hrs, Volume= 1.566 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	4.850	79	
	4.850		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.8	133	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	108	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.8	341	Total			

Summary for Subcatchment 14S: Area 14

Runoff = 7.82 cfs @ 12.01 hrs, Volume= 0.401 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	1.240	79	
	1.240		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	62	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	111	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.7	173	Total			

Summary for Subcatchment 15S: Area 15

[49] Hint: Tc<2dt may require smaller dt

Runoff = 24.79 cfs @ 11.95 hrs, Volume= 1.059 af, Depth> 3.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	3.270	79	
	3.270		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	58	0.2700	0.27		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.6	145	0.0600	3.94		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.2	203	Total			

Summary for Subcatchment 16S: Area 16

Runoff = 17.15 cfs @ 12.03 hrs, Volume= 0.928 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	2.870	79	
	2.870		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	44	0.0100	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.4	55	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.3	99	Total			

Summary for Subcatchment 30S: Detention/Sedimentation Basin

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 82.51 cfs @ 11.89 hrs, Volume= 3.928 af, Depth> 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

Area (ac)	CN	Description
7.860	98	Water Surface
7.860		Impervious Area

Summary for Subcatchment 31S: Phase 1 and 2

Runoff = 193.11 cfs @ 12.23 hrs, Volume= 16.809 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.55"

	Area (ac)	CN	Description
*	52.300	79	Closed Landfill
	52.300		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0400	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.8	400	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.1	2,976	0.0120	4.10	55.37	**Channel Flow, Perimeter Swale** Area= 13.5 sf Perim= 16.3' r= 0.83' n= 0.035 Earth, dense weeds
28.9	3,476	Total			

Summary for Reach 21R: West Swale

[91] Warning: Storage range exceeded by 0.22'
[55] Hint: Peak inflow is 126% of Manning's capacity
[62] Warning: Exceeded Reach 22R OUTLET depth by 2.51' @ 12.35 hrs

Inflow Area =	73.700 ac,	0.00% Impervious,	Inflow Depth > 3.85"	for 100-yr event
Inflow =	270.76 cfs @	12.22 hrs, Volume=	23.663 af	
Outflow =	242.71 cfs @	12.46 hrs, Volume=	23.342 af,	Atten= 10%, Lag= 14.5 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.08 fps, Min. Travel Time= 8.5 min
Avg. Velocity = 1.09 fps, Avg. Travel Time= 23.9 min

Peak Storage= 124,154 cf @ 12.32 hrs, Average Depth at Peak Storage= 3.22'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 214.18 cfs

15.00' x 3.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 33.00'
Length= 1,570.0' Slope= 0.0013 '/'
Inlet Invert= 684.08', Outlet Invert= 682.00'

Summary for Reach 22R: South Swale

Inflow Area = 13.630 ac, 0.00% Impervious, Inflow Depth > 3.87" for 100-yr event
Inflow = 67.37 cfs @ 12.07 hrs, Volume= 4.399 af
Outflow = 58.27 cfs @ 12.26 hrs, Volume= 4.345 af, Atten= 14%, Lag= 11.3 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.71 fps, Min. Travel Time= 6.8 min
Avg. Velocity = 1.43 fps, Avg. Travel Time= 22.5 min

Peak Storage= 24,052 cf @ 12.14 hrs, Average Depth at Peak Storage= 0.94'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 242.67 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 1,925.0' Slope= 0.0135 '/'
Inlet Invert= 710.00', Outlet Invert= 684.08'

Summary for Reach 28R: North Swale

Inflow Area = 13.160 ac, 0.00% Impervious, Inflow Depth > 3.88" for 100-yr event
Inflow = 63.20 cfs @ 12.00 hrs, Volume= 4.252 af
Outflow = 57.58 cfs @ 12.16 hrs, Volume= 4.213 af, Atten= 9%, Lag= 9.3 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.04 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 1.53 fps, Avg. Travel Time= 17.0 min

Peak Storage= 17,962 cf @ 12.07 hrs, Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 609.75 cfs

10.00' x 3.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 31.00'
Length= 1,560.0' Slope= 0.0167 '/'
Inlet Invert= 708.00', Outlet Invert= 682.00'

Perimeter Ditch and Diversion Berm Sizing

I-43 Landfill
Sheboygan, WI

Lining Type: Vegetation

Project ID: I-43 Landfill - Plan Modification		
Location: Sheboygan, WI		
Designer/Checker: KRG		
Date: 1/6/15		

	South Swale Q=25-yr	North Swale Q=25-yr	Int. Swale Q=25-yr
Channel/Ditch Geometry			
Channel Slope, S_o (ft/ft)	0.013	0.025	0.01
Channel Bottom Width, B (ft)	10	6	0
Channel Side Slope, z_1	4	3	2
Channel Side Slope, z_2	3	2	0.03
Flow Depth, d (ft) Solve iteratively	0.89	0.86	1.65
Safety Factor, SF	1.5	1.5	1.5
Vegetation/Soil Parameters			
Vegetation Retardance Class	D	D	D
Vegetation Condition	good	good	good
Vegetation Growth Form	turf	turf	turf
Soil Type	cohesive	cohesive	cohesive
D_{75} (in) (Set at 0.00 for cohesive soils)			
ASTM Soil Class	SC	SC	SC
Plasticity Index, PI	16	16	16
Results Summary			
Design Q (ft^3/s)	35.5	35.7	4.9
Calculated Q (ft^3/s)	35.8	35.7	4.8
Difference Between Design & Calc. Flow (%)	0.9%	0.0%	-0.5%
Stable (Yes or No)	YES	YES	YES
Channel Parameters			
Vegetation Height, h (ft)	0.33	0.33	0.33
Grass Roughness Coefficient, C_n	0.165	0.165	0.165
Cover Factor, C_f	0.90	0.90	0.90
Noncohesive Soil			
Soil Grain Roughness, n_s	0.016	0.016	0.016
Permissible Soil Shear Stress, τ_p (lb/ft^2)	N/A	N/A	N/A
Cohesive Soil			
Porosity, e	0.35	0.35	0.35
Soil Coefficient 1, c_1	1.0700	1.0700	1.0700
Soil Coefficient 2, c_2	14.30	14.30	14.30
Soil Coefficient 3, c_3	47.700	47.700	47.700
Soil Coefficient 4, c_4	1.42	1.42	1.42
Soil Coefficient 5, c_5	-0.61	-0.61	-0.61
Soil Coefficient 6, c_6	0.00010	0.00010	0.00010
Permissible Soil Shear Stress, τ_p (lb/ft^2)	0.080	0.080	0.080
Total Permissible Shear Stress, τ_p (lb/ft^2)	0.080	0.080	0.080
Cross Sectional Area, A (ft^2)	11.672	7.009	2.763
Wetted Perimeter, P (ft)	16.48	10.64	5.34
Hydraulic Radius, R (ft)	0.708	0.659	0.517
Top Width, T (ft)	16.23	10.30	3.35
Hydraulic Depth, D (ft)	0.719	0.680	0.825
Froude Number (Q design)	0.637	1.088	0.339
Channel Shear Stress, τ_o (lb/ft^2)	0.57	1.03	0.32
Actual Sheer Stress, τ_d (lb/ft^2)	0.72	1.34	1.03
Mannings n	0.044	0.035	0.055
Average Velocity, V (ft/s)	3.04	5.09	1.76
Calculated Flow, Q (ft^3/s)	35.8	35.7	4.8
Difference Between Design & Calc. Flow (%)	0.9%	0.0%	-0.5%
Effective Shear on Soil Surface, τ_e (lb/ft^2)	0.010	0.028	0.009
Total Permissible Shear on Veg., $\tau_{p\,veg}$ (lb/ft^2)	6.06	3.83	9.47
Stable (Y or N)	YES	YES	YES

SCS ENGINEERS

		Sheet No. 1/3	
		Calc. No.	
		Rev. No.	
Job No. 25214060	Job: I-43 Landfill	By: KRG	Date: 01/14/15
Client: Alliant Energy	Subject: Downslope Flume Sizing	Chk'd: ZB	Date: 02/09/15

Purpose: To size the downslope flume pipes to accommodate the flows expected from a 25-year, 24-hour storm event.

Approach: Use the orifice equation to size the downslope pipe inlet and Manning's equation to size the downslope pipes.

Calculations:

The runoff must first get into the down slope flume
The entrance to the flume is a Y with an open pipe on each branch of the Y.
1/2 of the flowrate of the 25-yr storm event for each drainage area will enter each branch of the flume.
An orifice equation calculates the flowrate of water that can enter the pipe.

Orifice Equation: $Q = C \times A \times (2 \times g \times h)^{0.5}$

Q = flow rate (cfs)
C = orifice coefficent = 0.63
A = area of orifice = 0.78 sf for 12" dia. pipe, 10" = 0.54 sf, 8" = 0.35 sf
g = acceleration due to gravity = 32.2 ft/sec^2
h = orifice head acting on centerline = 1.5 x pipe diameter = 1.5' for 12" dia. pipe, 1.25' for 10", 1.0
$Q_{12\text{" pipe}} = 0.63 \times .78 \times (2 \times 32.2 \times 1.5)^{0.5} =$ 4.83 cfs
$Q_{10\text{" pipe}} = 0.63 \times .54 \times (2 \times 32.2 \times 1.25)^{0.5} =$ 3.05 cfs

The downslope flume pipes have the following flow capacities at the designated slopes:

	Flow Capacity of Pipe*
Flume Size	25% slope
12" dia.	19.3 cfs
10" dia.	11.8 cfs

* See Sheets 2 - 3 for the Manning's flow calculations.

Results:

The downslope flumes will consist of the following sizes, as indicated on Plan Sheet 14.

Flume Number	Flow Rate (cfs)	1/2 the Flowrate (cfs)	Flume Size
Flume 1 (Area 1)	3.7	1.9	10 inch
Flume 2 (Area 2)	2.5	1.3	10 inch
Flume 3 (Area 3)	6.6	3.3	12 inch
Flume 4 (Area 4)	9.7	4.9	12 inch
Flume 5 (Area 5)	6.4	3.2	12 inch
Flume 6 (Area 6)	7.4	3.7	12 inch

Free Online Manning Pipe Flow Calculator

List of Calculators Hydraulics Language

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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I-43 Landfill

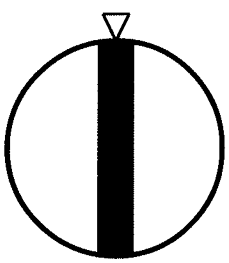
Down Slope Flumes

Set units: m | mm | ft | inches

Pipe diameter, d_0	10 inches ▼
Manning roughness, n ?	.012
Pressure slope (possibly ? equal to pipe slope), S_0	.25 rise/run ▼
Percent of (or ratio to) full depth (100% or 1 if flowing full)	100 % ▼

Results:

Flow, q	11.8668	cfs ▼
Velocity, v	21.7580	ft/sec ▼
Velocity head, h_v	88.2918	inches ▼
Flow area	78.5400	sq. in. ▼
Wetted perimeter	31.4159	inches ▼
Hydraulic radius	2.5000	inches ▼
Top width, T	0.0000	inches ▼
Froude number, F	0.00	
Shear stress (tractive force), tau	13.0078	psf ▼



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I-43 Landfill

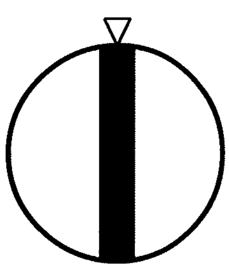
Down Slope Flumes

Set units: m mm ft inches

Pipe diameter, d_0	12 inches
Manning roughness, n ?	.012
Pressure slope (possibly ? equal to pipe slope), S_0	.25 rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	100 %

Results:

Flow, q	19.2967	cfs
Velocity, v	24.5700	ft/sec
Velocity head, h_v	112.5889	inches
Flow area	113.0976	sq. in.
Wetted perimeter	37.6991	inches
Hydraulic radius	3.0000	inches
Top width, T	0.0000	inches
Froude number, F	0.00	
Shear stress (tractive force), tau	15.6094	psf



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Downslope Flume and Energy Dissipator Sizing

Energy Dissipator Design

Design the Energy Dissipators located at the end of each downslope flume using the US Dept. of Transportation, Hydraulic Engineering Circular No. 14, "Hydraulic Design of Energy dissipators for Culverts and Channels", July 2006.

Pipe/Culvert: Flume 3, 4, 5, 6, and 7

* Peak flow in this flume from 25-year, 24-hour event is 9.7 cfs.

Flow is in a 12" dia. Flume

From an on-line Mannings Equation Calculator (see page 3)

$Q =$ 9.7 cfs

$n = 0.01$

$V =$ 28.2 ft/sec

$A =$ 49.64 sq. in. = 0.34 sq. ft.

$Fr = 8.58$

Compute Equivalent Depth of Flow Entering Dissipator:

$Y_e = (A/2)^{1/2}$ where: Ye = Equivalent depth

A = Area (from above)

$Y_e =$ 0.42 ft

Compute Energy at End of Pipe:

$H_o = Y_e + V^2/2g$ where: H_o = Energy

Y_e = Equivalent depth (from above)

V = Velocity (from above)

g = Gravity constant (32.2 ft/sec)

Ho = 12.76 ft

Determine Width of Dissipator:

Use Froude Number computed above and Figure 9.14 (see page 5) from "Hydraulic Design of Energy Dissipators for Culverts and Channels" to obtain value for H_o/W. Given H_o above, compute W (width of dissipator).

From Figure 9.14, $H_o/W_B =$ 3.9 (interpolated)

$W_B =$ 3.3 ft

Determine Remaining Dimensions of the Dissipator:

Based on W determined above, use Table 9.2 (CU) (page 6) to determine the remaining dissipator dimensions. Round the value of W_B to the nearest entry in the table (interpolation is not necessary).

Note: the smallest W_B on Table 9.2 is 4.0 ft, so this dimension is used.

Energy Dissipator Design

Pipe/Culvert: Flume 1 and 2

* Peak flow in this flume from 25-year, 24-hour event is 4.0 cfs.

Flow is in a 10" dia. Flume

From an on-line Mannings Equation Calculator (see page 4)

Q = 4 cfs

n = 0.01

V = 22.4 ft/sec

A = 25.7 sq. in. = 0.18 sq. ft.

Fr = 8.5

Compute Equivalent Depth of Flow Entering Dissipator:

$Y_e = (A/2)^{1/2}$ where: Ye = Equivalent depth

A = Area (from above)

$Y_e =$ 0.30 ft

Compute Energy at End of Pipe:

$H_o = Y_e + V^2/2g$ where: H_o = Energy

Y_e = Equivalent depth (from above)

V = Velocity (from above)

g = Gravity constant (32.2 ft/sec)

Ho = 8.09 ft

Determine Width of Dissipator:

Use Froude Number computed above and Figure 9.14 from "Hydraulic Design of Energy Dissipators for Culverts and Channels" to obtain value for H_o/W. Given H_o above, compute W (width of dissipator).

From Figure 9.14, H_o/W_B = 3.9 (interpolated)

W_B = 2.1 ft

Determine Remaining Dimensions of the Dissipator:

Based on W determined above, use Table 9.2 (CU) to determine the remaining dissipator dimensions. Round the value of W_B to the nearest entry in the table (interpolation is not necessary).

Note: the smallest W_B on Table 9.2 is 4.0 ft, so this dimension is used.

4

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List of Calculators Hydraulics Language

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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I-43 Landfill

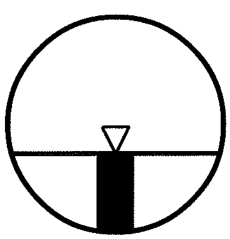
Down Slope Flumes 1,2,8,9,10

Set units: m mm ft inches

Pipe diameter, d_0	10	inches ▼
Manning roughness, n ?	.01	
Pressure slope (possibly ? equal to pipe slope), S_0	.25	rise/run ▼
Percent of (or ratio to) full depth (100% or 1 if flowing full)	36.3	% ▼

Results:

Flow, q	4.0097	cfs ▼
Velocity, v	22.4299	ft/sec ▼
Velocity head, h_v	93.8297	inches ▼
Flow area	25.7434	sq. in. ▼
Wetted perimeter	12.9325	inches ▼
Hydraulic radius	1.9906	inches ▼
Top width, T	9.6173	inches ▼
Froude number, F	8.50	
Shear stress (tractive force), tau	4.7218	psf ▼



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shows the relationship of the Froude number to the ratio of the energy entering the dissipator to the width of dissipator required. The Los Angeles tests indicate that limited extrapolation of this curve is permissible.

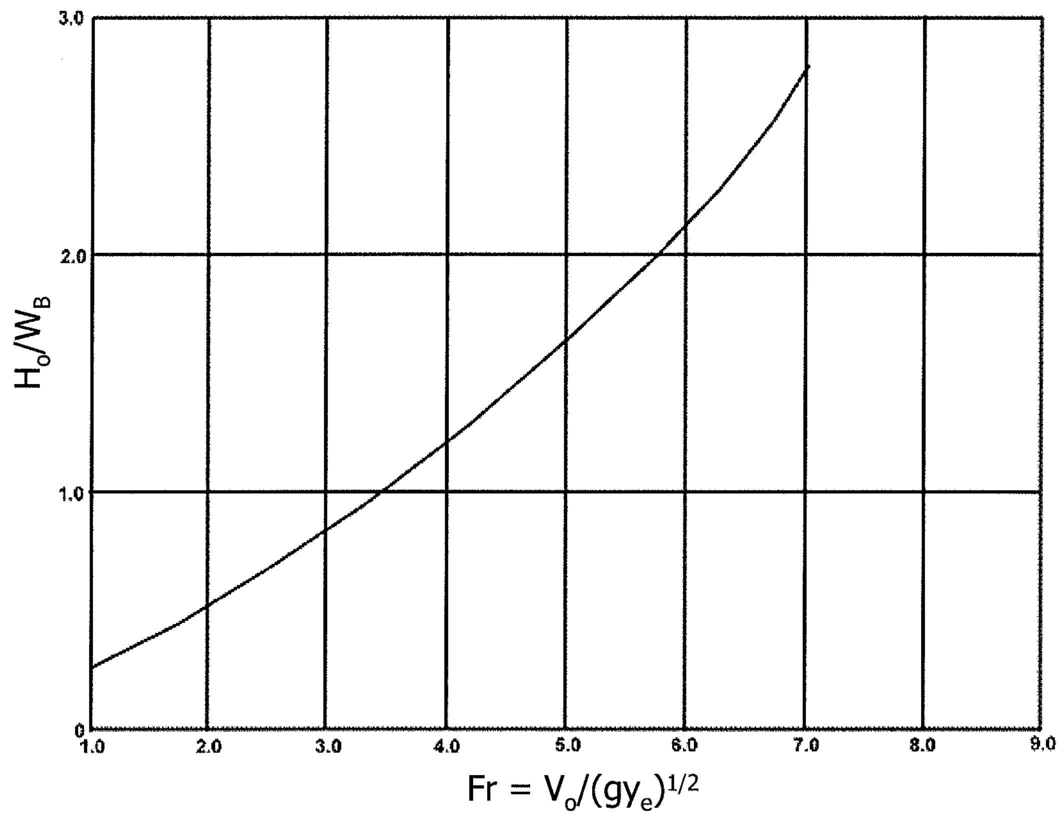

Figure 9.14. Design Curve for USBR Type VI Impact Basin

Once the basin width, W_B, has been determined, many of the other dimensions shown in Figure 9.13 follow according to Table 9.2. To use Table 9.2, round the value of W_B to the nearest entry in the table to determine the other dimensions. Interpolation is not necessary.

In calculating the energy and the Froude number, the equivalent depth of flow, $y_e = (A/2)^{1/2}$, entering the dissipator from a pipe or irregular-shaped conduit must be computed. In other words, the cross section flow area in the pipe is converted into an equivalent rectangular cross section in which the width is twice the depth of flow. The conduit preceding the dissipator can be open, closed, or of any cross section.

The effectiveness of the basin is best illustrated by comparing the energy losses within the structure to those in a natural hydraulic jump, Figure 9.15. The energy loss was computed based on depth and velocity measurements made in the approach pipe and also in the downstream channel with no tailwater. Compared with the natural hydraulic jump, the USBR Type VI impact basin shows a greater capacity for dissipating energy.

6

Table 9.2 (CU). USBR Type VI Impact Basin Dimensions (ft) (AASHTO, 2005)

W_B	h_1	h_2	h_3	h_4	L	L_1	L_2
4.	3.08	1.50	0.67	1.67	5.42	2.33	3.08
5.	3.83	1.92	0.83	2.08	6.67	2.92	3.83
6.	4.58	2.25	1.00	2.50	8.00	3.42	4.58
7.	5.42	2.58	1.17	2.92	9.42	4.00	5.42
8.	6.17	3.00	1.33	3.33	10.67	4.58	6.17
9.	6.92	3.42	1.50	3.75	12.00	5.17	6.92
10.	7.58	3.75	1.67	4.17	13.42	5.75	7.67
11.	8.42	4.17	1.83	4.58	14.58	6.33	8.42
12.	9.17	4.50	2.00	5.00	16.00	6.83	9.17
13.	10.17	4.92	2.17	5.42	17.33	7.42	10.00
14.	10.75	5.25	2.33	5.83	18.67	8.00	10.75
15.	11.50	5.58	2.50	6.25	20.00	8.50	11.50
16.	12.25	6.00	2.67	6.67	21.33	9.08	12.25
17.	13.00	6.33	2.83	7.08	21.50	9.67	13.00
18.	13.75	6.67	3.00	7.50	23.92	10.25	13.75
19.	14.58	7.08	3.17	7.92	25.33	10.83	14.58
20.	15.33	7.50	3.33	8.33	26.58	11.42	15.33

W_B	W_1	W_2	t_1	t_2	t_3	t_4	t_5
4.	0.33	1.08	0.50	0.50	0.50	0.50	0.25
5.	0.42	1.42	0.50	0.50	0.50	0.50	0.25
6.	0.50	1.67	0.50	0.50	0.50	0.50	0.25
7.	0.50	1.92	0.50	0.50	0.50	0.50	0.25
8.	0.58	2.17	0.50	0.58	0.58	0.50	0.25
9.	0.67	2.50	0.58	0.58	0.67	0.58	0.25
10.	0.75	2.75	0.67	0.67	0.75	0.67	0.25
11.	0.83	3.00	0.67	0.75	0.75	0.67	0.33
12.	0.92	3.00	0.67	0.83	0.83	0.75	0.33
13.	1.00	3.00	0.67	0.92	0.83	0.83	0.33
14.	1.08	3.00	0.67	1.00	0.92	0.92	0.42
15.	1.17	3.00	0.67	1.00	1.00	1.00	0.42
16.	1.25	3.00	0.75	1.00	1.00	1.00	0.50
17.	1.33	3.00	0.75	1.08	1.00	1.00	0.50
18.	1.33	3.00	0.75	1.08	1.08	1.08	0.58
19.	1.42	3.00	0.83	1.17	1.08	1.08	0.58
20.	1.50	3.00	0.83	1.17	1.17	1.17	0.67

Culvert Sizing

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 146 cfs

Maximum Flow: 270 cfs

Table 1 - Summary of Culvert Flows at Crossing: I-43 Landfill

Headwater Elevation (ft)	Total Discharge (cfs)	West Swale Culverts Discharge (cfs)	Roadway Discharge (cfs)	Iterations
678.70	0.00	0.00	0.00	1
680.07	27.00	27.00	0.00	1
680.67	54.00	54.00	0.00	1
681.15	81.00	81.00	0.00	1
681.63	108.00	108.00	0.00	1
682.07	135.00	135.00	0.00	1
682.23	146.00	146.00	0.00	1
683.11	189.00	189.00	0.00	1
683.47	216.00	216.00	0.00	1
683.81	243.00	243.00	0.00	1
684.16	270.00	270.00	0.00	1
686.00	392.66	392.66	0.00	Overtopping

Table 2 - Culvert Summary Table: West Swale Culverts

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	0.00	0.00	678.70	0.000	0.000	0-NF	0.000	0.000	0.300	0.000	0.000
	27.00	27.00	680.07	1.369	0.951	1-JS1t	0.985	1.006	1.238	0.938	3.542
	54.00	54.00	680.67	1.973	1.427	1-JS1t	1.408	1.437	1.674	1.374	4.669
	81.00	81.00	681.15	2.451	1.828	1-JS1t	1.739	1.772	2.008	1.708	5.484
	108.00	108.00	681.63	2.934	2.200	1-JS1t	2.031	2.060	2.287	1.987	6.168
	135.00	135.00	682.07	3.369	2.563	1-JS1t	2.308	2.317	2.531	2.231	6.769
	146.00	146.00	682.23	3.535	2.322	1-JS1t	2.413	2.415	2.622	2.322	7.000
	189.00	189.00	683.11	4.141	4.412	3-M1t	2.822	2.760	2.947	2.647	7.847
	216.00	216.00	683.47	4.506	4.766	3-M1t	3.076	2.960	3.131	2.831	8.348
	243.00	243.00	683.81	4.872	5.114	3-M2t	3.341	3.145	3.301	3.001	8.834
	270.00	270.00	684.16	5.250	5.459	3-M2t	3.614	3.324	3.461	3.161	9.308

****

Straight Culvert

Inlet Elevation (invert): 678.70 ft, Outlet Elevation (invert): 678.40 ft

Culvert Length: 100.00 ft, Culvert Slope: 0.0030

****

Site Data - West Swale Culverts

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 678.70 ft

Outlet Station: 100.00 ft

Outlet Elevation: 678.40 ft

Number of Barrels: 2

Culvert Data Summary - West Swale Culverts

Barrel Shape: Circular

Barrel Diameter: 5.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: I-43 Landfill)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	678.70	0.00	0.00	0.00	0.00
27.00	679.64	0.94	2.25	0.18	0.45
54.00	680.07	1.37	2.78	0.26	0.48
81.00	680.41	1.71	3.13	0.32	0.49
108.00	680.69	1.99	3.40	0.37	0.50
135.00	680.93	2.23	3.63	0.42	0.51
146.00	681.02	2.32	3.71	0.43	0.51
189.00	681.35	2.65	3.98	0.50	0.52
216.00	681.53	2.83	4.13	0.53	0.52
243.00	681.70	3.00	4.26	0.56	0.53
270.00	681.86	3.16	4.38	0.59	0.53

Tailwater Channel Data - I-43 Landfill

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 10.00 ft

Side Slope (H:V): 3.00 (_:1)

Channel Slope: 0.0030

Channel Manning's n: 0.0300

Channel Invert Elevation: 678.70 ft

Roadway Data for Crossing: I-43 Landfill

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 50.00 ft

Crest Elevation: 686.00 ft

Roadway Surface: Gravel

Roadway Top Width: 20.00 ft

Sedimentation Basin Sizing

SCS ENGINEERS

Calc. No.

Rev. No.

Job No. 25214060	Job: I-43 Landfill Plan Modification	By: KRG	Date: 02/06/15
Client: Alliant Energy	Subject: Sed Basin Sizing	Chk'd: ZB	Date: 02/10/15

Sedimentation Basin Sizing

Performance Criteria

* Sedimentation basin is designed to settle out particles 15 microns and greater for the 25-year, 24-hour storm event
* Principal spillway is designed to pass the 25-year, 24-hour storm event.
* Emergency spillway is designed to pass the 100-yr, 24-hour storm event.

Use the Table 8.1 presented in Erosion and Sediment Control Handbook (Goldman, *et al*., 1986) that provides the surface area to discharge ratios required to achieve settlement of the desired particle sizes. The table is included below. From this table, use the surface area to flow ratio for the sedimentation to determine the maximum particle size settled.

The table below summarized the surface area to flow ratios for sedimentation basins. It also summarizes the free board for the 100-year, 24-hour storm event. The information is based on the HydroCAD model output included in this appendix.

TABLE 8.1 Surface Area Requirements of Sediment Traps and Basins

Particle size, mm	Settling velocity, ft/sec (m/sec)	Surface area requirements, ft^2 per ft^3/sec discharge	(m^2 per m^3/sec discharge)
0.5 (coarse sand)	0.19 (0.058)	6.3	(20.7)
0.2 (medium sand)	0.067 (0.020)	17.9	(58.7)
0.1 (fine sand)	0.023 (0.0070)	52.2	(171.0)
0.05 (coarse silt)	0.0062 (0.0019)	193.6	(635.0)
0.02 (medium silt)	0.00096 (0.00029)	1,250.0	(4,101.0)
0.01 (fine silt)	0.00024 (0.000073)	5,000.0	(16,404.0)
0.005 (clay)	0.00006 (0.000018)	20,000.0	(65,617.0)

The output from the HydroCAD model for the 25 and 100-yr storm event is included on Pages 2 - 3.

25-year, 24 hour Storm			Surface Area at Peak Water Surface Elevation, SA (sf)	SA/Q Ratio	Maximum Particle Size Settled (mm)	100-yr, 24-hr Storm Peak Water Surface Elevation	Top of Berm Elevation (Freeboard)	Basin Freeboard for 100-yr Storm (feet)
Peak Inflow (cfs)	Peak Discharge Q (cfs)	Peak Water Surface Elevation						
165.09	17.1	684.74	230,955	13,506	< 0.01	685.90	686.50	0.6

I:\25214060\Calculations\Stormwater\[Sed Basin Sizing.xls]Sheet1

Summary for Pond 29P: Detention/Sedimentation Basin

[63] Warning: Exceeded Reach 21R INLET depth by 0.10' @ 15.40 hrs
[62] Warning: Exceeded Reach 28R OUTLET depth by 2.62' @ 14.55 hrs

Inflow Area = 96.610 ac, 8.14% Impervious, Inflow Depth > 2.52" for 25-yr event
Inflow = 165.09 cfs @ 12.49 hrs, Volume= 20.321 af
Outflow = 17.07 cfs @ 14.38 hrs, Volume= 10.223 af, Atten= 90%, Lag= 113.9 min
Primary = 17.07 cfs @ 14.38 hrs, Volume= 10.223 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 684.74' @ 14.38 hrs Surf.Area= 5.302 ac Storage= 13.038 af

Plug-Flow detention time= 247.0 min calculated for 10.223 af (50% of inflow)
Center-of-Mass det. time= 161.9 min (963.6 - 801.6)

Volume	Invert	Avail.Storage	Storage Description
#1	681.46'	20.170 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
681.46	2.750	0.000	0.000
682.00	2.880	1.520	1.520
684.00	4.860	7.740	9.260
686.00	6.050	10.910	20.170

Device	Routing	Invert	Outlet Devices
#1	Primary	681.50'	**24.0" x 50.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 681.00' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal
#2	Device 1	681.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600
#3	Device 1	682.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600
#4	Device 1	682.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600
#5	Device 1	683.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600
#6	Device 1	684.00'	**36.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
#7	Secondary	685.00'	**10.0' long x 30.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=17.07 cfs @ 14.38 hrs HW=684.74' (Free Discharge)
└─**1=Culvert** (Barrel Controls 17.07 cfs @ 5.43 fps)
  ├─**2=Orifice/Grate** (Passes < 6.26 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 5.66 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 4.99 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 4.22 cfs potential flow)
  └─**6=Orifice/Grate** (Passes < 19.76 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=681.46' (Free Discharge)
└─**7=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 29P: Detention/Sedimentation Basin

[63] Warning: Exceeded Reach 21R INLET depth by 0.92' @ 14.35 hrs
[62] Warning: Exceeded Reach 28R OUTLET depth by 3.71' @ 13.60 hrs

Inflow Area = 96.610 ac, 8.14% Impervious, Inflow Depth > 3.99" for 100-yr event
Inflow = 272.92 cfs @ 12.44 hrs, Volume= 32.094 af
Outflow = 44.56 cfs @ 13.47 hrs, Volume= 18.380 af, Atten= 84%, Lag= 62.0 min
Primary = 22.02 cfs @ 13.47 hrs, Volume= 13.215 af
Secondary = 22.55 cfs @ 13.47 hrs, Volume= 5.165 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 685.90' @ 13.47 hrs Surf.Area= 5.991 ac Storage= 19.576 af

Plug-Flow detention time= 214.7 min calculated for 18.331 af (57% of inflow)
Center-of-Mass det. time= 138.1 min (930.0 - 791.9)

Volume	Invert	Avail.Storage	Storage Description
#1	681.46'	20.170 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
681.46	2.750	0.000	0.000
682.00	2.880	1.520	1.520
684.00	4.860	7.740	9.260
686.00	6.050	10.910	20.170

Device	Routing	Invert	Outlet Devices
#1	Primary	681.50'	**24.0" x 50.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 681.00' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal
#2	Device 1	681.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600
#3	Device 1	682.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600
#4	Device 1	682.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600
#5	Device 1	683.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600
#6	Device 1	684.00'	**36.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
#7	Secondary	685.00'	**10.0' long x 30.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=22.02 cfs @ 13.47 hrs HW=685.90' (Free Discharge)
└─**1=Culvert** (Barrel Controls 22.02 cfs @ 7.01 fps)
  ├─**2=Orifice/Grate** (Passes < 7.47 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 6.97 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 6.44 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 5.86 cfs potential flow)
  └─**6=Orifice/Grate** (Passes < 46.93 cfs potential flow)

Secondary OutFlow Max=22.54 cfs @ 13.47 hrs HW=685.90' (Free Discharge)
└─**7=Broad-Crested Rectangular Weir** (Weir Controls 22.54 cfs @ 2.50 fps)

2025 Plan of Operation Modification
Drainage Design Calculations

Storm Water Management Calculations

Purpose:
The purpose of the storm water runoff calculations is to demonstrate that the proposed storm water management features for the Contact Water Swale Liner Conversion and Fully Developed Site closure conditions can accommodate and safely convey the runoff from a 25-year, 24-hour storm event during post construction conditions.

Items addressed in these calculations consist of;

- Diversion Berms
- Swales
- Rock Chute
- Downslope Flumes & Energy Dissipaters
- Existing Culverts
- Existing North Sedimentation Pond
- Existing South Sedimentation Pond
- Proposed Outfall Structure in South Sedimentation Pond

The proposed storm water management conditions are shown on **Sheet 1** (Contact Water Swale Liner Conversion Closure) and **Sheet 2** (Fully Developed Site Closure).

The calculations support the design of the following proposed storm water management features:

Feature	Purpose	Design Method
Swales	Convey storm water runoff to the North Sedimentation Pond and South Pond	HydroCAD runoff modeling and Swale Calculation
Rock Chutes	Erosion protection from culvert and concentrated flow discharges	HydroCAD runoff modeling and Rock Chute Calculations
Downslope Flumes & Energy Dissipators	Convey storm water from diversion berms down slope to discharge locations during post construction conditions	HydroCAD runoff modeling and Downslope Flume Calculations
Existing Culverts	Convey storm water under access points in swales during post construction conditions.	HydroCAD runoff modeling and HY-8 hydraulic modeling
North Sedimentation Pond	To safely handle 25-year, 24-hour storm event without overtopping the perimeter road.	HydroCAD runoff modeling
South Sedimentation Pond	To safely handle 25-year, 24-hour storm event without overtopping.	HydroCAD runoff modeling and Buoyancy Calculation
Outfall Riprap Apron	Erosion protection from Outfall concentrated flow	HydroCAD runoff modeling and Riprap Apron Calculation

Approach:
<u>Hydrograph Generation</u>
HydroCAD was used to model the storm water management systems and develop the hydrographs using TR-20 methodologies. The model is designed to simulate the surface runoff response of a watershed to a precipitation event. Input parameters for the model include precipitation depth for the

design storm events from NOAA ATLAS 14, storm type and curve (MSE 24-hr and 4), contributing drainage areas, runoff curve numbers, and time of concentration.

Diversion Berms

Diversion berms were sized for the 25-year, 24-hour storm event using the Manning's Equation to determine the depth of flow and velocity in the swale based on the swale geometry and peak flow for the storm event (as determined by the Hydrograph Generation Calculations).

Swale Sizing

The proposed swales were sized for the 25-year, 24-hour storm event. Existing swales were checked to confirm that they will still handle the 25-year, 24-hour storm event. A spreadsheet based on Manning's equation was used to determine the depth of flow and velocity in the swales based on the swale geometry and peak flow in the swales (as determined by the Hydrograph Generation models).

Rock Cute Sizing

Rock chutes were sized for the 25-year, 24-hour storm event. Rock Chutes were sized based on the flow to each culvert location. The NRCS Rock Chute Design spreadsheet was used to size the chute and riprap.

Downslope Flumes and Energy Dissipaters Sizing

Flumes and energy dissipaters were sized for the 25-year, 24-hour storm event. Manning's equation and the orifice equation were used to size the flumes. Energy dissipaters were sized using tables from the reference book "Hydraulic Design of Energy Dissipaters for Culverts and Channels" US Department of Transportation, Federal Highway Administration, July 2006.

Existing Culverts

Existing culverts were reviewed for capacity to convey the 25-year, 24-hour storm event previously. The culverts were rechecked for sizing based on updating the storm event to a MSE Type 4 and/or changes in flow patterns to the individual culvert.

Sedimentation Pond Sizing

The North Sedimentation Pond was checked to confirm the Pond can handle the 25-year, 24-hour storm and safely pass the 100-year, 24-hour storm event. The North Sedimentation Pond was also checked to confirm particle settling out during the design storm event.

The South Sedimentation Pond was checked to confirm the Pond could handle the 25-year, 24-hour storm event. The emergency spillway was sized for the 100-year, 24-hour storm event.

The HydroCAD model was used in conjunction with engineering calculations to evaluate the ability of the North Sedimentation Pond to meet the requirements of NR 504.09.

South Sedimentation Pond Outfall

The outfall structure was designed to withstand uplift.

Outfall Riprap Apron

The riprap apron for the South Sedimentation Pond outfall was sized for the 25-year, 24-hour storm event.

Key Assumptions:

- Drainage areas and time of concentration flow paths are as shown on **Sheet 1** for Early Closure Conditions and **Sheet 2** for Full Closure Conditions.
- A MSE 4 rainfall distribution was used based on the National Engineering Handbook Part 650. The precipitation depth for the 25-year, 24-hour storm was assumed to be 4.79 inches, based on NOAA ATLAS 14 Point Precipitation Frequency Estimates (NOAA's National Weather Service Hydrometeorological Design Studies Center Precipitation Frequency Data Server.
- Runoff curve numbers were based on tables presented in Urban Hydrology for Small Watersheds, and were assumed as follows and as listed in the modeling.

Cover Type	CN
Water	98 – Water Surface
Grass outside cover	79 – Open spaces (lawns, parks, etc) in fair condition with hydrologic soil group C
Final Cover	79 – Open spaces (lawns, parks, etc) in fair condition with hydrologic soil group C
Gravel	96 – Gravel

- Other assumptions are included with the calculations attached.

Results:

Hydrograph Generation

The hydrograph modeling results for the 25-year and 100-year, 24-hour storm events are included in the Post Construction Conditions Hydrograph Generation section below.

Diversion Berm Sizing

The proposed final berms will be constructed as shown on the Drawings. The diversion berms will contain the runoff from the 25-year, 24-hour storm event. Refer to the Diversion Berm Design section below.

Swale Sizing

The proposed swales will be constructed as shown on the Drawings. The swales have the capacity to safely convey the 25-year, 24-hour storm event and maintain a minimum 0.5 foot of freeboard. Refer to the Swale Sizing section below. Existing South and North swales can handle the updated peak runoff.

Appropriate erosion control products (Type 1, Class B) were selected based on the velocities and shear stress in the swales. Refer to the Swale Sizing section below for the evaluation.

Rock Chute Sizing

The proposed rock chute will be constructed as shown in the Drawings. The rock chutes will accommodate the runoff from the 25-year, 24-hour storm event. Refer to the Rock Chute Sizing section below.

Downslope Flume and Energy Dissipator Sizing

The downslope flumes and energy dissipators will be constructed as shown on the Drawings. The downslope flumes are designed to contain the runoff from the 25-year, 24-hour storm event. Energy dissipators at the bottom of the downslope flumes have been designed to handle the peak velocities. Refer to the Downslope Flume and Energy Dissipator Sizing section below for detailed calculations.

<u>Existing Culverts</u>

The existing culverts as shown on the Drawings were modeled to confirm each culvert could handle the 25-year, 24-hour storm event. Culverts not handling the 25-year, 24-hour runoff volume were removed, where feasible, or replaced with larger diameter culverts based on the model. Refer to the Existing Culvert section below for detailed calculations.

<u>Sedimentation Pond Sizing</u>

The outlet structure for the North Sedimentation Pond was sized to control runoff from the 25-year, 24-hour storm event, assuming the starting water elevation is at the bottom of the lowest outlet structure opening. The North Sedimentation Pond can continue to settle out particles 0.15 microns and larger in diameter under the updated model conditions. The South Sedimentation Pond can handle the runoff from the 25-year, 24-year storm event, when the water surface is at the bottom of the lowest outlet structure. The emergency spillway will pass the 100-year, 24-hour storm event at both ponds. Refer to the Sedimentation Pond Sizing section of this appendix for the detailed calculations.

<u>South Sedimentation Pond Outfall</u>

The outfall structure weight as designed is sufficient to avoid uplift forces. Refer to the Outfall Structure section of this appendix for detailed calculations.

<u>Outfall Riprap Apron</u>

The riprap apron for the South Sedimentation Pond outfall will be constructed as shown on the Drawings. The apron will accommodate the runoff from the or the 25-year, 24-hour storm event. Though the flow is low enough for WisDOT Select Crushed Material, WisDOT Light Riprap will be used to account for additional flow from the swale. Refer to the Outfall Structure section of this appendix for detailed calculations.

LEGEND

- APPROVED LIMITS OF WASTE
- EXISTING GRADE (2' CONTOUR)
- 690 EXISTING GRADE (10' CONTOUR)
- EXISTING CULVERT
- EXISTING HAUL ROAD
- FM LEACHATE FORCEMAIN
- E/I ELECTRIC AND INSTRUMENT CONDUITS
- PROPOSED GRADE (2' CONTOUR)
- 690 PROPOSED GRADE (10' CONTOUR)
- PROPOSED DIVERSION BERM
- PROPOSED DOWNSLOPE FLUME
- DRAINAGE DIVIDE
- FLOW PATH

NOTES:

1. SEE SHEET 2 FOR ADDITIONAL BASE MAP LEGEND ITEMS AND NOTES.
2. PROPOSED GRADES REPRESENT TOP OF FINAL COVER.

150 0 150

SCALE: 1" = 150'

N

DRAWN BY:	KP/RJG
CHECKED BY:	SJL
APPROVED BY:	MH
PROJECT NO.	25222259.00
DRAWN:	01/05/2024
REVISED:	05/24/2024

WISCONSIN POWER AND LIGHT COMPANY
EDGEWATER GENERATING STATION
3739 LAKESHORE DRIVE
SHEBOYGAN, WI 53081

CLIENT

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
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ENGINEER

PLAN MODIFICATION ADDENDUM NO. 1
EDGEWATER GENERATING STATION
EDGEWATER I-43 ASH DISPOSAL FACILITY
TOWN OF WILSON, WISCONSIN

SITE

STORM WATER - CONTACT WATER SWALE LINER CONVERSION

SHEET

1 of 2

LEGEND

- APPROVED LIMITS OF WASTE
- EXISTING GRADE (2' CONTOUR)
- 690 EXISTING GRADE (10' CONTOUR)
- EXISTING CULVERT
- EXISTING HAUL ROAD
- FM LEACHATE FORCEMAIN
- E/I ELECTRIC AND INSTRUMENT CONDUITS
- PROPOSED GRADE (2' CONTOUR)
- 690 PROPOSED GRADE (10' CONTOUR)
- PROPOSED DIVERSION BERM
- PROPOSED DOWNSLOPE FLUME
- DRAINAGE DIVIDE
- FLOW PATH

NOTES:

1. SEE SHEET 2 FOR ADDITIONAL BASE MAP LEGEND ITEMS AND NOTES.
2. PROPOSED GRADES REPRESENT TOP OF FINAL COVER GRADES.

PROJECT NO.	25222259.00	DRAWN BY:	KP/RJG
DRAWN:	01/05/2024	CHECKED BY:	SJL
REVISED:	05/24/2024	APPROVED BY:	MH

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ENGINEER

PLAN MODIFICATION ADDENDUM NO. 1
EDGEWATER GENERATING STATION
EDGEWATER I-43 ASH DISPOSAL FACILITY
TOWN OF WILSON, WISCONSIN

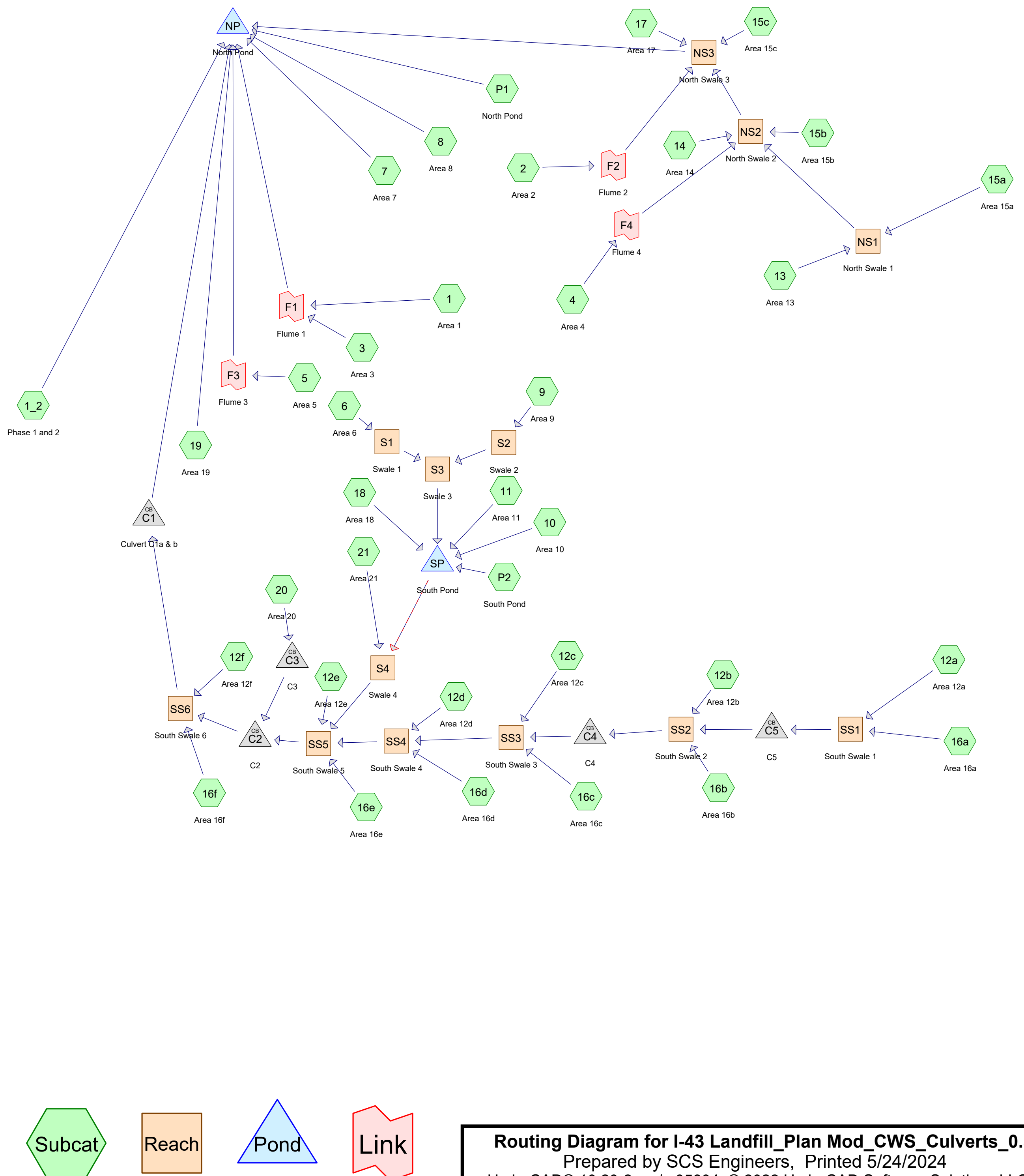
SITE

STORM WATER – FULLY DEVELOPED SITE CLOSURE

SHEET
2 of 2

Contact Water Swale Closure Conditions Hydrograph Generation

- 25-year, 24-hour Storm Event
- 100-year, 24-hour Storm Event



Routing Diagram for I-43 Landfill_Plan Mod_CWS_Culverts_0.3
Prepared by SCS Engineers, Printed 5/24/2024
HydroCAD® 10.20-2g s/n 05804 © 2022 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-yr	MSE 24-hr	4	Default	24.00	1	4.80	2
2	100-yr	MSE 24-hr	4	Default	24.00	1	6.55	2

Time span=0.00-90.00 hrs, dt=0.01 hrs, 9001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Area 1 Runoff Area=28,521 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=347' Tc=15.8 min CN=79 Runoff=1.93 cfs 0.144 af

Subcatchment1_2: Phase 1 and 2 Runoff Area=2,282,700 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=3,476' Tc=25.0 min CN=79 Runoff=122.93 cfs 11.486 af

Subcatchment2: Area 2 Runoff Area=28,787 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=491' Tc=15.8 min CN=79 Runoff=1.95 cfs 0.145 af

Subcatchment3: Area 3 Runoff Area=45,292 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=449' Tc=16.3 min CN=79 Runoff=3.02 cfs 0.228 af

Subcatchment4: Area 4 Runoff Area=52,914 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=475' Tc=15.6 min CN=79 Runoff=3.61 cfs 0.266 af

Subcatchment5: Area 5 Runoff Area=37,768 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=442' Tc=15.9 min CN=79 Runoff=2.54 cfs 0.190 af

Subcatchment6: Area 6 Runoff Area=61,616 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=114' Slope=0.2500 '/' Tc=5.9 min CN=79 Runoff=6.05 cfs 0.310 af

Subcatchment7: Area 7 Runoff Area=81,807 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=200' Tc=12.4 min CN=79 Runoff=6.18 cfs 0.412 af

Subcatchment8: Area 8 Runoff Area=63,362 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=198' Tc=13.8 min CN=79 Runoff=4.56 cfs 0.319 af

Subcatchment9: Area 9 Runoff Area=48,089 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=133' Tc=6.0 min CN=79 Runoff=4.70 cfs 0.242 af

Subcatchment10: Area 10 Runoff Area=63,729 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=138' Tc=4.2 min CN=79 Runoff=6.71 cfs 0.321 af

Subcatchment11: Area 11 Runoff Area=10,561 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=98' Slope=0.0610 '/' Tc=10.0 min CN=79 Runoff=0.87 cfs 0.053 af

Subcatchment12a: Area 12a Runoff Area=98,996 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=180' Tc=14.4 min CN=79 Runoff=7.00 cfs 0.498 af

Subcatchment12b: Area 12b Runoff Area=47,686 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=204' Tc=14.2 min CN=79 Runoff=3.38 cfs 0.240 af

Subcatchment12c: Area 12c Runoff Area=5,888 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=19' Slope=0.0050 '/' Tc=5.0 min CN=79 Runoff=0.60 cfs 0.030 af

Subcatchment12d: Area 12d Runoff Area=1,651 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=23' Slope=0.0050 '/' Tc=8.5 min CN=79 Runoff=0.14 cfs 0.008 af

Subcatchment12e: Area 12e Runoff Area=4,957 sf 0.00% Impervious Runoff Depth=3.09"
Flow Length=47' Tc=4.1 min CN=84 Runoff=0.60 cfs 0.029 af

Subcatchment12f: Area 12f Runoff Area=9,031 sf 0.00% Impervious Runoff Depth=2.90"
Flow Length=52' Slope=0.0788 '/' Tc=5.4 min CN=82 Runoff=0.99 cfs 0.050 af

Subcatchment13: Area 13 Runoff Area=174,279 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=205' Tc=14.5 min CN=79 Runoff=12.25 cfs 0.877 af

Subcatchment14: Area 14 Runoff Area=59,877 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=125' Slope=0.2500 '/' Tc=5.9 min CN=79 Runoff=5.88 cfs 0.301 af

Subcatchment15a: Area 15a Runoff Area=99,614 sf 5.36% Impervious Runoff Depth=2.99"
Flow Length=58' Tc=3.3 min CN=83 Runoff=12.10 cfs 0.571 af

Subcatchment15b: Area 15b Runoff Area=11,056 sf 0.00% Impervious Runoff Depth=3.18"
Flow Length=33' Slope=0.1176 '/' Tc=2.4 min CN=85 Runoff=1.43 cfs 0.067 af

Subcatchment15c: Area 15c Runoff Area=9,032 sf 0.00% Impervious Runoff Depth=2.90"
Flow Length=1,656' Tc=7.2 min CN=82 Runoff=0.92 cfs 0.050 af

Subcatchment16a: Area 16a Runoff Area=37,043 sf 0.00% Impervious Runoff Depth=3.28"
Flow Length=50' Tc=5.6 min CN=86 Runoff=4.46 cfs 0.232 af

Subcatchment16b: Area 16b Runoff Area=23,150 sf 0.00% Impervious Runoff Depth=3.18"
Flow Length=78' Tc=1.8 min CN=85 Runoff=3.04 cfs 0.141 af

Subcatchment16c: Area 16c Runoff Area=22,754 sf 0.00% Impervious Runoff Depth=2.99"
Flow Length=54' Tc=3.0 min CN=83 Runoff=2.79 cfs 0.130 af

Subcatchment16d: Area 16d Runoff Area=7,112 sf 0.00% Impervious Runoff Depth=2.99"
Flow Length=65' Tc=4.2 min CN=83 Runoff=0.84 cfs 0.041 af

Subcatchment16e: Area 16e Runoff Area=11,038 sf 0.00% Impervious Runoff Depth=2.90"
Flow Length=75' Tc=4.7 min CN=82 Runoff=1.24 cfs 0.061 af

Subcatchment16f: Area 16f Runoff Area=19,413 sf 0.00% Impervious Runoff Depth=2.99"
Flow Length=75' Tc=4.7 min CN=83 Runoff=2.24 cfs 0.111 af

Subcatchment17: Area 17 Runoff Area=18,834 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=140' Slope=0.2500 '/' Tc=6.0 min CN=79 Runoff=1.84 cfs 0.095 af

Subcatchment18: Area 18 Runoff Area=20,237 sf 0.00% Impervious Runoff Depth=2.72"
Flow Length=55' Slope=0.0714 '/' Tc=5.9 min CN=80 Runoff=2.05 cfs 0.105 af

Subcatchment19: Area 19 Runoff Area=5,416 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=141' Slope=0.2500 '/' Tc=6.0 min CN=79 Runoff=0.53 cfs 0.027 af

Subcatchment20: Area 20 Runoff Area=53,255 sf 0.00% Impervious Runoff Depth=2.72"
Flow Length=100' Slope=0.0050 '/' Tc=2.3 min CN=80 Runoff=6.08 cfs 0.277 af

Subcatchment21: Area 21 Runoff Area=7,329 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=62' Slope=0.0758 '/' Tc=6.4 min CN=79 Runoff=0.70 cfs 0.037 af

SubcatchmentP1: North Pond Runoff Area=342,674 sf 100.00% Impervious Runoff Depth=4.56"
Tc=0.0 min CN=98 Runoff=54.53 cfs 2.992 af

SubcatchmentP2: South Pond Runoff Area=3.099 ac 100.00% Impervious Runoff Depth=4.56"
Tc=0.0 min CN=98 Runoff=21.48 cfs 1.179 af

Reach NS1: North Swale 1 Avg. Flow Depth=0.41' Max Vel=3.64 fps Inflow=20.02 cfs 1.447 af
n=0.030 L=1,043.0' S=0.0209 '/' Capacity=302.62 cfs Outflow=17.15 cfs 1.447 af

Reach NS2: North Swale 2 Avg. Flow Depth=0.59' Max Vel=3.33 fps Inflow=24.00 cfs 2.082 af
n=0.030 L=381.0' S=0.0115 '/' Capacity=224.48 cfs Outflow=23.59 cfs 2.082 af

Reach NS3: North Swale 3 Avg. Flow Depth=0.54' Max Vel=4.12 fps Inflow=26.58 cfs 2.372 af
n=0.030 L=195.0' S=0.0193 '/' Capacity=290.78 cfs Outflow=26.50 cfs 2.372 af

Reach S1: Swale 1 Avg. Flow Depth=0.34' Max Vel=2.20 fps Inflow=6.05 cfs 0.310 af
n=0.030 L=423.0' S=0.0118 '/' Capacity=45.58 cfs Outflow=5.46 cfs 0.310 af

Reach S2: Swale 2 Avg. Flow Depth=0.30' Max Vel=2.10 fps Inflow=4.70 cfs 0.242 af
n=0.030 L=320.0' S=0.0125 '/' Capacity=46.88 cfs Outflow=4.37 cfs 0.242 af

Reach S3: Swale 3 Avg. Flow Depth=0.48' Max Vel=3.16 fps Inflow=9.78 cfs 0.552 af
n=0.030 L=68.7' S=0.0146 '/' Capacity=37.92 cfs Outflow=9.74 cfs 0.552 af

Reach S4: Swale 4 Avg. Flow Depth=0.14' Max Vel=0.75 fps Inflow=1.20 cfs 2.028 af
n=0.030 L=125.0' S=0.0032 '/' Capacity=123.75 cfs Outflow=1.14 cfs 2.027 af

Reach SS1: South Swale 1 Avg. Flow Depth=0.32' Max Vel=2.56 fps Inflow=9.79 cfs 0.731 af
n=0.030 L=686.0' S=0.0140 '/' Capacity=247.65 cfs Outflow=9.07 cfs 0.731 af

Reach SS2: South Swale 2 Avg. Flow Depth=0.38' Max Vel=2.92 fps Inflow=12.82 cfs 1.112 af
n=0.030 L=327.0' S=0.0146 '/' Capacity=253.11 cfs Outflow=12.71 cfs 1.112 af

Reach SS3: South Swale 3 Avg. Flow Depth=0.45' Max Vel=2.56 fps Inflow=13.51 cfs 1.272 af
n=0.030 L=320.0' S=0.0093 '/' Capacity=201.47 cfs Outflow=13.35 cfs 1.272 af

Reach SS4: South Swale 4 Avg. Flow Depth=0.26' Max Vel=4.72 fps Inflow=13.56 cfs 1.321 af
n=0.030 L=114.0' S=0.0605 '/' Capacity=514.50 cfs Outflow=13.55 cfs 1.321 af

Reach SS5: South Swale 5 Avg. Flow Depth=0.66' Max Vel=1.82 fps Inflow=14.75 cfs 3.439 af
n=0.030 L=140.0' S=0.0030 '/' Capacity=114.55 cfs Outflow=14.69 cfs 3.438 af

Reach SS6: South Swale 6 Avg. Flow Depth=0.71' Max Vel=1.88 fps Inflow=17.37 cfs 3.876 af
n=0.030 L=215.0' S=0.0030 '/' Capacity=114.10 cfs Outflow=16.57 cfs 3.875 af

Pond C1: Culvert C1a & b Peak Elev=688.88' Inflow=16.57 cfs 3.875 af
Outflow=16.57 cfs 3.875 af

Pond C2: C2 Peak Elev=691.21' Inflow=15.73 cfs 3.715 af
24.0" Round Culvert n=0.012 L=46.0' S=0.0030 '/' Outflow=15.73 cfs 3.715 af

Pond C3: C3 Peak Elev=696.36' Inflow=6.08 cfs 0.277 af
12.0" Round Culvert n=0.012 L=48.0' S=0.0146 '/' Outflow=6.08 cfs 0.277 af

Pond C4: C4 Peak Elev=701.35' Inflow=12.71 cfs 1.112 af
24.0" Round Culvert n=0.013 L=40.5' S=0.0121 '/' Outflow=12.71 cfs 1.112 af

Pond C5: C5 Peak Elev=707.50' Inflow=9.07 cfs 0.731 af
18.0" Round Culvert n=0.025 L=38.0' S=0.0034 '/' Outflow=9.07 cfs 0.731 af

Pond NP: North Pond Peak Elev=684.79' Storage=13.287 af Inflow=184.24 cfs 22.044 af
Primary=17.29 cfs 21.803 af Secondary=0.00 cfs 0.000 af Outflow=17.29 cfs 21.803 af

Pond SP: South Pond Peak Elev=690.69' Storage=636,660 cf Inflow=34.99 cfs 2.210 af
Primary=0.71 cfs 1.991 af Secondary=0.00 cfs 0.000 af Outflow=0.71 cfs 1.991 af

Link F1: Flume 1 Inflow=4.95 cfs 0.371 af
Primary=4.95 cfs 0.371 af

Link F2: Flume 2 Inflow=1.95 cfs 0.145 af
Primary=1.95 cfs 0.145 af

Link F3: Flume 3 Inflow=2.54 cfs 0.190 af
Primary=2.54 cfs 0.190 af

Link F4: Flume 4 Inflow=3.61 cfs 0.266 af
Primary=3.61 cfs 0.266 af

Total Runoff Area = 92.527 ac Runoff Volume = 22.265 af Average Runoff Depth = 2.89"
88.02% Pervious = 81.438 ac 11.98% Impervious = 11.088 ac

Summary for Subcatchment 1: Area 1

Runoff = 1.93 cfs @ 12.24 hrs, Volume= 0.144 af, Depth= 2.63"
Routed to Link F1 : Flume 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	28,521	79	
	28,521		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.5	106	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	141	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.8	347	Total			

Summary for Subcatchment 1_2: Phase 1 and 2

Runoff = 122.93 cfs @ 12.36 hrs, Volume= 11.486 af, Depth= 2.63"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	2,282,700	79	Closed Landfill
	2,282,700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0400	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.8	400	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.2	2,976	0.0120	6.04	380.82	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=3.00' Z= 10.0 & 4.0 '/' Top.W=42.00' n= 0.035 Earth, dense weeds
25.0	3,476	Total			

Summary for Subcatchment 2: Area 2

Runoff = 1.95 cfs @ 12.24 hrs, Volume= 0.145 af, Depth= 2.63"
Routed to Link F2 : Flume 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	28,787	79	
	28,787		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	78	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	203	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	110	0.2500	20.09	10.95	**Pipe Channel,** 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
15.8	491	Total			

Summary for Subcatchment 3: Area 3

Runoff = 3.02 cfs @ 12.25 hrs, Volume= 0.228 af, Depth= 2.63"
Routed to Link F1 : Flume 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	45,292	79	
	45,292		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.5	108	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	241	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.3	449	Total			

Summary for Subcatchment 4: Area 4

Runoff = 3.61 cfs @ 12.24 hrs, Volume= 0.266 af, Depth= 2.63"
Routed to Link F4 : Flume 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	52,914	79	
	52,914		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	83	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	173	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	119	0.2500	22.68	17.81	**Pipe Channel, Flume 4** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
15.6	475	Total			

Summary for Subcatchment 5: Area 5

Runoff = 2.54 cfs @ 12.24 hrs, Volume= 0.190 af, Depth= 2.63"
Routed to Link F3 : Flume 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	37,768	79	
	37,768		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.0	73	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	269	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Diversion Berm** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.9	442	Total			

Summary for Subcatchment 6: Area 6

Runoff = 6.05 cfs @ 12.13 hrs, Volume= 0.310 af, Depth= 2.63"
Routed to Reach S1 : Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	61,616	79	
	61,616		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.1	14	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.9	114	Total			

Summary for Subcatchment 7: Area 7

Runoff = 6.18 cfs @ 12.20 hrs, Volume= 0.412 af, Depth= 2.63"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	81,807	79	
	81,807		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	63	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.6	37	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	100	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.4	200	Total			

Summary for Subcatchment 8: Area 8

Runoff = 4.56 cfs @ 12.22 hrs, Volume= 0.319 af, Depth= 2.63"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	62,504	79	
	858	96	Gravel surface, HSG C
	63,362	79	Weighted Average
	63,362		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	91	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	9	0.2500	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	98	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.8	198	Total			

Summary for Subcatchment 9: Area 9

Runoff = 4.70 cfs @ 12.13 hrs, Volume= 0.242 af, Depth= 2.63"
Routed to Reach S2 : Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	48,089	79	
	48,089		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.0	5	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	28	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.0	133	Total			

Summary for Subcatchment 10: Area 10

Runoff = 6.71 cfs @ 12.12 hrs, Volume= 0.321 af, Depth= 2.63"
Routed to Pond SP : South Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	63,729	79	
	63,729		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	100	0.2500	0.42		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
0.1	19	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	19	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.2	138	Total			

Summary for Subcatchment 11: Area 11

Runoff = 0.87 cfs @ 12.18 hrs, Volume= 0.053 af, Depth= 2.63"
Routed to Pond SP : South Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	10,561	79	
	10,561		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	98	0.0610	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment 12a: Area 12a

Runoff = 7.00 cfs @ 12.23 hrs, Volume= 0.498 af, Depth= 2.63"
Routed to Reach SS1 : South Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	98,996	79	
	98,996		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	57	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.4	180	Total			

Summary for Subcatchment 12b: Area 12b

Runoff = 3.38 cfs @ 12.23 hrs, Volume= 0.240 af, Depth= 2.63"
Routed to Reach SS2 : South Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	47,328	79	
	358	96	Gravel surface, HSG C
	47,686	79	Weighted Average
	47,686		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.3	24	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	57	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.3333	4.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.2	204	Total			

Summary for Subcatchment 12c: Area 12c

Runoff = 0.60 cfs @ 12.12 hrs, Volume= 0.030 af, Depth= 2.63"
Routed to Reach SS3 : South Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	5,888	79	
	5,888		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	19	0.0050	0.06		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"

Summary for Subcatchment 12d: Area 12d

Runoff = 0.14 cfs @ 12.16 hrs, Volume= 0.008 af, Depth= 2.63"
Routed to Reach SS4 : South Swale 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	1,651	79	
	1,651		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	23	0.0050	0.04		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment 12e: Area 12e

Runoff = 0.60 cfs @ 12.12 hrs, Volume= 0.029 af, Depth= 3.09"
Routed to Reach SS5 : South Swale 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	3,521	79	
	1,436	96	Gravel surface, HSG C
	4,957	84	Weighted Average
	4,957		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	9	0.0050	0.44		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
3.8	38	0.0400	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
4.1	47	Total			

Summary for Subcatchment 12f: Area 12f

Runoff = 0.99 cfs @ 12.13 hrs, Volume= 0.050 af, Depth= 2.90"
Routed to Reach SS6 : South Swale 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	7,374	79	
	1,657	96	Gravel surface, HSG C
	9,031	82	Weighted Average
	9,031		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	52	0.0788	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment 13: Area 13

Runoff = 12.25 cfs @ 12.23 hrs, Volume= 0.877 af, Depth= 2.63"
Routed to Reach NS1 : North Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	174,279	79	
	174,279		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	56	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	49	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.5	205	Total			

Summary for Subcatchment 14: Area 14

Runoff = 5.88 cfs @ 12.13 hrs, Volume= 0.301 af, Depth= 2.63"
Routed to Reach NS2 : North Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	59,877	79	
	59,877		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.1	25	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.9	125	Total			

Summary for Subcatchment 15a: Area 15a

Runoff = 12.10 cfs @ 12.11 hrs, Volume= 0.571 af, Depth= 2.99"
Routed to Reach NS1 : North Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	78,118	79	
	5,343	98	Paved roads w/curbs & sewers, HSG C
	16,153	96	Gravel surface, HSG C
	99,614	83	Weighted Average
	94,271		94.64% Pervious Area
	5,343		5.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	32	0.0050	0.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
2.4	26	0.1538	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
3.3	58	Total			

Summary for Subcatchment 15b: Area 15b

Runoff = 1.43 cfs @ 12.10 hrs, Volume= 0.067 af, Depth= 3.18"
Routed to Reach NS2 : North Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	7,026	79	
	4,030	96	Gravel surface, HSG C
	11,056	85	Weighted Average
	11,056		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.1176	1.62		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
2.3	22	0.1176	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.4	33	Total			

Summary for Subcatchment 15c: Area 15c

Runoff = 0.92 cfs @ 12.14 hrs, Volume= 0.050 af, Depth= 2.90"
Routed to Reach NS3 : North Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	7,178	79	
	1,854	96	Gravel surface, HSG C
	9,032	82	Weighted Average
	9,032		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	14	0.1250	1.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
4.4	50	0.1250	0.19		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.7	1,592	0.0167	9.92	610.36	**Trap/Vee/Rect Channel Flow,** Bot.W=10.00' D=3.00' Z= 4.0 & 3.0 '/' Top.W=31.00' n= 0.030 Earth, grassed & winding
7.2	1,656	Total			

Summary for Subcatchment 16a: Area 16a

Runoff = 4.46 cfs @ 12.13 hrs, Volume= 0.232 af, Depth= 3.28"
Routed to Reach SS1 : South Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	20,948	79	
	16,095	96	Gravel surface, HSG C
	37,043	86	Weighted Average
	37,043		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	13	0.0050	0.06		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
0.7	21	0.0050	0.52		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.2	16	0.3300	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
5.6	50	Total			

Summary for Subcatchment 16b: Area 16b

Runoff = 3.04 cfs @ 12.10 hrs, Volume= 0.141 af, Depth= 3.18"
Routed to Reach SS2 : South Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	14,694	79	
	8,456	96	Gravel surface, HSG C
	23,150	85	Weighted Average
	23,150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	64	0.0450	1.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.1	14	0.3333	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.8	78	Total			

Summary for Subcatchment 16c: Area 16c

Runoff = 2.79 cfs @ 12.11 hrs, Volume= 0.130 af, Depth= 2.99"
Routed to Reach SS3 : South Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	17,622	79	
	5,132	96	Gravel surface, HSG C
	22,754	83	Weighted Average
	22,754		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	24	0.2500	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	7	0.1666	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.1	18	0.1667	2.05		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
0.3	5	0.3333	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
3.0	54	Total			

Summary for Subcatchment 16d: Area 16d

Runoff = 0.84 cfs @ 12.12 hrs, Volume= 0.041 af, Depth= 2.99"
Routed to Reach SS4 : South Swale 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	5,564	79	
	1,548	96	Gravel surface, HSG C
	7,112	83	Weighted Average
	7,112		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	38	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	14	0.0050	0.48		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.0	13	0.3300	0.21		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.2	65	Total			

Summary for Subcatchment 16e: Area 16e

Runoff = 1.24 cfs @ 12.12 hrs, Volume= 0.061 af, Depth= 2.90"
Routed to Reach SS5 : South Swale 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	8,772	79	
	2,266	96	Gravel surface, HSG C
	11,038	82	Weighted Average
	11,038		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	43	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	16	0.0050	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.3	16	0.2500	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.7	75	Total			

Summary for Subcatchment 16f: Area 16f

Runoff = 2.24 cfs @ 12.12 hrs, Volume= 0.111 af, Depth= 2.99"
Routed to Reach SS6 : South Swale 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	14,568	79	
	4,845	96	Gravel surface, HSG C
	19,413	83	Weighted Average
	19,413		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	43	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	16	0.0050	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.3	16	0.2500	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.7	75	Total			

Summary for Subcatchment 17: Area 17

Runoff = 1.84 cfs @ 12.13 hrs, Volume= 0.095 af, Depth= 2.63"
Routed to Reach NS3 : North Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	18,834	79	
	18,834		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.2	40	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.0	140	Total			

Summary for Subcatchment 18: Area 18

Runoff = 2.05 cfs @ 12.13 hrs, Volume= 0.105 af, Depth= 2.72"
Routed to Pond SP : South Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	19,430	79	
	807	96	Gravel surface, HSG C
	20,237	80	Weighted Average
	20,237		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	55	0.0714	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment 19: Area 19

Runoff = 0.53 cfs @ 12.13 hrs, Volume= 0.027 af, Depth= 2.63"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	5,416	79	
	5,416		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.2	41	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.0	141	Total			

Summary for Subcatchment 20: Area 20

Runoff = 6.08 cfs @ 12.10 hrs, Volume= 0.277 af, Depth= 2.72"
Routed to Pond C3 : C3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	50,854	79	
	2,401	96	Gravel surface, HSG C
	53,255	80	Weighted Average
	53,255		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	100	0.0050	0.71		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"

Summary for Subcatchment 21: Area 21

Runoff = 0.70 cfs @ 12.14 hrs, Volume= 0.037 af, Depth= 2.63"
Routed to Reach S4 : Swale 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	7,177	79	
	152	96	Gravel surface, HSG C
	7,329	79	Weighted Average
	7,329		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	62	0.0758	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment P1: North Pond

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 54.53 cfs @ 12.09 hrs, Volume= 2.992 af, Depth= 4.56"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

Area (sf)	CN	Description
342,674	98	Water Surface
342,674		100.00% Impervious Area

Summary for Subcatchment P2: South Pond

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 21.48 cfs @ 12.09 hrs, Volume= 1.179 af, Depth= 4.56"
Routed to Pond SP : South Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

Area (ac)	CN	Description
3.099	98	Water Surface, HSG C
3.099		100.00% Impervious Area

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

Summary for Reach NS1: North Swale 1

Inflow Area = 6.288 ac, 1.95% Impervious, Inflow Depth = 2.76" for 25-yr event
Inflow = 20.02 cfs @ 12.12 hrs, Volume= 1.447 af
Outflow = 17.15 cfs @ 12.23 hrs, Volume= 1.447 af, Atten= 14%, Lag= 6.9 min
Routed to Reach NS2 : North Swale 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.64 fps, Min. Travel Time= 4.8 min
Avg. Velocity = 0.93 fps, Avg. Travel Time= 18.8 min

Peak Storage= 4,910 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.41' , Surface Width= 12.88'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 302.62 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 1,043.0' Slope= 0.0209 '/'
Inlet Invert= 714.00', Outlet Invert= 692.16'

‡

Summary for Reach NS2: North Swale 2

[62] Hint: Exceeded Reach NS1 OUTLET depth by 0.20' @ 12.39 hrs

Inflow Area = 9.131 ac, 1.34% Impervious, Inflow Depth = 2.74" for 25-yr event
Inflow = 24.00 cfs @ 12.22 hrs, Volume= 2.082 af
Outflow = 23.59 cfs @ 12.28 hrs, Volume= 2.082 af, Atten= 2%, Lag= 3.2 min
Routed to Reach NS3 : North Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.33 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.82 fps, Avg. Travel Time= 7.7 min

Peak Storage= 2,698 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.59' , Surface Width= 14.11'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 224.48 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 381.0' Slope= 0.0115 '/'
Inlet Invert= 692.16', Outlet Invert= 687.77'

‡

Summary for Reach NS3: North Swale 3

[61] Hint: Exceeded Reach NS2 outlet invert by 0.54' @ 12.28 hrs

Inflow Area = 10.431 ac, 1.18% Impervious, Inflow Depth = 2.73" for 25-yr event
Inflow = 26.58 cfs @ 12.27 hrs, Volume= 2.372 af
Outflow = 26.50 cfs @ 12.29 hrs, Volume= 2.372 af, Atten= 0%, Lag= 1.3 min
Routed to Pond NP : North Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.12 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.03 fps, Avg. Travel Time= 3.2 min

Peak Storage= 1,256 cf @ 12.28 hrs
Average Depth at Peak Storage= 0.54' , Surface Width= 13.79'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 290.78 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 195.0' Slope= 0.0193 '/'
Inlet Invert= 687.77', Outlet Invert= 684.00'

‡

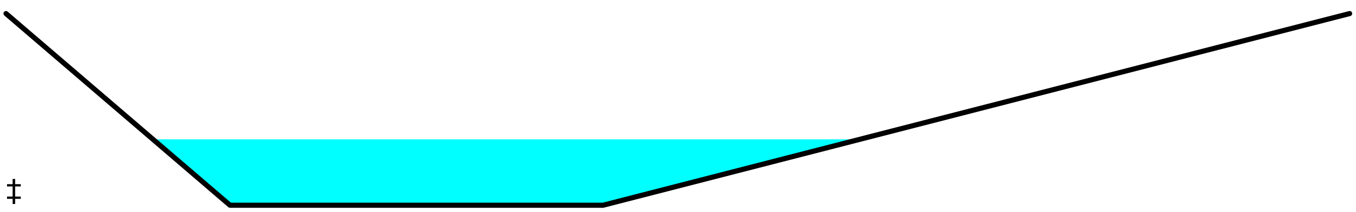
Summary for Reach S1: Swale 1

Inflow Area = 1.415 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 6.05 cfs @ 12.13 hrs, Volume= 0.310 af
Outflow = 5.46 cfs @ 12.21 hrs, Volume= 0.310 af, Atten= 10%, Lag= 4.8 min
Routed to Reach S3 : Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.20 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 0.55 fps, Avg. Travel Time= 12.8 min

Peak Storage= 1,053 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.34' , Surface Width= 9.47'
Bank-Full Depth= 1.00' Flow Area= 11.5 sf, Capacity= 45.58 cfs

5.00' x 1.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 3.0 10.0 '/' Top Width= 18.00'
Length= 423.0' Slope= 0.0118 '/'
Inlet Invert= 700.00', Outlet Invert= 695.00'



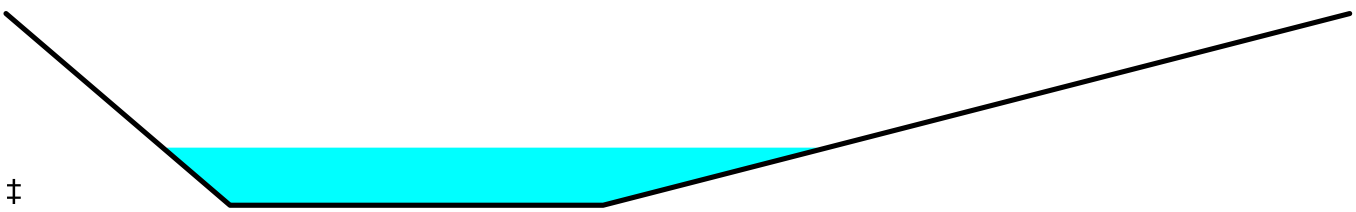
Summary for Reach S2: Swale 2

Inflow Area = 1.104 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 4.70 cfs @ 12.13 hrs, Volume= 0.242 af
Outflow = 4.37 cfs @ 12.20 hrs, Volume= 0.242 af, Atten= 7%, Lag= 3.9 min
Routed to Reach S3 : Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.10 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 0.53 fps, Avg. Travel Time= 10.1 min

Peak Storage= 668 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.30' , Surface Width= 8.91'
Bank-Full Depth= 1.00' Flow Area= 11.5 sf, Capacity= 46.88 cfs

5.00' x 1.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 3.0 10.0 '/' Top Width= 18.00'
Length= 320.0' Slope= 0.0125 '/'
Inlet Invert= 699.00', Outlet Invert= 695.00'



Summary for Reach S3: Swale 3

[62] Hint: Exceeded Reach S1 OUTLET depth by 0.18' @ 12.23 hrs
[62] Hint: Exceeded Reach S2 OUTLET depth by 0.23' @ 12.23 hrs

Inflow Area = 2.518 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 9.78 cfs @ 12.21 hrs, Volume= 0.552 af
Outflow = 9.74 cfs @ 12.22 hrs, Volume= 0.552 af, Atten= 0%, Lag= 0.6 min
Routed to Pond SP : South Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.16 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.74 fps, Avg. Travel Time= 1.6 min

Peak Storage= 212 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.48' , Surface Width= 7.88'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 37.92 cfs

5.00' x 1.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 68.7' Slope= 0.0146 '/'
Inlet Invert= 695.00', Outlet Invert= 694.00'

‡

Summary for Reach S4: Swale 4

[79] Warning: Submerged Pond SP Primary device # 1 OUTLET by 0.14'

Inflow Area = 7.956 ac, 38.95% Impervious, Inflow Depth > 3.06" for 25-yr event
Inflow = 1.20 cfs @ 12.14 hrs, Volume= 2.028 af
Outflow = 1.14 cfs @ 12.21 hrs, Volume= 2.027 af, Atten= 4%, Lag= 4.3 min
Routed to Reach SS5 : South Swale 5

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.75 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 0.40 fps, Avg. Travel Time= 5.3 min

Peak Storage= 192 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.14' , Surface Width= 11.16'
Bank-Full Depth= 2.00' Flow Area= 36.0 sf, Capacity= 123.75 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 4.0 '/' Top Width= 26.00'
Length= 125.0' Slope= 0.0032 '/'
Inlet Invert= 689.50', Outlet Invert= 689.10'

Summary for Reach SS1: South Swale 1

Inflow Area = 3.123 ac, 0.00% Impervious, Inflow Depth = 2.81" for 25-yr event
Inflow = 9.79 cfs @ 12.15 hrs, Volume= 0.731 af
Outflow = 9.07 cfs @ 12.30 hrs, Volume= 0.731 af, Atten= 7%, Lag= 8.6 min
Routed to Pond C5 : C5

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.56 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 17.4 min

Peak Storage= 2,434 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.32' , Surface Width= 12.23'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 247.65 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 686.0' Slope= 0.0140 '/'
Inlet Invert= 714.00', Outlet Invert= 704.38'

Summary for Reach SS2: South Swale 2

[79] Warning: Submerged Pond C5 Primary device # 1 INLET by 0.25'

Inflow Area = 4.749 ac, 0.00% Impervious, Inflow Depth = 2.81" for 25-yr event
Inflow = 12.82 cfs @ 12.27 hrs, Volume= 1.112 af
Outflow = 12.71 cfs @ 12.33 hrs, Volume= 1.112 af, Atten= 1%, Lag= 3.3 min
Routed to Pond C4 : C4

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.92 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 7.2 min

Peak Storage= 1,423 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.38' , Surface Width= 12.68'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 253.11 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 327.0' Slope= 0.0146 '/'
Inlet Invert= 704.25', Outlet Invert= 699.46'

Summary for Reach SS3: South Swale 3

[79] Warning: Submerged Pond C4 Primary device # 1 OUTLET by 0.45'

Inflow Area = 5.407 ac, 0.00% Impervious, Inflow Depth = 2.82" for 25-yr event
Inflow = 13.51 cfs @ 12.32 hrs, Volume= 1.272 af
Outflow = 13.35 cfs @ 12.38 hrs, Volume= 1.272 af, Atten= 1%, Lag= 3.5 min
Routed to Reach SS4 : South Swale 4

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.56 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 8.0 min

Peak Storage= 1,670 cf @ 12.34 hrs
Average Depth at Peak Storage= 0.45' , Surface Width= 13.15'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 201.47 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 320.0' Slope= 0.0093 '/'
Inlet Invert= 698.97', Outlet Invert= 696.00'


‡

Summary for Reach SS4: South Swale 4

[61] Hint: Exceeded Reach SS3 outlet invert by 0.26' @ 12.38 hrs

Inflow Area = 5.608 ac, 0.00% Impervious, Inflow Depth = 2.83" for 25-yr event
Inflow = 13.56 cfs @ 12.38 hrs, Volume= 1.321 af
Outflow = 13.55 cfs @ 12.39 hrs, Volume= 1.321 af, Atten= 0%, Lag= 0.7 min
Routed to Reach SS5 : South Swale 5

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.72 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 1.4 min

Peak Storage= 327 cf @ 12.38 hrs
Average Depth at Peak Storage= 0.26' , Surface Width= 11.84'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 514.50 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 114.0' Slope= 0.0605 '/'
Inlet Invert= 696.00', Outlet Invert= 689.10'

Summary for Reach SS5: South Swale 5

[63] Warning: Exceeded Reach S4 INLET depth by 0.14' @ 12.40 hrs
[62] Hint: Exceeded Reach SS4 OUTLET depth by 0.40' @ 12.41 hrs

Inflow Area = 13.931 ac, 22.25% Impervious, Inflow Depth > 2.96" for 25-yr event
Inflow = 14.75 cfs @ 12.38 hrs, Volume= 3.439 af
Outflow = 14.69 cfs @ 12.42 hrs, Volume= 3.438 af, Atten= 0%, Lag= 2.2 min
Routed to Pond C2 : C2

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.82 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.43 fps, Avg. Travel Time= 5.5 min

Peak Storage= 1,133 cf @ 12.40 hrs
Average Depth at Peak Storage= 0.66' , Surface Width= 14.61'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 114.55 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 140.0' Slope= 0.0030 '/'
Inlet Invert= 689.10', Outlet Invert= 688.68'

‡

Summary for Reach SS6: South Swale 6

[79] Warning: Submerged Pond C2 Primary device # 1 INLET by 0.57'

Inflow Area = 15.806 ac, 19.61% Impervious, Inflow Depth > 2.94" for 25-yr event
Inflow = 17.37 cfs @ 12.12 hrs, Volume= 3.876 af
Outflow = 16.57 cfs @ 12.16 hrs, Volume= 3.875 af, Atten= 5%, Lag= 3.0 min
Routed to Pond C1 : Culvert C1a & b

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.88 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.43 fps, Avg. Travel Time= 8.2 min

Peak Storage= 1,894 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.71' , Surface Width= 14.94'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 114.10 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 215.0' Slope= 0.0030 '/'
Inlet Invert= 688.54', Outlet Invert= 687.90'

‡

Summary for Pond C1: Culvert C1a & b

[62] Hint: Exceeded Reach SS6 OUTLET depth by 0.29' @ 12.17 hrs

Inflow Area = 15.806 ac, 19.61% Impervious, Inflow Depth > 2.94" for 25-yr event
Inflow = 16.57 cfs @ 12.16 hrs, Volume= 3.875 af
Outflow = 16.57 cfs @ 12.16 hrs, Volume= 3.875 af, Atten= 0%, Lag= 0.0 min
Primary = 16.57 cfs @ 12.16 hrs, Volume= 3.875 af
Routed to Pond NP : North Pond

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 688.88' @ 12.16 hrs
Flood Elev= 691.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	687.71'	**24.0" Round C1a** L= 341.7' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 687.71' / 683.12' S= 0.0134 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	687.47'	**24.0" Round C1b** L= 341.6' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 687.47' / 683.25' S= 0.0124 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=16.53 cfs @ 12.16 hrs HW=688.88' (Free Discharge)
├—**1=C1a** (Inlet Controls 6.99 cfs @ 3.68 fps)
└—**2=C1b** (Inlet Controls 9.53 cfs @ 4.04 fps)

Summary for Pond C2: C2

[63] Warning: Exceeded Reach SS5 INLET depth by 1.45' @ 12.42 hrs
[79] Warning: Submerged Pond C3 Primary device # 1 OUTLET by 0.20'

Inflow Area =	15.153 ac, 20.45% Impervious,	Inflow Depth > 2.94"	for 25-yr event	
Inflow =	15.73 cfs @	12.41 hrs, Volume=	3.715 af	
Outflow =	15.73 cfs @	12.41 hrs, Volume=	3.715 af,	Atten= 0%, Lag= 0.0 min
Primary =	15.73 cfs @	12.41 hrs, Volume=	3.715 af	

Routed to Reach SS6 : South Swale 6

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 691.21' @ 12.41 hrs
Flood Elev= 694.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	688.68'	**24.0" Round Culvert** L= 46.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 688.68' / 688.54' S= 0.0030 '/' Cc= 0.900 n= 0.012 Steel, smooth, Flow Area= 3.14 sf

Primary OutFlow Max=15.73 cfs @ 12.41 hrs HW=691.21' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 15.73 cfs @ 5.11 fps)

Summary for Pond C3: C3

[58] Hint: Peaked 2.36' above defined flood level

Inflow Area = 1.223 ac, 0.00% Impervious, Inflow Depth = 2.72" for 25-yr event
Inflow = 6.08 cfs @ 12.10 hrs, Volume= 0.277 af
Outflow = 6.08 cfs @ 12.10 hrs, Volume= 0.277 af, Atten= 0%, Lag= 0.0 min
Primary = 6.08 cfs @ 12.10 hrs, Volume= 0.277 af
Routed to Pond C2 : C2

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 696.36' @ 12.10 hrs
Flood Elev= 694.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	691.71'	**12.0" Round Culvert** L= 48.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 691.71' / 691.01' S= 0.0146 '/' Cc= 0.900 n= 0.012 Steel, smooth, Flow Area= 0.79 sf

Primary OutFlow Max=6.07 cfs @ 12.10 hrs HW=696.35' (Free Discharge)
└─**1=Culvert** (Inlet Controls 6.07 cfs @ 7.73 fps)

Summary for Pond C4: C4

[62] Hint: Exceeded Reach SS2 OUTLET depth by 1.51' @ 12.33 hrs

Inflow Area = 4.749 ac, 0.00% Impervious, Inflow Depth = 2.81" for 25-yr event
Inflow = 12.71 cfs @ 12.33 hrs, Volume= 1.112 af
Outflow = 12.71 cfs @ 12.33 hrs, Volume= 1.112 af, Atten= 0%, Lag= 0.0 min
Primary = 12.71 cfs @ 12.33 hrs, Volume= 1.112 af
Routed to Reach SS3 : South Swale 3

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 701.35' @ 12.33 hrs
Flood Elev= 702.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	699.46'	**24.0" Round Culvert** L= 40.5' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 699.46' / 698.97' S= 0.0121 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=12.70 cfs @ 12.33 hrs HW=701.35' (Free Discharge)
└─**1=Culvert** (Inlet Controls 12.70 cfs @ 4.13 fps)

Summary for Pond C5: C5

[62] Hint: Exceeded Reach SS1 OUTLET depth by 2.81' @ 12.30 hrs

Inflow Area = 3.123 ac, 0.00% Impervious, Inflow Depth = 2.81" for 25-yr event
Inflow = 9.07 cfs @ 12.30 hrs, Volume= 0.731 af
Outflow = 9.07 cfs @ 12.30 hrs, Volume= 0.731 af, Atten= 0%, Lag= 0.0 min
Primary = 9.07 cfs @ 12.30 hrs, Volume= 0.731 af
Routed to Reach SS2 : South Swale 2

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 707.50' @ 12.30 hrs
Flood Elev= 708.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	704.38'	**18.0" Round Culvert** L= 38.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 704.38' / 704.25' S= 0.0034 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=9.07 cfs @ 12.30 hrs HW=707.50' (Free Discharge)
└─**1=Culvert** (Barrel Controls 9.07 cfs @ 5.13 fps)

Summary for Pond NP: North Pond

[62] Hint: Exceeded Reach NS3 OUTLET depth by 0.68' @ 14.15 hrs
[79] Warning: Submerged Pond C1 Primary device # 1 OUTLET by 1.67'
[79] Warning: Submerged Pond C1 Primary device # 2 OUTLET by 1.54'

Inflow Area = 92.527 ac, 11.98% Impervious, Inflow Depth > 2.86" for 25-yr event
Inflow = 184.24 cfs @ 12.33 hrs, Volume= 22.044 af
Outflow = 17.29 cfs @ 13.94 hrs, Volume= 21.803 af, Atten= 91%, Lag= 96.5 min
Primary = 17.29 cfs @ 13.94 hrs, Volume= 21.803 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Starting Elev= 681.75' Surf.Area= 2.820 ac Storage= 0.808 af
Peak Elev= 684.79' @ 13.94 hrs Surf.Area= 5.330 ac Storage= 13.287 af (12.479 af above start)

Plug-Flow detention time= 576.0 min calculated for 20.996 af (95% of inflow)
Center-of-Mass det. time= 457.3 min (1,385.6 - 928.3)

Volume	Invert	Avail.Storage	Storage Description
#1	681.46'	20.170 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
681.46	2.750	0.000	0.000
682.00	2.880	1.520	1.520
684.00	4.860	7.740	9.260
686.00	6.050	10.910	20.170

Device	Routing	Invert	Outlet Devices
#1	Primary	681.50'	**24.0" Round Culvert** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 681.50' / 681.00' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.14 sf
#2	Device 1	681.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	682.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	682.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#5	Device 1	683.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#6	Device 1	684.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#7	Secondary	685.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 1.00 Width (feet) 10.00 20.00 30.00

Primary OutFlow Max=17.29 cfs @ 13.94 hrs HW=684.79' (Free Discharge)
└─**1=Culvert** (Barrel Controls 17.29 cfs @ 5.51 fps)
  ├─**2=Orifice/Grate** (Passes < 6.32 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 5.72 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 5.06 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 4.30 cfs potential flow)
  └─**6=Orifice/Grate** (Passes < 21.65 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=681.75' (Free Discharge)
└─**7=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Pond SP: South Pond

Inflow Area = 7.788 ac, 39.79% Impervious, Inflow Depth = 3.40" for 25-yr event
Inflow = 34.99 cfs @ 12.09 hrs, Volume= 2.210 af
Outflow = 0.71 cfs @ 16.09 hrs, Volume= 1.991 af, Atten= 98%, Lag= 240.3 min
Primary = 0.71 cfs @ 16.09 hrs, Volume= 1.991 af
Routed to Reach S4 : Swale 4
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach S4 : Swale 4

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Starting Elev= 690.00' Surf.Area= 104,799 sf Storage= 563,180 cf
Peak Elev= 690.69' @ 16.09 hrs Surf.Area= 108,753 sf Storage= 636,660 cf (73,480 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 1,257.2 min (2,034.5 - 777.4)

Volume	Invert	Avail.Storage	Storage Description
#1	682.00'	1,159,218 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
682.00	4,661	0	0
683.00	34,274	19,468	19,468
684.00	54,009	44,142	63,609
685.00	67,049	60,529	124,138
686.00	76,841	71,945	196,083
687.00	84,846	80,844	276,927
688.00	92,571	88,709	365,635
689.00	98,860	95,716	461,351
690.00	104,799	101,830	563,180
691.00	110,544	107,672	670,852
692.00	116,064	113,304	784,156
693.00	121,865	118,965	903,120
694.00	127,659	124,762	1,027,882
695.00	135,013	131,336	1,159,218

Device	Routing	Invert	Outlet Devices
#1	Primary	690.00'	**12.0" Round Culvert** L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 690.00' / 689.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Secondary	692.00'	**10.0' long x 50.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Device 1	690.00'	**3.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	691.00'	**3.0" Vert. Orifice/Grate X 6.00** C= 0.600 Limited to weir flow at low heads
#5	Device 1	692.00'	**36.0" Horiz. Orifice/Grate** C= 0.600

Limited to weir flow at low heads

Primary OutFlow Max=0.71 cfs @ 16.09 hrs HW=690.69' (Free Discharge)
└─**1=Culvert** (Passes 0.71 cfs of 1.55 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.71 cfs @ 3.61 fps)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  └─**5=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=690.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link F1: Flume 1

Inflow Area = 1.695 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 4.95 cfs @ 12.25 hrs, Volume= 0.371 af
Primary = 4.95 cfs @ 12.25 hrs, Volume= 0.371 af, Atten= 0%, Lag= 0.0 min
Routed to Pond NP : North Pond

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F2: Flume 2

Inflow Area = 0.661 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 1.95 cfs @ 12.24 hrs, Volume= 0.145 af
Primary = 1.95 cfs @ 12.24 hrs, Volume= 0.145 af, Atten= 0%, Lag= 0.0 min
Routed to Reach NS3 : North Swale 3

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F3: Flume 3

Inflow Area = 0.867 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 2.54 cfs @ 12.24 hrs, Volume= 0.190 af
Primary = 2.54 cfs @ 12.24 hrs, Volume= 0.190 af, Atten= 0%, Lag= 0.0 min
Routed to Pond NP : North Pond

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F4: Flume 4

Inflow Area = 1.215 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 3.61 cfs @ 12.24 hrs, Volume= 0.266 af
Primary = 3.61 cfs @ 12.24 hrs, Volume= 0.266 af, Atten= 0%, Lag= 0.0 min
Routed to Reach NS2 : North Swale 2

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Time span=0.00-90.00 hrs, dt=0.01 hrs, 9001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Area 1 Runoff Area=28,521 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=347' Tc=15.8 min CN=79 Runoff=3.04 cfs 0.228 af

Subcatchment1_2: Phase 1 and 2 Runoff Area=2,282,700 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=3,476' Tc=25.0 min CN=79 Runoff=194.30 cfs 18.230 af

Subcatchment2: Area 2 Runoff Area=28,787 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=491' Tc=15.8 min CN=79 Runoff=3.07 cfs 0.230 af

Subcatchment3: Area 3 Runoff Area=45,292 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=449' Tc=16.3 min CN=79 Runoff=4.76 cfs 0.362 af

Subcatchment4: Area 4 Runoff Area=52,914 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=475' Tc=15.6 min CN=79 Runoff=5.69 cfs 0.423 af

Subcatchment5: Area 5 Runoff Area=37,768 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=442' Tc=15.9 min CN=79 Runoff=4.01 cfs 0.302 af

Subcatchment6: Area 6 Runoff Area=61,616 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=114' Slope=0.2500 '/' Tc=5.9 min CN=79 Runoff=9.46 cfs 0.492 af

Subcatchment7: Area 7 Runoff Area=81,807 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=200' Tc=12.4 min CN=79 Runoff=9.72 cfs 0.653 af

Subcatchment8: Area 8 Runoff Area=63,362 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=198' Tc=13.8 min CN=79 Runoff=7.18 cfs 0.506 af

Subcatchment9: Area 9 Runoff Area=48,089 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=133' Tc=6.0 min CN=79 Runoff=7.34 cfs 0.384 af

Subcatchment10: Area 10 Runoff Area=63,729 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=138' Tc=4.2 min CN=79 Runoff=10.44 cfs 0.509 af

Subcatchment11: Area 11 Runoff Area=10,561 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=98' Slope=0.0610 '/' Tc=10.0 min CN=79 Runoff=1.37 cfs 0.084 af

Subcatchment12a: Area 12a Runoff Area=98,996 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=180' Tc=14.4 min CN=79 Runoff=11.03 cfs 0.791 af

Subcatchment12b: Area 12b Runoff Area=47,686 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=204' Tc=14.2 min CN=79 Runoff=5.32 cfs 0.381 af

Subcatchment12c: Area 12c Runoff Area=5,888 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=19' Slope=0.0050 '/' Tc=5.0 min CN=79 Runoff=0.94 cfs 0.047 af

Subcatchment12d: Area 12d Runoff Area=1,651 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=23' Slope=0.0050 '/' Tc=8.5 min CN=79 Runoff=0.23 cfs 0.013 af

Subcatchment12e: Area 12e Runoff Area=4,957 sf 0.00% Impervious Runoff Depth=4.71"
Flow Length=47' Tc=4.1 min CN=84 Runoff=0.90 cfs 0.045 af

Subcatchment12f: Area 12f Runoff Area=9,031 sf 0.00% Impervious Runoff Depth=4.50"
Flow Length=52' Slope=0.0788 '/' Tc=5.4 min CN=82 Runoff=1.50 cfs 0.078 af

Subcatchment13: Area 13 Runoff Area=174,279 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=205' Tc=14.5 min CN=79 Runoff=19.29 cfs 1.392 af

Subcatchment14: Area 14 Runoff Area=59,877 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=125' Slope=0.2500 '/' Tc=5.9 min CN=79 Runoff=9.19 cfs 0.478 af

Subcatchment15a: Area 15a Runoff Area=99,614 sf 5.36% Impervious Runoff Depth=4.60"
Flow Length=58' Tc=3.3 min CN=83 Runoff=18.14 cfs 0.877 af

Subcatchment15b: Area 15b Runoff Area=11,056 sf 0.00% Impervious Runoff Depth=4.82"
Flow Length=33' Slope=0.1176 '/' Tc=2.4 min CN=85 Runoff=2.11 cfs 0.102 af

Subcatchment15c: Area 15c Runoff Area=9,032 sf 0.00% Impervious Runoff Depth=4.50"
Flow Length=1,656' Tc=7.2 min CN=82 Runoff=1.40 cfs 0.078 af

Subcatchment16a: Area 16a Runoff Area=37,043 sf 0.00% Impervious Runoff Depth=4.93"
Flow Length=50' Tc=5.6 min CN=86 Runoff=6.55 cfs 0.350 af

Subcatchment16b: Area 16b Runoff Area=23,150 sf 0.00% Impervious Runoff Depth=4.82"
Flow Length=78' Tc=1.8 min CN=85 Runoff=4.47 cfs 0.214 af

Subcatchment16c: Area 16c Runoff Area=22,754 sf 0.00% Impervious Runoff Depth=4.60"
Flow Length=54' Tc=3.0 min CN=83 Runoff=4.18 cfs 0.200 af

Subcatchment16d: Area 16d Runoff Area=7,112 sf 0.00% Impervious Runoff Depth=4.60"
Flow Length=65' Tc=4.2 min CN=83 Runoff=1.26 cfs 0.063 af

Subcatchment16e: Area 16e Runoff Area=11,038 sf 0.00% Impervious Runoff Depth=4.50"
Flow Length=75' Tc=4.7 min CN=82 Runoff=1.88 cfs 0.095 af

Subcatchment16f: Area 16f Runoff Area=19,413 sf 0.00% Impervious Runoff Depth=4.60"
Flow Length=75' Tc=4.7 min CN=83 Runoff=3.37 cfs 0.171 af

Subcatchment17: Area 17 Runoff Area=18,834 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=140' Slope=0.2500 '/' Tc=6.0 min CN=79 Runoff=2.88 cfs 0.150 af

Subcatchment18: Area 18 Runoff Area=20,237 sf 0.00% Impervious Runoff Depth=4.28"
Flow Length=55' Slope=0.0714 '/' Tc=5.9 min CN=80 Runoff=3.17 cfs 0.166 af

Subcatchment19: Area 19 Runoff Area=5,416 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=141' Slope=0.2500 '/' Tc=6.0 min CN=79 Runoff=0.83 cfs 0.043 af

Subcatchment20: Area 20 Runoff Area=53,255 sf 0.00% Impervious Runoff Depth=4.28"
Flow Length=100' Slope=0.0050 '/' Tc=2.3 min CN=80 Runoff=9.34 cfs 0.436 af

Subcatchment21: Area 21 Runoff Area=7,329 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=62' Slope=0.0758 '/' Tc=6.4 min CN=79 Runoff=1.10 cfs 0.059 af

SubcatchmentP1: North Pond Runoff Area=342,674 sf 100.00% Impervious Runoff Depth=6.31"
Tc=0.0 min CN=98 Runoff=74.56 cfs 4.137 af

SubcatchmentP2: South Pond Runoff Area=3.099 ac 100.00% Impervious Runoff Depth=6.31"
Tc=0.0 min CN=98 Runoff=29.37 cfs 1.630 af

Reach NS1: North Swale 1 Avg. Flow Depth=0.54' Max Vel=4.27 fps Inflow=30.98 cfs 2.269 af
n=0.030 L=1,043.0' S=0.0209 '/' Capacity=302.62 cfs Outflow=27.37 cfs 2.269 af

Reach NS2: North Swale 2 Avg. Flow Depth=0.77' Max Vel=3.89 fps Inflow=38.55 cfs 3.272 af
n=0.030 L=381.0' S=0.0115 '/' Capacity=224.48 cfs Outflow=38.05 cfs 3.272 af

Reach NS3: North Swale 3 Avg. Flow Depth=0.71' Max Vel=4.82 fps Inflow=43.03 cfs 3.730 af
n=0.030 L=195.0' S=0.0193 '/' Capacity=290.78 cfs Outflow=42.94 cfs 3.730 af

Reach S1: Swale 1 Avg. Flow Depth=0.44' Max Vel=2.52 fps Inflow=9.46 cfs 0.492 af
n=0.030 L=423.0' S=0.0118 '/' Capacity=45.58 cfs Outflow=8.69 cfs 0.492 af

Reach S2: Swale 2 Avg. Flow Depth=0.38' Max Vel=2.40 fps Inflow=7.34 cfs 0.384 af
n=0.030 L=320.0' S=0.0125 '/' Capacity=46.88 cfs Outflow=6.93 cfs 0.384 af

Reach S3: Swale 3 Avg. Flow Depth=0.62' Max Vel=3.65 fps Inflow=15.56 cfs 0.876 af
n=0.030 L=68.7' S=0.0146 '/' Capacity=37.92 cfs Outflow=15.50 cfs 0.876 af

Reach S4: Swale 4 Avg. Flow Depth=0.18' Max Vel=0.86 fps Inflow=1.76 cfs 3.043 af
n=0.030 L=125.0' S=0.0032 '/' Capacity=123.75 cfs Outflow=1.70 cfs 3.042 af

Reach SS1: South Swale 1 Avg. Flow Depth=0.42' Max Vel=3.00 fps Inflow=15.12 cfs 1.140 af
n=0.030 L=686.0' S=0.0140 '/' Capacity=247.65 cfs Outflow=14.25 cfs 1.140 af

Reach SS2: South Swale 2 Avg. Flow Depth=0.50' Max Vel=3.42 fps Inflow=20.30 cfs 1.735 af
n=0.030 L=327.0' S=0.0146 '/' Capacity=253.11 cfs Outflow=20.14 cfs 1.735 af

Reach SS3: South Swale 3 Avg. Flow Depth=0.59' Max Vel=2.99 fps Inflow=21.38 cfs 1.982 af
n=0.030 L=320.0' S=0.0093 '/' Capacity=201.47 cfs Outflow=21.21 cfs 1.982 af

Reach SS4: South Swale 4 Avg. Flow Depth=0.35' Max Vel=5.57 fps Inflow=21.57 cfs 2.058 af
n=0.030 L=114.0' S=0.0605 '/' Capacity=514.50 cfs Outflow=21.56 cfs 2.058 af

Reach SS5: South Swale 5 Avg. Flow Depth=0.85' Max Vel=2.10 fps Inflow=23.33 cfs 5.240 af
n=0.030 L=140.0' S=0.0030 '/' Capacity=114.55 cfs Outflow=23.26 cfs 5.239 af

Reach SS6: South Swale 6 Avg. Flow Depth=0.94' Max Vel=2.22 fps Inflow=28.72 cfs 5.924 af
n=0.030 L=215.0' S=0.0030 '/' Capacity=114.10 cfs Outflow=27.71 cfs 5.922 af

Pond C1: Culvert C1a & b Peak Elev=689.43' Inflow=27.71 cfs 5.922 af
Outflow=27.71 cfs 5.922 af

Pond C2: C2 Peak Elev=692.47' Inflow=24.86 cfs 5.675 af
24.0" Round Culvert n=0.012 L=46.0' S=0.0030 '/' Outflow=24.86 cfs 5.675 af

Pond C3: C3 Peak Elev=701.99' Inflow=9.34 cfs 0.436 af
12.0" Round Culvert n=0.012 L=48.0' S=0.0146 '/' Outflow=9.34 cfs 0.436 af

Pond C4: C4 Peak Elev=702.74' Inflow=20.14 cfs 1.735 af
24.0" Round Culvert n=0.013 L=40.5' S=0.0121 '/' Outflow=20.14 cfs 1.735 af

Pond C5: C5 Peak Elev=710.06' Inflow=14.25 cfs 1.140 af
18.0" Round Culvert n=0.025 L=38.0' S=0.0034 '/' Outflow=14.25 cfs 1.140 af

Pond NP: North Pond Peak Elev=685.75' Storage=18.653 af Inflow=290.58 cfs 34.113 af
Primary=21.42 cfs 28.517 af Secondary=33.72 cfs 5.301 af Outflow=55.14 cfs 33.818 af

Pond SP: South Pond Peak Elev=691.03' Storage=674,066 cf Inflow=51.38 cfs 3.265 af
Primary=0.93 cfs 2.985 af Secondary=0.00 cfs 0.000 af Outflow=0.93 cfs 2.985 af

Link F1: Flume 1 Inflow=7.80 cfs 0.589 af
Primary=7.80 cfs 0.589 af

Link F2: Flume 2 Inflow=3.07 cfs 0.230 af
Primary=3.07 cfs 0.230 af

Link F3: Flume 3 Inflow=4.01 cfs 0.302 af
Primary=4.01 cfs 0.302 af

Link F4: Flume 4 Inflow=5.69 cfs 0.423 af
Primary=5.69 cfs 0.423 af

Total Runoff Area = 92.527 ac Runoff Volume = 34.397 af Average Runoff Depth = 4.46"
88.02% Pervious = 81.438 ac 11.98% Impervious = 11.088 ac

Summary for Subcatchment 1: Area 1

Runoff = 3.04 cfs @ 12.24 hrs, Volume= 0.228 af, Depth= 4.17"
Routed to Link F1 : Flume 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	28,521	79	
	28,521		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.5	106	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	141	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.8	347	Total			

Summary for Subcatchment 1_2: Phase 1 and 2

Runoff = 194.30 cfs @ 12.36 hrs, Volume= 18.230 af, Depth= 4.17"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	2,282,700	79	Closed Landfill
	2,282,700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0400	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.8	400	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.2	2,976	0.0120	6.04	380.82	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=3.00' Z= 10.0 & 4.0 '/' Top.W=42.00' n= 0.035 Earth, dense weeds
25.0	3,476	Total			

Summary for Subcatchment 2: Area 2

Runoff = 3.07 cfs @ 12.24 hrs, Volume= 0.230 af, Depth= 4.17"
Routed to Link F2 : Flume 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	28,787	79	
	28,787		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	78	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	203	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	110	0.2500	20.09	10.95	**Pipe Channel,** 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
15.8	491	Total			

Summary for Subcatchment 3: Area 3

Runoff = 4.76 cfs @ 12.24 hrs, Volume= 0.362 af, Depth= 4.17"
Routed to Link F1 : Flume 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	45,292	79	
	45,292		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.5	108	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	241	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.3	449	Total			

Summary for Subcatchment 4: Area 4

Runoff = 5.69 cfs @ 12.24 hrs, Volume= 0.423 af, Depth= 4.17"
Routed to Link F4 : Flume 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	52,914	79	
	52,914		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	83	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	173	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	119	0.2500	22.68	17.81	**Pipe Channel, Flume 4** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
15.6	475	Total			

Summary for Subcatchment 5: Area 5

Runoff = 4.01 cfs @ 12.24 hrs, Volume= 0.302 af, Depth= 4.17"
Routed to Link F3 : Flume 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	37,768	79	
	37,768		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.0	73	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	269	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Diversion Berm** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.9	442	Total			

Summary for Subcatchment 6: Area 6

Runoff = 9.46 cfs @ 12.13 hrs, Volume= 0.492 af, Depth= 4.17"
Routed to Reach S1 : Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	61,616	79	
	61,616		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.1	14	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.9	114	Total			

Summary for Subcatchment 7: Area 7

Runoff = 9.72 cfs @ 12.20 hrs, Volume= 0.653 af, Depth= 4.17"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	81,807	79	
	81,807		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	63	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.6	37	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	100	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.4	200	Total			

Summary for Subcatchment 8: Area 8

Runoff = 7.18 cfs @ 12.22 hrs, Volume= 0.506 af, Depth= 4.17"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	62,504	79	
	858	96	Gravel surface, HSG C
	63,362	79	Weighted Average
	63,362		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	91	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	9	0.2500	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	98	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.8	198	Total			

Summary for Subcatchment 9: Area 9

Runoff = 7.34 cfs @ 12.13 hrs, Volume= 0.384 af, Depth= 4.17"
Routed to Reach S2 : Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	48,089	79	
	48,089		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.0	5	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	28	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.0	133	Total			

Summary for Subcatchment 10: Area 10

Runoff = 10.44 cfs @ 12.12 hrs, Volume= 0.509 af, Depth= 4.17"
Routed to Pond SP : South Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	63,729	79	
	63,729		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	100	0.2500	0.42		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
0.1	19	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	19	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.2	138	Total			

Summary for Subcatchment 11: Area 11

Runoff = 1.37 cfs @ 12.17 hrs, Volume= 0.084 af, Depth= 4.17"
Routed to Pond SP : South Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	10,561	79	
	10,561		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	98	0.0610	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment 12a: Area 12a

Runoff = 11.03 cfs @ 12.22 hrs, Volume= 0.791 af, Depth= 4.17"
Routed to Reach SS1 : South Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	98,996	79	
	98,996		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	57	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.4	180	Total			

Summary for Subcatchment 12b: Area 12b

Runoff = 5.32 cfs @ 12.22 hrs, Volume= 0.381 af, Depth= 4.17"
Routed to Reach SS2 : South Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	47,328	79	
	358	96	Gravel surface, HSG C
	47,686	79	Weighted Average
	47,686		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.3	24	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	57	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.3333	4.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.2	204	Total			

Summary for Subcatchment 12c: Area 12c

Runoff = 0.94 cfs @ 12.12 hrs, Volume= 0.047 af, Depth= 4.17"
Routed to Reach SS3 : South Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	5,888	79	
	5,888		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	19	0.0050	0.06		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"

Summary for Subcatchment 12d: Area 12d

Runoff = 0.23 cfs @ 12.16 hrs, Volume= 0.013 af, Depth= 4.17"
Routed to Reach SS4 : South Swale 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	1,651	79	
	1,651		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	23	0.0050	0.04		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment 12e: Area 12e

Runoff = 0.90 cfs @ 12.12 hrs, Volume= 0.045 af, Depth= 4.71"
Routed to Reach SS5 : South Swale 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	3,521	79	
	1,436	96	Gravel surface, HSG C
	4,957	84	Weighted Average
	4,957		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	9	0.0050	0.44		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
3.8	38	0.0400	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
4.1	47	Total			

Summary for Subcatchment 12f: Area 12f

Runoff = 1.50 cfs @ 12.13 hrs, Volume= 0.078 af, Depth= 4.50"
Routed to Reach SS6 : South Swale 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	7,374	79	
	1,657	96	Gravel surface, HSG C
	9,031	82	Weighted Average
	9,031		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	52	0.0788	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment 13: Area 13

Runoff = 19.29 cfs @ 12.23 hrs, Volume= 1.392 af, Depth= 4.17"
Routed to Reach NS1 : North Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	174,279	79	
	174,279		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	56	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	49	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.5	205	Total			

Summary for Subcatchment 14: Area 14

Runoff = 9.19 cfs @ 12.13 hrs, Volume= 0.478 af, Depth= 4.17"
Routed to Reach NS2 : North Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	59,877	79	
	59,877		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.1	25	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.9	125	Total			

Summary for Subcatchment 15a: Area 15a

Runoff = 18.14 cfs @ 12.11 hrs, Volume= 0.877 af, Depth= 4.60"
Routed to Reach NS1 : North Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	78,118	79	
	5,343	98	Paved roads w/curbs & sewers, HSG C
	16,153	96	Gravel surface, HSG C
	99,614	83	Weighted Average
	94,271		94.64% Pervious Area
	5,343		5.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	32	0.0050	0.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
2.4	26	0.1538	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
3.3	58	Total			

Summary for Subcatchment 15b: Area 15b

Runoff = 2.11 cfs @ 12.10 hrs, Volume= 0.102 af, Depth= 4.82"
Routed to Reach NS2 : North Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	7,026	79	
	4,030	96	Gravel surface, HSG C
	11,056	85	Weighted Average
	11,056		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.1176	1.62		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
2.3	22	0.1176	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.4	33	Total			

Summary for Subcatchment 15c: Area 15c

Runoff = 1.40 cfs @ 12.14 hrs, Volume= 0.078 af, Depth= 4.50"
Routed to Reach NS3 : North Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	7,178	79	
	1,854	96	Gravel surface, HSG C
	9,032	82	Weighted Average
	9,032		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	14	0.1250	1.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
4.4	50	0.1250	0.19		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.7	1,592	0.0167	9.92	610.36	**Trap/Vee/Rect Channel Flow,** Bot.W=10.00' D=3.00' Z= 4.0 & 3.0 '/' Top.W=31.00' n= 0.030 Earth, grassed & winding
7.2	1,656	Total			

Summary for Subcatchment 16a: Area 16a

Runoff = 6.55 cfs @ 12.13 hrs, Volume= 0.350 af, Depth= 4.93"
Routed to Reach SS1 : South Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	20,948	79	
	16,095	96	Gravel surface, HSG C
	37,043	86	Weighted Average
	37,043		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	13	0.0050	0.06		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
0.7	21	0.0050	0.52		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.2	16	0.3300	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
5.6	50	Total			

Summary for Subcatchment 16b: Area 16b

Runoff = 4.47 cfs @ 12.10 hrs, Volume= 0.214 af, Depth= 4.82"
Routed to Reach SS2 : South Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	14,694	79	
	8,456	96	Gravel surface, HSG C
	23,150	85	Weighted Average
	23,150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	64	0.0450	1.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.1	14	0.3333	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.8	78	Total			

Summary for Subcatchment 16c: Area 16c

Runoff = 4.18 cfs @ 12.11 hrs, Volume= 0.200 af, Depth= 4.60"
Routed to Reach SS3 : South Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	17,622	79	
	5,132	96	Gravel surface, HSG C
	22,754	83	Weighted Average
	22,754		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	24	0.2500	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	7	0.1666	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.1	18	0.1667	2.05		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
0.3	5	0.3333	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
3.0	54	Total			

Summary for Subcatchment 16d: Area 16d

Runoff = 1.26 cfs @ 12.12 hrs, Volume= 0.063 af, Depth= 4.60"
Routed to Reach SS4 : South Swale 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	5,564	79	
	1,548	96	Gravel surface, HSG C
	7,112	83	Weighted Average
	7,112		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	38	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	14	0.0050	0.48		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.0	13	0.3300	0.21		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.2	65	Total			

Summary for Subcatchment 16e: Area 16e

Runoff = 1.88 cfs @ 12.12 hrs, Volume= 0.095 af, Depth= 4.50"
Routed to Reach SS5 : South Swale 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	8,772	79	
	2,266	96	Gravel surface, HSG C
	11,038	82	Weighted Average
	11,038		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	43	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	16	0.0050	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.3	16	0.2500	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.7	75	Total			

Summary for Subcatchment 16f: Area 16f

Runoff = 3.37 cfs @ 12.12 hrs, Volume= 0.171 af, Depth= 4.60"
Routed to Reach SS6 : South Swale 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	14,568	79	
	4,845	96	Gravel surface, HSG C
	19,413	83	Weighted Average
	19,413		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	43	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	16	0.0050	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.3	16	0.2500	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.7	75	Total			

Summary for Subcatchment 17: Area 17

Runoff = 2.88 cfs @ 12.13 hrs, Volume= 0.150 af, Depth= 4.17"
Routed to Reach NS3 : North Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	18,834	79	
	18,834		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.2	40	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.0	140	Total			

Summary for Subcatchment 18: Area 18

Runoff = 3.17 cfs @ 12.13 hrs, Volume= 0.166 af, Depth= 4.28"
Routed to Pond SP : South Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	19,430	79	
	807	96	Gravel surface, HSG C
	20,237	80	Weighted Average
	20,237		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	55	0.0714	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment 19: Area 19

Runoff = 0.83 cfs @ 12.13 hrs, Volume= 0.043 af, Depth= 4.17"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	5,416	79	
	5,416		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.2	41	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.0	141	Total			

Summary for Subcatchment 20: Area 20

Runoff = 9.34 cfs @ 12.10 hrs, Volume= 0.436 af, Depth= 4.28"
Routed to Pond C3 : C3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	50,854	79	
	2,401	96	Gravel surface, HSG C
	53,255	80	Weighted Average
	53,255		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	100	0.0050	0.71		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"

Summary for Subcatchment 21: Area 21

Runoff = 1.10 cfs @ 12.14 hrs, Volume= 0.059 af, Depth= 4.17"
Routed to Reach S4 : Swale 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	7,177	79	
	152	96	Gravel surface, HSG C
	7,329	79	Weighted Average
	7,329		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	62	0.0758	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"

Summary for Subcatchment P1: North Pond

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 74.56 cfs @ 12.09 hrs, Volume= 4.137 af, Depth= 6.31"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

Area (sf)	CN	Description
342,674	98	Water Surface
342,674		100.00% Impervious Area

Summary for Subcatchment P2: South Pond

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 29.37 cfs @ 12.09 hrs, Volume= 1.630 af, Depth= 6.31"
Routed to Pond SP : South Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

Area (ac)	CN	Description
3.099	98	Water Surface, HSG C
3.099		100.00% Impervious Area

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

Summary for Reach NS1: North Swale 1

Inflow Area = 6.288 ac, 1.95% Impervious, Inflow Depth = 4.33" for 100-yr event
Inflow = 30.98 cfs @ 12.12 hrs, Volume= 2.269 af
Outflow = 27.37 cfs @ 12.22 hrs, Volume= 2.269 af, Atten= 12%, Lag= 5.9 min
Routed to Reach NS2 : North Swale 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.27 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 1.04 fps, Avg. Travel Time= 16.7 min

Peak Storage= 6,688 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.54' , Surface Width= 13.78'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 302.62 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 1,043.0' Slope= 0.0209 '/'
Inlet Invert= 714.00', Outlet Invert= 692.16'

‡

Summary for Reach NS2: North Swale 2

[62] Hint: Exceeded Reach NS1 OUTLET depth by 0.25' @ 12.23 hrs

Inflow Area = 9.131 ac, 1.34% Impervious, Inflow Depth = 4.30" for 100-yr event
Inflow = 38.55 cfs @ 12.21 hrs, Volume= 3.272 af
Outflow = 38.05 cfs @ 12.25 hrs, Volume= 3.272 af, Atten= 1%, Lag= 2.7 min
Routed to Reach NS3 : North Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.89 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.93 fps, Avg. Travel Time= 6.8 min

Peak Storage= 3,726 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.77' , Surface Width= 15.39'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 224.48 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 381.0' Slope= 0.0115 '/'
Inlet Invert= 692.16', Outlet Invert= 687.77'

‡

Summary for Reach NS3: North Swale 3

[61] Hint: Exceeded Reach NS2 outlet invert by 0.71' @ 12.25 hrs

Inflow Area = 10.431 ac, 1.18% Impervious, Inflow Depth = 4.29" for 100-yr event
Inflow = 43.03 cfs @ 12.25 hrs, Volume= 3.730 af
Outflow = 42.94 cfs @ 12.27 hrs, Volume= 3.730 af, Atten= 0%, Lag= 1.1 min
Routed to Pond NP : North Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.82 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.16 fps, Avg. Travel Time= 2.8 min

Peak Storage= 1,736 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.71' , Surface Width= 14.99'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 290.78 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 195.0' Slope= 0.0193 '/'
Inlet Invert= 687.77', Outlet Invert= 684.00'

‡

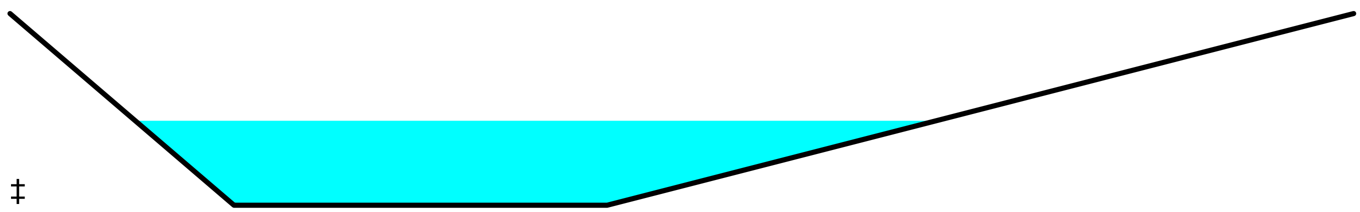
Summary for Reach S1: Swale 1

Inflow Area = 1.415 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 9.46 cfs @ 12.13 hrs, Volume= 0.492 af
Outflow = 8.69 cfs @ 12.20 hrs, Volume= 0.492 af, Atten= 8%, Lag= 4.3 min
Routed to Reach S3 : Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.52 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 0.62 fps, Avg. Travel Time= 11.4 min

Peak Storage= 1,463 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.44' , Surface Width= 10.72'
Bank-Full Depth= 1.00' Flow Area= 11.5 sf, Capacity= 45.58 cfs

5.00' x 1.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 3.0 10.0 '/' Top Width= 18.00'
Length= 423.0' Slope= 0.0118 '/'
Inlet Invert= 700.00', Outlet Invert= 695.00'



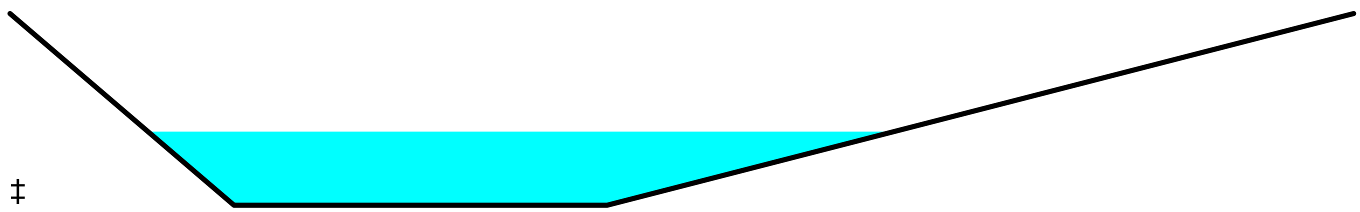
Summary for Reach S2: Swale 2

Inflow Area = 1.104 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 7.34 cfs @ 12.13 hrs, Volume= 0.384 af
Outflow = 6.93 cfs @ 12.19 hrs, Volume= 0.384 af, Atten= 6%, Lag= 3.5 min
Routed to Reach S3 : Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.40 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 0.59 fps, Avg. Travel Time= 9.0 min

Peak Storage= 923 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.38' , Surface Width= 10.00'
Bank-Full Depth= 1.00' Flow Area= 11.5 sf, Capacity= 46.88 cfs

5.00' x 1.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 3.0 10.0 '/' Top Width= 18.00'
Length= 320.0' Slope= 0.0125 '/'
Inlet Invert= 699.00', Outlet Invert= 695.00'



Summary for Reach S3: Swale 3

[62] Hint: Exceeded Reach S1 OUTLET depth by 0.23' @ 12.22 hrs
[62] Hint: Exceeded Reach S2 OUTLET depth by 0.29' @ 12.22 hrs

Inflow Area = 2.518 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 15.56 cfs @ 12.20 hrs, Volume= 0.876 af
Outflow = 15.50 cfs @ 12.21 hrs, Volume= 0.876 af, Atten= 0%, Lag= 0.5 min
Routed to Pond SP : South Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.65 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.83 fps, Avg. Travel Time= 1.4 min

Peak Storage= 292 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.62' , Surface Width= 8.72'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 37.92 cfs

5.00' x 1.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 68.7' Slope= 0.0146 '/'
Inlet Invert= 695.00', Outlet Invert= 694.00'

‡

Summary for Reach S4: Swale 4

[79] Warning: Submerged Pond SP Primary device # 1 OUTLET by 0.18'

Inflow Area = 7.956 ac, 38.95% Impervious, Inflow Depth > 4.59" for 100-yr event
Inflow = 1.76 cfs @ 12.14 hrs, Volume= 3.043 af
Outflow = 1.70 cfs @ 12.20 hrs, Volume= 3.042 af, Atten= 3%, Lag= 3.7 min
Routed to Reach SS5 : South Swale 5

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.86 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 0.47 fps, Avg. Travel Time= 4.5 min

Peak Storage= 246 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.18' , Surface Width= 11.47'
Bank-Full Depth= 2.00' Flow Area= 36.0 sf, Capacity= 123.75 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 4.0 '/' Top Width= 26.00'
Length= 125.0' Slope= 0.0032 '/'
Inlet Invert= 689.50', Outlet Invert= 689.10'

‡ 

Summary for Reach SS1: South Swale 1

Inflow Area = 3.123 ac, 0.00% Impervious, Inflow Depth = 4.38" for 100-yr event
Inflow = 15.12 cfs @ 12.16 hrs, Volume= 1.140 af
Outflow = 14.25 cfs @ 12.28 hrs, Volume= 1.140 af, Atten= 6%, Lag= 7.3 min
Routed to Pond C5 : C5

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.00 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 15.6 min

Peak Storage= 3,263 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.42' , Surface Width= 12.91'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 247.65 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 686.0' Slope= 0.0140 '/'
Inlet Invert= 714.00', Outlet Invert= 704.38'

Summary for Reach SS2: South Swale 2

[79] Warning: Submerged Pond C5 Primary device # 1 INLET by 0.37'

Inflow Area = 4.749 ac, 0.00% Impervious, Inflow Depth = 4.38" for 100-yr event
Inflow = 20.30 cfs @ 12.26 hrs, Volume= 1.735 af
Outflow = 20.14 cfs @ 12.30 hrs, Volume= 1.735 af, Atten= 1%, Lag= 2.7 min
Routed to Pond C4 : C4

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.42 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.85 fps, Avg. Travel Time= 6.4 min

Peak Storage= 1,925 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.50' , Surface Width= 13.51'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 253.11 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 327.0' Slope= 0.0146 '/'
Inlet Invert= 704.25', Outlet Invert= 699.46'

Summary for Reach SS3: South Swale 3

[79] Warning: Submerged Pond C4 Primary device # 1 INLET by 0.10'

Inflow Area = 5.407 ac, 0.00% Impervious, Inflow Depth = 4.40" for 100-yr event
Inflow = 21.38 cfs @ 12.30 hrs, Volume= 1.982 af
Outflow = 21.21 cfs @ 12.35 hrs, Volume= 1.982 af, Atten= 1%, Lag= 3.0 min
Routed to Reach SS4 : South Swale 4

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.99 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 7.1 min

Peak Storage= 2,269 cf @ 12.32 hrs
Average Depth at Peak Storage= 0.59' , Surface Width= 14.12'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 201.47 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 320.0' Slope= 0.0093 '/'
Inlet Invert= 698.97', Outlet Invert= 696.00'

‡

Summary for Reach SS4: South Swale 4

[61] Hint: Exceeded Reach SS3 outlet invert by 0.35' @ 12.35 hrs

Inflow Area = 5.608 ac, 0.00% Impervious, Inflow Depth = 4.40" for 100-yr event
Inflow = 21.57 cfs @ 12.35 hrs, Volume= 2.058 af
Outflow = 21.56 cfs @ 12.36 hrs, Volume= 2.058 af, Atten= 0%, Lag= 0.6 min
Routed to Reach SS5 : South Swale 5

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.57 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.46 fps, Avg. Travel Time= 1.3 min

Peak Storage= 441 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.35' , Surface Width= 12.42'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 514.50 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 114.0' Slope= 0.0605 '/'
Inlet Invert= 696.00', Outlet Invert= 689.10'

‡

Summary for Reach SS5: South Swale 5

[63] Warning: Exceeded Reach S4 INLET depth by 0.31' @ 12.37 hrs
[62] Hint: Exceeded Reach SS4 OUTLET depth by 0.51' @ 12.38 hrs

Inflow Area = 13.931 ac, 22.25% Impervious, Inflow Depth > 4.51" for 100-yr event
Inflow = 23.33 cfs @ 12.35 hrs, Volume= 5.240 af
Outflow = 23.26 cfs @ 12.38 hrs, Volume= 5.239 af, Atten= 0%, Lag= 1.9 min
Routed to Pond C2 : C2

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.10 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.51 fps, Avg. Travel Time= 4.6 min

Peak Storage= 1,548 cf @ 12.36 hrs
Average Depth at Peak Storage= 0.85' , Surface Width= 15.96'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 114.55 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 140.0' Slope= 0.0030 '/'
Inlet Invert= 689.10', Outlet Invert= 688.68'

Summary for Reach SS6: South Swale 6

[79] Warning: Submerged Pond C2 Primary device # 1 INLET by 0.80'

Inflow Area = 15.806 ac, 19.61% Impervious, Inflow Depth > 4.50" for 100-yr event
Inflow = 28.72 cfs @ 12.12 hrs, Volume= 5.924 af
Outflow = 27.71 cfs @ 12.16 hrs, Volume= 5.922 af, Atten= 4%, Lag= 2.6 min
Routed to Pond C1 : Culvert C1a & b

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.22 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 6.9 min

Peak Storage= 2,693 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.94' , Surface Width= 16.59'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 114.10 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 215.0' Slope= 0.0030 '/'
Inlet Invert= 688.54', Outlet Invert= 687.90'

Summary for Pond C1: Culvert C1a & b

[62] Hint: Exceeded Reach SS6 OUTLET depth by 0.60' @ 12.16 hrs

Inflow Area = 15.806 ac, 19.61% Impervious, Inflow Depth > 4.50" for 100-yr event
Inflow = 27.71 cfs @ 12.16 hrs, Volume= 5.922 af
Outflow = 27.71 cfs @ 12.16 hrs, Volume= 5.922 af, Atten= 0%, Lag= 0.0 min
Primary = 27.71 cfs @ 12.16 hrs, Volume= 5.922 af
Routed to Pond NP : North Pond

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 689.43' @ 12.16 hrs
Flood Elev= 691.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	687.71'	**24.0" Round C1a** L= 341.7' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 687.71' / 683.12' S= 0.0134 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	687.47'	**24.0" Round C1b** L= 341.6' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 687.47' / 683.25' S= 0.0124 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=27.71 cfs @ 12.16 hrs HW=689.43' (Free Discharge)
1=C1a (Inlet Controls 12.82 cfs @ 4.46 fps)
2=C1b (Inlet Controls 14.89 cfs @ 4.76 fps)

Summary for Pond C2: C2

[63] Warning: Exceeded Reach SS5 INLET depth by 2.52' @ 12.38 hrs
[79] Warning: Submerged Pond C3 Primary device # 1 INLET by 0.76'

Inflow Area = 15.153 ac, 20.45% Impervious, Inflow Depth > 4.49" for 100-yr event
Inflow = 24.86 cfs @ 12.38 hrs, Volume= 5.675 af
Outflow = 24.86 cfs @ 12.38 hrs, Volume= 5.675 af, Atten= 0%, Lag= 0.0 min
Primary = 24.86 cfs @ 12.38 hrs, Volume= 5.675 af
Routed to Reach SS6 : South Swale 6

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 692.47' @ 12.38 hrs
Flood Elev= 694.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	688.68'	**24.0" Round Culvert** L= 46.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 688.68' / 688.54' S= 0.0030 '/' Cc= 0.900 n= 0.012 Steel, smooth, Flow Area= 3.14 sf

Primary OutFlow Max=24.85 cfs @ 12.38 hrs HW=692.47' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 24.85 cfs @ 7.91 fps)

Summary for Pond C3: C3

[58] Hint: Peaked 7.99' above defined flood level

Inflow Area = 1.223 ac, 0.00% Impervious, Inflow Depth = 4.28" for 100-yr event
Inflow = 9.34 cfs @ 12.10 hrs, Volume= 0.436 af
Outflow = 9.34 cfs @ 12.10 hrs, Volume= 0.436 af, Atten= 0%, Lag= 0.0 min
Primary = 9.34 cfs @ 12.10 hrs, Volume= 0.436 af
Routed to Pond C2 : C2

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 701.99' @ 12.10 hrs
Flood Elev= 694.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	691.71'	**12.0" Round Culvert** L= 48.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 691.71' / 691.01' S= 0.0146 '/' Cc= 0.900 n= 0.012 Steel, smooth, Flow Area= 0.79 sf

Primary OutFlow Max=9.33 cfs @ 12.10 hrs HW=701.97' (Free Discharge)
└—**1=Culvert** (Inlet Controls 9.33 cfs @ 11.88 fps)

Summary for Pond C4: C4

[58] Hint: Peaked 0.74' above defined flood level
[62] Hint: Exceeded Reach SS2 OUTLET depth by 2.78' @ 12.30 hrs

Inflow Area = 4.749 ac, 0.00% Impervious, Inflow Depth = 4.38" for 100-yr event
Inflow = 20.14 cfs @ 12.30 hrs, Volume= 1.735 af
Outflow = 20.14 cfs @ 12.30 hrs, Volume= 1.735 af, Atten= 0%, Lag= 0.0 min
Primary = 20.14 cfs @ 12.30 hrs, Volume= 1.735 af
Routed to Reach SS3 : South Swale 3

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 702.74' @ 12.30 hrs
Flood Elev= 702.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	699.46'	**24.0" Round Culvert** L= 40.5' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 699.46' / 698.97' S= 0.0121 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=20.14 cfs @ 12.30 hrs HW=702.74' (Free Discharge)
1=Culvert (Inlet Controls 20.14 cfs @ 6.41 fps)

Summary for Pond C5: C5

[58] Hint: Peaked 2.06' above defined flood level
[62] Hint: Exceeded Reach SS1 OUTLET depth by 5.28' @ 12.28 hrs

Inflow Area = 3.123 ac, 0.00% Impervious, Inflow Depth = 4.38" for 100-yr event
Inflow = 14.25 cfs @ 12.28 hrs, Volume= 1.140 af
Outflow = 14.25 cfs @ 12.28 hrs, Volume= 1.140 af, Atten= 0%, Lag= 0.0 min
Primary = 14.25 cfs @ 12.28 hrs, Volume= 1.140 af
Routed to Reach SS2 : South Swale 2

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 710.06' @ 12.28 hrs
Flood Elev= 708.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	704.38'	**18.0" Round Culvert** L= 38.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 704.38' / 704.25' S= 0.0034 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=14.24 cfs @ 12.28 hrs HW=710.06' (Free Discharge)
↑**1=Culvert** (Barrel Controls 14.24 cfs @ 8.06 fps)

Summary for Pond NP: North Pond

[62] Hint: Exceeded Reach NS3 OUTLET depth by 1.52' @ 13.34 hrs
[79] Warning: Submerged Pond C1 Primary device # 1 OUTLET by 2.63'
[79] Warning: Submerged Pond C1 Primary device # 2 OUTLET by 2.50'

Inflow Area = 92.527 ac, 11.98% Impervious, Inflow Depth > 4.42" for 100-yr event
Inflow = 290.58 cfs @ 12.29 hrs, Volume= 34.113 af
Outflow = 55.14 cfs @ 13.18 hrs, Volume= 33.818 af, Atten= 81%, Lag= 53.1 min
Primary = 21.42 cfs @ 13.18 hrs, Volume= 28.517 af
Secondary = 33.72 cfs @ 13.18 hrs, Volume= 5.301 af

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Starting Elev= 681.75' Surf.Area= 2.820 ac Storage= 0.808 af
Peak Elev= 685.75' @ 13.18 hrs Surf.Area= 5.899 ac Storage= 18.653 af (17.845 af above start)

Plug-Flow detention time= 504.5 min calculated for 33.007 af (97% of inflow)
Center-of-Mass det. time= 407.9 min (1,336.2 - 928.3)

Volume	Invert	Avail.Storage	Storage Description
#1	681.46'	20.170 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
681.46	2.750	0.000	0.000
682.00	2.880	1.520	1.520
684.00	4.860	7.740	9.260
686.00	6.050	10.910	20.170

Device	Routing	Invert	Outlet Devices
#1	Primary	681.50'	**24.0" Round Culvert** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 681.50' / 681.00' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.14 sf
#2	Device 1	681.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	682.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	682.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#5	Device 1	683.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#6	Device 1	684.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#7	Secondary	685.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 1.00 Width (feet) 10.00 20.00 30.00

Primary OutFlow Max=21.42 cfs @ 13.18 hrs HW=685.75' (Free Discharge)
└─**1=Culvert** (Barrel Controls 21.42 cfs @ 6.82 fps)
  ├─**2=Orifice/Grate** (Passes < 7.32 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 6.81 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 6.27 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 5.67 cfs potential flow)
  └─**6=Orifice/Grate** (Passes < 44.97 cfs potential flow)

Secondary OutFlow Max=33.69 cfs @ 13.18 hrs HW=685.75' (Free Discharge)
└─**7=Custom Weir/Orifice** (Weir Controls 33.69 cfs @ 2.59 fps)

Summary for Pond SP: South Pond

Inflow Area = 7.788 ac, 39.79% Impervious, Inflow Depth = 5.03" for 100-yr event
Inflow = 51.38 cfs @ 12.09 hrs, Volume= 3.265 af
Outflow = 0.93 cfs @ 16.80 hrs, Volume= 2.985 af, Atten= 98%, Lag= 283.1 min
Primary = 0.93 cfs @ 16.80 hrs, Volume= 2.985 af
Routed to Reach S4 : Swale 4
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach S4 : Swale 4

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Starting Elev= 690.00' Surf.Area= 104,799 sf Storage= 563,180 cf
Peak Elev= 691.03' @ 16.80 hrs Surf.Area= 110,704 sf Storage= 674,066 cf (110,886 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 1,399.0 min (2,171.0 - 772.0)

Volume	Invert	Avail.Storage	Storage Description
#1	682.00'	1,159,218 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
682.00	4,661	0	0
683.00	34,274	19,468	19,468
684.00	54,009	44,142	63,609
685.00	67,049	60,529	124,138
686.00	76,841	71,945	196,083
687.00	84,846	80,844	276,927
688.00	92,571	88,709	365,635
689.00	98,860	95,716	461,351
690.00	104,799	101,830	563,180
691.00	110,544	107,672	670,852
692.00	116,064	113,304	784,156
693.00	121,865	118,965	903,120
694.00	127,659	124,762	1,027,882
695.00	135,013	131,336	1,159,218

Device	Routing	Invert	Outlet Devices
#1	Primary	690.00'	**12.0" Round Culvert** L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 690.00' / 689.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Secondary	692.00'	**10.0' long x 50.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Device 1	690.00'	**3.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	691.00'	**3.0" Vert. Orifice/Grate X 6.00** C= 0.600 Limited to weir flow at low heads
#5	Device 1	692.00'	**36.0" Horiz. Orifice/Grate** C= 0.600

Limited to weir flow at low heads

Primary OutFlow Max=0.91 cfs @ 16.80 hrs HW=691.03' (Free Discharge)
└—**1=Culvert** (Passes 0.91 cfs of 2.75 cfs potential flow)
  ├—**3=Orifice/Grate** (Orifice Controls 0.90 cfs @ 4.58 fps)
  ├—**4=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.58 fps)
  └—**5=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=690.00' (Free Discharge)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link F1: Flume 1

Inflow Area = 1.695 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 7.80 cfs @ 12.24 hrs, Volume= 0.589 af
Primary = 7.80 cfs @ 12.24 hrs, Volume= 0.589 af, Atten= 0%, Lag= 0.0 min
Routed to Pond NP : North Pond

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F2: Flume 2

Inflow Area = 0.661 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 3.07 cfs @ 12.24 hrs, Volume= 0.230 af
Primary = 3.07 cfs @ 12.24 hrs, Volume= 0.230 af, Atten= 0%, Lag= 0.0 min
Routed to Reach NS3 : North Swale 3

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F3: Flume 3

Inflow Area = 0.867 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 4.01 cfs @ 12.24 hrs, Volume= 0.302 af
Primary = 4.01 cfs @ 12.24 hrs, Volume= 0.302 af, Atten= 0%, Lag= 0.0 min
Routed to Pond NP : North Pond

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F4: Flume 4

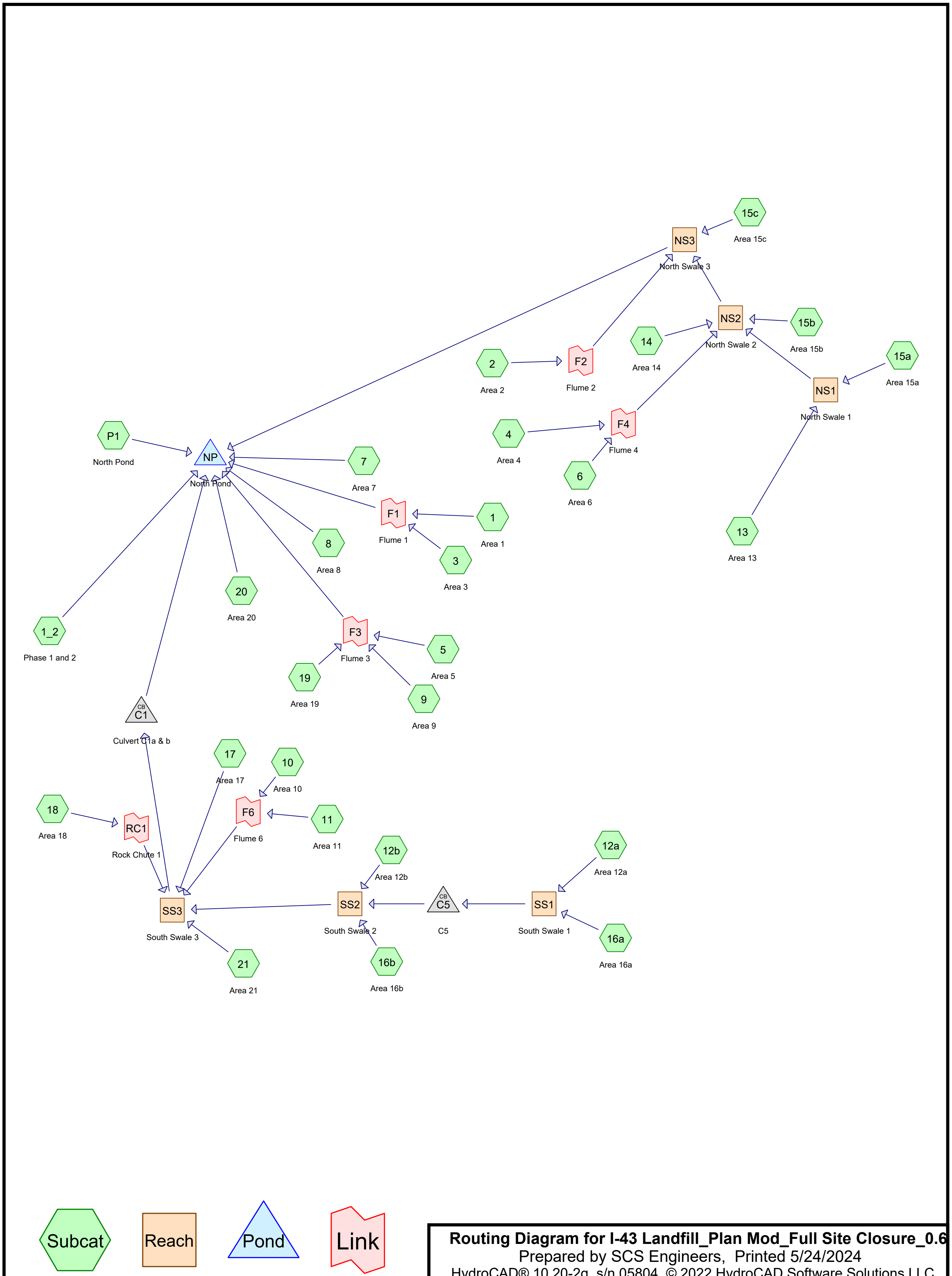
Inflow Area =	1.215 ac,	0.00% Impervious,	Inflow Depth = 4.17"	for 100-yr event	
Inflow =	5.69 cfs @	12.24 hrs,	Volume=	0.423 af	
Primary =	5.69 cfs @	12.24 hrs,	Volume=	0.423 af,	Atten= 0%, Lag= 0.0 min

Routed to Reach NS2 : North Swale 2

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Fully Developed Site Closure Conditions Hydrograph Generation

- 25-year, 24-hour Storm Event
- 100-year, 24-hour Storm Event



Routing Diagram for I-43 Landfill_Plan Mod_Full Site Closure_0.6
Prepared by SCS Engineers, Printed 5/24/2024
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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-yr	MSE 24-hr	4	Default	24.00	1	4.80	2
2	100-yr	MSE 24-hr	4	Default	24.00	1	6.55	2

Time span=0.00-90.00 hrs, dt=0.01 hrs, 9001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Area 1 Runoff Area=28,521 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=347' Tc=15.8 min CN=79 Runoff=1.93 cfs 0.144 af

Subcatchment1_2: Phase 1 and 2 Runoff Area=2,282,700 sf 1.80% Impervious Runoff Depth=2.63"
Flow Length=3,476' Tc=25.5 min CN=79 Runoff=121.27 cfs 11.486 af

Subcatchment2: Area 2 Runoff Area=28,787 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=491' Tc=15.8 min CN=79 Runoff=1.95 cfs 0.145 af

Subcatchment3: Area 3 Runoff Area=45,296 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=494' Tc=16.4 min CN=79 Runoff=3.02 cfs 0.228 af

Subcatchment4: Area 4 Runoff Area=39,815 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=475' Tc=15.6 min CN=79 Runoff=2.72 cfs 0.200 af

Subcatchment5: Area 5 Runoff Area=62,799 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=442' Tc=15.9 min CN=79 Runoff=4.23 cfs 0.316 af

Subcatchment6: Area 6 Runoff Area=81,297 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=569' Tc=17.1 min CN=79 Runoff=5.29 cfs 0.409 af

Subcatchment7: Area 7 Runoff Area=81,807 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=200' Tc=12.4 min CN=79 Runoff=6.18 cfs 0.412 af

Subcatchment8: Area 8 Runoff Area=104,501 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=240' Tc=13.8 min CN=79 Runoff=7.52 cfs 0.526 af

Subcatchment9: Area 9 Runoff Area=63,901 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=630' Tc=17.3 min CN=79 Runoff=4.13 cfs 0.322 af

Subcatchment10: Area 10 Runoff Area=84,606 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=454' Tc=16.9 min CN=79 Runoff=5.54 cfs 0.426 af

Subcatchment11: Area 11 Runoff Area=29,415 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=223' Tc=15.1 min CN=79 Runoff=2.03 cfs 0.148 af

Subcatchment12a: Area 12a Runoff Area=98,996 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=180' Tc=14.4 min CN=79 Runoff=7.00 cfs 0.498 af

Subcatchment12b: Area 12b Runoff Area=89,691 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=204' Tc=14.2 min CN=79 Runoff=6.36 cfs 0.451 af

Subcatchment13: Area 13 Runoff Area=226,080 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=205' Tc=14.5 min CN=79 Runoff=15.89 cfs 1.138 af

Subcatchment14: Area 14 Runoff Area=59,877 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=125' Slope=0.2500 '/' Tc=5.9 min CN=79 Runoff=5.88 cfs 0.301 af

Subcatchment15a: Area 15a Runoff Area=99,614 sf 5.36% Impervious Runoff Depth=2.99"
Flow Length=58' Tc=3.3 min CN=83 Runoff=12.10 cfs 0.571 af

Subcatchment15b: Area 15b Runoff Area=11,056 sf 0.00% Impervious Runoff Depth=3.18"
Flow Length=33' Slope=0.1176 '/' Tc=2.4 min CN=85 Runoff=1.43 cfs 0.067 af

Subcatchment15c: Area 15c Runoff Area=9,032 sf 0.00% Impervious Runoff Depth=2.90"
Flow Length=1,656' Tc=7.2 min CN=82 Runoff=0.92 cfs 0.050 af

Subcatchment16a: Area 16a Runoff Area=37,043 sf 0.00% Impervious Runoff Depth=3.28"
Flow Length=50' Tc=5.6 min CN=86 Runoff=4.46 cfs 0.232 af

Subcatchment16b: Area 16b Runoff Area=32,470 sf 0.00% Impervious Runoff Depth=3.18"
Flow Length=78' Tc=1.8 min CN=85 Runoff=4.26 cfs 0.198 af

Subcatchment17: Area 17 Runoff Area=123,541 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=271' Tc=14.8 min CN=79 Runoff=8.63 cfs 0.622 af

Subcatchment18: Area 18 Runoff Area=13,884 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=303' Tc=5.1 min CN=79 Runoff=1.41 cfs 0.070 af

Subcatchment19: Area 19 Runoff Area=60,482 sf 0.00% Impervious Runoff Depth=2.63"
Flow Length=648' Tc=7.7 min CN=79 Runoff=5.50 cfs 0.304 af

Subcatchment20: Area 20 Runoff Area=2,125 sf 0.00% Impervious Runoff Depth=2.72"
Flow Length=31' Tc=5.5 min CN=80 Runoff=0.22 cfs 0.011 af

Subcatchment21: Area 21 Runoff Area=50,989 sf 0.00% Impervious Runoff Depth=2.72"
Flow Length=75' Tc=4.7 min CN=80 Runoff=5.42 cfs 0.265 af

SubcatchmentP1: North Pond Runoff Area=342,674 sf 36.61% Impervious Runoff Depth=3.28"
Tc=0.0 min CN=86 Runoff=46.44 cfs 2.151 af

Reach NS1: North Swale 1 Avg. Flow Depth=0.45' Max Vel=3.82 fps Inflow=22.44 cfs 1.708 af
n=0.030 L=1,043.0' S=0.0209 '/' Capacity=302.62 cfs Outflow=19.68 cfs 1.708 af

Reach NS2: North Swale 2 Avg. Flow Depth=0.68' Max Vel=3.61 fps Inflow=30.57 cfs 2.686 af
n=0.030 L=381.0' S=0.0115 '/' Capacity=224.48 cfs Outflow=30.24 cfs 2.686 af

Reach NS3: North Swale 3 Avg. Flow Depth=0.61' Max Vel=4.40 fps Inflow=32.49 cfs 2.881 af
n=0.030 L=195.0' S=0.0193 '/' Capacity=290.78 cfs Outflow=32.44 cfs 2.881 af

Reach SS1: South Swale 1 Avg. Flow Depth=0.32' Max Vel=2.56 fps Inflow=9.79 cfs 0.731 af
n=0.030 L=686.0' S=0.0140 '/' Capacity=247.65 cfs Outflow=9.07 cfs 0.731 af

Reach SS2: South Swale 2 Avg. Flow Depth=0.45' Max Vel=3.02 fps Inflow=15.95 cfs 1.380 af
n=0.030 L=481.0' S=0.0130 '/' Capacity=238.39 cfs Outflow=15.63 cfs 1.380 af

Reach SS3: South Swale 3 Avg. Flow Depth=0.65' Max Vel=3.98 fps Inflow=32.10 cfs 2.910 af
n=0.030 L=721.0' S=0.0147 '/' Capacity=253.69 cfs Outflow=31.65 cfs 2.910 af

Pond C1: Culvert C1a & b Peak Elev=689.68' Inflow=31.65 cfs 2.910 af
Outflow=31.65 cfs 2.910 af

Pond C5: C5 Peak Elev=707.50' Inflow=9.07 cfs 0.731 af
18.0" Round Culvert n=0.025 L=38.0' S=0.0034 '/' Outflow=9.07 cfs 0.731 af

Pond NP: North Pond Peak Elev=684.95' Storage=617,328 cf Inflow=213.22 cfs 21.690 af
Primary=18.09 cfs 21.672 af Secondary=0.00 cfs 0.000 af Outflow=18.09 cfs 21.672 af

Link F1: Flume 1 Inflow=4.94 cfs 0.371 af
Primary=4.94 cfs 0.371 af

Link F2: Flume 2 Inflow=1.95 cfs 0.145 af
Primary=1.95 cfs 0.145 af

Link F3: Flume 3 Inflow=12.17 cfs 0.942 af
Primary=12.17 cfs 0.942 af

Link F4: Flume 4 Inflow=7.99 cfs 0.609 af
Primary=7.99 cfs 0.609 af

Link F6: Flume 6 Inflow=7.54 cfs 0.574 af
Primary=7.54 cfs 0.574 af

Link RC1: Rock Chute 1 Inflow=1.41 cfs 0.070 af
Primary=1.41 cfs 0.070 af

Total Runoff Area = 96.212 ac Runoff Volume = 21.690 af Average Runoff Depth = 2.71"
95.90% Pervious = 92.267 ac 4.10% Impervious = 3.945 ac

Summary for Subcatchment 1: Area 1

Runoff = 1.93 cfs @ 12.24 hrs, Volume= 0.144 af, Depth= 2.63"
Routed to Link F1 : Flume 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	28,521	79	
	28,521		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.5	106	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	141	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.8	347	Total			

Summary for Subcatchment 1_2: Phase 1 and 2

Runoff = 121.27 cfs @ 12.38 hrs, Volume= 11.486 af, Depth= 2.63"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	2,241,655	79	Closed Landfill
	41,045	98	Paved parking, HSG C
	2,282,700	79	Weighted Average
	2,241,655		98.20% Pervious Area
	41,045		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0400	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.8	400	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.7	2,976	0.0120	5.70	256.59	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=3.00' Z= 10.0 & 0.0 '/' Top.W=30.00' n= 0.035 Earth, dense weeds
25.5	3,476	Total			

Summary for Subcatchment 2: Area 2

Runoff = 1.95 cfs @ 12.24 hrs, Volume= 0.145 af, Depth= 2.63"
Routed to Link F2 : Flume 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	28,787	79	
	28,787		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	78	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	203	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	110	0.2500	20.09	10.95	**Pipe Channel,** 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
15.8	491	Total			

Summary for Subcatchment 3: Area 3

Runoff = 3.02 cfs @ 12.25 hrs, Volume= 0.228 af, Depth= 2.63"
Routed to Link F1 : Flume 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	45,296	79	
	45,296		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.3	94	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	300	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.4	494	Total			

Summary for Subcatchment 4: Area 4

Runoff = 2.72 cfs @ 12.24 hrs, Volume= 0.200 af, Depth= 2.63"
Routed to Link F4 : Flume 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	39,815	79	
	39,815		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	83	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	173	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	119	0.2500	22.68	17.81	**Pipe Channel, Flume 4** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
15.6	475	Total			

Summary for Subcatchment 5: Area 5

Runoff = 4.23 cfs @ 12.24 hrs, Volume= 0.316 af, Depth= 2.63"
Routed to Link F3 : Flume 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	62,799	79	
	62,799		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.0	73	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	269	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.9	442	Total			

Summary for Subcatchment 6: Area 6

Runoff = 5.29 cfs @ 12.26 hrs, Volume= 0.409 af, Depth= 2.63"
Routed to Link F4 : Flume 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	81,297	79	
	81,297		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.6	189	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	161	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	119	0.2500	22.68	17.81	**Pipe Channel, Flume 4** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
17.1	569	Total			

Summary for Subcatchment 7: Area 7

Runoff = 6.18 cfs @ 12.20 hrs, Volume= 0.412 af, Depth= 2.63"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	81,807	79	
	81,807		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	63	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.6	37	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	100	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.4	200	Total			

Summary for Subcatchment 8: Area 8

Runoff = 7.52 cfs @ 12.22 hrs, Volume= 0.526 af, Depth= 2.63"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	104,501	79	
	104,501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	93	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.4	4	0.2500	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.7	143	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.8	240	Total			

Summary for Subcatchment 9: Area 9

Runoff = 4.13 cfs @ 12.26 hrs, Volume= 0.322 af, Depth= 2.63"
Routed to Link F3 : Flume 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	63,901	79	
	63,901		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.4	99	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	431	0.0100	3.00	9.01	**Trap/Vee/Rect Channel Flow, Diversion Berm** Bot.W=0.00' D=1.00' Z= 2.0 & 4.0 '/' Top.W=6.00' n= 0.030 Short grass
17.3	630	Total			

Summary for Subcatchment 10: Area 10

Runoff = 5.54 cfs @ 12.26 hrs, Volume= 0.426 af, Depth= 2.63"
Routed to Link F6 : Flume 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	84,606	79	
	84,606		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.5	183	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	171	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Diversion Berm** Bot.W=0.00' D=1.00' Z= 33.0 & 4.0 '/' Top.W=37.00' n= 0.030 Earth, grassed & winding
16.9	454	Total			

Summary for Subcatchment 11: Area 11

Runoff = 2.03 cfs @ 12.23 hrs, Volume= 0.148 af, Depth= 2.63"
Routed to Link F6 : Flume 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	29,415	79	
	29,415		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.6	119	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	4	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 33.0 & 4.0 '/' Top.W=37.00' n= 0.030 Earth, grassed & winding
15.1	223	Total			

Summary for Subcatchment 12a: Area 12a

Runoff = 7.00 cfs @ 12.23 hrs, Volume= 0.498 af, Depth= 2.63"
Routed to Reach SS1 : South Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	98,996	79	
	0	96	Gravel surface, HSG C
	98,996	79	Weighted Average
	98,996		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	57	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.4	180	Total			

Summary for Subcatchment 12b: Area 12b

Runoff = 6.36 cfs @ 12.23 hrs, Volume= 0.451 af, Depth= 2.63"
Routed to Reach SS2 : South Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	89,333	79	
	358	96	Gravel surface, HSG C
	89,691	79	Weighted Average
	89,691		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.3	24	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	57	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.3333	4.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.2	204	Total			

Summary for Subcatchment 13: Area 13

Runoff = 15.89 cfs @ 12.23 hrs, Volume= 1.138 af, Depth= 2.63"
Routed to Reach NS1 : North Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	226,080	79	
	226,080		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	56	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	49	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.5	205	Total			

Summary for Subcatchment 14: Area 14

Runoff = 5.88 cfs @ 12.13 hrs, Volume= 0.301 af, Depth= 2.63"
Routed to Reach NS2 : North Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	59,877	79	
	59,877		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.1	25	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.9	125	Total			

Summary for Subcatchment 15a: Area 15a

Runoff = 12.10 cfs @ 12.11 hrs, Volume= 0.571 af, Depth= 2.99"
Routed to Reach NS1 : North Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	78,118	79	
	5,343	98	Paved roads w/curbs & sewers, HSG C
	16,153	96	Gravel surface, HSG C
	99,614	83	Weighted Average
	94,271		94.64% Pervious Area
	5,343		5.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	32	0.0050	0.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
2.4	26	0.1538	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
3.3	58	Total			

Summary for Subcatchment 15b: Area 15b

Runoff = 1.43 cfs @ 12.10 hrs, Volume= 0.067 af, Depth= 3.18"
Routed to Reach NS2 : North Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	7,026	79	
	4,030	96	Gravel surface, HSG C
	11,056	85	Weighted Average
	11,056		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.1176	1.62		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
2.3	22	0.1176	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.4	33	Total			

Summary for Subcatchment 15c: Area 15c

Runoff = 0.92 cfs @ 12.14 hrs, Volume= 0.050 af, Depth= 2.90"
Routed to Reach NS3 : North Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	7,178	79	
	1,854	96	Gravel surface, HSG C
	9,032	82	Weighted Average
	9,032		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	14	0.1250	1.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
4.4	50	0.1250	0.19		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.7	1,592	0.0167	9.92	610.36	**Trap/Vee/Rect Channel Flow,** Bot.W=10.00' D=3.00' Z= 4.0 & 3.0 '/' Top.W=31.00' n= 0.030 Earth, grassed & winding
7.2	1,656	Total			

Summary for Subcatchment 16a: Area 16a

Runoff = 4.46 cfs @ 12.13 hrs, Volume= 0.232 af, Depth= 3.28"
Routed to Reach SS1 : South Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	20,948	79	
	16,095	96	Gravel surface, HSG C
	37,043	86	Weighted Average
	37,043		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	13	0.0050	0.06		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
0.7	21	0.0050	0.52		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.2	16	0.3300	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
5.6	50	Total			

Summary for Subcatchment 16b: Area 16b

Runoff = 4.26 cfs @ 12.10 hrs, Volume= 0.198 af, Depth= 3.18"
Routed to Reach SS2 : South Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	21,666	79	
	10,804	96	Gravel surface, HSG C
	32,470	85	Weighted Average
	32,470		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	64	0.0450	1.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.1	14	0.3333	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.8	78	Total			

Summary for Subcatchment 17: Area 17

Runoff = 8.63 cfs @ 12.23 hrs, Volume= 0.622 af, Depth= 2.63"
Routed to Reach SS3 : South Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	123,541	79	
	123,541		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.7	48	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	123	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.8	271	Total			

Summary for Subcatchment 18: Area 18

Runoff = 1.41 cfs @ 12.13 hrs, Volume= 0.070 af, Depth= 2.63"
Routed to Link RC1 : Rock Chute 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	13,884	79	
	13,884		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	100	0.2500	0.42		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
0.0	3	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	200	0.0100	3.00	9.01	**Trap/Vee/Rect Channel Flow, Diversion Berm** Bot.W=0.00' D=1.00' Z= 2.0 & 4.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
5.1	303	Total			

Summary for Subcatchment 19: Area 19

Runoff = 5.50 cfs @ 12.15 hrs, Volume= 0.304 af, Depth= 2.63"
Routed to Link F3 : Flume 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	60,482	79	
	60,482		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.0	8	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.9	540	0.0100	4.77	57.18	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 & 4.0 '/' Top.W=12.00' n= 0.030 Earth, grassed & winding
7.7	648	Total			

Summary for Subcatchment 20: Area 20

Runoff = 0.22 cfs @ 12.13 hrs, Volume= 0.011 af, Depth= 2.72"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	1,965	79	
	160	96	Gravel surface, HSG C
	2,125	80	Weighted Average
	2,125		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	23	0.2500	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
3.7	8	0.0050	0.04		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
5.5	31	Total			

Summary for Subcatchment 21: Area 21

Runoff = 5.42 cfs @ 12.12 hrs, Volume= 0.265 af, Depth= 2.72"
Routed to Reach SS3 : South Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
*	49,452	79	
	1,537	96	Gravel surface, HSG C
	50,989	80	Weighted Average
	50,989		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	43	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	16	0.0050	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.3	16	0.2500	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.7	75	Total			

Summary for Subcatchment P1: North Pond

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 46.44 cfs @ 12.09 hrs, Volume= 2.151 af, Depth= 3.28"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 25-yr Rainfall=4.80"

	Area (sf)	CN	Description
	125,453	98	Water Surface
*	210,716	79	
	6,505	96	Gravel surface, HSG C
	342,674	86	Weighted Average
	217,221		63.39% Pervious Area
	125,453		36.61% Impervious Area

Summary for Reach NS1: North Swale 1

Inflow Area = 7.477 ac, 1.64% Impervious, Inflow Depth = 2.74" for 25-yr event
Inflow = 22.44 cfs @ 12.12 hrs, Volume= 1.708 af
Outflow = 19.68 cfs @ 12.31 hrs, Volume= 1.708 af, Atten= 12%, Lag= 11.1 min
Routed to Reach NS2 : North Swale 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.82 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.97 fps, Avg. Travel Time= 17.8 min

Peak Storage= 5,375 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.45' , Surface Width= 13.12'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 302.62 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 1,043.0' Slope= 0.0209 '/'
Inlet Invert= 714.00', Outlet Invert= 692.16'

‡

Summary for Reach NS2: North Swale 2

[62] Hint: Exceeded Reach NS1 OUTLET depth by 0.26' @ 12.38 hrs

Inflow Area = 11.886 ac, 1.03% Impervious, Inflow Depth = 2.71" for 25-yr event
Inflow = 30.57 cfs @ 12.23 hrs, Volume= 2.686 af
Outflow = 30.24 cfs @ 12.29 hrs, Volume= 2.686 af, Atten= 1%, Lag= 3.3 min
Routed to Reach NS3 : North Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.61 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 7.1 min

Peak Storage= 3,188 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.68' , Surface Width= 14.74'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 224.48 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 381.0' Slope= 0.0115 '/'
Inlet Invert= 692.16', Outlet Invert= 687.77'

‡

Summary for Reach NS3: North Swale 3

[61] Hint: Exceeded Reach NS2 outlet invert by 0.61' @ 12.29 hrs

Inflow Area = 12.754 ac, 0.96% Impervious, Inflow Depth = 2.71" for 25-yr event
Inflow = 32.49 cfs @ 12.28 hrs, Volume= 2.881 af
Outflow = 32.44 cfs @ 12.30 hrs, Volume= 2.881 af, Atten= 0%, Lag= 1.3 min
Routed to Pond NP : North Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.40 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.09 fps, Avg. Travel Time= 3.0 min

Peak Storage= 1,437 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.61' , Surface Width= 14.25'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 290.78 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 195.0' Slope= 0.0193 '/'
Inlet Invert= 687.77', Outlet Invert= 684.00'

‡

Summary for Reach SS1: South Swale 1

Inflow Area = 3.123 ac, 0.00% Impervious, Inflow Depth = 2.81" for 25-yr event
Inflow = 9.79 cfs @ 12.15 hrs, Volume= 0.731 af
Outflow = 9.07 cfs @ 12.30 hrs, Volume= 0.731 af, Atten= 7%, Lag= 8.6 min
Routed to Pond C5 : C5

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.56 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 17.4 min

Peak Storage= 2,434 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.32' , Surface Width= 12.23'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 247.65 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 686.0' Slope= 0.0140 '/'
Inlet Invert= 714.00', Outlet Invert= 704.38'

‡


Summary for Reach SS2: South Swale 2

[79] Warning: Submerged Pond C5 Primary device # 1 INLET by 0.32'

Inflow Area = 5.927 ac, 0.00% Impervious, Inflow Depth = 2.79" for 25-yr event
Inflow = 15.95 cfs @ 12.26 hrs, Volume= 1.380 af
Outflow = 15.63 cfs @ 12.34 hrs, Volume= 1.380 af, Atten= 2%, Lag= 4.5 min
Routed to Reach SS3 : South Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.02 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 10.4 min

Peak Storage= 2,492 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.45' , Surface Width= 13.14'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 238.39 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 481.0' Slope= 0.0130 '/'
Inlet Invert= 704.25', Outlet Invert= 698.00'

‡

Summary for Reach SS3: South Swale 3

[62] Hint: Exceeded Reach SS2 OUTLET depth by 0.21' @ 12.18 hrs

Inflow Area = 12.870 ac, 0.00% Impervious, Inflow Depth = 2.71" for 25-yr event
Inflow = 32.10 cfs @ 12.28 hrs, Volume= 2.910 af
Outflow = 31.65 cfs @ 12.36 hrs, Volume= 2.910 af, Atten= 1%, Lag= 4.8 min
Routed to Pond C1 : Culvert C1a & b

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.98 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.99 fps, Avg. Travel Time= 12.1 min

Peak Storage= 5,728 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.65' , Surface Width= 14.53'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 253.69 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 721.0' Slope= 0.0147 '/'
Inlet Invert= 698.00', Outlet Invert= 687.39'

‡

Summary for Pond C1: Culvert C1a & b

[62] Hint: Exceeded Reach SS3 OUTLET depth by 1.66' @ 12.37 hrs

Inflow Area = 12.870 ac, 0.00% Impervious, Inflow Depth = 2.71" for 25-yr event
Inflow = 31.65 cfs @ 12.36 hrs, Volume= 2.910 af
Outflow = 31.65 cfs @ 12.36 hrs, Volume= 2.910 af, Atten= 0%, Lag= 0.0 min
Primary = 31.65 cfs @ 12.36 hrs, Volume= 2.910 af
Routed to Pond NP : North Pond

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 689.68' @ 12.36 hrs
Flood Elev= 691.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	687.71'	**24.0" Round C1a** L= 341.7' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 687.71' / 683.12' S= 0.0134 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	687.47'	**24.0" Round C1b** L= 341.6' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 687.47' / 683.25' S= 0.0124 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=31.65 cfs @ 12.36 hrs HW=689.68' (Free Discharge)
├─**1=C1a** (Inlet Controls 14.99 cfs @ 4.78 fps)
└─**2=C1b** (Inlet Controls 16.66 cfs @ 5.30 fps)

Summary for Pond C5: C5

[62] Hint: Exceeded Reach SS1 OUTLET depth by 2.81' @ 12.30 hrs

Inflow Area = 3.123 ac, 0.00% Impervious, Inflow Depth = 2.81" for 25-yr event
Inflow = 9.07 cfs @ 12.30 hrs, Volume= 0.731 af
Outflow = 9.07 cfs @ 12.30 hrs, Volume= 0.731 af, Atten= 0%, Lag= 0.0 min
Primary = 9.07 cfs @ 12.30 hrs, Volume= 0.731 af
Routed to Reach SS2 : South Swale 2

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 707.50' @ 12.30 hrs
Flood Elev= 708.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	704.38'	**18.0" Round Culvert** L= 38.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 704.38' / 704.25' S= 0.0034 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=9.07 cfs @ 12.30 hrs HW=707.50' (Free Discharge)
└**1=Culvert** (Barrel Controls 9.07 cfs @ 5.13 fps)

Summary for Pond NP: North Pond

[62] Hint: Exceeded Reach NS3 OUTLET depth by 0.83' @ 14.16 hrs
[79] Warning: Submerged Pond C1 Primary device # 1 OUTLET by 1.83'
[79] Warning: Submerged Pond C1 Primary device # 2 OUTLET by 1.70'

Inflow Area = 96.212 ac, 4.10% Impervious, Inflow Depth = 2.71" for 25-yr event
Inflow = 213.22 cfs @ 12.33 hrs, Volume= 21.690 af
Outflow = 18.09 cfs @ 13.97 hrs, Volume= 21.672 af, Atten= 92%, Lag= 98.4 min
Primary = 18.09 cfs @ 13.97 hrs, Volume= 21.672 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Starting Elev= 681.75' Surf.Area= 122,831 sf Storage= 35,180 cf
Peak Elev= 684.95' @ 13.97 hrs Surf.Area= 236,450 sf Storage= 617,328 cf (582,148 cf above start)
Flood Elev= 886.00' Surf.Area= 263,538 sf Storage= 878,611 cf (843,431 cf above start)

Plug-Flow detention time= 527.6 min calculated for 20.862 af (96% of inflow)
Center-of-Mass det. time= 484.9 min (1,311.4 - 826.5)

Volume	Invert	Avail.Storage	Storage Description
#1	681.46'	878,611 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
681.46	119,790	0	0
682.00	125,453	66,216	66,216
684.00	211,702	337,155	403,371
686.00	263,538	475,240	878,611

Device	Routing	Invert	Outlet Devices
#1	Primary	681.50'	**24.0" Round Culvert** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 681.50' / 681.00' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.14 sf
#2	Device 1	681.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	682.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	682.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#5	Device 1	683.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#6	Device 1	684.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#7	Secondary	685.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 1.00 Width (feet) 10.00 20.00 30.00

Primary OutFlow Max=18.07 cfs @ 13.97 hrs HW=684.95' (Free Discharge)
└─**1=Culvert** (Barrel Controls 18.07 cfs @ 5.75 fps)
  ├─**2=Orifice/Grate** (Passes < 6.50 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 5.93 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 5.29 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 4.56 cfs potential flow)
  └─**6=Orifice/Grate** (Passes < 28.76 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=681.75' (Free Discharge)
└─**7=Custom Weir/Orifice** (Controls 0.00 cfs)

Summary for Link F1: Flume 1

Inflow Area =	1.695 ac,	0.00% Impervious,	Inflow Depth = 2.63"	for 25-yr event	
Inflow =	4.94 cfs @	12.25 hrs,	Volume=	0.371 af	
Primary =	4.94 cfs @	12.25 hrs,	Volume=	0.371 af,	Atten= 0%, Lag= 0.0 min

Routed to Pond NP : North Pond

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F2: Flume 2

Inflow Area =	0.661 ac,	0.00% Impervious, Inflow Depth = 2.63"	for 25-yr event	
Inflow =	1.95 cfs @	12.24 hrs, Volume=	0.145 af	
Primary =	1.95 cfs @	12.24 hrs, Volume=	0.145 af,	Atten= 0%, Lag= 0.0 min

Routed to Reach NS3 : North Swale 3

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F3: Flume 3

Inflow Area = 4.297 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 12.17 cfs @ 12.19 hrs, Volume= 0.942 af
Primary = 12.17 cfs @ 12.19 hrs, Volume= 0.942 af, Atten= 0%, Lag= 0.0 min
Routed to Pond NP : North Pond

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F4: Flume 4

Inflow Area = 2.780 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 7.99 cfs @ 12.25 hrs, Volume= 0.609 af
Primary = 7.99 cfs @ 12.25 hrs, Volume= 0.609 af, Atten= 0%, Lag= 0.0 min
Routed to Reach NS2 : North Swale 2

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F6: Flume 6

Inflow Area = 2.618 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 7.54 cfs @ 12.25 hrs, Volume= 0.574 af
Primary = 7.54 cfs @ 12.25 hrs, Volume= 0.574 af, Atten= 0%, Lag= 0.0 min
Routed to Reach SS3 : South Swale 3

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link RC1: Rock Chute 1

Inflow Area = 0.319 ac, 0.00% Impervious, Inflow Depth = 2.63" for 25-yr event
Inflow = 1.41 cfs @ 12.13 hrs, Volume= 0.070 af
Primary = 1.41 cfs @ 12.13 hrs, Volume= 0.070 af, Atten= 0%, Lag= 0.0 min
Routed to Reach SS3 : South Swale 3

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Time span=0.00-90.00 hrs, dt=0.01 hrs, 9001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Area 1 Runoff Area=28,521 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=347' Tc=15.8 min CN=79 Runoff=3.04 cfs 0.228 af

Subcatchment1_2: Phase 1 and 2 Runoff Area=2,282,700 sf 1.80% Impervious Runoff Depth=4.17"
Flow Length=3,476' Tc=25.5 min CN=79 Runoff=191.41 cfs 18.230 af

Subcatchment2: Area 2 Runoff Area=28,787 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=491' Tc=15.8 min CN=79 Runoff=3.07 cfs 0.230 af

Subcatchment3: Area 3 Runoff Area=45,296 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=494' Tc=16.4 min CN=79 Runoff=4.75 cfs 0.362 af

Subcatchment4: Area 4 Runoff Area=39,815 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=475' Tc=15.6 min CN=79 Runoff=4.28 cfs 0.318 af

Subcatchment5: Area 5 Runoff Area=62,799 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=442' Tc=15.9 min CN=79 Runoff=6.66 cfs 0.502 af

Subcatchment6: Area 6 Runoff Area=81,297 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=569' Tc=17.1 min CN=79 Runoff=8.34 cfs 0.649 af

Subcatchment7: Area 7 Runoff Area=81,807 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=200' Tc=12.4 min CN=79 Runoff=9.72 cfs 0.653 af

Subcatchment8: Area 8 Runoff Area=104,501 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=240' Tc=13.8 min CN=79 Runoff=11.84 cfs 0.835 af

Subcatchment9: Area 9 Runoff Area=63,901 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=630' Tc=17.3 min CN=79 Runoff=6.52 cfs 0.510 af

Subcatchment10: Area 10 Runoff Area=84,606 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=454' Tc=16.9 min CN=79 Runoff=8.74 cfs 0.676 af

Subcatchment11: Area 11 Runoff Area=29,415 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=223' Tc=15.1 min CN=79 Runoff=3.20 cfs 0.235 af

Subcatchment12a: Area 12a Runoff Area=98,996 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=180' Tc=14.4 min CN=79 Runoff=11.03 cfs 0.791 af

Subcatchment12b: Area 12b Runoff Area=89,691 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=204' Tc=14.2 min CN=79 Runoff=10.01 cfs 0.716 af

Subcatchment13: Area 13 Runoff Area=226,080 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=205' Tc=14.5 min CN=79 Runoff=25.02 cfs 1.806 af

Subcatchment14: Area 14 Runoff Area=59,877 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=125' Slope=0.2500 '/' Tc=5.9 min CN=79 Runoff=9.19 cfs 0.478 af

Subcatchment15a: Area 15a Runoff Area=99,614 sf 5.36% Impervious Runoff Depth=4.60"
Flow Length=58' Tc=3.3 min CN=83 Runoff=18.14 cfs 0.877 af

Subcatchment15b: Area 15b Runoff Area=11,056 sf 0.00% Impervious Runoff Depth=4.82"
Flow Length=33' Slope=0.1176 '/' Tc=2.4 min CN=85 Runoff=2.11 cfs 0.102 af

Subcatchment15c: Area 15c Runoff Area=9,032 sf 0.00% Impervious Runoff Depth=4.50"
Flow Length=1,656' Tc=7.2 min CN=82 Runoff=1.40 cfs 0.078 af

Subcatchment16a: Area 16a Runoff Area=37,043 sf 0.00% Impervious Runoff Depth=4.93"
Flow Length=50' Tc=5.6 min CN=86 Runoff=6.55 cfs 0.350 af

Subcatchment16b: Area 16b Runoff Area=32,470 sf 0.00% Impervious Runoff Depth=4.82"
Flow Length=78' Tc=1.8 min CN=85 Runoff=6.26 cfs 0.300 af

Subcatchment17: Area 17 Runoff Area=123,541 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=271' Tc=14.8 min CN=79 Runoff=13.60 cfs 0.987 af

Subcatchment18: Area 18 Runoff Area=13,884 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=303' Tc=5.1 min CN=79 Runoff=2.20 cfs 0.111 af

Subcatchment19: Area 19 Runoff Area=60,482 sf 0.00% Impervious Runoff Depth=4.17"
Flow Length=648' Tc=7.7 min CN=79 Runoff=8.62 cfs 0.483 af

Subcatchment20: Area 20 Runoff Area=2,125 sf 0.00% Impervious Runoff Depth=4.28"
Flow Length=31' Tc=5.5 min CN=80 Runoff=0.34 cfs 0.017 af

Subcatchment21: Area 21 Runoff Area=50,989 sf 0.00% Impervious Runoff Depth=4.28"
Flow Length=75' Tc=4.7 min CN=80 Runoff=8.37 cfs 0.418 af

SubcatchmentP1: North Pond Runoff Area=342,674 sf 36.61% Impervious Runoff Depth=4.93"
Tc=0.0 min CN=86 Runoff=67.48 cfs 3.235 af

Reach NS1: North Swale 1 Avg. Flow Depth=0.58' Max Vel=4.46 fps Inflow=34.91 cfs 2.683 af
n=0.030 L=1,043.0' S=0.0209 '/' Capacity=302.62 cfs Outflow=31.25 cfs 2.683 af

Reach NS2: North Swale 2 Avg. Flow Depth=0.88' Max Vel=4.20 fps Inflow=48.82 cfs 4.230 af
n=0.030 L=381.0' S=0.0115 '/' Capacity=224.48 cfs Outflow=48.36 cfs 4.230 af

Reach NS3: North Swale 3 Avg. Flow Depth=0.79' Max Vel=5.13 fps Inflow=52.05 cfs 4.538 af
n=0.030 L=195.0' S=0.0193 '/' Capacity=290.78 cfs Outflow=51.98 cfs 4.538 af

Reach SS1: South Swale 1 Avg. Flow Depth=0.42' Max Vel=3.00 fps Inflow=15.12 cfs 1.140 af
n=0.030 L=686.0' S=0.0140 '/' Capacity=247.65 cfs Outflow=14.25 cfs 1.140 af

Reach SS2: South Swale 2 Avg. Flow Depth=0.59' Max Vel=3.53 fps Inflow=25.27 cfs 2.156 af
n=0.030 L=481.0' S=0.0130 '/' Capacity=238.39 cfs Outflow=24.90 cfs 2.156 af

Reach SS3: South Swale 3 Avg. Flow Depth=0.85' Max Vel=4.65 fps Inflow=51.87 cfs 4.582 af
n=0.030 L=721.0' S=0.0147 '/' Capacity=253.69 cfs Outflow=51.15 cfs 4.582 af

Pond C1: Culvert C1a & b Peak Elev=691.45' Inflow=51.15 cfs 4.582 af
Outflow=51.15 cfs 4.582 af

Pond C5: C5 Peak Elev=710.06' Inflow=14.25 cfs 1.140 af
18.0" Round Culvert n=0.025 L=38.0' S=0.0034 '/' Outflow=14.25 cfs 1.140 af

Pond NP: North Pond Peak Elev=685.89' Storage=850,819 cf Inflow=337.29 cfs 34.174 af
Primary=21.98 cfs 26.485 af Secondary=49.59 cfs 7.668 af Outflow=71.57 cfs 34.153 af

Link F1: Flume 1 Inflow=7.79 cfs 0.590 af
Primary=7.79 cfs 0.590 af

Link F2: Flume 2 Inflow=3.07 cfs 0.230 af
Primary=3.07 cfs 0.230 af

Link F3: Flume 3 Inflow=19.25 cfs 1.495 af
Primary=19.25 cfs 1.495 af

Link F4: Flume 4 Inflow=12.59 cfs 0.967 af
Primary=12.59 cfs 0.967 af

Link F6: Flume 6 Inflow=11.89 cfs 0.911 af
Primary=11.89 cfs 0.911 af

Link RC1: Rock Chute 1 Inflow=2.20 cfs 0.111 af
Primary=2.20 cfs 0.111 af

Total Runoff Area = 96.212 ac Runoff Volume = 34.174 af Average Runoff Depth = 4.26"
95.90% Pervious = 92.267 ac 4.10% Impervious = 3.945 ac

Summary for Subcatchment 1: Area 1

Runoff = 3.04 cfs @ 12.24 hrs, Volume= 0.228 af, Depth= 4.17"
Routed to Link F1 : Flume 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	28,521	79	
	28,521		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.5	106	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	141	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.8	347	Total			

Summary for Subcatchment 1_2: Phase 1 and 2

Runoff = 191.41 cfs @ 12.36 hrs, Volume= 18.230 af, Depth= 4.17"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	2,241,655	79	Closed Landfill
	41,045	98	Paved parking, HSG C
	2,282,700	79	Weighted Average
	2,241,655		98.20% Pervious Area
	41,045		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0400	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.8	400	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.7	2,976	0.0120	5.70	256.59	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=3.00' Z= 10.0 & 0.0 '/' Top.W=30.00' n= 0.035 Earth, dense weeds
25.5	3,476	Total			

Summary for Subcatchment 2: Area 2

Runoff = 3.07 cfs @ 12.24 hrs, Volume= 0.230 af, Depth= 4.17"
Routed to Link F2 : Flume 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	28,787	79	
	28,787		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	78	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	203	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	110	0.2500	20.09	10.95	**Pipe Channel,** 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.013 Corrugated PE, smooth interior
15.8	491	Total			

Summary for Subcatchment 3: Area 3

Runoff = 4.75 cfs @ 12.25 hrs, Volume= 0.362 af, Depth= 4.17"
Routed to Link F1 : Flume 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	45,296	79	
	45,296		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.3	94	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	300	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
16.4	494	Total			

Summary for Subcatchment 4: Area 4

Runoff = 4.28 cfs @ 12.24 hrs, Volume= 0.318 af, Depth= 4.17"
Routed to Link F4 : Flume 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	39,815	79	
	39,815		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.1	83	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	173	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	119	0.2500	22.68	17.81	**Pipe Channel, Flume 4** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
15.6	475	Total			

Summary for Subcatchment 5: Area 5

Runoff = 6.66 cfs @ 12.24 hrs, Volume= 0.502 af, Depth= 4.17"
Routed to Link F3 : Flume 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	62,799	79	
	62,799		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.0	73	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	269	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
15.9	442	Total			

Summary for Subcatchment 6: Area 6

Runoff = 8.34 cfs @ 12.26 hrs, Volume= 0.649 af, Depth= 4.17"
Routed to Link F4 : Flume 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	81,297	79	
	81,297		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.6	189	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	161	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Intermediate Swale** Bot.W=0.00' D=1.00' Z= 4.0 & 33.0 '/' Top.W=37.00' n= 0.030 Short grass
0.1	119	0.2500	22.68	17.81	**Pipe Channel, Flume 4** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
17.1	569	Total			

Summary for Subcatchment 7: Area 7

Runoff = 9.72 cfs @ 12.20 hrs, Volume= 0.653 af, Depth= 4.17"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	81,807	79	
	81,807		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	63	0.0300	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.6	37	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	100	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.4	200	Total			

Summary for Subcatchment 8: Area 8

Runoff = 11.84 cfs @ 12.22 hrs, Volume= 0.835 af, Depth= 4.17"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	104,501	79	
	104,501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	93	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.4	4	0.2500	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.7	143	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.8	240	Total			

Summary for Subcatchment 9: Area 9

Runoff = 6.52 cfs @ 12.26 hrs, Volume= 0.510 af, Depth= 4.17"
Routed to Link F3 : Flume 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	63,901	79	
	63,901		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.4	99	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	431	0.0100	3.00	9.01	**Trap/Vee/Rect Channel Flow, Diversion Berm** Bot.W=0.00' D=1.00' Z= 2.0 & 4.0 '/' Top.W=6.00' n= 0.030 Short grass
17.3	630	Total			

Summary for Subcatchment 10: Area 10

Runoff = 8.74 cfs @ 12.26 hrs, Volume= 0.676 af, Depth= 4.17"
Routed to Link F6 : Flume 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	84,606	79	
	84,606		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.5	183	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	171	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow, Diversion Berm** Bot.W=0.00' D=1.00' Z= 33.0 & 4.0 '/' Top.W=37.00' n= 0.030 Earth, grassed & winding
16.9	454	Total			

Summary for Subcatchment 11: Area 11

Runoff = 3.20 cfs @ 12.23 hrs, Volume= 0.235 af, Depth= 4.17"
Routed to Link F6 : Flume 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	29,415	79	
	29,415		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.6	119	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	4	0.0100	3.11	57.58	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 33.0 & 4.0 '/' Top.W=37.00' n= 0.030 Earth, grassed & winding
15.1	223	Total			

Summary for Subcatchment 12a: Area 12a

Runoff = 11.03 cfs @ 12.22 hrs, Volume= 0.791 af, Depth= 4.17"
Routed to Reach SS1 : South Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	98,996	79	
	0	96	Gravel surface, HSG C
	98,996	79	Weighted Average
	98,996		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	57	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.4	180	Total			

Summary for Subcatchment 12b: Area 12b

Runoff = 10.01 cfs @ 12.22 hrs, Volume= 0.716 af, Depth= 4.17"
Routed to Reach SS2 : South Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	89,333	79	
	358	96	Gravel surface, HSG C
	89,691	79	Weighted Average
	89,691		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.3	24	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	57	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.3333	4.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.2	204	Total			

Summary for Subcatchment 13: Area 13

Runoff = 25.02 cfs @ 12.23 hrs, Volume= 1.806 af, Depth= 4.17"
Routed to Reach NS1 : North Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	226,080	79	
	226,080		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.8	56	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	49	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.5	205	Total			

Summary for Subcatchment 14: Area 14

Runoff = 9.19 cfs @ 12.13 hrs, Volume= 0.478 af, Depth= 4.17"
Routed to Reach NS2 : North Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	59,877	79	
	59,877		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.1	25	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.9	125	Total			

Summary for Subcatchment 15a: Area 15a

Runoff = 18.14 cfs @ 12.11 hrs, Volume= 0.877 af, Depth= 4.60"
Routed to Reach NS1 : North Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	78,118	79	
	5,343	98	Paved roads w/curbs & sewers, HSG C
	16,153	96	Gravel surface, HSG C
	99,614	83	Weighted Average
	94,271		94.64% Pervious Area
	5,343		5.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	32	0.0050	0.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
2.4	26	0.1538	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
3.3	58	Total			

Summary for Subcatchment 15b: Area 15b

Runoff = 2.11 cfs @ 12.10 hrs, Volume= 0.102 af, Depth= 4.82"
Routed to Reach NS2 : North Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	7,026	79	
	4,030	96	Gravel surface, HSG C
	11,056	85	Weighted Average
	11,056		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.1176	1.62		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
2.3	22	0.1176	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.4	33	Total			

Summary for Subcatchment 15c: Area 15c

Runoff = 1.40 cfs @ 12.14 hrs, Volume= 0.078 af, Depth= 4.50"
Routed to Reach NS3 : North Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	7,178	79	
	1,854	96	Gravel surface, HSG C
	9,032	82	Weighted Average
	9,032		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	14	0.1250	1.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
4.4	50	0.1250	0.19		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
2.7	1,592	0.0167	9.92	610.36	**Trap/Vee/Rect Channel Flow,** Bot.W=10.00' D=3.00' Z= 4.0 & 3.0 '/' Top.W=31.00' n= 0.030 Earth, grassed & winding
7.2	1,656	Total			

Summary for Subcatchment 16a: Area 16a

Runoff = 6.55 cfs @ 12.13 hrs, Volume= 0.350 af, Depth= 4.93"
Routed to Reach SS1 : South Swale 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	20,948	79	
	16,095	96	Gravel surface, HSG C
	37,043	86	Weighted Average
	37,043		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	13	0.0050	0.06		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
0.7	21	0.0050	0.52		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.2	16	0.3300	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
5.6	50	Total			

Summary for Subcatchment 16b: Area 16b

Runoff = 6.26 cfs @ 12.10 hrs, Volume= 0.300 af, Depth= 4.82"
Routed to Reach SS2 : South Swale 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	21,666	79	
	10,804	96	Gravel surface, HSG C
	32,470	85	Weighted Average
	32,470		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	64	0.0450	1.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.1	14	0.3333	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
1.8	78	Total			

Summary for Subcatchment 17: Area 17

Runoff = 13.60 cfs @ 12.23 hrs, Volume= 0.987 af, Depth= 4.17"
Routed to Reach SS3 : South Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	123,541	79	
	123,541		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.7	48	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	123	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.8	271	Total			

Summary for Subcatchment 18: Area 18

Runoff = 2.20 cfs @ 12.12 hrs, Volume= 0.111 af, Depth= 4.17"
Routed to Link RC1 : Rock Chute 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	13,884	79	
	13,884		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	100	0.2500	0.42		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.59"
0.0	3	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	200	0.0100	3.00	9.01	**Trap/Vee/Rect Channel Flow, Diversion Berm** Bot.W=0.00' D=1.00' Z= 2.0 & 4.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
5.1	303	Total			

Summary for Subcatchment 19: Area 19

Runoff = 8.62 cfs @ 12.15 hrs, Volume= 0.483 af, Depth= 4.17"
Routed to Link F3 : Flume 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	60,482	79	
	60,482		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2500	0.29		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.0	8	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.9	540	0.0100	4.77	57.18	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 & 4.0 '/' Top.W=12.00' n= 0.030 Earth, grassed & winding
7.7	648	Total			

Summary for Subcatchment 20: Area 20

Runoff = 0.34 cfs @ 12.13 hrs, Volume= 0.017 af, Depth= 4.28"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	1,965	79	
	160	96	Gravel surface, HSG C
	2,125	80	Weighted Average
	2,125		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	23	0.2500	0.22		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
3.7	8	0.0050	0.04		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
5.5	31	Total			

Summary for Subcatchment 21: Area 21

Runoff = 8.37 cfs @ 12.12 hrs, Volume= 0.418 af, Depth= 4.28"
Routed to Reach SS3 : South Swale 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
*	49,452	79	
	1,537	96	Gravel surface, HSG C
	50,989	80	Weighted Average
	50,989		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	43	0.2500	0.24		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
0.5	16	0.0050	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.59"
1.3	16	0.2500	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.59"
4.7	75	Total			

Summary for Subcatchment P1: North Pond

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 67.48 cfs @ 12.09 hrs, Volume= 3.235 af, Depth= 4.93"
Routed to Pond NP : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 100-yr Rainfall=6.55"

	Area (sf)	CN	Description
	125,453	98	Water Surface
*	210,716	79	
	6,505	96	Gravel surface, HSG C
	342,674	86	Weighted Average
	217,221		63.39% Pervious Area
	125,453		36.61% Impervious Area

Summary for Reach NS1: North Swale 1

Inflow Area = 7.477 ac, 1.64% Impervious, Inflow Depth = 4.31" for 100-yr event
Inflow = 34.91 cfs @ 12.12 hrs, Volume= 2.683 af
Outflow = 31.25 cfs @ 12.22 hrs, Volume= 2.683 af, Atten= 10%, Lag= 6.1 min
Routed to Reach NS2 : North Swale 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.46 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 1.10 fps, Avg. Travel Time= 15.9 min

Peak Storage= 7,302 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.58' , Surface Width= 14.07'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 302.62 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 1,043.0' Slope= 0.0209 '/'
Inlet Invert= 714.00', Outlet Invert= 692.16'

‡

Summary for Reach NS2: North Swale 2

[62] Hint: Exceeded Reach NS1 OUTLET depth by 0.32' @ 12.36 hrs

Inflow Area = 11.886 ac, 1.03% Impervious, Inflow Depth = 4.27" for 100-yr event
Inflow = 48.82 cfs @ 12.22 hrs, Volume= 4.230 af
Outflow = 48.36 cfs @ 12.26 hrs, Volume= 4.230 af, Atten= 1%, Lag= 2.8 min
Routed to Reach NS3 : North Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.20 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.01 fps, Avg. Travel Time= 6.3 min

Peak Storage= 4,390 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.88' , Surface Width= 16.17'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 224.48 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 381.0' Slope= 0.0115 '/'
Inlet Invert= 692.16', Outlet Invert= 687.77'

‡

Summary for Reach NS3: North Swale 3

[61] Hint: Exceeded Reach NS2 outlet invert by 0.79' @ 12.27 hrs

Inflow Area = 12.754 ac, 0.96% Impervious, Inflow Depth = 4.27" for 100-yr event
Inflow = 52.05 cfs @ 12.26 hrs, Volume= 4.538 af
Outflow = 51.98 cfs @ 12.28 hrs, Volume= 4.538 af, Atten= 0%, Lag= 1.1 min
Routed to Pond NP : North Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.13 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.23 fps, Avg. Travel Time= 2.6 min

Peak Storage= 1,977 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.79' , Surface Width= 15.55'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 290.78 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 195.0' Slope= 0.0193 '/'
Inlet Invert= 687.77', Outlet Invert= 684.00'

‡

Summary for Reach SS1: South Swale 1

Inflow Area = 3.123 ac, 0.00% Impervious, Inflow Depth = 4.38" for 100-yr event
Inflow = 15.12 cfs @ 12.16 hrs, Volume= 1.140 af
Outflow = 14.25 cfs @ 12.28 hrs, Volume= 1.140 af, Atten= 6%, Lag= 7.3 min
Routed to Pond C5 : C5

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.00 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 15.6 min

Peak Storage= 3,263 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.42' , Surface Width= 12.91'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 247.65 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 686.0' Slope= 0.0140 '/'
Inlet Invert= 714.00', Outlet Invert= 704.38'

Summary for Reach SS2: South Swale 2

[79] Warning: Submerged Pond C5 Primary device # 1 INLET by 0.46'

Inflow Area = 5.927 ac, 0.00% Impervious, Inflow Depth = 4.37" for 100-yr event
Inflow = 25.27 cfs @ 12.25 hrs, Volume= 2.156 af
Outflow = 24.90 cfs @ 12.31 hrs, Volume= 2.156 af, Atten= 1%, Lag= 3.9 min
Routed to Reach SS3 : South Swale 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.53 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 0.87 fps, Avg. Travel Time= 9.3 min

Peak Storage= 3,393 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.59' , Surface Width= 14.10'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 238.39 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 481.0' Slope= 0.0130 '/'
Inlet Invert= 704.25', Outlet Invert= 698.00'

Summary for Reach SS3: South Swale 3

[62] Hint: Exceeded Reach SS2 OUTLET depth by 0.27' @ 12.17 hrs

Inflow Area = 12.870 ac, 0.00% Impervious, Inflow Depth = 4.27" for 100-yr event
Inflow = 51.87 cfs @ 12.26 hrs, Volume= 4.582 af
Outflow = 51.15 cfs @ 12.33 hrs, Volume= 4.582 af, Atten= 1%, Lag= 4.2 min
Routed to Pond C1 : Culvert C1a & b

Routing by Stor-Ind+Trans method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.65 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.13 fps, Avg. Travel Time= 10.7 min

Peak Storage= 7,937 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.85' , Surface Width= 15.94'
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 253.69 cfs

10.00' x 2.00' deep channel, n= 0.030 Earth, dense weeds
Side Slope Z-value= 4.0 3.0 '/' Top Width= 24.00'
Length= 721.0' Slope= 0.0147 '/'
Inlet Invert= 698.00', Outlet Invert= 687.39'

‡

Summary for Pond C1: Culvert C1a & b

[58] Hint: Peaked 0.45' above defined flood level
[62] Hint: Exceeded Reach SS3 OUTLET depth by 3.23' @ 12.34 hrs

Inflow Area = 12.870 ac, 0.00% Impervious, Inflow Depth = 4.27" for 100-yr event
Inflow = 51.15 cfs @ 12.33 hrs, Volume= 4.582 af
Outflow = 51.15 cfs @ 12.33 hrs, Volume= 4.582 af, Atten= 0%, Lag= 0.0 min
Primary = 51.15 cfs @ 12.33 hrs, Volume= 4.582 af
Routed to Pond NP : North Pond

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 691.45' @ 12.33 hrs
Flood Elev= 691.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	687.71'	**24.0" Round C1a** L= 341.7' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 687.71' / 683.12' S= 0.0134 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	687.47'	**24.0" Round C1b** L= 341.6' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 687.47' / 683.25' S= 0.0124 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=51.13 cfs @ 12.33 hrs HW=691.45' (Free Discharge)
1=C1a (Inlet Controls 25.03 cfs @ 7.97 fps)
2=C1b (Inlet Controls 26.10 cfs @ 8.31 fps)

Summary for Pond C5: C5

[58] Hint: Peaked 2.06' above defined flood level
[62] Hint: Exceeded Reach SS1 OUTLET depth by 5.28' @ 12.28 hrs

Inflow Area = 3.123 ac, 0.00% Impervious, Inflow Depth = 4.38" for 100-yr event
Inflow = 14.25 cfs @ 12.28 hrs, Volume= 1.140 af
Outflow = 14.25 cfs @ 12.28 hrs, Volume= 1.140 af, Atten= 0%, Lag= 0.0 min
Primary = 14.25 cfs @ 12.28 hrs, Volume= 1.140 af
Routed to Reach SS2 : South Swale 2

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 710.06' @ 12.28 hrs
Flood Elev= 708.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	704.38'	**18.0" Round Culvert** L= 38.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 704.38' / 704.25' S= 0.0034 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=14.24 cfs @ 12.28 hrs HW=710.06' (Free Discharge)
└─**1=Culvert** (Barrel Controls 14.24 cfs @ 8.06 fps)

Summary for Pond NP: North Pond

[62] Hint: Exceeded Reach NS3 OUTLET depth by 1.62' @ 13.17 hrs
[79] Warning: Submerged Pond C1 Primary device # 1 OUTLET by 2.77'
[79] Warning: Submerged Pond C1 Primary device # 2 OUTLET by 2.64'

Inflow Area = 96.212 ac, 4.10% Impervious, Inflow Depth = 4.26" for 100-yr event
Inflow = 337.29 cfs @ 12.33 hrs, Volume= 34.174 af
Outflow = 71.57 cfs @ 13.04 hrs, Volume= 34.153 af, Atten= 79%, Lag= 42.9 min
Primary = 21.98 cfs @ 13.04 hrs, Volume= 26.485 af
Secondary = 49.59 cfs @ 13.04 hrs, Volume= 7.668 af

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Starting Elev= 681.75' Surf.Area= 122,831 sf Storage= 35,180 cf
Peak Elev= 685.89' @ 13.04 hrs Surf.Area= 260,790 sf Storage= 850,819 cf (815,638 cf above start)
Flood Elev= 886.00' Surf.Area= 263,538 sf Storage= 878,611 cf (843,431 cf above start)

Plug-Flow detention time= 423.6 min calculated for 33.345 af (98% of inflow)
Center-of-Mass det. time= 397.2 min (1,212.5 - 815.3)

Volume	Invert	Avail.Storage	Storage Description
#1	681.46'	878,611 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
681.46	119,790	0	0
682.00	125,453	66,216	66,216
684.00	211,702	337,155	403,371
686.00	263,538	475,240	878,611

Device	Routing	Invert	Outlet Devices
#1	Primary	681.50'	**24.0" Round Culvert** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 681.50' / 681.00' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.14 sf
#2	Device 1	681.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	682.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	682.75'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#5	Device 1	683.25'	**6.0" Vert. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads
#6	Device 1	684.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#7	Secondary	685.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 1.00 Width (feet) 10.00 20.00 30.00

Primary OutFlow Max=21.99 cfs @ 13.04 hrs HW=685.89' (Free Discharge)
└─**1=Culvert** (Barrel Controls 21.99 cfs @ 7.00 fps)
  ├─**2=Orifice/Grate** (Passes < 7.46 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 6.97 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 6.43 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 5.85 cfs potential flow)
  └─**6=Orifice/Grate** (Passes < 46.84 cfs potential flow)

Secondary OutFlow Max=47.48 cfs @ 13.04 hrs HW=685.89' (Free Discharge)
└─**7=Custom Weir/Orifice** (Weir Controls 47.48 cfs @ 2.80 fps)

Summary for Link F1: Flume 1

Inflow Area = 1.695 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 7.79 cfs @ 12.24 hrs, Volume= 0.590 af
Primary = 7.79 cfs @ 12.24 hrs, Volume= 0.590 af, Atten= 0%, Lag= 0.0 min
Routed to Pond NP : North Pond

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F2: Flume 2

Inflow Area =	0.661 ac,	0.00% Impervious, Inflow Depth = 4.17"	for 100-yr event	
Inflow =	3.07 cfs @	12.24 hrs, Volume=	0.230 af	
Primary =	3.07 cfs @	12.24 hrs, Volume=	0.230 af,	Atten= 0%, Lag= 0.0 min

Routed to Reach NS3 : North Swale 3

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F3: Flume 3

Inflow Area = 4.297 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 19.25 cfs @ 12.18 hrs, Volume= 1.495 af
Primary = 19.25 cfs @ 12.18 hrs, Volume= 1.495 af, Atten= 0%, Lag= 0.0 min
Routed to Pond NP : North Pond

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F4: Flume 4

Inflow Area = 2.780 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 12.59 cfs @ 12.25 hrs, Volume= 0.967 af
Primary = 12.59 cfs @ 12.25 hrs, Volume= 0.967 af, Atten= 0%, Lag= 0.0 min
Routed to Reach NS2 : North Swale 2

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link F6: Flume 6

Inflow Area = 2.618 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 11.89 cfs @ 12.25 hrs, Volume= 0.911 af
Primary = 11.89 cfs @ 12.25 hrs, Volume= 0.911 af, Atten= 0%, Lag= 0.0 min
Routed to Reach SS3 : South Swale 3

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Summary for Link RC1: Rock Chute 1

Inflow Area = 0.319 ac, 0.00% Impervious, Inflow Depth = 4.17" for 100-yr event
Inflow = 2.20 cfs @ 12.12 hrs, Volume= 0.111 af
Primary = 2.20 cfs @ 12.12 hrs, Volume= 0.111 af, Atten= 0%, Lag= 0.0 min
Routed to Reach SS3 : South Swale 3

Primary outflow = Inflow, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs

Diversion Berm Sizing and Spacing

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Universal Soil Loss Equation (USLE) Calculation

Purpose/Approach:

Use USLE to properly space diversion berms/swales along the 3% slope of the final cover and a 4:1 to maintain average annual soil loss along the final cover to 3 tons/acre or less. Also check average slope.

References:

1. Figure 7.2 Rainfall factors for use with the universal soil loss equation, Sheet 2
2. Table 5.1. Soil Erodibility Factor K_{fact}, Sheet 3
3. Table 10. Factor C for permanent pasture, range, and idle land, Sheet 4
4. Table of P-factors per land cover, Sheet 5

Assumptions:

A = 3 tons/acre

R =	98	see pg. 2
K =	0.33	see pg. 3 for silt loam assuming 4% organic matter
C =	0.0065	see pg. 4
P =	1.0	see pg. 5 for Dense vegetation

Calculations: USLE Equation: $A = R * K * LS * C * P$

where: A = Average annual soil loss, ton/acre
R = Rainfall and runoff erosivity index
K = Soil erodibility factor, tons/acre
LS = Slope length and steepness factor
C = Cover management factor
P = Practice factor

or $$LS = \frac{A}{R \times K \times C \times P} = \frac{3}{98 \times 0.33 \times 0.0065 \times 1.0}$$

$$= 14.27$$

From the LS Values Table (Sheet 5), based on the final cover slopes, the slope distance is between as shown below. Use linear interpolation between the LS values to determine the slope length for each slope. Then check average slope.

Slope Length @	200	ft	LS=	13.34
Slope Length @	250	ft	LS=	14.91

Conclusion:

The distance between the intermediate berms/swales on the final cover 4:1 slope cannot exceed 230 ft. The 3% slope and the average slope 10% can not be computed from the graphs since the LS value would require a slope greater than 1000 feet. No intermediate/swale is required for the final cover.

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		Calc. No.	
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Job No. 25222159	Job: I-43 Plan Mod Addendum	By: RJG	Date: 2/27/24
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Calculations (Continued):

Slope length for the calculate LS factor for 4:1 = 230 ft
Slope length for the calculate LS factor for 3% = <1,000 ft

Determine average slope along longest flow length. From the drawings the longest slope is
130 ft @ 4:1 slope and 280 ft @ 3% slope
Total Length = 410 ft
Average slope = (Slope1 * Length1 + Slope2 * Length2)/Total Length = 0.1 = ~10%

At 10% the calculated LS value gives a slope greater than 1000 ft, which exceeds
the longest potential flow path of the proposed intermediate and final closure design.

I:\25222259.00\Data and Calculations\Stormwater\2_Diversion Berms\[240405_Diversion Berm-Swale Spacing.xls]Intermediate Swale

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		Sheet No.	3 of 7
		Calc. No.	
		Rev. No.	
Job No. 25222259	Job: I-43 Plan Mod Addendum	By: RJG	Date: 2/27/24
Client: WPL	Subject: Intermediate Diversion Berm Spacing	Chk'd: SJL	Date: 4/5/24

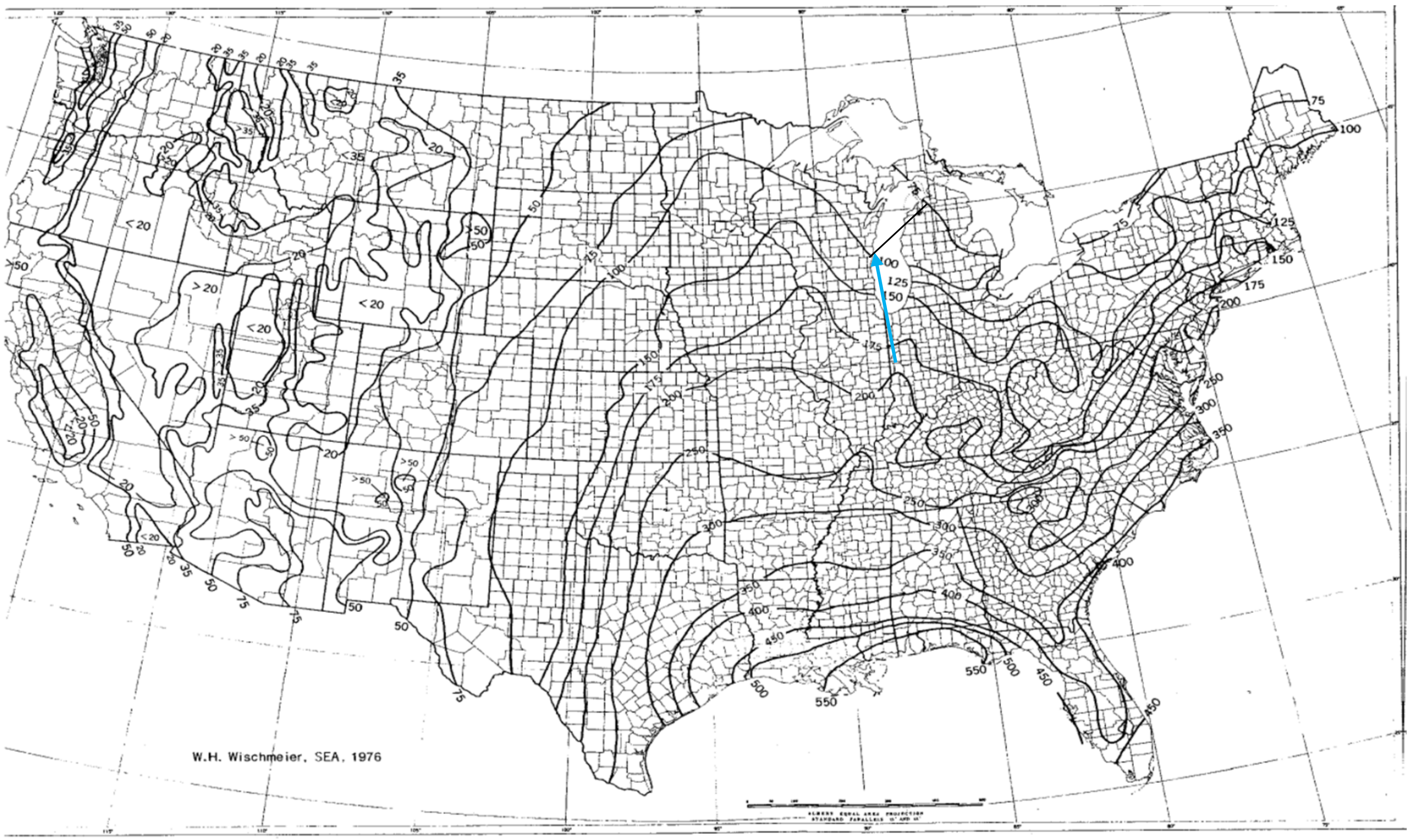

FIGURE 1.—Average annual values of the rainfall erosion index.

Source: "Predicting Rainfall Erosion Losses," USDA Agriculture Handbook Number 537, 1978.

Table 5.10. Soil Erodibility Factor K_{fact} (after Stewart et al. 1975)[a]

	P_{om}(%)		
Textural Class	<0.5	2	4
Sand	0.05	0.03	0.02
Fine sand	0.16	0.14	0.10
Very finesand	0.42	0.36	0.28
Loamy sand	0.12	0.10	0.08
Loamy finesand	0.24	0.20	0.16
Loamy veryfine sand	0.44	0.38	0.30
Sandy loam	0.27	0.24	0.19
Fine sandyloam	0.35	0.30	0.24
Very fine sandy loam	0.47	0.41	0.33
Loam	0.38	0.34	0.29
Silt loam	0.48	0.42	0.33
Silt	0.60	0.52	0.42
Sandy clayloam	0.27	0.25	0.21
Clay loam	0.28	0.25	0.21
Silty clayloam	0.37	0.32	0.26
Sandy clay	0.14	0.13	0.12
Silty clay	0.25	0.23	0.19
Clay		0.13-0.2	

(a) The values shown are estimated averages of broad ranges of specific soil values. When a texture is near the border line of two texture classes, use the average of the two K_{fact} values. In addition, the values shown are commensurate with the English units used in the cited reference (and as used in the source-term module input files). To obtain analagous values in the metric units used in this report, the above values should be multiplied by 1.292.

Assuming an organic content (P_{om}) of 4% to be conservative, typically range for topsoil is 4% and 8%.

K = 0.33

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TABLE 10.—*Factor **C** for permanent pasture, range, and idle land*[1]

Vegetative canopy: Type and height[2]	Percent cover[3]	Cover that contacts the soil surface: Type[4]	Percent ground cover: 0	20	40	60	80	95+
No appreciable canopy		G	0.45	0.20	0.10	0.042	0.013	0.003
		W	.45	.24	.15	.091	.043	.011
Tall weeds or short brush with average drop fall height of 20 in	25	G	.36	.17	.09	.038	.013	.003
		W	.36	.20	.13	.083	.041	.011
	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.076	.039	.011
	75	G	.17	.10	.06	.032	.011	.003
		W	.17	.12	.09	.068	.038	.011
Appreciable brush or bushes, with average drop fall height of 6½ ft	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.087	.042	.011
	50	G	.34	.16	.08	.038	.012	.003
		W	.34	.19	.13	.082	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.078	.040	.011
Trees, but no appreciable low brush. Average drop fall height of 13 ft	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.089	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.087	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.084	.041	.011

[1] The listed **C** values assume that the vegetation and mulch are randomly distributed over the entire area.

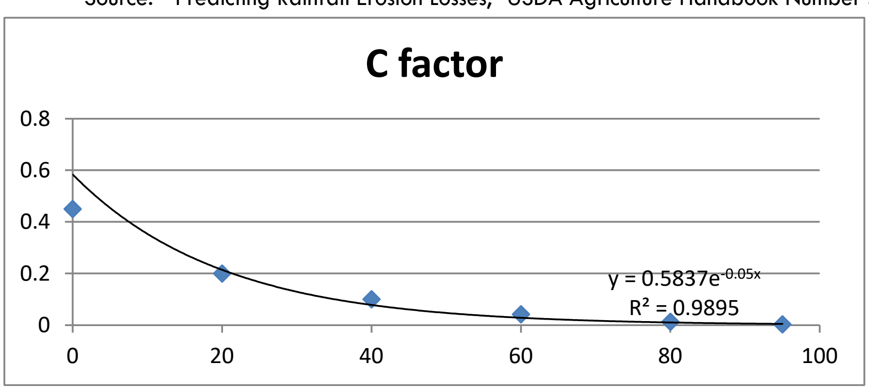
[2] Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

[3] Portion of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

[4] G: cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 in deep.

W: cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface) or undecayed residues or both.

Source: "Predicting Rainfall Erosion Losses," USDA Agriculture Handbook Number 537, 1978.



90 % Cover = 0.0065

S. no.	Land use/land cover classes	*P* values
1	Dense vegetation	1
2	Sparse vegetation	0.8
3	Built- up	1
4	Water bodies	1
5	Scrub land	1
6	Agricultural cropland	0.5
7	Fallow land	0.9
8	Bare soil/barren land	1

Source: USDA Handbook No. 282 (1981)

P factor for different land cover types

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TABLE 5.5 LS Values* (10)

Slope ratio	Slope gradient s, %	LS values for following slope lengths l, ft (m)									
		10 (3.0)	20 (6.1)	30 (9.1)	40 (12.2)	50 (15.2)	60 (18.3)	70 (21.3)	80 (24.4)	90 (27.4)	100 (30.5)
	0.5	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.09	0.09	0.10
100:1	1	0.08	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.12	0.12
	2	0.10	0.12	0.14	0.15	0.16	0.17	0.18	0.19	0.19	0.20
	3	0.14	0.18	0.20	0.22	0.23	0.25	0.26	0.27	0.28	0.29
	4	0.16	0.21	0.25	0.28	0.30	0.33	0.35	0.37	0.38	0.40
20:1	5	0.17	0.24	0.29	0.34	0.38	0.41	0.45	0.48	0.51	0.53
	6	0.21	0.30	0.37	0.43	0.48	0.52	0.56	0.60	0.64	0.67
	7	0.26	0.37	0.45	0.52	0.58	0.64	0.69	0.74	0.78	0.82
12½:1	8	0.31	0.44	0.54	0.63	0.70	0.77	0.83	0.89	0.94	0.99
	9	0.37	0.52	0.64	0.74	0.83	0.91	0.98	1.05	1.11	1.17
10:1	10	0.43	0.61	0.75	0.87	0.97	1.06	1.15	1.22	1.30	1.37
	11	0.50	0.71	0.86	1.00	1.12	1.22	1.32	1.41	1.50	1.58
8:1	12.5	0.61	0.86	1.05	1.22	1.36	1.49	1.61	1.72	1.82	1.92
	15	0.81	1.14	1.40	1.62	1.81	1.98	2.14	2.29	2.43	2.56
6:1	16.7	0.96	1.36	1.67	1.92	2.15	2.36	2.54	2.72	2.88	3.04
5:1	20	1.29	1.82	2.23	2.58	2.88	3.16	3.41	3.65	3.87	4.08
4½:1	22	1.51	2.13	2.61	3.02	3.37	3.69	3.99	4.27	4.53	4.77
4:1	25	1.86	2.63	3.23	3.73	4.16	4.56	4.93	5.27	5.59	5.89
	30	2.51	3.56	4.36	5.03	5.62	6.16	6.65	7.11	7.54	7.95
3:1	33.3	2.98	4.22	5.17	5.96	6.67	7.30	7.89	8.43	8.95	9.43
	35	3.23	4.57	5.60	6.46	7.23	7.92	8.55	9.14	9.70	10.22
2½:1	40	4.00	5.66	6.93	8.00	8.95	9.80	10.59	11.32	12.00	12.65
	45	4.81	6.80	8.33	9.61	10.75	11.77	12.72	13.60	14.42	15.20
2:1	50	5.64	7.97	9.76	11.27	12.60	13.81	14.91	15.94	16.91	17.82
	55	6.48	9.16	11.22	12.96	14.48	15.87	17.14	18.32	19.43	20.48
1¾:1	57	6.82	9.64	11.80	13.63	15.24	16.69	18.03	19.28	20.45	21.55
	60	7.32	10.35	12.68	14.64	16.37	17.93	19.37	20.71	21.96	23.15
1½:1	66.7	8.44	11.93	14.61	16.88	18.87	20.67	22.32	23.87	25.31	26.68
	70	8.98	12.70	15.55	17.96	20.08	21.99	23.75	25.39	26.93	28.39
	75	9.78	13.83	16.94	19.56	21.87	23.95	25.87	27.66	29.34	30.92
1¼:1	80	10.55	14.93	18.28	21.11	23.60	25.85	27.93	29.85	31.66	33.38
	85	11.30	15.98	19.58	22.61	25.27	27.69	29.90	31.97	33.91	35.74
	90	12.02	17.00	20.82	24.04	26.88	29.44	31.80	34.00	36.06	38.01
	95	12.71	17.97	22.01	25.41	28.41	31.12	33.62	35.94	38.12	40.18
1:1	100	13.36	18.89	23.14	26.72	29.87	32.72	35.34	37.78	40.08	42.24

Slope ratio	Slope gradient s, %	LS values for following slope lengths l, ft (m)												
		150 (46)	200 (61)	250 (76)	300 (91)	350 (107)	400 (122)	450 (137)	500 (152)	600 (183)	700 (213)	800 (244)	900 (274)	1000 (305)
	0.5	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.15	0.15
100:1	1	0.14	0.14	0.15	0.16	0.16	0.16	0.17	0.17	0.18	0.18	0.19	0.19	0.20
	2	0.23	0.25	0.26	0.28	0.29	0.30	0.32	0.33	0.34	0.36	0.37	0.39	0.40
	3	0.32	0.35	0.38	0.40	0.42	0.43	0.45	0.46	0.49	0.51	0.54	0.55	0.57
	4	0.47	0.53	0.58	0.62	0.66	0.70	0.73	0.76	0.82	0.87	0.92	0.96	1.00
20:1	5	0.66	0.76	0.85	0.93	1.00	1.07	1.13	1.20	1.31	1.42	1.51	1.60	1.69
	6	0.82	0.95	1.06	1.16	1.26	1.34	1.43	1.50	1.65	1.78	1.90	2.02	2.13
	7	1.01	1.17	1.30	1.43	1.54	1.65	1.75	1.84	2.02	2.18	2.33	2.47	2.61
12½:1	8	1.21	1.40	1.57	1.72	1.85	1.98	2.10	2.22	2.43	2.62	2.80	2.97	3.13
	9	1.44	1.66	1.85	2.03	2.19	2.35	2.49	2.62	2.87	3.10	3.32	3.52	3.71
10:1	10	1.68	1.94	2.16	2.37	2.56	2.74	2.90	3.06	3.35	3.62	3.87	4.11	4.33
	11	1.93	2.23	2.50	2.74	2.95	3.16	3.35	3.53	3.87	4.18	4.47	4.74	4.99
8:1	12.5	2.35	2.72	3.04	3.33	3.59	3.84	4.08	4.30	4.71	5.08	5.43	5.76	6.08
	15	3.13	3.62	4.05	4.43	4.79	5.12	5.43	5.72	6.27	6.77	7.24	7.68	8.09
6:1	16.7	3.72	4.30	4.81	5.27	5.69	6.08	6.45	6.80	7.45	8.04	8.60	9.12	9.62
5:1	20	5.00	5.77	6.45	7.06	7.63	8.16	8.65	9.12	9.99	10.79	11.54	12.24	12.90
4½:1	22	5.84	6.75	7.54	8.26	8.92	9.54	10.12	10.67	11.68	12.62	13.49	14.31	15.08
4:1	25	7.21	8.33	9.31	10.20	11.02	11.78	12.49	13.17	14.43	15.58	16.66	17.67	18.63
	30	9.74	11.25	12.57	13.77	14.88	15.91	16.87	17.78	19.48	21.04	22.49	23.86	25.15
3:1	33.3	11.55	13.34	14.91	16.33	17.64	18.86	20.00	21.09	23.10	24.95	26.67	28.29	29.82
	35	12.52	14.46	16.16	17.70	19.12	20.44	21.68	22.86	25.04	27.04	28.91	30.67	32.32
2½:1	40	15.50	17.89	20.01	21.91	23.67	25.30	26.84	28.29	30.99	33.48	35.79	37.96	40.01
	45	18.62	21.50	24.03	26.33	28.44	30.40	32.24	33.99	37.23	40.22	42.99	45.60	48.07
2:1	50	21.83	25.21	28.18	30.87	33.34	35.65	37.81	39.85	43.66	47.16	50.41	53.47	56.36
	55	25.09	28.97	32.39	35.48	38.32	40.97	43.45	45.80	50.18	54.20	57.94	61.45	64.78
1¾:1	57	26.40	30.48	34.08	37.33	40.32	43.10	45.72	48.19	52.79	57.02	60.96	64.66	68.15
	60	28.35	32.74	36.60	40.10	43.31	46.30	49.11	51.77	56.71	61.25	65.48	69.45	73.21
1½:1	66.7	32.68	37.74	42.19	46.22	49.92	53.37	56.60	59.66	65.36	70.60	75.47	80.05	84.38
	70	34.77	40.15	44.89	49.17	53.11	56.78	60.23	63.48	69.54	75.12	80.30	85.17	89.78
	75	37.87	43.73	48.89	53.56	57.85	61.85	65.60	69.15	75.75	81.82	87.46	92.77	97.79
1¼:1	80	40.88	47.20	52.77	57.81	62.44	66.75	70.80	74.63	81.76	88.31	94.41	100.13	105.55
	85	43.78	50.55	56.51	61.91	66.87	71.48	75.82	79.92	87.55	94.57	101.09	107.23	113.03
	90	46.55	53.76	60.10	65.84	71.11	76.02	80.63	84.99	93.11	100.57	107.51	114.03	120.20
	95	49.21	56.82	63.53	69.59	75.17	80.36	85.23	89.84	98.42	106.30	113.64	120.54	127.06
1:1	100	51.74	59.74	66.79	73.17	79.03	84.49	89.61	94.46	103.48	111.77	119.48	126.73	133.59

*Calculated from

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right)\left(\frac{l}{72.5}\right)^m$$

LS = topographic factor
l = slope length, ft (m × 0.3048)
s = slope steepness,
m = exponent dependent upon slope steep
(0.2 for slopes < 1%, 0.3 for slopes 1
0.4 for slopes 3.5 to 4.5%, and
0.5 for slopes > 5%)

FROM "EROSION & SEDIMENT CONTROL HANDBOOK," Goldman, Jackson, + Bursztynsky, 1986

Source: Erosion and Sediment Control Handbook," Goldman, Jackson, & Bursztynsky, 1986.

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		Sheet No: 1/3	
		Calc. No.	
		Rev. No.	
Job No. 25222259.00	Job: I-43 Plan Mod Addendum	By: RJG	Date: 4/5/24
Client: WPL	Subject: Diversion Berm Sizing	Chk'd: SJL	Date: 5/23/24

Purpose:

To size the diversion berm to accommodate the 25-year, 24-hour storm event.

References:

1. WisDOT Facilities Development Manual Chapter 13, Section 30-15, Grass Lined Channels.
2. Design of Roadside Channels with Flexible Linings, HEC-15, USDOT FHWA.
3. HydroCAD Report_I-43_CWS Liner Conversion.pdf
4. HydroCAD Report_I-43_Fully Developed Site Closure.pdf

Approach:

Use HydroCAD to determine the 25-year, 24-hour peak flow to each diversion berm drainage area. Use Grass Lined Channel Design WisDOT Spreadsheet, FDM 13-30 Attachment 15.2 (from Reference #1) to size the diversion berms. The WisDOT spreadsheet incorporates the design guidelines and equations described in "Design of Roadside Channels with Flexible Linings", HEC-15, USDOT FHWA (Reference #2).

Confirm the diversion berm swale is stable and has enough capacity for the design flow rate.

Assumptions:

1. Assume the channel geometry is a v-notch swale with one sideslope at either 4:1 (final cover slope) or 3% and the other sideslope at 2:1.
2. Assume 1.0% slope along the flow path of the diversion berm.
3. Assume the following parameters per Section 15.2 - Grass Lining Properties from Reference #1:
   Vegetation Retardance Class = C
   Vegetation Condition = Good
   Vegetation Growth Form = Turf
4. Assume Cohesive soil type with ASTM Soil Class SC and a Plasticity Index (PI) of 16.
5. Existing diversion berms are not evaluated because they will accept the same or less drainage area for the two closure options compared to when they were constructed.

Calculations:

Diversion berm flow rates:

Contact Water Swale Liner Conversion		**Fully Developed Site Closure**		
Drainage Area	Flowrate (cfs)	Drainage Area	Flowrate (cfs)	
Area 1	*1.93*	*Area 1*	*1.93*	
Area 3	*3.02*	*Area 3*	*3.02*	
Area 5	*2.54*	*Area 5*	*4.23*	
		Area 6	*5.29*	
		Area 9	*4.13*	4:1 cover
		Area 10	*5.54*	
		Area 11	*2.03*	
		Area 18	*1.41*	4:1 cover
		Area 19	*5.50*	4:1 cover

Size the diversion berm on the 3% cover based on a flow rate of: 5.54 cfs

Size the diversion berms on the 4:1 cover based on a flow rate of: 5.50 cfs

Use the WisDOT Grass Swale Design Spreadsheet to determine the flow depth, velocity and shear stress in the swale.

Results:

The calculated flow depth on the 3% final cover diversion berm is 0.65 feet with a flow velocity of 0.74 fps.
The diversion berm is stable at the design flow rate. The design diversion berm depth of 2 feet maintains at least 0.5 ft of during the 25-year, 24-hour storm event. Based on the shear stress o 0.41 lb/sf, install a Class 1, Type B channel erosion mat.

The calculated flow depth on the 4:1 final cover diversion berm is 1.19 feet with a flow velocity of 1.29 fps.
The diversion berm is stable at the design flow rate. The design diversion berm depth of 2.0 feet maintains at least 0.5 ft of during the 25-year, 24-hour storm event. Based on the shear stress o 0.74 lb/sf, install a Class 1, Type B channel erosion mat.

Channel/Ditch Geometry		
Channel Slope, S_o (ft/ft)	**0.01**	**0.01**
Channel Bottom Width, B (ft)	**0**	**0**
Channel Side Slope, z_1	**2**	**2**
Channel Side Slope, z_2	**33.33**	**4**
Flow Depth, d (ft) Solve iteratively	**0.65**	**1.19**
Safety Factor, SF	**1.0**	**1.0**
Vegetation/Soil Parameters		
Vegetation Retardance Class	**C**	**C**
Vegetation Condition	**good**	**good**
Vegetation Growth Form	**turf**	**turf**
Soil Type	**cohesive**	**cohesive**
D_{75} (in) (Set at 0.00 for cohesive soils)		
ASTM Soil Class	**SC**	**SC**
Plasticity Index, PI	**16**	**16**
Results Summary		
Design Q (ft^3/s)	**5.5**	**5.5**
Calculated Q (ft^3/s)	5.4	5.6
Difference Between Design & Calc. Flow (%)	-1.6%	1.7%
Stable (Yes or No)	**YES**	**YES**
Channel Parameters		
Vegetation Height, h (ft)	0.67	0.67
Grass Roughness Coefficient, C_n	0.238	0.238
Cover Factor, C_f	0.90	0.90
Noncohesive Soil		
Soil Grain Roughness, n_s	0.016	0.016
Permissible Soil Shear Stress, τ_p (lb/ft^2)	N/A	N/A
Cohesive Soil		
Porosity, e	0.35	0.35
Soil Coefficient 1, c_1	1.0700	1.0700
Soil Coefficient 2, c_2	14.30	14.30
Soil Coefficient 3, c_3	47.700	47.700
Soil Coefficient 4, c_4	1.42	1.42
Soil Coefficient 5, c_5	-0.61	-0.61
Soil Coefficient 6, c_6	0.00010	0.00010
Permissible Soil Shear Stress, τ_p (lb/ft^2)	0.080	0.080
Total Permissible Shear Stress, τ_p (lb/ft^2)	0.080	0.080
Cross Sectional Area, A (ft^2)	7.463	4.248
Wetted Perimeter, P (ft)	23.13	7.57
Hydraulic Radius, R (ft)	0.323	0.561
Top Width, T (ft)	22.96	7.14
Hydraulic Depth, D (ft)	0.325	0.595
Froude Number (Q design)	0.226	0.301
Channel Shear Stress, τ_o (lb/ft^2)	0.20	0.35
Actual Sheer Stress, τ_d (lb/ft^2)	0.41	0.74
Mannings n	0.096	0.077
Average Velocity, V (ft/s)	0.74	1.29
Calculated Flow, Q (ft^3/s)	5.4	5.6
Difference Between Design & Calc. Flow (%)	-1.6%	1.7%
Effective Shear on Soil Surface, τ_e (lb/ft^2)	0.001	0.003
Total Permissible Shear on Veg., $\tau_{p,veg}$ (lb/ft^2)	28.84	18.56
Stable (Y or N)	YES	YES

Source: Grass Lined Channel Design WisDOT Spreadsheet, FDM 13-30 Attachment 15.2

To differentiate applications WisDOT organizes erosion mats into three classes of mats, which are further broken down into various Types.

A. **Class I**: A short-term duration (minimum of 6 months), light duty, organic ECRM with plastic or biodegradable netting.

1. **Type A** – Only suitable for slope applications, not channel applications.
2. **Type B** – Double netted product for use in channels where the calculated (design) shear stress is 1.5 lbs/ft^2 or less.

B. **Class II**: A long-term duration (three years or greater), organic ECRM.

1. **Type A** – Jute fiber only for use in channels to reinforce sod.
2. **Type B** – For use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Made with plastic or biodegradable mat.
3. **Type C** – A woven mat of 100% organic material for use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Applicable for use in environmentally sensitive areas where plastic netting is inappropriate.

C. **Class III**: A permanent 100% synthetic ECRM or TRM. Class I, Type B erosion mat or Class II, Type B or C erosion mat must be placed over a soil filled TRM.

1. **Type A** – An ECRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.
2. **Type B** – A TRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.
3. **Type C** – A TRM for use in channels where the calculated (design) shear stress of 3.5 lbs/ft^2 or less.
4. **Type D** – A TRM for use in channels where the calculated (design) shear stress of 5.0 lbs/ft^2 or less.

Swale Sizing

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		Sheet No:	1/2
		Calc. No.	
		Rev. No.	
Job No.: 25222259.00	Job: I-43 Plan Mod Addendum	By: RJG	Date: 5/22/24
Client: WPL	Subject: Perimeter Swale Sizing	Chk'd: SJL	Date: 5/23/24

Purpose:

To size the perimeter swale to accommodate the 25-year, 24-hour storm event.

References:

1. WisDOT Facilities Development Manual Chapter 13, Section 30-15 - Grass Lined Channels.
2. Design of Roadside Channels with Flexible Linings, HEC-15, USDOT FHWA.
3. HydroCAD Report_I-43_CWS Liner Conversion.pdf
4. HydroCAD Report_I-43_Fully Developed Site Closure.pdf

Approach:

Use HydroCAD to determine the 25-year, 24-hour peak flow rate for the perimeter swale. Use Grass Lined Channel Design WisDOT Spreadsheet, FDM 13-30 Attachment 15.2 (from Reference #1) to size the perimeter swale for each design swale cross section. The WisDOT spreadsheet incorporates the design guidelines and equations described in "Design of Roadside Channels with Flexible Linings", HEC-15, USDOT FHWA (Reference #2).

Confirm the swale is stable and has enough capacity for the design flow rate.

Assumptions:

1. Assume the channel sideslopes are as shown on drawings.
2. Assume slope along the flowpath of the swale as shown on drawings.
3. Assume the following parameters per Section 15.2 - Grass Lining Properties from Reference #1:
   Vegetation Retardance Class = C
   Vegetation Condition = Good
   Vegetation Growth Form = Turf
4. Assume Cohesive soil type with ASTM Soil Class SC and a Plasticity Index (PI) of 16.

Calculations:

See Page 2, 3 and 4

Results:

The North and South perimeter swales can handle the flow rate without overtopping based on the average slope and as individual sections.

The proposed swales are designed to handle the 25-year, 24-hour storm peak discharge.

Based on the shear stress of each proposed swale install a Class 1, Type B channel erosion mat and where a swale is regraded.

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Job No.: 25222259.00	Job: I-43 Plan Mod Addendum	By: RJG	Date: 5/22/24
Client: WPL	Subject: Perimeter Swale Sizing	Chk'd: SJL	Date: 5/23/24

Calculations (Continued):

Contact Water Swale Liner Conversion:

Size proposed Swale 1 in Area 6 based on a flow rate of:	6.05 cfs from Node S1 from Reference 1.
Size proposed Swale 2 in Area 9 based on a flow rate of:	4.70 cfs from Node S2 from Reference 1.
Size proposed Swale 3 based on a flow rate of:	9.78 cfs from Node S3 from Reference 1.
Size proposed Swale 4 based on a flow rate of:	1.20 cfs from Node S4 from Reference 1.
Confirm Size of South Swale 1 based on a flow rate of:	9.79 cfs from Node SS1 from Reference 1.
Confirm Size of South Swale 2 based on a flow rate of:	12.82 cfs from Node SS2 from Reference 1.
Confirm Size of South Swale 3 based on a flow rate of:	13.51 cfs from Node SS3 from Reference 1.
Confirm Size of South Swale 4 based on a flow rate of:	13.56 cfs from Node SS4 from Reference 1.
Size regraded South Swale 5 based on a flow rate of:	14.75 cfs from Node SS5 from Reference 1.
Size regraded South Swale 6 based on a flow rate of:	17.37 cfs from Node SS6 from Reference 1.
Average South Swale flow rate:	17.37 cfs from Node SS6 from Reference 1.
Confirm Size of North Swale 1 based on a flow rate of:	20.02 cfs from Node NS1 from Reference 1.
Confirm Size of North Swale 2 based on a flow rate of:	24.00 cfs from Node NS2 from Reference 1.
Confirm Size of North Swale 3 based on a flow rate of:	26.58 cfs from Node NS3 from Reference 1.
Average North Swale flow rate:	26.58 cfs from Node NS3 from Reference 1.

Fully Developed Site Closure:

Confirm Size of North Swale 1 based on a flow rate of:	22.44 cfs from Node NS1 from Reference 2.
Confirm Size of North Swale 2 based on a flow rate of:	30.57 cfs from Node NS2 from Reference 2.
Confirm Size of North Swale 3 based on a flow rate of:	32.49 cfs from Node NS3 from Reference 2.
Confirm Size of South Swale 1 based on a flow rate of:	9.79 cfs from Node SS1 from Reference 2.
Confirm Size of South Swale 2 based on a flow rate of:	15.95 cfs from Node SS2 from Reference 2.
Confirm Size of South Swale 3 based on a flow rate of:	32.10 cfs from Node SS3 from Reference 2.

Use the WisDOT Grass Swale Design Spreadsheet (Sheet 2) to determine the flow depth, velocity and shear stress in the swale.

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Rev. No.	
By: RJG	Date: 5/22/24
Chk'd: SJL	Date: 5/23/24

Job No.: 25222259.00 Job: I-43 Plan Mod Addendum

Client: WPL Subject: Perimeter Swale Sizing

Contact Water Swale Liner Conversion

Channel/Ditch Geometry	***Swale 1***	***Swale 2***	***Swale 3***	***Swale 4***	***SS1***	***SS2***	***SS3***	***SS4***	***SS5***	***SS6***	***South Swale (average)***	***NS1***	***NS2***	***NS3***	***North Swale (averag***
Channel Slope, S_o (ft/ft)	0.0118	0.0125	0.0146	0.0032	0.014	0.0146	0.0093	0.0605	0.003	0.003	0.014	0.0209	0.0115	0.0193	0.01852996
Channel Bottom Width, B (ft)	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10
Channel Side Slope, z_1	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Channel Side Slope, z_2	10	10	3	4	3	3	3	3	3	3	3	3	3	3	3
Flow Depth (ft)	0.61	0.53	0.74	0.38	0.56	0.62	0.77	0.35	1.28	1.38	0.72	0.65	0.92	0.78	0.79
Safety Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Vegetation/Soil Parameters															
Vegetation Retardance Class	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Vegetation Condition	good	good	good	good	good	good	good	good	good	good	good	good	good	good	good
Vegetation Growth Form	turf	turf	turf	turf	turf	turf	turf	turf	turf	turf	turf	turf	turf	turf	turf
Soil Type	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive	cohesive
D_{75} (in) (Set at 0.00 for cohesive soils)															
ASTM Soil Class	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC
Plasticity Index, PI	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Results Summary															
Design Q (ft^3/s)	6.1	4.7	9.8	1.2	9.8	12.8	13.5	13.6	14.8	17.4	17.4	20.0	24.0	26.6	26.6
Calculated Q (ft^3/s)	6.1	4.7	9.7	1.2	9.8	12.9	13.5	13.5	14.6	17.3	17.5	19.7	23.8	26.6	26.7
Difference Between Design & Calc. Flow (%)	1.1%	-1.0%	-1.2%	-1.5%	0.5%	0.7%	0.1%	-0.5%	-1.3%	-0.5%	0.9%	-1.7%	-0.7%	0.0%	0.3%
Stable (Yes or No)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Channel Parameters															
Vegetation Height, h (ft)	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Grass Roughness Coefficient, C_n	0.238	0.238	0.238	0.238	0.238	0.238	0.238	0.238	0.238	0.238	0.238	0.238	0.238	0.238	0.238
Cover Factor, C_f	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Noncohesive Soil															
Soil Grain Roughness, n_s	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Permissible Soil Shear Stress, τ_p (lb/ft^2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cohesive Soil															
Porosity, e	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Soil Coefficient 1, c_1	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700
Soil Coefficient 2, c_2	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30
Soil Coefficient 3, c_3	47.700	47.700	47.700	47.700	47.700	47.700	47.700	47.700	47.700	47.700	47.700	47.700	47.700	47.700	47.700
Soil Coefficient 4, c_4	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
Soil Coefficient 5, c_5	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61
Soil Coefficient 6, c_6	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
Permissible Soil Shear Stress, τ_p (lb/ft^2)	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
Total Permissible Shear Stress, τ_p (lb/ft^2)	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
Cross Sectional Area, A (ft^2)	5.469	4.476	5.343	4.378	6.628	7.545	9.775	3.867	18.534	20.465	9.014	7.979	12.162	9.929	10.084
Wetted Perimeter, P (ft)	13.06	12.00	9.68	13.13	14.04	14.52	15.61	12.51	19.33	20.05	15.25	14.74	16.70	15.68	15.76
Hydraulic Radius, R (ft)	0.419	0.373	0.552	0.333	0.472	0.520	0.626	0.309	0.959	1.021	0.591	0.541	0.728	0.633	0.640
Top Width, T (ft)	12.93	11.89	9.44	13.04	13.89	14.34	15.39	12.42	18.96	19.66	15.04	14.55	16.44	15.46	15.53
Hydraulic Depth, D (ft)	0.423	0.376	0.566	0.336	0.477	0.526	0.635	0.311	0.978	1.041	0.599	0.548	0.740	0.642	0.649
Froude Number (Q design)	0.303	0.299	0.424	0.082	0.379	0.416	0.306	1.102	0.140	0.146	0.442	0.587	0.401	0.589	0.578
Channel Shear Stress τ_o (lb/ft^2)	0.31	0.29	0.50	0.07	0.41	0.47	0.36	1.17	0.18	0.19	0.53	0.71	0.52	0.76	0.74
Actual Sheer Stress τ_d (lb/ft^2)	0.45	0.41	0.67	0.08	0.48	0.56	0.45	1.30	0.24	0.26	0.65	0.85	0.66	0.94	0.91
Mannings n	0.081	0.083	0.067	0.150	0.072	0.068	0.076	0.048	0.101	0.098	0.065	0.058	0.066	0.057	0.057
Average Velocity, V (ft/s)	1.11	1.05	1.83	0.27	1.48	1.70	1.38	3.51	0.80	0.85	1.93	2.51	1.97	2.68	2.64
Calculated Flow, Q (ft^3/s)	6.1	4.7	9.7	1.2	9.8	12.9	13.5	13.5	14.6	17.3	17.5	19.7	23.8	26.6	26.7
Difference Between Design & Calc. Flow (%)	1.1%	-1.0%	-1.2%	-1.5%	0.5%	0.7%	0.1%	-0.5%	-1.3%	-0.5%	0.9%	-1.7%	-0.7%	0.0%	0.3%
Effective Shear on Soil Surface, τ_e (lb/ft^2)	0.002	0.002	0.004	0.000	0.002	0.003	0.002	0.014	0.001	0.001	0.004	0.006	0.004	0.007	0.007
Total Permissible Shear on Veg., $\tau_{p,veg}$ (lb/ft^2)	20.53	21.56	14.05	70.42	16.22	14.47	18.08	7.21	31.93	30.06	13.22	10.53	13.63	10.17	10.17
Stable (Y or N)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Source: Grass Lined Channel Design WisDOT Spreadsheet, FDM 13-30 Attachment 15.2

Fully Developed Site Closure

Channel/Ditch Geometry	***SS1***	***SS2***	***SS3***	***NS1***	***NS2***	***NS3***
Channel Slope, S_o (ft/ft)	**0.014**	**0.013**	**0.0147**	**0.0209**	**0.0115**	**0.0193**
Channel Bottom Width, B (ft)	**10**	**10**	**10**	**10**	**10**	**10**
Channel Side Slope, z_1	**4**	**4**	**4**	**4**	**4**	**4**
Channel Side Slope, z_2	**3**	**3**	**3**	**3**	**3**	**3**
Flow Depth (ft)	**0.56**	**0.72**	**0.95**	**0.69**	**1.03**	**0.85**
Safety Factor	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Vegetation/Soil Parameters						
Vegetation Retardance Class	**C**	**C**	**C**	**C**	**C**	**C**
Vegetation Condition	**good**	**good**	**good**	**good**	**good**	**good**
Vegetation Growth Form	**turf**	**turf**	**turf**	**turf**	**turf**	**turf**
Soil Type	**cohesive**	**cohesive**	**cohesive**	**cohesive**	**cohesive**	**cohesive**
D_{75} (in) (Set at 0.00 for cohesive soils)						
ASTM Soil Class	**SC**	**SC**	**SC**	**SC**	**SC**	**SC**
Plasticity Index, PI	**16**	**16**	**16**	**16**	**16**	**16**
Results Summary						
Design Q (ft^3/s)	**9.8**	**16.0**	**32.1**	**22.4**	**30.6**	**32.5**
Calculated Q (ft^3/s)	9.8	15.9	31.9	22.3	30.6	32.1
Difference Between Design & Calc. Flow (%)	0.5%	-0.5%	-0.5%	-0.8%	0.2%	-1.1%
Stable (Yes or No)	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Channel Parameters						
Vegetation Height, h (ft)	0.67	0.67	0.67	0.67	0.67	0.67
Grass Roughness Coefficient, C_n	0.238	0.238	0.238	0.238	0.238	0.238
Cover Factor, C_f	0.90	0.90	0.90	0.90	0.90	0.90
Noncohesive Soil						
Soil Grain Roughness, n_s	0.016	0.016	0.016	0.016	0.016	0.016
Permissible Soil Shear Stress, τ_p (lb/ft^2)	N/A	N/A	N/A	N/A	N/A	N/A
Cohesive Soil						
Porosity, e	0.35	0.35	0.35	0.35	0.35	0.35
Soil Coefficient 1, c_1	1.0700	1.0700	1.0700	1.0700	1.0700	1.0700
Soil Coefficient 2, c_2	14.30	14.30	14.30	14.30	14.30	14.30
Soil Coefficient 3, c_3	47.700	47.700	47.700	47.700	47.700	47.700
Soil Coefficient 4, c_4	1.42	1.42	1.42	1.42	1.42	1.42
Soil Coefficient 5, c_5	-0.61	-0.61	-0.61	-0.61	-0.61	-0.61
Soil Coefficient 6, c_6	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
Permissible Soil Shear Stress, τ_p (lb/ft^2)	0.080	0.080	0.080	0.080	0.080	0.080
Total Permissible Shear Stress, τ_p (lb/ft^2)	0.080	0.080	0.080	0.080	0.080	0.080
Cross Sectional Area, A (ft^2)	6.628	9.014	12.659	8.566	14.013	11.029
Wetted Perimeter, P (ft)	14.04	15.25	16.92	15.03	17.50	16.19
Hydraulic Radius, R (ft)	0.472	0.591	0.748	0.570	0.801	0.681
Top Width, T (ft)	13.89	15.04	16.65	14.83	17.21	15.95
Hydraulic Depth, D (ft)	0.477	0.599	0.760	0.578	0.814	0.691
Froude Number (Q design)	0.379	0.401	0.510	0.602	0.427	0.617
Channel Shear Stress, τ_o (lb/ft^2)	0.41	0.48	0.69	0.74	0.57	0.82
Actual Sheer Stress, τ_d (lb/ft^2)	0.48	0.58	0.87	0.90	0.74	1.02
Mannings n	0.072	0.068	0.059	0.057	0.063	0.055
Average Velocity, V (ft/s)	1.48	1.77	2.54	2.62	2.18	2.95
Calculated Flow, Q (ft^3/s)	9.8	15.9	31.9	22.3	30.6	32.1
Difference Between Design & Calc. Flow (%)	0.5%	-0.5%	-0.5%	-0.8%	0.2%	-1.1%
Effective Shear on Soil Surface, τ_e (lb/ft^2)	0.002	0.003	0.006	0.007	0.005	0.009
Total Permissible Shear on Veg., $\tau_{p,veg}$ (lb/ft^2)	16.22	14.47	10.89	10.17	12.42	9.47
Stable (Y or N)	YES	YES	YES	YES	YES	YES

Source: Grass Lined Channel Design WisDOT Spreadsheet, FDM 13-30 Attachment 15.2

To differentiate applications WisDOT organizes erosion mats into three classes of mats, which are further broken down into various Types.

A. **Class I**: A short-term duration (minimum of 6 months), light duty, organic ECRM with plastic or biodegradable netting.

1. **Type A** – Only suitable for slope applications, not channel applications.

2. **Type B** – Double netted product for use in channels where the calculated (design) shear stress is 1.5 lbs/ft^2 or less.

B. **Class II**: A long-term duration (three years or greater), organic ECRM.

1. **Type A** – Jute fiber only for use in channels to reinforce sod.

2. **Type B** – For use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Made with plastic or biodegradable mat.

3. **Type C** – A woven mat of 100% organic material for use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Applicable for use in environmentally sensitive areas where plastic netting is inappropriate.

C. **Class III**: A permanent 100% synthetic ECRM or TRM. Class I, Type B erosion mat or Class II, Type B or C erosion mat must be placed over a soil filled TRM.

1. **Type A** – An ECRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.

2. **Type B** – A TRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.

3. **Type C** – A TRM for use in channels where the calculated (design) shear stress of 3.5 lbs/ft^2 or less.

4. **Type D** – A TRM for use in channels where the calculated (design) shear stress of 5.0 lbs/ft^2 or less.

Rock Chute Sizing

SCS ENGINEERS	Sheet No: 1/2	
	Calc. No.	
	Rev. No.	

Job No. 25222259.00	Job: I-43 Plan Mod Addendum	By: RJG	Date: 4/4/24
Client: WPL	Subject: Rock Chute Sizing	Chk'd: SJL	Date: 4/5/24

Purpose:

To size the rock chute to accommodate the 25-year, 24-hour storm event.

References:

1. WisDOT Facilities Development Manual Chapter 13, Section 30-30 - Rock Riprap Lined Chutes.
2. HydroCAD Report_I-43_Fully Developed Site Closure.pdf

Approach:

Use HydroCAD to determine the 25-year, 24-hour peak flow rate for the perimeter swale. Use WisDOT Rock Chute Data Spreadsheet, FDM 13-30-30 Attachment 30.1 (from Reference #1) to design the rock chute. The WisDOT spreadsheet was developed using a design procedure developed by NRCS and modified by WisDOT to account for WisDOT specific riprap sizes and design requirements.

Confirm the swale is stable and has enough capacity for the design flow rate.

Assumptions:

1. Assume the channel is a diversion berm that is 0 ft wide with sideslopes of 2H:1V and 4H:1V.
2. Assume 1.0 % slope along the flowpath of the chute.
3. Assume 4H:1V slope for calculation.

Calculations:

Chute flow rates:

Size the chute based on a flow rate of 1.41 cfs.

Use the WisDOT Rock Chute Data Spreadsheet (Sheet 2) to determine the flow depth, riprap size and apron dimensions.

Results:

A rock chute designed as summarized on Sheet 3 and the project plan set will accommodate the runoff from a 25-year, 24-hour storm event in a stable manner. Use light riprap per table below.

Table 25.1 Typical Particle Sizes of Native Sands at 75 Percent Passing (D_{75})

Riprap Type	D50 (inches)	D50 (feet)	Riprap Thickness (in)	Geotextile Type
Select Crushed Material	2.2	0.18	5	Type R
Light Riprap	10	0.83	12	Type R
Medium Riprap	12.5	1.04	18	Type HR
Heavy Riprap	16	1.33	24	Type HR
Extra-Heavy Riprap	20	1.67	30	Type HR

Rock Chute Design Data

(Version WI-April-2005, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)
Revised for WisDOT 9/2010

Project: I-43 Plan Mod Add. **County:** Sheboygan
Designer: RJG **Checked by:** SJL
Date: April 4, 2024 **Date:** 04/05/24

Input Geometry:

Upstream Channel		Chute			Downstream Channel	
Bottom Width =	0.0 ft.	Bottom Width =	4.0 ft.		Bottom Width =	4.0 ft.
Side slopes =	4.0 (m:1)	Factor of safety =	1.20 (SF)	1.2 Min	Side slopes =	4.0 (m:1)
Mannings n value =	0.030	Side slopes =	3.0 (z:1)	2.0:1 max.	Mannings n value =	0.030
Bed slope =	0.0100 ft./ft.	Bed slope =	0.2500 ft./ft	3.0:1 max.	Bed slope =	0.0050 ft./ft.
Note: Use procedures 13-30-15 or 13-30-25 for		Freeboard =	1.0 ft.			
upstream and downstream Mannings n		Outlet apron depth, d =	1.0 ft.		Base flow =	0.0 cfs

Flow and Elevation Data:

Apron elev. --- Inlet = 698.0 ft. ------- Outlet 690.0 ft. --- (H_{drop} = 7 ft.)

Degree of angularity = 1
1 --> 50% angular, 50% rounded
2 --> 100 % rounded

Q_{high} = Runoff from design storm
Q_5 = Runoff from a 5-year,24-hour storm

Q_{high}= 1.4 cfs High flow storm through chute → Tw (ft.) = Program
Q_{low} = 1.4 cfs Low flow storm through chute → Tw (ft.) = Program

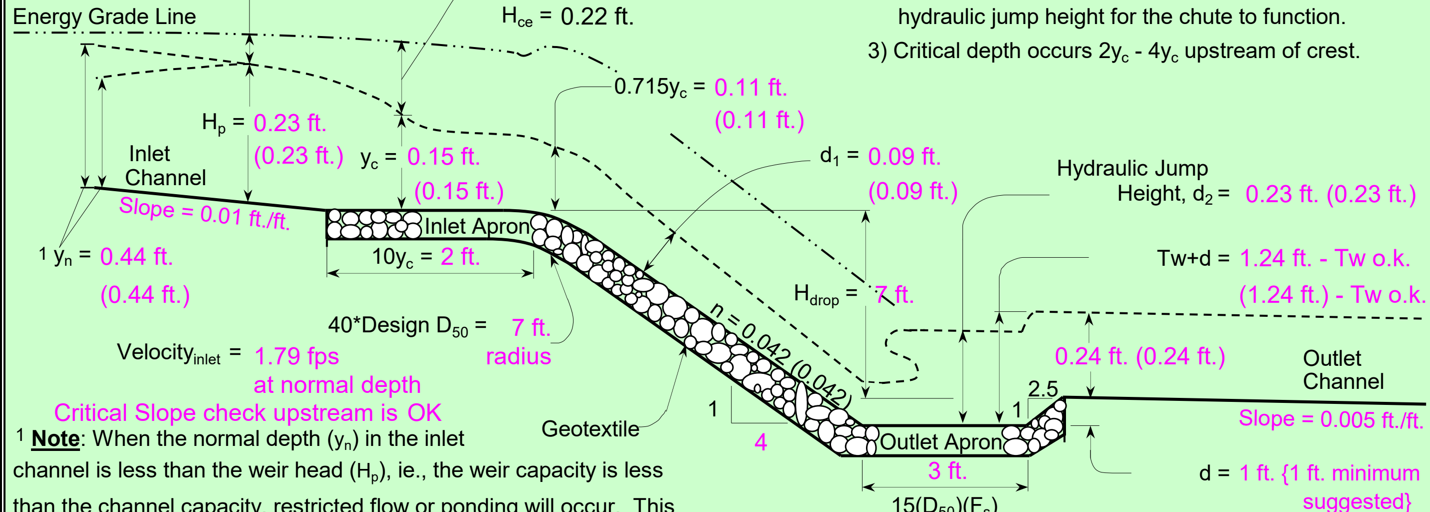
Note: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.

Input tailwater (Tw): 0.25 1.20

Profile and Cross Section (Output):

Starting Station = 3+00.0

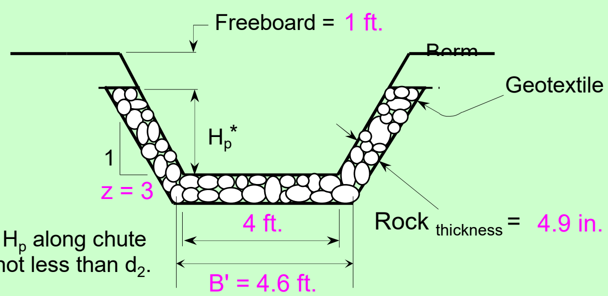
Notes:
1) Output given as **High Flow (Low Flow)** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.



[1] **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute

Typical Cross Section



* Use H_p along chute but not less than d_2.

	0.33 cfs/ft.	Equivalent unit discharge
SF =	1.20	Factor of safety (multiplier)
d_1 =	0.09 ft.	Normal depth in chute
n-value =	0.042	Manning's roughness coefficient
D_{50}(SF) =	2.4 in.	Minimum Design D_{50}*
$2(D_{50})$(SF) =	4.9 in.	Rock chute thickness
Tw + d =	1.24 ft.	Tailwater above outlet apron
d_2 =	0.23 ft.	Hydraulic jump height
***** The outlet**	**will**	**function adequately**

High Flow Storm Information

Existing Culverts

SCS ENGINEERS

		Sheet No:	1 of 16
		Calc. No.	
		Rev. No.	
Job No. 25222259.00	Job: I-43 Plan Mod Addendum	By: RJG	Date: 5/22/24
Client: WPL	Subject: Culvert Sizing	Chk'd: SJL	Date: 5/23/24

Purpose:

To size the post closure culverts to accommodate the 25-year, 24-hour storm event.

References:

1. HY-8 7.40 Computer Model
2. HydroCAD Report_I-43_CWS Liner Conversion.pdf and HydroCAD Report_I-43_Fully Developed Site Closure.pdf
3. Sheet 1 - Storm Water - Contact Water Swale Liner Conversion
4. Sheet 2 - Storm Water - Fully Developed Site Closure

Approach:

1. Create culvert crossing in HY-8 and input data from Reference #2, #3, and #4.
2. Adjust diameter size and number of culverts in model until design flow does not over top berm/road crossing.

Assumptions:

1. Assume the tailwater channel data is a based on discharge swale or rock chute geometry (Reference #2).
2. Culverts are circular, PE Pipe with smooth interior, and with square edge with headwall.
3. Culvert elevations, lengths, and slopes based on Sheet 1 (Reference #3) and Sheet 2 (Reference #4).
4. Roadway data for crossing based on Sheet 1 (Reference #3) and Sheet 2 (Reference #4).
5. Discharge flows from HydroCAD report (Refence #2).

Calculations:

See attached HY-8 Model output reports for C1 through C5.

Results:

The existing culverts are adequately designed to accommodate the flows from the 25-year, 24-hour storm event for the Contact Water Swale Liner Conversion and Fully Developed Site Closure conditions.

HY-8 Culvert Analysis Report – Fully Developed Site

Culvert Data: Culvert C1 a & b

Site Data - Culvert C1 a & b
Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 687.47 ft
Outlet Station: 341.60 ft
Outlet Elevation: 683.25 ft
Number of Barrels: 2
Culvert Data Summary - Culvert C1 a & b
Barrel Shape: Circular
Barrel Diameter: 2.00 ft
Barrel Material: Smooth HDPE
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight
Inlet Configuration: Square Edge with Headwall (Ke=0.5)
Inlet Depression: None
Culvert Barrel Data
Culvert Barrel Type Straight Culvert
Inlet Elevation (invert): 687.47 ft,
Outlet Elevation (invert): 683.25 ft
Culvert Length: 341.63 ft,
Culvert Slope: 0.0124
Tailwater Channel Data - Fully Developed Site Closure
Tailwater Channel Option: Trapezoidal Channel
Bottom Width: 10.00 ft
Side Slope (H:V): 3.50 (_:1)
Channel Slope: 0.0130
Channel Manning's n: 0.0270
Roadway Data for Crossing: CWS Liner Conversion
Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 100.00 ft
Crest Elevation: 691.00 ft
Roadway Surface: Gravel
Roadway Top Width: 50.00 ft
Crossing Discharge Data
Discharge Selection Method: Specify Minimum, Design, and Maximum Flow
Minimum Flow: 31.65 cfs
Design Flow: 31.65 cfs
Maximum Flow: 51.15 cfs

Table 1 - Summary of Culvert Flows at Crossing: Fully Developed Site Closure

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert C1 a & b Discharge (cfs)	Roadway Discharge (cfs)	Iterations
689.82	31.65	31.65	0.00	1 25-yr Storm
689.94	33.60	33.60	0.00	1
690.07	35.55	35.55	0.00	1
690.21	37.50	37.50	0.00	1
690.36	39.45	39.45	0.00	1
690.51	41.40	41.40	0.00	1
690.68	43.35	43.35	0.00	1
690.85	45.30	45.30	0.00	1
691.01	47.25	47.03	0.13	30
691.04	49.20	47.35	1.77	7
691.06	51.15	47.57	3.54	6
691.00	46.96	46.96	0.00	Overtopping

Table 2 - Culvert Summary Table: Culvert C1 a & b

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
31.65 cfs	31.65 cfs	689.82	2.35	0.0*	5-S2n	1.09	1.43	1.09	0.63	9.01	4.10
33.60 cfs	33.60 cfs	689.94	2.47	0.0*	5-S2n	1.13	1.48	1.13	0.65	9.14	4.18
35.55 cfs	35.55 cfs	690.07	2.60	0.072	5-S2n	1.18	1.52	1.18	0.67	9.25	4.26
37.50 cfs	37.50 cfs	690.21	2.74	0.377	5-S2n	1.22	1.56	1.22	0.70	9.36	4.34
39.45 cfs	39.45 cfs	690.36	2.89	0.697	5-S2n	1.26	1.60	1.26	0.72	9.46	4.41
41.40 cfs	41.40 cfs	690.51	3.04	1.030	5-S2n	1.30	1.63	1.30	0.74	9.56	4.48
43.35 cfs	43.35 cfs	690.68	3.21	1.378	5-S2n	1.35	1.66	1.35	0.75	9.64	4.54
45.30 cfs	45.30 cfs	690.85	3.38	1.740	5-S2n	1.39	1.70	1.39	0.77	9.71	4.61
47.25 cfs	47.03 cfs	691.01	3.54	2.072	5-S2n	1.43	1.72	1.43	0.79	9.77	4.67
49.20 cfs	47.35 cfs	691.04	3.57	2.136	5-S2n	1.44	1.73	1.44	0.81	9.78	4.73
51.15 cfs	47.57 cfs	691.06	3.59	2.180	5-S2n	1.44	1.73	1.45	0.83	9.77	4.79

* Full Flow Headwater elevation is below inlet invert.

Culvert Data: Culvert C5

Site Data - Culvert C5

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 704.38 ft
Outlet Station: 38.05 ft
Outlet Elevation: 704.25 ft
Number of Barrels: 1

Culvert Data Summary - Culvert C5

Barrel Shape: Circular
Barrel Diameter: 1.50 ft
Barrel Material: Smooth HDPE
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: None

Culvert Barrel Data

Culvert Barrel Type Straight Culvert
Inlet Elevation (invert): 704.38 ft,
Outlet Elevation (invert): 704.25 ft
Culvert Length: 38.06 ft,
Culvert Slope: 0.0035

Tailwater Channel Data - Fully Developed Site Closure

Tailwater Channel Option: Trapezoidal Channel
Bottom Width: 10.00 ft
Side Slope (H:V): 3.50 (_:1)
Channel Slope: 0.0128
Channel Manning's n: 0.0300
Channel Invert Elevation: 704.25 ft

Roadway Data for Crossing: Fully Developed Site Closure

Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 25.00 ft
Crest Elevation: 708.00 ft
Roadway Surface: Gravel
Roadway Top Width: 25.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow
Minimum Flow: 9.07 cfs
Design Flow: 9.07 cfs
Maximum Flow: 14.25 cfs

Table 1 - Summary of Culvert Flows at Crossing: Fully Developed Site Closure

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert C5 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
706.76	9.07	9.07	0.00	1
706.92	9.59	9.59	0.00	1
707.09	10.11	10.11	0.00	1
707.27	10.62	10.62	0.00	1
707.46	11.14	11.14	0.00	1
707.67	11.66	11.66	0.00	1
707.88	12.18	12.18	0.00	1
708.02	12.70	12.49	0.18	19
708.05	13.21	12.55	0.65	7
708.07	13.73	12.60	1.13	6
708.09	14.25	12.64	1.60	5
708.00	12.44	12.44	0.00	Overtopping

Table 2 - Culvert Summary Table: Culvert C5

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
9.07 cfs	9.07 cfs	706.76	2.38	2.227	7-M2c	1.50	1.16	1.16	0.33	6.16	2.48
9.59 cfs	9.59 cfs	706.92	2.54	2.345	7-M2c	1.50	1.20	1.20	0.34	6.35	2.53
10.11 cfs	10.11 cfs	707.09	2.71	2.484	7-M2c	1.50	1.22	1.22	0.35	6.54	2.58
10.62 cfs	10.62 cfs	707.27	2.89	2.642	7-M2c	1.50	1.25	1.25	0.36	6.74	2.63
11.14 cfs	11.14 cfs	707.46	3.08	2.793	7-M2c	1.50	1.28	1.28	0.37	6.95	2.67
11.66 cfs	11.66 cfs	707.67	3.29	2.959	7-M2c	1.50	1.30	1.30	0.38	7.17	2.71
12.18 cfs	12.18 cfs	707.88	3.50	3.124	7-M2c	1.50	1.32	1.32	0.39	7.39	2.75
12.70 cfs	12.49 cfs	708.02	3.64	3.226	7-M2c	1.50	1.33	1.33	0.40	7.53	2.79
13.21 cfs	12.55 cfs	708.05	3.67	3.242	7-M2c	1.50	1.34	1.34	0.41	7.55	2.83
13.73 cfs	12.60 cfs	708.07	3.69	3.257	7-M2c	1.50	1.34	1.34	0.42	7.57	2.87
14.25 cfs	12.64 cfs	708.09	3.71	3.270	7-M2c	1.50	1.34	1.34	0.43	7.59	2.91

Culverts – Contact Water Swale Liner Conversion

Culvert Data: Culvert C1 a & b CWS Liner Conversion

Site Data - Culvert C1 a & b

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 687.47 ft

Outlet Station: 341.60 ft

Outlet Elevation: 683.25 ft

Number of Barrels: 2

Culvert Data Summary - Culvert C1 a & b

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall (Ke=0.5)

Inlet Depression: None

Tailwater Channel Data - Fully Developed Site Closure

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 10.00 ft

Side Slope (H:V): 3.50 (_:1)

Channel Slope: 0.0130

Channel Manning's n: 0.0270

Roadway Data for Crossing: CWS Liner Conversion

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 691.00 ft

Roadway Surface: Gravel

Roadway Top Width: 50.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 16.57 cfs

Design Flow: 16.57 cfs

Maximum Flow: 27.70 cfs

Table 1 - Summary of Culvert Flows at Crossing: CWS Liner Conversion

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert C1 a & b Discharge (cfs)	Roadway Discharge (cfs)	Iterations
688.98	16.57	16.57	0.00	1
689.04	17.68	17.68	0.00	1
689.10	18.80	18.80	0.00	1
689.16	19.91	19.91	0.00	1
689.22	21.02	21.02	0.00	1
689.28	22.13	22.13	0.00	1
689.34	23.25	23.25	0.00	1
689.40	24.36	24.36	0.00	1
689.46	25.47	25.47	0.00	1
689.52	26.59	26.59	0.00	1
689.58	27.70	27.70	0.00	1
691.00	46.97	46.97	0.00	Overtopping

Table 2 - Culvert Summary Table: Culvert C1 a & b

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
16.57 cfs	16.57 cfs	688.98	1.51	0.0*	1-S2n	0.76	1.03	0.76	0.44	7.62	3.30
17.68 cfs	17.68 cfs	689.04	1.57	0.0*	1-S2n	0.78	1.06	0.78	0.45	7.76	3.37
18.80 cfs	18.80 cfs	689.10	1.63	0.0*	1-S2n	0.81	1.10	0.81	0.47	7.89	3.45
19.91 cfs	19.91 cfs	689.16	1.69	0.0*	1-S2n	0.84	1.13	0.84	0.48	8.01	3.51
21.02 cfs	21.02 cfs	689.22	1.75	0.0*	1-S2n	0.86	1.16	0.86	0.50	8.12	3.58
22.13 cfs	22.13 cfs	689.28	1.81	0.0*	1-S2n	0.89	1.19	0.89	0.51	8.23	3.64
23.25 cfs	23.25 cfs	689.34	1.87	0.0*	1-S2n	0.91	1.22	0.91	0.53	8.34	3.70
24.36 cfs	24.36 cfs	689.40	1.93	0.0*	1-S2n	0.94	1.25	0.94	0.54	8.44	3.76
25.47 cfs	25.47 cfs	689.46	1.99	0.0*	1-S2n	0.96	1.28	0.96	0.56	8.54	3.82
26.59 cfs	26.59 cfs	689.52	2.05	0.0*	5-S2n	0.98	1.31	0.98	0.57	8.63	3.87
27.70 cfs	27.70 cfs	689.58	2.11	0.0*	5-S2n	1.01	1.34	1.01	0.59	8.72	3.93

* Full Flow Headwater elevation is below inlet invert.

Culvert Data: Culvert C2

Site Data - Culvert C2

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 688.68 ft
Outlet Station: 46.00 ft
Outlet Elevation: 688.54 ft
Number of Barrels: 1

Culvert Data Summary - Culvert C2

Barrel Shape: Circular
Barrel Diameter: 2.00 ft
Barrel Material: Smooth HDPE
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: None

Culvert Barrel Data

Culvert Barrel Type Straight Culvert
Inlet Elevation (invert): 688.68 ft,
Outlet Elevation (invert): 688.54 ft
Culvert Length: 46.00 ft,
Culvert Slope: 0.0030

Tailwater Channel Data - CWS Liner Conversion

Tailwater Channel Option: Trapezoidal Channel
Bottom Width: 10.00 ft
Side Slope (H:V): 3.50 (_:1)
Channel Slope: 0.0030
Channel Manning's n: 0.0300
Channel Invert Elevation: 688.54 ft

Roadway Data for Crossing: CWS Liner Conversion

Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 27.00 ft
Crest Elevation: 694.00 ft
Roadway Surface: Gravel
Roadway Top Width: 25.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow
Minimum Flow: 15.73 cfs
Design Flow: 15.73 cfs
Maximum Flow: 24.86 cfs

Table 1 - Summary of Culvert Flows at Crossing: CWS Liner Conversion

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert C2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
691.33	15.73	15.73	0.00	1
691.48	16.64	16.64	0.00	1
691.65	17.56	17.56	0.00	1
691.82	18.47	18.47	0.00	1
692.00	19.38	19.38	0.00	1
692.19	20.30	20.30	0.00	1
692.39	21.21	21.21	0.00	1
692.61	22.12	22.12	0.00	1
692.83	23.03	23.03	0.00	1
693.07	23.95	23.95	0.00	1
693.31	24.86	24.86	0.00	1
694.00	27.20	27.20	0.00	Overtopping

Table 2 - Culvert Summary Table: Culvert C2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
15.73 cfs	15.73 cfs	691.33	2.65	2.600	7-M2c	2.00	1.43	1.43	0.68	6.55	1.86
16.64 cfs	16.64 cfs	691.48	2.80	2.710	7-M2c	2.00	1.47	1.47	0.71	6.72	1.89
17.56 cfs	17.56 cfs	691.65	2.97	2.824	7-M2c	2.00	1.51	1.51	0.73	6.90	1.92
18.47 cfs	18.47 cfs	691.82	3.14	2.944	7-M2c	2.00	1.55	1.55	0.75	7.08	1.95
19.38 cfs	19.38 cfs	692.00	3.32	3.071	7-M2c	2.00	1.58	1.58	0.77	7.27	1.99
20.30 cfs	20.30 cfs	692.19	3.51	3.208	7-M2c	2.00	1.62	1.62	0.79	7.46	2.01
21.21 cfs	21.21 cfs	692.39	3.71	3.375	7-M2c	2.00	1.65	1.65	0.81	7.66	2.04
22.12 cfs	22.12 cfs	692.61	3.93	3.536	7-M2c	2.00	1.68	1.68	0.83	7.86	2.07
23.03 cfs	23.03 cfs	692.83	4.15	3.717	7-M2c	2.00	1.71	1.71	0.85	8.06	2.10
23.95 cfs	23.95 cfs	693.07	4.39	3.893	7-M2c	2.00	1.73	1.73	0.87	8.28	2.12
24.86 cfs	24.86 cfs	693.31	4.63	4.075	7-M2c	2.00	1.76	1.76	0.88	8.50	2.15

Culvert Data: Culvert C3

Site Data - Culvert C3

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 691.71 ft
Outlet Station: 48.00 ft
Outlet Elevation: 691.01 ft
Number of Barrels: 1

Culvert Data Summary - Culvert C3

Barrel Shape: Circular
Barrel Diameter: 12.00 ft
Barrel Material: Smooth HDPE
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: None

Culvert Barrel Data

Culvert Barrel Type Straight Culvert
Inlet Elevation (invert): 691.71 ft,
Outlet Elevation (invert): 691.01 ft
Culvert Length: 48.01 ft,
Culvert Slope: 0.0146

Tailwater Channel Data - CWS Liner Conversion

Tailwater Channel Option: Trapezoidal Channel
Bottom Width: 10.00 ft
Side Slope (H:V): 3.50 (_:1)
Channel Slope: 0.0030
Channel Manning's n: 0.0300
Channel Invert Elevation: 691.01 ft

Roadway Data for Crossing: CWS Liner Conversion

Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 25.00 ft
Crest Elevation: 702.00 ft
Roadway Surface: Gravel
Roadway Top Width: 25.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow
Minimum Flow: 6.08 cfs
Design Flow: 6.08 cfs
Maximum Flow: 9.34 cfs

Table 1 - Summary of Culvert Flows at Crossing: CWS Liner Conversion

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert C3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
692.47	6.08	6.08	0.00	1
692.49	6.41	6.41	0.00	1
692.51	6.73	6.73	0.00	1
692.53	7.06	7.06	0.00	1
692.55	7.38	7.38	0.00	1
692.57	7.71	7.71	0.00	1
692.60	8.04	8.04	0.00	1
692.61	8.36	8.36	0.00	1
692.63	8.69	8.69	0.00	1
692.64	9.01	9.01	0.00	1
692.66	9.34	9.34	0.00	1
702.00	809.83	809.83	0.00	Overtopping

Table 2 - Culvert Summary Table: Culvert C3

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
6.08 cfs	6.08 cfs	692.47	0.76	0.0*	1-S2n	0.35	0.54	0.38	0.40	5.51	1.35
6.41 cfs	6.41 cfs	692.49	0.78	0.0*	1-S2n	0.36	0.55	0.39	0.41	5.56	1.37
6.73 cfs	6.73 cfs	692.51	0.80	0.0*	1-S2n	0.37	0.56	0.40	0.42	5.63	1.40
7.06 cfs	7.06 cfs	692.53	0.82	0.0*	1-S2n	0.37	0.58	0.41	0.43	5.70	1.42
7.38 cfs	7.38 cfs	692.55	0.84	0.0*	1-S2n	0.38	0.59	0.42	0.44	5.78	1.44
7.71 cfs	7.71 cfs	692.57	0.86	0.0*	1-S2n	0.39	0.60	0.42	0.45	5.84	1.46
8.04 cfs	8.04 cfs	692.60	0.89	0.0*	1-S2n	0.40	0.62	0.43	0.47	5.92	1.48
8.36 cfs	8.36 cfs	692.61	0.90	0.0*	1-S2n	0.40	0.63	0.44	0.48	5.97	1.50
8.69 cfs	8.69 cfs	692.63	0.92	0.0*	1-S2n	0.41	0.64	0.45	0.49	6.06	1.52
9.01 cfs	9.01 cfs	692.64	0.93	0.0*	1-S2n	0.42	0.65	0.46	0.50	6.10	1.54
9.34 cfs	9.34 cfs	692.66	0.95	0.0*	1-S2n	0.43	0.66	0.47	0.51	6.18	1.56

* Full Flow Headwater elevation is below inlet invert.

Culvert Data: Culvert C4

Site Data - Culvert C4

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 699.46 ft

Outlet Station: 40.55 ft

Outlet Elevation: 698.97 ft

Number of Barrels: 1

Culvert Data Summary - Culvert C4

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 699.46 ft,
Outlet Elevation (invert): 698.97 ft

Culvert Length: 40.55 ft,
Culvert Slope: 0.0122

Tailwater Channel Data - CWS Liner Conversion

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 10.00 ft

Side Slope (H:V): 3.50 (_:1)

Channel Slope: 0.0128

Channel Manning's n: 0.0300

Channel Invert Elevation: 698.97 ft

Roadway Data for Crossing: CWS Liner Conversion

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 25.00 ft

Crest Elevation: 702.00 ft

Roadway Surface: Gravel

Roadway Top Width: 25.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 12.71 cfs

Design Flow: 12.71 cfs

Maximum Flow: 20.14 cfs

Table 1 - Summary of Culvert Flows at Crossing: CWS Liner Conversion

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert C4 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
701.64	12.71	12.71	0.00	1
701.75	13.45	13.45	0.00	1
701.86	14.20	14.20	0.00	1
701.97	14.94	14.94	0.00	1
702.03	15.68	15.31	0.36	10
702.06	16.43	15.48	0.92	6
702.08	17.17	15.63	1.53	6
702.10	17.91	15.75	2.14	5
702.12	18.65	15.87	2.78	5
702.14	19.40	15.97	3.42	5
702.16	20.14	16.07	4.05	4
702.00	15.11	15.11	0.00	Overtopping

Table 2 - Culvert Summary Table: Culvert C4

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
12.71 cfs	12.71 cfs	701.64	2.18	1.380	5-S2n	0.96	1.28	1.02	0.40	7.89	2.80
13.45 cfs	13.45 cfs	701.75	2.29	1.490	5-S2n	1.00	1.32	1.06	0.41	8.00	2.85
14.20 cfs	14.20 cfs	701.86	2.40	1.602	5-S2n	1.03	1.36	1.09	0.43	8.11	2.91
14.94 cfs	14.94 cfs	701.97	2.51	1.717	5-S2n	1.06	1.39	1.12	0.44	8.21	2.96
15.68 cfs	15.31 cfs	702.03	2.57	1.775	5-S2n	1.08	1.41	1.14	0.45	8.26	3.01
16.43 cfs	15.48 cfs	702.06	2.60	1.802	5-S2n	1.08	1.42	1.15	0.46	8.29	3.05
17.17 cfs	15.63 cfs	702.08	2.62	1.826	5-S2n	1.09	1.42	1.16	0.47	8.31	3.10
17.91 cfs	15.75 cfs	702.10	2.64	1.846	5-S2n	1.10	1.43	1.16	0.49	8.32	3.15
18.65 cfs	15.87 cfs	702.12	2.66	1.865	5-S2n	1.10	1.44	1.17	0.50	8.34	3.19
19.40 cfs	15.97 cfs	702.14	2.68	1.882	5-S2n	1.10	1.44	1.17	0.51	8.35	3.23
20.14 cfs	16.07 cfs	702.16	2.70	1.898	5-S2n	1.11	1.45	1.18	0.52	8.37	3.27

Culvert Data: Culvert C5

Site Data - Culvert C5

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 704.38 ft
Outlet Station: 38.05 ft
Outlet Elevation: 704.25 ft
Number of Barrels: 1

Culvert Data Summary - Culvert C5

Barrel Shape: Circular
Barrel Diameter: 1.50 ft
Barrel Material: Smooth HDPE
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: None

Culvert Barrel Data

Culvert Barrel Type Straight Culvert
Inlet Elevation (invert): 704.38 ft,
Outlet Elevation (invert): 704.25 ft
Culvert Length: 38.06 ft,
Culvert Slope: 0.0035

Tailwater Channel Data - CWS Liner Conversion

Tailwater Channel Option: Trapezoidal Channel
Bottom Width: 10.00 ft
Side Slope (H:V): 3.50 (_:1)
Channel Slope: 0.0128
Channel Manning's n: 0.0300
Channel Invert Elevation: 704.25 ft

Roadway Data for Crossing: CWS Liner Conversion

Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 25.00 ft
Crest Elevation: 708.00 ft
Roadway Surface: Gravel
Roadway Top Width: 25.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow
Minimum Flow: 9.07 cfs
Design Flow: 9.07 cfs
Maximum Flow: 14.25 cfs

Table 1 - Summary of Culvert Flows at Crossing: CWS Liner Conversion

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert C5 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
706.76	9.07	9.07	0.00	1
706.92	9.59	9.59	0.00	1
707.09	10.11	10.11	0.00	1
707.27	10.62	10.62	0.00	1
707.46	11.14	11.14	0.00	1
707.67	11.66	11.66	0.00	1
707.88	12.18	12.18	0.00	1
708.02	12.70	12.49	0.18	19
708.05	13.21	12.55	0.65	7
708.07	13.73	12.60	1.13	6
708.09	14.25	12.64	1.60	5
708.00	12.44	12.44	0.00	Overtopping

Table 2 - Culvert Summary Table: Culvert C5

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
9.07 cfs	9.07 cfs	706.76	2.38	2.227	7-M2c	1.50	1.16	1.16	0.33	6.16	2.48
9.59 cfs	9.59 cfs	706.92	2.54	2.345	7-M2c	1.50	1.20	1.20	0.34	6.35	2.53
10.11 cfs	10.11 cfs	707.09	2.71	2.484	7-M2c	1.50	1.22	1.22	0.35	6.54	2.58
10.62 cfs	10.62 cfs	707.27	2.89	2.642	7-M2c	1.50	1.25	1.25	0.36	6.74	2.63
11.14 cfs	11.14 cfs	707.46	3.08	2.793	7-M2c	1.50	1.28	1.28	0.37	6.95	2.67
11.66 cfs	11.66 cfs	707.67	3.29	2.959	7-M2c	1.50	1.30	1.30	0.38	7.17	2.71
12.18 cfs	12.18 cfs	707.88	3.50	3.124	7-M2c	1.50	1.32	1.32	0.39	7.39	2.75
12.70 cfs	12.49 cfs	708.02	3.64	3.226	7-M2c	1.50	1.33	1.33	0.40	7.53	2.79
13.21 cfs	12.55 cfs	708.05	3.67	3.242	7-M2c	1.50	1.34	1.34	0.41	7.55	2.83
13.73 cfs	12.60 cfs	708.07	3.69	3.257	7-M2c	1.50	1.34	1.34	0.42	7.57	2.87
14.25 cfs	12.64 cfs	708.09	3.71	3.270	7-M2c	1.50	1.34	1.34	0.43	7.59	2.91

Downslope Flume and Energy Dissipator Sizing

SCS ENGINEERS

		Sheet No: 1/3	
		Calc. No.	
		Rev. No.	
Job No. 25222259.00	Job: I-43 - Plan Mod Addendum	By: RJG	Date: 04/5/24
Client: WPL	Subject: Downslope Pipe and Inlet Sizing	Chk'd: SJL	Date: 4/5/24

Purpose:

To size the downslope pipe and inlet to accommodate the 25-year, 24-hour storm event.

References:

1. HydroCAD Report_I-43_Fully Developed Site Closure.pdf

Approach:

Use the orifice equation to size the downslope pipe inlet. Size the inlet for the largest diversion berm flow rate and apply that inlet size to all downslope pipe inlets. Confirm the head (h) acting on the orifice will not overtop the diversion berm depth of 2.0 ft.

Use Manning's equation to size the downslope pipe based on the largest diversion berm flow rate. Confirm the pipe has capacity for the design flow under open channel flow conditions.

Assumptions:

1. Orifice coefficient = 0.63
2. Assume the orifice head (h) acts on the centerline of the inlet pipe.
3. Manning's n = 0.013 from HydroCAD report
4. Size flumes under the vegetated cover condition.
5. The peak flow rate at each flume is experienced in the Full Closure condition of the site.
6. Flume 1 and 4 were not evaluated because they were designed and constructed based on a larger drainage area with a higher flow rate. Therefore, it is concluded that the flume pipe size is appropriate.

Calculations:

Size the downslope pipe inlet:

From the HydroCAD report (Reference #1), the maximum 25-year, 24-hour flow along a diversion berm is 5.54 cfs from Area 10.

Orifice Equation: $Q = C * A * (2 * g * h)^{0.5}$

where: Q = flow rate (cfs) = 5.54 (From above)

C = orifice coefficient = 0.63 (See assumption #1)

A = orifice area (sf) = 1.77 (area of 18" diameter pipe) Actual Pipe Diameter = 18 inches

g = gravity (ft/sec^2)= 32.2

h = orifice head acting on centerline (ft)

$h = (Q/(C * A))^2/(2 * g)$ = 0.4 ft

Given Assumption #2, depth of flow along diversion berm = h + D/2/12 = 1.13 ft <2 ft

The diversion swale depth of 2 ft is sufficient to prevent overtopping at the downslope pipe inlet locations.

Results:

Based on the inlet sizing calculation, Flume 1, 3 and 6 will need 18" diameter inlets and based on flume pipe sizing the flume pipe diameter should be a minimum 18".

Calculations (Continued):

Size the downslope flume pipe:

Use Manning's equation to size the downslope pipe.

Manning's Equation: Q = (1.49/n) x A x R^(2/3) x S^(1/2)

where: Q = Flow Rate, cfs
n = Manning's Roughness Coefficient
A = Flow Area, sf
R = Hydraulic Radius, ft (= A/P)
S = Channel Slope, ft/ft

From the HydroCAD Report (Reference 1) , the peak discharge to each downslope flume resulting from a 25-year, 24-hour storm is as follows:

Flume 1	4.94 cfs	Flume 3	12.17 cfs	Flume 6	7.54 cfs
Area 1 =	1.9 cfs	Area 5 =	4.2 cfs	Area 10 =	5.5 cfs
Area 3 =	3.0 cfs	Area 9 =	4.1 cfs	Area 11 =	2.0 cfs
		Area 19 =	5.5 cfs		

For Flumes, assume an 18" diameter downslope flume for flows less than 20 cfs:

Use 12.17 cfs to Flume 3 to check sizing (max flow to site flumes)

Design Criteria

Pipe Diameter (in) = D = 18

Pipe Slope (ft/ft) = S = 0.25

Manning's Roughness Coefficient = n = 0.013

See Downslope Flume pipe flow calculator on Sheet 3

The 12" dia. flume can adequately accommodate flows for Flume 3.

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Job No. 25222259.00	Job: I-43 - Plan Mod Addendum	By: RJG	Date: 04/5/24
Client: WPL	Subject: Downslope Pipe and Inlet Sizing	Chk'd: SJL	Date: 4/5/24

Calculations (Continued):

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Inputs:

Pipe Diameter, d_o	18.00	in
Manning Roughness, n	0.0130	
Pressure slope (possibly equal to pipe slope), S_0	0.2500	slope
Percent of (or ratio to) full depth (100% or 1 if flowing full)	0.3515	fraction

Results:

Flow, Q	13.9210	ft^3/s
Velocity, v	25.1088	ft/s
Velocity head, hv	9.7982	ft
Flow Area, A	0.5544	ft^2
Wetted Perimeter, P	1.9039	ft
Hydraulic Radius	0.2912	ft
Top Width, T	1.4323	ft
Froude Number, F	7.22	
Shear Stress (tractive force), τ	8.2282	psf

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HawsEDC Calculators

SCS ENGINEERS

		Calc. No.	
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Job No. 25222259.00	Job: I-43 - Plan Mod Addendum	By: RJG	Date: 04/5/24
Client: WPL	Subject: Energy Dissipator Sizing	Chk'd: SJL	Date: 4/5/24

Purpose:

To size an energy dissipator structure and riprap apron at the outlet of the downslope flume pipes.

References:

1. "Hydraulic Design of Energy Dissipators for Culverts and Channels," HEC-14, Third Edition, July 2006, USDOT FHWA.
2. Downslope Pipe and Inlet Sizing calculation (for pipe size, flow rate, and pipe velocity).
3. HydroCAD Report_I-43_Fully Developed Site Closure.pdf
4. Facilities Development Manual Chapter 13, Section 13-30 - Rock Riprap Lined Chutes.
5. WisDOT FDM Table 25.1

Approach:

Use the downslope pipe outlet velocity to size an energy dissipator structure (USBR Type VI Impact Basin) following the design approach outlined in Section 9.4 of Reference #1.

Use Rock Chute Data Spreadsheet, FDM 13-30-30 Attachment 30.1 (from Reference #4) to design the rock chute.

For construction purposes use the maximum flow to size all dissipators and riprap aprons.

Assumptions:

1. Riprap specific gravity = 2.65
2. From the HydroCAD Report, the 25-year, 24-hour peak discharge to each downslope flume is as follows:

Flume 1	4.94 cfs
Flume 3	12.17 cfs
Flume 6	7.54 cfs

** Please note that the total flow rate at each flume calculated above may not reflect the flow rate shown in the HydroCAD Model due to the inflow to the flume occurring at different times during the storm event. The calculation above reflects the peak flow rate.*

Size energy dissipators based on the final closure conditions to the 18" dia. downslope flume pipes from the downslope flume pipe and inlet sizing calculation.

Results:

The energy dissipator structures for the 18" dia. downslope flume pipes will consist of dissipator structures with widths (W_B) of 5 feet, with the remaining dimensions from Table 9.2 on Sheets 5 and 6.

Use Select Crushed Material as riprap at the dissipator outlet, D_{50} = 0.18 feet.

Calculations:

For 18" dia. downslope flume pipes

From Reference #2:

Flow rate (Q) = 12.17 cfs

Pipe velocity (V) = 24.2 ft/s

Flow area (A) = Q/V = 0.50 sf

Design procedure from pg. 9-40 of Reference #1:

Step 1: Compute the Equivalent Depth of Flow Entering Dissipator:

$Y_e = (A/2)^{1/2}$ where: Ye = Equivalent depth

A = Area (from above)

$Y_e =$ 0.50 ft

Step 2: Compute the Froude Number and the energy at the end of the pipe:

$Fr = V/[(g*Y_e)^{1/2}]$ where: Fr = Froude Number

V = Velocity (from above)

g = Gravity constant (32.2 ft/sec^2)

Fr = 6.0 Y_e = Equivalent depth (from Step 1 above)

$H_o = Y_e+V^2/2g$ where: H_o = Energy at the end of the pipe

Y_e = Equivalent depth (from above)

V = Velocity (from above)

H_o = 9.6 ft g = Gravity constant (32.2 ft/sec^2)

Step 3: Determine H_o/W_B and calculate the required width of the energy dissipator:

Using Figure 9.14 (See Sheet 6), enter the Froude Number and the Energy from Step 2 to determine the width of the energy dissipator.

From Figure 9.14, H_o/W_B = 2.10

$W_B = H_o/(H_o/W_B)$ W_B = 4.6 ft.

Use W_B = 5.0 ft.

Step 4: Obtain the remaining energy dissipator dimensions from Table 9.2 from Reference #1 (see Sheets 7 and 8)

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Client: WPL	Subject: Energy Dissipator Sizing	Chk'd: SJL	Date: 4/5/24

Calculations:

Step 5: Determine the exit velocity from the energy dissiaptor structure and size the riprap apron at the structure outlet.

Use the relationship:

$H_B = Q/(W_B \times V_B) + V_B^2 / 2g = H_o \times (1-H_L/H_o)$

Where:

$Q =$ 12.2 cfs, flowrate
$W_B =$ 5.0 ft, width of energy dissipator
$g =$ 32.2 ft/s^2, gravity
H_O 9.6 Energy at end of pipe
H_L/H_O 72 %, Energy loss (From Figure 9.15 from Reference #1, see Sheet 3)
$V_B =$ Velocity at exit of dissipator (ft/s)
HB = Energy at exit of dissipator (ft)

Calculate HB using the second part of the equation:

$H_B = H_o \times (1-H_L/H_o)$

$H_B =$ 2.68 ft

Using trial and error, select values for V_B and use the first part of the equation to calculate H_B:

Try $V_B =$ 1.61 ft/s $H_B =$ 2.68 ft

Based on the energy dissipator structure exit velocity, calculate the riprap size at the dissipator outlet.

From Equation 10.6 from Reference #1:

$D_{50} = (0.692 / (S-1)) \times (V^2/2g)$

Where:

$S =$ 2.65 Specific gravity (See Assumption #1)
$V =$ 1.61 Velocity = V_B from above.
$D_{50} =$ riprap size

$D_{50\ Calc'd} =$ 0.017 feet

Round the calculated D_{50} up to the nearest IDOT standard riprap size:

$D_{50\ Design} =$ 0.18 feet, use Select Crushed Material

Riprap Table (From Reference #5)

Riprap Type	D_{50}	D_{50}	Riprap Thickness (in)	Type
Select Crushed Material	2.2	0.18	5	Type R
Light Riprap	10	0.83	12	Type R
Medium Riprap	12.5	1.04	18	Type HR
Heavy Riprap	16	1.33	24	Type HR
Extra-Heavy Riprap	20	1.67	30	Type HR

18" dia.

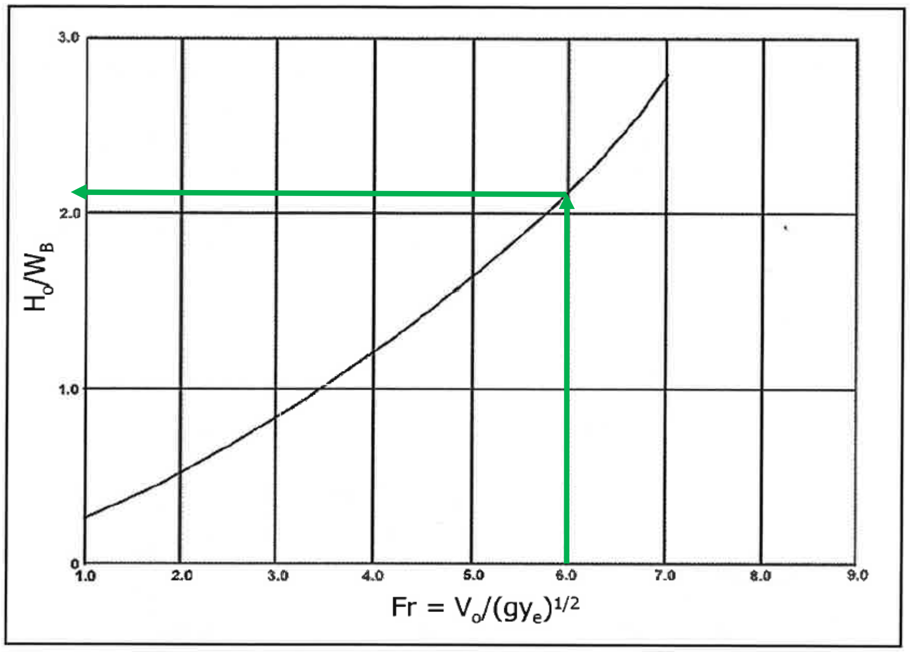

Figure 9.14. Design Curve for USBR Type VI Impact Basin

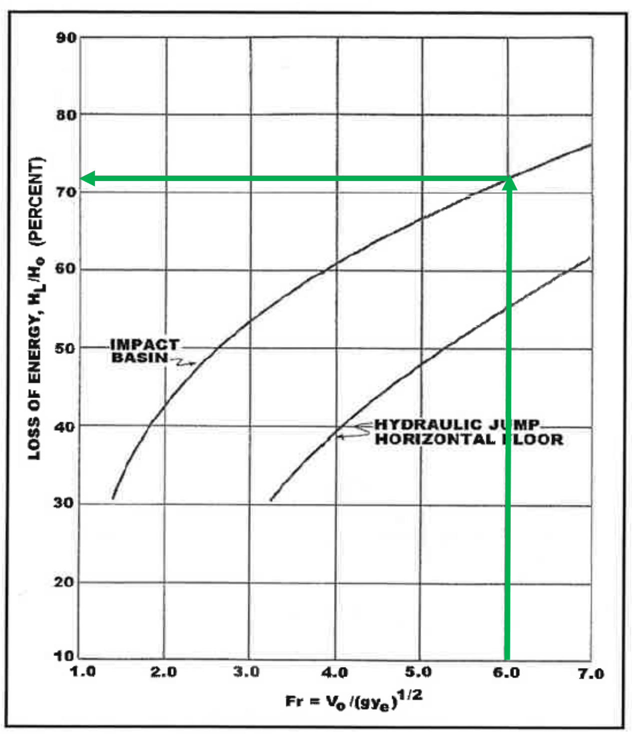

Figure 9.15. Energy Loss of USBR Type VI Impact Basin versus Hydraulic Jump

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Job No. 25222259.00 | Job: I-43 - Plan Mod Addendum | By: RJG | Date: 04/5/24

Client: WPL | Subject: Energy Dissipator Sizing | Chk'd: SJL | Date: 4/5/24

Table 9.2 (CU). USBR Type VI Impact Basin Dimensions (ft) (AASHTO, 2005)

W_B	h_1	h_2	h_3	h_4	L	L_1	L_2
4.	3.08	1.50	0.67	1.67	5.42	2.33	3.08
5.	3.83	1.92	0.83	2.08	6.67	2.92	3.83
6.	4.58	2.25	1.00	2.50	8.00	3.42	4.58
7.	5.42	2.58	1.17	2.92	9.42	4.00	5.42
8.	6.17	3.00	1.33	3.33	10.67	4.58	6.17
9.	6.92	3.42	1.50	3.75	12.00	5.17	6.92
10.	7.58	3.75	1.67	4.17	13.42	5.75	7.67
11.	8.42	4.17	1.83	4.58	14.58	6.33	8.42
12.	9.17	4.50	2.00	5.00	16.00	6.83	9.17
13.	10.17	4.92	2.17	5.42	17.33	7.42	10.00
14.	10.75	5.25	2.33	5.83	18.67	8.00	10.75
15.	11.50	5.58	2.50	6.25	20.00	8.50	11.50
16.	12.25	6.00	2.67	6.67	21.33	9.08	12.25
17.	13.00	6.33	2.83	7.08	21.50	9.67	13.00
18.	13.75	6.67	3.00	7.50	23.92	10.25	13.75
19.	14.58	7.08	3.17	7.92	25.33	10.83	14.58
20.	15.33	7.50	3.33	8.33	26.58	11.42	15.33

W_B	W_1	W_2	t_1	t_2	t_3	t_4	t_5
4.	0.33	1.08	0.50	0.50	0.50	0.50	0.25
5.	0.42	1.42	0.50	0.50	0.50	0.50	0.25
6.	0.50	1.67	0.50	0.50	0.50	0.50	0.25
7.	0.50	1.92	0.50	0.50	0.50	0.50	0.25
8.	0.58	2.17	0.50	0.58	0.58	0.50	0.25
9.	0.67	2.50	0.58	0.58	0.67	0.58	0.25
10.	0.75	2.75	0.67	0.67	0.75	0.67	0.25
11.	0.83	3.00	0.67	0.75	0.75	0.67	0.33
12.	0.92	3.00	0.67	0.83	0.83	0.75	0.33
13.	1.00	3.00	0.67	0.92	0.83	0.83	0.33
14.	1.08	3.00	0.67	1.00	0.92	0.92	0.42
15.	1.17	3.00	0.67	1.00	1.00	1.00	0.42
16.	1.25	3.00	0.75	1.00	1.00	1.00	0.50
17.	1.33	3.00	0.75	1.08	1.00	1.00	0.50
18.	1.33	3.00	0.75	1.08	1.08	1.08	0.58
19.	1.42	3.00	0.83	1.17	1.08	1.08	0.58
20.	1.50	3.00	0.83	1.17	1.17	1.17	0.67

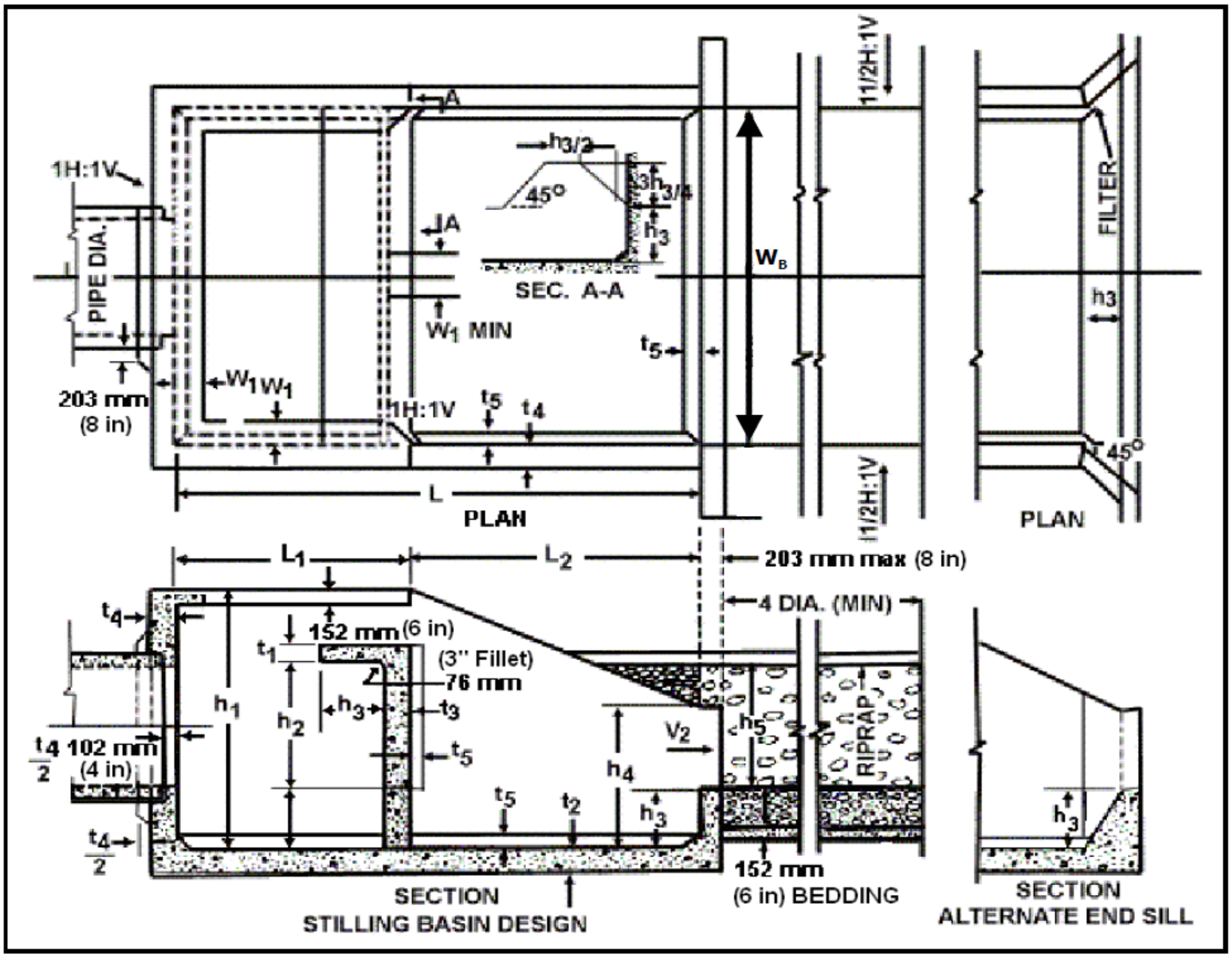

Figure 9.13. USBR Type VI Impact Basin

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		Calc. No.	
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Job No. 25222259.00	Job: I-43 - Plan Mod Addendum	By: RJG	Date: 04/5/24
Client: WPL	Subject: Energy Dissipator Sizing	Chk'd: SJL	Date: 4/5/24

Calculations (Continued):

Downslope Flume 3 - Velocity Calculator (Q = 12.17 cfs)

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Inputs:

Pipe Diameter, d_o	18	in
Manning Roughness, n	0.0130	
Pressure slope (possibly equal to pipe slope), S_o	0.2500	slope
Percent of (or ratio to) full depth (100% or 1 if flowing full)	0.3275	fraction

Results:

Flow, Q	12.1739	ft^3/s
Velocity, v	24.1885	ft/s
Velocity head, hv	109.1173	in
Flow Area, A	0.5033	ft^2
Wetted Perimeter, P	1.8278	ft
Hydraulic Radius	0.2753	ft
Top Width, T	1.4079	ft
Froude Number, F	7.24	
Shear Stress (tractive force), τ	7.6664	psf

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HawsEDC Calculators

South Sedimentation Pond Outfall

SCS ENGINEERS

Sheet No.	1 of 2
Calc. No.	
Rev. No.	0
By: RJG	Date: 4/9/24
Chk'd: SJL	Date: 4/10/24

Job No. 25222259.00 — Job: I-43 Plan Mod Addendum

Client: WPL — Subject: Riprap Sizing at South Sedimentation Basin Outfall

Purpose:

To size the riprap apron dimensions at the South Pond Outfall based on a 25-year, 24 hour storm event:

References:

1. "Energy Dissipators," Wisconsin Department of Transportation (WisDOT), Facilities Development Manual (FDM) 13-35-5.
2. HydroCAD Report_I-43_CWS Liner Conversion.pdf
3. "Rock Riprap Lined Channels," WisDOT FDM 13-30-25.
4. WisDOT FDM Chapter 13, Section 30 - Rock Riprap Lined Chutes

Approach:

Use the equations in Section 5.2 - Riprap Blanket of WisDOT FDM 13-35-5 (Energy Dissipators) to determine the average size of stone (d_{50}) and riprap apron length. Round up the calculated d_{50} to the nearest WisDOT standard riprap size.

Use WisDOT FDM 13-35 Attachment 5.2 to determine the width of the riprap apron for discharges to a flat area. For discharges to channels, extend riprap across the channel bottom and up the sides.

Assumptions:

Assume riprap apron thickness (T) is 2 * d_{50} to protect against washout and undercutting of the riprap.

Assume tailwater depth, TW = 0.40 * D_o

Assume max TW conditions for the riprap apron width.

Assume that when there are multiple culverts, the total discharge to the culverts is distributed evenly through each barrel.

Calculation:

From WisDOT Section 5.2 - Riprap Blanket:

$$d_{50}/D_o = 0.020\ (D_o/TW)\ (Q/D_o^{5/2})^{4/3}$$

$$L_{sp}/D_o = 1.7\ (Q/D_o^{5/2}) + 8$$

Or:

$d_{50} = 0.02 \times (D_o/TW) \times (Q/D_o^{5/2})^{4/3} \times D_o$

$L_{sp} = (1.7\ (Q/D_o^{5/2}) + 8) \times D_o$

where: D_o = Diameter or width of culvert (ft)

Q = Flow rate (cfs) (discharge rate through culvert, from Worst Case Condition HydroCAD Model (Reference #2))

TW = Tail water depth (ft)

d_{50} = Average size of stone (ft)

L_{sp} = Length of stone protection (Apron Length) (ft)

Location	Total Flow (Q, cfs)	Number of Pipes	D_o (ft)	Q (cfs)	TW (ft)	$d_{50\ calculated}$	$d_{50\ Design}$	L_{sp}
Outfall	0.71	1	1	0.7	0.40	0.03	0.18	9

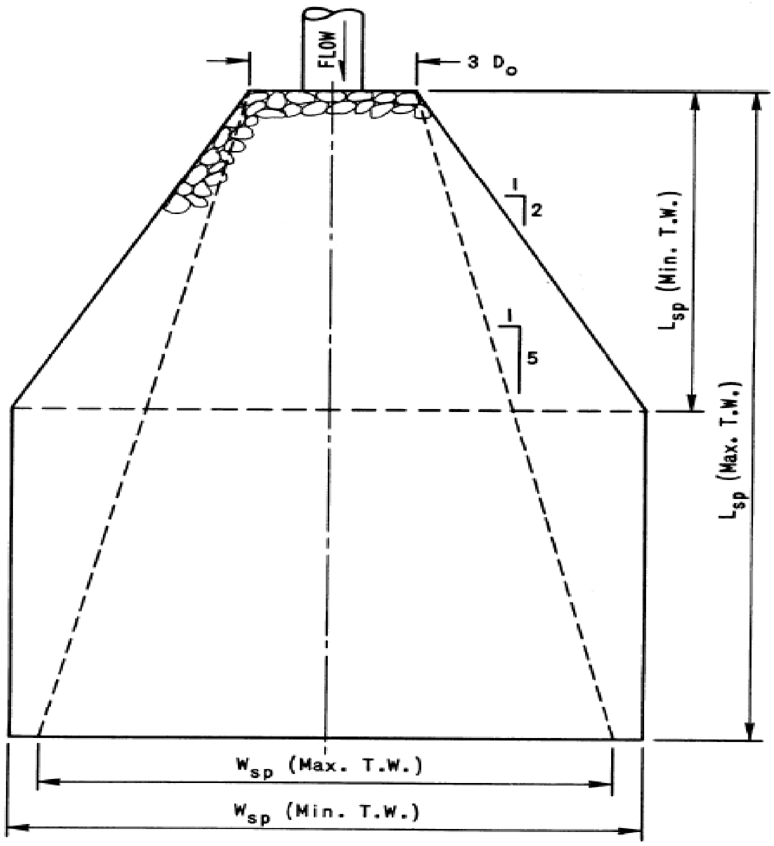
Results:

Below is a summary of the d_{50} , thickness (T), and configuration of the riprap apron. Also refer to WisDOT FDM Attachment 5.2 (Sheet 2) for details on apron layout. Use WisDOT Light Riprap at culvert discharge.

Location	d_{50} (in)*	T (in)	L_{sp} (ft)	W_{sp} (ft)	WisDOT Riprap sizes
Outfall	2.2	6	9	See Note 1	Select Crushed Material

1. For discharges to channels, place riprap along channel bottom and up side of channel.

FDM 13-35 Attachment 5.2 Recommended Configuration of Riprap Blanket Subject to Maximum and Minimum Tail Waters



RECOMMENDED CONFIGURATION OF RIPRAP BLANKET SUBJECT TO MAXIMUM AND MINIMUM TAILWATERS

Source: Miscellaneous paper H-72-5, "Practical Guidance for Estimating and Controlling Erosion at Culvert Outlets", U.S. Army Engineer Waterways Experiment Station, May, 1972.

Table 25.1 Typical Particle Sizes of Native Sands at 75 Percent Passing (D_{75})

Riprap Type	D50 (inches)	D50 (feet)	Riprap Thickness (in)	Geotextile Type
Select Crushed Material	2.2	0.18	5	Type R
Light Riprap	10	0.83	12	Type R
Medium Riprap	12.5	1.04	18	Type HR
Heavy Riprap	16	1.33	24	Type HR
Extra-Heavy Riprap	20	1.67	30	Type HR

Source: Table 25.1 from WisDOT FDM.

Job No.	25222259	Job	I-43 Plan Mod Addendum	By RJG	Date: 4/10/24
Client	WPL	Subject	Outlet Buoyancy Calculation	Chk'd: SJL	Date: 4/10/24

Purpose: Determine if the Outlet will float due to buoyancy forces due to high groundwater/pond level.

Approach: Calculate the buoyancy force and the weight of the Outlet to determine if the weight of the Outlet can withstand the buoyancy force up.

References:

1. County Materials Corporation Reinforced Concrete Pipe Properties.

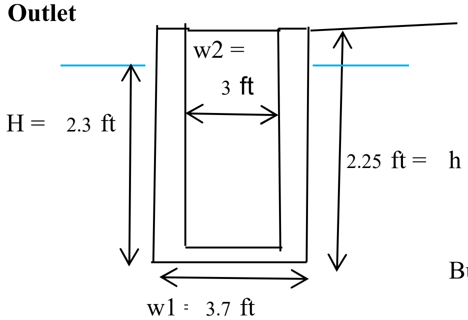
Assumptions:
1. Concrete unit weight is 150 lb/cf
2. Water unit weight is 62.4 lb/cf
3. Safety factor of 1.2 is sufficient.
4. Buoyancy is the weight of the water displaced.
5. Thickness (t) of Outlet base is 0.5 ft
6. Wall thickness is 4 inches

From Details and assumed surface water elevation is to top:

Top of Outlet =	692.00	ft
Bottom of Outlet =	689.75	ft
Surface Water =	692.00	ft
Ground Surface =	689.50	ft
Lowest Orifice Outlet =	690.0	ft

Calculation:

Outlet



Buoyancy Force = π x r2 x H x 62.4 lb/cf, where r = w1/2
= 3.14 x 1.8 ^2 x 2.3 x 62.4 = 1,483 lb.

Weight of Outlet

Outlet Wall Volume = ((π x (w1/2)2) - (π x (w2/2)2)) x h
= 10.6 sf - 7 sf = 3.5 sf
x 2.3 ft = 7.9 cf

Outlet Base Volume = π x (w1/2)2 x t
= 3.14 x 3.4 x 0.5 ft = 5.3 cf

Outlet Total Volume = Outlet Wall Vol. + Outlet Base Volume
= 7.9 + 5.3 = 13.1 cf

Total weight of Outlet = Outlet Total Volume x Unit Weight of Concrete
= 13 cf x 150 lb/cf = 1,970 lb

Manhole Weight vs Buoyance
1,970 lb - 1,483 lb = 488 lb Outlet weighs more than buoyancy

Sedimentation Pond Sizing

SCS ENGINEERS

				Sheet No. 1 of 5	
				Calc. No.	
				Rev. No.	
Job No.	25222259	Project	I-43 Plan Mod Addendum	By RJG	Date 5/22/24
Client	WPL	Subject	Sedimentation Pond Evaluation	Chk'd: SJL	Date: 5/22/24

Permanent Sedimentation Pond Evaluation

Purpose:

To demonstrate that the existing North Pond meets the following performance standards:

NR 504.09(1) (d) and (e):

- Settle a 15 micron particle during a 25-year, 6-hour storm event
- Principal spillway and outlet protection designed to pass a 25-year, time of concentration storm event
- Emergency spillway can pass a 100-year, time of concentration storm event
- Dewatering structures designed to dewater basin in no less than 3 days

References:

1. HydroCAD Report_I-43_Fully Developed Site Closure.pdf
2. HydroCAD Report_I-43_CWS Liner Conversion.pdf

Approach:

Calculate the required surface area using Equation 1 (below) and the settling velocity for a 15 micron particle.

$S_a = 1.2*(q_{out}/v_s)$, where: (Equation 1)

S_a = Treatment surface area measured at the invert of the lowest outlet of sediment basin (sf)

q_{out} = Peak outflow (cfs) during the 25-year, 24-hour design storm for the principal outlet

v_s = Particle settling velocity (fps)

1.2 = EPA recommended safety factor

Use the pond routing results as documented in the Hydrograph Generation section of this appendix to document that the basin meets the principal and emergency spillway sizing requirements.

Use the pond routing results as from the Hydrograph Generation section of this appendix to document that the basin meets the dewatering requirement.

Assumptions:

The 25-year, 24-hour and 100-year, 24-hour storm events are used to document conformance with the requirements of NR 504.09(1)(e). Rainfall distributions for these storm events include nested, higher intensity storm events within those needed for longer durations at the same probability. This allows a single storm event to be used for a range of drainage area sizes (USDA, 1986). The resulting peak flows using this method meet or exceed the peak flows obtained using a 6-hour and time-of-concentration storm event.

Other assumptions are noted throughout the calculation.

Results:

The North Pond meets the performance criteria outlined in the Purpose.

The North Pond has a limited discharge under the 25-year, 24-hour storm event.

The South Pond is an internal drainage structure and was not analyzed for performance criteria.

Permanent Sedimentation Pond Evaluation

Calculations:

Particle settling for the 25-year, 6 hour storm

For the North Pond

$S_a = 1.2*(q_{out}/v_s)$

q_{out} = 13.22 cfs (from Final Closure Hydrograph Generation section)

v_s = 6.60E-04 fps (from Dane County Erosion Control and Stormwater Management Manual, see Sheet 3)

s_a = 24,036 sf

Actual surface area at the lowest outlet elevation (681.75) = 122,839 sf

The 25-year, 24-hour HydroCAD model for each basin documents that the principal spillways and outlet protection can pass the 25-year, 24-hour storm event (see Hydrograph Generation section).

The 100-year, 24-hour HydroCAD model for each basin documents that the emergency spillways can pass the 100-year, 24-hour storm event (see Hydrograph Generation section).

The 25-year, 24-hour HydroCAD model for each basin documentats that the basins will dewater in no less than 3 days (see Sheets 4 and 5, from the Hydrograph Generation section).

Job No.	25222259	Project	I-43 Plan Mod Addendum	By RJG	Date 5/22/24
Client	WPL	Subject	Sedimentation Pond Evaluation	Chk'd: SJL	Date: 5/22/24

Permanent Sedimentation Pond Evaluation

Settling Velocities for Spherical Particles - Stokes Law

	Diameter (micron)	Velocity (ft/s)	Example Settling Time (hours for 2 foot depth)
CLAY	1	0.000003	185
	1.5	0.000007	76
	2	0.000012	46
SILT	3	0.000026	21
	4	0.000045	12
	5	0.000073	8
	6	0.000106	5
	7	0.000138	4
	8	0.00019	3
	9	0.00023	2.4
	10	0.00029	2
	12	0.00042	1.3
	15	0.00066	0.8
	20	0.0012	0.5
	25	0.0018	0.3
	30	0.0027	0.2
	40	0.0047	0.1
SAND	50	0.0074	0.07
	60	0.011	0.05
	80	0.019	0.03
	100	0.029	0.02

← 15 microns

Note: Assumes specific gravity of 2.65 for soil particles and 20 degrees C water temperature.

From Dane County Erosion Control and Stormwater Management Manual

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Calc. No.	
Rev. No.	

Job No. 25222259	Project I-43 Plan Mod Addendum	By RJG	Date 5/22/24
Client WPL	Subject Sedimentation Pond Evaluation	Chk'd: SJL	Date: 5/22/24

Permanent Sedimentation Pond Evaluation

Dewatering time documentation - North Sedimentation Pond during Fully Developed Site Closure

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	35,180	681.75	0.00	0.00	**0.00**
2.00	0.00	35,180	681.75	0.00	0.00	0.00
4.00	0.00	35,180	681.75	0.00	0.00	0.00
6.00	0.00	35,180	681.75	0.00	0.00	0.00
8.00	0.14	35,539	681.75	0.01	0.01	0.00
10.00	2.31	40,492	681.79	0.11	0.11	0.00
12.00	**88.47**	**139,651**	**682.53**	**3.71**	**3.71**	0.00
14.00	**17.72**	**617,870**	**684.95**	**18.09**	**18.09**	0.00
16.00	8.52	582,372	684.80	17.44	17.44	0.00
18.00	6.88	516,425	684.50	16.23	16.23	0.00
20.00	5.23	447,731	684.20	14.96	14.96	0.00
22.00	3.57	376,766	683.87	13.36	13.36	0.00
24.00	1.81	307,527	683.52	11.32	11.32	0.00
26.00	0.03	239,334	683.15	8.38	8.38	0.00
28.00	0.00	188,381	682.84	5.93	5.93	0.00
30.00	0.00	152,129	682.61	4.26	4.26	0.00
32.00	0.00	125,883	682.43	3.09	3.09	0.00
34.00	0.00	106,839	682.30	2.24	2.24	0.00
36.00	0.00	92,951	682.20	1.67	1.67	0.00
38.00	0.00	82,424	682.12	1.27	1.27	0.00
40.00	0.00	74,381	682.06	0.97	0.97	0.00
42.00	0.00	68,234	682.02	0.74	0.74	0.00
44.00	0.00	63,447	681.98	0.61	0.61	0.00
46.00	0.00	59,386	681.94	0.52	0.52	0.00
48.00	0.00	55,908	681.92	0.45	0.45	0.00
50.00	0.00	52,930	681.89	0.38	0.38	0.00
52.00	0.00	50,380	681.87	0.33	0.33	0.00
54.00	0.00	48,197	681.85	0.28	0.28	0.00
56.00	0.00	46,327	681.84	0.24	0.24	0.00
58.00	0.00	44,725	681.83	0.21	0.21	0.00
60.00	0.00	43,354	681.82	0.18	0.18	0.00
62.00	0.00	42,180	681.81	0.15	0.15	0.00
64.00	0.00	41,174	681.80	0.13	0.13	0.00
66.00	0.00	40,313	681.79	0.11	0.11	0.00
68.00	0.00	39,576	681.79	0.09	0.09	0.00
70.00	0.00	38,944	681.78	0.08	0.08	0.00
72.00	0.00	38,403	681.78	0.07	0.07	0.00
74.00	0.00	37,940	681.77	0.06	0.06	0.00
76.00	0.00	37,544	681.77	0.05	0.05	0.00
78.00	0.00	37,204	681.77	0.04	0.04	0.00
80.00	0.00	36,913	681.76	0.04	0.04	0.00
82.00	0.00	36,664	681.76	0.03	0.03	0.00
84.00	0.00	36,451	681.76	0.03	0.03	0.00
86.00	0.00	36,269	681.76	0.02	0.02	0.00
88.00	0.00	36,112	681.76	0.02	0.02	0.00
90.00	0.00	35,978	681.76	0.02	0.02	0.00

Discharge starts around 8 hours and is still discharging at 90 hours, which is greater than 72 hours.

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Sheet No.	5 of 5
Calc. No.	
Rev. No.	

Job No. 25222259	Project I-43 Plan Mod Addendum	By RJG	Date 5/22/24
Client WPL	Subject Sedimentation Pond Evaluation	Chk'd: SJL	Date: 5/22/24

Permanent Sedimentation Pond Evaluation

Dewatering time documentation - North Sedimentation Pond during CWS Liner Conversion

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0.808	681.75	0.00	0.00	**0.00**
2.00	0.04	0.808	681.75	0.00	0.00	0.00
4.00	0.28	0.835	681.76	0.00	0.00	0.00
6.00	0.51	0.899	681.78	0.02	0.02	0.00
8.00	0.73	0.995	681.82	0.06	0.06	0.00
10.00	3.01	1.215	681.89	0.24	0.24	0.00
12.00	**91.32**	**3.564**	**682.64**	**4.42**	**4.42**	0.00
14.00	**16.54**	**13.285**	**684.79**	**17.29**	**17.29**	0.00
16.00	8.30	12.491	684.64	16.55	16.55	0.00
18.00	6.82	11.115	684.37	15.15	15.15	0.00
20.00	5.35	9.726	684.10	14.32	14.32	0.00
22.00	3.84	8.198	683.78	13.08	13.08	0.00
24.00	2.25	6.729	683.45	10.78	10.78	0.00
26.00	0.66	5.334	683.11	8.10	8.10	0.00
28.00	0.61	4.301	682.84	5.80	5.80	0.00
30.00	0.58	3.559	682.64	4.41	4.41	0.00
32.00	0.55	3.028	682.48	3.22	3.22	0.00
34.00	0.51	2.651	682.37	2.47	2.47	0.00
36.00	0.48	2.365	682.28	2.01	2.01	0.00
38.00	0.45	2.134	682.21	1.72	1.72	0.00
40.00	0.42	1.946	682.14	1.42	1.42	0.00
42.00	0.38	1.799	682.10	1.16	1.16	0.00
44.00	0.33	1.684	682.06	0.95	0.95	0.00
46.00	0.29	1.592	682.02	0.79	0.79	0.00
48.00	0.25	1.516	682.00	0.66	0.66	0.00
50.00	0.22	1.454	681.98	0.57	0.57	0.00
52.00	0.19	1.402	681.96	0.48	0.48	0.00
54.00	0.17	1.357	681.94	0.42	0.42	0.00
56.00	0.15	1.318	681.93	0.37	0.37	0.00
58.00	0.14	1.284	681.92	0.32	0.32	0.00
60.00	0.13	1.256	681.91	0.29	0.29	0.00
62.00	0.12	1.231	681.90	0.26	0.26	0.00
64.00	0.11	1.208	681.89	0.24	0.24	0.00
66.00	0.10	1.189	681.88	0.22	0.22	0.00
68.00	0.10	1.171	681.88	0.20	0.20	0.00
70.00	0.09	1.156	681.87	0.18	0.18	0.00
72.00	0.08	1.142	681.87	0.17	0.17	0.00
74.00	0.08	1.129	681.86	0.16	0.16	0.00
76.00	0.07	1.116	681.86	0.15	0.15	0.00
78.00	0.07	1.105	681.85	0.14	0.14	0.00
80.00	0.06	1.094	681.85	0.13	0.13	0.00
82.00	0.06	1.084	681.85	0.12	0.12	0.00
84.00	0.06	1.074	681.84	0.11	0.11	0.00
86.00	0.05	1.065	681.84	0.11	0.11	0.00
88.00	0.05	1.056	681.84	0.10	0.10	0.00
90.00	0.05	1.048	681.84	0.09	0.09	0.00

Discharge starts at 5 hours and is still discharging at 89 hours, which is greater than 72 hours.