

Appendix U

Preliminary Storm Water Calculations



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MEMORANDUM

TO: Project File

FROM: Erik D. Henningsgard, PE (Lic. MN, WI)

DATE: August 28, 2023

RE: Vernon County Landfill Feasibility Study - Stormwater Considerations
SEH No. VERSW 167824 14.00

RESULTS

The Vernon County Landfill Feasibility Study is required for the expansion of the landfill. The relocation and expansion of the existing sedimentation basin is required to meet stormwater standards included in NR 504.09. The limiting factor in the required size for the ponds is the surface area to settle 0.015 mm particles during the 25-yr, 6hr storm event. The size of the basin is included on the proposed grading plans.

BACKGROUND

The Vernon County Landfill (Landfill) is planning to expand the landfill area to the east, encompassing areas that are currently occupied by grassed areas, woodland, stormwater drainage ditch, and an existing stormwater management basin. The expansion will require stormwater management controls to provide stormwater treatment to meet the DNR standards associated with NR 504.09. To meet the applicable standards the Landfill will relocate and expand the existing sedimentation basin.

This memo reviews the modeling considerations and stormwater pond sizing needs to meet the requirements of the DNR standards.

The project is exempt from NR 151 per NR 151.121(2)(a) "A post-construction site with less than 10 percent connected imperviousness, based on the area of land disturbance, provided the cumulative area of all impervious surfaces is less than one acre." The only impervious area on the site is from the gravel access drives. Table 1 shows the disturbed area has 0.66% impervious area. Table 2 shows the cumulative impervious area is 2.73% of the entire site.

Table 1: Disturbed Areas	
Total Disturbed Area	9.05 Acre
Gravel Roads	0.06 Acre
Impervious Area Percentage	0.66%

Table 2: Site Areas	
Total Site Area	26.74 Acre
Gravel Roads	0.73 Acre
Impervious Area Percentage	2.73%

The pond sizing was completed to meet the following requirements:

NR 504.09 Standards

1. Settle the 0.015 mm size particles for all storms up to and including the 25-year, 6 hour storm.

Engineers | Architects | Planners | Scientists

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2. Calculate the surface area of the sediment basin based on the intensity of a 25-year, 6 hour storm event.
3. Principal spillways designed to pass a 25-year, 6 hour time of concentration storm event.
4. Emergency spillways designed to pass the 100-year, 24 hour time of concentration storm event.
5. Design of the dewatering structures for sediment basins shall be dewatered in no less than 3 days.

HYDROLOGIC ANALYSIS

The watershed for the sedimentation basin consists of only the landfill site, which was delineated based on the completed grading design for the landfill expansion. A HydroCAD version 10.20-3c model was created using the delineated watershed, MSE4 distributions, and Atlas 14 rainfall depths for post-development scenarios.

The post-development model includes the landfill expansion and the land uses associated with the expansion. For the landfill areas a hydrologic soil group of D soils was utilized to account for compaction during construction. The expanded sedimentation basin, along with the proposed outlet structures were included in the modeling.

The HydroCAD modeling was utilized to design the size of the basin and the emergency spillway for the 100-year, 24 hour storm event. The modeling results show that the overflow weir safely conveys the 100-year storm event with 1 foot of freeboard. Table 3 below includes the critical elevations included in the modeling.

Table 3 – 100-year, 24 hour Storm Event Critical Elevations

Pond Elevations (feet)					
	Bottom of Basin	Rate Control Culvert	Overflow Weir	Top of Bank	100-yr, 24 hr
Sediment Basin	1176	1184	1188	1190	1188.79

SEDIMENT BASIN SURFACE AREA CALCULATION

To review compliance with the surface area sizing for the sediment basins, in accordance with NR 504.09, WDNR Technical Standard 1064 Sediment Basin was utilized. The technical standard includes the following equation for the calculation of the required surface area:

$$S_a = 1.2 * (q_{out} / v_s)$$

- S_a = Minimum Treatment Surface Area (square feet)
- q_{out} = Peak Outflow of the 25-year, 6 hour event (NR 504.09)
- v_s = Settling Velocity

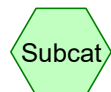
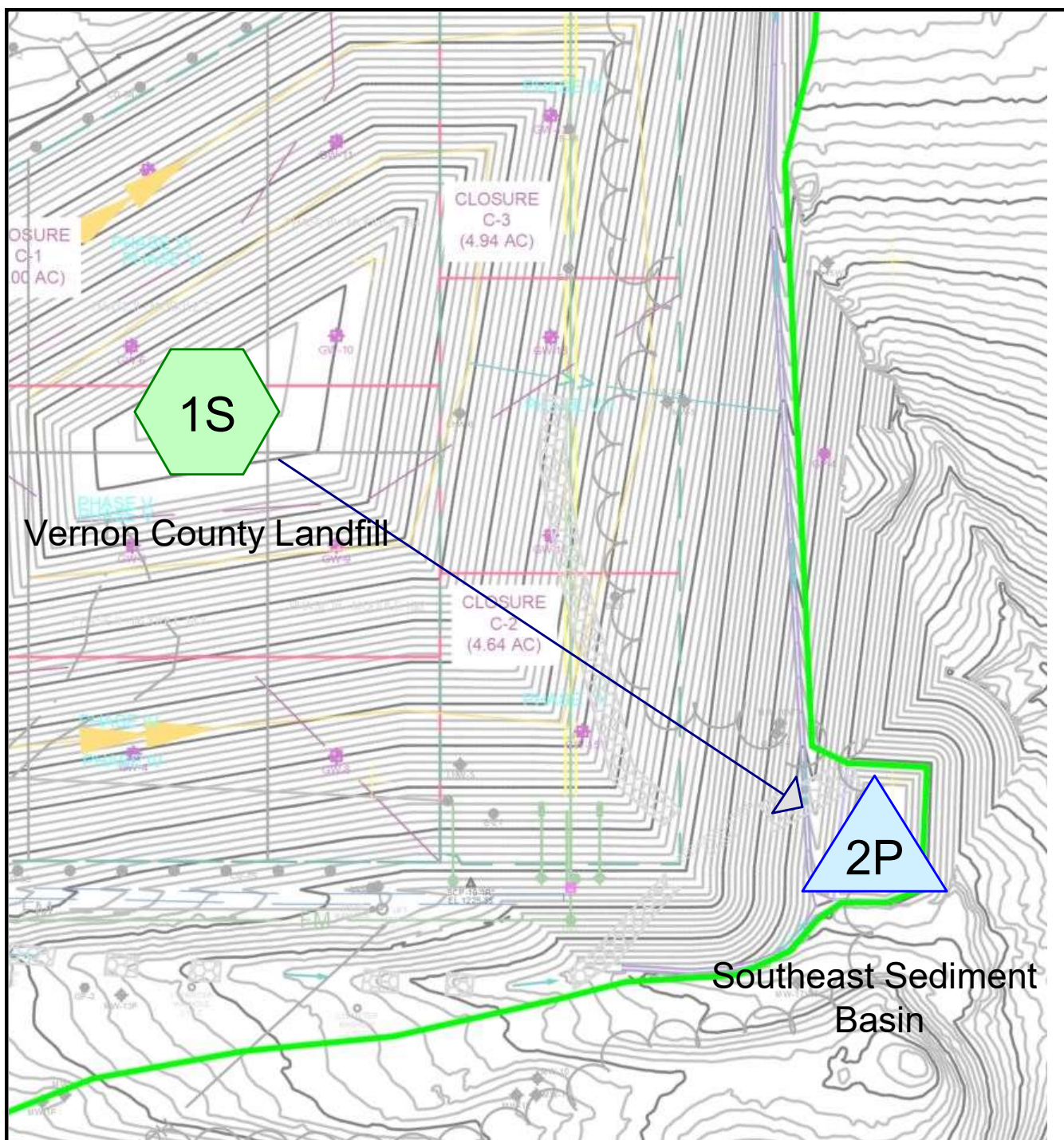
NR 504.09 requires the sizing of the sediment basin to settle the 0.015 mm, or 15 micron, particle size. According to Tech Standard 1064, Soil Class 2 includes particle sizes between 5 and 20 microns and includes a settling velocity of 7.3×10^{-5} ft/sec. Including the pond discharge rates for the 25-year, 6 hour storm event the basin is designed greater than the minimum size required as indicated in Table 4.

Table 4 – Sediment Basin Surface Area Design

	Sediment Basin
Pond Discharge (cfs)	1.38
Minimum Pond Surface (sf)	22,685
25-year Storm Pond Surface (sf)	25,031

Attachments: HydroCAD Modeling

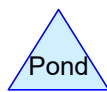
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Subcat



Reach



Pond



Link

Routing Diagram for Vernon County Landfill

Prepared by Short Elliott Hendrickson Inc, Printed 8/28/2023
HydroCAD® 10.20-3c s/n 00569 © 2023 HydroCAD Software Solutions LLC

Vernon County Landfill

Prepared by Short Elliott Hendrickson Inc

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Type II 6-hr 25-yr Rainfall=4.16"

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Summary for Subcatchment 1S: Vernon County Landfill

Runoff = 48.05 cfs @ 3.45 hrs, Volume= 4.491 af, Depth= 2.02"
Routed to Pond 2P : Southeast Sediment Basin

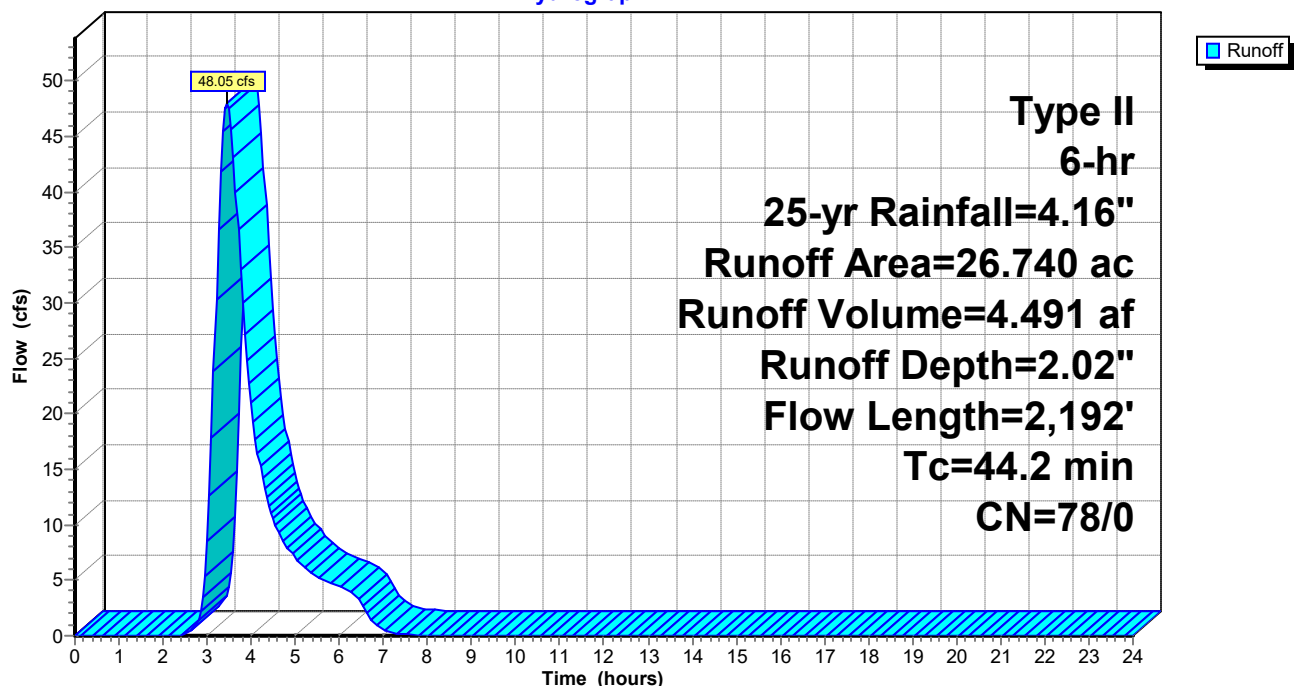
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 6-hr 25-yr Rainfall=4.16"

Area (ac)	CN	Description
* 26.010	78	Grassland
* 0.730	96	Gravel Access Road
26.740	78	Weighted Average
26.740	78	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.2500	0.30		Sheet Flow, Steep Sheet Flow Grass: Dense n= 0.240 P2= 2.89"
22.2	200	0.0300	0.15		Sheet Flow, Shallow Slope Sheet Grass: Dense n= 0.240 P2= 2.89"
13.2	1,191	0.0100	1.50		Shallow Concentrated Flow, Shallow Slope Waterway Grassed Waterway Kv= 15.0 fps
3.3	701	0.0550	3.52		Shallow Concentrated Flow, Steep Slope Waterway Grassed Waterway Kv= 15.0 fps
44.2	2,192	Total			

Subcatchment 1S: Vernon County Landfill

Hydrograph



Vernon County Landfill

Prepared by Short Elliott Hendrickson Inc

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Type II 6-hr 25-yr Rainfall=4.16"

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Summary for Pond 2P: Southeast Sediment Basin

Inflow Area = 26.740 ac, 0.00% Impervious, Inflow Depth = 2.02" for 25-yr event
 Inflow = 48.05 cfs @ 3.45 hrs, Volume= 4.491 af
 Outflow = 1.45 cfs @ 6.73 hrs, Volume= 1.819 af, Atten= 97%, Lag= 197.2 min
 Discarded = 0.08 cfs @ 6.73 hrs, Volume= 0.116 af
 Primary = 1.38 cfs @ 6.73 hrs, Volume= 1.703 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,187.51' @ 6.73 hrs Surf.Area= 25,031 sf Storage= 180,938 cf

Plug-Flow detention time= 566.1 min calculated for 1.819 af (41% of inflow)
 Center-of-Mass det. time= 523.9 min (766.4 - 242.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,176.00'	249,236 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,176.00	7,911	0	0
1,178.00	10,224	18,135	18,135
1,180.00	12,813	23,037	41,172
1,182.00	15,679	28,492	69,664
1,184.00	18,821	34,500	104,164
1,186.00	22,239	41,060	145,224
1,188.00	25,934	48,173	193,397
1,190.00	29,905	55,839	249,236

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,188.00'	30.0' long + 2.0 ' SideZ x 21.0' 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
#2	Discarded	1,176.00'	0.130 in/hr Exfiltration over Surface area
#3	Primary	1,184.00'	6.0" Round Culvert L= 45.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,184.00' / 1,183.55' S= 0.0100 ' / ' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.08 cfs @ 6.73 hrs HW=1,187.51' (Free Discharge)
 ↑ **2=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=1.38 cfs @ 6.73 hrs HW=1,187.51' (Free Discharge)
 ↑ **3=Culvert** (Barrel Controls 1.38 cfs @ 7.01 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,176.00' (Free Discharge)
 ↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Vernon County Landfill

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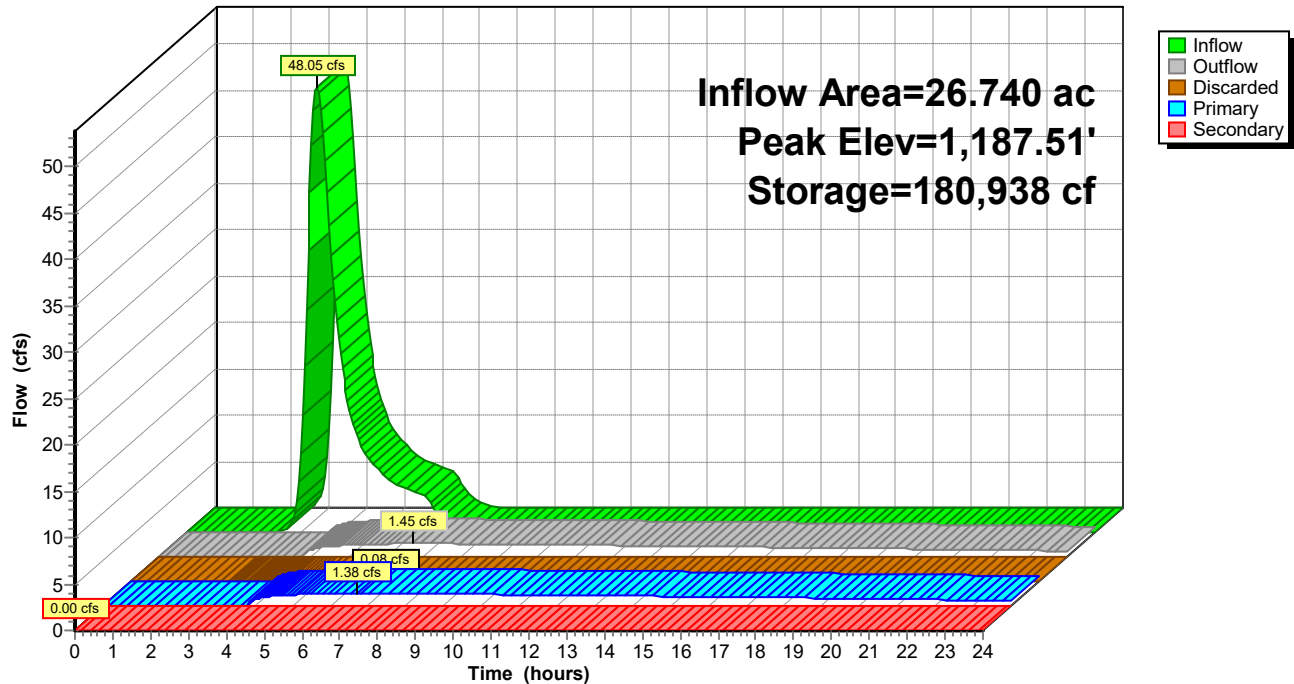
Type II 6-hr 25-yr Rainfall=4.16"

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Pond 2P: Southeast Sediment Basin

Hydrograph



Vernon County Landfill

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MSE 24-hr 4 100-yr Rainfall=7.60"

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Summary for Subcatchment 1S: Vernon County Landfill

Runoff = 85.81 cfs @ 12.60 hrs, Volume= 11.143 af, Depth> 5.00"
Routed to Pond 2P : Southeast Sediment Basin

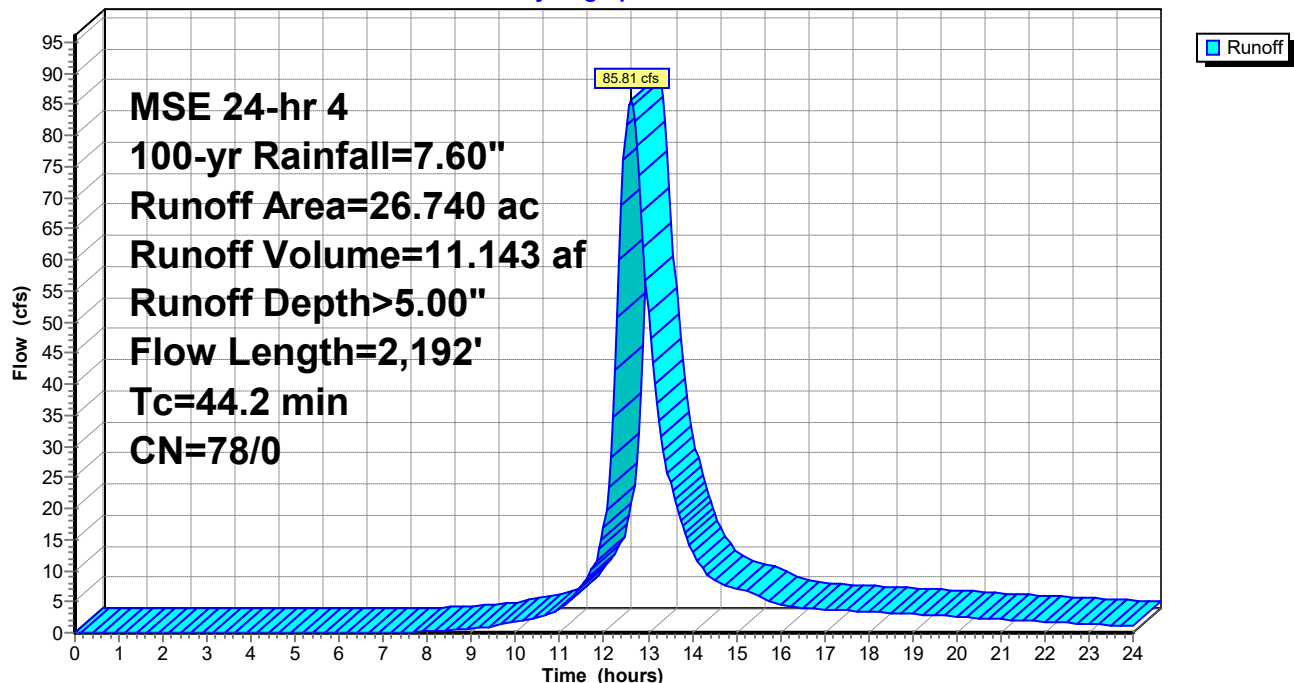
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MSE 24-hr 4 100-yr Rainfall=7.60"

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Summary for Pond 2P: Southeast Sediment Basin

Inflow Area = 26.740 ac, 0.00% Impervious, Inflow Depth > 5.00" for 100-yr event
 Inflow = 85.81 cfs @ 12.60 hrs, Volume= 11.143 af
 Outflow = 60.37 cfs @ 12.92 hrs, Volume= 6.733 af, Atten= 30%, Lag= 19.3 min
 Discarded = 0.08 cfs @ 12.92 hrs, Volume= 0.086 af
 Primary = 1.61 cfs @ 12.92 hrs, Volume= 1.419 af
 Secondary = 58.67 cfs @ 12.92 hrs, Volume= 5.228 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1,188.79' @ 12.92 hrs Surf.Area= 27,509 sf Storage= 214,591 cf

Plug-Flow detention time= 165.3 min calculated for 6.719 af (60% of inflow)

Center-of-Mass det. time= 78.6 min (910.6 - 832.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,176.00'	249,236 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
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Discarded OutFlow Max=0.08 cfs @ 12.92 hrs HW=1,188.79' (Free Discharge)↑ **2=Exfiltration** (Exfiltration Controls 0.08 cfs)**Primary OutFlow** Max=1.61 cfs @ 12.92 hrs HW=1,188.79' (Free Discharge)↑ **3=Culvert** (Barrel Controls 1.61 cfs @ 8.20 fps)**Secondary OutFlow** Max=57.63 cfs @ 12.92 hrs HW=1,188.79' (Free Discharge)↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 57.63 cfs @ 2.32 fps)

Pond 2P: Southeast Sediment Basin

Hydrograph

