AECOM
27777 Franklin Road, Suite 2000
Southfield, MI 48034
248.204.5900 tel

April 12, 2018
August 30, 2019, Revision 1

Mr. Robert Lee
DTE Electric Company
One Energy Plaza
Detroit, MI 48226

RE: CCR Impoundment Inflow Design Flood Control System Plan: Inactive Bottom Ash Impoundment, Monroe Power Plant, DTE Energy, Monroe, Michigan

The purpose of this Inflow Design Flood Control System Plan is to document how the inflow design flood control system has been designed and constructed to meet the requirements of 40 C.F.R. § 257.82 for the Monroe Power Plant Inactive Bottom Ash Impoundment. The hydrologic and hydraulic (H&H) analysis must assess if the basin storage capacity and hydraulic outlet structures are sufficient to pass the Inflow Design Flood Event, in a safe and non-erosive manner without overtopping the embankment.

1.0 DESIGN INPUTS

Inputs for H&H analysis include:

- Design storm based on the CCR Hazard Classification
- Basin configurations
- Basin outlet conditions
- Basin hydrology; and
- Basin stage-storage.

2.0 METHODOLOGY

H&H modeling and supporting calculations were conducted using accepted practices and models. An evaluation was made of the hydraulic capacity of the outlet structures. H&H calculations for the analysis were performed using methodologies presented in:

- SCS Unit Hydrograph Method, (TR-20);
- “Urban Hydrology of Small Watersheds: Technical Release No. 55” (TR-55);
- “Earth Dams and Reservoirs: Technical Release No. 60” (TR-60); and
- NOAA Atlas 14 Point Precipitation Frequency Estimates.

The computer program HydroCAD (Version 10.0) was used to perform the H&H calculations. The existing conditions for the basin were obtained from best available reports and topographic data.

3.0 BASIN CONFIGURATION

The Inactive Bottom Ash Impoundment is an inactive CCR surface impoundment as defined by 40 CFR §257.53. It consists of a bottom ash impoundment bordered by a geosynthetic lined process wastewater ditch (anticipated construction completion in late 2019) to the north and east and the Plant cooling water discharge channel to the west, which discharges cooling water from the Monroe coal power plant to the lake. The impoundment is separated from the cooling water discharge channel by a perimeter dike. The southern boundary of the impoundment is formed by an earthen divider berm

constructed of aggregate material, which separates the impoundment from the process waste and stormwater basin to the south. The normal water surface elevation of the Inactive Bottom Ash Impoundment is approximately 574.10 ft (Plant Datum) and the state ordinary high water surface elevation of Lake Erie/the cooling water discharge channel is approximately 572.20 ft (Plant Datum). Industrial process water and storm water from the Inactive Bottom Ash Impoundment discharge into the cooling water discharge channel via an overflow weir. The overflow weir consists of a 203 foot long sharp crested weir which discharges onto a riprap apron and then into the cooling water discharge channel.

The following table provides information on the existing conditions for the basin (reflecting completion of 2019 construction work).

Existing Basin Conditions

Basin Characteristic	Basin
Dike Crest Elevation (ft)	575.94
Basin Surface Area (acres)	86.4
Initial Pool Elevation (ft)	574.10
Contributing Watershed Area (acres)	313.44
Est. Curve Number (CN)	91
Time of Concentration (min)	40.2
Spillway Characteristic	
Length (ft)	203
Material	Steel
Elevation (ft)	574.25
Outlet Type	Weir
Basin Discharge Receiving Waterbody/Watershed	cooling water discharge channel (Lake Erie)

Note: Elevations presented in table above are based on Plant Datum. Add 0.90 to convert elevations from Plant Datum to NAVD88.

4.0 BASIN STAGE-STORAGE

The available storage for the impoundment was calculated from the assumed initial water elevations to the dike crest. The storage was calculated using the irregular volume calculation method with elevation, surface area, and perimeter input data. The storage volumes were calculated from available topographic data.

5.0 INFLOW DESIGN STORM EVENT

The Inactive Bottom Ash Impoundment has a Hazard Potential Classification of Significant. Therefore, the minimum Inflow Design Flood Event for this basin is the 1,000-year event.

6.0 CONCLUSION

The hydrologic and hydraulic analysis and modeling indicate the basin storage capacity and hydraulic outlet structure are sufficient to pass the Inflow Design Flood Event, in a safe and non-erosive manner without overtopping the embankment. The calculated results for the H&H model are as follows:

Results	Inactive Bottom Ash Impoundment
Maximum Water Elevation (ft)	574.63
Dike Crest Elevation (ft)	575.94

The model results are provided as an attachment. Values presented for Contributing Watershed Area and Est. Curve Number have been separated for informational purposes.

7.0 AMENDMENTS TO THE PLAN

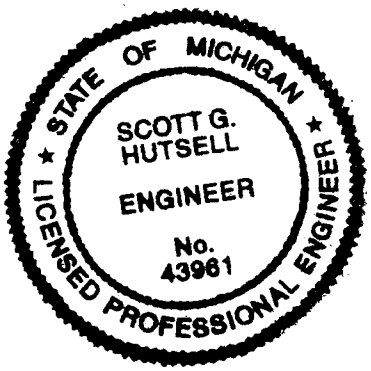
The owner or operator of the CCR unit may amend the written inflow design flood control system plan at any time provided the revised plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(4). The owner or operator must amend the written inflow design flood control plan whenever there is a change in conditions that would substantially affect the written plan in effect.

AECOM

Professional Engineer Certification

I, Scott G. Hutsell, being a Registered Professional Engineer, in accordance with the Michigan Professional Engineer's Registration, do hereby certify to the best of my knowledge, information and belief, that this Inflow Design Flood Control Plan, dated August 30, 2019, meets the requirements of 40 C.F.R. § 257.82, is true and correct, and has been prepared in accordance with generally accepted good engineering practices.

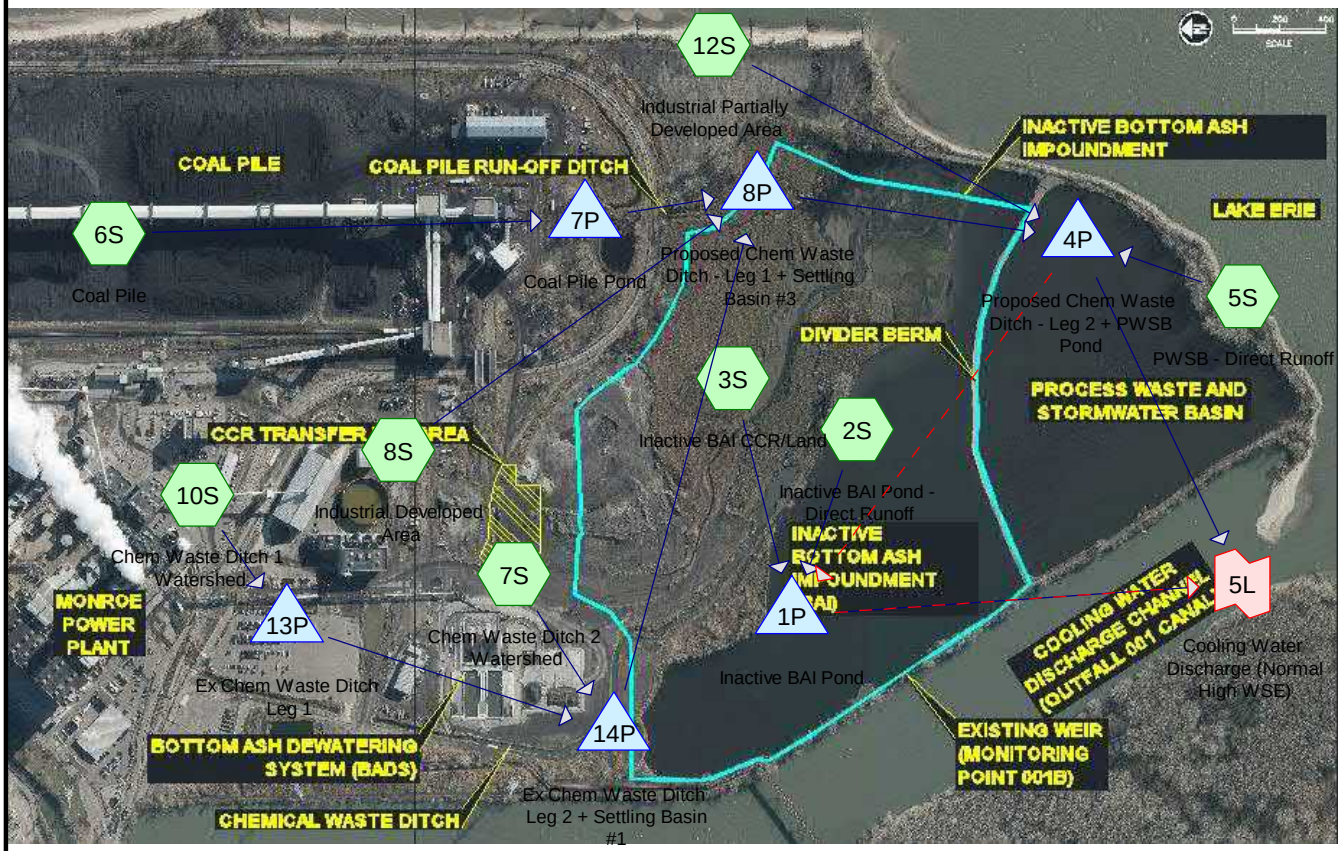
SIGNATURE Scott G Hutsell DATE 08/30/19



Revision Log

The table below provides a description of revisions to the CCR Impoundment Inflow Design Flood Control System Plan.

1	08/30/2019	Changed text on pages 1-4 and hydrologic and hydraulic analysis results appendix.



Subcat Reach Pond Link

Routing Diagram for DTE MONPP Inactive BAI - Proposed
Prepared by AECOM, Printed 8/13/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
16.137	84	50-75% Grass cover, Fair, HSG D (6S)
45.300	80	Bottom Ash (3S)
80.685	86	Coal (6S)
2.320	96	Gravel surface, HSG D (12S)
10.000	86	Newly graded area, HSG B (12S)
25.190	98	Paved parking, HSG A (7S, 10S)
37.290	98	Unconnected pavement, HSG A (8S)
10.758	98	Unconnected roofs, HSG A (6S)
85.760	98	Water Surface, HSG A (2S, 5S)
313.440	**91**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Sim-Route method - Pond routing by Sim-Route method

Subcatchment 2S: Inactive BAI Pond - Direct Runoff Area=48.660 ac 100.00% Impervious Runoff Depth=7.25"
Flow Length=2,392' Tc=2.2 min CN=98 Runoff=584.54 cfs 29.401 af

Subcatchment 3S: Inactive BAI CCR/Land Runoff Area=45.300 ac 0.00% Impervious Runoff Depth=5.15"
Flow Length=2,500' Slope=0.0400 '/' Tc=33.1 min CN=80 Runoff=188.78 cfs 19.436 af

Subcatchment 5S: PWSB - Direct Runoff Runoff Area=37.100 ac 100.00% Impervious Runoff Depth=7.25"
Flow Length=1,650' Tc=2.6 min CN=98 Runoff=440.91 cfs 22.416 af

Subcatchment 6S: Coal Pile Runoff Area=107.580 ac 10.00% Impervious Runoff Depth=5.84"
Flow Length=4,600' Tc=19.0 min UI Adjusted CN=86 Runoff=695.11 cfs 52.337 af

Subcatchment 7S: Chem Waste Ditch 2 Runoff Area=13.750 ac 100.00% Impervious Runoff Depth=7.25"
Flow Length=2,147' Slope=0.0100 '/' Tc=27.7 min CN=98 Runoff=80.44 cfs 8.308 af

Subcatchment 8S: Industrial Developed Area Runoff Area=37.290 ac 100.00% Impervious Runoff Depth=7.25"
Flow Length=1,892' Slope=0.0100 '/' Tc=25.1 min CN=98 Runoff=231.52 cfs 22.531 af

Subcatchment 10S: Chem Waste Ditch 1 Runoff Area=11.440 ac 100.00% Impervious Runoff Depth=7.25"
Flow Length=2,147' Slope=0.0100 '/' Tc=27.7 min CN=98 Runoff=66.93 cfs 6.912 af

Subcatchment 12S: Industrial Partially Runoff Area=12.320 ac 0.00% Impervious Runoff Depth=6.07"
Flow Length=1,892' Slope=0.0100 '/' Tc=40.2 min CN=88 Runoff=51.87 cfs 6.232 af

Pond 1P: Inactive BAI Pond Peak Elev=574.63' Storage=15,786,679 cf Inflow=637.93 cfs 48.837 af
Primary=158.91 cfs 42.664 af Secondary=0.00 cfs 0.000 af Outflow=158.91 cfs 42.664 af

Pond 4P: Proposed Chem Waste Ditch - Peak Elev=575.81' Storage=6,220,760 cf Inflow=947.20 cfs 223.115 af
Outflow=223.28 cfs 218.924 af

Pond 7P: Coal Pile Pond Peak Elev=579.30' Storage=324,789 cf Inflow=695.11 cfs 52.337 af
Outflow=689.66 cfs 52.293 af

Pond 8P: Proposed Chem Waste Ditch - Peak Elev=578.24' Storage=7.785 af Inflow=933.36 cfs 194.573 af
Outflow=856.72 cfs 194.489 af

Pond 13P: Ex Chem Waste Ditch Leg 1 Peak Elev=581.87' Storage=2.380 af Inflow=83.34 cfs 72.010 af
24.0" Round Culvert x 2.00 n=0.020 L=155.0' S=0.0032 '/' Outflow=44.65 cfs 71.857 af

Pond 14P: Ex Chem Waste Ditch Leg 2 + Peak Elev=578.30' Storage=4.397 af Inflow=120.49 cfs 119.821 af
Outflow=218.19 cfs 119.771 af

Link 5L: Cooling Water Discharge (Normal High WSE) Inflow=370.77 cfs 261.566 af
Primary=370.77 cfs 261.566 af

Total Runoff Area = 313.440 ac Runoff Volume = 167.573 af Average Runoff Depth = 6.42"
49.27% Pervious = 154.442 ac 50.73% Impervious = 158.998 ac

Summary for Subcatchment 2S: Inactive BAI Pond - Direct Runoff

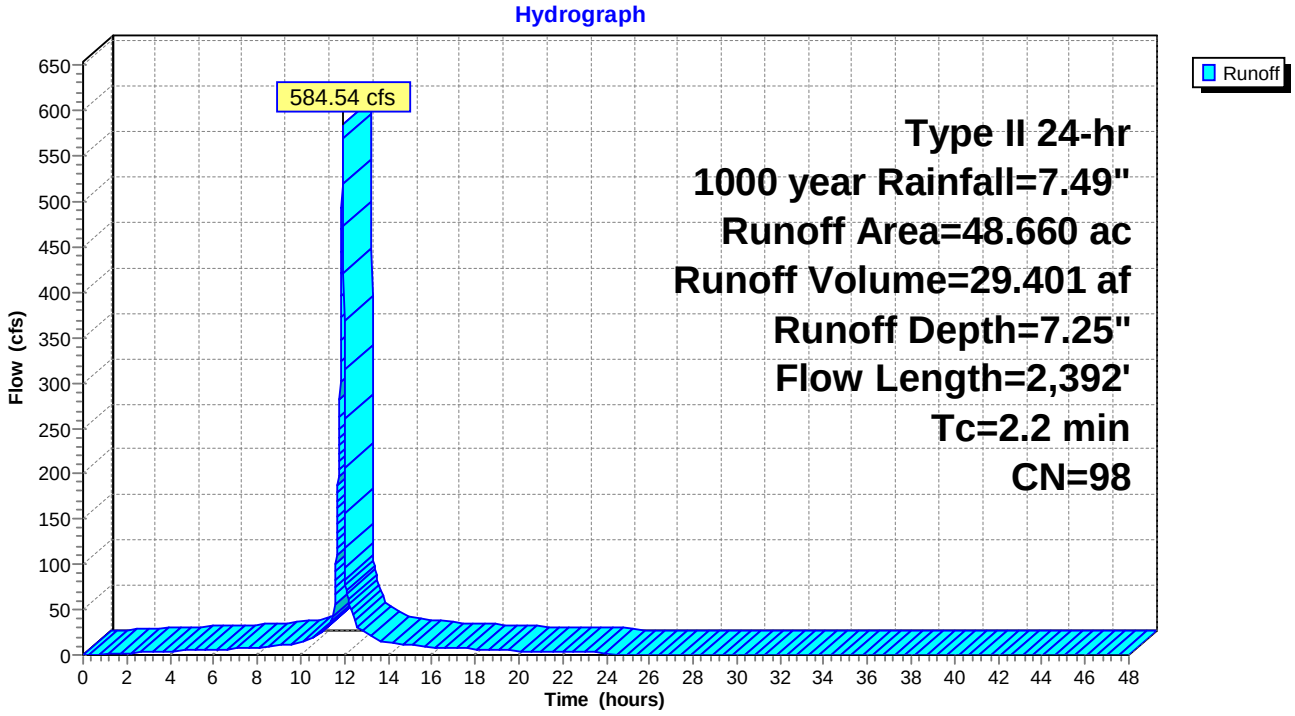
Runoff = 584.54 cfs @ 11.92 hrs, Volume= 29.401 af, Depth= 7.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000 year Rainfall=7.49"

Area (ac)	CN	Description
48.660	98	Water Surface, HSG A
48.660		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	2,392		17.94		**Lake or Reservoir, Lake** Mean Depth= 10.00'

Subcatchment 2S: Inactive BAI Pond - Direct Runoff



Summary for Subcatchment 3S: Inactive BAI CCR/Land

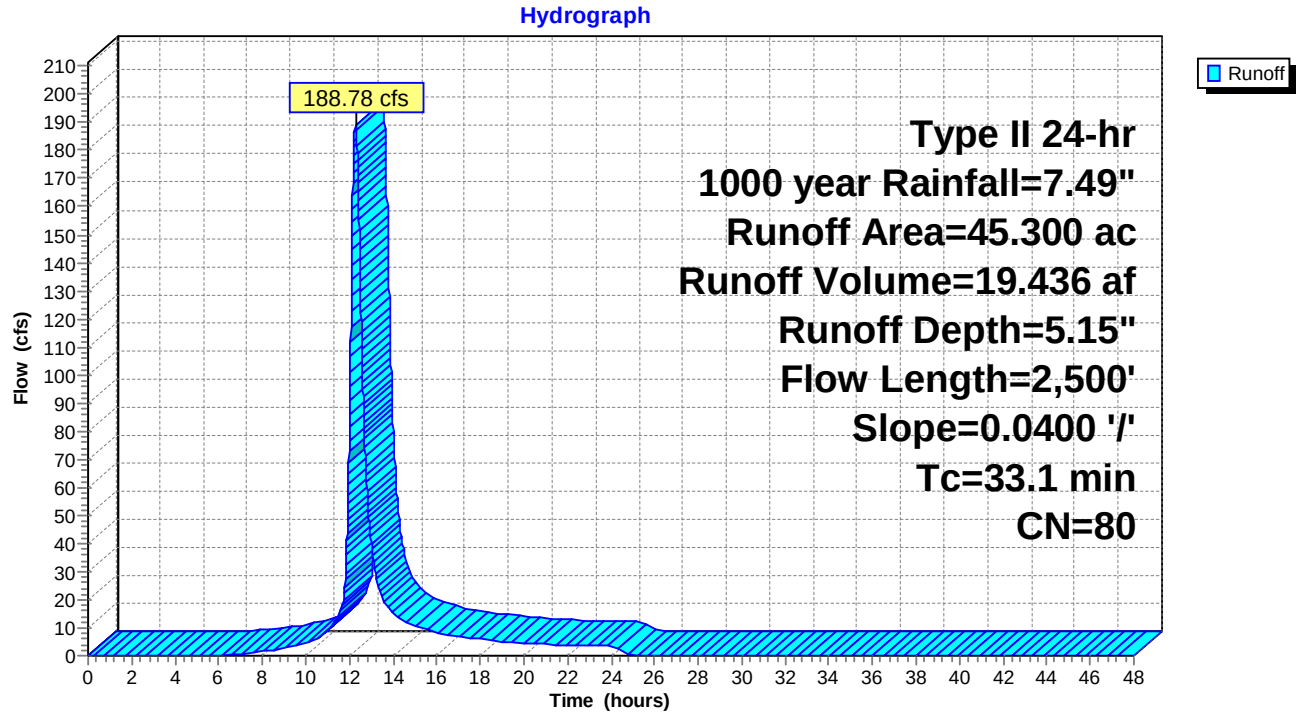
Runoff = 188.78 cfs @ 12.28 hrs, Volume= 19.436 af, Depth= 5.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000 year Rainfall=7.49"

	Area (ac)	CN	Description
*	45.300	80	Bottom Ash
	45.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.1	2,500	0.0400	1.26		**Lag/CN Method,**

Subcatchment 3S: Inactive BAI CCR/Land



Summary for Subcatchment 5S: PWSB - Direct Runoff

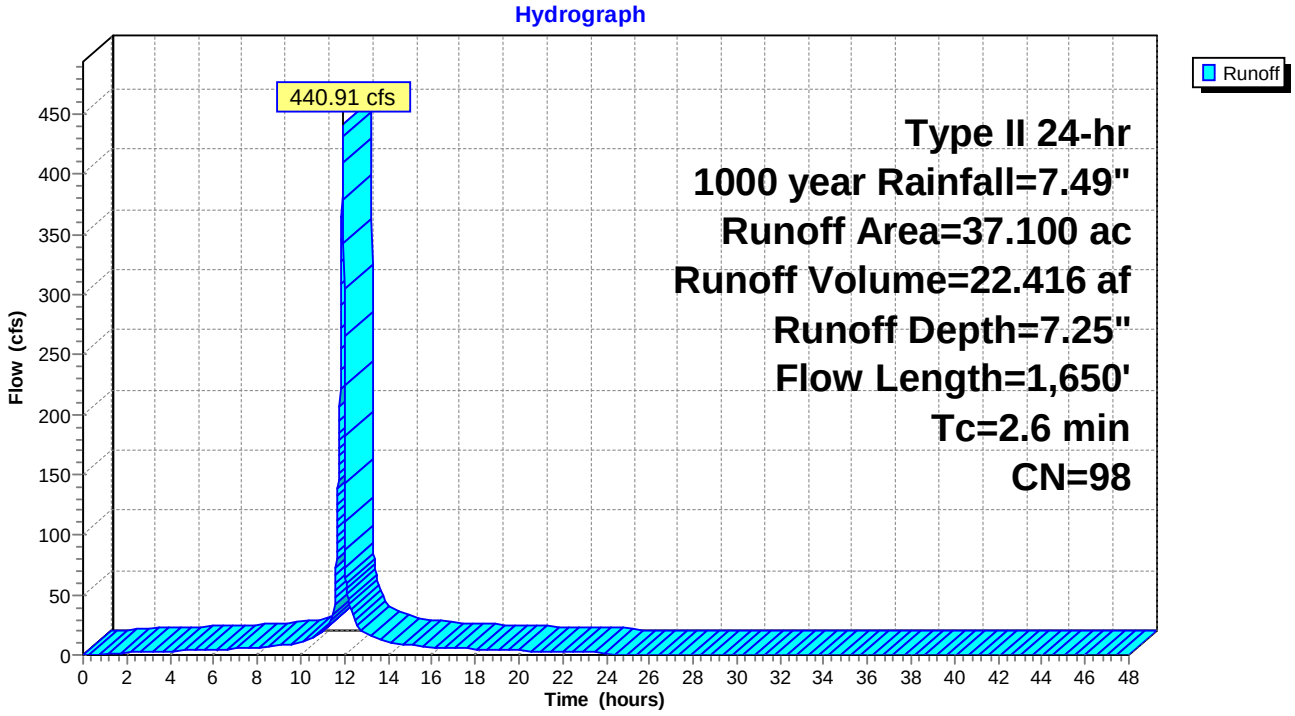
Runoff = 440.91 cfs @ 11.93 hrs, Volume= 22.416 af, Depth= 7.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000 year Rainfall=7.49"

Area (ac)	CN	Description
37.100	98	Water Surface, HSG A
37.100		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	1,650		10.46		**Lake or Reservoir, Lake** Mean Depth= 3.40'

Subcatchment 5S: PWSB - Direct Runoff



Summary for Subcatchment 6S: Coal Pile

Time of concentration was calculated conservatively for the coal pile due to lack of topography for the area and information about the drainage ditches.

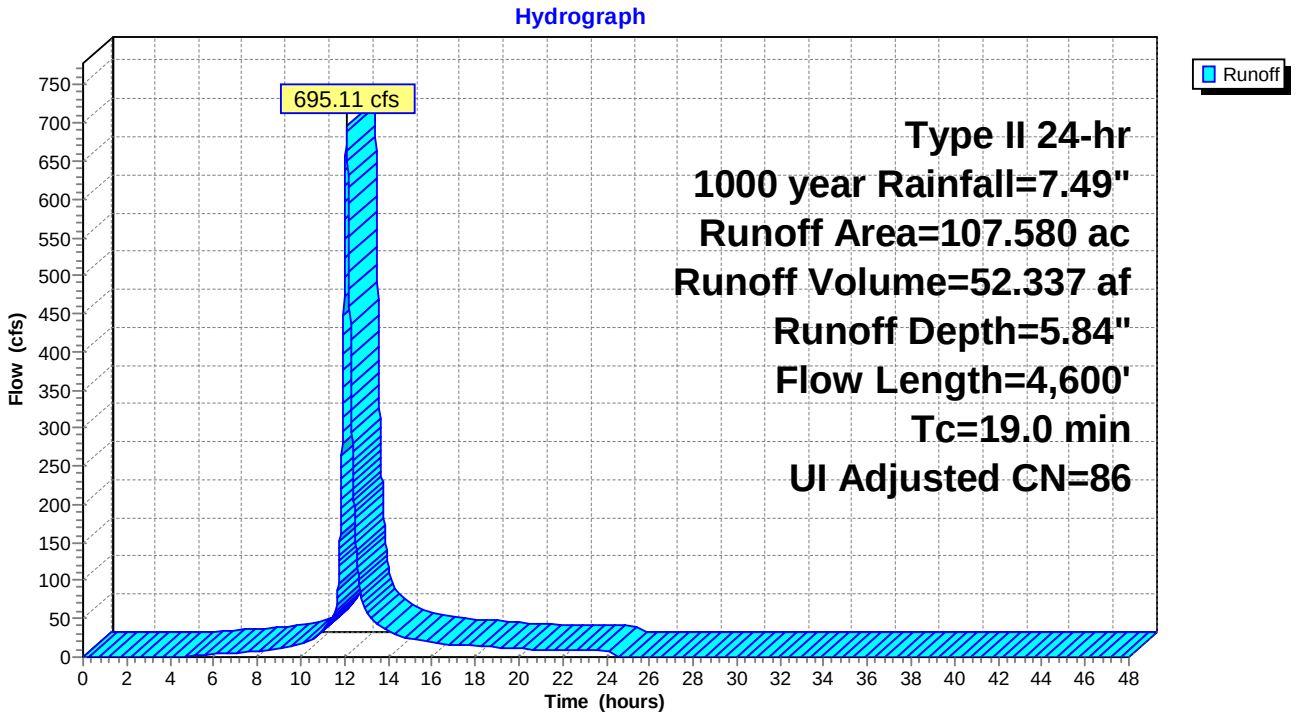
Runoff = 695.11 cfs @ 12.10 hrs, Volume= 52.337 af, Depth= 5.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000 year Rainfall=7.49"

	Area (ac)	CN	Adj	Description
*	80.685	86		Coal
	10.758	98		Unconnected roofs, HSG A
	16.137	84		50-75% Grass cover, Fair, HSG D
	107.580	87	86	Weighted Average, UI Adjusted
	96.822			90.00% Pervious Area
	10.758			10.00% Impervious Area
	10.758			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	4,000	0.0010	7.25	543.56	**Channel Flow,** Area= 75.0 sf Perim= 12.0' r= 6.25' n= 0.022 Earth, clean & straight
6.0	100	0.1000	0.28		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.35"
3.8	500	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
19.0	4,600	Total			

Subcatchment 6S: Coal Pile



Summary for Subcatchment 7S: Chem Waste Ditch 2 Watershed

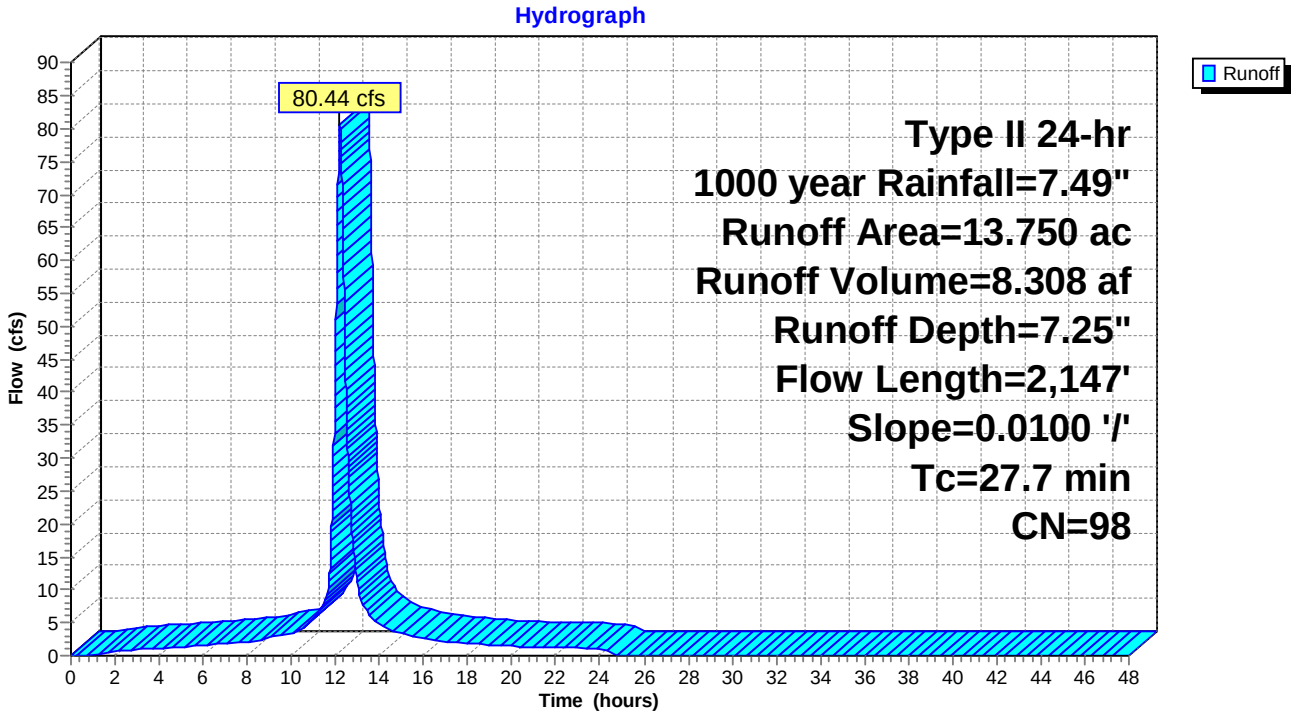
Runoff = 80.44 cfs @ 12.20 hrs, Volume= 8.308 af, Depth= 7.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000 year Rainfall=7.49"

Area (ac)	CN	Description
13.750	98	Paved parking, HSG A
13.750		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.7	2,147	0.0100	1.29		**Lag/CN Method,**

Subcatchment 7S: Chem Waste Ditch 2 Watershed



Summary for Subcatchment 8S: Industrial Developed Area

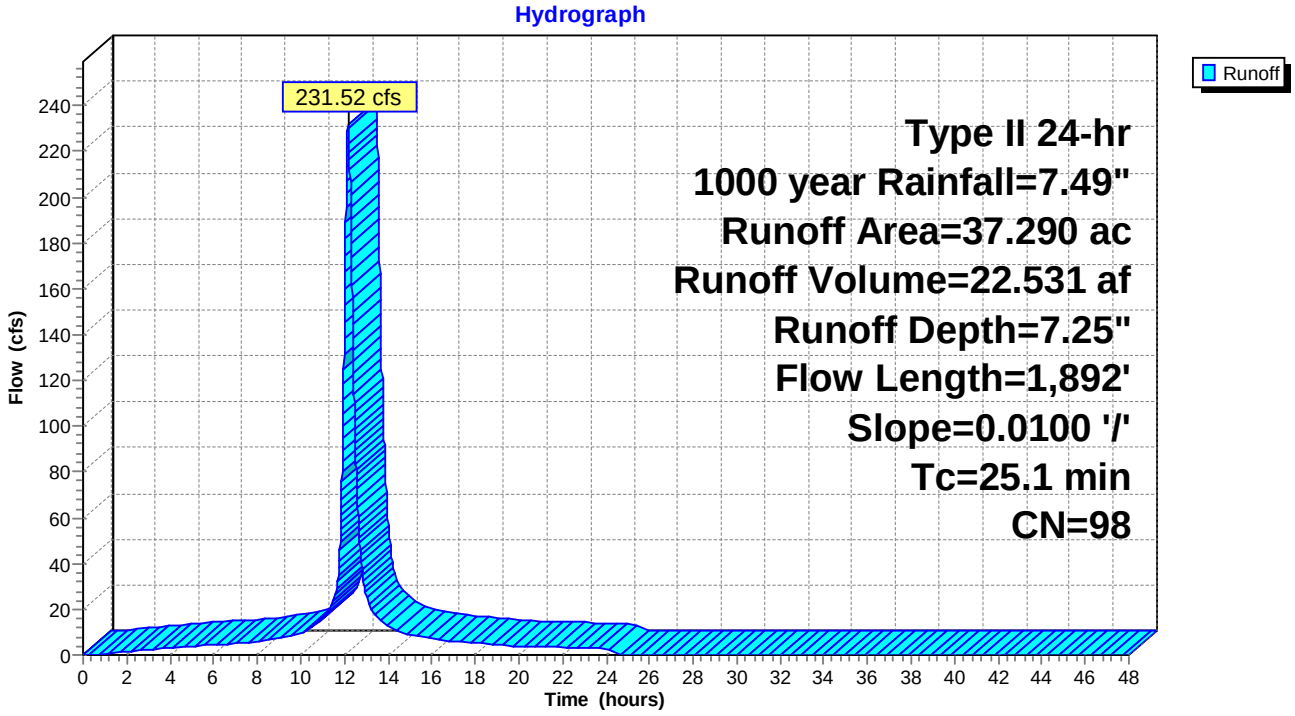
Runoff = 231.52 cfs @ 12.18 hrs, Volume= 22.531 af, Depth= 7.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000 year Rainfall=7.49"

Area (ac)	CN	Description
37.290	98	Unconnected pavement, HSG A
37.290		100.00% Impervious Area
37.290		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.1	1,892	0.0100	1.26		**Lag/CN Method,**

Subcatchment 8S: Industrial Developed Area



Summary for Subcatchment 10S: Chem Waste Ditch 1 Watershed

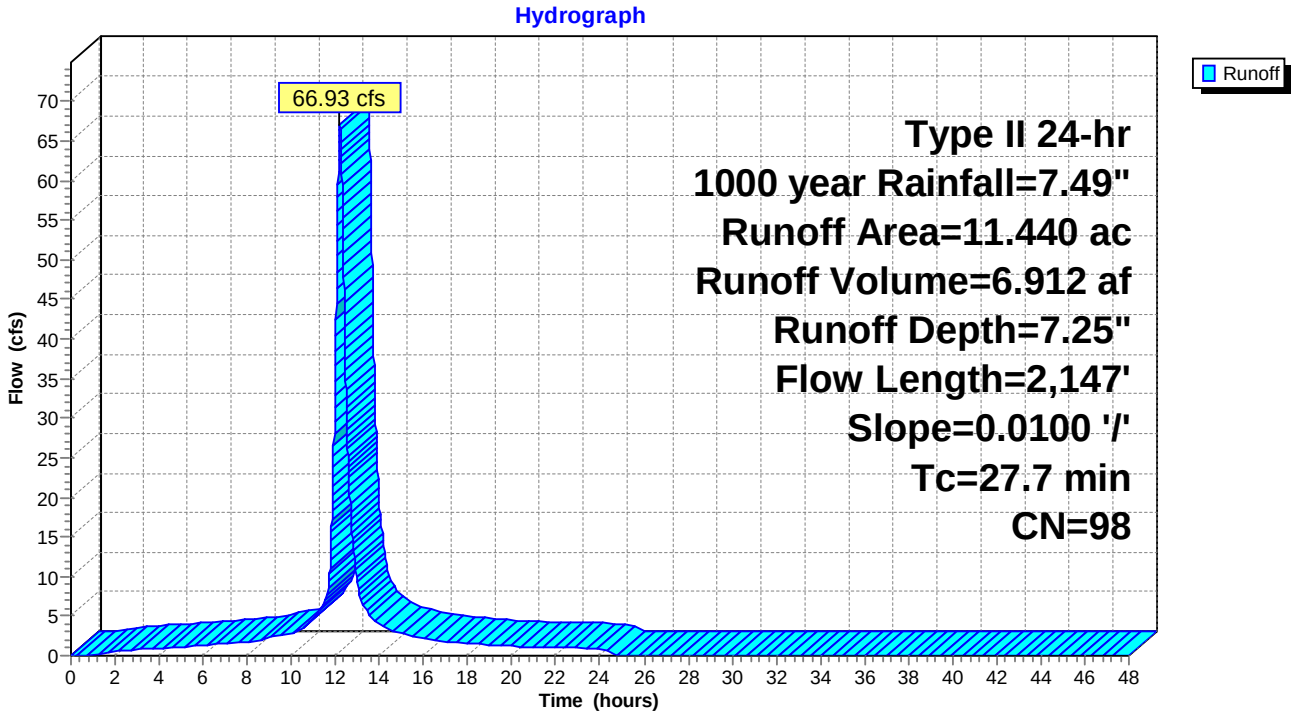
Runoff = 66.93 cfs @ 12.20 hrs, Volume= 6.912 af, Depth= 7.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000 year Rainfall=7.49"

Area (ac)	CN	Description
11.440	98	Paved parking, HSG A
11.440		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.7	2,147	0.0100	1.29		**Lag/CN Method,**

Subcatchment 10S: Chem Waste Ditch 1 Watershed



Summary for Subcatchment 12S: Industrial Partially Developed Area

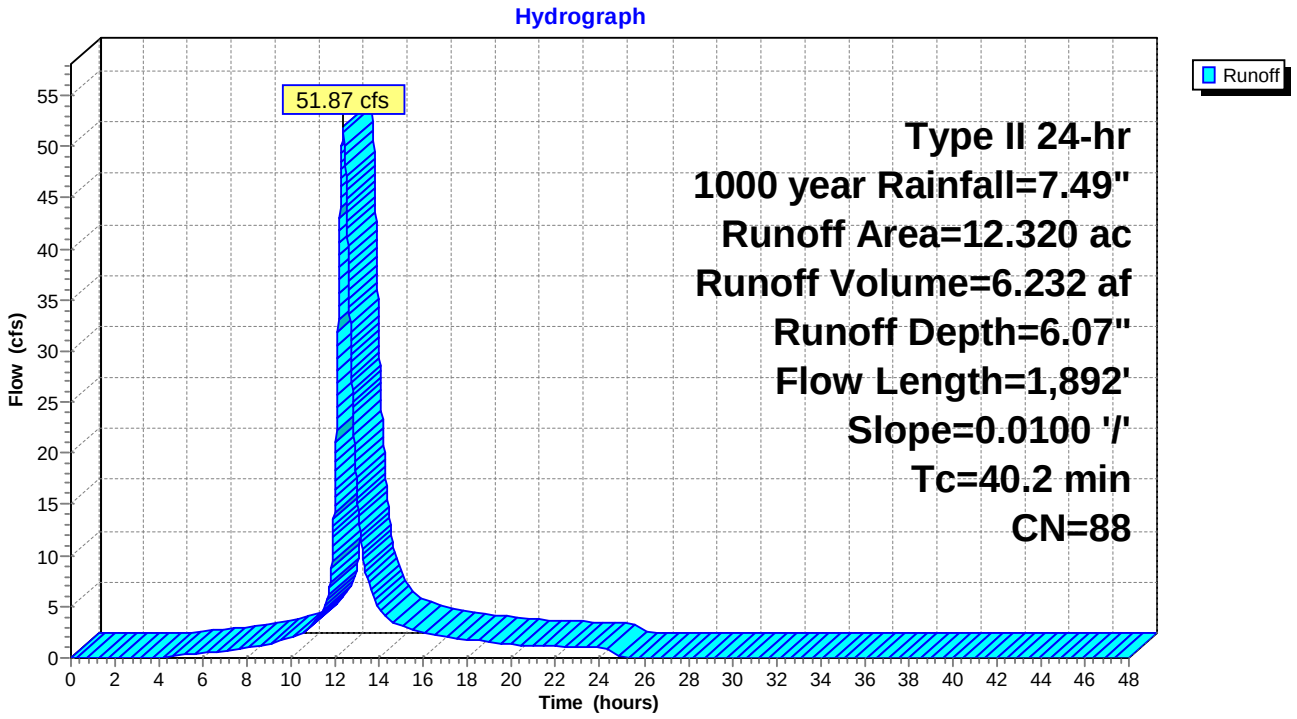
Runoff = 51.87 cfs @ 12.37 hrs, Volume= 6.232 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000 year Rainfall=7.49"

Area (ac)	CN	Description
2.320	96	Gravel surface, HSG D
10.000	86	Newly graded area, HSG B
12.320	88	Weighted Average
12.320		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.2	1,892	0.0100	0.78		**Lag/CN Method,**

Subcatchment 12S: Industrial Partially Developed Area



Summary for Pond 1P: Inactive BAI Pond

Storage between 576 and 577 is artificial. Should not allow water level to rise above 576, as dike will begin overtopping near the existing weir.

All model elevations are in Plant Datum. Add 0.9 to convert from Plant Datum to NAVD88.

Weir dimensions/elevation based on historical drawing 6C695-270 (weir #2). Although the drawing indicates the invert to be 574.00', this was conservatively adjusted to 574.25' to calibrate with the surveyed water elevation of 574.34' and average base flow rate of 17.64 cfs.

Inflow Area = 93.960 ac, 51.79% Impervious, Inflow Depth = 6.24" for 1000 year event
Inflow = 637.93 cfs @ 11.93 hrs, Volume= 48.837 af
Outflow = 158.91 cfs @ 12.52 hrs, Volume= 42.664 af, Atten= 75%, Lag= 35.5 min
Primary = 158.91 cfs @ 12.52 hrs, Volume= 42.664 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 574.10' Surf.Area= 1,727,285 sf Storage= 14,798,671 cf
Peak Elev= 574.63' @ 12.52 hrs Surf.Area= 1,978,401 sf Storage= 15,786,679 cf (988,008 cf above start)
Flood Elev= 575.94' Surf.Area= 2,718,646 sf Storage= 18,832,867 cf (4,034,196 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 161.4 min (932.8 - 771.4)

Volume	Invert	Avail.Storage	Storage Description
#1	555.00'	21,753,554 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

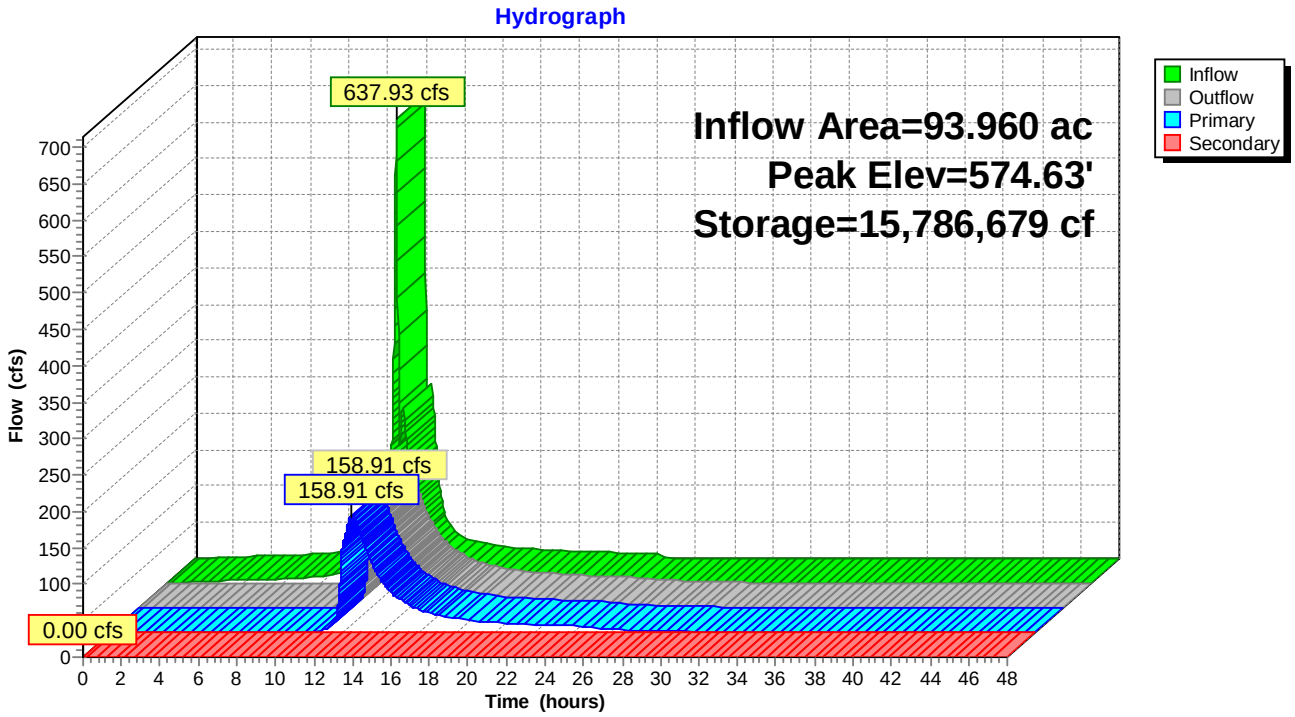
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
555.00	77,623	1,651.3	0	0	77,623
556.00	177,260	1,877.2	124,061	124,061	141,078
557.00	230,132	2,314.1	203,122	327,183	286,813
558.00	321,306	3,197.8	274,454	601,637	674,434
559.00	464,061	4,003.1	390,503	992,140	1,135,909
560.00	545,591	4,074.9	504,276	1,496,417	1,182,240
561.00	595,521	4,154.9	570,374	2,066,790	1,234,794
562.00	637,571	4,217.1	616,426	2,683,217	1,276,444
563.00	674,537	4,282.6	655,967	3,339,184	1,320,951
564.00	710,097	4,354.8	692,241	4,031,425	1,370,765
565.00	747,174	4,428.2	728,557	4,759,982	1,422,254
566.00	790,902	4,569.0	768,934	5,528,916	1,523,163
567.00	844,886	4,408.8	817,745	6,346,662	1,637,703
568.00	879,663	4,506.1	862,216	7,208,878	1,706,874
569.00	915,793	4,610.7	897,667	8,106,545	1,782,897
570.00	970,583	4,701.2	943,055	9,049,600	1,850,120
571.00	1,078,279	5,020.2	1,023,959	10,073,559	2,096,948
572.00	1,557,607	7,568.3	1,310,618	11,384,178	4,649,543
573.00	1,624,363	7,481.1	1,590,868	12,975,046	4,754,244
574.00	1,682,124	7,570.5	1,653,159	14,628,205	4,861,589
575.00	2,160,656	12,380.1	1,916,405	16,544,610	12,497,404
576.00	2,756,436	17,581.0	2,452,508	18,997,118	24,897,548
577.00	2,756,436	17,581.0	2,756,436	21,753,554	24,915,129

Device	Routing	Invert	Outlet Devices
#1	Primary	574.25'	**203.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 6.0' Crest Height
#2	Secondary	575.94'	**Uncontrolled Overtopping Dike, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 100.00 460.00

Primary OutFlow Max=158.91 cfs @ 12.52 hrs HW=574.63' TW=572.20' (Dynamic Tailwater)
1=Sharp-Crested Rectangular Weir (Weir Controls 158.91 cfs @ 2.04 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=574.10' TW=572.20' (Dynamic Tailwater)
2=Uncontrolled Overtopping Dike (Controls 0.00 cfs)

Pond 1P: Inactive BAI Pond



Summary for Pond 4P: Proposed Chem Waste Ditch - Leg 2 + PWSB Pond

Inflow Area = 219.480 ac, 50.27% Impervious, Inflow Depth > 12.20" for 1000 year event
Inflow = 947.20 cfs @ 12.24 hrs, Volume= 223.115 af
Outflow = 223.28 cfs @ 12.95 hrs, Volume= 218.924 af, Atten= 76%, Lag= 42.8 min
Primary = 223.28 cfs @ 12.95 hrs, Volume= 218.924 af

Routing by Sim-Route method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 574.10' Surf.Area= 1,441,227 sf Storage= 3,726,033 cf
Peak Elev= 575.81' @ 12.95 hrs Surf.Area= 1,473,092 sf Storage= 6,220,760 cf (2,494,727 cf above start)
Flood Elev= 577.00' Surf.Area= 1,504,611 sf Storage= 7,991,291 cf (4,265,258 cf above start)

Plug-Flow detention time= 949.1 min calculated for 133.386 af (60% of inflow)
Center-of-Mass det. time= 141.2 min (1,250.6 - 1,109.4)

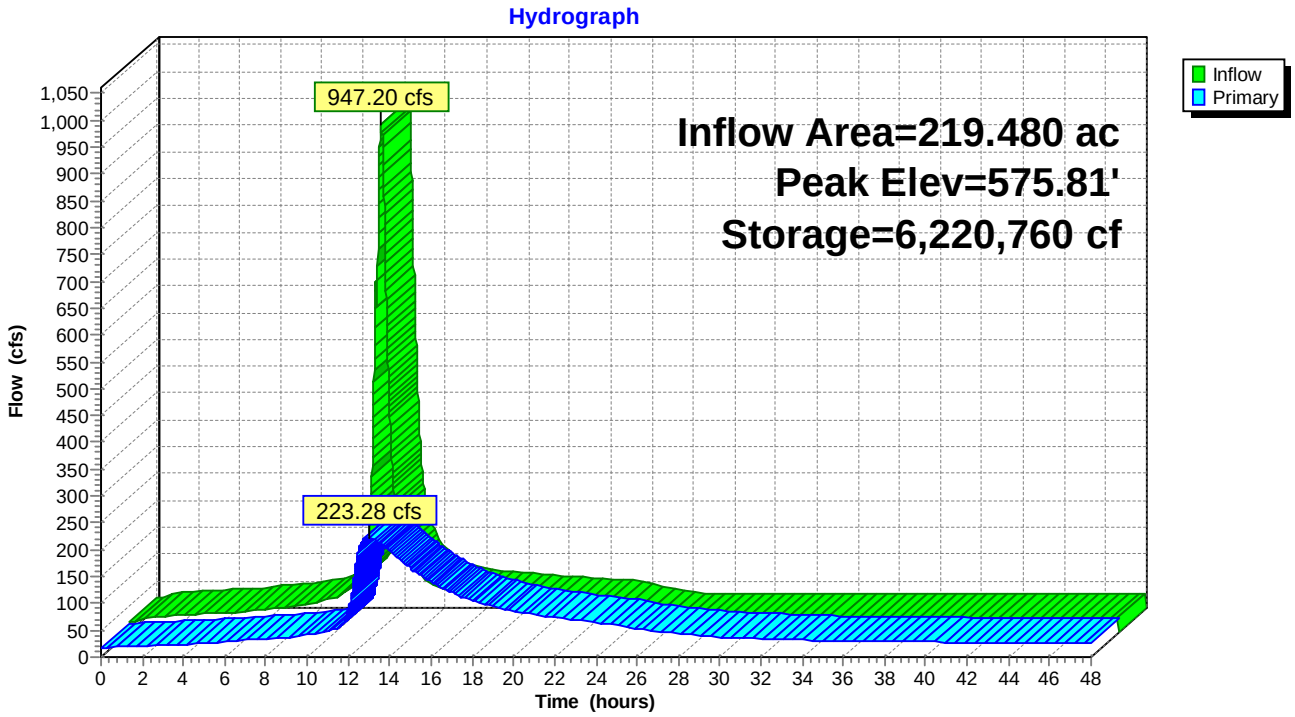
Volume	Invert	Avail.Storage	Storage Description
#1	571.00'	9,495,902 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
571.00	455,392	5,928.0	0	0	455,392
572.00	1,284,243	4,716.0	834,793	834,793	1,481,997
573.00	1,386,039	4,883.0	1,334,817	2,169,611	1,609,653
574.00	1,438,953	4,846.0	1,412,413	3,582,024	1,638,709
575.00	1,461,773	4,832.0	1,450,348	5,032,372	1,650,527
576.00	1,475,756	4,875.0	1,468,759	6,501,131	1,684,095
577.00	1,504,611	4,986.0	1,490,160	7,991,291	1,771,338
578.00	1,504,611	4,986.0	1,504,611	9,495,902	1,776,324

Device	Routing	Invert	Outlet Devices
#1	Primary	573.70'	**7.0' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 2.0' Crest Height
#2	Primary	576.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 2.00 Width (feet) 1,700.00 1,825.00 1,900.00

Primary OutFlow Max=223.28 cfs @ 12.95 hrs HW=575.81' TW=572.20' (Dynamic Tailwater)
1=Sharp-Crested Rectangular Weir (Weir Controls 223.28 cfs @ 5.36 fps)
2=Custom Weir/Orifice (Controls 0.00 cfs)

Pond 4P: Proposed Chem Waste Ditch - Leg 2 + PWSB Pond



Summary for Pond 7P: Coal Pile Pond

[58] Hint: Peaked 0.30' above defined flood level

Inflow Area = 107.580 ac, 10.00% Impervious, Inflow Depth = 5.84" for 1000 year event
Inflow = 695.11 cfs @ 12.10 hrs, Volume= 52.337 af
Outflow = 689.66 cfs @ 12.13 hrs, Volume= 52.293 af, Atten= 1%, Lag= 1.5 min
Primary = 689.66 cfs @ 12.13 hrs, Volume= 52.293 af

Routing by Sim-Route method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 574.59' Surf.Area= 18,955 sf Storage= 5,592 cf
Peak Elev= 579.30' @ 12.13 hrs Surf.Area= 290,712 sf Storage= 324,789 cf (319,197 cf above start)
Flood Elev= 579.00' Surf.Area= 200,000 sf Storage= 250,600 cf (245,008 cf above start)

Plug-Flow detention time= 70.5 min calculated for 52.165 af (100% of inflow)
Center-of-Mass det. time= 66.9 min (865.7 - 798.8)

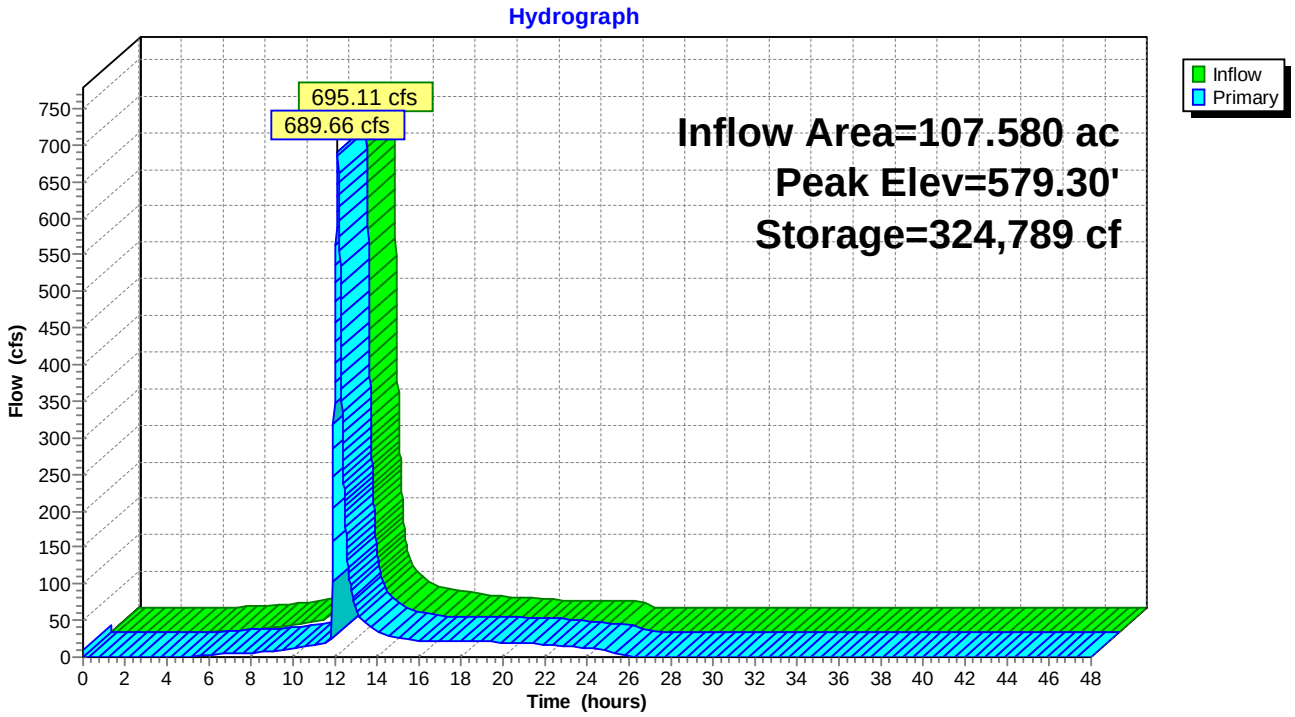
Volume	Invert	Avail.Storage	Storage Description
#1	574.00'	1,100,600 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
574.00	0	0	0
575.00	32,127	16,064	16,064
576.00	32,127	32,127	48,191
577.00	39,065	35,596	83,787
578.00	47,281	43,173	126,960
579.00	200,000	123,641	250,600
580.00	500,000	350,000	600,600
581.00	500,000	500,000	1,100,600

Device	Routing	Invert	Outlet Devices
#1	Primary	572.00'	**24.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 572.00' / 572.00' S= 0.0000 '/' Cc= 0.900 n= 0.021 Corrugated metal, Flow Area= 3.14 sf
#2	Primary	579.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 1,000.00 3,000.00

Primary OutFlow Max=689.12 cfs @ 12.13 hrs HW=579.30' TW=577.92' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 13.08 cfs @ 4.16 fps)
└─**2=Custom Weir/Orifice** (Weir Controls 676.04 cfs @ 1.72 fps)

Pond 7P: Coal Pile Pond



Summary for Pond 8P: Proposed Chem Waste Ditch - Leg 1 + Settling Basin #3

[58] Hint: Peaked 0.24' above defined flood level
[80] Warning: Exceeded Pond 7P by 0.16' @ 3.95 hrs (4.48 cfs 1.624 af)
[80] Warning: Exceeded Pond 14P by 0.71' @ 12.10 hrs (372.71 cfs 6.839 af)

Inflow Area = 170.060 ac, 43.07% Impervious, Inflow Depth > 13.73" for 1000 year event
Inflow = 933.36 cfs @ 12.22 hrs, Volume= 194.573 af
Outflow = 856.72 cfs @ 12.24 hrs, Volume= 194.489 af, Atten= 8%, Lag= 0.9 min
Primary = 856.72 cfs @ 12.24 hrs, Volume= 194.489 af

Routing by Sim-Route method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 574.59' Surf.Area= 1.127 ac Storage= 2.171 af
Peak Elev= 578.24' @ 12.24 hrs Surf.Area= 1.947 ac Storage= 7.785 af (5.613 af above start)
Flood Elev= 578.00' Surf.Area= 1.892 ac Storage= 7.316 af (5.144 af above start)

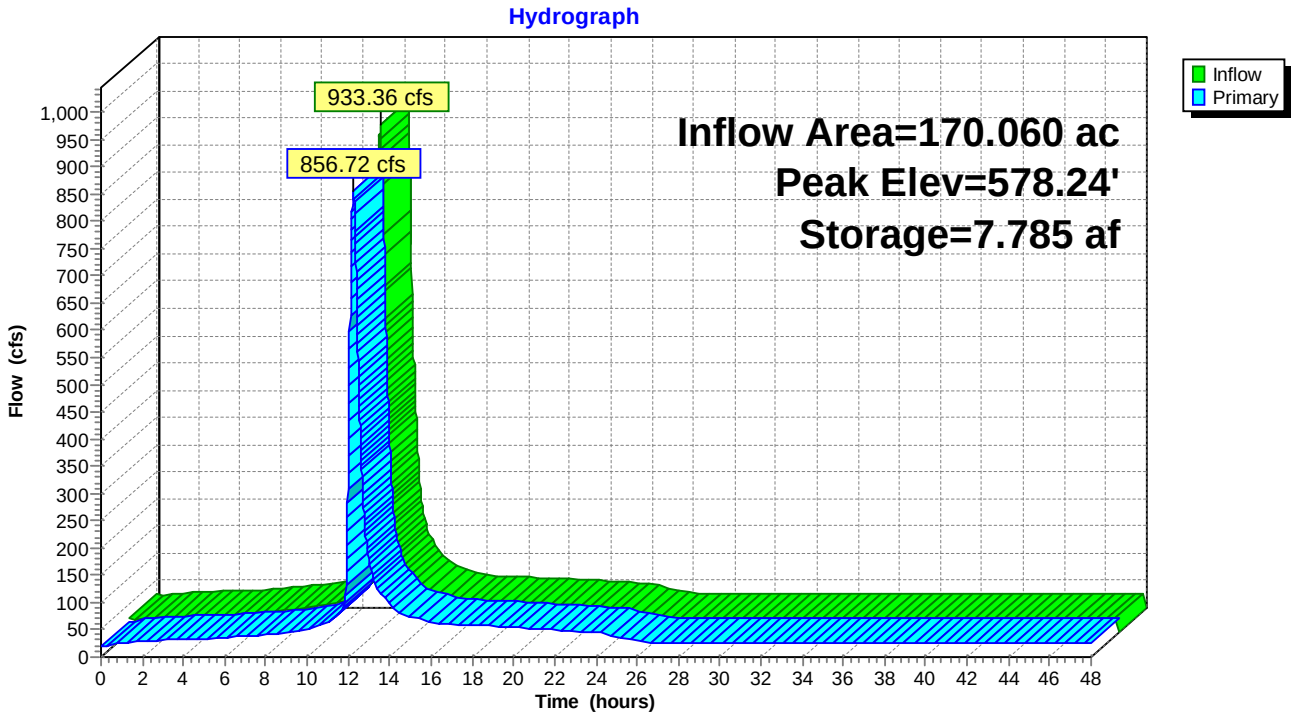
Plug-Flow detention time= 37.7 min calculated for 192.317 af (99% of inflow)
Center-of-Mass det. time= 5.2 min (1,162.3 - 1,157.1)

Volume	Invert	Avail.Storage	Storage Description
#1	572.00'	9.321 af	**10.00'W x 2,400.00'L x 7.00'H Prismatoid Z=2.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	574.25'	**34.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=853.41 cfs @ 12.24 hrs HW=578.24' TW=575.26' (Dynamic Tailwater)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 853.41 cfs @ 6.29 fps)

Pond 8P: Proposed Chem Waste Ditch - Leg 1 + Settling Basin #3



Summary for Pond 13P: Ex Chem Waste Ditch Leg 1

Baseflow for normal (sunny day) conditions is 17.64 cfs (11.4 MGD), split between two existing chem waste ditch nodes to approximately reflect existing conditions as observed in site visit on March 26, 2019 (sunny day with no recent wet weather event).

Baseflow for storm event modeling is 17.64 cfs (11.4 MGD) plus maximum oil/water separator storm event flow of 8.77 cfs, which totals 26.41 cfs.

---

[86] Warning: Oscillations may require smaller dt (severity=1)

Inflow Area = 11.440 ac,100.00% Impervious, Inflow Depth > 75.53" for 1000 year event
Inflow = 83.34 cfs @ 12.20 hrs, Volume= 72.010 af, Incl. 16.41 cfs Base Flow
Outflow = 44.65 cfs @ 12.76 hrs, Volume= 71.857 af, Atten= 46%, Lag= 33.5 min
Primary = 44.65 cfs @ 12.76 hrs, Volume= 71.857 af

Routing by Sim-Route method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 576.21' Surf.Area= 0.213 ac Storage= 0.215 af
Peak Elev= 581.87' @ 12.56 hrs Surf.Area= 0.557 ac Storage= 2.380 af (2.166 af above start)
Flood Elev= 582.00' Surf.Area= 0.565 ac Storage= 2.456 af (2.241 af above start)

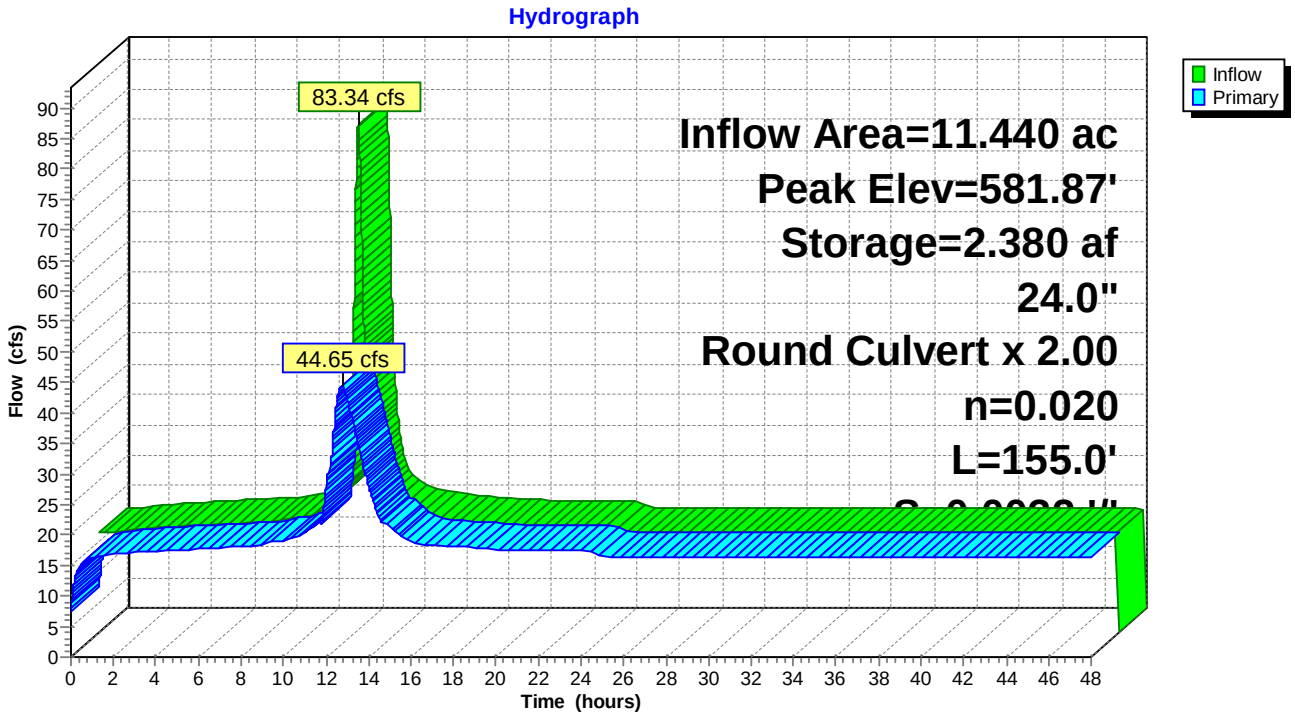
Plug-Flow detention time= 18.3 min calculated for 71.627 af (99% of inflow)
Center-of-Mass det. time= 6.5 min (1,380.7 - 1,374.3)

Volume	Invert	Avail.Storage	Storage Description
#1	575.00'	7.008 af	**10.00'W x 620.00'L x 13.00'H Prismatoid Z=2.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	575.00'	**24.0" Round Culvert X 2.00** L= 155.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 575.00' / 574.50' S= 0.0032 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 3.14 sf

Primary OutFlow Max=44.74 cfs @ 12.76 hrs HW=581.63' TW=576.54' (Dynamic Tailwater)
1=Culvert (Outlet Controls 44.74 cfs @ 7.12 fps)

Pond 13P: Ex Chem Waste Ditch Leg 1



Summary for Pond 14P: Ex Chem Waste Ditch Leg 2 + Settling Basin #1

[58] Hint: Peaked 0.30' above defined flood level
[89] Warning: Qout>Qin may require smaller dt
[86] Warning: Oscillations may require smaller dt (severity=4)

Inflow Area = 25.190 ac,100.00% Impervious, Inflow Depth > 57.08" for 1000 year event
Inflow = 120.49 cfs @ 12.21 hrs, Volume= 119.821 af, Incl. 10.00 cfs Base Flow
Outflow = 218.19 cfs @ 12.29 hrs, Volume= 119.771 af, Atten= 0%, Lag= 4.8 min
Primary = 218.19 cfs @ 12.29 hrs, Volume= 119.771 af

Routing by Sim-Route method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 575.08' Surf.Area= 0.688 ac Storage= 1.528 af
Peak Elev= 578.30' @ 12.28 hrs Surf.Area= 1.095 ac Storage= 4.397 af (2.869 af above start)
Flood Elev= 578.00' Surf.Area= 1.057 ac Storage= 4.073 af (2.546 af above start)

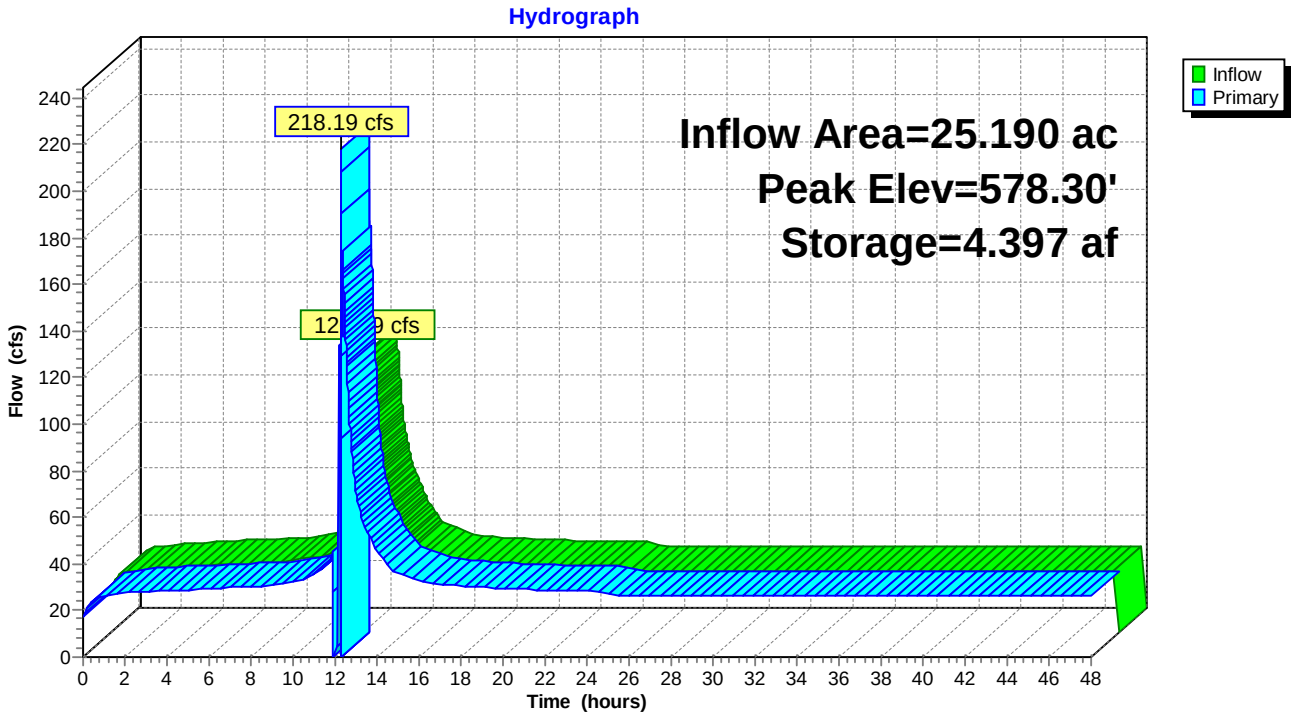
Plug-Flow detention time= 40.5 min calculated for 118.243 af (99% of inflow)
Center-of-Mass det. time= 3.2 min (1,360.1 - 1,356.9)

Volume	Invert	Avail.Storage	Storage Description
#1	572.00'	5.194 af	**10.00'W x 1,330.00'L x 7.00'H Prismatoid Z=2.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	574.75'	**34.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=225.87 cfs @ 12.29 hrs HW=578.26' TW=578.16' (Dynamic Tailwater)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 225.87 cfs @ 1.89 fps)

Pond 14P: Ex Chem Waste Ditch Leg 2 + Settling Basin #1



Summary for Link 5L: Cooling Water Discharge (Normal High WSE)

Average annual high water surface elevation of Lake Erie (thus cooling water discharge also) per DTE email Thu 6/7/2018 10:44 AM.

Inflow Area = 313.440 ac, 50.73% Impervious, Inflow Depth > 10.01" for 1000 year event
Inflow = 370.77 cfs @ 12.70 hrs, Volume= 261.566 af
Primary = 370.77 cfs @ 12.71 hrs, Volume= 261.566 af, Atten= 0%, Lag= 0.6 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Fixed water surface Elevation= 572.20'

Link 5L: Cooling Water Discharge (Normal High WSE)