Submitted to
Southern Indiana
Gas & Electric Company
(SIGECO) dba
CenterPoint Energy Indiana
South (CEIS)
211 Northwest Riverside
Drive, Evansville, IN 47708

Submitted by
AECOM
9400 Amberglen Boulevard
Austin, Texas 78729

October 13, 2021

CCR Certification: Inflow Design Flood Control System Plan §257.82

for the

Ash Pond

at the

A.B. Brown Generating Station

Table of Contents

Tables

Appendices

Executive Summary

This Coal Combustion Residuals (CCR) Inflow Design Flood Control System Plan (Inflow Flood Control Plan) for the Ash Pond at the Southern Indiana Gas & Electric Company (SIGECO), dba CenterPoint Energy Indiana South (CEIS)., A.B. Brown Generating Station has been prepared in accordance with the requirements specified in the USEPA CCR Rule under 40 Code of Federal Regulations §257.82 (a). The CCR Rule required that the specified documentation, assessments and plans for an existing CCR surface impoundment be prepared by October 17, 2016. Pursuant to that requirement, the Initial Inflow Flood Control Plan was completed and placed in the facility operating record on October 13, 2016. These regulations also require that the specified documentation and assessments for an existing CCR surface impoundment be prepared within five years of the placement of the previous assessment in the facility's operating record. Since the Initial Inflow Flood Control Plan assessment was placed in the facility's operating record on October 13, 2016, the deadline for completing this 5-year update is October 13, 2021.

This Inflow Flood Control Plan meets all requirements as summarized in **Table ES-1.**

Table ES-1 – Certification Summary

Report Section	CCR Rule Reference	Requirement Summary	Requirement Met?	Comments
Inflow Design Flood Control System Plan				
4.1	§257.82 (a)(1)	*Adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood*	Yes	CCR unit has the storage capacity to handle the inflow design flood
4.2	§257.82 (a)(2)	*Adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood*	Yes	The outlet devices of the CCR unit control the peak discharge from the inflow design flood
4.3	§257.82 (a)(3)	*Required Inflow design flood for Significant Hazard Potential Impoundment*	Yes	Inflow design flood utilized was the 1,000 year event
4.4	§257.82 (b)	*Discharge handled in accordance with* §257.3 – 3	Yes	CCR unit discharges in accordance with the existing NPDES permit

The Ash Pond is considered to be a significant hazard potential CCR surface impoundment, therefore per §257.82 (a)(3), the inflow design flood is the 1,000-year flood. In accordance with the requirements of §257.82 (a)(3), an Inflow Flood Control Plan was developed for the Ash Pond. This was accomplished by evaluating the effects of a 24-hour duration design storm for the 1,000-year Inflow Design Flood (IDF) to evaluate the Ash Pond's ability to collect and control the 1,000-year IDF of 10.0 inches, under existing operational and maintenance procedures. The results for the Ash Pond indicate that the CCR unit has sufficient storage capacity and spillway structures to adequately manage inflows and collect and control outflows during peak discharge conditions created by the 1,000-year IDF.

1 Introduction

1.1 Purpose of This Report

The purpose of the Inflow Design Flood Control System Plan (Inflow Flood Control Plan) is to document that the requirements specified in 40 Code of Federal Regulations (CFR) §257.82 have been met to support the certification required under each of the applicable regulatory provisions for the A.B. Brown Generating Station (Brown) Ash Pond. The Ash Pond is an existing coal combustion residuals (CCR) surface impoundment as defined by 40 CFR §257.53. The CCR Rule required that the specified documentation, assessments and plans for an existing CCR surface impoundment be prepared by October 17, 2016. Pursuant to that requirement, the Initial Inflow Flood Control Plan was completed and placed in the facility operating record on October 13, 2016. These regulations also require that the specified documentation and assessments for an existing CCR surface impoundment be prepared within five years of the placement of the previous assessment in the facility's operating record. Since the Initial Inflow Flood Control Plan assessment was placed in the facility's operating record on October 13, 2016, the deadline for completing this 5-year update is October 13, 2021.

The Brown station has an interconnected existing CCR surface impoundment, the Ash Pond, which consists of a lower pool and an upper pool. The following table summarizes the documentation required within the CCR Rule and the sections that specifically respond to those requirements of this plan.

Table 1-1 – CCR Rule Cross Reference Table		
Report Section	**Title**	**CCR Rule Reference**
4.1	Inflow Analysis	§257.82 (a)(1)
4.2	Outflow Analysis	§257.82 (a)(2)
4.3	Inflow Design Flood	§257.82 (a)(3)
4.4	Discharge handled in accordance with *§257.3 – 3*	§257.82 (b)

Analyses completed for the hydrologic and hydraulic assessments of the Ash Pond are described in this report. Data and analyses results in the following sections are based on spillway design information shown on design drawings, topographic surveys, information about operational and maintenance procedures provided by Southern Indiana Gas & Electric Company (SIGECO), dba CenterPoint Energy Indiana South (CEIS), and limited field measurements collected by AECOM. The analysis approach and results of the hydrologic and hydraulic analyses presented in the following sections were used by AECOM to confirm that the Ash Pond meets the hydrologic and hydraulic capacity requirements of the rules referenced above for CCR surface impoundments.

1.2 Brief Description of Impoundment

The Brown station is a coal-fired power plant located approximately 10 miles east of Mount Vernon in Posey County, Indiana and is owned and operated by SIGECO. The station is situated just west of the Vanderburgh-Posey County line and north of the Ohio River with the Ash Pond positioned on the east side of the generating station.

The Ash Pond was commissioned in 1978. An earthen dam was constructed across an existing valley to create the impoundment. In 2003, a second dam was constructed east of the original dam and further up the valley to increase the storage capacity. This temporarily created an upper pond and a lower pond. The upper and lower ponds were operated separately until 2016 when the upper dam was decommissioned. A 10' wide breach was installed in the upper embankment and the normal pool elevation was lowered. Currently, the upper pool and the lower pool act as one CCR unit referred to as the Ash Pond, which has a surface area of approximately 164 acres.

The lower pool dam embankment is approximately 1,540 feet long, 30 feet high, and has 3 to 1 (horizontal to vertical) side slopes covered with grassy vegetation. The embankment crest elevation is 450.9 feet[1] and has a crest width of 20 feet. An earthen buttress was constructed against the downstream slope of the dam. The buttress crest extends the length of the dam, is up to 200 feet wide and varies in elevation from 442.0 feet to 432.0 feet. The operating elevation of the pool fluctuates from 439.0 feet to 444.0 feet. However, the pool normally operates at an elevation of 441.0 feet. The surface area of the lower pool impoundment is approximately 57 acres. The surface area of the upper pool impoundment is approximately 107 acres and has a normal operating level of 450 feet. A Site Location Map showing the area surrounding the station is included as **Figure 1** of **Appendix A**. **Figure 2** in **Appendix A** presents the Brown Site Map.

1.2.1 Inflow from Plant Operations and Stormwater Runoff

The Ash Pond impoundment is operated as a zero-discharge facility during normal operating conditions. It receives and impounds sluiced ash from the plant and also recirculates water back to the plant for other necessary processes. Inflows including runoff from the coal pile, process flows from Bottom Ash and Fly Ash are received by the lower pool at a combined rate of 13.64 cubic feet per second (cfs). Water is recirculated back to the plant from the lower pool pump station at a variable rate of up to 14.0 cfs. The Ash Pond is operated such that the outflow to the plant is larger than the inflow from plant processes. Therefore, there is zero-discharge from the Ash Pond outlet devices during normal operating conditions.

In addition to rain that falls directly into the ponds, there are upstream areas that contribute runoff to the impoundments. Approximately 73.7 acres drain to the upper pool from upstream areas. The lower pool receives runoff from approximately 19.7 acres upstream as well as the discharged runoff from the upper pool.

1.2.2 Outlet Structures

The upper pool has two outlet devices that are located at the southern end of the embankment. The primary outlet device is a 66-inch diameter RCP drop inlet that is lined with a 63-inch diameter HDPE pipe that has an invert elevation of 450.0 feet. The drop inlet connects to a 30-inch diameter RCP pipe lined with a 26-inch HDPE pipe that discharges into the lower pool. The secondary outlet device is a 10' wide flat bottom trapezoidal breach with 5 to 1 (horizontal to vertical) side slopes and an invert elevation of 455.0 feet. The total length of the breach is approximately 302 feet. The upper reach of the channel has a slope of 1.8% for 217 feet while the lower reach has

[1] Unless otherwise noted, all elevations in this report are in the NAVD88 datum.

an 8.2% slope over 85 feet. The channel discharges to the lower pool at the approximate elevation of 444.0 feet. Class II riprap, which has a median diameter of approximately 15 inches, lines the channel to prevent erosion.

The lower pool has four outlet devices. The first outlet is the Ash Pond Discharge Line. It consists of a 1,500 gallons per minute (gpm) pump which discharges into a 12-inch HDPE pipe that goes to a chemical precipitation treatment system prior to mixing with other plant water and going to an NPDES permitted outfall. Under normal conditions, the line discharges 0.6 cfs to the treatment system. The second and third outlet devices are two sets of pumps at the lower ash pond pump station: a Low Pressure Recirculation System and a High Pressure Recirculation System. The Low Pressure Recirculation System mainly supplies water to the bottom ash and fly ash handling systems. This system is comprised of three pumps that are rated for 2,750 gpm each. All three pumps discharge into individual 8-inch diameter carbon steel pipes before combining into a common header and proceeding as a 20-inch diameter carbon steel pipeline to the plant. Typically, two pumps operate at a time. Under normal conditions, the pumps recirculate 11.0 cfs back to the plant. The High Pressure Recirculation System supplies water to the scrubber at various locations. This system is comprised of two high pressure pumps that are rated for 2,100 gpm each. Both pumps discharge into individual 8-inch diameter carbon steel pipes before combining into a common header and proceeding as a 10-inch diameter carbon steel pipeline to the plant. Typically, one pump operates at a time. Under normal conditions, the pump recirculates 2.4 cfs back to the plant. Under normal conditions (both systems in operation) two low pressure pumps and one high pressure pump are in use. The fourth outlet device is the Principal Spillway that also acts as the Emergency Spillway. The spillway is a 30 foot wide trapezoidal channel with 5 to 1 (horizontal to vertical) side slopes and an upstream invert elevation of 447.0 feet. The upper reach of the spillway channel has a slope of 0.22% for 115 feet before the channel slope steepens down the backside of the embankment and outlets to a tributary at the toe of the slope. The channel is lined with Class II rip-rap. The former Principal Spillway located in the center of the dam embankment and the associated gooseneck inlet structure with a 36-inch RCP drop inlet has been grouted at both ends and abandoned in place.

2 Hydrologic Analysis

2.1 Design Storm

The Ash Pond has been categorized as a Significant hazard potential CCR impoundment, which indicates that the inflow design flood is the 1,000-year return frequency design storm event. The full analysis for this classification determination is included in the *CCR Certification: Hazard Potential Classification for the Ash Pond at the A.B. Brown Generating Station*.

2.2 Rainfall Data

The rainfall information used in the analysis was based on the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3 which provides rainfall data for storm events with average recurrence intervals ranging from 1 to 1,000 years and durations ranging from 5 minutes to 60 days. The design storm rainfall depth, obtained from the NOAA website, is 10.0 inches for the 1,000-year, 24-hour storm. The Indiana Huff Third Quartile rainfall distribution used by AECOM is appropriate to use for storms up to the 1,000-year, 24-hour flood at the project site.

2.3 Runoff Computations

The drainage areas for the Ash Pond were determined using a computer-aided design (CAD) analysis of topographic surveys completed in 2014. In addition to rain that falls directly into the pond, there are upstream areas that contribute runoff to the impoundments. Approximately 73.7 acres drain to the upper pool from upstream areas. When the upstream area is added to the 90.7 acres within the embankments of the impoundment, the total drainage area of the upper pool is 164.4 acres. The lower pool receives direct runoff from approximately 27.1 acres upstream and 49.8 acres within the embankments of the impoundment. Because the upper pool discharges into the lower pool, the total drainage area to the lower pool is 241.3 acres. See **Figure 3** in **Appendix A** for the Drainage Area Maps.

Runoff was calculated using the SCS Curve Number Method, where curve numbers (CN) were assigned to each subcatchment based on the type of land cover and soil type present. Using the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey, the soil type of the site was determined to be hydrologic soil group C. CN values for the land cover were selected from the CN Table available in HydroCAD. This data was obtained from the SCS NRCS Technical Release-55 (TR-55) publication. Ash, 50%-75% Grass Cover, and Water Surface land covers that are located on site were determined to have a CN value of 98, 79, and 98 respectively. A composite CN was calculated for each subcatchment area by summing the products of each CN multiplied by its percentage of the total area.

The time of concentration is commonly defined as the time required for runoff to travel from the most hydrologically distant point to the point of collection. Calculations for the time of concentration for each sub-watershed were performed in HydroCAD and are included in **Appendix B**.

Stormwater runoff from the 1000-year event into the upper pool has an inflow of 139.01 cfs and inflow volume of 120.20 acre-feet. Stormwater runoff into the lower pool (not including the discharged runoff from the upper pool) has a peak inflow of 64.79 cfs and total inflow volume of 57.49 acre-feet. When added to the process flow from the plant and flows from the upper pool, the lower pool has a total inflow of 104.62 cfs and 305.39 acre-feet. Refer to **Appendix B** for HydroCAD results.

3 Hydraulic Analyses

3.1 Process Flows

The Ash Pond impoundment is operated as a zero-discharge facility during normal operating conditions. The lower pool receives process flow from the plant at a rate of 13.64 cfs and the lower pool recirculates water back to the plant for other necessary processes. The Ash Pond is operated such that the recirculation back to the plant is larger than the inflow from plant processes. Therefore, there is zero-discharge from the Ash Pond outlet devices during normal operating conditions.

3.2 Storage Capacity

The storage volumes for the Ash Pond were determined using a computer-aided design (CAD) analysis of topographic surveys completed in 2020. The volume of storage was calculated by estimating the incremental storage volume present for each 1 foot elevation within the updated topographic surface supplied by SIGECO representatives. The incremental storage volume was then used to calculate a cumulative storage volume and was input into HydroCAD. The volume of storage within the upper pool from normal pool elevation of 450.0 feet to the top of embankment elevation of 464.0 feet is 412.6 acre-feet. Although the lower pool normally operates at an elevation of 441.0 feet, the water surface level can fluctuate. Therefore, the maximum operating level of 444.0 feet was used as the starting water surface elevation during the hydraulic analysis. The volume of storage within the lower pool from the starting water surface elevation of 444.0 feet to the top of embankment elevation of 450.9 feet is 316.2 acre-feet. Refer to **Appendix B** for further storage volume details.

3.3 Discharge Analysis

A hydraulic model was created in HydroCAD 10.00 to assess the capacity of the pond to store and convey the storm flows. HydroCAD has the capability to evaluate each pool within the network, to respond to variable tailwater, pumping rates, permit flow loops, and reversing flows. HydroCAD routing calculations reevaluate the pond's discharge capability at each time increment, making the program an efficient and dynamic tool for this evaluation.

The analyzed scenario assumes a starting water surface elevation at the following invert elevations of each pool. The upper pool water surface elevation is 450.9 feet, and the lower pool is 444.0 feet. Therefore, the facility does not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the NPDES under section 402 of the Clean Water Act.

4 Results

The hydrologic and hydraulic conditions of Ash Pond were modeled with the peak discharge of the 1,000-year storm event and the current process flow from the plant.

Regulatory Citation: 40 CFR §257.82 (a);

- *The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section.*

4.1 Inflow Analysis

Regulatory Citation: 40 CFR §257.82 (a);

- *(1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflows design flood specified in paragraph (3).*

Background and Assessment

Runoff to the impoundment is added to the process flow from the plant to produce the total inflow to the Ash Pond. Using the HydroCAD model, the total inflow was stored and routed through the outlet devices of the Ash Pond to determine the peak water surface elevations.

Table 4-1 summarizes the water surface elevations of the Ash Pond prior to and after the inflow design flood.

Table 4-1 - Summary of Hydrologic and Hydraulic Analysis
1,000-Year, 24-Hour Storm

CCR Unit	Beginning WSE[1] (feet)	Peak WSE (feet)	Top of Embankment Elevation (feet)	Freeboard Above Peak WSE (feet)
Upper Pool	450.9	456.00	N/A[2]	N/A[2]
Lower Pool	444.0	447.53	450.9	3.37

Notes:
[1] WSE = Water Surface Elevation used for hydraulic analysis
[2] Since the upper dam has been breached a top of embankment elevation or freeboard is not listed for the upper pool. It must be noted that the upper pool has an average embankment elevation of 464 feet.

Conclusion and Recommendation

No modifications are necessary or recommended to this unit for compliance with the CCR Rule.

As there is adequate storage within the Ash Pond to manage the inflow design flood as well as the process flow from the plant, there is no anticipated overtopping of the Ash Pond embankment, which meets the requirements in §257.82 (a)(1).

4.2 Outflow Analysis

Regulatory Citation: 40 CFR §257.82 (a);

- *(2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (3) of this section.*

Background and Assessment

Runoff to the impoundment is added to the process flow from the plant to produce the total inflow to the Ash Pond. Using the HydroCAD model, the total inflow was stored and routed through the outlet devices of the Ash Pond to determine the peak flowrate and velocity through the outlet devices.

Table 4-2 summarizes the peak flowrates and velocities through each of the outlet devices.

Table 4-2 - Summary of Outlet Devices 1,000-Year, 24-Hour Storm				
Outlet Device	Type and Size	Invert Elevation (feet)	Peak Flowrate (cfs)	Velocity at Peak Flowrate (fps)
Upper Pool Primary Outlet	63” HDPE drop inlet	450.0	32.30	11.39
Upper Pool Secondary Outlet	10’ wide trapezoidal breach	455.0	17.59	1.75
Lower Pool Spillway	30’ wide trapezoidal channel	447.0	18.13	1.14
Lower Pool Pump Station	1 – 5,000 gpm pump (Low Pressure Pump average capacity) 1 – 1,500 gpm pump (High Pressure Pump average capacity) (Combined capacity 6,500 gpm)	441.5	14.52	NA

Conclusion and Recommendation

No modifications are necessary or recommended to this unit for compliance with the CCR Rule.

As the Ash Pond outlet devices manage the discharge of the inflow design flood and the process flow from the plant without the peak water surface elevation overtopping the Ash Pond embankment, the pond meets the requirements in §257.82 (a)(2).

4.3 Inflow Design Flood

Regulatory Citation: 40 CFR §257.82 (a);

- *(3) The inflow design flood is:*
  - *(i) For a high hazard potential CCR surface impoundment, as determined under §257.73(a)(2), the probable maximum flood;*
  - *(ii) For a significant hazard potential CCR surface impoundment, as determined under §257.73(a)(2), the 1,000-year flood;*
  - *(iii) For a low hazard potential CCR surface impoundment, as determined under §257.73(a)(2), the 100-year flood; or*
  - *(iv) For an incised CCR surface impoundment, the 25-year flood.*

Background and Assessment

The calculations for the inflow design flood are based on the hazard potential given to the impoundment. The different classifications of the impoundment hazard potential are high, significant, and low.

Conclusion and Recommendation

As the impoundment was given a significant hazard potential, the 1,000 year design storm was utilized in the analysis, which meets the requirements in §257.82 (a)(3).

4.4 Discharge

Regulatory Citation: 40 CFR §257.82 (b);

- *Discharge from the CCR unit must be handled in accordance with the surface water requirements under: §257.3 – 3.*

Background and Assessment

The primary discharge from the pond flows through a chemical precipitation treatment system prior to mixing with other plant water and discharging to an NPDES permitted outfall. The emergency discharge from the Ash Pond outlet devices enters a tributary via a permitted NPDES outfall that leads to the Ohio River. The discharge must meet the requirements of the NDPES permit under section 402 of the Clean Water Act to meet the CCR rule.

Conclusion and Recommendation

No modifications are necessary or recommended to this unit for compliance with the CCR Rule.

Runoff discharges from the site through a permitted NPDES outfall to an unnamed tributary which travels west for approximately 0.5 miles before turning south for approximately one mile and discharging into the Ohio River. As per the current NPDES permit, all discharged water is tested for pollutants to meet the minimum regulatory requirements of the permit, and thereby meets the requirements in §257.82 (b).

5 Conclusions

The Inflow Flood Control Plan of the Ash Pond adequately manages flow into the CCR unit during and following the peak discharge of the 1,000-year frequency storm event inflow design flood. The inflow design flood control system of the Ash Pond adequately manages flow from the CCR unit to collect and control the peak discharge resulting from the 1,000-year frequency storm event inflow design flood. Therefore, the Ash Pond meets the requirements for certification.

The contents of this report, specifically **Section 1** through **Section 4**, represent the Inflow Design Flood Control System Plan for this site.

6 Certification

This Certification Statement documents that the Ash Pond at the A.B. Brown Generating Station meets the Inflow Design Flood Control System Plan requirements specified in 40 CFR §257.82. The Ash Pond is an existing CCR surface impoundment as defined by 40 CFR §257.53. The CCR Rule required that the specified documentation, assessments and plans for an existing CCR surface impoundment be prepared by October 17, 2016. Pursuant to that requirement, the Initial Inflow Flood Control Plan was completed and placed in the facility operating record on October 13, 2016. These regulations also require that the specified documentation and assessments for an existing CCR surface impoundment be prepared within five years of the placement of the previous assessment in the facility's operating record. Accordingly, the deadline for completing this 5-year update is October 13, 2021.

CCR Unit: Southern Indiana Gas & Electric Company; A.B. Brown Generating Station; Ash Pond

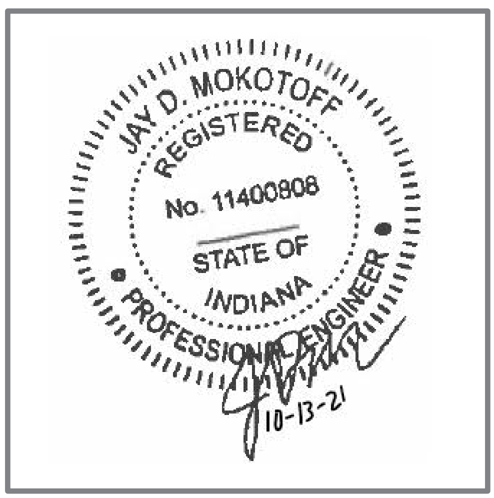
I, Jay Mokotoff, being a Registered Professional Engineer in good standing in the State of Indiana, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above referenced CCR Unit, that the Inflow Design Flood Control System Plan dated October 13, 2021 meets the requirements of 40 CFR § 257.82.

Jay Mokotoff

Printed Name

10-13-2021

Date



7 Limitations

Background information, design basis, and other data have been furnished to AECOM by SIGECO, which AECOM has used in preparing this report. AECOM has relied on this information as furnished, and is not responsible for the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations may be updated as future investigations are performed.

The conclusions presented in this report are intended only for the purpose, site location, and project indicated. The recommendations presented in this report should not be used for other projects or purposes. Conclusions or recommendations made from these data by others are their responsibility. The conclusions and recommendations are based on AECOM’s understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as provided by SIGECO. Changes in any of these operations or procedures may invalidate the findings in this report until AECOM has had the opportunity to review the findings, and revise the report if necessary.

This hydrologic and hydraulic analysis was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the geological and geotechnical engineering profession. The conclusions presented in this report are professional opinions based on the indicated project criteria and data available at the time this report was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.

While the CCR unit adequately manages the inflow design flood, SIGECO must perform routine maintenance on the CCR unit to continually manage flood events without failure. Outlet devices should be cleared of debris that could block or damage the device. Pipes and intake structures should be monitored and repaired if deterioration or deformation occurs. All grass lined slopes should be examined for erosion and repaired if damaged. Rip-rap lined channels should be inspected for stones that have shifted or bare spots that have formed. Replace rip-rap as needed.

Appendix A
Figures

AECOM

9400 Amberglen Boulevard
Austin, TX 78729-1100
512-454-4797 (phone)
512-454-8807 (fax)

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY

211 Northwest Riverside Drive
Evansville, IN 47708
1-800-227-1376 (phone)

A.B. BROWN GENERATING STATION
MT. VERNON, IN

CCR CERTIFICATION
ASH POND

ISSUED FOR CERTIFICATION

ISSUED FOR BIDDING ____ DATE BY

ISSUED FOR CONSTRUCTION ____ DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60583533
DRAWN BY:	AG
DESIGNED BY:	AG
CHECKED BY:	JDM
DATE CREATED:	12/17/2020
PLOT DATE:	01/04/2021
SCALE:	1" = 1000'
ACAD VER:	2019

SHEET TITLE

LOCATION MAP

FIGURE 1

AECOM

9400 Amberglen Boulevard
Austin, TX 78729-1100
512-454-4797 (phone)
512-454-8807 (fax)

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY

211 Northwest Riverside Drive
Evansville, IN 47708
1-800-227-1376 (phone)

A.B. BROWN GENERATING STATION
MT. VERNON, IN

CCR CERTIFICATION
ASH POND

ISSUED FOR CERTIFICATION

ISSUED FOR BIDDING ____ DATE BY

ISSUED FOR CONSTRUCTION ____ DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60442676
DRAWN BY:	AG
DESIGNED BY:	AG
CHECKED BY:	JDM
DATE CREATED:	12/08/2020
PLOT DATE:	01/04/2021
SCALE:	AS SHOWN
ACAD VER:	2019

SHEET TITLE

SITE MAP

FIGURE 2

- AERIAL PHOTOGRAPHY BY THREE-I ENGINEERING, INC. DATED 2018.
- BATHYMETRY BY AFFILIATED RESEARCHERS DATED 8-17-2015

AECOM
9400 Amberglen Boulevard
Austin, TX 78729-1100
512-454-4797 (phone)
512-454-8807 (fax)

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY dba CENTERPOINT ENERGY INDIANA SOUTH (CEIS)
211 Northwest Riverside Drive
Evansville, IN 47708
1-800-227-1376 (phone)

A.B. BROWN GENERATING STATION
MT. VERNON, IN

CCR CERTIFICATION
ASH POND

ISSUED FOR CERTIFICATION

ISSUED FOR BIDDING ____ DATE BY

ISSUED FOR CONSTRUCTION ____ DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60442676
DRAWN BY:	
DESIGNED BY:	
CHECKED BY:	
DATE CREATED:	
PLOT DATE:	10/13/2021
SCALE:	
ACAD VER:	2019

SHEET TITLE

SITE DRAINAGE AREA MAP

FIGURE 3

Last saved by: GOVINDARAJANA(2021-10-04) Last Plotted: 2021-10-05
Filename: L:\DCS\PROJECTS\VECTREN CORPORATION\60442676_ABBCLOSURE\400-TECHNICAL\437-H&H\CLOSURE STORMWATER\DRAINAGE AREA-STORAGE VOLUMES_1.DWG

Project Management Initials: ____ Designer: ____ Checked: ____ Approved: ____ ARCH D 24" x 36"

Printed on ___% Post-Consumer Recycled Content Paper

Appendix B
Hydrologic and Hydraulic Calculations

NOAA Precipitation Data
Soils Data
Water Balance
HydroCAD Output

NOAA Precipitation Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Mount Vernon, Indiana, US*
Latitude: 37.9028°, Longitude: -87.7092°
Elevation: 440 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

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	0.394 (0.360–0.433)	0.465 (0.425–0.511)	0.551 (0.503–0.604)	0.620 (0.564–0.678)	0.707 (0.640–0.773)	0.776 (0.700–0.847)	0.843 (0.757–0.919)	0.914 (0.815–0.997)	1.01 (0.893–1.10)	1.08 (0.950–1.18)
10-min	0.612 (0.559–0.672)	0.726 (0.664–0.798)	0.856 (0.782–0.939)	0.956 (0.870–1.05)	1.08 (0.979–1.18)	1.18 (1.06–1.28)	1.27 (1.14–1.38)	1.37 (1.22–1.49)	1.48 (1.31–1.62)	1.57 (1.38–1.72)
15-min	0.750 (0.685–0.824)	0.888 (0.812–0.976)	1.05 (0.960–1.15)	1.18 (1.07–1.29)	1.34 (1.21–1.46)	1.46 (1.31–1.59)	1.58 (1.42–1.72)	1.70 (1.51–1.85)	1.85 (1.64–2.02)	1.96 (1.73–2.15)
30-min	0.993 (0.907–1.09)	1.19 (1.09–1.31)	1.44 (1.31–1.58)	1.63 (1.49–1.79)	1.89 (1.71–2.06)	2.08 (1.88–2.27)	2.28 (2.04–2.48)	2.48 (2.21–2.70)	2.74 (2.43–2.99)	2.94 (2.59–3.22)
60-min	1.21 (1.11–1.33)	1.46 (1.33–1.60)	1.81 (1.65–1.98)	2.08 (1.89–2.28)	2.45 (2.22–2.68)	2.74 (2.47–2.99)	3.05 (2.73–3.32)	3.36 (3.00–3.67)	3.79 (3.36–4.14)	4.14 (3.64–4.52)
2-hr	1.46 (1.34–1.60)	1.77 (1.62–1.94)	2.21 (2.03–2.42)	2.56 (2.34–2.80)	3.05 (2.77–3.32)	3.44 (3.11–3.74)	3.84 (3.46–4.18)	4.26 (3.82–4.64)	4.85 (4.31–5.27)	5.31 (4.69–5.78)
3-hr	1.57 (1.44–1.72)	1.90 (1.74–2.08)	2.38 (2.17–2.60)	2.76 (2.52–3.02)	3.31 (3.00–3.60)	3.75 (3.38–4.08)	4.21 (3.78–4.58)	4.70 (4.20–5.11)	5.39 (4.76–5.86)	5.94 (5.22–6.46)
6-hr	1.93 (1.77–2.11)	2.33 (2.13–2.55)	2.90 (2.66–3.18)	3.37 (3.08–3.69)	4.04 (3.67–4.41)	4.59 (4.14–5.00)	5.17 (4.64–5.63)	5.78 (5.16–6.30)	6.66 (5.88–7.25)	7.37 (6.45–8.04)
12-hr	2.28 (2.09–2.49)	2.75 (2.52–3.00)	3.41 (3.13–3.72)	3.96 (3.61–4.31)	4.72 (4.30–5.13)	5.34 (4.84–5.81)	6.00 (5.41–6.52)	6.70 (5.99–7.27)	7.68 (6.80–8.34)	8.47 (7.44–9.21)
24-hr	2.74 (2.56–2.93)	3.29 (3.09–3.53)	4.10 (3.83–4.38)	4.75 (4.43–5.07)	5.65 (5.26–6.03)	6.39 (5.93–6.82)	7.16 (6.61–7.63)	7.97 (7.31–8.50)	9.10 (8.27–9.73)	10.0 (9.03–10.7)
2-day	3.25 (3.02–3.49)	3.91 (3.63–4.20)	4.86 (4.52–5.23)	5.65 (5.24–6.07)	6.77 (6.25–7.28)	7.70 (7.09–8.28)	8.70 (7.95–9.37)	9.76 (8.86–10.5)	11.3 (10.1–12.2)	12.5 (11.2–13.6)
3-day	3.46 (3.22–3.73)	4.15 (3.87–4.47)	5.15 (4.79–5.56)	5.98 (5.56–6.45)	7.19 (6.65–7.74)	8.19 (7.54–8.82)	9.27 (8.48–9.99)	10.4 (9.48–11.3)	12.1 (10.9–13.1)	13.5 (12.0–14.6)
4-day	3.67 (3.42–3.96)	4.39 (4.10–4.75)	5.44 (5.07–5.88)	6.32 (5.87–6.82)	7.61 (7.04–8.20)	8.68 (8.00–9.36)	9.84 (9.01–10.6)	11.1 (10.1–12.0)	12.9 (11.6–14.0)	14.4 (12.9–15.7)
7-day	4.27 (3.97–4.61)	5.11 (4.75–5.52)	6.31 (5.86–6.83)	7.32 (6.78–7.92)	8.78 (8.09–9.50)	10.0 (9.18–10.8)	11.3 (10.3–12.3)	12.7 (11.5–13.8)	14.8 (13.2–16.1)	16.4 (14.6–18.0)
10-day	4.81 (4.46–5.23)	5.75 (5.34–6.26)	7.11 (6.59–7.74)	8.23 (7.61–8.96)	9.85 (9.06–10.7)	11.2 (10.2–12.2)	12.6 (11.5–13.7)	14.2 (12.8–15.4)	16.4 (14.6–17.9)	18.2 (16.1–19.9)
20-day	6.63 (6.23–7.07)	7.87 (7.40–8.39)	9.43 (8.86–10.1)	10.7 (10.0–11.4)	12.4 (11.6–13.2)	13.8 (12.9–14.7)	15.2 (14.1–16.3)	16.7 (15.4–17.8)	18.7 (17.1–20.0)	20.2 (18.4–21.8)
30-day	8.17 (7.71–8.67)	9.65 (9.10–10.2)	11.4 (10.7–12.1)	12.8 (12.0–13.6)	14.7 (13.8–15.6)	16.2 (15.2–17.2)	17.7 (16.5–18.8)	19.2 (17.9–20.5)	21.3 (19.6–22.8)	22.9 (21.0–24.5)
45-day	10.2 (9.71–10.8)	12.0 (11.4–12.7)	14.1 (13.3–14.8)	15.7 (14.8–16.5)	17.8 (16.8–18.8)	19.5 (18.3–20.6)	21.2 (19.8–22.4)	22.8 (21.3–24.2)	25.1 (23.3–26.6)	26.8 (24.7–28.5)
60-day	12.2 (11.5–12.8)	14.3 (13.6–15.1)	16.6 (15.8–17.5)	18.4 (17.4–19.4)	20.8 (19.6–21.9)	22.5 (21.3–23.8)	24.3 (22.9–25.7)	26.0 (24.4–27.5)	28.2 (26.4–30.0)	29.9 (27.8–31.8)

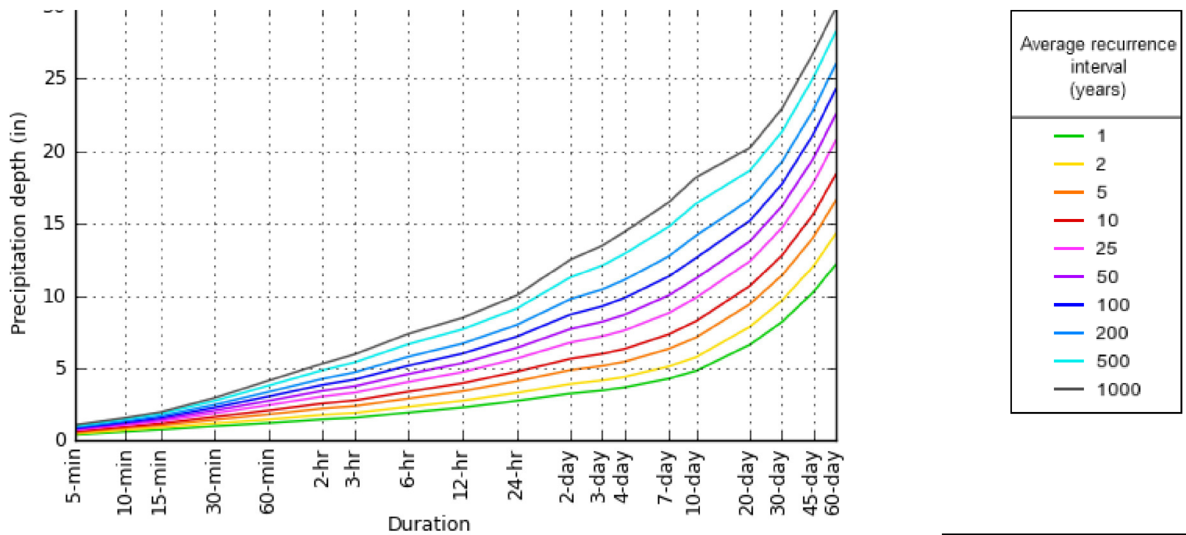
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

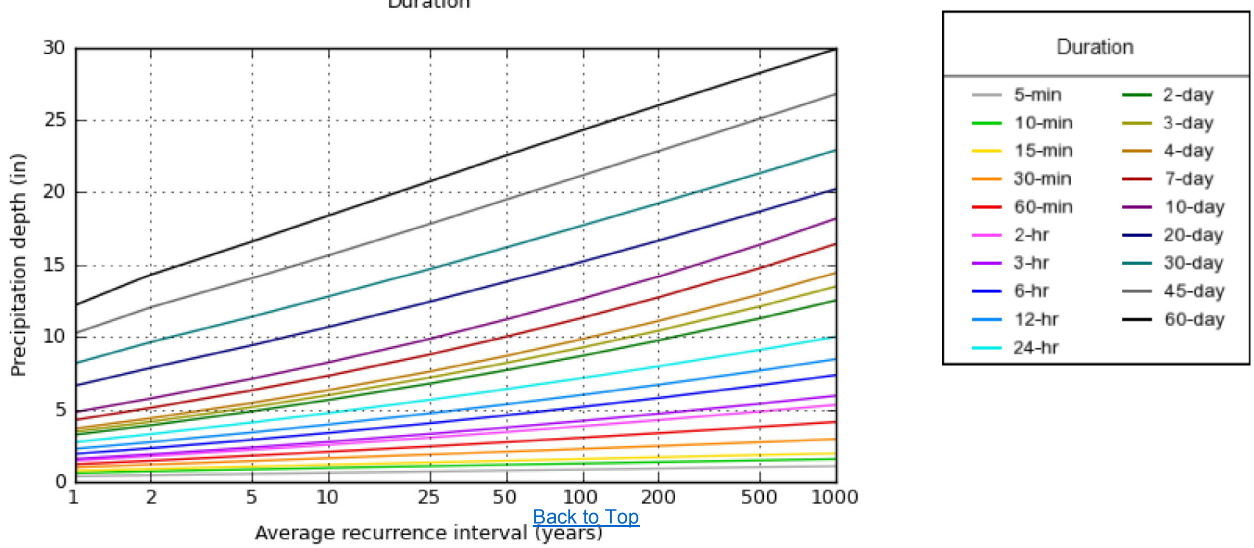
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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.

Back to Top

PF graphical



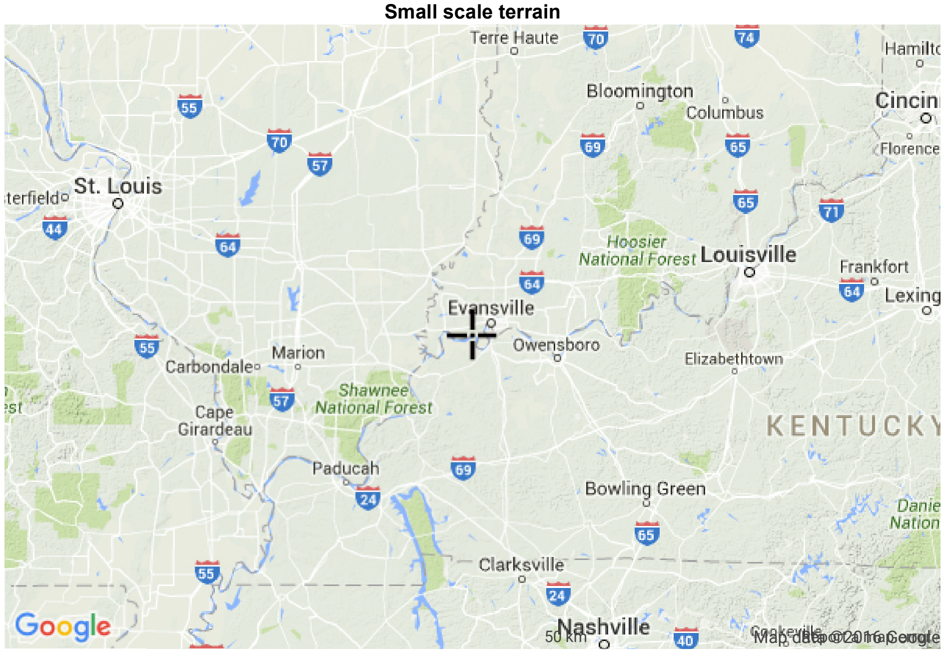


Back to Top

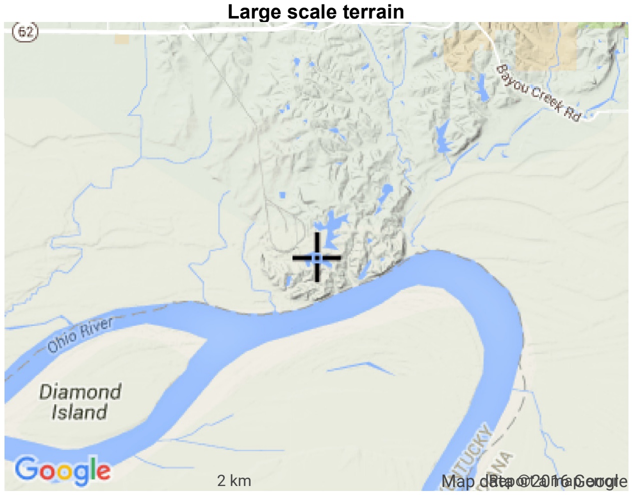
NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Thu Jun 30 17:57:02 2016

Maps & aerials

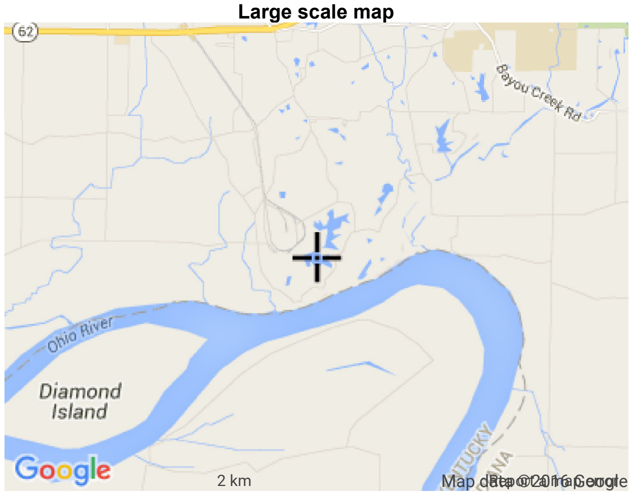
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

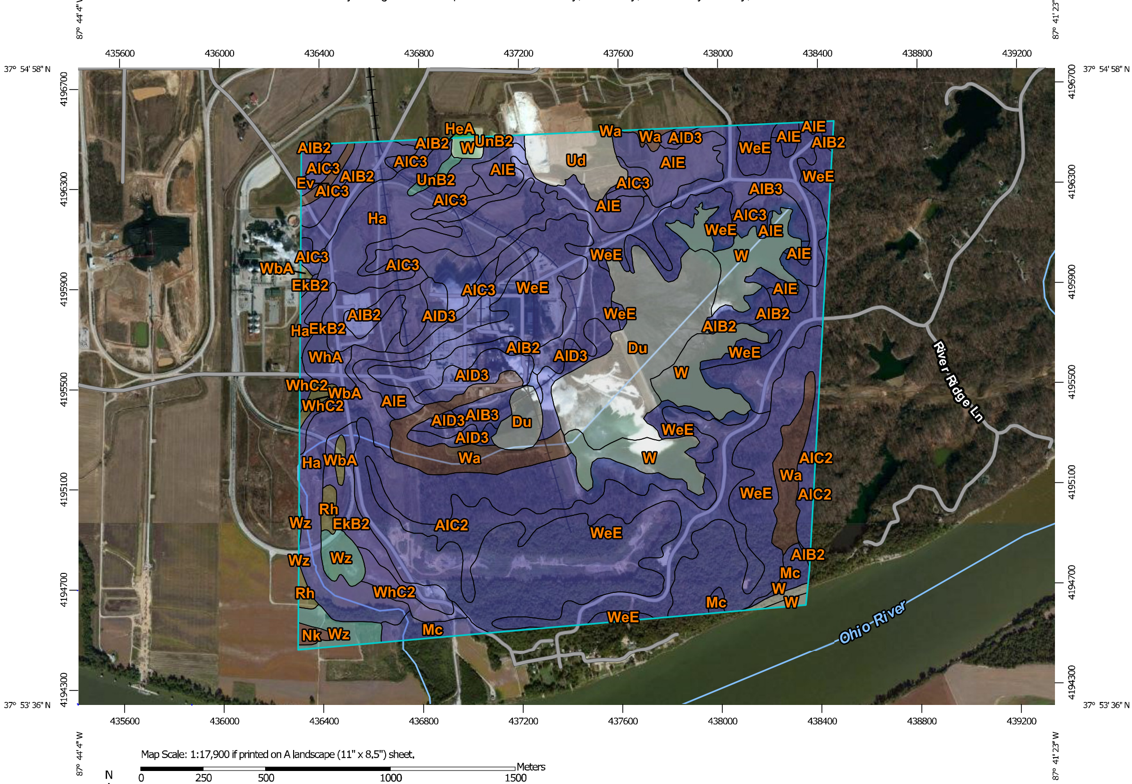
[Back to Top](#)

Questions?: HDSC.Questions@noaa.gov

Disclaimer

Soils Data

Hydrologic Soil Group—Henderson County, Kentucky, and Posey County, Indiana



Map Scale: 1:17,900 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 250, 500, 1000, 1500

Feet: 0, 500, 1000, 2000, 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Henderson County, Kentucky
Survey Area Data: Version 15, Sep 15, 2015

Soil Survey Area: Posey County, Indiana
Survey Area Data: Version 15, Sep 10, 2015

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Data not available.

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Henderson County, Kentucky (KY101)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
W	Water		1.1	0.1%
Subtotals for Soil Survey Area			**1.1**	**0.1%**
Totals for Area of Interest			**1,022.6**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Posey County, Indiana (IN129)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
AlB2	Alford silt loam, 2 to 6 percent slopes, eroded	B	111.3	10.9%
AlB3	Alford silt loam, 2 to 6 percent slopes, severely eroded	B	37.0	3.6%
AlC2	Alford silt loam, 6 to 12 percent slopes, eroded	B	67.5	6.6%
AlC3	Alford silt loam, 6 to 12 percent slopes, severely eroded	B	67.5	6.6%
AlD3	Alford silt loam, 12 to 18 percent slopes, severely eroded	B	33.9	3.3%
AlE	Alford silt loam, 18 to 25 percent slopes	B	49.6	4.9%
Du	Dumps, mine		75.8	7.4%
EkA	Elkinsville silt loam, 0 to 2 percent slopes, rarely flooded	B	0.3	0.0%
EkB2	Elkinsville silt loam, 2 to 6 percent slopes, eroded, rarely flooded	B	18.8	1.8%
Ev	Evansville silt loam, rarely flooded	B/D	2.9	0.3%
Ha	Haymond silt loam, wet substratum, frequently flooded	B	90.1	8.8%
HeA	Henshaw silt loam, 0 to 2 percent slopes, rarely flooded	C/D	0.2	0.0%
Mc	McAdoo silt loam, frequently flooded	B	13.0	1.3%
Nk	Newark silty clay loam, frequently flooded	B/D	2.1	0.2%

Hydrologic Soil Group— Summary by Map Unit — Posey County, Indiana (IN129)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
Rh	Rahm silt loam, occasionally flooded	C/D	4.3	0.4%
Ud	Udorthents, cut and filled		19.4	1.9%
UnA	Uniontown silt loam, 0 to 2 percent slopes, rarely flooded	C	0.1	0.0%
UnB2	Uniontown silt loam, 2 to 6 percent slopes, eroded, rarely flooded	C	2.9	0.3%
W	Water		62.7	6.1%
Wa	Wakeland silt loam, frequently flooded	B/D	41.0	4.0%
WbA	Weinbach silt loam, 0 to 2 percent slopes, rarely flooded	C/D	4.7	0.5%
WeE	Wellston silt loam, 18 to 25 percent slopes	B	279.6	27.3%
WhA	Wheeling loam, 0 to 2 percent slopes, rarely flooded	B	10.2	1.0%
WhC2	Wheeling loam, 6 to 12 percent slopes, eroded, rarely flooded	B	11.4	1.1%
Wz	Woodmere silt loam, occasionally flooded	C	15.4	1.5%
Subtotals for Soil Survey Area			**1,021.5**	**99.9%**
Totals for Area of Interest			**1,022.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

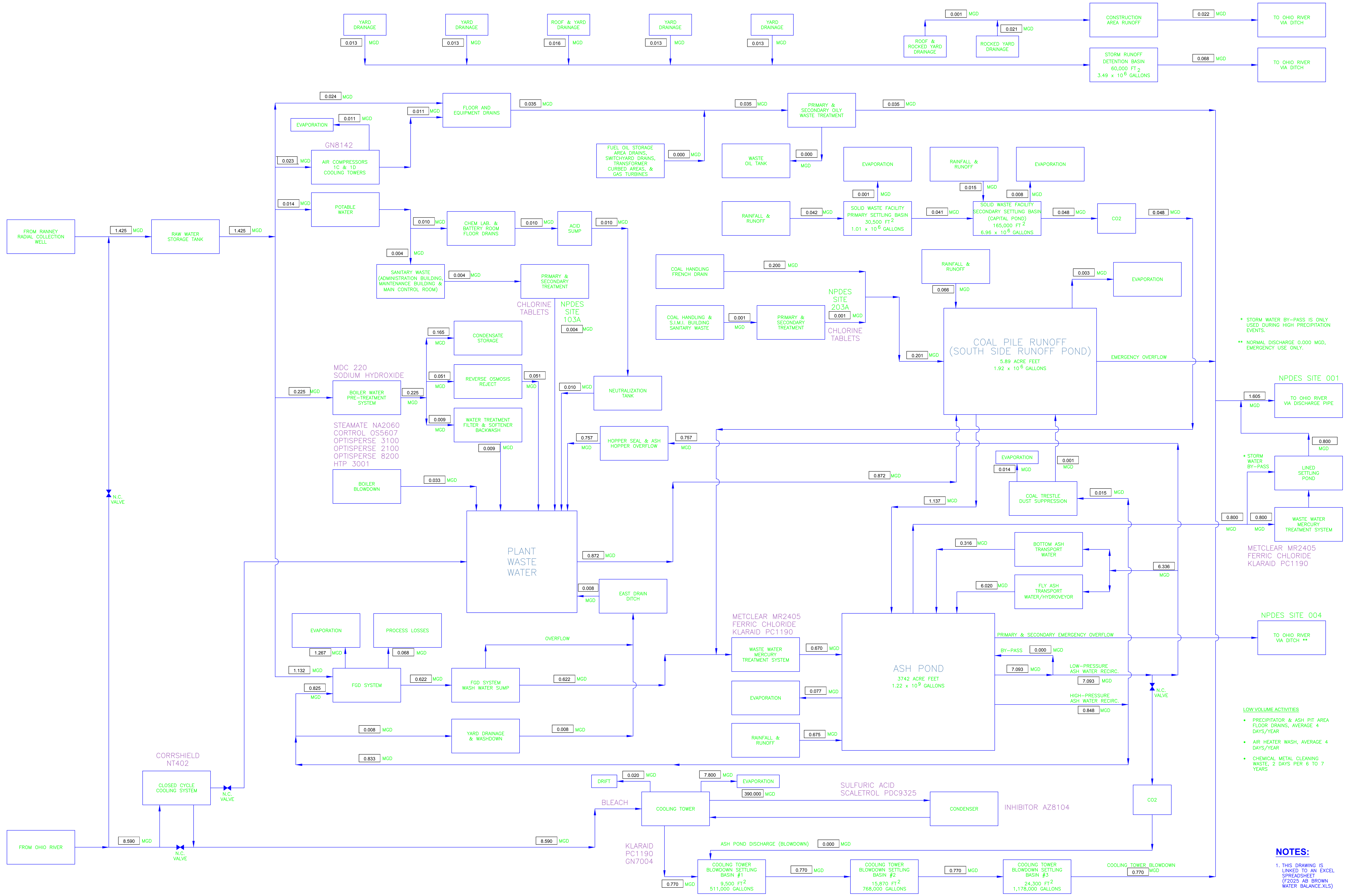
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Water Balance



NOTES:

1. THIS DRAWING IS LINKED TO AN EXCEL SPREADSHEET (F2025 AB BROWN WATER BALANCE.XLS)

VECTREN POWER SUPPLY
A. B. BROWN POWER STATION
EVANSVILLE, INDIANA

VECTREN

REV.	DATE			BY	ITEM
0	12	24	03	3i	ISSUED FOR RECORD
1	4	22	09	3i	UPDATED TREATMENT INFORMATION
2	5	4	11	3i	ADD AIR COMPRESSOR COOLING TOWERS
3	6	18	14	RES/3i	ADD MERCURY TREATMENT SYSTEMS
4	1	12	17	AJW/3i	UPDATED PER VECTREN RED-LINES

THREE i DESIGN
ENGINEERING + ARCHITECTURE
2425 W. INDIANA ST., EVANSVILLE, IN 47712
WWW.THREEIDESIGN.COM (812) 423-6800
THREE I DESIGN JOB NUMBER: 02218A

PLANT WATER BALANCE WITH GE BETZ TREATMENT

DRAWN BY: H.W.D.	DATE 12-23-03
CKD. BY: J.M.R.	SCALE: NONE
DRAWING NO: F-2025.1	SHEET NO:

HydroCAD Output Report

Subcat Reach Pond Link

Routing Diagram for Brown - Existing Conditions_IDF
Prepared by AECOM, Printed 10/13/2021
HydroCAD® 10.00 s/n 01723 © 2013 HydroCAD Software Solutions LLC

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	99.830	0.000	0.000	99.830	50-75% Grass cover, Fair	2S, 3S
0.000	0.000	0.000	0.000	71.720	71.720	Ash	2S, 3S
0.000	0.000	69.710	0.000	0.000	69.710	Water Surface	2S, 4S
0.000	**0.000**	**169.540**	**0.000**	**71.720**	**241.260**	**TOTAL AREA**	

Summary for Subcatchment 2S: Upper Drainage Area

see autoCAD file Brown-Ash-Pond-Hydro.dwg for lenghts, slopes for Tc

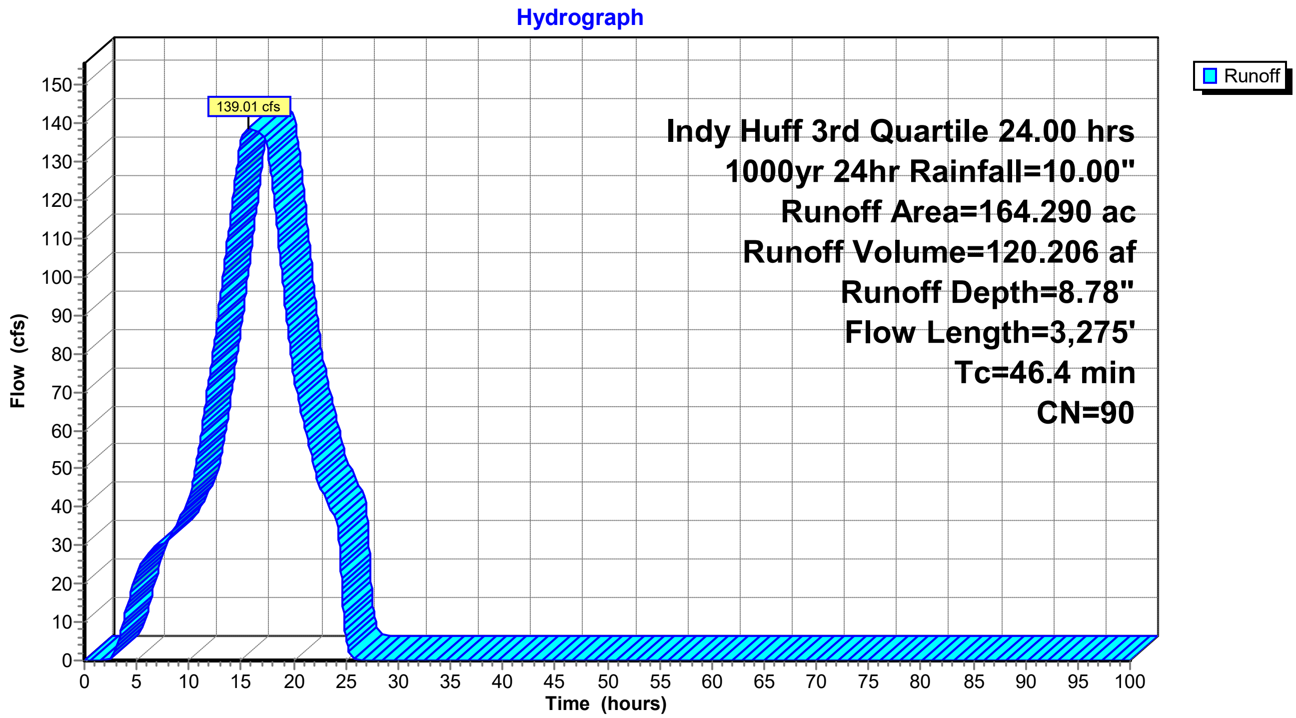
Runoff = 139.01 cfs @ 15.72 hrs, Volume= 120.206 af, Depth= 8.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Indy Huff 3rd Quartile 24.00 hrs 1000yr 24hr Rainfall=10.00"

	Area (ac)	CN	Description
	67.530	79	50-75% Grass cover, Fair, HSG C
	22.630	98	Water Surface, HSG C
	5.590	98	Water Surface, HSG C
*	57.410	98	Ash
*	5.930	98	Water Surface, HSG C
*	5.200	79	50-75% Grass cover, Fair, HSG C
	164.290	90	Weighted Average
	72.730		44.27% Pervious Area
	91.560		55.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0	300	0.0600	0.33		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.29"
0.8	225	0.1000	4.74		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
30.6	2,750	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
46.4	3,275	Total			

Subcatchment 2S: Upper Drainage Area



Summary for Subcatchment 3S: Drainage Area2

see autoCAD file Brown-Ash-Pond-Hydro.dwg for lenghts, slopes for Tc

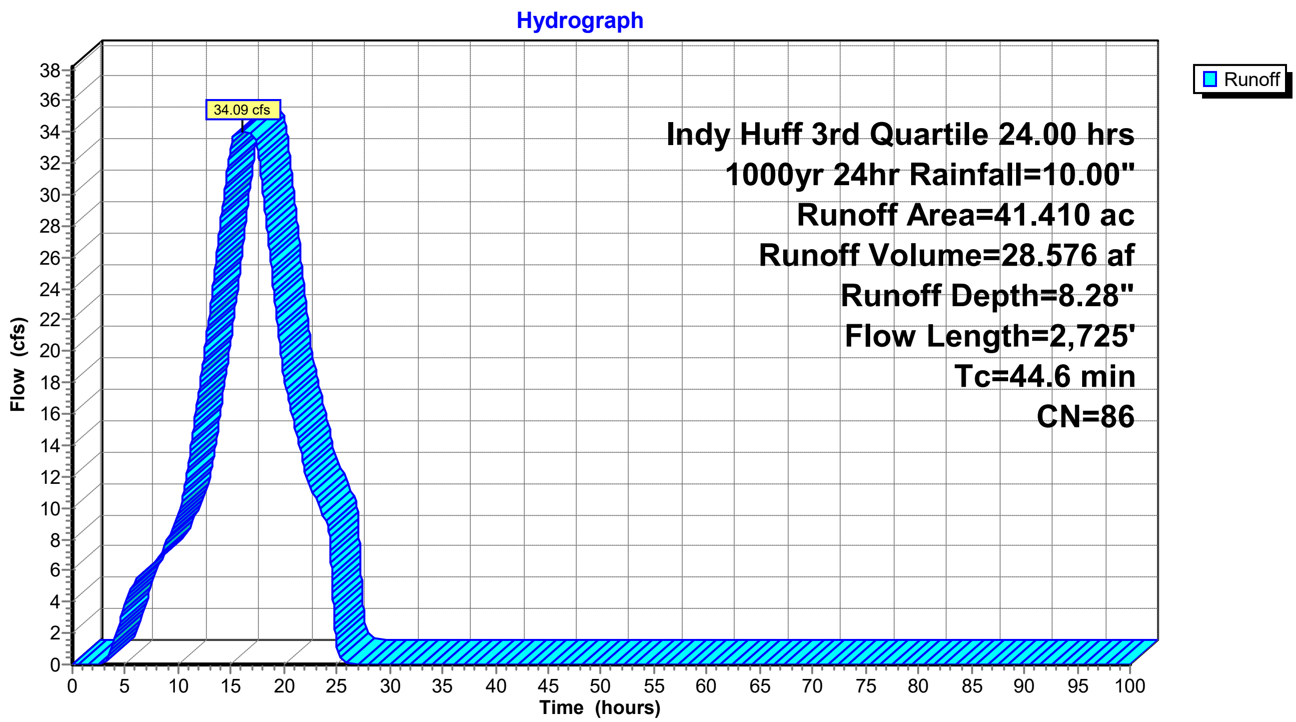
Runoff = 34.09 cfs @ 16.01 hrs, Volume= 28.576 af, Depth= 8.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Indy Huff 3rd Quartile 24.00 hrs 1000yr 24hr Rainfall=10.00"

	Area (ac)	CN	Description
	27.100	79	50-75% Grass cover, Fair, HSG C
*	14.310	98	Ash
	41.410	86	Weighted Average
	27.100		65.44% Pervious Area
	14.310		34.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.8	300	0.0300	0.25		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.29"
1.7	350	0.0500	3.35		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
23.1	2,075	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
44.6	2,725	Total			

Subcatchment 3S: Drainage Area2



Summary for Subcatchment 4S: Ponded Area

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

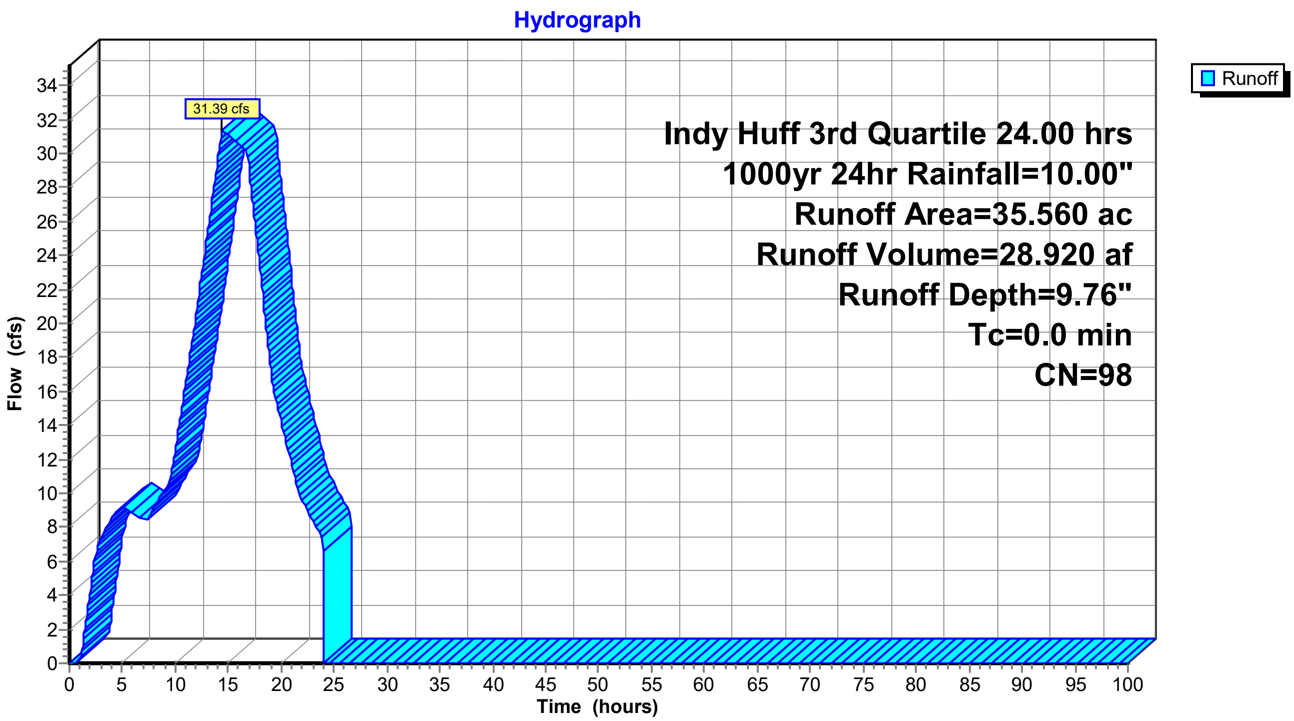
Runoff = 31.39 cfs @ 14.41 hrs, Volume= 28.920 af, Depth= 9.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Indy Huff 3rd Quartile 24.00 hrs 1000yr 24hr Rainfall=10.00"

Area (ac)	CN	Description
35.560	98	Water Surface, HSG C
35.560		100.00% Impervious Area

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

Subcatchment 4S: Ponded Area



Summary for Reach 2R: Spillway - Lower Reach

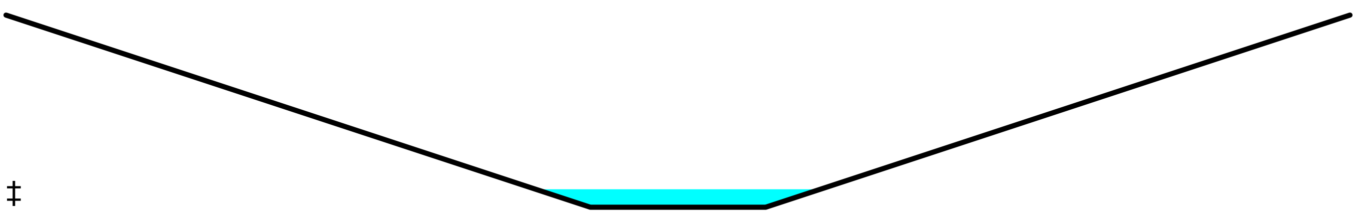
[62] Hint: Exceeded Reach 7R OUTLET depth by 0.04' @ 57.73 hrs

Inflow	=	18.13 cfs @	57.69 hrs,	Volume=	56.415 af
Outflow	=	18.13 cfs @	57.69 hrs,	Volume=	56.414 af, Atten= 0%, Lag= 0.1 min

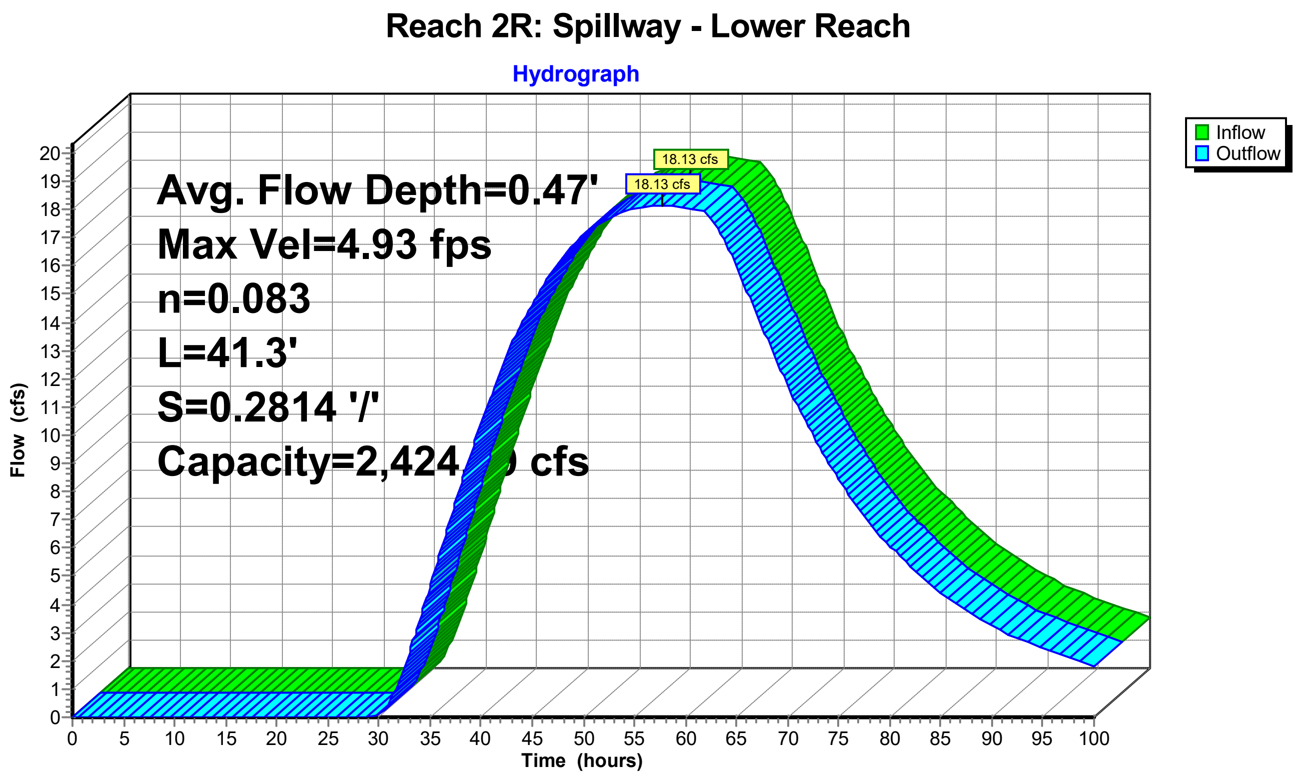
Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.93 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.79 fps, Avg. Travel Time= 0.2 min

Peak Storage= 152 cf @ 57.69 hrs
Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 5.00' Flow Area= 130.0 sf, Capacity= 2,424.69 cfs

6.00' x 5.00' deep channel, n= 0.083
Side Slope Z-value= 4.0 '/' Top Width= 46.00'
Length= 41.3' Slope= 0.2814 '/'
Inlet Invert= 442.88', Outlet Invert= 431.26'



‡



Summary for Reach 3R: Spillway - Upper Reach

Inflow = 18.13 cfs @ 57.67 hrs, Volume= 56.424 af
Outflow = 18.13 cfs @ 57.69 hrs, Volume= 56.415 af, Atten= 0%, Lag= 1.0 min

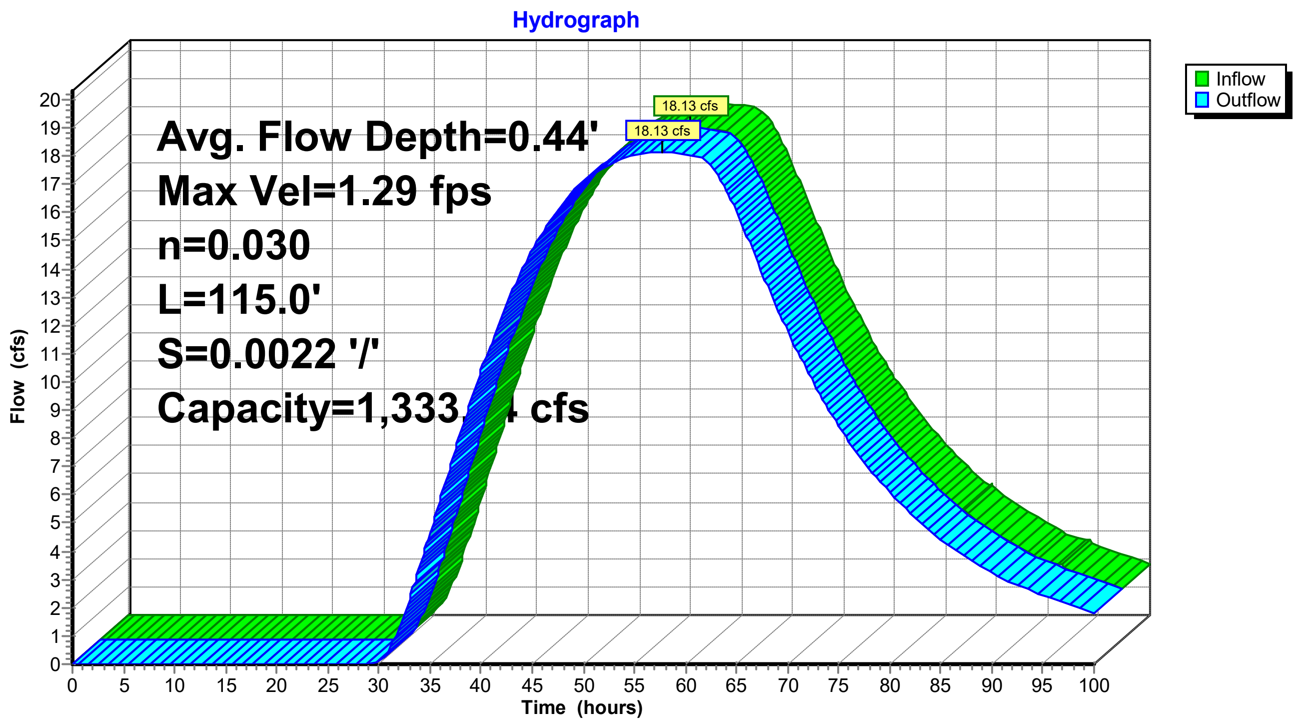
Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.29 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.96 fps, Avg. Travel Time= 2.0 min

Peak Storage= 1,615 cf @ 57.69 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 5.00' Flow Area= 250.0 sf, Capacity= 1,333.44 cfs

30.00' x 5.00' deep channel, n= 0.030 Short grass
Side Slope Z-value= 4.0 '/' Top Width= 70.00'
Length= 115.0' Slope= 0.0022 '/'
Inlet Invert= 447.00', Outlet Invert= 446.75'

‡

Reach 3R: Spillway - Upper Reach



Summary for Reach 4R: Breach-Lower Reach

[61] Hint: Exceeded Reach 6R outlet invert by 0.49' @ 22.03 hrs

Inflow =	17.59 cfs @ 22.02 hrs, Volume= 5.912 af
Outflow =	17.59 cfs @ 22.03 hrs, Volume= 5.912 af, Atten= 0%, Lag= 0.3 min

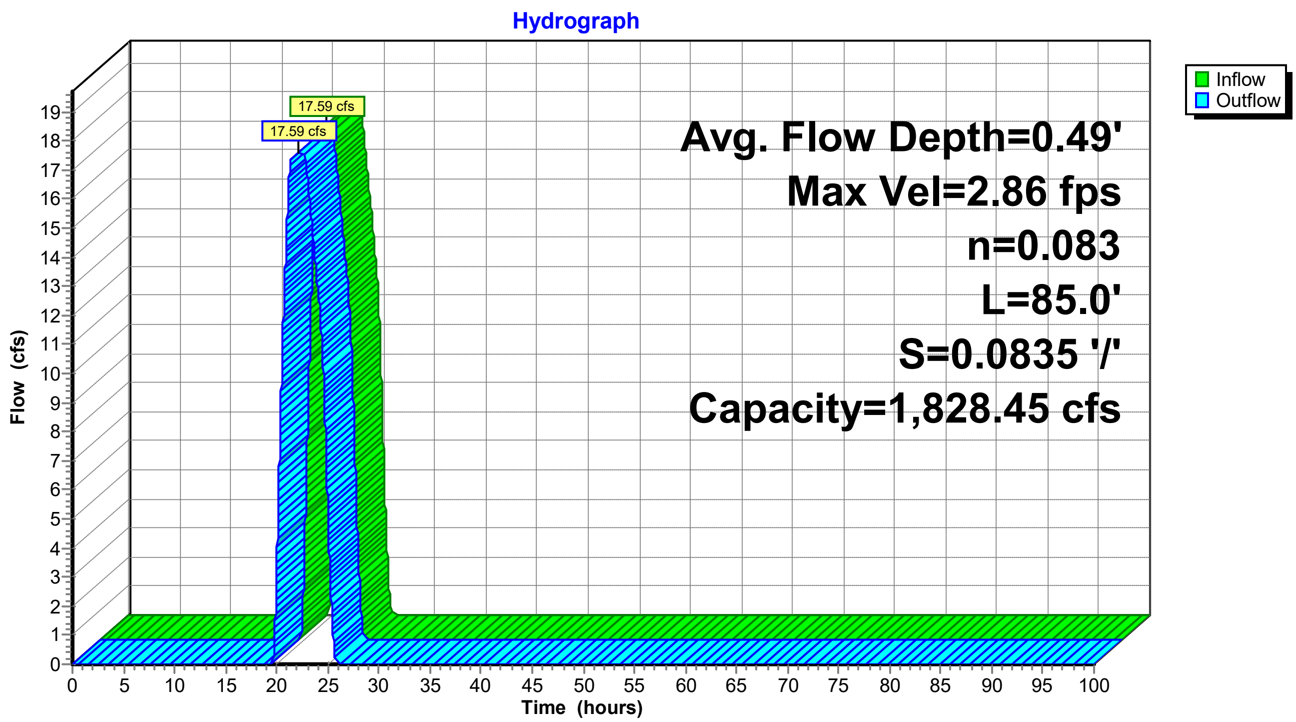
Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.86 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.03 fps, Avg. Travel Time= 0.7 min

Peak Storage= 524 cf @ 22.03 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 5.00' Flow Area= 175.0 sf, Capacity= 1,828.45 cfs

10.00' x 5.00' deep channel, n= 0.083
Side Slope Z-value= 5.0 '/' Top Width= 60.00'
Length= 85.0' Slope= 0.0835 '/'
Inlet Invert= 451.10', Outlet Invert= 444.00'

‡

Reach 4R: Breach-Lower Reach



Summary for Reach 5R: Discharge Creek

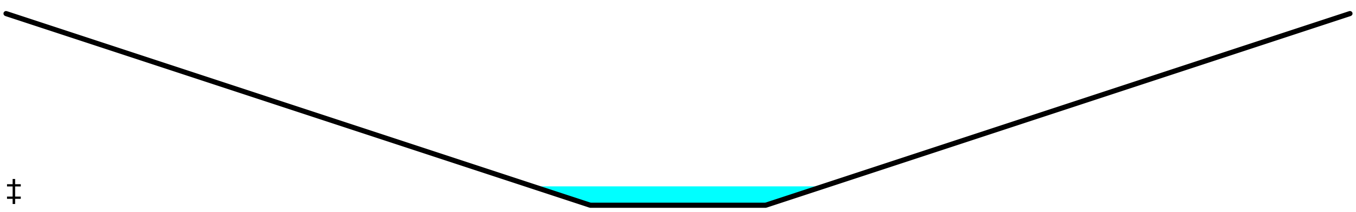
[62] Hint: Exceeded Reach 8R OUTLET depth by 5.26' @ 0.00 hrs

Inflow Area = 241.260 ac, 58.62% Impervious, Inflow Depth > 2.81" for 1000yr 24hr event
Inflow = 18.13 cfs @ 57.69 hrs, Volume= 56.413 af
Outflow = 18.13 cfs @ 57.72 hrs, Volume= 56.398 af, Atten= 0%, Lag= 2.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.64 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 3.58 fps, Avg. Travel Time= 3.7 min

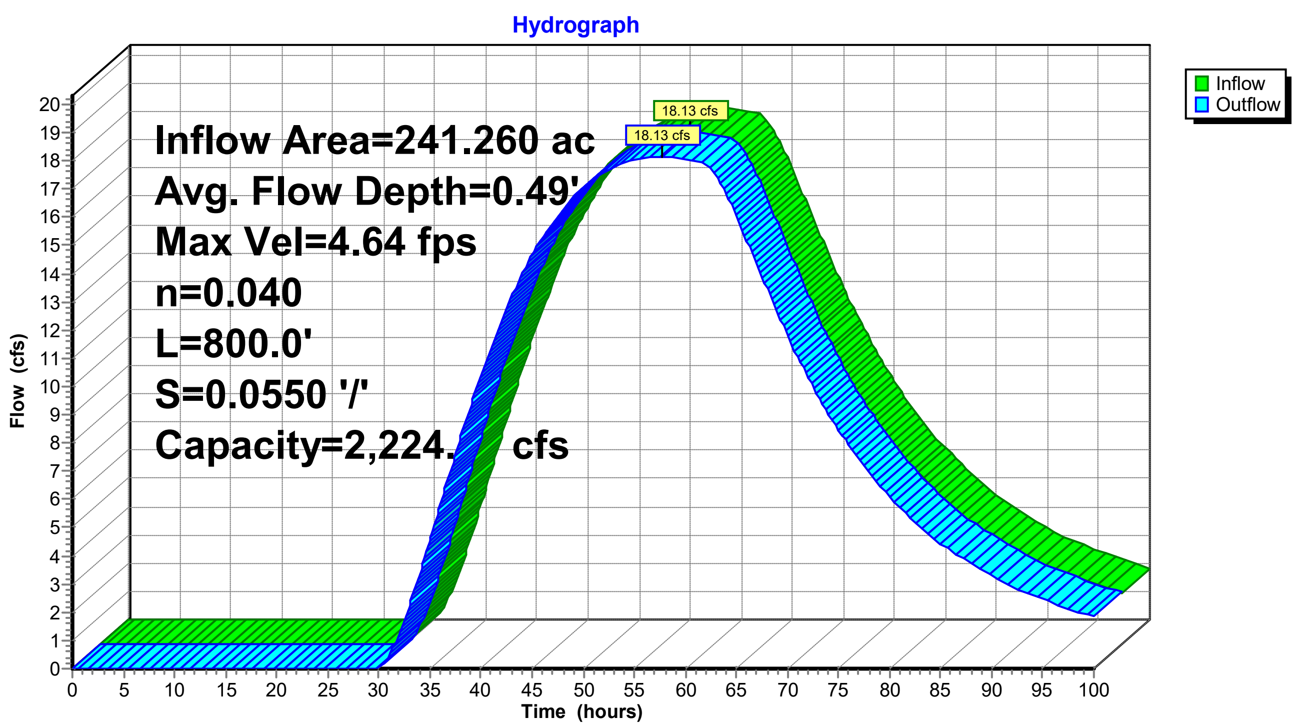
Peak Storage= 3,123 cf @ 57.72 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 5.00' Flow Area= 130.0 sf, Capacity= 2,224.47 cfs

6.00' x 5.00' deep channel, n= 0.040 Winding stream, pools & shoals
Side Slope Z-value= 4.0 '/' Top Width= 46.00'
Length= 800.0' Slope= 0.0550 '/'
Inlet Invert= 428.00', Outlet Invert= 384.00'



‡

Reach 5R: Discharge Creek



Summary for Reach 6R: Breach - Upper Reach

[80] Warning: Exceeded Pond 1P by 1.40' @ 30.99 hrs (0.00 cfs 0.003 af)

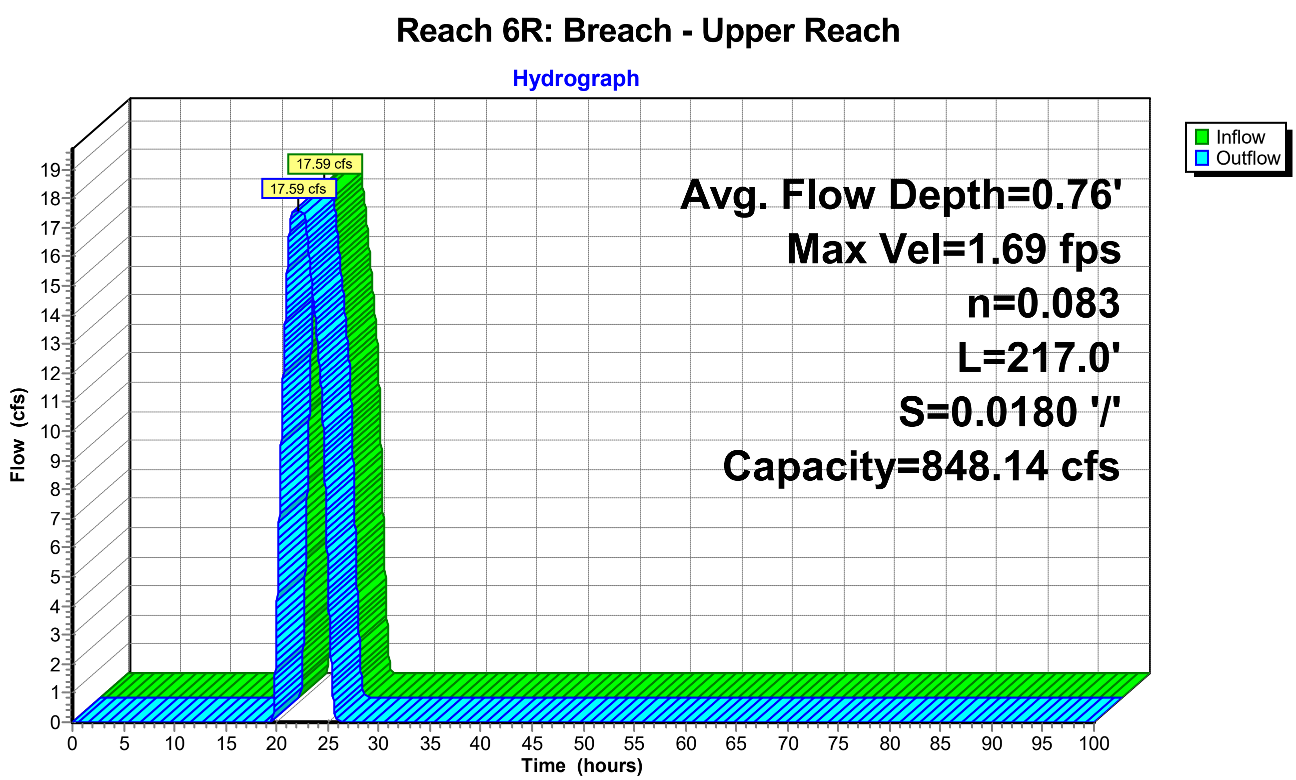
Inflow = 17.59 cfs @ 22.00 hrs, Volume= 5.912 af
Outflow = 17.59 cfs @ 22.02 hrs, Volume= 5.912 af, Atten= 0%, Lag= 1.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.69 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.18 fps, Avg. Travel Time= 3.1 min

Peak Storage= 2,264 cf @ 22.02 hrs
Average Depth at Peak Storage= 0.76'
Bank-Full Depth= 5.00' Flow Area= 175.0 sf, Capacity= 848.14 cfs

10.00' x 5.00' deep channel, n= 0.083
Side Slope Z-value= 5.0 '/' Top Width= 60.00'
Length= 217.0' Slope= 0.0180 '/'
Inlet Invert= 455.00', Outlet Invert= 451.10'

‡



Summary for Reach 7R: Spillway - Middle Reach

[61] Hint: Exceeded Reach 3R outlet invert by 0.13' @ 57.69 hrs

Inflow = 18.13 cfs @ 57.69 hrs, Volume= 56.415 af
Outflow = 18.13 cfs @ 57.69 hrs, Volume= 56.415 af, Atten= 0%, Lag= 0.0 min

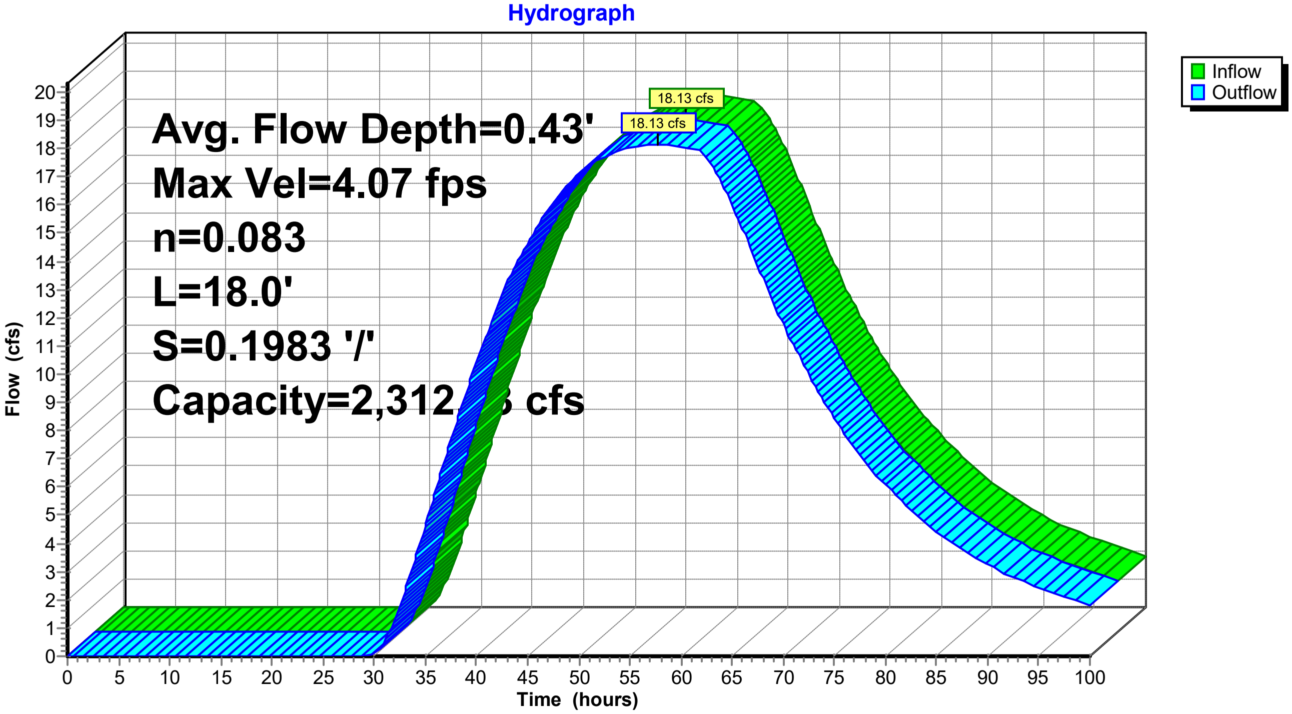
Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.07 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.09 fps, Avg. Travel Time= 0.1 min

Peak Storage= 80 cf @ 57.69 hrs
Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 5.00' Flow Area= 143.5 sf, Capacity= 2,312.83 cfs

8.70' x 5.00' deep channel, n= 0.083
Side Slope Z-value= 4.0 '/' Top Width= 48.70'
Length= 18.0' Slope= 0.1983 '/'
Inlet Invert= 446.45', Outlet Invert= 442.88'

‡

Reach 7R: Spillway - Middle Reach



Summary for Reach 8R: Discharge Ditch

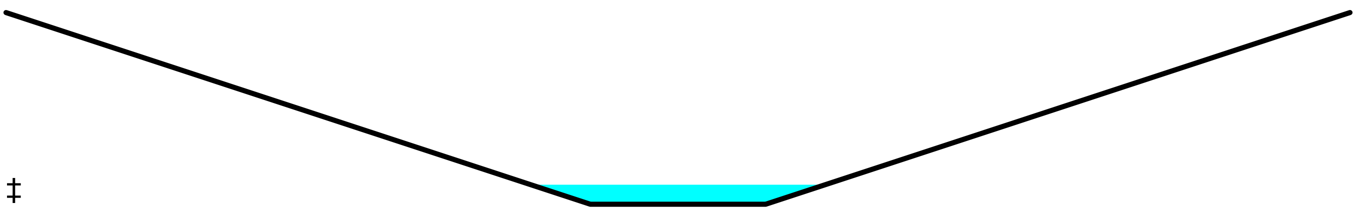
[62] Hint: Exceeded Reach 2R OUTLET depth by 0.05' @ 57.71 hrs

Inflow = 18.13 cfs @ 57.69 hrs, Volume= 56.414 af
Outflow = 18.13 cfs @ 57.69 hrs, Volume= 56.413 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.38 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.38 fps, Avg. Travel Time= 0.2 min

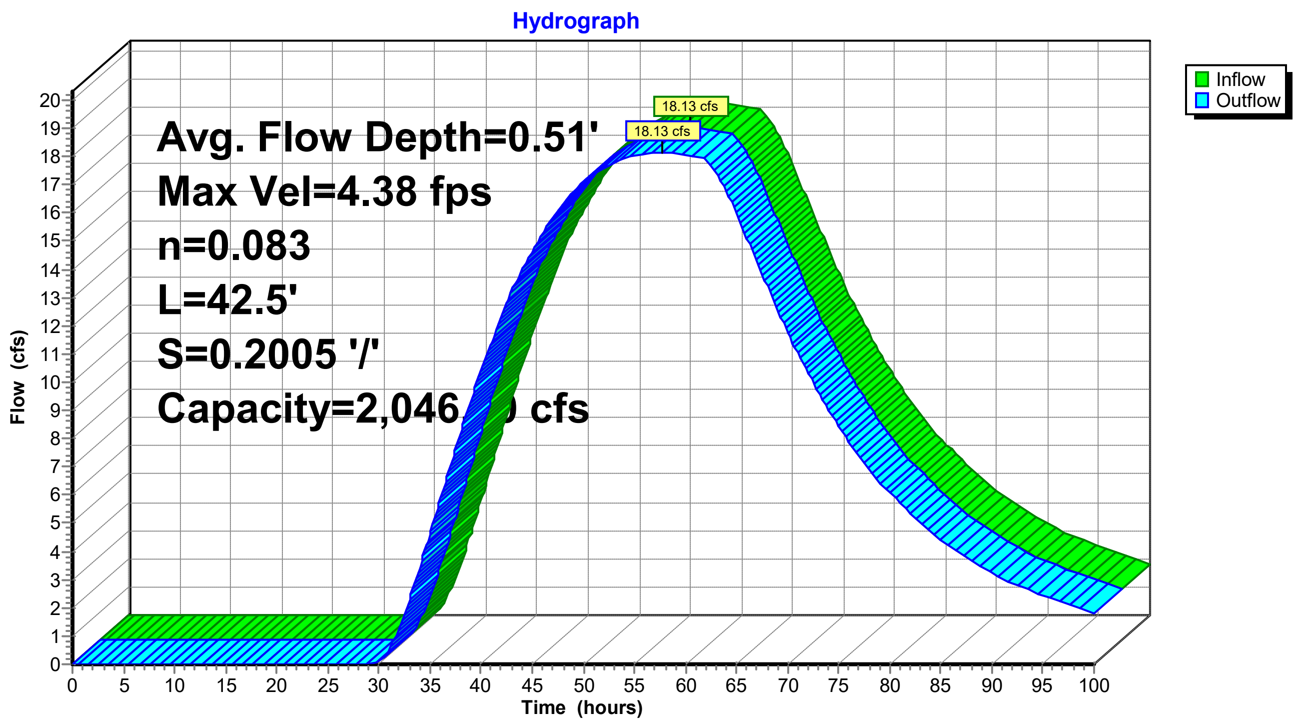
Peak Storage= 176 cf @ 57.69 hrs
Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 5.00' Flow Area= 130.0 sf, Capacity= 2,046.70 cfs

6.00' x 5.00' deep channel, n= 0.083
Side Slope Z-value= 4.0 '/' Top Width= 46.00'
Length= 42.5' Slope= 0.2005 '/'
Inlet Invert= 431.26', Outlet Invert= 422.74'



‡

Reach 8R: Discharge Ditch



Summary for Pond 1P: Upper Pond

Elevations of outlet taken from ATC Hydraulic analyses and decommising report dated Feb 17, 2016

Outlet sizes from ATC Report are shown in Outside Diameter. Inside diameter for 63" HDPE DR 21pipe is 56.6". Inside Diameter for 26" HDPE DR 17 pipe is 22.8".

Inflow Area = 164.290 ac, 55.73% Impervious, Inflow Depth = 8.78" for 1000yr 24hr event
Inflow = 139.01 cfs @ 15.72 hrs, Volume= 120.206 af
Outflow = 49.89 cfs @ 21.99 hrs, Volume= 135.158 af, Atten= 64%, Lag= 375.7 min
Primary = 32.30 cfs @ 21.99 hrs, Volume= 129.246 af
Secondary = 17.59 cfs @ 22.00 hrs, Volume= 5.912 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Starting Elev= 450.90' Surf.Area= 0.000 ac Storage= 86.845 af
Peak Elev= 456.00' @ 22.01 hrs Surf.Area= 0.000 ac Storage= 152.520 af (65.675 af above start)

Plug-Flow detention time= 2,507.8 min calculated for 48.308 af (40% of inflow)
Center-of-Mass det. time= 994.6 min (1,924.4 - 929.8)

Volume	Invert	Avail.Storage	Storage Description
#1	437.00'	889.000 af	**Custom Stage Data** Listed below

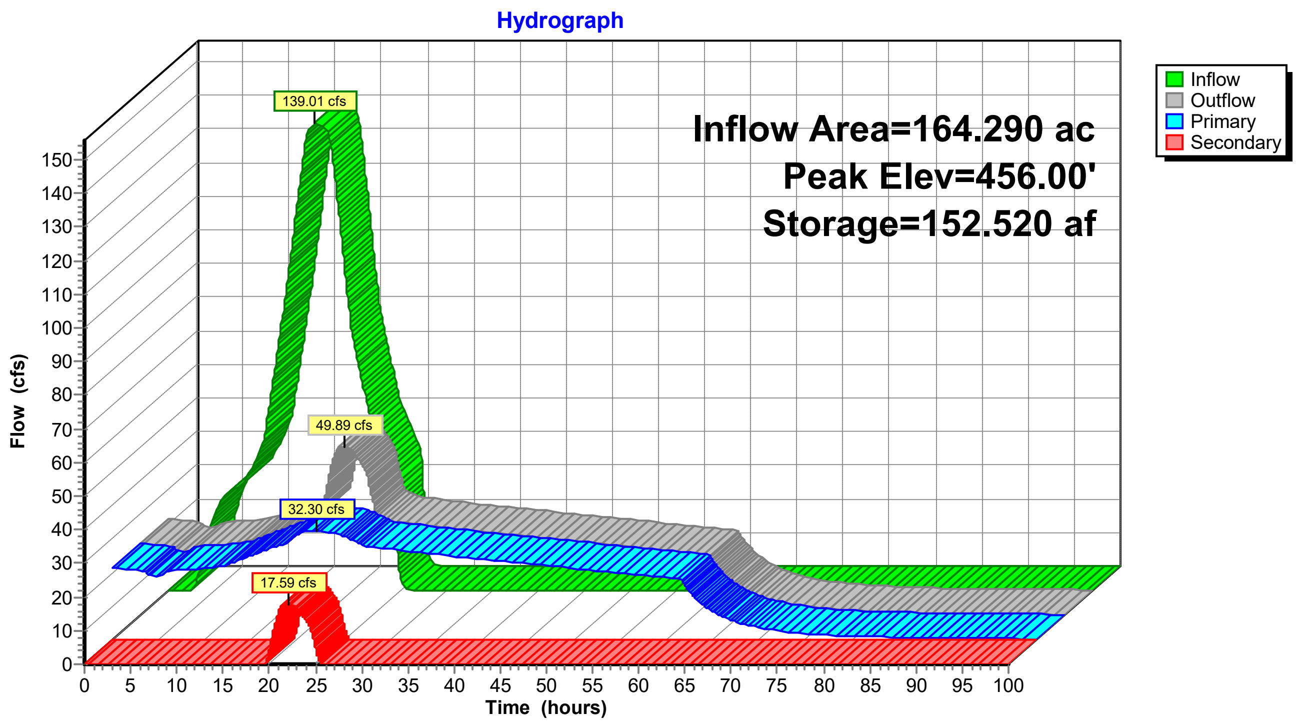
Elevation (feet)	Cum.Store (acre-feet)
437.00	0.000
438.00	2.190
440.00	7.410
441.00	8.200
442.00	10.410
443.00	16.000
444.00	19.200
445.00	27.330
446.00	31.840
447.00	42.590
448.00	49.050
449.00	62.870
450.00	71.410
451.00	88.560
452.00	104.620
454.00	144.360
456.00	152.310
458.00	249.410
460.00	342.630
462.00	489.560
464.00	679.630
466.00	889.000

Device	Routing	Invert	Outlet Devices
#1	Primary	446.00'	**22.8" Round Culvert** L= 300.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 446.00' / 444.50' S= 0.0050 '/' Cc= 0.900 n= 0.011, Flow Area= 2.84 sf
#2	Device 1	450.00'	**56.6" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	455.00'	**10.0' long x 217.0' 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=32.30 cfs @ 21.99 hrs HW=456.00' TW=446.40' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 32.30 cfs @ 11.39 fps)
↑—**2=Orifice/Grate** (Passes 32.30 cfs of 206.15 cfs potential flow)

Secondary OutFlow Max=17.59 cfs @ 22.00 hrs HW=456.00' TW=455.76' (Dynamic Tailwater)
↑—**3=Broad-Crested Rectangular Weir** (Weir Controls 17.59 cfs @ 1.75 fps)

Pond 1P: Upper Pond



Summary for Pond 2P: Lower Pond

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=5)
[62] Hint: Exceeded Reach 4R OUTLET depth by 3.53' @ 57.68 hrs

Inflow Area = 241.260 ac, 58.62% Impervious, Inflow Depth > 15.19" for 1000yr 24hr event
Inflow = 104.62 cfs @ 16.80 hrs, Volume= 305.392 af, Incl. 13.64 cfs Base Flow
Outflow = 32.65 cfs @ 57.67 hrs, Volume= 176.411 af, Atten= 69%, Lag= 2,452.5 min
Secondary = 18.13 cfs @ 57.67 hrs, Volume= 56.424 af
Tertiary = 14.52 cfs @ 57.69 hrs, Volume= 119.987 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Starting Elev= 444.00' Surf.Area= 0.000 ac Storage= 218.970 af
Peak Elev= 447.53' @ 57.68 hrs Surf.Area= 0.000 ac Storage= 366.064 af (147.094 af above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 1,059.4 min (3,186.9 - 2,127.4)

Volume	Invert	Avail.Storage	Storage Description
#1	430.00'	580.200 af	**Custom Stage Data** Listed below

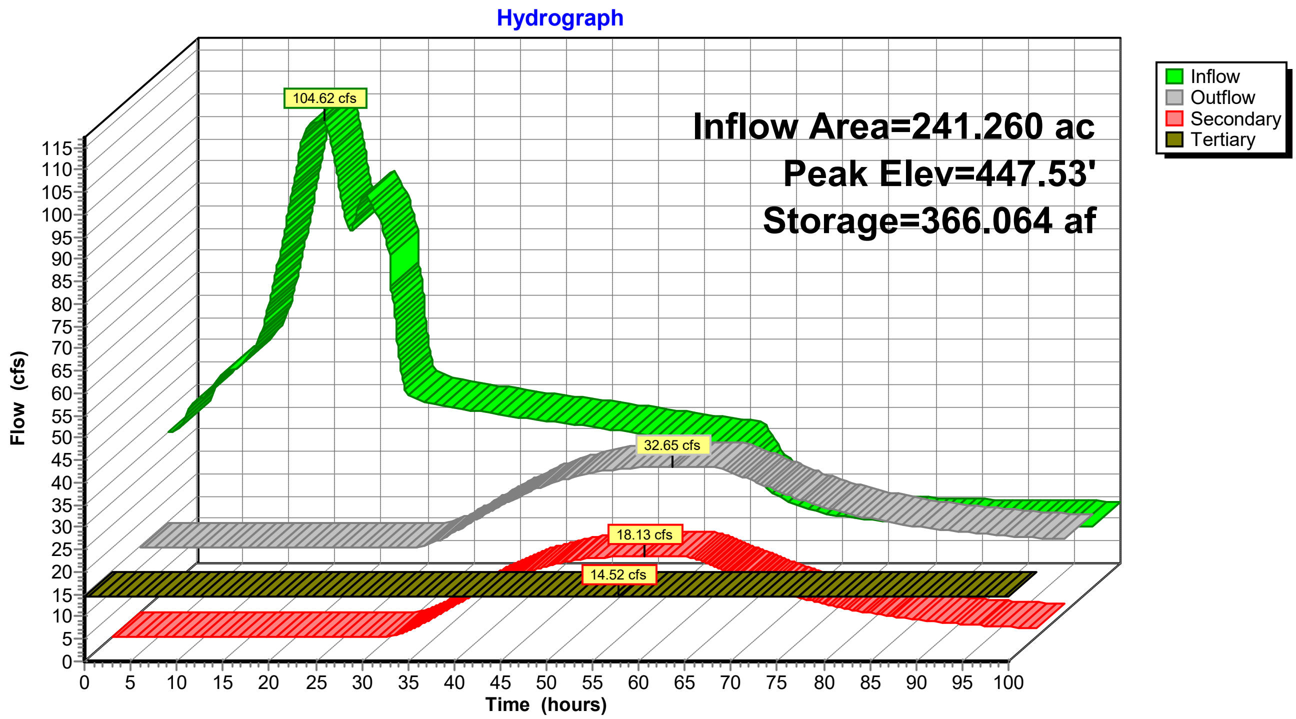
Elevation (feet)	Cum.Store (acre-feet)
430.00	0.000
435.00	80.240
440.00	138.500
441.00	152.440
442.00	167.800
443.00	188.760
444.00	218.970
445.00	258.580
446.00	299.210
447.00	342.320
448.00	387.020
449.00	437.130
450.00	464.600
451.00	545.710
452.00	580.200

Device	Routing	Invert	Outlet Devices
#1	Secondary	447.00'	**30.0' long x 115.0' 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	Tertiary	441.50'	**Pump** Discharges@450.90' Turns Off@441.01' Flow (gpm)= 6,516.0 6,516.1 Head (feet)= 500.00 0.00

Secondary OutFlow Max=18.13 cfs @ 57.67 hrs HW=447.53' TW=447.44' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 18.13 cfs @ 1.14 fps)

Tertiary OutFlow Max=14.52 cfs @ 57.69 hrs HW=447.53' (Free Discharge)
└─**2=Pump** (Pump Controls 14.52 cfs)

Pond 2P: Lower Pond



9400 Amberglen Boulevard
Austin, Texas 78729
1-512-454-4797

About AECOM

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With approximately 45,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. A Fortune 500 company, AECOM serves clients in more than 100 countries and has annual revenue in excess of $6 billion.