**PERIODIC INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN**
**PLANT BARRY ASH POND**
**ALABAMA POWER COMPANY**

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities Final Rule (40 C.F.R. Part 257 and Part 261) and the State of Alabama's ADEM Admin. Code Chapter 335-13-15 establish certain hydrologic and hydraulic capacity requirements for CCR surface impoundments. Per §257.82 and ADEM Admin. Code r. 335-13-15-.05(3), the owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment is required to design, construct, operate and maintain an inflow design flood control system capable of safely managing flow during and following the peak discharge of the specified inflow design flood. The owner or operator also must prepare a written plan documenting how the inflow flood control system has been designed and constructed to meet the requirements of the referenced sections of the rules. In addition, §257.82(f)(4) and ADEM Admin. Code r. 335-13-15-.05(3)(c)4. require a revision to the inflow design flood control system plan be prepared every 5 years.

The existing CCR surface impoundment referred to as the Plant Barry Ash Pond is located at Alabama Power Company's Plant Barry. The inflow design flood consists only of the rainfall that falls within the limits of the surface impoundment, as the impoundment no longer receives process water flows and does not receive any off-site runoff. The surface impoundment is currently undergoing closure in place and water levels have been lowered from normal operational pool levels. Stormwater is temporarily stored within the limits of the surface impoundment and discharged through a temporary water treatment system that discharges through the original 54-inch CMP outlet pipe that is accessed under normal flow conditions via a four-sided concrete outfall structure. The CMP pipe has been lined to yield an effective inner diameter of 51-inches.

The inflow design flood has been calculated using the Natural Resources Conservation Service method (also known as the Soil Conservation Service (SCS) method) using the 1000-yr storm event required for a Significant Hazard Potential facility. Runoff curve number data was determined using Table 2-2A from the Urban Hydrology for Small Watersheds (TR-55). Appendix A and B from the TR-55 were used to determine the rainfall distribution methodology. Precipitation values were determined from NOAA's Precipitation Frequency Data Server (Atlas-14).

The NRCS provided information on the soil characteristics and hydrologic groups present at the site. It was determined that the hydrological group "D" should be used to best reflect the characteristics of the soils on site. This information was placed into HydroCAD™ 2016 software and used to generate appropriate precipitation curves, storm basin routing information, and resulting rating curves to evaluate surface impoundment capacity.

Calculations indicate the unit will adequately manage flow during and following the peak discharge of the inflow design flood without overtopping the perimeter embankments.

The facility is operated subject to and in accordance with §257.3-3 and ADEM Admin. Code r. 335-13-4-.01(2)(a) and (b).

I hereby certify that the inflow design flood control system plan meets the requirements of 40 C.F.R. §257.82 and ADEM Admin. Code r. 335-13-15-.05(3).

ALABAMA LICENSED 16516 PROFESSIONAL ENGINEER JAMES C. PEGUES, JR.

10/15/2021

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

# Inflow Design Control System Plan:
# Hydrologic and Hydraulic Calculation
# for
# Plant Barry Ash Pond

**Prepared by:**

**Geosyntec Consultants, Inc.**

**Prepared for:**

**Southern Company Services**

**Technical Services**

Originator: Geosyntec Consultants 14 June 2021
Date

Reviewer: 10-7-21
Jason S. Wilson Date

Approval: 10/7/21
James C. Pegues Date

## 1 PURPOSE OF CALCULATION

The purpose of this report is to demonstrate the hydraulic capacity of the subject CCR impoundment in order to prepare an inflow design flood control plan as required by the United States Environmental Protection Agency's (EPA) final rule for Disposal of CCR from Electric Utilities (EPA 40 CFR 257) and ADEM Admin. Code Chapter 334-13-15.

## 2 SUMMARY OF CONCLUSIONS

A hydrologic and hydraulic model was developed for the Plant Barry Ash Pond to evaluate the capacity of the impoundment using an inflow design storm event equal to 1000-yr, 24-hr rainfall event. The pond footprint is segmented by an intermediate dike, splitting the basin into two hydraulically connected storage basins, referred to as the North and South Ponds. The North and South Ponds are hydraulically connected through East and West weir openings within the separator dike.

Based on the calculations presented and summarized herein, the design of the proposed surface water management system meets or exceeds the requirements to safely manage peak stages from the 1000-yr, 24-hr storm event within the perimeter embankment. Results from the analysis are included in **Attachment 1** and summarized in **Table 1** below:

**Table 1. Flood Routing Results for Plant Barry Ash Pond**

| Plant Barry Ash Pond | Normal Pool Elev. (ft)[1] | Top of Bank Elev. (ft) | Auxiliary Spillway Crest Elev. (ft) | Peak Water Surface Elev. (ft) | Minimum Freeboard (ft)[2] | Peak Inflow (cfs) | Peak Outflow (cfs) |
|---|---|---|---|---|---|---|---|
| North Pond | 16 | 22.0 | N/A | 21.70 | 0.30 | 1,583 | 505 |
| South Pond | 10 | 21.5 | N/A | 20.20 | 1.30 | 679 | 205 |

Notes:
1. The North and South Pond normal pool elevations are based on measured average water levels recorded daily between January 2021 and May 2021. These levels are maintained currently as normal operating levels.
2. Freeboard is measured from the top of perimeter embankment to the peak water surface elevation.

## 3 METHODOLOGY

### 3.1 HYDROLOGIC ANALYSIS

Design Storm Event

The Plant Barry Ash Pond is classified as a significant hazard structure. The design storm for a significant hazard structure is a 1000-yr, 24-hr rainfall event. The pond no longer receives process water flows from the plant; therefore, inflow outside of run-off generated from the aforementioned storm event was not considered.

A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized in **Table 2** below and discussed in detail in the following subsections.

**Table 2. Plant Barry Ash Pond Storm Distribution**

| Hazard Classification | Return Frequency (yr) | Storm Duration (hr) | Rainfall Total (in.) | Rainfall Source | Storm Distribution |
|---|---|---|---|---|---|
| Significant | 1,000 | 24 | 21.9 | NOAA Atlas 14 | SCS Type III |

Stormwater peak stages were calculated using hydrology and hydraulic procedures presented in the SCS TR-55 manual, Manning's kinematic equation, and other recognized engineering procedures encoded in HydroCADTM software [SCS, 1986; HydroCAD, 2016].

<u>Rainfall Distribution</u>

**Attachment 2** [Soil Conservation Service (SCS), 1986] shows the Site location on the rainfall distribution map of the United States. The Site is located in Bucks, Alabama, which is categorized by SCS Type III Rainfall Distribution. Rainfall depths for the design storm events were obtained from the NOAA Precipitation Frequency Data Server and are shown in **Attachment 2** and presented in the table below.

<u>Drainage Areas</u>

Drainage areas were delineated based on aerial photography and recent LiDAR topographic data. **Attachment 3** presents the drainage area (i.e., subcatchment) delineations for surface impoundment.

**Table 3** summarizes hydrologic input parameters and basin characteristics is provided below:

**Table 3. Ash Pond Hydrologic Information**

| | |
|---|---|
| **Total Drainage Basin Area (acres)** | 591.5 |
| **North Pond Hydrologic Curve Number, CN** | 93 |
| **South Pond Hydrologic Curve Number, CN** | 93 |
| **North Pond Time of Concentration (min)** | 299.7 |
| **South Pond Time of Concentration (min)** | 50.2 |
| **Hydrologic Methodology** | SCS Method |
| **Hydrologic Software** | HydroCAD™ |

## 3.2 HYDRAULIC ANALYSIS

Storage Volume

Storage values for each pond were determined by developing a stage-storage relationship utilizing 2021 topographic data. Available storage volumes for the North and South Ponds is provided in **Attachment 4**.

Outlet Devices

Water within the South Pond can be detained within the basin footprint, pumped to the waste water treatment facility (WWTF), or discharged through the existing outlet structure to the Mobile River, depending on the surface water elevation within the pond footprint. For the purpose of this analysis, pumping of water to the WWTF was disregarded and the existing outlet structure was considered the only mechanism of discharge from the pond, as it is the only mechanism that facilitates offsite discharge (Outfall 001) from the ponds to the Mobile River. As such, peak stages observed as part of this analysis are conservative. The structure has both vertical and horizontal orifices that facilitate flow through the structure and ultimately through the 51-inch fiberglass-lined corrugated metal pipe (CMP). The outlet structure characteristics are summarized in the table below.

North and South Pond Hydraulic Connections

The North and South Ponds are hydraulically connected via East and West Bridge weirs within the intermediate dike. Both the East and West Bridge weirs have various associate weir and orifice components, which control discharge from the North Pond to the South Pond at various elevations. At elevation 23.5 ft, the crest elevation of the intermediate dike, the intermediate dike serves as a broad crested weir connecting the North and South Ponds. Each weir component is summarized in **Table 4** below:

**Table 4. Weir Summary Table**

| Component | Invert El (feet) |
|---|---|
| East Channel Weir | 17.80 |
| East Channel Check Dam | 20.40 |
| West Gate | 15.30 |
| West Channel Weir | 15.40 |
| West Channel Check Dam | 19.50 |

Outlet Devices

An existing outlet structure located within the South Pond is the only mechanism that facilitates offsite discharges from the ponds to the Mobile River. The structure has both vertical and horizontal orifices that facilitate flow through the structure and ultimately through the 51-inch corrugated metal pipe (CMP). The outlet structure characteristics are summarized in the table below.

**Table 5. Spillway Attribute Table**

| Spillway Component | US Invert El (feet) | DS Invert El (feet) | Dimension | Slope (ft/ft) | Length (ft) |
|---|---|---|---|---|---|
| Sides 1 & 3 / Vertical Orifices | 14.7 | N/A | (1/each) 8 ft x 1.7 ft | N/A | N/A |
| Sides 2 & 4 / Vertical Orifices | 14.41 | N/A | (1/each) 8 ft x 2 ft | N/A | N/A |
| Top of Structure / Horizontal Grates | 17.90 | N/A | (1) 7 ft x 7ft<br>(4) 9.5 in x 8 ft | N/A | N/A |
| Discharge Pipe | 6.11 | 5.56 | 51" Diameter | 0.5% | 110 |

## 4 SUPPORTING INFORMATION

Curve Number (CN)

Due to the industrial nature of the Site and physical characteristics of the material within the existing ash pond, hydrologic soil group (HSG) D soil type was used to represent CCR material and developed areas within the surface impoundment footprint.

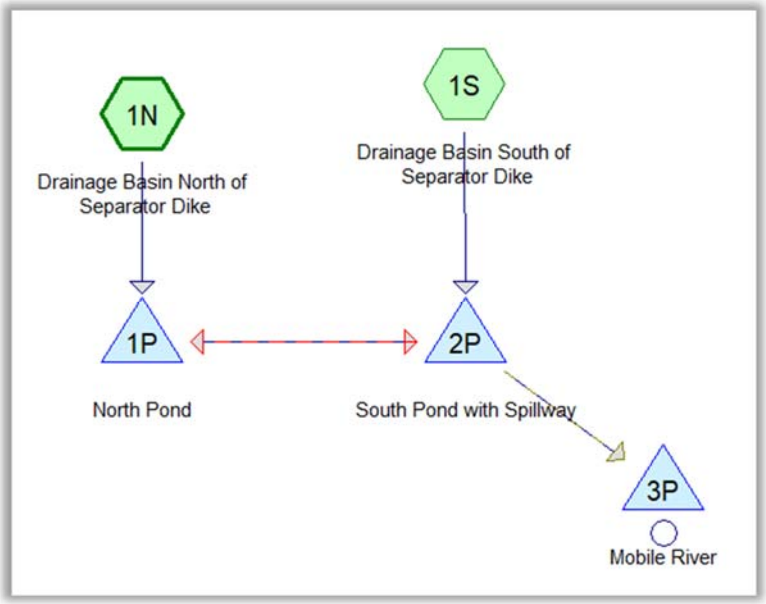
**Table 1** presents curve numbers (CNs) for the various surface and soil types within the surface impoundment contributing drainage area. The CNs corresponding to the land cover and HSG were selected based on Table 2-2 of TR-55 [SCS, 1986]. The following table summarizes the CNs chosen for the analyses.

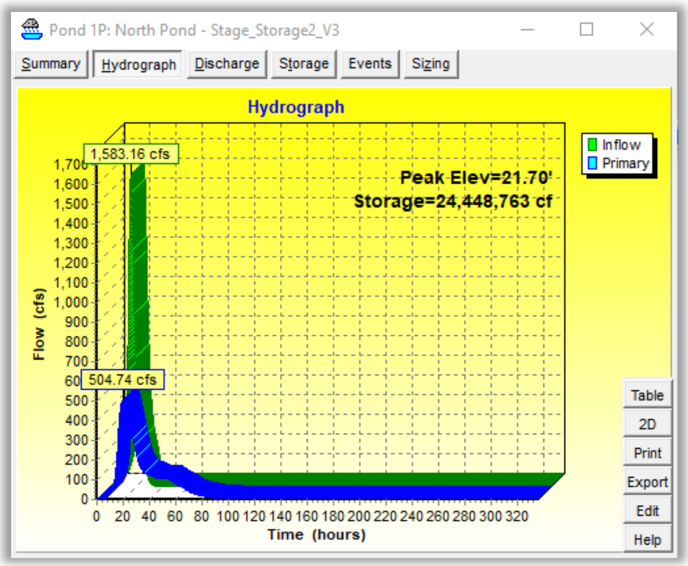
| Area Description | Condition | HSG | CN |
|---|---|---|---|
| CCR Material | Urban Districts: Industrial | D | 93 |
| Water Surfaces/ Channels/ Stormwater Ponds | Impervious Area | D | 98 |

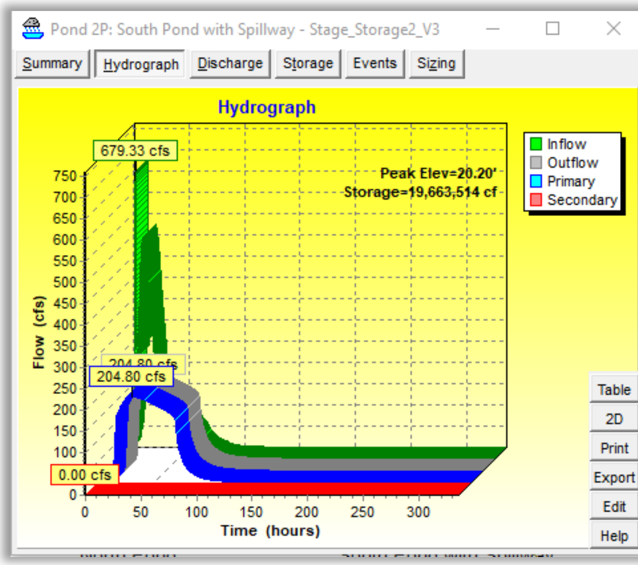
## Time of Concentration

Time of Concentration (Tc) paths were calculated for each drainage area. A minimum Tc was selected to be 6 minutes, based on recommendations from TR-55 [SCS, 1986]. Computations for travel time of sheet flows and shallow concentrated flows were performed using Manning's kinematic solution equation [SCS, 1986] and are documented within HydroCAD model.

# ATTACHMENT 1
## Model Results



# ATTACHMENT 2
## SCS Rainfall Distributions and NOAA Precipitation Frequency Data

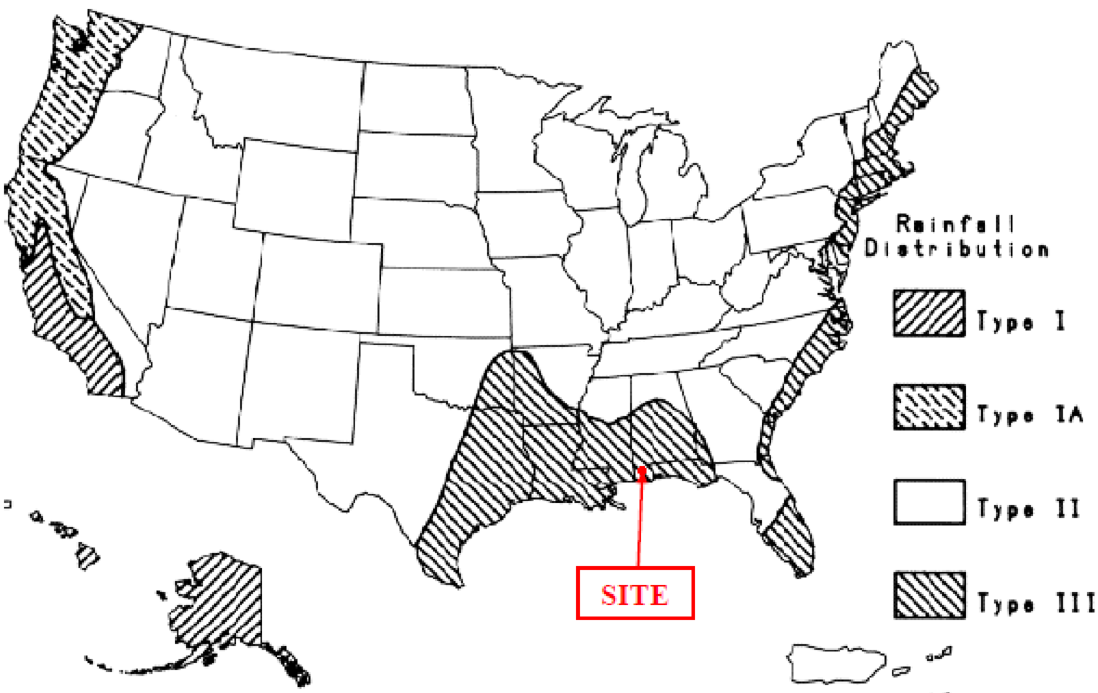



Figure B-2.—Approximate geographic boundaries for SCS rainfall distributions.

**NOAA Atlas 14, Volume 9, Version 2**
**Location name: Axis, Alabama, USA***
**Latitude: 31.0014°, Longitude: -87.9956°**
**Elevation: 33.87 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

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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 | 0.581 (0.468-0.730) | 0.658 (0.530-0.827) | 0.786 (0.631-0.991) | 0.895 (0.714-1.13) | 1.05 (0.810-1.36) | 1.17 (0.882-1.53) | 1.29 (0.943-1.72) | 1.41 (0.994-1.92) | 1.58 (1.07-2.20) | 1.71 (1.13-2.41) |
| 10-min | 0.851 (0.685-1.07) | 0.964 (0.775-1.21) | 1.15 (0.924-1.45) | 1.31 (1.05-1.66) | 1.53 (1.19-1.99) | 1.71 (1.29-2.23) | 1.89 (1.38-2.51) | 2.07 (1.46-2.82) | 2.31 (1.57-3.22) | 2.50 (1.66-3.52) |
| 15-min | 1.04 (0.835-1.30) | 1.18 (0.946-1.48) | 1.40 (1.13-1.77) | 1.60 (1.27-2.02) | 1.87 (1.45-2.42) | 2.08 (1.58-2.73) | 2.30 (1.68-3.07) | 2.52 (1.78-3.43) | 2.82 (1.91-3.92) | 3.05 (2.02-4.30) |
| 30-min | 1.51 (1.22-1.90) | 1.72 (1.39-2.17) | 2.07 (1.66-2.61) | 2.37 (1.89-2.99) | 2.78 (2.15-3.60) | 3.10 (2.34-4.05) | 3.42 (2.51-4.56) | 3.75 (2.64-5.11) | 4.20 (2.85-5.84) | 4.54 (3.00-6.39) |
| 60-min | 2.01 (1.62-2.53) | 2.29 (1.84-2.88) | 2.77 (2.22-3.48) | 3.18 (2.54-4.02) | 3.79 (2.95-4.94) | 4.29 (3.26-5.64) | 4.81 (3.53-6.44) | 5.36 (3.78-7.33) | 6.13 (4.17-8.55) | 6.74 (4.46-9.48) |
| 2-hr | 2.51 (2.04-3.14) | 2.86 (2.31-3.56) | 3.46 (2.79-4.33) | 4.00 (3.21-5.02) | 4.81 (3.77-6.25) | 5.48 (4.19-7.18) | 6.20 (4.59-8.27) | 6.97 (4.96-9.49) | 8.06 (5.52-11.2) | 8.93 (5.95-12.5) |
| 3-hr | 2.84 (2.31-3.53) | 3.22 (2.62-4.01) | 3.91 (3.17-4.88) | 4.56 (3.67-5.70) | 5.54 (4.38-7.22) | 6.39 (4.91-8.37) | 7.30 (5.43-9.74) | 8.30 (5.93-11.3) | 9.73 (6.70-13.5) | 10.9 (7.28-15.2) |
| 6-hr | 3.44 (2.81-4.25) | 3.91 (3.19-4.82) | 4.78 (3.89-5.92) | 5.62 (4.55-6.98) | 6.95 (5.54-9.03) | 8.10 (6.28-10.6) | 9.37 (7.03-12.5) | 10.8 (7.77-14.6) | 12.8 (8.89-17.7) | 14.5 (9.74-20.1) |
| 12-hr | 4.09 (3.36-5.01) | 4.67 (3.84-5.73) | 5.79 (4.74-7.12) | 6.86 (5.59-8.46) | 8.55 (6.86-11.0) | 10.0 (7.82-13.0) | 11.6 (8.78-15.4) | 13.4 (9.74-18.1) | 16.0 (11.2-22.0) | 18.2 (12.3-25.0) |
| 24-hr | 4.75 (3.93-5.78) | 5.50 (4.54-6.70) | 6.90 (5.68-8.42) | 8.22 (6.74-10.1) | 10.3 (8.30-13.2) | 12.1 (9.47-15.6) | 14.0 (10.7-18.4) | 16.2 (11.8-21.7) | 19.3 (13.6-26.3) | 21.9 (14.9-29.9) |
| 2-day | 5.44 (4.53-6.58) | 6.35 (5.28-7.68) | 8.02 (6.65-9.72) | 9.59 (7.90-11.7) | 12.0 (9.73-15.3) | 14.1 (11.1-18.0) | 16.3 (12.5-21.3) | 18.8 (13.8-25.0) | 22.4 (15.8-30.3) | 25.3 (17.4-34.3) |
| 3-day | 5.92 (4.95-7.13) | 6.88 (5.74-8.28) | 8.63 (7.18-10.4) | 10.3 (8.50-12.4) | 12.8 (10.4-16.2) | 15.0 (11.9-19.1) | 17.4 (13.3-22.5) | 19.9 (14.7-26.4) | 23.7 (16.8-31.9) | 26.7 (18.4-36.1) |
| 4-day | 6.35 (5.32-7.63) | 7.31 (6.11-8.78) | 9.07 (7.56-10.9) | 10.7 (8.90-13.0) | 13.3 (10.8-16.8) | 15.5 (12.3-19.7) | 17.9 (13.8-23.2) | 20.6 (15.2-27.1) | 24.4 (17.3-32.8) | 27.5 (19.0-37.0) |
| 7-day | 7.51 (6.32-8.96) | 8.41 (7.07-10.0) | 10.1 (8.47-12.1) | 11.7 (9.78-14.1) | 14.3 (11.7-17.9) | 16.5 (13.2-20.8) | 18.9 (14.6-24.3) | 21.6 (16.0-28.3) | 25.4 (18.2-34.0) | 28.6 (19.8-38.3) |
| 10-day | 8.48 (7.15-10.1) | 9.39 (7.92-11.2) | 11.1 (9.33-13.2) | 12.7 (10.6-15.2) | 15.2 (12.5-19.0) | 17.4 (14.0-21.9) | 19.8 (15.4-25.3) | 22.4 (16.7-29.3) | 26.3 (18.9-35.0) | 29.4 (20.5-39.2) |
| 20-day | 11.0 (9.36-13.0) | 12.2 (10.4-14.4) | 14.3 (12.1-16.9) | 16.1 (13.6-19.1) | 18.8 (15.4-23.1) | 21.0 (16.9-26.0) | 23.4 (18.2-29.5) | 25.9 (19.3-33.3) | 29.3 (21.2-38.6) | 32.1 (22.5-42.6) |
| 30-day | 13.2 (11.3-15.5) | 14.7 (12.5-17.3) | 17.2 (14.6-20.2) | 19.3 (16.2-22.8) | 22.2 (18.2-26.9) | 24.5 (19.7-30.0) | 26.9 (20.9-33.6) | 29.3 (21.9-37.4) | 32.6 (23.5-42.5) | 35.1 (24.7-46.4) |
| 45-day | 16.1 (13.8-18.9) | 18.0 (15.4-21.1) | 21.0 (17.9-24.6) | 23.4 (19.8-27.6) | 26.7 (21.9-32.1) | 29.2 (23.5-35.5) | 31.7 (24.6-39.2) | 34.1 (25.6-43.2) | 37.3 (27.0-48.3) | 39.7 (28.0-52.2) |
| 60-day | 18.8 (16.1-21.9) | 20.9 (17.9-24.4) | 24.3 (20.7-28.4) | 27.0 (23.0-31.7) | 30.7 (25.2-36.6) | 33.3 (26.8-40.4) | 35.9 (28.0-44.4) | 38.5 (28.9-48.5) | 41.7 (30.2-53.8) | 44.0 (31.2-57.8) |

[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.

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## PF graphical

# ATTACHMENT 3
## Drainage Areas

# ATTACHMENT 4
## North and South Pond Stage-Storage

| North Pond | |
|---|---|
| Elev. (ft) | Area (sf) |
| 11 | 9,415 |
| 12 | 59,948 |
| 13 | 111,991 |
| 14 | 246,824 |
| 15 | 297,964 |
| 16 | 330,136 |
| 17 | 836,273 |
| 18 | 2,588,164 |
| 19 | 4,261,094 |
| 20 | 6,155,440 |
| 21 | 7,684,423 |
| 21.5 | 8,341,923 |
| 22 | 9,054,933 |
| 22.5 | 10,004,316 |
| 23 | 10,671,547 |
| 23.5 | 11,333,954 |
| 23.95 | 11,632,149 |
| 24 | 11,857,845 |

| South Pond | |
|---|---|
| Elev. (ft) | Area (sf) |
| 4 | 530 |
| 5 | 96,539 |
| 6 | 186,059 |
| 6.5 | 216,712 |
| 7 | 253,827 |
| 7.5 | 281,140 |
| 8 | 321,260 |
| 8.5 | 355,991 |
| 9 | 442,204 |
| 9.5 | 473,383 |
| 10 | 501,697 |
| 11 | 556,898 |
| 12 | 671,664 |
| 13 | 979,978 |
| 14 | 1,598,784 |
| 15 | 2,149,580 |
| 16 | 2,392,108 |
| 17 | 2,522,252 |
| 18 | 2,564,049 |
| 19 | 2,597,847 |
| 20 | 2,628,436 |
| 21 | 2,659,526 |
| 21.5 | 2,685,686 |
| 22 | 2,697,269 |
| 22.5 | 2,724,949 |
| 23 | 2,740,276 |
| 24 | 2,740,276 |