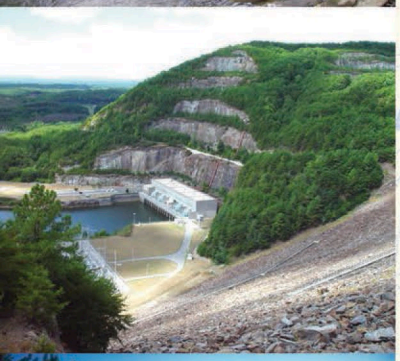
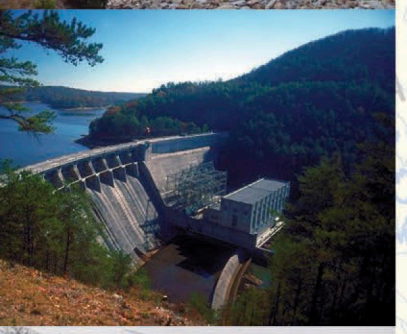
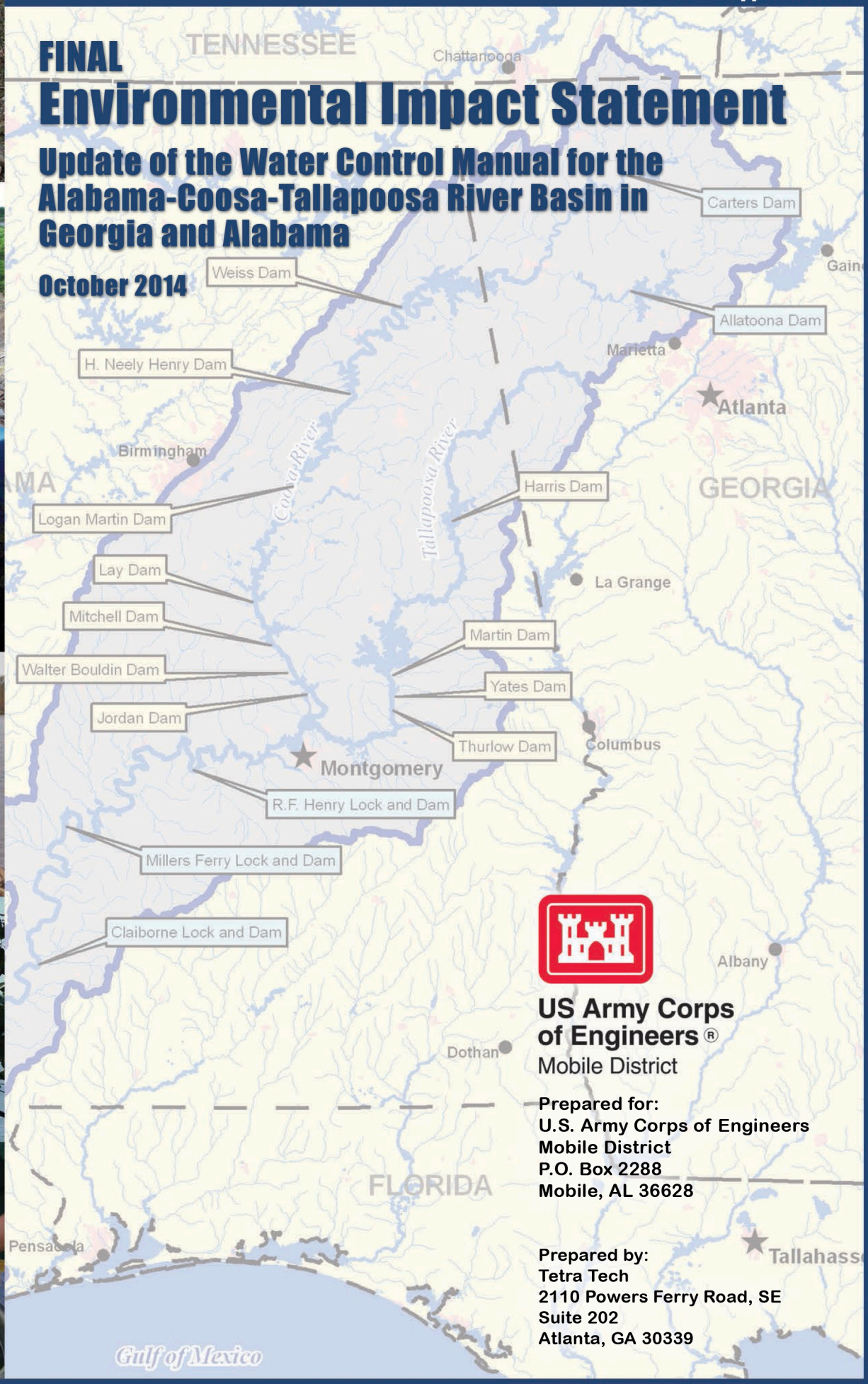




FINAL
Environmental Impact Statement

Update of the Water Control Manual for the Alabama-Coosa-Tallapoosa River Basin in Georgia and Alabama

October 2014



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ALABAMA-COOSA-TALLAPOOSA RIVER BASIN WATER CONTROL MANUAL

APPENDIX I

R. L. HARRIS DAM AND LAKE
(ALABAMA POWER COMPANY)

TALLAPOOSA RIVER, ALABAMA

U.S. ARMY CORPS OF ENGINEERS
SOUTH ATLANTIC DIVISION
MOBILE DISTRICT
MOBILE, ALABAMA

SEPTEMBER 1972
REVISED OCTOBER 1993; JUNE 2004; and
DECEMBER 2014 (scheduled)

R. L. Harris Dam and Lake

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be published in a hard copy binder with loose-leaf form, and only those sections, or parts thereof; requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be made to keep the manual current. Changes to individual pages must carry the date of revision, which is the South Atlantic Division's approval date.

REGULATION ASSISTANCE PROCEDURES

If unusual conditions arise, contact can be made with the Water Management Section, Mobile District Office by phoning (251) 690-2730 during regular duty hours and (251) 509-5368 during non-duty hours. The Alabama Power Company Reservoir Management Section Hydro Desk can be reached at (205) 257-4010 during regular duty hours.

METRIC CONVERSION

The values presented in the text are shown in English units only. Exhibit B contains a conversion table that can be used for metric units.

VERTICAL DATUM

All vertical data presented in this manual are referenced to the project's historical vertical datum, National Geodetic Vertical Datum of 1929 (NGVD29).

MEMORANDUM OF UNDERSTANDING

The R. L. Harris Dam and Lake Project will be operated during floods and in support of navigation downstream in accordance with regulations prescribed by the Secretary of the Army and published in the Code of Federal Regulations, Title 33, Chapter II, Part 208, Section 208. A Memorandum of Understanding (MOU) concerning the design, construction, and operation of the R. L. Harris development for flood control (now termed flood risk management) was adopted by the Alabama Power Company (APC) and the U.S. Army Corps of Engineers (herein referred to as the Corps of Engineers or Corps) on 27 September 1972 and later revised on 11 October 1990. This MOU is also intended to memorialize the functions and procedures for both the Corps and APC for implementing these plans and meeting their responsibilities with regard to the orderly exchange of hydrologic data. A copy of the MOU is included in this manual as Exhibit C.

R. L. HARRIS DAM AND LAKE

WATER CONTROL MANUAL
TALLAPOOSA RIVER, ALABAMA

U.S. Army Corps of Engineers, Mobile District, South Atlantic Division

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PERTINENT DATA

(see Exhibit A, page E-A-1 for Supplementary Pertinent Data)

GENERAL

Other names of project	Crooked Creek
Dam site location	
Miles above mouth of Tallapoosa River	139.1
Miles above mouth of Mobile River	494
Drainage area above dam site, square miles	1,454

STREAM FLOW AT USGS GAGE (#02414500) AT WADLEY, AL (cfs)

Average for Period of Record (calendar year 1924 – 2009)	2,562
Maximum daily discharge (8 May 2003)	103,000
Minimum daily discharge (Oct 1987)	41

RESERVOIR

Top of power pool (May through Sep) - feet NGVD29	793.0
Top of power pool (Dec through Mar) - feet NGVD29	785.0
Minimum operating pool elevation, feet NGVD29	768.0
Area at pool elevation 793.0, acres	10,660
Total volume at elevation 793.0, acre-feet	424,969
Power storage (elevation 768 to 793 ft NGVD29), acre-feet	206,944
Inactive Storage (below elevation 768 ft NGVD29), acre-feet	218,025
Length, miles	29
Shoreline distance at elevation 793 (summer pool), miles	272

SPILLWAY

Type	concrete-gravity
Net length, feet	310
Elevation of crest, feet above NGVD29	753.0
Type of gates	Tainter
Number of gates (40.5 ft x 40 ft)	6
Maximum discharge capacity (pool elev. 795.0), cfs	267,975

DAM

Total length including dikes, feet	3,242
Total length of non-overflow section, feet	2,632
Maximum height above stream bed, feet	151.5
Elevation, top of dam, feet NGVD29	810

POWER PLANT

Gross static head at full power pool (793 ft NGVD29), feet	131.7
Normal operating head at full turbine discharge, feet	124.0
Number of units	2
Maximum discharge per unit (approximate full gate), cfs	8,000
Total installation, kW	135,000

I - INTRODUCTION

1-01. Authorization. The River and Harbor Act approved 2 March 1945 (59 Stat. 10) authorized the Corps to develop a site at Crooked Creek for flood control, hydropower, and other purposes. Section 12 of Public Law (P.L.) 89-789 (80 Stat., 1405), approved 7 November 1966, suspended for two years the authority as far as hydropower was concerned, to permit development of the Tallapoosa River by private concerns. The Alabama Power Company (APC) filed an application with the Federal Power Commission (FPC) for the proposed project on 5 November 1968, and was issued a license for the construction of the Crooked Creek Hydroelectric Project (later renamed R. L. Harris). Operations for flood risk management and navigation support are conducted in accordance with regulations prescribed by the Secretary of the Army and published in 33 CFR, Chapter II, Part 208, Section 208.65. Therefore, this water control manual has been prepared as directed and in accordance with the Corps Water Management Regulations, specifically Engineering Regulation (ER) 1110-2-241, *Use of Storage Allocated for Flood Control and Navigation at Non-Corps Projects*. Also, ER 1110-2-240, *Water Control Management* prescribes the policies and procedures to be followed in carrying out water management activities, including establishment and updating of water control plans for non-Corps projects, as required by federal laws and directives. This manual is also prepared in accordance with pertinent sections of the Corps' Engineering Manual (EM) 1110-2-3600, *Management of Water Control Systems*; under the format and recommendations described in ER 1110-2-8156, *Preparation of Water Control Manuals*; and ER 1110-2-1941, *Drought Contingency Plans*. This manual is subject to review and revision at any time upon request of APC or the District Commander. Revisions to this manual are processed in accordance with ER 1110-2-240.

Below is a complete list of pertinent regulations and guidance and the date enacted:

ER 1110-2-240	Water Control Management	8 October 1982
ER 1110-2-241	Use of Storage Allocated for Flood Control and Navigation at Non-Corps Projects	24 May 1990
ER 1110-2-8156	Preparation of Water Control Manuals	31 August 1995
ER 1110-2-1941	Drought Contingency Plans	15 September 1981
EM-1110-2-3600	Management of Water Control Systems	30 November 1987

1-02. Purpose and Scope. This individual project manual primarily describes the flood risk management water control plan for the APC R. L. Harris Dam and Lake Project. In addition, the manual includes descriptions of the plans for navigation support and drought contingency operations. The description of the project's physical components, history of development, water control activities, and coordination with others are provided as supplemental information to enhance the knowledge and understanding of the water control plan. R. L. Harris Dam water control regulations must be coordinated with the multiple projects in the Alabama-Coosa-Tallapoosa (ACT) Basin to ensure consistency with the purposes for which the system was authorized. In conjunction with the ACT Basin Master Water Control Manual, this manual provides a general reference source for R. L. Harris water control regulation, guidance for water management decision making, and training for new personnel.

1-03. Related Manuals and Reports.

Other manuals related to the R. L. Harris Project water control regulation activities include the ACT Master Water Control Manual for the entire basin and nine appendices that compose the complete set of water control manuals for the ACT Basin:

Alabama-Coosa-Tallapoosa River Basin Master Water Control Manual	
Appendix A	Allatoona Dam and Lake Allatoona
Appendix B	Weiss Dam and Lake (Alabama Power Company)
Appendix C	Logan Martin Dam and Lake (Alabama Power Company)
Appendix D	H. Neely Henry Dam and Lake (Alabama Power Company)
Appendix E	Millers Ferry Lock and Dam and William “Bill” Dannelly Lake
Appendix F	Claiborne Lock and Dam and Lake
Appendix G	Robert F. Henry Lock and Dam and R. E. “Bob” Woodruff Lake
Appendix H	Carters Dam and Lake and Carters Reregulation Dam
Appendix I	R. L. Harris Dam and Lake (Alabama Power Company)

Other pertinent information regarding the R. L. Harris Project and other APC Tallapoosa River projects are contained within the Federal Energy Regulatory Commission (FERC) licenses for the Harris, Martin, and Yates/Thurlow Projects. Historical, definite project reports and design memoranda also have useful information.

1-04. Project Owner. The R. L. Harris Dam and Lake Project is owned and operated by the APC under provisions of the licensing through the FERC for Project Number 2628.

1-05. Operating Agency. The R. L. Harris Project is operated for flood control and navigation support in accordance with regulations prescribed by the Secretary of the Army, which are published in the Code of Federal Regulations, Title 33, Chapter II, Part 208, Section 208.65. Day-to-day operation of the facility is assigned to the APC’s Reservoir Management Section in Birmingham, Alabama, which is part of the Transmission Department under the direction of the Reservoir Operations Coordinator. Long-range water planning and flood control operation is assigned to Reservoir Management in Birmingham, Alabama, which is part of Southern Company Hydro Services, under the direction of the Reservoir Management Supervisor. Operation of the project is in accordance with the FERC license and this water control manual.

1-06. Regulating Agencies. Regulating authority is shared between the Corps, the FERC, and the APC. A Memorandum of Understanding (MOU) has been adopted by the APC and the Corps concerning the operation of the project. The purpose of the MOU was to clarify the responsibilities of the Corps and APC with regard to the operation of the project for flood risk management and other purposes and to provide direction for the orderly exchange of hydrologic data. Those modifications agreed upon by both parties are contained in the regulation plan as presented in this manual. The MOU and this manual will be used to provide direction to implement the prescribed flood risk management operations. A copy of the MOU is included in this manual as Exhibit C.

II - DESCRIPTION OF PROJECT

2-01. Location. R. L. Harris Dam is located on the Tallapoosa River at river mile 139.1, near Lineville in Randolph County, Alabama. It is located 77 river miles above Martin Dam. The 29-mile long reservoir extends up both the Tallapoosa and Little Tallapoosa Rivers and is contained within Randolph and Clay Counties, Alabama. The area of the watershed above the project is 1,454 square miles and the maximum depth at the dam is 135 feet. Crooked Creek is located just below the dam. The location of the dam is about midway between Montgomery, Alabama and Atlanta, Georgia and is shown on Plate 2-1. The dam is also shown in Figure 2-1.

Figure 2-1. R. L. Harris Dam

2-02. Purpose. R. L. Harris Dam is a multiple-purpose project which constitutes one unit in the proposed total development of the power potential and other water resources of the Tallapoosa River. The dam was built by the APC principally for the production of hydroelectric power but the dam also provides flood risk management benefits and supports navigational flow requirements downstream as prescribed by the Secretary of the Army, published in the Code of Federal Regulations, Title 33, Chapter II, Part 208, Section 208.65. The R. L. Harris Lake provides a source of potential water supply for domestic, agricultural, and municipal and industrial users subject to FERC license requirements. The lake also creates a large

recreational area providing opportunities for fishing, boating, and other water-based recreational activities.

2-03. Physical Components. The R. L. Harris Development consists of a dam having a concrete gated spillway section with compacted earth abutment dikes; a reservoir having a surface area of 10,660 acres and extends 29 miles upstream at full summer pool elevation of 793 feet NGVD29; a 135,000 kilowatt power plant, which is part of the main dam, located on the west side of the river between the spillway and the left bank earth abutment; a substation; and appurtenant electrical and mechanical facilities. The project is shown under construction in Figure 2-2. The principal features of the project are described in detail in subsequent paragraphs. Sections and plan of the dam, powerhouse and appurtenant works are shown on Plates 2-2 and 2-3.

a. Dam. The dam is a concrete gravity-type structure having a top elevation of 810 feet NGVD29 and a length of 3,242 feet including the dikes. The maximum height above the existing river bed is 151.5 feet. Sections and plan of the dam and appurtenant works are shown on Plate 2-3. The dam is located at river mile 139.1 on the Tallapoosa River approximately midway between Montgomery, Alabama, and Atlanta, Georgia.

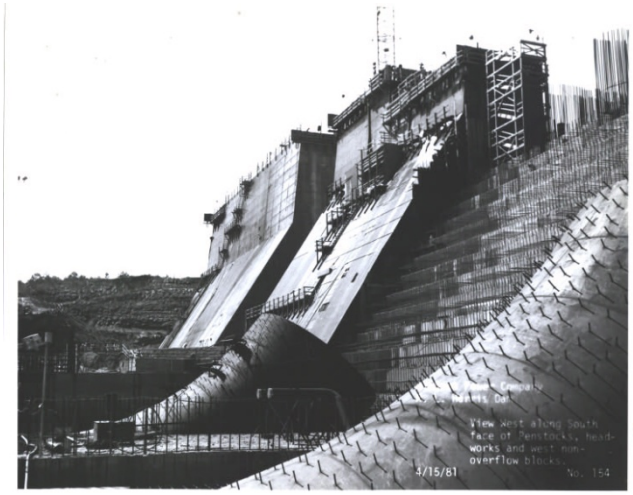


Figure 2-2. R. L. Harris Project Under Construction

b. Reservoir. R. L. Harris Lake extends up the Tallapoosa River a distance of 29 miles with an arm also extending up the Little Tallapoosa River. The maximum summer full pool elevation is 793 feet NGVD29 which provides a total storage of 424,969 acre-feet, covers a surface area of 10,660 acres, and has 272 miles of shoreline. During the flood season (December through March), the lake is normally maintained at elevation 785 feet NGVD29 which provides 100,108 acre-feet of storage for flood risk management operations between elevations 795 and 785 feet NGVD29. At elevation 795 feet NGVD29, the upper limits of the Induced Surcharge Curve, the lake has a total storage of 446,711 acre-feet, and a surface area of 11,120 acres. R. L. Harris Lake provides 206,944 acre-feet of power storage between elevations 768 and 793 feet NGVD29 during summer operation and 128,578 acre-feet between elevations 768 and 785 feet NGVD29 during winter operation. The lake drainage area is 1,454 square miles. Area-capacity curves and associated data points are shown on Plate 2-19.

c. Spillway. The spillway is 310 feet long and contains six tainter gates, each 40.5 feet wide and 40.0 feet high. The spillway crest is at elevation 753.0. A section and downstream elevation are shown on Plate 2-3. The gates are operated by plant personnel and are controlled from the powerhouse. One of the gates is split horizontally so that the upper section can be raised for the periodic passing of trash. The gate opening sequence and schedule are given on Plates 2-6 through 2-17. At elevation 795.0, the upper limits of the Induced Surcharge Curve,

the spillway has a capacity of almost 270,000 cfs. A rating curve of the spillway discharge is shown on Plate 2-18.

In December 2012 into January 2013, APC upgraded the original hydraulically driven pawl and ratchet operating mechanisms and controls on its 6 Harris Dam spillway gates to an electric motor gear driven system with digital controls. This upgrade required a removal of most of the original equipment that is depicted below in Figure 2-3 and Figure 2-4.

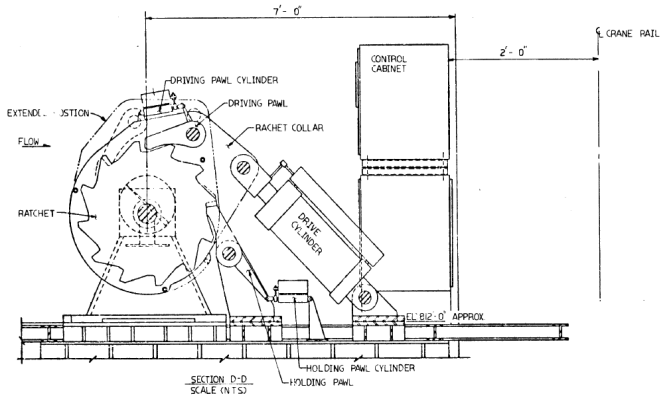


Figure 2-3. Original Spillway Machinery **Figure 2-4. Original Spillway Machinery**

The spillway gate operations defined in this manual were based on single ratchet movements, defined over a series of steps found in Plates 2-6 through 2-17. The ratchet itself, as seen in Figure 2-3, consists of 12 positions, meaning that 12 ratchet movements equates to 1 full 360 degree revolution of the attached torque tube.

During this upgrade, only the ratchet system and controls for the ratchet system were removed. In the upgraded system now installed, electric motors, rather than hydraulics, drive a large gear which drives the same torque tube, which rotates the drum containing the wire cables that move the spillway gates. The torque tubes, drums, and wire cable systems all remain the same. Therefore, one revolution of the torque tube by any operator, whether hydraulic or electric, will result in the same displacement of the radial spill gate, and result in the same discharge as well. Figures 2-5 through 2-10 show the new drive system.

In place of the hydraulically driven pawl and ratchet operating mechanism a series of electric motors, gears, and digital controls that can provide accurate control over the range of the gate opening was installed. The key in this new system is a digital rotational transducer (Figure 2-9) that measures revolutions of the torque tube. Recall that one revolution of the torque tube by any operator will result in the same displacement of the radial spill gate, and result in the same discharge as well.

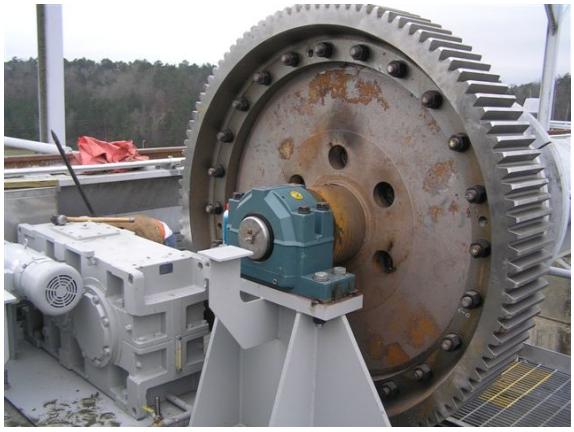


Figure 2-5. New Spillway Machinery

Figure 2-6. New Spillway Machinery

Figure 2-7. New Spillway Machinery

Figure 2-8. New Spillway Machinery

Figure 2-9. New Spillway Machinery

Figure 2-10. New Spillway Machinery

In an effort to keep future operations of the gates consistent with historical operations and the reservoir regulation manual, the digital controls were programmed to mimic the old pawl and ratchet operating mechanism movements. The indicators for gate position (Figure 2-10) were

programmed so that one full revolution of the torque tube, as measured by the rotational transducer would display “12”; two full revolutions of the torque tube, as measured by the rotational transducer would display “24”; three full revolutions of the torque tube, as measured by the rotational transducer would display “36”, etc. This allows the operator to program the gates to move to a particular position.

This is best illustrated by looking at the Gate Opening Schedule in Plates 2-6 through 2-17. For this illustration, assume that hydrologic conditions were calling for step 231. At this step, the human operator would set gate numbers 1, 2, 3, 4, and 5 to position 40 and gate 6 to position 31 (see Plate 2-17). The transition is seamless because of the translation from ratchets to revolutions, i.e., no difference in gate displacement between the two.

d. Powerhouse and Penstocks. The powerhouse is situated on the right bank or west toe of the non-overflow section. The building is approximately 91 feet wide and 225 feet long and houses two 67,500 kW generators operating at a 121 feet net head with a best gate release of approximately 13,000 cfs. The penstocks leading to the turbines are 27 feet in diameter with the invert of the intake at the upstream face of the dam at elevation 710.0 feet NGVD29. The centerline of the distributor is at elevation 659.0 feet NGVD29. A section of the powerhouse is shown on Plate 2-5. Performance curves for the turbines are shown on Plate 7-2.

2-04. Related Control Facilities. Operation of the R. L. Harris powerhouse and spillway gates can be operated either locally or remotely controlled. Operation is closely coordinated with the operation of the other developments in the Tallapoosa River Basin downstream.

2-05. Public Facilities. Many recreational advantages are inherent in an impoundment of this nature including fishing, hunting, boating, swimming, and picnicking and special attention has been given to the encouragement of recreational aspects where they do not conflict with major purposes. Development of project lands for recreational purposes is in accordance with the Land Use Plan approved by the FERC. There are presently seven public boat ramps available with plans for additional ramps as recreational activity increases. Located on the west side of the dam is a public tailrace fishing platform and associated parking and restroom facilities. Public hiking and nature trails are also available on project lands.

III - HISTORY OF PROJECT

3-01. Authorization. Because of abundant streamflow and numerous excellent power sites, the ACT River System has long been recognized as having vast hydroelectric power potential. The system has been studied for the development of hydropower by both private interests and the Federal Government.

The Corps, as an agency of the United States Government, was authorized by the River and Harbor Act, approved 2 March 1945 (59 Stat. 10), to develop a site at Crooked Creek for flood control, hydropower and other purposes. The project was a part of the comprehensive plan for the development of Alabama-Coosa River System as contained in House Document No. 414, 77th Congress, 1st Session. Section 12 of Public Law 89-789 (80 Stat., 1405), approved 7 November 1966, suspended for two years the authority as far as hydropower was concerned, to permit development of the Tallapoosa River by private concerns. The APC filed an application for a preliminary permit with the Federal Power Commission (FPC) on 7 November 1966 to study the Crooked Creek site for development. Subsequently, APC filed an application for a license for the proposed project on 5 November 1968.

3-02. Planning and Design. On 28 December 1973, the FPC issued a license to APC for construction of the Crooked Creek Hydroelectric Project, No. 2628. At the request of APC, the project was renamed R. L. Harris Dam and Lake 15 February 1974.

3-03. Construction. Construction was started on 1 November 1974, and temporarily stopped on 22 December 1978. The construction then resumed on a limited basis on 11 August 1980 and fully resumed on 20 January 1981. The dam and spillway were completed on 27 October 1982. The powerhouse and appurtenance works were completed on 20 April 1983, with Units 1 and 2 available for commercial operation on 20 April 1983. Filling of the reservoir began on 27 October 1982 and the pool reached the minimum power guide curve elevation of 785 feet NGVD29 on 16 December 1982.

3-04. Related Projects. The R. L. Harris Dam and Lake Project is the most upstream of the APC projects on the Tallapoosa River at river mile 139.1. Downstream of the R. L. Harris Dam is the Martin Dam and Powerhouse at river mile 60.6, followed by the Yates Dam and Powerhouse at river mile 52.7, and the Thurlow Dam and Powerhouse at river mile 49.7. The sites are shown on Plate 2-1.

3-05. Modifications to Regulations. The Harris water control manual was revised in October 1993, administratively revised in June 2004, and revised in December 2014.

3-06. Principal Regulation Problems. There have been no significant regulation problems, such as erosion, boils, severe leakage, etc., at the R. L. Harris Project.

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics

a. ACT Basin. The head of the Coosa River is at Rome, Georgia at the confluence of the Etowah and Oostanaula Rivers. It flows west to the Alabama State line, then in a southwesterly then southerly direction for about 286 miles to join the Tallapoosa River near Wetumpka, Alabama. The Tallapoosa River forms in northwest Georgia about 40 miles west of Atlanta, Georgia. It flows in a southwesterly direction for about 195 miles into East Central Alabama and then westerly for about 40 miles to join the Coosa River to form the Alabama River. The Alabama River flows in a southwesterly direction about 310 miles where it joins the Tombigbee River to form the Mobile River. The Mobile River flows southerly about 45 miles where it empties into Mobile Bay at Mobile, Alabama, an estuary of the Gulf of Mexico. The entire ACT Basin with the Tallapoosa River Basin highlighted, and some of the other ACT projects are shown on Plate 2-1. The river mile and size of the drainage area above selected sites in the ACT Basin are shown on Table 4-1.

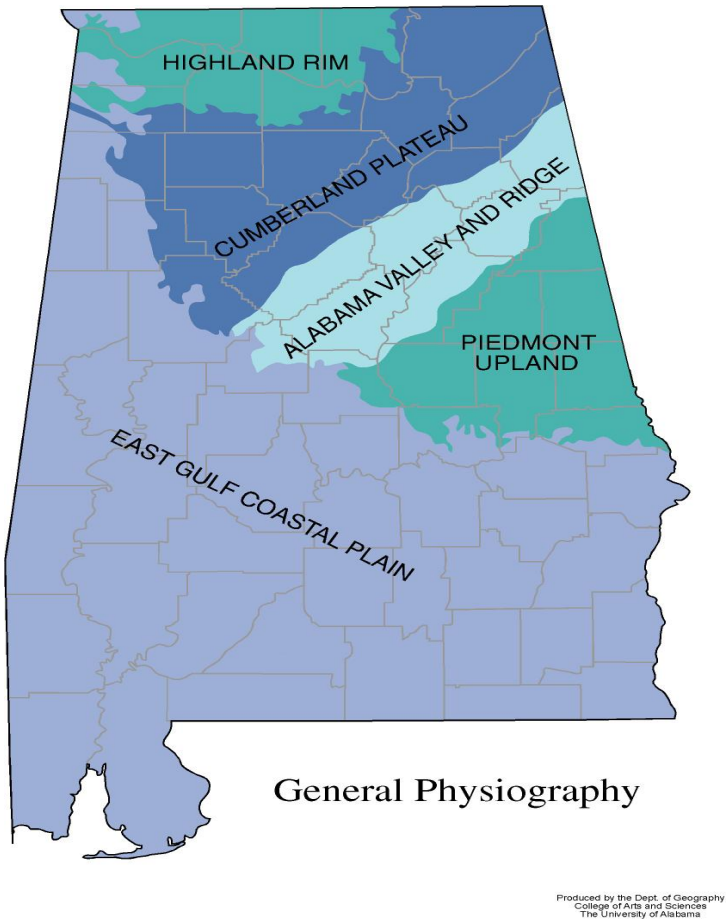
b. Tallapoosa River Basin. The Tallapoosa River Basin drains a total of 4,687 square miles of which 721 square miles are in Georgia and 3,966 square miles are in Alabama. The main river width varies from about 250 to over 700 feet with banks generally about 20 feet above the river bed. The total fall of the river is 1,144 feet in 268 miles, giving an average fall of about 4.3 feet per mile. The principal tributary streams are the Little Tallapoosa River and Sougahatchee, South Sandy, Uphapee, and Hillabee Creeks. The width of the drainage area of the basin ranges from approximately 30 miles to 50 miles.

c. Principal Tributaries and Structures of the Tallapoosa River. The principal tributaries of the Tallapoosa River are the Little Tallapoosa River and Sougahatchee, South Sandy, Crooked, Uphapee and Hillabee Creeks. The APC operates three additional hydropower projects on the Tallapoosa River; Martin, Yates and Thurlow Dams, all of which are located below R. L. Harris Dam.

Table 4-1. River Mile and Drainage Area for Selected Sites in ACT Basin

River Mile and Drainage Area for Important Sites in the ACT Basin				
River Mile above mouth of Mobile River	**River**	**Location**	**Drainage Area (sq mi)**	**Owner**
693	Etowah	Allatoona Dam	1,122	CORPS
645.2	Etowah	Mouth	1,861	
672	Coosawattee	Carters Dam	374	CORPS
645.2	Oostanaula	Mouth	2,150	
638.1	Coosa	Mayos Bar	4,040	
585.1	Coosa	Weiss Dam	5,270	APC
506.2	Coosa	H Neely Henry Dam	6,596	APC
457.4	Coosa	Logan Martin Dam	7,743	APC
410.2	Coosa	Lay Dam	9,053	APC
396.2	Coosa	Mitchell Dam	9,778	APC
378.3	Coosa	Jordan Dam	10,102	APC
497.4	Tallapoosa	R. L. Harris Dam	1,454	APC
420	Tallapoosa	Martin Dam	2,984	APC
412.1	Tallapoosa	Yates Dam	3,293	APC
409.1	Tallapoosa	Thurlow Dam	3,308	APC
281.2	Alabama	Robert F Henry Dam*	16,233	CORPS
178	Alabama	Millers Ferry Dam*	20,637	CORPS
117.5	Alabama	Claiborne Dam*	21,473	CORPS
* Navigation Lock at Project				
CORPS - Corps of Engineers; APC - Alabama Power Company				

4-02. Topography. The R. L. Harris Project is located in the Piedmont Upland physiographic province of the southern Appalachian Mountains (see Figure 4-1). The Piedmont Upland ecoregion is characterized by low, rolling hills in the north and broad rolling uplands in the south. Land surface altitudes range from 500 to 1,000 feet. Like the Blue Ridge, the Piedmont Upland is underlain by impervious metamorphic and igneous crystalline rocks. The regolith, composed of soils and saprolite, can be 10 to 150 feet depending on the differential weathering of the crystalline rocks. Groundwater is stored in the regolith and enters the crystalline rocks at fault zones. The ecoregion has a dissected upland with rounded interstream valleys with typically dendritic streams. The streams in the Piedmont Upland are fast flowing and are characterized by rapids and riffles, making them ideal for hydropower development.



The Piedmont Upland ecoregion is underlain by Precambrian and Paleozoic crystalline rocks, which include mica schist, felsic gneiss and schist, and granite and granite gneiss. Less extensive outcrops of quartzites are also present. The principal aquifers in the Piedmont Upland province are fracture-conduit aquifers in the bedrock, where water-bearing zones occur along geologic features such as lithologic contacts, joints, fractures, faults, folds, and veins.

4-03. Geology and Soils. Piedmont Upland soils are typically shallow and well drained, and water moves rapidly toward streams during precipitation events. The R. L. Harris Project area soils are dominantly Ultisols. This soil order, which covers the majority of the State of Alabama, has developed in forested, humid/high rainfall, subtropical conditions on old landscapes (*e.g.*, not glaciated or recently flooded). These soils are characterized by a surface soil that is often acidic and low in plant nutrients. The surface has a low base status (a measure of fertility) due to high rainfall weathering that has occurred over long time periods and parent materials low in base forming minerals. Although Ultisols are not as fertile as many other soil orders they do support abundant forest growth and respond well to management for agriculture.

4-04. Sediment. Significant sources of sediment within the basin are agricultural land erosion, dredging and mining activities, unpaved roads, sliviculture, and variation in land uses that result in conversion of forests to lawns or pastures. In general, the quantity and size of sediment transported by rivers is influenced by the presence of dams. Impoundments behind dams serve as sediment traps where particles settle in the lake headwaters because of slower flows. Large impoundments typically trap coarser particles plus some of the silt and clay. Often releases from dams scour or erode the streambed downstream. Ultisols dominate the Piedmont Upland

ecoregion. They generally lack the original topsoil because of erosion during intensive cotton farming beginning in the 18th century.

Siltation studies by APC indicate that shoaling over the years is reduced because of increased vegetation in the basin. Siltation is the major source of impairment to meeting State water quality standards on the Tallapoosa River; however, the vast majority of the water bodies on the 2012 303(d) list of impaired waters are not within the Harris Project. Erosion studies indicate that sheet and rill erosion on cropland in Alabama fell by 17 percent from 1982 to 1997.

4-05. Climate. Chief factors that control the climate of the ACT Basin are its geographical position in the southern end of the temperate zone and its proximity to the Gulf of Mexico and South Atlantic Ocean. Another factor is the range in altitude from almost sea level at the southern end to higher than 3,000 feet in the Blue Ridge Mountains to the north. Frontal systems influence conditions throughout the year. During the warmer months, thunderstorms are a major producer of rainfall. Tropical disturbances and hurricanes also affect the region.

a. Temperature. The average annual temperature in the vicinity of the Harris watershed for the time period 1981-2010 is 61.9º F. Table 4-2 provides average, maximum and minimum monthly normal temperature data for six locations in or nearby the Harris watershed. Climatologists define a climatic normal as the arithmetic average of a climate element, such as temperature, over a prescribed 30-year time interval. The National Climatic Data Center (NCDC) uses a homogenous and complete dataset with no changes to the collection site or missing values to determine the 30-year normal values. When developing this 30-year normal dataset, the NCDC has standard methods available to them to make adjustments to the dataset for any inhomogeneities or missing data before computing normal values. Extreme temperatures recorded in the mid-ACT Basin range from 108º to -18º F. Both extremes occurred at Valley Head, Alabama. An interactive map showing the location of these stations and others is shown at:
http://www.sercc.com/climateinfo/historical/historical.html.

Table 4-3 shows the extreme temperatures for four stations within the middle ACT Basin. The maximum and minimum recorded temperatures for each month are shown. These stations are Gadsden, Childersburg, and Valley Head in Alabama, and Calhoun Experiment Station in Georgia.

b. Precipitation. Due to the topographic lift of the Blue Ridge Mountains, the upland slopes are subject to intense local storms and to general storms of heavy rainfall lasting days. Heavy rains may occur at any time during the year, but are most frequent between late fall and mid-spring, when the majority of the large floods in the basin have been recorded. The large flood of March 1990 occurred when a storm front extended from Mobile, Alabama, to Montgomery, Alabama, to Rome, Georgia, and subtropical moisture was continuously drawn along the line producing an extended period of heavy rain. The normal monthly and annual precipitation in and around the Harris watershed is shown on Table 4-4. This is based on the arithmetical mean of the normals at six stations. These stations are the same as the temperature stations. About 40 percent of the normal annual precipitation occurs from January through April, while only about 30 percent occurs during the dry period August through November. The average annual snowfall is three to five inches, usually in January and February, but is of minor importance in producing runoff.

The maximum annual rainfall recorded in the mid-ACT Basin was 80.88 inches at Wadley, Alabama in 1975 while the lowest was 32.72 inches recorded at Carrollton, Georgia in 1954.

The maximum basin average rainfall of 73.22 inches occurred in 1975 while the minimum of 33.96 inches occurred in 1954.

Flood-producing storms can occur over the basin at any time, but they are much more frequent in the winter and early spring. Major storms in the winter are usually of the frontal type. Summer storms consist mainly of convective thundershowers with occasional tropical storms affecting southern sections of the basin.

Table 4-2. Monthly Temperatures for Various Locations in Middle ACT Basin

NORMAL MONTHLY TEMPERATURE (ºF) FOR MIDDLE ACT BASIN (MAX & MIN), 1981-2010														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
WEST POINT, GA	MAX	53.5	57.8	65.7	73.0	80.3	86.7	89.2	88.1	83.0	73.7	65.3	55.9	72.8
USC00099291	MIN	32.1	35.2	41.5	48.0	57.5	65.7	69.7	69.1	62.7	50.9	41.8	34.6	50.8
	AVG	42.8	46.5	53.6	60.5	68.9	76.2	79.4	78.6	72.9	62.3	53.5	45.3	61.8
CARROLLTON, GA	MAX	51.3	56.0	64.0	71.9	79.0	85.3	87.6	86.7	81.0	71.9	63.2	53.5	71.0
USC00091640	MIN	29.4	32.9	38.5	46.5	55.2	63.4	67.3	67.0	59.9	47.9	38.8	32.0	48.3
	AVG	40.4	44.4	51.2	59.2	67.1	74.4	77.4	76.9	70.4	59.9	51.0	42.7	59.7
BANKHEAD LOCK & DAM, AL	MAX	53.2	57.9	66.0	74.1	81.2	88.2	91.0	90.7	85.4	75.4	65.6	55.5	73.8
USC00010505	MIN	32.3	36.2	41.9	48.7	58.3	66.5	70.3	69.7	63.3	51.6	42.6	35.4	51.5
	AVG	42.8	47.0	54.0	61.4	69.8	77.4	80.6	80.2	74.3	63.5	54.1	45.4	62.6
TUSCALOOSA ACFD, AL	MAX	56.3	61.2	69.7	77.2	84.1	90.2	92.7	92.6	87.7	77.7	67.7	58.2	76.3
USC00018380	MIN	34.9	38.4	45.1	51.6	61.0	68.5	72.1	71.6	65.3	53.5	44.1	37.3	53.7
	AVG	45.6	49.8	57.4	64.4	72.5	79.3	82.4	82.1	76.5	65.6	55.9	47.8	65.0
CENTRE, AL	MAX	50.7	55.3	64.7	73.2	80.4	87.1	90.3	89.6	84.1	73.9	63.6	52.7	72.2
USC00011490	MIN	27.9	30.5	37.5	44.9	53.6	62.8	66.8	66.1	59.4	47.1	37.7	30.3	47.1
	AVG	39.3	42.9	51.1	59.1	67.0	75.0	78.6	77.9	71.8	60.5	50.7	41.5	59.7
BESSEMER 3 WSW, AL	MAX	53.6	58.4	66.7	74.6	81.5	88.0	90.9	90.8	85.3	75.1	65.2	55.7	73.9
USC00010764	MIN	32.9	36.1	42.3	49.3	59.1	66.2	70.1	69.3	62.9	51.6	42.2	35.2	51.5
	AVG	43.2	47.2	54.5	61.9	70.3	77.1	80.5	80.1	74.1	63.3	53.7	45.5	62.7
BASIN AVG	MAX	53.1	57.8	66.1	74.0	81.1	87.6	90.3	89.8	84.4	74.6	65.1	55.3	73.3
BASIN AVG	MIN	31.3	34.9	41.1	48.2	57.5	65.5	69.4	68.8	62.3	50.4	41.2	34.1	50.5
BASIN AVG	AVG	42.4	46.3	53.6	61.1	69.3	76.6	79.8	79.3	73.3	62.5	53.2	44.7	61.9

Table 4-3. Extreme Temperatures Within Middle ACT Basin

Extreme Temperatures (ºF) Within Middle ACT Basin											
Month	Station:(013151) GADSDEN			Station:(011620) CHILDERSBURG WATER PLAN			Station:(018469) VALLEY HEAD			Station:(091474) CALHOUN EXPERIMENT STN	
	High	Low		High	Low		High	Low		High	Low
Period	1893 To 1968			1957 To 2009			1893 To 2009			1953 To 1997	
January	80	-4		81	-4		79	-15		76	-10
February	91	-13		85	4		80	-18		80	-7
March	93	6		89	7		90	2		86	4
April	94	24		93	23		92	19		91	22
May	101	34		97	33		100	29		97	33
June	108	44		102	41		104	35		103	40
July	108	50		105	51		106	45		105	50
August	106	49		104	49		105	45		104	47
September	108	34		100	34		104	29		102	32
October	99	25		93	22		98	19		95	20
November	87	4		88	14		90	-2		85	12
December	82	5		83	2		85	-8		77	-2

Table 4-4. Normal Rainfall (inches) Based on 30-Year Period – 1981 Through 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
WEST POINT, GA USC00099291	4.45	4.82	5.36	3.94	3.12	3.96	4.98	3.77	3.36	3.03	4.48	4.81	50.08
CARROLLTON, GA USC00091640	4.65	5.20	5.25	3.92	4.08	3.78	4.88	3.43	3.62	3.55	4.55	4.48	51.39
BANKHEAD LOCK & DAM, AL USC00010505	5.99	5.68	5.69	4.58	4.67	5.07	5.57	4.05	4.01	4.15	5.17	5.21	59.84
TUSCALOOSA ACFD, AL USC00018380	5.37	5.61	4.84	4.32	4.14	4.50	5.10	3.76	3.56	3.80	5.21	4.74	54.95
CENTRE, AL USC00011490	5.21	5.26	5.26	4.27	4.34	4.34	4.74	4.41	3.73	3.39	4.48	4.67	54.10
BESSEMER 3 WSW, AL USC00010764	5.53	5.15	5.61	4.62	5.04	4.51	5.07	3.72	3.85	3.74	5.08	5.20	57.12
BASIN AVG	5.19	5.15	6.10	4.90	4.18	4.16	5.28	3.95	3.63	2.84	4.07	4.93	54.58

Extreme rainfall events for three stations within the middle ACT Basin are shown on Table 4-5. Gadsden and Valley Head, Alabama, and Rome, Georgia, are shown with the monthly maximum and minimum values. Also shown is the one-day maximum rainfall for each location.

Table 4-5. Extreme Rainfall Events (inches), Period of Record

	Station:(013151)				Station:(018469)				Station:(097600)		
	GADSDEN				VALLEY HEAD				ROME		
	Monthly Maximum	Monthly Minimum	1 Day Maximum		Monthly Maximum	Monthly Minimum	1 Day Maximum		Monthly Maximum	Monthly Minimum	1 Day Maximum
Period	1893 To 1968				1893 To 2009				1893 To 2009		
January	13.95	1.40	5.60		12.05	1.70	5.00		12.42	0.85	4.65
February	14.10	0.71	4.86		14.73	0.74	7.39		13.45	0.74	5.30
March	12.87	1.26	6.65		15.87	0.89	4.78		17.98	1.07	6.22
April	11.84	0.06	4.57		11.40	0.58	5.15		13.60	0.30	4.30
May	8.59	0.00	4.69		11.27	0.12	4.19		11.33	0.22	2.99
June	9.09	0.43	2.75		12.47	0.54	3.60		10.85	0.23	3.31
July	17.57	0.69	4.88		12.50	0.66	4.52		14.76	0.87	4.05
August	10.44	0.56	3.12		13.80	0.00	8.05		14.54	0.49	4.92
September	10.30	0.00	3.36		11.02	0.00	8.06		11.33	0.00	4.95
October	13.43	0.00	4.98		9.91	0.00	6.02		10.37	0.00	6.67
November	20.03	0.03	4.60		11.72	0.51	4.72		16.26	0.36	5.58
December	14.13	0.57	8.38		13.67	0.77	4.28		16.47	0.58	5.96

4-06. Storms and Floods. Flood producing storms may occur over the Tallapoosa River Basin at anytime but are more frequent during the winter and spring. Major storms in the winter are usually of the frontal type, which persist for several days and cover large areas. Summer thunderstorms are typically non-frontal convective type events that are normally short and intense, and usually cover small areas. In addition, during the summer and fall, tropical weather systems occasionally pass through the area and can produce major rainfall events over a period of several days. Gage records for the "Tallapoosa River near Heflin" gage (USGS gage 02412000) near Heflin, Alabama, approximately 59 miles upstream of the dam, are available from July 1952 to the present. The USGS gage "Tallapoosa River at Wadley" (02414500), at Wadley, Alabama is approximately 14 miles below the R. L. Harris Dam. Daily flow data at Wadley is available from 1 October 1923 through the present. The gage is used in determination of minimum flow requirements in the Tallapoosa River. Flow hydrographs at Wadley are shown from 1923 to 2012 on Plates 4-1 to 4-9. Mean monthly and average flows at this site are also presented on Plates 4-10 and 4-12. The rating curve at the gage is shown on Plate 4-13. Inflow and discharge records from 1983 to December 2012 at R. L. Harris Dam are shown on Plates 4-14 to 4-17. The tailwater rating curve for Harris Dam is shown on Plate 4-18.

A major storm system in the spring of 1990 produced record floods on the Alabama River. On 16 March 1990, with the river still high from previous rains, the entire basin received very heavy rainfall for two days. The Rock Mills, Alabama gage reported 5.3 inches for the one-day total. A flow of 60,100 cfs was recorded at the USGS Wadley gage. The greatest one-day precipitation at Rock Mills of 7 inches was recorded in February 1961. Plate 4-19 shows the pool elevation, inflow, and discharge for the March 1990 flood.

After a summer with very little rain, heavy rains from Hurricane Opal brought flash flooding to parts of Alabama and the Tallapoosa River Basins. Hurricane Opal made landfall as a marginal Category 3 hurricane near Pensacola, FL on Oct 4, 1995 and moved inland resulting in

rainfall totals from 5 to 10 inches over portions of the Florida panhandle, Alabama and Georgia. Plate 4-20 shows the pool elevation, inflow, and discharge for the October 1995 flood.

In 2003, a storm over the basin produced a one day rainfall total of 6.3 inches at the Rock Mills gage. The corresponding flow at Wadley was recorded at 103,000 cfs (37.30 feet stage at gage). The largest flood recorded at the dam since construction is the flood of 2003. Plate 4-21 shows the pool elevation, inflow, and discharge for the May 2003 flood.

4-07. Runoff Characteristics. In the ACT Basin, rainfall occurs throughout the year but is less abundant from August through November. Only a portion of rainfall actually runs into local streams to form the major rivers. Factors that determine the percent of rainfall entering streams include the intensity of the rain, antecedent conditions, ground cover and time of year (plants growing or dormant). Intense storms will have high runoff potential regardless of other conditions while a slow rain can produce little measurable runoff. The annual runoff in the vicinity of the dam is about 21 inches or about 38 percent of the annual rainfall. Runoff is usually high during the winter and spring and relatively low during the summer and early fall. Ice and snow are somewhat common but have little effect on runoff.

4-08. Water Quality. Alabama Department of Environmental Management (ADEM) has designated various portions of R. L. Harris Lake with 'use classifications' of *swimming and other whole body water-contact sports*, and *fish and wildlife*. The lake meets all designated water use criteria established by the state of Alabama. Various portions of the Tallapoosa River above the lake have designated 'use classifications' of *outstanding Alabama waters*, *public water supply*, and *fish and wildlife*. Georgia sections of the Tallapoosa River and Little Tallapoosa River have been designated 'use classifications' of *drinking water* and *secondary trout waters* by the Georgia Environmental Protection Division. Tallapoosa River below R. L. Harris Dam has been designated 'use classification' of *fish and wildlife*, in accordance with Alabama Water Quality Control laws. Both Alabama and Georgia have promulgated water quality criteria with specific criteria related to the use classifications.

Total maximum daily loads (TMDLs) have been identified for various portions of the Tallapoosa and Little Tallapoosa Rivers. In the Alabama portion of the rivers, TMDLs for pathogens and siltation have been proposed. In Georgia, TMDLs have been finalized for fecal coliforms, and sedimentation for sections of the Tallapoosa and Little Tallapoosa Rivers. Several of the most important water quality parameters are discussed below.

a. Dissolved Oxygen: Alabama's water quality criteria regulations (ADEM Admin. Code R. 335-6-10-.09) states the following for segments designated with use classifications of Swimming, Fish and Wildlife and Public Water Supply:

> *For a diversified warm water biota, including game fish, daily dissolved oxygen concentrations shall not be less than 5.0 milligrams per liter (mg/l) at all times; except under extreme conditions due to natural causes, it may range between 5.0 mg/l and 4 mg/l, provided that the water quality is favorable in all other parameters. The normal seasonal and daily fluctuations shall be maintained above these levels. In no event shall the dissolved oxygen level be less than 4 mg/l due to discharges from existing hydroelectric generation impoundments. All new hydroelectric generation impoundments, including addition of new hydroelectric generation units to existing impoundments, shall be designed so that the discharge will contain at least 5.0 mg/l dissolved oxygen where practicable and technologically possible. The Environmental Protection Agency, in cooperation with the State of Alabama and parties responsible for impoundments, shall develop a program to improve the design of existing facilities.*

> *The dissolved oxygen criterion is established at a depth of 5 feet in water 10 feet or greater in depth; for those waters less than 10 feet in depth, the dissolved oxygen criterion is applied at mid-depth. Levels of organic materials may not deplete the daily dissolved oxygen concentration below this level, nor may nutrient loads result in algal growth and decay that violates the dissolved oxygen criterion.*

For segments classified as *outstanding Alabama water*, the dissolved oxygen standard is at least 5.5 mg/l at all times with no less than 4 mg/l under extreme conditions from natural causes.

The Georgia dissolved oxygen standard for waters classified as *drinking water* is a daily average greater or equal to 5 mg/l and no less than 4 mg/l at all times. For waters classified as *secondary trout waters*, the dissolved oxygen standard is a daily average greater or equal to 6 mg/l and no less than 5 mg/l at all times.

In-lake water quality data collected by Alabama Department of Environmental Management (ADEM) and the Lake Wedowee Property Owners Association (Lake Wedowee is a local name for R. L. Harris Lake) indicate near saturated levels of dissolved oxygen in the epilimnion (upper portion of the water column) and reduced or near anoxic dissolved oxygen levels in the hypolimnion (lower portion of the water column) in the summertime. This is due to thermal stratification which occurs in relatively deep, lakes in the southeast during the summertime and is described further in paragraph 4.08.c. below. In the wintertime, the lake is completely mixed vertically (destratified) and high levels of dissolved oxygen occur throughout the water column.

b. Nutrients: R. L. Harris Lake is currently classified as mesotrophic, which indicates an intermediate level of productivity, greater than oligotrophic lakes, but less than eutrophic lakes. A mesotrophic lake is commonly clear with beds of submerged aquatic plants and medium levels of nutrients. R. L. Harris Lake was classified as eutrophic in the mid 1990's and early 2000's, but since 2005, nutrients and chlorophyll *a* levels have dropped to mesotrophic levels.

In 2001, ADEM established a lake nutrient standard (measured by concentration levels of chlorophyll *a,* a surrogate measure of algal biomass) for R. L. Harris Lake during the growing season (April – October) of an average of less than 10 micrograms per liter (µg/l) of chlorophyll *a* or an average of less than 12 *ug/l* if measured immediately upstream of the Tallapoosa River, Little Tallapoosa River confluence.

c. Lake Stratification. During the colder winter months, the water in R. L. Harris Lake is generally cold, relatively clear, and the same temperature from the top to the bottom. Water on the top and bottom of the reservoir has similar densities. Wind action keeps the lake well mixed, resulting in adequate dissolved oxygen levels throughout the water column. During winter-time, water temperature and oxygen concentrations do not limit fish movement in the lake. Lake water, which is released through the hydropower units from near the bottom of the lake into the Tallapoosa River below the dam, is cold, oxygenated, and relatively clear.

During spring and early summer, the lake warms and stratifies into three distinct layers: a surface layer called the epilimnion, a bottom layer called the hypolimnion, and a transition layer between the two called the metalimnion, or the thermocline. Figure 4-2 shows the summer stratification layers.

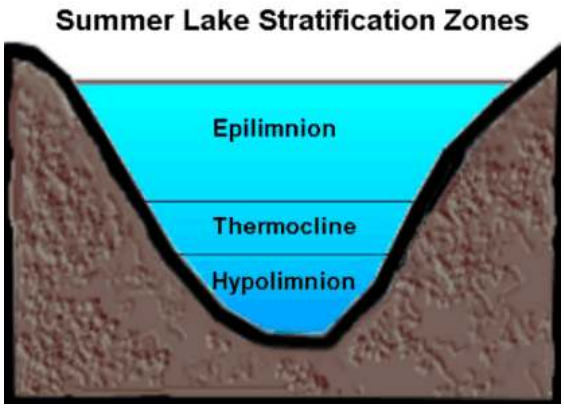


Figure 4-2. Lake Stratification

The warm, upper layer is fairly uniform in temperature and varies from 15 to 30 feet thick throughout the summer. It is well oxygenated from wind action and photosynthesis.

The hypolimnion, the cold (45 to 55 °F) bottom layer, becomes isolated and no longer mixes with the warm, oxygenated epilimnion. Oxygen is not produced in the hypolimnion because the cold, deep layer does not receive sunlight and is devoid of phytoplankton production. Early in the lake stratification process, the hypolimnion still contains some oxygen but declines through the summer as biological and chemical processes consume oxygen. By summer's end, the lake is strongly stratified. The epilimnion is warm and well oxygenated. Water temperature and oxygen concentrations in the thermocline are both lower but still often provide acceptable habitat for cool-water fish species. In the hypolimnion, the water is cold and low in oxygen (less than 3 mg/l). As oxygen levels fall, some metals and sulfides in the lake sediments become soluble. They dissolve in the water and can be released downstream, entering the river. The river water becomes re-aerated rapidly as it flows downstream, thus releasing the metals and sulfides that have become soluble.

In the fall, the lake begins to lose heat, and the process of destratification begins. The warm water of the epilimnion cools and becomes deeper and denser. As the epilimnion's density approaches the density of the hypolimnion, mixing of the layers occurs and the stratification is broken. This event is called *lake turnover*, and generally occurs around November - December each year. After mixing, no layers exist, and the entire lake has a relatively uniform temperature and oxygen levels.

d. Downstream Water Quality Conditions. Water quality conditions in the releases from R. L. Harris Dam are typical for hydropower projects in the southeast; i.e., cold water year-round with low dissolved oxygen levels during summer-time lake stratification periods and high dissolved oxygen levels during winter-time lake destratification periods. Turbidity is relatively low year-round. The potential for sediment release of solubilized metals occurs during lake stratification periods when the hypolimnion reaches anoxic conditions. The water use classification established by the State of Alabama for the Tallapoosa River below R. L. Harris Dam is *fish and wildlife*, with corresponding water quality standards as described in Paragraph 4-08.a.

4-09. Channel and Floodway Characteristics. There are no major damage centers between R. L .Harris and Martin Dam downstream. However, information on the historical high and low stages at the Wadley Gage (USGS #02414500), 15 miles downstream of Harris Dam, is shown in Table 4-6. Table 4-7 provides details for river stages and flood damages at Wadley, Alabama. Flooding during a potential dam failure is addressed in Chapter 9.

Table 4-6
Historical Crests for Tallapoosa River at Wadley, AL, USGS #02414500
(1) 37.30 ft on 05/08/2003 (2) 30.57 ft on 04/14/1979 (3) 27.90 ft on 02/05/1936 (4) 27.90 ft on 03/16/1976 (5) 26.72 ft on 03/17/1990 (6) 25.83 ft on 05/01/1963 (7) 25.62 ft on 03/30/1977 (8) 25.35 ft on 02/25/1961 (9) 24.30 ft on 01/07/1946 (10) 24.00 ft on 03/20/1970
Low Water Records
(1) 2.00 ft on 10/02/1954

Table 4-7. Flood Impacts at Wadley, Alabama (15 miles downstream of Harris Dam, USGS# 02414500)	
Stages (feet)	**Impacts**
35	The east end of the Highway 22 bridge begins to flood. Water reaches the store/gas station on Highway 22 just west of town.
30	Major Flood Stage is reached and some flooding of businesses occur in the Wadley area, including Plantation Patterns.
20	Moderate Flood Stage is reached and some flooding occurs in lower lying areas around Wadley. Between 22 and 25 feet, the bridge over Beaverdam Creek floods..
13	Flood Stage is reached with flooding of pasture lands in the area.

4-10. Upstream Structures. There are no federal or APC projects located on the Tallapoosa River above the R. L. Harris Dam and Lake Project.

4-11. Downstream Structures. The APC projects downstream of the R. L. Harris Project include Martin, Yates, and Thurlow Dams. Below those, on the Alabama River, are three federal projects, Robert F. Henry, Millers Ferry, and Claiborne Locks and Dams. Locations of these projects are shown on Plate 2-1.

The existing upstream and downstream Federal and APC projects and the drainage areas above them are shown on Table 4-8 below.

Table 4-8. Federal and APC Projects on the ACT

Agency	Alabama River Projects	Drainage Area (sq mi)
CORPS	Claiborne	21,473
CORPS	Millers Ferry	20,637
CORPS	R.F. Henry	16,233
	Coosa River Projects	
APC	Jordan/Bouldin*	10,102
APC	Mitchell	9,778
APC	Lay	9,053
APC	Logan Martin	7,743
APC	Henry	6,596
APC	Weiss	5,270
CORPS	Allatoona	1,122
CORPS	Carters	374
	Tallapoosa Projects	
APC	Thurlow	3,308
APC	Yates	3,293
APC	Martin	2,984
APC	Harris	1,454

* Jordan and Bouldin Dams share the same drainage area and reservoir

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological Stations. Management of water resources requires continuous, real-time knowledge of hydrologic conditions. Both the APC and the Corps collect and maintain records of hydrologic data and other information in connection with the operation of projects in the Coosa River Basin. Since the data collected by the APC are needed by the Corps in carrying out its responsibility of monitoring the flood control operations of the H. Neely Henry Project, and the data collected by the Corps supplements that being collected by the APC and is of value to them in planning their project operations, it is important that each agency furnish the other with such of its hydrologic and operating data as may be needed or found beneficial in its operation. This requires that communications facilities be available between the Mobile District Office of the Corps of Engineers and Reservoir Management. The USGS and National Weather Service (NWS), in cooperation with the APC, the Corps, and other federal and state agencies, maintain a network of real-time gaging stations throughout the ACT Basin..

a. Facilities APC's Hydrologic Data Acquisition System (HDAS) is a combination of over 100 rain, stage, and evaporation gages located in the river basins where APC dams and reservoirs are located. The largest majority of these gages are owned and operated by APC. APC also utilizes data from relevant USGS gages. The rainfall gages and river gages are equipped with data collecting platforms that store data on site and transmit to orbiting satellites. The stations continuously collect various types of data including stage, flow, and precipitation. All the rainfall, reservoir, and river stage reporting gages regularly used by the Corps and APC in the ACT Basin, including the Tallapoosa River Basin above R. L. Harris Dam, are shown on Plate 5-1. Figure 5-1 shows a typical encoder with wheel tape housed in a stilling well used for measuring river stage or lake elevation. Figure 5-2 shows a typical precipitation station, with rain gage, solar panel, and Geostationary Operational Environmental Satellite (GOES) antenna for transmission of data.

Figure 5-1. Encoder with Wheel Tape for Measuring the River Stage or Lake Elevation in the Stilling Well

Figure 5-2. Typical Field Installation of a Precipitation Gage

All rainfall gages equipped as data collecting platforms are capable of being part of the reporting network. Data are available from many stations in and adjacent to the ACT Basin. For operation of the R. L. Harris Project, APC operates the HDAS that delivers real time rainfall and river stage data through SouthernLINC packet data radios and dedicated network

connections. The rainfall stations APC uses to operate the facility are listed in Table 5-1. The sites in the vicinity of R. L. Harris are shown on Plate 5-1, along with other gage locations.

Table 5-1. Rainfall Reporting Network for the Tallapoosa River Basin Above R. L. Harris Dam

Rainfall Reporting Network	
River Basin	**Station**
Little Tallapoosa	Villa Rica, GA
Little Tallapoosa	Carrollton, GA
Tallapoosa	Bremen, GA
Tallapoosa	Heflin, AL
Little Tallapoosa	Newell, AL
Tallapoosa	Harris Dam, AL

All river stage gages equipped as data collecting platforms are also capable of being part of the reporting network. Data are available from many stations in and adjacent to the ACT Basin. The river stage reporting network gages used for operation of the R. L. Harris Dam are shown in the Table 5-2 below. The locations of river stage stations are shown on Plate 5-1.

Table 5-2. River Stage Reporting Network for R. L. Harris Dam

River Reporting Network			
River	**Station**	**River Miles above Mouth**	**Drainage Area (sq miles)**
Tallapoosa	Tallapoosa River near Heflin, AL; USGS # 02412000	186.8	448
Little Tallapoosa	Little Tallapoosa River near Newell, AL; USGS # 02413300		406

Data are collected at sites throughout the ACT Basin through a variety of sources and integrated into one verified and validated central database. The basis for automated data collection at a gage location is the Data Collection Platform. The Data Collection Platform is a computer microprocessor at the gage site. A Data Collection Platform has the capability to interrogate sensors at regular intervals to obtain real-time information (e.g., river stage, reservoir elevation, water and air temperature, precipitation). The Data Collection Platform then saves the information, performs simple analysis of it, and then transmits the information to a fixed geostationary satellite. Data Collection Platforms transmit real-time data at regular intervals to the GOES System operated by the National Oceanic and Atmospheric Administration (NOAA). The GOES Satellite's Data Collection System sends the data directly down to the NOAA Satellite and Information Service in Wallops Island, Virginia. The data are then rebroadcast over a domestic communications satellite (DOMSAT). The Mobile District Water Management Section operates and maintains a Local Readout Ground System (LRGS) that collects the Data Collection Platform-transmitted, real-time data from the DOMSAT. Figure 5-3 depicts a typical schematic of how the system operates.

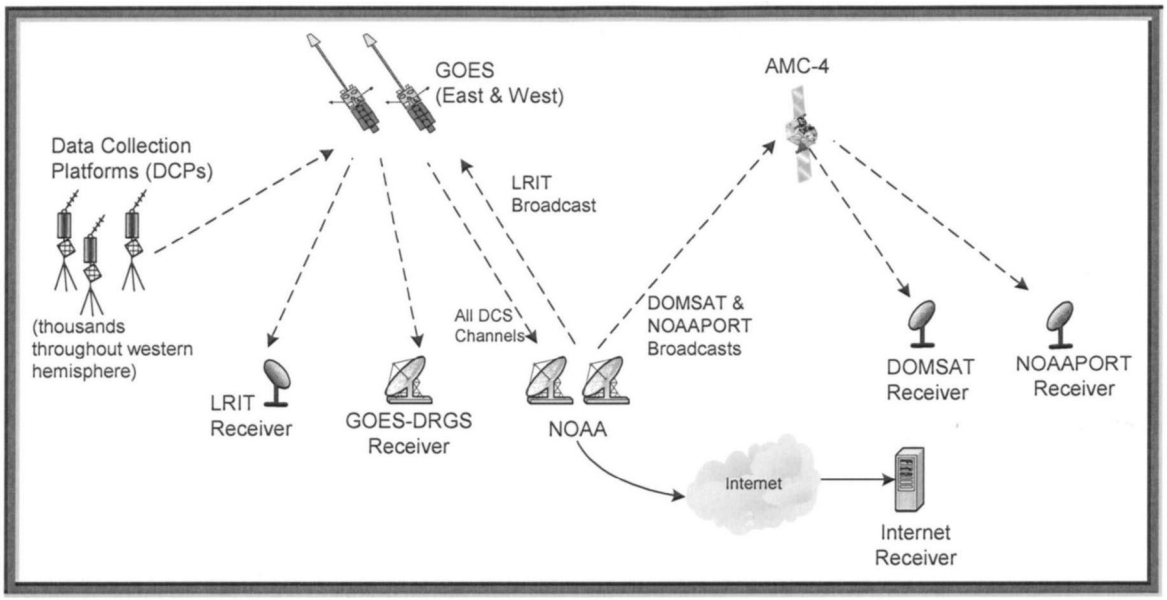


Figure 5-3. Typical configuration of the GOES System

b. Reporting. Central to APC hydro operations, monitoring, and reporting network is the Hydro Optimization Management System (HOMS). HOMS is a complex and dynamic system of data collection, analysis, and management tools, and includes an arrangement of hydrologic and flow monitoring systems and tools as well. HOMS exists for the purpose of real time monitoring, and as a decision tool and support for computer applications related to the operation of Alabama Power's 14 hydroelectric facilities located within the Coosa, Tallapoosa and Black Warrior River Basins.

The Corps operates and maintains a Water Control Data System (WCDS) for the Mobile District that integrates large volumes of hydrometeorological and project data so the basin can be regulated to meet the operational objectives of the system. The WCDS, in combination with the new Corps Water Management System (CWMS), together automate and integrate data acquisition, data management, and data dissemination.

c. Maintenance. Maintenance of data reporting equipment in the Tallapoosa River Basin near R. L. Harris Dam is a cooperative effort among the USGS, NWS, Corps, and APC.

If gages appear to be out of service, the following agencies can be contacted for repair:

USGS Georgia Water Science Center, 3039 Amwiler Road, Suite 130, Atlanta, GA 30022-5803
Phone: (770) 903-9100 Web: http://ga.water.usgs.gov

USGS Alabama Water Science Center, 75 Technacenter Drive, Montgomery, AL 36117
Phone: (334) 395-4120 Web: http://al.water.usgs.gov

NWS Southern Region, 819 Taylor Street, Room 10E09, Fort Worth, TX 76102
Phone: (817) 978-1100 Web: http://www.srh.noaa.gov/

U.S. Army Corps of Engineers, Mobile District, 109 Saint Joseph Street, Mobile, AL 36602-3630
Phone: (251) 690-2730 Web: http://www.sam.usace.army.mil/water/

5-02. Water Quality Stations. Water quality measurements are made at 14 USGS gaging stations within the Alabama River Basin. The data for these stations can be obtained from the USGS yearly publication, *Water Resources Data Alabama* and *Water Resources Data Georgia.*

5-03. Recording Hydrologic Data. At Harris Dam, the plant control system is equipped with one or more programmable logic controllers (PLC). The PLC receives data from various inputs from the dam then a server located at the Alabama Power's corporate headquarters polls the plant PLC for data. Additional data essential to HOMS is collected through HDAS, a combination of over 100 rain, stage, and evaporation gages located in the river basins where Alabama Power dams and reservoirs are located. The largest majority of these gages are owned and operated by Alabama Power. Where physically practical, Alabama Power pulls data from adjacent USGS rain and stage gages to enhance the viability of the overall HDAS. All data collected in the field is transmitted either via Alabama Power's dedicated network connections, where available, or the SouthernLINC Wireless radio network. Data is stored on servers located at the Alabama Power Corporate Headquarters.

Data collected from the various sources are then rendered into web and desktop applications to monitor operations and activities at the Alabama Power hydro facilities. These applications are provided to the Power System Coordinator (PSC) at the Alabama Control Center Hydro Desk (ACC or Hydro Desk) to monitor the operations and activities at hydropower facilities 24 hours per day, seven days per week.

Most reservoir data are transmitted in hourly increments for inclusion in daily log sheets that are retained indefinitely. Gage data are transmitted in increments of 15 minutes, one hour, or other intervals. Reservoir data are examined and recorded in water control models every morning (or other times when needed). The data are automatically transferred to forecast models.

Automated timed processes also provide provisional real-time data needed for support of real-time operational decisions. Interagency data exchange has been implemented with the USGS and NWS Southeast River Forecast Center (SERFC). A direct link to SERFC is maintained to provide real-time products generated by NWS offices. Information includes weather and flood forecasts and warnings, tropical storm information, NEXRAD radar rainfall, graphical weather maps and more. Likewise, a direct link to USGS gages in the field allows for direct downloading of USGS data to Corps databases.

5-04. Communications

a. Regulating Office With Project Office. Direct communication between the APC and R. L. Harris Dam is provided by the company's SouthernLINC network telephone and email. The power plant at R. L. Harris Dam is operated by remote control from the Reservoir Management Section located in Birmingham, Alabama. Personnel are available but not always on duty at the dam.

b. Between Project Office and Others. The Water Management Section communicates daily with the NWS and APC's Reservoir Management section to exchange data and forecasting information. Data exchange is normally accomplished by electronic transmission to the Mobile District server and is supplemented by telephone and facsimile when necessary. The Water Management Section also has a computer link with the NWS's AWIPS (Advanced Weather Interactive Processing System) communication system via the River Forecast Center in Atlanta, Georgia. The Water Management Section uses a telephone auto-answer recorded message to provide daily information to the public. Water resources information for the R. L.

Harris Project is available to the public at the Corps' website, http://www.sam.usace.army.mil/water/. The site contains real-time information, historical data and general information. Information for the R. L. Harris Lake is also provided by the APC at https://lakes.alabamapower.com.

Emergency communication for the Corps and APC personnel during non-duty hours is available at the numbers found on the emergency contact information list located in Exhibit E.

The United States Geological Survey operates numerous stage and rain gages in the Tallapoosa River basin near Harris Dam which are funded by both the Corps and APC. These measurements are reported through the GOES system and are available to both APC and the Corps on the USGS web site.

5-05. Project Reporting Instructions. Communications for exchange of data between the Corps Water Management Section and APC's Reservoir Management and ACC Hydro Desk will normally be accomplished by electronic transmission to the Corps' WCDS server. The APC provides the Corps with hourly and daily reservoir data for all of their ACT projects. This includes reservoir pool and tailwater elevations, inflows, discharges and precipitation. APC also provides 7-day discharge forecasts for each project. The hourly data is transmitted and stored in the Corps database once every hour, 24 hours a day. Daily data, including the 7-day forecast for each project, is provided once a day around 0800 hours, and includes both midnight and 0600 hours data for the APC projects.

In addition to automated data, project operators maintain record logs of gate position, water elevation, and other relevant hydrological information including inflow and discharge. This information is stored by the APC and the Corps Water Management Section. Unforeseen or emergency conditions at the project that require unscheduled manipulations of the reservoir should be reported to the Corps Water Management Section as soon as possible.

If the automatic data collection and transfer are not working, operators will, upon request, fax or email daily or hourly project data to the Water Management Section for manual input into the database.

5-06. Warnings. During floods, dangerous flow conditions, or other emergencies, the proper authorities and the public must be informed. In general, flood warnings are coupled with river forecasting. The NWS has the legal responsibility for issuing flood forecast to the public, and will have the lead role for disseminating the information. For emergencies involving the R. L. Harris Project, the Reservoir Management Section will begin notifications of local law enforcement, government officials, and emergency management agencies in accordance with APC's Emergency Action Plan for Harris Dam.

5-07. Role of Regulating Office. Regulating authority for the R. L. Harris Project is shared between APC, FERC, and the Corps in accordance with the MOU that was adopted by APC and the Corps prior to the completion of the project. The purpose of the MOU is to clarify the responsibilities of the two agencies with regard to the operation of the project for flood risk management and navigation support and to provide direction for the orderly exchange of hydrologic data. The Water Management Section of the Mobile District Office is responsible for developing operating procedures for flood conditions and to prepare water control manuals, such as this one, that describe water management regulation for flood risk management and navigation support at the project. These water control manuals are regularly reviewed and updated as needed.

VI - HYDROLOGIC FORECASTS

6-01. General. Obtaining forecasts for the operation of the R. L. Harris Dam is the responsibility of the APC. The APC, the NWS, and the Corps exchange data daily to provide quality forecasts on inflows, headwater elevations, tailwater elevations and river stages.

a. Role of the Corps. The Corps Water Management Section obtains flow estimates for the APC projects on a daily basis. Sub-daily updates are obtained as necessary. The Water Management Section considers these inflows, local flows, current pool levels, and discharge requirements in scheduling releases from downstream federal projects on the Alabama River. The Water Management Section maintains records of precipitation, river stages, reservoir elevations and general stream-flow conditions throughout the Mobile District, with special emphasis on the areas affecting or affected by reservoir operation. The Water Management Section performs the following duties in connection with the operation of the R. L. Harris Project:

(1) Maintains liaison with personnel of APC Reservoir Management for the daily exchange of hydrologic data.

(2) Maintains records of rainfall and river stages for the Coosa River Basin, and records of pool level and outflow at R. L. Harris Dam and other impoundments in the basin.

(3) Monitors operation of the power plant and spillway at R. L. Harris Dam for compliance with the regulation schedule for flood control operation.

(4) Transmits to APC Reservoir Management any instructions for special operations which may be required due to unusual flood conditions. (Except in emergencies where time does not permit, these instructions will first be cleared with the Chief of Engineering Division.)

(5) Evaluates special water control plan variance requests submitted by APC Reservoir Management and provides approval or disapproval.

The Water Management Section maintains close liaison with the NWS's River Forecast Center in Peachtree City, Georgia, and their Birmingham, Alabama, offices at all times to receive forecast and other data as needed. A mutual exchange of information increases the forecasting capability of the NWS at NWS river stations which may be affected by operations at Corps projects.

b. Role of Alabama Power Company. The flood control regulation schedule that has been adopted is based on current reservoir level and inflows or forecasts of inflow. The APC has developed a computer model of the river system that utilizes rainfall and river gage stations located strategically throughout the basin. The APC is continually evaluating the results, and as experience is gained, improvements will be incorporated into the model.

c. Role of Other Agencies. The NWS is responsible for preparing and publicly disseminating forecasts relating to precipitation, temperatures, and other meteorological elements related to weather and weather-related forecasting in the ACT Basin. For the Tallapoosa River Basin, forecasts are prepared by the SERFC located in Peachtree City, Georgia, and are issued through their office in Birmingham, Alabama. The Water Management Section uses the NWS as a key source of information for weather forecasts. The meteorological forecasting provided by the NWS is considered critical to the Corps' water resources management mission. The 24- and 48-hour Quantitative Precipitation Forecasts (QPFs) are invaluable in providing guidance for basin release determinations. Using

precipitation forecasts and subsequent runoff directly relates to project release decisions during normal operations.

(1) The NWS is the federal agency responsible for preparing and issuing streamflow and river-stage forecasts for public dissemination. The SERFC routinely prepares and distributes five-day streamflow and river-stage forecasts at key gaging stations along the Alabama, Coosa, and Tallapoosa Rivers. Streamflow forecasts are available at additional forecast points during periods above normal rainfall. In addition, SERFC provides a revised regional QPF on the basis of local expertise beyond the NWS Hydrologic Prediction Center QPF. SERFC also provides the Water Management Section with flow forecasts for selected locations on request.

(2) The Corps and SERFC have a cyclical procedure for providing forecast data between federal agencies. As soon as reservoir release decisions have been planned and scheduled for the proceeding days, the release decision data are sent to SERFC. Taking release decision data, coupled with local inflow forecasts at forecast points along the ACT, SERFC can provide inflow forecasts into Corps and APC projects. Having revised inflow forecasts from SERFC, the Corps and APC have up-to-date forecast data to make the following days' release decisions.

6-02. Flood Condition Forecasts. During flood conditions, quantifiable flow forecasts are prepared based on rainfall that has already fallen. Operational decisions are made on the basis of actual streamflow and/or stage data unless following Section 7-05, Alternative Flood Control Operation. Streamflow and/or stage forecasts resulting from rainfall that has already occurred are considered in the planning process of potential future operations including any variances that may need to be obtained. APC prepares flow and stage forecasts on an as needed basis for internal use and decision support, where applicable. The NWS SERFC produces official forecasts that are made publically available on their website.

a. Requirements. Accurate flood forecasting requires a knowledge of antecedent conditions, rainfall and runoff that has occurred, and tables or unit hydrographs to apply the runoff to existing flow conditions. Predictive QPF data are needed for what if scenario.

b. Methods. The Corps provides a link to the NWS website so that the Water Management Section, the affected county emergency management officials, and the public can obtain this vital information in a timely fashion. When hydrologic conditions exist so that all or portions of the ACT Basin are considered to be flooding, existing Corps streamflow and short and long-range forecasting runoff models are run on a more frequent, as-needed basis. Experience demonstrates that the sooner a significant flood event can be recognized and the appropriate release of flows scheduled, an improvement in overall flood control can be achieved. Stored storm water that has accumulated from significant rainfall events must be evacuated following the event and as downstream conditions permit to provide effective flood risk management. Flood risk management carries the highest priority during significant runoff events that pose a threat to human health and safety. The accumulation and evacuation of storage for the authorized purpose of flood risk management is accomplished in a manner that will prevent, insofar as possible, flows exceeding those which will cause flood damage downstream. During periods of significant basin flooding, the frequency of contacts between the Water Management Section and SERFC staff are increased to allow a complete interchange of available data upon which the most reliable forecasts and subsequent project regulation can be based. Table 6-1 provides SERFC forecast locations in the Alabama River Basin.

Table 6-1. SERFC Forecast Locations for the Alabama River Basin

Daily Stage/Elevation Forecasts				
	Station	**Station ID**	**Critical Stage**	**Flood Stage**
	Montgomery	MGMA1	26	35
	R. F. Henry TW	TYLA1		122
	Millers Ferry TW	MRFA1		66
	Claiborne TW	CLBA1	35	42
Daily 24-hour Inflow in 1000 SFD Forecast				
Reservoir		**Station ID**		
R. F. Henry		TYLA1		
Millers Ferry		MRFA1		
Additional Stage Forecasts Only for Significant Rises				
River/Creek	**Station**	**Station ID**	**Critical Stage**	**Flood Stage**
Coosa	Weiss Dam	CREA1		564
Coosa	Gadsden	GAPA1		511
Coosa	Logan Martin Dam	CCSA1		465
Coosa	Childersburg	CHLA1		402
Coosa	Wetumpka	WETA1	40	45
Tallapoosa	Wadley	WDLA1	30	13
Tallapoosa	Milstead	MILA1	15	40
Tallapoosa	Tallapoosa Wt Pit	MGYA1	15	25
Catoma Creek	Montgomery	CATA1	16	20
Alabama	Selma	SELA1	30	45
Cahaba	Cahaba Hts	CHGA1		14
Cahaba	Centreville	CKLA1	20	23
Cahaba	Suttle	SUTA1	28	32
Cahaba	Marion Junction	MNJA1	15	36

VII - WATER CONTROL PLAN

7-01. General Objectives. The R. L. Harris Project will normally operate to produce peaking hydropower. During periods of low streamflow, hydropower generation will also augment the flow of the river downstream. The power guide curve, which defines the upper limit of the power pool, varies seasonally. The maximum storage for flood risk management operation is about 100,000 acre-feet. Hydropower generation releases will be made for operations, and in accordance to the prescribed operating plans for flood risk management, to keep the reservoir elevation at or below the seasonal elevation specified by the power guide curve. Reservoir regulation during major storms may require special consideration and the operation may deviate from these schedules with the approval of the Corps.

7-02. Constraints. APC releases water from the R. L. Harris Project in conjunction with other reservoirs to provide a weekly volume of flow to the Alabama River for navigation.

7-03. Overall Plan for Water Control

a. General Regulation. The water control operations of R. L. Harris Dam are in accordance with the regulation schedule as outlined in the following paragraphs. Any deviation from the prescribed instructions during flood operations will be at the direction of the Water Management Section Mobile District, Corps of Engineers. Deviations during normal operations will be coordinated with the APC Reservoir Management Section. Mobile Water Management Section will notify SAD regarding all deviations.

b. Basin Above R. L. Harris Project. There are no federal or APC projects located above the R. L. Harris Dam and Lake Project. The annual runoff from the 1,454 square-mile drainage area above the dam of about 21 inches or about 38 percent of the annual rainfall is controlled by the R. L. Harris Project to the maximum extent possible within its storage capability. Runoff is usually high during the winter and spring and relatively low during the summer and early fall.

7-04. Flood Risk Management. A summary of the basic regulation schedule for flood risk management procedures is provided in the table on Plate 7-3. This schedule provides detailed instructions to be used by the operating personnel of APC to carry out the operation of the project during floods. During floods, the project will operate to pass the inflow up to approximately 13,000 cfs by releasing water through the powerhouse to maintain the reservoir near the power guide curve. If the reservoir rises above the power guide curve or is predicted to in the near future but below elevation 790 feet NGVD29, the project will operate to discharge 13,000 cfs or an amount that will not cause the USGS river gage at Wadley, Alabama to exceed 13.0 feet, unless greater discharge amounts are required by the induced surcharge curves. When R. L. Harris Lake level rises above elevation 790 feet NGVD29, the powerhouse discharge will be increased to the larger of approximately 16,000 cfs or the amount indicated by the induced surcharge curves, Plate 7-4. Once the lake level begins to fall, all spillway gate openings and the powerhouse discharge will be maintained at those settings until the lake level returns to the power guide curve as shown on Plate 7-1. If a second flood enters the lake prior to the complete evacuation of the stored flood waters, the release will be as directed by the induced surcharge curve or the flood control operating instructions described in section 7-05 below.

7-05. Alternative Flood Control Operation. APC has developed a real time computer model and data collection network for the basin above R. L. Harris Dam. The model has the capabilities of incorporating data from rainfall, both actual and predicted QPF, and river stations

at upstream control gages and based on that data, prepares inflow forecasts for periods of up to 144 hours. The model then uses the forecasted inflow values to compute the anticipated storage requirements for the current rate of discharge. If it is determined that the anticipated storage requirement will exceed the available storage, the discharge is increased until the required storage and the available storage match. This balancing of storage has the same objective as the traditional induced surcharge method which is to reduce downstream flooding as much as reasonably possible while protecting the safety of the dam.

The flood risk management operation at the R. L. Harris Project may be in accordance with either of the plans identified in Paragraphs 7-04 or 7-05 and may be used interchangeably. However, currently, APC does not operate by the alternative plan described in Paragraph 7-05. Additionally, there is no schedule to implement the real-time model. If the alternative plan as described in Paragraph 7-05 is used, producing discharge rates in excess of those indicated in the induced surcharge schedule for a period of six consecutive hours and additional increases are indicated that will cause the USGS gage at Wadley, Alabama to exceed 13 feet, the operator will contact the Water Management Section of the Corps before increasing the release rate. If the operator is unable to contact the Water Management Section, the current discharge rate will be maintained until releases in excess of that amount are required by the induced surcharge schedule.

The flood risk management operating plans described above are designed to provide optimum benefits for the limited storage available in the project. However, in the event of a major storm over the basin, the APC and the District Commander will collaborate in the prompt analysis of all available information. Temporary modification in flood risk management regulations that will provide the most effective utilization of the flood risk management capacities at the project (i.e., a variance) may be employed after receiving approval from the South Atlantic Division Office by telephone or electronic mail.

7-06. Correlation with Other Projects. R. L. Harris Dam is the farthest upstream of a series of four APC dams on the Tallapoosa River. Those dams; Harris, Martin, Yates, and Thurlow, utilize a large portion of the available head of the Tallapoosa River in Alabama. The three dams below R. L. Harris Dam provide a continuous series of pools in the Tallapoosa River. R. L. Harris and Martin are the only storage projects, while Yates and Thurlow essentially operate as run-of-the-river projects passing the inflow as it enters each lake. Operation of the R. L. Harris project affects the operation of all the downstream projects especially Martin, the closest downstream project. The operation of Yates and Thurlow are directly dependent upon the operation at Martin and are scheduled in accordance with the discharge from that project. The flood risk management operation at R. L. Harris is designed to be completely independent from downstream operations. Following a flood, emptying of flood storage from R. L. Harris Lake may prolong the time required to evacuate the stored flood waters in Martin Lake. The Corps and APC have arranged for regular and rapid exchange of data which will permit the maximum benefit for downstream projects during flood risk management operations.

7-07. Spillway Gate Operating Schedule. The operation of the spillway gates will be in accordance with the gate opening schedule as shown on Plates 2-6 through 2-17. The Reservoir management Section will determine the appropriate discharge from the induced surcharge schedule and set the gates to the step that will produce a discharge as near as practical to that rate. The spillway gates will be operated in accordance with the gate regulation schedule to ensure that the top of the gates remain out of the water.

7-08. Minimum Flow Agreement. Flow in the Alabama River is largely controlled by APC impoundments on the Coosa and Tallapoosa Rivers. Pursuant to articles in the FERC licenses for these impoundments, a minimum discharge must be released to support navigation on the Alabama River. These flows also benefit downstream water quality. Under the terms of the previous negotiated agreement, APC projects would provide releases from the Jordan/Bouldin Project on the Coosa and Thurlow Project on the Tallapoosa River equal to a continuous minimum 7-day average flow of 4,640-cfs (32,480 dsf/7 days). This navigation flow target of 4,640 cfs was originally derived from the 7Q10 flow at Claiborne Lake of 6,600 cfs (determined from observed flow between 1929 – 1981 at the USGS gage # 02429500, Alabama River at Claiborne, Alabama). Those flows were established with the understanding that if APC provided 4,640 cfs from their Bouldin, Jordan, and Thurlow Projects, the Corps and intervening basin inflow would be able to provide the remaining water to meet 6,600 cfs at Claiborne Lake. However, as dry conditions continued in 2007, water managers realized that, if the basin inflows from rainfall were insufficient, the minimum flow target would not likely be achievable. Therefore, in coordination with APC, drought operations for the middle reaches of the ACT Basin have been revised and are described in detail in Exhibit D, *ACT River Basin Drought Contingency Plan*. The Drought Contingency Plan is summarized in Paragraph 7-13 of this manual. The Drought Contingency Plan flows are described in Table 7-5, ACT Drought Management Plan.

7-09. Recreation. Recreational activities are best served by maintaining a full conservation pool. Lake levels above top of conservation pool invade the camping and park sites. When the lake recedes several feet below the top of conservation pool, access to the water and beaches may become limited. Water management personnel are aware of recreational impacts resulting from reservoir fluctuations and attempt to maintain reasonable lake levels, especially during the peak recreational use periods, but there are no specific requirements relative to maintaining recreational levels. Other project functions usually determine releases from the dam and the resulting lake levels.

7-10. Water Quality. Water Quality Criteria established by the State of Alabama applicable to the R. L. Harris Project requires that the dissolved oxygen in the discharge from the project shall not be less than 5.0 mg/L. The APC has incorporated several design and operational features into the project in recognition of this criterion. Each hydroelectric turbine has been designed with a turbine aeration system to augment the discharged dissolved oxygen levels. This aeration system is designed to naturally aspirate air below the turbine wheel. A movable skimmer weir near the face of the dam can also be used during summer-time thermal stratification periods to make selective withdrawal from the upper layers of the lake where dissolved oxygen levels are higher. In addition, the APC is required to maintain a minimum continuous flow of 45 cfs downstream of R. L. Harris Dam at Wadley, Alabama. When conditions cause the USGS stream gage at Wadley, Alabama to approach a flow of 45 cfs, releases from the dam will be made so that flows do not fall below that amount. These flows are made in the interest of protecting and developing the downstream aquatic habitat.

7-11. Hydroelectric Power. A guide curve delineating the seasonally varying, top-of-power-pool level in R. L. Harris Lake is shown on Plate 7-1. Normally, the lake level will be maintained on or below the curve except when flood inflows exceeding the discharge capacity of the hydropower units cause the lake level to rise. The lake is lowered each year during the flood season to elevation 785 feet NGVD29 to provide additional flood storage capacity in the system. The hydropower performance curve is shown on Plate 7-2.

R. L. Harris Dam will normally operate on a weekly cycle with the hydropower generated available for use in the daily peak-load periods on Monday through Friday although weekend peaking power operations also occur. When R. L. Harris Lake is below the top of the power pool curve, the power plant will be operated to provide APC system power demand. Whenever the lake reaches the top of the power pool elevation, the power plant will operate as necessary, up to full-gate capacity, in order to discharge the amount of water required to keep the lake level from exceeding the top of the power pool curve elevation.

7-12. Navigation. Navigation is an important use of water resources in the ACT Basin. The Alabama River, from Montgomery downstream to the Mobile area, provides a navigation route for commercial barge traffic, serving as a regional economic resource. A minimum flow is required to ensure usable water depths to support navigation. APC releases water from the R. L. Harris Project in conjunction with other storage projects in the basin to provide a weekly volume of flow to the Alabama River. Congress has authorized continuous navigation on the river, when sufficient water is available. The three Corps locks and dams on the Alabama River and a combination of dredging, river training works, and flow augmentation together support navigation depths on the river. The lack of regular dredging and routine maintenance has led to inadequate depths at times in the Alabama River navigation channel.

When supported by maintenance dredging, ACT Basin reservoir storage, and hydrologic conditions, adequate flows will provide a reliable navigation channel. In doing so, the goal of the water control plan is to ensure a predictable minimum navigable channel in the Alabama River for a continuous period that is sufficient for navigation use. Figure 7-1 shows the effect of dredging on flow requirements for different navigation channel depths using 2004 – 2010 survey data. As shown on Figure 7-1, pre-dredging conditions exist between November and April; dredging occurs between May and August; and post-dredging conditions exist from September through October, until November rainfall causes shoaling to occur somewhere along the navigation channel.

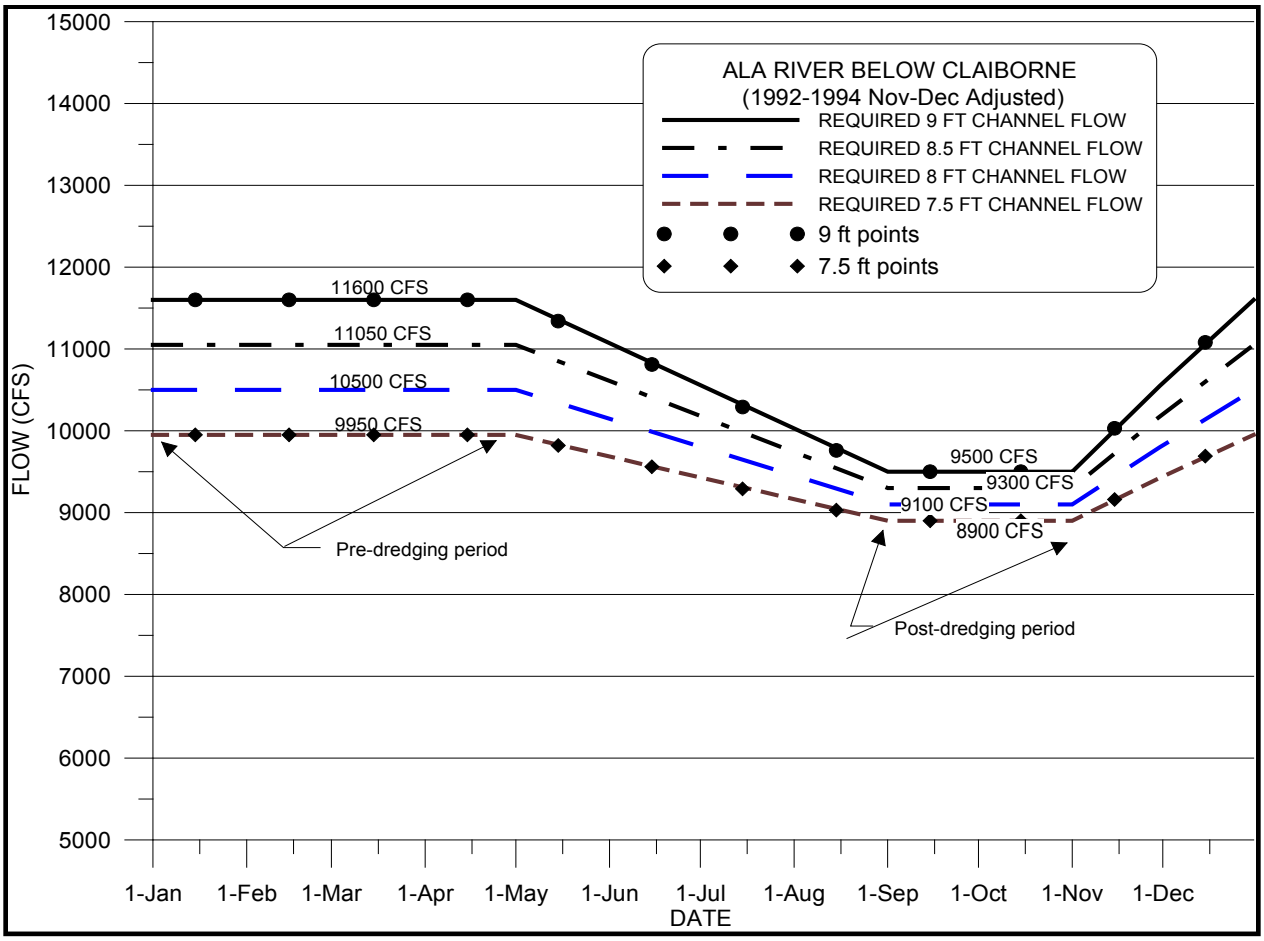


Figure 7-1. Flow-Depth Pattern (Navigation Template) Using 2004 – 2010 Survey Data

A 9-foot-deep by 200-foot-wide navigation channel is authorized on the Alabama River to Montgomery, Alabama. When a 9.0-foot channel cannot be met, a shallower 7.5-foot channel would still allow for light loaded barges moving through the navigation system. A minimum depth of 7.5 feet can provide a limited amount of navigation. Under low flow conditions, even the 7.5 feet depth has not been available at all times.

Flow releases from upstream APC projects have a direct influence on flows needed to support navigation depths on the lower Alabama River. Flows for navigation are most needed in the unregulated part of the lower Alabama River below Claiborne Lock and Dam. When flows are available, R. F. Henry, Millers Ferry, and Claiborne are regulated to maintain stable pool levels, coupled with the necessary channel maintenance dredging, to support sustained use of the authorized navigation channel and to provide the full navigation depth of nine feet. When river conditions or funding available for dredging of the river indicates that project conditions (9-foot channel) will probably not be attainable in the low water season, the three Alabama River projects are operated to provide flows for a reduced project channel depth as determined by surveys of the river. APC operates its reservoirs on the Coosa and Tallapoosa Rivers (specifically flows from their Jordan, Bouldin, and Thurlow (JBT) Projects) to provide a minimum navigation flow target in the Alabama River at Montgomery, Alabama. The monthly minimum navigation flow targets are shown in Table 7-1. However, flows may be reduced if conditions warrant. Additional intervening flow or drawdown discharge from the R. F. Henry and Millers Ferry Projects must be used to provide a usable depth for navigation and/or meet the 7Q10 flow

of 6,600 cfs below Claiborne Dam. However, the limited storage afforded in both the R. E. "Bob" Woodruff and William "Bill" Dannelly Lakes can only help meet the 6,600 cfs level at Claiborne Lake for a short period. As local inflows diminish or the storage is exhausted, a lesser amount would be released depending on the amount of local inflows. Table 7-2 and Figure 7-2 show the required basin inflow for a 9.0-foot channel; Table 7-3 and Figure 7-3 show the required basin inflow for a 7.5-foot channel.

During low-flow periods, it is not always possible to provide the authorized 9-foot deep by 200-foot-wide channel dimensions. In recent years, funding for dredging has been reduced resulting in higher flows being required to provide the design navigation depth. In addition, recent droughts in 2000 and 2007 had a severe impact on the availability of navigation depths in the Alabama River.

Historically, navigation has been supported by releases from storage in the ACT Basin. Therefore, another critical component in the water control plan for navigation involves using an amount of storage from APC storage projects similar to that which has historically been used, but in a more efficient manner.

The ACT Basin navigation regulation plan is based on storage and flow/stage/channel depth analyses using basin inflows and average storage usage by APC (e.g., navigation operations would not be predicated on use of additional storage) during normal hydrologic conditions. Under that concept, the Corps and APC make releases that support navigation when basin inflows meet or exceed seasonal targets for either the 9.0-foot or 7.5-foot channel templates. Triggers are also identified (e.g., when basin inflow are less than required natural flows) to change operational goals between the 9.0-foot and 7.5-foot channels. Similarly, basin inflow triggers are identified when releases for navigation are suspended and only 4,640 cfs releases would occur. During drought operations, releases to support navigation are suspended until system recovery occurs as defined in the ACT Basin Drought Contingency Plan (Exhibit D).

Table 7-1. Monthly Navigation Flow Target in CFS

Month	9.0-ft target below Claiborne Lake (from Navigation Template) (cfs)	9.0-ft Jordan, Bouldin, Thurlow goal (cfs)	7.5-ft target below Claiborne Lake (from Navigation Template) (cfs)	7.5-ft Jordan, Bouldin, Thurlow goal (cfs)
Jan	11,600	9,280	9,950	7,960
Feb	11,600	9,280	9,950	7,960
Mar	11,600	9,280	9,950	7,960
Apr	11,600	9,280	9,950	7,960
May	11,340	9,072	9.820	7,856
Jun	10,810	8,648	9,560	7,648
Jul	10,290	8,232	9,290	7,432
Aug	9,760	7,808	9,030	7,224
Sep	9,500	7,600	8,900	7,120
Oct	9,500	7,600	8,900	7,120
Nov	10,030	8,024	9,160	7,328
Dec	11,080	8,864	9,690	7,752

Table 7-2. Basin Inflow Above APC Projects Required to Meet a 9.0-foot Navigation Channel

Month	APC navigation Target (cfs)	Monthly historic storage usage (cfs)	Required basin inflow (cfs)
Jan	9,280	–994	10,274
Feb	9,280	–1,894	11,174
Mar	9,280	–3,028	12,308
Apr	9,280	–3,786	13,066
May	9,072	–499	9,571
Jun	8,648	412	8,236
Jul	8,232	749	7,483
Aug	7,808	1,441	6,367
Sep	7,600	1,025	6,575
Oct	7,600	2,118	5,482
Nov	8,024	2,263	5,761
Dec	8,864	1,789	7,075

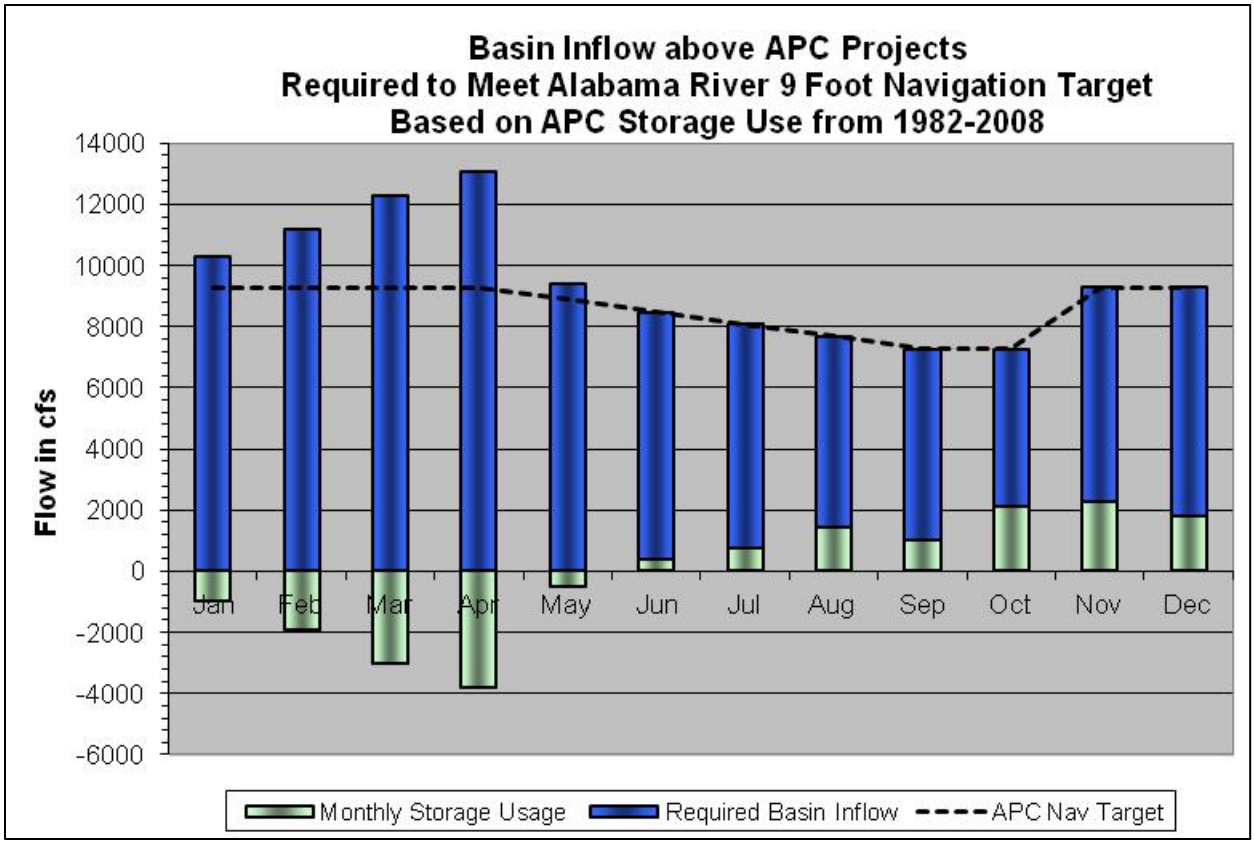


Figure 7-2. Flow Requirements From Rainfall (or Natural Sources) and Reservoir Storage to Achieve the JBT Goal for Navigation Flows for a 9-foot Channel.

Table 7-3. Basin Inflow Above APC Projects Required to Meet a 7.5-foot Navigation Channel

Month	APC navigation Target (cfs)	Monthly historic storage usage (cfs)	Required basin inflow (cfs)
Jan	7,960	–994	8,954
Feb	7,960	–1,894	9,854
Mar	7,960	–3,028	10,988
Apr	7,960	–3,786	11,746
May	7,856	–499	8,355
Jun	7,648	412	7,236
Jul	7,432	749	6,683
Aug	7,224	1,441	5,783
Sep	7,120	1,025	6,095
Oct	7,120	2,118	5,002
Nov	7,328	2,263	5,065
Dec	7,752	1,789	5,963

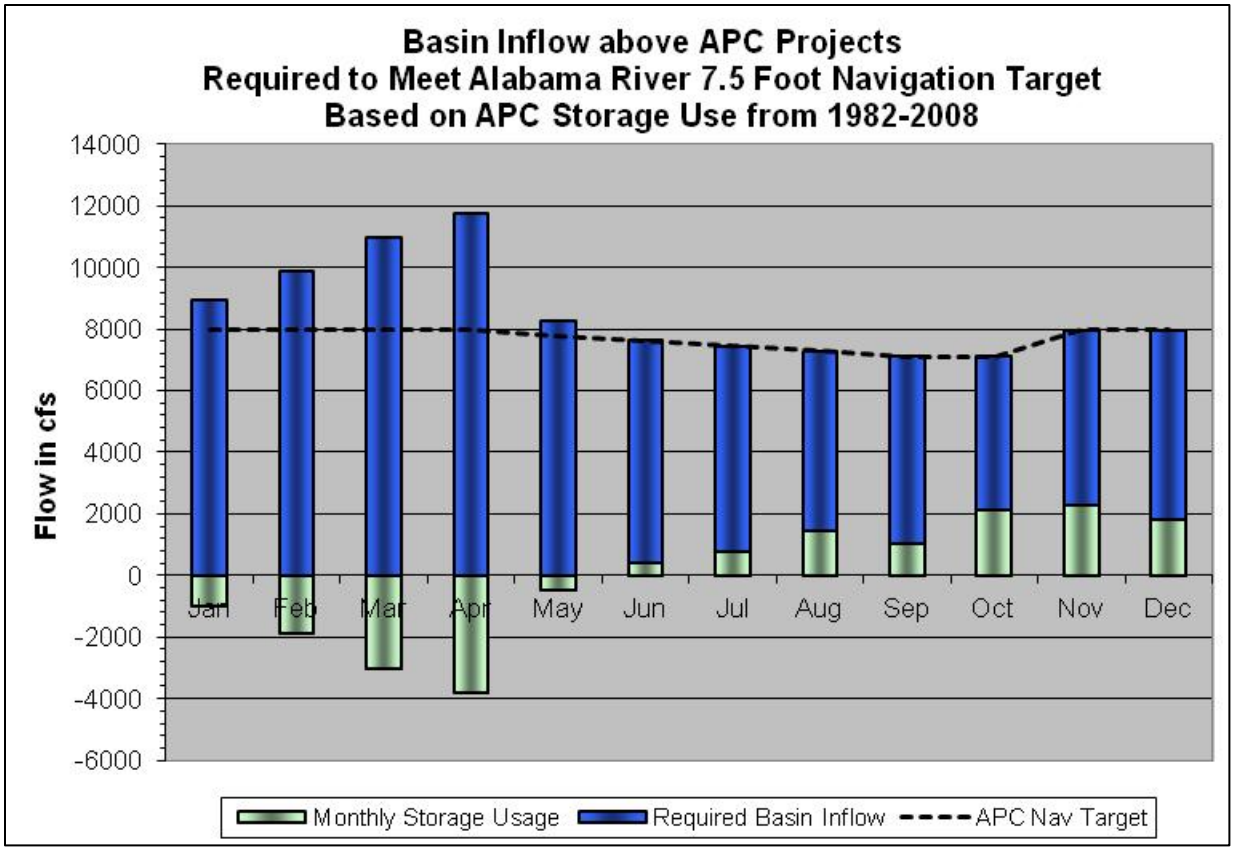


Figure 7-3. Flow Requirements From Rainfall (or Natural Sources) and Reservoir Storage to Achieve the JBT Goal for Navigation Flows for a 7.5-foot Channel.

During normal flow periods, no special water control procedures are required for navigation at the R. F. Henry Project other than maintaining the proper pool level. The normal maximum allowable drawdown at elevation 123.0 feet NGVD29 provides a clearance of 13.0 feet over the upper lock sill and should provide minimum depths for a 9-foot navigation channel at Montgomery and up to Bouldin Dam. Navigable depth is normally available downstream of the project if Millers Ferry is within its normal operating level. However, shoaling between Selma and R. F. Henry may result in the need to make water releases to increase the depth over any shoals. This will be accomplished by regular or specially scheduled hydropower releases when possible.

During high flow periods, navigation will be discontinued through the R. F. Henry lock during flood periods when the headwater reaches elevation 131.0 feet NGVD29. At this elevation the discharge will be 156,000 cfs which is expected to occur on an average of once every three years and the freeboard will be one-foot on the guide and lock walls.

In the event that the Mobile District Water Management Section determines upcoming reductions in water releases may impact the available navigation channel depth, they shall contact the Black Warrior/Tombigbee - Alabama/Coosa Project Office, and the Mobile District Navigation Section, to coordinate the impact. Water Management shall provide the Claiborne tailwater gage forecast to the project office and the Navigation Section. Using this forecast and the latest available project channel surveys, the project office and the Navigation Section will evaluate the potential impact to available navigation depths. Should this evaluation determine

that the available channel depth is adversely impacted, the project office and the Navigation Section will work together, providing Water Management with their determination of the controlling depth. Thereafter, the project office and the Navigation Section will coordinate the issuance of a navigation bulletin. The notices will be issued as expeditiously as possible to give barge owners, and other waterway users, sufficient time to make arrangements to lighten loads or remove their vessels before action is taken at upstream projects to reduce flows. The bulletin will be posted to the Mobile District Navigation website at

http://navigation.sam.usace.army.mil/docs/index.asp?type=nn

Although special releases will not be standard practice, they could occur for a short duration to assist maintenance dredging and commercial navigation for special shipments if basin hydrologic conditions are adequate. The Corps will evaluate such requests on a case by case basis, subject to applicable laws and regulations and the basin conditions.

7-13. Drought Contingency Plan.

An ACT Basin Drought Contingency Plan (DCP) has been developed to implement water control regulation drought management actions. The plan includes operating guidelines for drought conditions and normal conditions. The R. L. Harris Project operates in concert with other APC projects to meet the provisions of the DCP related to flow requirements from the Coosa and Tallapoosa River Basins. APC and the Corps will coordinate water management during drought with other federal agencies, navigation interests, the states, and other interested parties as necessary. The following information provides a summary of the DCP water control actions for the ACT Basin projects. The drought plan is described in detail in Exhibit D Drought Contingency Plan.

The ACT Basin Drought Plan matrix defines monthly minimum flow requirements except where noted for the Coosa, Tallapoosa, and Alabama Rivers as a function of a Drought Intensity Level (DIL) and time of year. Such flow requirements are daily averages. The ACT Basin drought plan is activated when one or more of the following drought triggers is exceeded:

1. Low basin inflow
2. Low state line flow
3. Low composite conservation storage

Drought management actions would become increasingly more austere when two triggers are exceeded (Drought Level 2) or all three are exceeded (Drought Level 3). The combined occurrences of the drought triggers determine the DIL. Table 7-4 lists the three drought operation intensity levels applicable to APC projects.

Table 7-4. ACT Basin Drought Intensity Levels

Drought Intensity Level (DIL)	Drought Level	No. of Triggers Exceeded
-	Normal Regulation	0
DIL 1	Moderate Drought	1
DIL 2	Severe Drought	2
DIL 3	Exceptional Drought	3

Drought management measures for ACT Basin-wide drought regulation consists of three major components:

- Headwater regulation at Allatoona Lake and Carters Lake in Georgia
- Regulation at APC projects on the Coosa and Tallapoosa Rivers
- Regulation at Corps projects downstream of Montgomery on the Alabama River

The headwater regulation component includes water control actions in accordance with established action zones, minimum releases, and hydropower generation releases in accordance with project water control plans. Regulation of APC projects will be in accordance with Table 7-5, ACT Drought Management Plan, in which the drought response will be triggered by one or more of the three indicators - state line flows, basin inflow, or composite conservation storage. Corps operation of its Alabama River projects downstream of Montgomery will respond to drought operations of the APC projects upstream.

7-14. Flood Emergency Action Plan. APC maintains the Flood Emergency Action Plan for the R. L. Harris Project. The plan was developed and is updated in accordance with FERC guidelines. APC is responsible for notifying the appropriate agencies/organizations in the unlikely event of an emergency at Harris Dam. The Flood Emergency Action Plan is updated at least once a year, with a full reprint every five years. Inundation maps, developed by APC and updated as necessary, are also provided in the R. L. Harris Project Flood Emergency Action Plan.

7-15. Rate of Release Change. Gradual changes are important when releases are being decreased and downstream conditions are very wet, resulting in saturated riverbank conditions. The Corps acknowledges that a significant reduction in basin releases over a short period can result in some bank sloughing, and release changes are scheduled accordingly when a slower rate of change does not significantly affect downstream flood risk. Overall, the effect of basin regulation on streambank erosion has been reduced by the regulation of the basin because higher peak-runoff flows into the basin are captured and metered out more slowly.

Table 7-5. ACT Drought Management Plan

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought Level Response[a]	DIL 0 - Normal Operations											
	DIL 1: Low Basin Inflows or Low Composite or Low State Line Flow											
	DIL 2: DIL 1 criteria + (Low Basin Inflows or Low Composite or Low State Line Flow)											
	DIL 3: Low Basin Inflows + Low Composite + Low State Line Flow											
Coosa River Flow[b]	Normal Operation: 2,000 cfs			4,000 (8,000)		4,000 – 2,000	Normal Operation: 2,000 cfs					
	Jordan 2,000 +/-cfs			4,000 +/- cfs		6/15 Linear Ramp down	Jordan 2,000 +/-cfs			Jordan 2,000 +/-cfs		
	Jordan 1,600 to 2,000 +/-cfs			2,500 +/- cfs		6/15 Linear Ramp down	Jordan 2,000 +/-cfs			Jordan 1,600 to 2,000 +/-cfs		
	Jordan 1,600 +/-cfs			Jordan 1,600 to 2,000 +/-cfs			Jordan 2,000 +/-cfs			Jordan 1,600 to 2,000 +/-cfs		Jordan 1,600 +/-cfs
Tallapoosa River Flow[c]	Normal Operations: 1200 cfs											
	Greater of: 1/2 Yates Inflow or 2 x Heflin Gage(Thurlow Lake releases > 350 cfs)				1/2 Yates Inflow					1/2 Yates Inflow		
	Thurlow Lake 350 cfs				1/2 Yates Inflow					Thurlow Lake 350 cfs		
	Maintain 400 cfs at Montgomery WTP (Thurlow Lake release 350 cfs)						Thurlow Lake 350 cfs			Maintain 400 cfs at Montgomery WTP (Thurlow Lake release 350 cfs)		
Alabama River Flow[d]	Normal Operation: Navigation or 4,640 cfs flow											
	4,200 cfs (10% Cut) - Montgomery				4,640 cfs - Montgomery					Reduce: Full – 4,200 cfs		
	3,700 cfs (20% Cut) - Montgomery					4,200 cfs (10% Cut) - Montgomery				Reduce: 4,200 cfs-> 3,700 cfs Montgomery (1 week ramp)		
	2,000 cfs Montgomery				3,700 cfs Montgomery		4,200 cfs (10% Cut) - Montgomery			Reduce: 4,200 cfs -> 2,000 cfs Montgomery (1 month ramp)		
Guide Curve Elevation	Normal Operations: Elevations follow Guide Curves as prescribed in License (Measured in Feet)											
	Corps Variances: As Needed; FERC Variance for Lake Martin											
	Corps Variances: As Needed; FERC Variance for Lake Martin											
	Corps Variances: As Needed; FERC Variance for Lake Martin											

a. Note these are base flows that will be exceeded when possible.
b. Jordan flows are based on a continuous +/- 5% of target flow.
c. Thurlow Lake flows are based on continuous +/- 5% of target flow: flows are reset on noon each Tuesday based on the prior day's daily average at Heflin or Yates.
d. Alabama River flows are 7-Day Average Flow.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. The River and Harbor Act, approved 2 March 1945 (59 Stat. 10) authorized the Corps of Engineers to develop a site at Crooked Creek for flood control, hydropower, and other purposes. Section 12 of Public Law 89-789 (80 Stat., 1405), approved 7 November 1966, suspended for two years the authority as far as hydropower was concerned, to permit development of the Tallapoosa River by private concerns. The APC filed an application with the Federal Power Commission for the proposed project on 5 November 1968, and was issued a license for the construction, operation and maintenance of the Crooked Creek Hydroelectric Project (later renamed R. L. Harris). The R. L. Harris Project is a peaking hydropower peaking project with operating lake elevations that range from 793 to 785 feet NGVD29.

The impacts of the *ACT Master Water Control Manual* and its Appendices, including this water control manual have been fully evaluated in an Environmental Impact Statement (EIS) that was published on _____. A Record of Decision (ROD) for the action was signed on _____. During the preparation of the EIS, a review of all direct, secondary and cumulative impacts was made. As detailed in the EIS, the decision to prepare the Water Control Manual and the potential impacts were coordinated with Federal and State agencies, environmental organizations, Native American tribes, and other stakeholder groups and individuals having an interest in the basin. The ROD and EIS are public documents and references to their accessible locations are available upon request.

8-02. Flood Risk Management. R. L. Harris Dam controls 7.9 percent of the conservation storage in the ACT basin (see Table 4-7). The discharge frequency curve at the dam site for the period 1983 – 2010 is shown on Plate 8-1. The curve was developed from average daily discharge data from the APC. The pre-dam and post-dam discharge frequency curves at Wadley, Alabama, 14 miles below the dam are shown on Plate 8-2. The data were taken from the USGS “Tallapoosa River at Wadley” gage, No. 02414500. The floods of 1977 and 1979 were routed through the reservoir using the Induced Surcharge Regulation as well as Basin Model Regulation. Results are shown on Plates 8-3 through 8-6. The observed maximum post-construction flood of 2003 is also presented on Plate 4-21. The data for this flood were APC hourly values. Regulation of the probable maximum flood is shown on Plate 8-7. Headwater and tailwater stage frequency curves are shown on Plates 8-8 and 8-9.

8-03. Recreation. R. L. Harris Lake is an important recreational resource, providing significant economic and social benefits for the region and the Nation. The project contains 10,660 acres of water at the summer power pool elevation of 793.0 feet NGVD29. A wide variety of recreational opportunities are provided at the lake including boating, fishing, camping, picnicking, water skiing, hunting, and sightseeing. The local and regional economic benefits of recreation at R. L. Harris Lake are significant. The effects of the R. L. Harris water control operations on recreation opportunities are minimal between the maximum and minimum power pool elevations of 793 to 785 feet NGVD29.

8-04. Water Quality. The water quality conditions that are generally present in R. L. Harris Lake are typical of water quality conditions and trends that exist in reservoirs throughout the ACT Basin that are relatively deep with thermal stratification during the summer and completely mixed during the winter. Water quality conditions in the main body of the lake are typically better than in the arms because of nutrient and sediment-rich, riverine inflows. Sediment and phosphorus concentrations are also highest in the upper arms and decrease toward the main pool as velocity is lowered and sediment is removed from suspension. During summer-time,

dissolved oxygen levels and water temperatures are typically highest near the top of the water column, with colder, less oxygenated water existing near the bottom. Additionally, chlorophyll *a* concentrations vary both seasonally and spatially and are highest from July to October during periods of low flow. Point and nonpoint sources from urban areas increase sediment and pollutant loads in the rivers immediately downstream. Reservoirs in the ACT Basin, including R. L. Harris Lake, typically act as a sink, removing pollutant loads and sediment.

Total maximum daily loads (TMDLs) have been identified for various portions of the Tallapoosa and Little Tallapoosa Rivers. In the Alabama portion of the rivers, TMDLs for pathogens and siltation have been proposed. In Georgia, TMDLs have been finalized for fecal coliforms, and sedimentation for sections of the Tallapoosa and Little Tallapoosa Rivers. R. L. Harris Lake is currently classified as mesotrophic, which indicates an intermediate level of productivity in the lake. ADEM has established a lake chlorophyll *a* criterion for R. L. Harris Lake during the growing season (April – October) of an average of less than 10 micrograms per liter (µg/l) of chlorophyll *a* or an average of less than 12 *ug/l* if measured immediately upstream of the Tallapoosa River, Little Tallapoosa River confluence.

8-05. Fish and Wildlife. The Tallapoosa River, a 4,687-square-mile watershed, originates in Paulding County located in western Georgia. The upper portion of the river (above Harris Dam) represents the last unimpounded and unregulated habitat in the watershed. Recent surveys estimate 86 fish species below the fall line (geographical boundary between the Piedmont and Southeastern Plains) and 42 fish species above the fall line. Twenty species of mussels have also been documented from the river and its tributaries, including the federally threatened fine-lined pocketbook.

The four reservoirs (R.L. Harris, Martin, Yates, and Thurlow) in this sub-basin impound 71 of the 268 miles of the Tallapoosa River to create 53,234 acres of reservoir habitat. R. L. Harris Lake contains an abundance of Alabama spotted bass and largemouth bass. Lake Martin is known for producing great Alabama spotted bass fishing during the winter. Lake Martin spills immediately into two smaller lakes, Yates and Thurlow. Fisheries at the two lakes are dictated by the flow from Lake Martin. Rising or steady water levels can produce good fishing for striped bass, Alabama spotted bass, white bass, and various sunfish species.

The Tallapoosa River below R. L. Harris Dam represents one of the longest and highest quality segments of Piedmont River habitat remaining in the Mobile River drainage, one of the most biologically diverse river drainages in North America. Extensive areas of shoal habitat, river features that typically support high faunal diversity are characteristic along this portion of the river. The native fish assemblage includes at least 57 species, including at least five species endemic to the Tallapoosa River System. The invertebrate fauna is less well known; however, the fine-lined pocketbook (*Hamiota altilis*), which is listed as Threatened under the Endangered Species Act, and at least two endemic species of crayfishes occur in the Piedmont reach.

Operational flow changes affect habitat for reservoir fisheries and other aquatic resources mainly through changes in water levels, changes in reservoir flushing rates (retention times), and associated changes in water quality parameters, such as primary productivity, nutrient loading, dissolved oxygen concentrations, and vertical stratification. Seasonal water level fluctuations can substantially influence littoral (shallow-water) habitats, decreasing woody debris deposition, restricting access to backwaters and wetlands, and limiting seed banks and stable water levels necessary for native aquatic vegetation. Those limitations, in turn, significantly influence the reproductive success of resident fish populations. High water levels inundating

shoreline vegetation during spawning periods frequently have been associated with enhanced reproductive success and strong year class development for largemouth bass, spotted bass, bluegill, crappie, and other littoral species. Conversely, low or declining water levels can adversely affect reproductive success by reducing the area of available littoral spawning and rearing habitats. Substantial daily or weekly fluctuations in lake levels associated with hydropower peaking operations can negatively affect lake fisheries by dewatering spawning and nursery habitats for littoral species, exposing nests and eggs deposited in shallow-water habitats, and reducing the availability of shoreline cover and its associated invertebrate food supply.

8-06. Hydroelectric Power. The R. L. Harris Dam Hydropower Project, along with 13 other hydroelectric facilities throughout the State of Alabama, provides approximately six percent of the Alabama Power Company's power generation. The State of Alabama depends on these facilities as a source of dependable and stable electricity. Hydroelectric power is also one of the cheaper forms of electrical energy, and it can be generated and supplied quickly as needed in response to changing demand.

Hydropower is typically produced as peak energy at R. L. Harris Dam, i.e., power is generated during the hours that the demand for electrical power is highest, causing significant variations in downstream flows. Daily hydropower releases from the dam vary from zero during off-peak periods to as much as 13,000 cfs, which is approximately best gate turbine discharge. Often, the weekend releases are lower than those during the weekdays. Lake elevations can vary 0.5 to 1.5 feet during a 24-hour period as a result of hydropower releases. Tailwater levels can also vary significantly daily because of peaking hydropower operations at R. L. Harris Dam, characterized by a rapid rise in downstream water levels immediately after generation is initiated and a rapid fall in stage as generation is ceased. Except during high flow conditions when hydropower may be generated for more extended periods of time, this peaking power generation scenario with daily fluctuating stages downstream is repeated nearly every weekday (not generally on weekends).

Hydropower generation by the R. L. Harris Dam Hydropower Plant, in combination with the other hydropower power projects in the ACT Basin, helps to provide direct benefits to a large segment of the basin's population in the form of dependable, stable, and relatively low-cost power. Hydropower plays an important role in meeting the electrical power demands of the region.

8-07. Navigation. APC releases water from R. L. Harris Project in conjunction with their other storage projects in the Tallapoosa and Coosa Rivers to provide flows to support navigation. The navigation plan provides the flexibility to support flow targets when the system experiences normal flow conditions, reduced support as basin hydrology trends to drier conditions, and suspension of navigation support during sustained low flow conditions.

8-08. Drought Contingency Plans. The importance of drought contingency plans has become increasingly obvious as more demands are placed on the water resources of the basin. During low flow conditions, the reservoirs within the basin may not be able to fully support all project purposes. Several drought periods have occurred since construction of the R. L. Harris Project in 1983. The duration of low flows can be seasonal or they can last for several years. Some of the more extreme droughts occurred in the early and mid 1980's, and most of the time period between late-1998 to mid-2009. There were periods of high flows during these droughts but the lower than normal rainfall trend continued.

The purpose of drought planning is to minimize the effect of drought, to develop methods for identifying drought conditions, and to develop both long- and short-term measures to be used to respond to and mitigate the effects of drought conditions. During droughts, reservoir regulation techniques are planned to preserve and ensure the more critical needs. Minimum instream flows protect the area below R. L. Harris Dam and conservation efforts strengthen the ability to supply water supply needs.

For the R. L. Harris Project, the APC and the Corps will coordinate water management activities during the drought with other private power companies and federal agencies, navigation interests, the States, and other interested state and local parties as necessary. Drought operations will be in accordance with Table 7-5, ACT Drought Management Plan, Tallapoosa River flows.

8-09. Flood Emergency Action Plans. Normally, all flood risk management operations are directed by APC Reservoir Management following the flood risk management procedures outlined in this manual with data sharing and communication between APC and the Water Management Section of the Corps. If, however, a storm of flood-producing magnitude occurs and all communications are disrupted between APC and the Corps, flood risk management measures, as previously described in Chapter VII of this appendix, will begin and/or continue.

The R. L. Harris Dam is well maintained and has not experienced unusual events or problems. Discharges from the dam are released into the Tallapoosa River which flow into Lake Martin. Most of the area between R. L. Harris Dam and Lake Martin is largely undeveloped rural and agricultural land. The most immediate downstream development is the City of Wadley, Alabama. Dam failure at R. L. Harris would pose little impact to roads and highways immediately downstream, with the exception of County road 15, and Highway 77/22 in the Wadley, Alabama area.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization. Many agencies in federal and state governments are responsible for developing and monitoring water resources in the ACT Basin. Some of the federal agencies are the Corps, U.S. Environmental Protection Agency, National Parks Service, U.S. Coast Guard, USGS, U.S. Department of Energy, U.S. Department of Agriculture, USFWS, and NOAA. In addition to the federal agencies, each state has agencies involved: the Georgia Environmental Protection Division (GAEPD), The Middle Chattahoochee Regional Water Planning Council (includes Tallapoosa and Little Tallapoosa River Basins in Georgia), and the Alabama Department of Environmental Management, Alabama Office of Water Resources.

a. Alabama Power Company. The R. L. Harris Project was constructed and is operated by the APC. Day-to-day operation of the project is assigned to the APC's Reservoir Management Section in Birmingham, Alabama, as part of the Power Delivery System under the direction of Reservoir Operations Supervisor. Long-range water planning and flood risk management operation is assigned to APC's Reservoir Management in Birmingham, Alabama, as part of Southern Company Services Hydro Services, under the direction of the System Operations Supervisor.

b. U.S. Army Corps of Engineers. Authority for water control regulation of federal projects in the ACT Basin has been delegated to the South Atlantic Division (SAD) Commander. The responsibility for water control regulation activities has been entrusted to the Mobile District, Engineering Division, Water Management Section. Water control actions for federal projects are regulated to meet the authorized project purposes in coordination with federally authorized ACT Basin-wide system purposes and public law. It is the responsibility of the Water Management Section to coordinate with APC to develop the Harris Project water control regulation procedures for flood risk management and navigation. The Water Management Section monitors the Coosa River projects for compliance with the approved water control plans and agreements. The Water Management Section will perform the following specific duties in connection with the operation of the R. L. Harris Project:

(1) Maintain liaison with personnel of APC's Reservoir Management for the daily exchange of hydrologic data.

(2) Maintain records of rainfall and river stages for the Coosa River Basin, and records of pool level and outflow at R. L. Harris Dam and other impoundments in the basin.

(3) Monitor operations of the power plant and spillway at R. L. Harris Dam for compliance with the regulation schedule for flood control operations, Plate 7-2.

(4) Transmit to APC Reservoir Management any instructions for special operations which may be required due to unusual flood conditions (except in emergencies where time does not permit, these instructions will first be cleared with the Chief of Hydrology and Hydraulics Branch and the Chief of Engineering Division).

(5) Evaluate special water control plan variance requests submitted by APC Reservoir Management and provide approval or disapproval

c. Other Federal Agencies. Other federal agencies work closely with APC and the Corps to provide their agency support for the various project purposes of R. L. Harris and to meet the federal requirements for which they might be responsible. The responsibilities and interagency coordination between the Corps and the federal agencies are discussed in Paragraph 9-02.

d. State and County Agencies

(1) Alabama. The Alabama Office of Water Resources (OWR) administers programs for river basin management, river assessment, water supply assistance, water conservation, flood mapping, the National Flood Insurance Program and water resources development. Further, OWR serves as the state liaison with federal agencies on major water resources related projects, conducts any special studies on instream flow needs, and administers environmental education and outreach programs to increase awareness of Alabama's water resources.

i. The Alabama Department of Environmental Management Drinking Water Branch works closely with the more than 700 water systems in Alabama that provide safe drinking water to four million citizens.

ii. The Alabama Chapter of the Soil and Water Conservation Society fosters the science and the art of soil, water, and related natural resource management to achieve sustainability.

(2) Georgia. Georgia Environmental Protection Division (GAEPD) conducts water resource assessments to determine a sound scientific understanding of the condition of the water resources, in terms of the quantity of surface water and groundwater available to support current and future in-stream and off-stream uses and the capacity of the surface water resources to assimilate pollution. Regional water planning councils in Georgia (Middle Chattahoochee Planning Council covers the Tallapoosa and Little Tallapoosa River Basins) prepare recommended Water Development and Conservation Plans. Those regional plans promote the sustainable use of Georgia's waters by selecting an array of management practices, to support the state's economy, to protect public health and natural systems, and to enhance the quality of life for all citizens.

e. Stakeholders. Many non-federal stakeholder interest groups are active in the ACT Basin. The groups include lake associations, M&I water users, navigation interests, environmental organizations, and other basin-wide interests groups. Coordinating water management activities with the interest groups, state and federal agencies, and others is accomplished as required on an ad-hoc basis and on regularly scheduled water management teleconferences when needed to share information regarding water control regulation actions and gather stakeholder feedback. The Master Water Control Manual includes a list of state and federal agencies and active stakeholders in the ACT Basin that have participated in the ACT Basin water management teleconferences and meetings.

9-02. Interagency Coordination

a. Local Press and Corps Bulletins. The local press includes any periodic publications in or near the R. L. Harris Watershed and the ACT Basin. Montgomery, Alabama, and Atlanta, Georgia, have some of the larger daily papers. These papers often publish articles related to the rivers and streams. Their representatives have direct contact with the Corps and APC through their respective Public Affairs offices. In addition, the local press and the public can access current project information on the Corps and APC web pages.

b. National Weather Service (NWS). NWS is the federal agency in NOAA that is responsible for weather and weather forecasts. The NWS along with its River Forecast Center maintains a network of reporting stations throughout the Nation. It continuously provides current weather conditions and forecasts. It prepares river forecasts for many locations including the ACT Basin. Often, it prepares predictions on the basis of *what if* scenarios. Those include

rainfall that is possible but has not occurred. In addition, the NWS provides information on hurricane tracts and other severe weather conditions. It monitors drought conditions and provides the information. Information is available through the Internet, the news, and the Mobile District's direct access.

c. U.S. Geological Survey (USGS). The USGS is an unbiased, multidisciplinary science organization that focuses on biology, geography, geology, geospatial information, and water. The agency is responsible for the timely, relevant, and impartial study of the landscape, natural resources, and natural hazards. Through the APC-USGS partnership and the Corps-USGS Cooperative Gaging program, the USGS maintains a comprehensive network of gages in the ACT Basin. The USGS Water Science Centers in Georgia and Alabama publish real-time reservoir levels, river and tributary stages, and flow data through the USGS National Water Information Service (NWIS) web site.

d. U.S. Fish and Wildlife Service (USFWS). The USFWS is an agency of the Department of the Interior whose mission is working with others to conserve, protect and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The USFWS is the responsible agency for the protection of federally listed threatened and endangered species and federally designated critical habitat in accordance with the Endangered Species Act of 1973. The USFWS also coordinates with other federal agencies under the auspices of the Fish and Wildlife Coordination Act. APC and the Corps, Mobile District, with support from the Water Management Section, coordinate water control actions and management with USFWS in accordance with both laws.

9-03. Framework for Water Management Changes. Special interest groups often request modifications of the basin water control plan or project specific water control plan. The R. L. Harris Project and other ACT Basin projects were constructed to meet specific, authorized purposes, and major changes in the water control plans would require modifying, either the project itself or the purposes for which the projects were built. However, continued increases in the use of water resources demand constant monitoring and evaluating reservoir regulations and reservoir systems to insure their most efficient use. Within the constraints of the FERC regulating license for the R. L. Harris Project, Congressional authorizations, and engineering regulations, the water control plan and operating techniques are often reviewed to see if improvements are possible without violating authorized project functions. When deemed appropriate, temporary variances to the water control plan approved by FERC and the Corps can be implemented to provide the most efficient regulation while balancing the multiple purposes of the ACT Basin-wide System.

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

EXHIBIT A
SUPPLEMENTARY PERTINENT DATA

GENERAL

Other names of project	Crooked Creek
Dam site location	
State	Alabama
Basin	Alabama-Tallapoosa
River	Tallapoosa
Miles above mouth of Tallapoosa River	139.1
Miles above mouth of Mobile River	494
Drainage area above dam site, sq. miles	1,454
Drainage area above Martin Dam, sq. miles	2,984
Drainage area above mouth of Tallapoosa, sq. miles	4,687
1 inch of runoff equals, acre-ft (1,454 sq mi)	77,493
Type of project	Dam, Reservoir and Power plant
Objectives of regulation	Hydropower, Navigation, and Flood Risk Management
Project Owner	Alabama Power Company (APC)
Regulating Agencies	APC, Corps of Eng, and FERC

STREAM FLOW AT USGS Gage at WADLEY, AL (cfs)

Average for Period of Record (calendar yr 1924 – 2009)	2,562
Maximum daily discharge	103,000
Minimum daily discharge	41
Maximum annual discharge (calendar yr 1975)	4,904
Minimum annual discharge (calendar yr 2007)	790

REGULATED FLOODS

Maximum flood of project record (8 May 2003)	
Peak inflow, cfs (@ 0400 hrs)	106,494
Peak outflow, cfs (0400 hrs)	98,454
Peak pool elevation, feet above NGVD29	794.9
Peak discharge of Probable Maximum Flood, cfs	310,300

RESERVOIR

Elevation of probable maximum flood, ft above NGVD29	800.3
Full pool elevation May through September, feet above NGVD29	793.0
Full pool elevation December through March, feet above NGVD29	785.0
Maximum operating pool elevation, feet above NGVD29	793.0

Minimum operating pool elevation, feet above NGVD29	768.0
RESERVOIR (Cont'd)	
Area at pool elevation 793.0, acres	10,660
Total volume at elevation 793.0, acre-feet	425,721
Power storage (elevation 768 to 793 ft NGVD29)	206,944
Inactive Storage (below elevation 768 ft NGVD29)	218,025
Length, miles	29
Shoreline distance at elevation 793 (summer pool), miles	272
Shoreline distance at elevation 785 (winter pool), miles	229

SPILLWAY	
Type	concrete-gravity
Net length, feet	310
Elevation of crest, feet above NGVD29	753.0
Type of gates	Tainter
Number of gates	6
Length of gates, feet	40.5
Height of gates, feet	40.0
Maximum discharge capacity (pool elev. 795.0), cfs	267,975
Elevation of top of gates in closed position, feet above NGVD29	793.5

DAM	
Total length including dikes, feet	3,242
Total length of non-overflow section, feet	2,632
Maximum height above stream bed, feet	151.5
Elevation, top of dam, feet	810

POWER PLANT	
Maximum power pool elevation, feet above NGVD29	793.0
Gross static head at full power pool (793 ft NGVD29), feet	131.7
Normal operating head at full turbine discharge, feet	124.0
Length of powerhouse, feet	225
Width of powerhouse, feet	91
Number of units	2
Maximum discharge per unit (approximate full gate) cfs	8,000
Diameter of penstock leading to the turbines, ft	27
Elevation of centerline of intake to turbine	710.0
Elevation of centerline of distributor	659.0
Total installation, kW	135,000

EXHIBIT B

UNIT CONVERSIONS

AREA CONVERSION

UNIT	m^2	km^2	ha	in^2	ft^2	yd^2	mi^2	ac
1 m^2	1	10^{-6}	10^{-4}	1550	10.76	1.196	3.86×10^{-7}	2.47×10^{-4}
1 km^2	10^6	1	100	1.55×10^9	1.076×10^7	1.196×10^6	0.3861	247.1
1 ha	10^4	0.01	1	1.55×10^7	1.076×10^7	1.196×10^4	3.86×10^{-3}	2,471
1 in^2	6.45×10^{-4}	6.45×10^{10}	6.45×10^{-8}	1	6.94×10^{-3}	7.7×10^{-4}	2.49×10^{-10}	1.57×10^7
1 ft^2	.0929	9.29×10^{-8}	9.29×10^{-6}	144	1	0.111	3.59×10^{-8}	2.3×10^{-5}
1 yd^2	0.8361	8.36×10^{-7}	8.36×10^{-5}	1296	9	1	3.23×10^{-7}	2.07×10^{-4}
1 mi^2	2.59×10^6	2.59	259	4.01×10^9	2.79×10^7	3.098×10^6	1	640
1 ac	4047	0.004047	0.4047	6.27×10^6	43560	4840	1.56×10^{-3}	1

LENGTH CONVERSION

UNIT	cm	m	Km	in.	ft	yd	mi
Cm	1	0.01	0.00001	0.3937	0.0328	0.0109	6.21×10^{-6}
M	100	1	0.001	39.37	3.281	1.094	6.21×10^{-4}
Km	10^5	1000	1	39,370	3281	1093.6	0.621
in.	2.54	0.0254	2.54×10^{-5}	1	0.0833	0.0278	1.58×10^{-5}
Ft	30.48	0.3048	3.05×10^{-4}	12	1	0.33	1.89×10^{-4}
Yd	91.44	0.9144	9.14×10^{-4}	36	3	1	5.68×10^{-4}
Mi	1.01×10^5	1.61×10^3	1.6093	63,360	5280	1760	1

FLOW CONVERSION

UNIT	m^3/s	m^3/day	l/s	ft^3/s	ft^3/day	ac-ft/day	gal/min	gal/day	mgd
m^3/s	1	86,400	1000	35.31	3.05×10^6	70.05	1.58×10^4	2.28×10^7	22.824
m^3/day	1.16×10^{-5}	1	0.0116	4.09×10^{-4}	35.31	8.1×10^{-4}	0.1835	264.17	2.64×10^{-4}
l/s	0.001	86.4	1	0.0353	3051.2	0.070	15.85	2.28×10^4	2.28×10^{-2}
ft^3/s	0.0283	2446.6	28.32	1	8.64×10^4	1.984	448.8	6.46×10^5	0.646
ft^3/day	3.28×10^{-7}	1233.5	3.28×10^{-4}	1.16×10^{-5}	1	2.3×10^{-5}	5.19×10^{-3}	7.48	7.48×10^{-6}
ac-ft/day	0.0143	5.451	14.276	0.5042	43,560	1	226.28	3.26×10^5	0.3258
gal/min	6.3×10^{-5}	0.00379	0.0631	2.23×10^{-3}	192.5	4.42×10^{-3}	1	1440	1.44×10^{-3}
gal/day	4.3×10^{-8}	3785	4.38×10^{-4}	1.55×10^{-6}	11,337	3.07×10^{-6}	6.94×10^{-4}	1	10^{-6}
Mgd	0.0438		43.82	1.55	1.34×10^5	3.07	694	10^6	1

VOLUME CONVERSION

UNIT	liters	m^3	in^3	ft^3	gal	ac-ft	million gal
Liters	1	0.001	61.02	0.0353	0.264	8.1×10^{-7}	2.64×10^{-7}
m^3	1000	1	61,023	35.31	264.17	8.1×10^{-4}	2.64×10^{-4}
in^3	1.64×10^{-2}	1.64×10^{-5}	1	5.79×10^{-4}	4.33×10^{-3}	1.218×10^{-8}	4.33×10^{-9}
ft^3	28.317	0.02832	1728	1	7.48	2.296×10^{-5}	7.48×10^6
Gal	3.785	3.78×10^{-3}	231	0.134	1	3.07×10^{-6}	10^6
ac-ft	1.23×10^6	1233.5	75.3×10^6	43,560	3.26×10^5	1	0.3260
million gallon	3.785×10^6	3785	2.31×10^8	1.34×10^5	10^6	3.0684	1

COMMON CONVERSIONS

1 million gallons per day (MGD) = 1.55 cfs
1 day-second-ft (DSF) = 1.984 acre-ft = 1 cfs for 24 hours
1 cubic foot per second of water falling 8.81 feet = 1 horsepower
1 cubic foot per second of water falling 11.0 feet at 80% efficiency = 1 horsepower
1 inch of depth over one square mile = 2,323,200 cubic feet
1 inch of depth over one square mile = 0.0737 cubic feet per second for one year.

EXHIBIT C

MEMORANDUM OF UNDERSTANDING BETWEEN CORPS OF ENGINEERS AND ALABAMA POWER COMPANY

INSERT SIGNED COPIES: MOU DATED 27 SEP 1972; REVISION TO MOU DATED 11 OCT 1990; AND 2011 "ATTACHMENT"

EXHIBIT D

ALABAMA-COOSA-TALLAPOOSA (ACT) RIVER BASIN

DROUGHT CONTINGENCY PLAN

DROUGHT CONTINGENCY PLAN

FOR

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

ALLATOONA DAM AND LAKE
CARTERS DAM AND LAKE
ALABAMA POWER COMPANY COOSA RIVER PROJECTS
ALABAMA POWER COMPANY TALLAPOOSA RIVER PROJECTS
ALABAMA RIVER PROJECTS

US Army Corps of Engineers ®

South Atlantic Division
Mobile District

December 2014

DRAFT

DROUGHT CONTINGENCY PLAN FOR THE ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

I – INTRODUCTION

1-01. Purpose of Document. The purpose of this Drought Contingency Plan (DCP) is to provide a basic reference for water management decisions and responses to water shortage in the Alabama-Coosa-Tallapoosa (ACT) River Basin induced by climatological droughts. As a water management document it is limited to those drought concerns relating to water control management actions for federal U.S. Army Corps of Engineers (Corps) and Alabama Power Company (APC) dams. This DCP does not prescribe all possible actions that might be taken in a drought situation due to the long-term nature of droughts and unique issues that may arise. The primary value of this DCP is in documenting the overall ACT Basin Drought Management Plan for the system of Corps and APC projects; in documenting the data needed to support water management decisions related to drought regulation; and in defining the coordination needed to manage the ACT project's water resources to ensure that they are used in a manner consistent with the needs which develop during a drought. This DCP addresses the water control regulation of the five Corps impoundments and the APC Coosa and Tallapoosa projects (Table 1) in regard to water control regulation during droughts. Details of the drought management plan as it relates to each project and its water control regulation during droughts are provided in the water control manual within the respective project appendix to the ACT Basin Master Water Control Manual.

II – AUTHORITIES

2-01. Authorities. The following list provides the policies and guidance that are pertinent to the development of drought contingency plans and actions directed therein.

A. ER 1110-2-1941, "Drought Contingency Plans", dated 15 Sep 1981. This regulation provides policy and guidance for the preparation of drought contingency plans as part of the Corps of Engineers' overall water management activities.

B. ER 1110-2-8156, "Preparation of Water Control Manuals", dated 31 Aug 1995. This document provides a guide for preparing water control manuals for individual water resource projects and for overall river basins to include drought contingency plans.

C. ER 1110-2-240, "Water Control Management", dated 8 Oct 1982. This regulation prescribes the policies and procedures to be followed in water management activities including special regulations to be conducted during droughts. It also sets the responsibility and approval authority in development of water control plans.

D. EM 1110-2-3600, "Management of Water Control Systems", dated 30 Nov 1987. This guidance memorandum requires that the drought management plan be incorporated into the project water control manuals and master water control manuals. It also provides guidance in formulating strategies for project regulation during droughts.

DRAFT

Table 1. Reservoir impoundments within the ACT River Basin

River/Project Name	Owner/State/ Year Initially Completed	Total storage at Full Pool (acre-feet)	Conservation Storage (acre-feet)	Percentage of ACT Basin Conservation Storage (%)
Coosawattee River				
Carters Dam and Lake	Corps/GA/1974	383,565	141,402	5.9
Carters Reregulation Dam	Corps/GA/1974	17,500	16,000	0.1
Etowah River				
Allatoona Dam and Lake	Corps/GA/1949	367,471	284,580	10.8
Hickory Log Creek Dam	CCMWA/Canton/ 2007	17,702	NA	NA
Coosa River				
Weiss Dam and Lake	APC/AL/1961	306,655	263,417	10.0
H. Neely Henry Dam and Lake	APC/AL/1966	120,853	118,210	4.5
Logan Martin Dam and Lake	APC/AL/1964	273,467	144,383	5.5
Lay Dam and Lake	APC/AL/1914	262,887	92,352	3.5
Mitchell Dam and Lake	APC/AL/1923	170,783	51,577	1.9
Jordan Dam and Lake	APC/AL/1928	236,130	19,057	0.7
Walter Bouldin Dam	APC/AL/1967	236,130	NA	--
Tallapoosa River				
Harris Dam and Lake	APC/AL/1982	425,721	207,317	7.9
Martin Dam and Lake	APC/AL/1926	1,628,303	1,202,340	45.7
Yates Dam and Lake	APC/AL/1928	53,908	6,928	0.3
Thurlow Dam and Lake	APC/AL/1930	17,976	NA	--
Alabama River				
Robert F. Henry Lock and Dam/R.E. “Bob” Woodruff Lake	Corps/AL/1972	247,210	36,450	1.4
Millers Ferry Lock and Dam/William “Bill” Dannelly Lake	Corps/AL/1969	346,254	46,704	1.8
Claiborne Lock and Dam and Lake	Corps/AL/1969	102,480	NA	--

III – DROUGHT IDENTIFICATION

3-01. <u>Definition</u>. Drought can be defined in different ways - meteorological, hydrological, agricultural, and socioeconomic. In this DCP, the definition of drought used in the *National Study of Water Management During Drought* is used:

> “Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or streamflow.”

That definition defines drought in terms of its impact on water control regulation, reservoir levels, and associated conservation storage. Water management actions during droughts are intended

to balance the water use and water availability to meet water use needs. Because of hydrologic variability, there cannot be 100 percent reliability that all water demands are met. Droughts occasionally will be declared and mitigation or emergency actions initiated to lessen the stresses placed on the water resources within a river basin. Those responses are tactical measures to conserve the available water resources (USACE 2009).

3-02. Drought Identification. There is no known method of predicting how severe or when a drought will occur. There are, however, indicators that are useful in determining when conditions are favorable: below normal rainfall; lower than average inflows; and low reservoir levels, especially immediately after the spring season when rainfall and runoff conditions are normally the highest. When conditions indicate that a drought is imminent, the Corps Water Management Section (WMS) and APC will increase the monitoring of the conditions and evaluate the impacts on reservoir projects if drought conditions continue or become worse for 30-, 60-, or 90-day periods. Additionally, WMS and APC will determine if a change in operating criteria would aid in the total regulation of the river system and if so, what changes would provide the maximum benefits from any available water.

Various products are used to detect and monitor the extent and severity of basin drought conditions. One key indicator is the U.S. Drought Monitor available through the U.S. Drought Portal, www.drought.gov. The National Weather Service (NWS) Climate Prediction Center (CPC) also develops short-term (6- to 10-day and 8- to 14-day) and long-term (1-month and 3-month) precipitation and temperature outlooks and a U.S. Seasonal Drought Outlook, which are useful products for monitoring dry conditions. The Palmer Drought Severity Index is also used as a drought reference. The Palmer index assesses total moisture by using temperature and precipitation to compute water supply and demand and soil moisture. It is considered most relevant for non-irrigated cropland and primarily reflects long-term drought. However, the index requires detailed data and cannot reflect an operation of a reservoir system. The Alabama Office of the State Climatologist also produces a Lawn and Garden Moisture Index for Alabama, Florida, Georgia, and South Carolina, which gives a basin-wide ability to determine the extent and severity of drought conditions. The runoff forecasts developed for both short- and long-range periods reflect drought conditions when appropriate. There is also a heavy reliance on the latest El Niño Southern Oscillation (ENSO) forecast modeling to represent the potential effects of La Niña on drought conditions and spring inflows. Long-range models are used with greater frequency during drought conditions to forecast potential effects on reservoir elevations, ability to meet minimum flows, and water supply availability. A long-term, numerical model, Extended Streamflow Prediction, developed by the NWS, provides probabilistic forecasts of streamflow and reservoir stages on the basis of climatic conditions, streamflow, and soil moisture. Extended Streamflow Prediction results are used in projecting possible future drought conditions. Other parameters and models can indicate a lack of rainfall and runoff and the degree of severity and continuance of a drought. For example, models using data of previous droughts or a percent of current to mean monthly flows with several operational schemes have proven helpful in forecasting reservoir levels for water management planning purposes. Other parameters considered during drought management are the ability of the various lakes to meet the demands placed on storage, the probability that lake elevations will return to normal seasonal levels, basin streamflows, basin groundwater table levels, and the total available storage to meet hydropower marketing system demands.

3-03. Historical Droughts. Drought events have occurred in the ACT Basin with varying degrees of severity and duration. Five of the most significant historical basin wide droughts occurred in 1940-1941, 1954-1958, 1984-1989, 1999-2003, and 2006-2009. The 1984 to 1989 drought caused water shortages across the basin in 1986. This resulted in the need for the

Corps to make adjustments in the water management practices. Water shortages occurred again from 1999 through 2002 and during 2007 through 2008. The 2006 to 2009 drought was the most devastating recorded in Alabama and western Georgia. Precipitation declines began in December 2005. These shortfalls continued through winter 2006-07 and spring 2007, exhibiting the driest winter and spring in the recorded period of record. The Corps and APC had water levels that were among the lowest recorded since the impoundments were constructed. North Georgia received less than 75 percent of normal precipitation (30-year average). The drought reached peak intensity in 2007, resulting in a D-4 Exceptional Drought Intensity (the worst measured) throughout the summer of 2007.

3-04. Severity. Water shortage problems experienced during droughts are not uniform throughout the ACT River Basin. Even during normal, or average, hydrologic conditions, various portions of the basin experience water supply problems. The severity of the problems are primarily attributed to the pattern of human habitation within the basin; the source of water utilized (surface water vs. ground water); and the characteristics of the water resources available for use. During droughts, these problems can be intensified. A severe drought in the basin develops when a deficiency of rainfall occurs over a long time period and has a typical duration of 18 to 24 months. The number of months of below normal rainfall is more significant in determining the magnitude of a drought in the basin than the severity of the deficiency in specific months. However, the severity of the rainfall deficiency during the normal spring wet season has a significant impact on the ability to refill reservoirs after the fall/winter drawdown period. Another confounding factor which influences droughts in the basin is the variability of rainfall over the basin, both temporarily and spatially.

IV – BASIN AND PROJECT DESCRIPTION

4-01. Basin Description. The headwater streams of the Alabama-Coosa-Tallapoosa (ACT) River Basin rise in the Blue Ridge Mountains of Georgia and Tennessee and flow southwest, combining at Rome, Georgia, to form the Coosa River. The confluence of the Coosa and Tallapoosa Rivers in central Alabama forms the Alabama River near Wetumpka, Alabama. The Alabama River flows through Montgomery and Selma and joins with the Tombigbee River at the mouth of the ACT Basin to form the Mobile River about 45 miles above Mobile, Alabama. The Mobile River flows into Mobile Bay at an estuary of the Gulf of Mexico. The total drainage area of the ACT Basin is approximately 22,739 square miles: 17,254 square miles in Alabama; 5,385 square miles in Georgia; and 100 square miles in Tennessee. A detailed description of the ACT River Basin is provided in the ACT Master Water Control Manual, Chapter II – Basin Description and Characteristics.

4-02. Project Description. The Corps operates five projects in the ACT Basin: Allatoona Dam and Lake on the Etowah River; Carters Dam and Lake and Reregulation Dam on the Coosawattee River; and Robert F. Henry Lock and Dam, Millers Ferry Lock and Dam, and Claiborne Lock and Dam on the Alabama River. Claiborne is a lock and dam without any appreciable water storage behind it. Robert F. Henry and Millers Ferry are operated as run-of-river projects and only very limited pondage is available to support hydropower peaking and other project purposes. APC owns and operates eleven hydropower dams in the ACT Basin; seven dams on the Coosa River and four dams on the Tallapoosa River. Figure 1 depicts the percentage of conservation storage of each project in the ACT Basin. Figure 2 shows the project locations within the basin. Figure 3 provides a profile of the basin and each project.

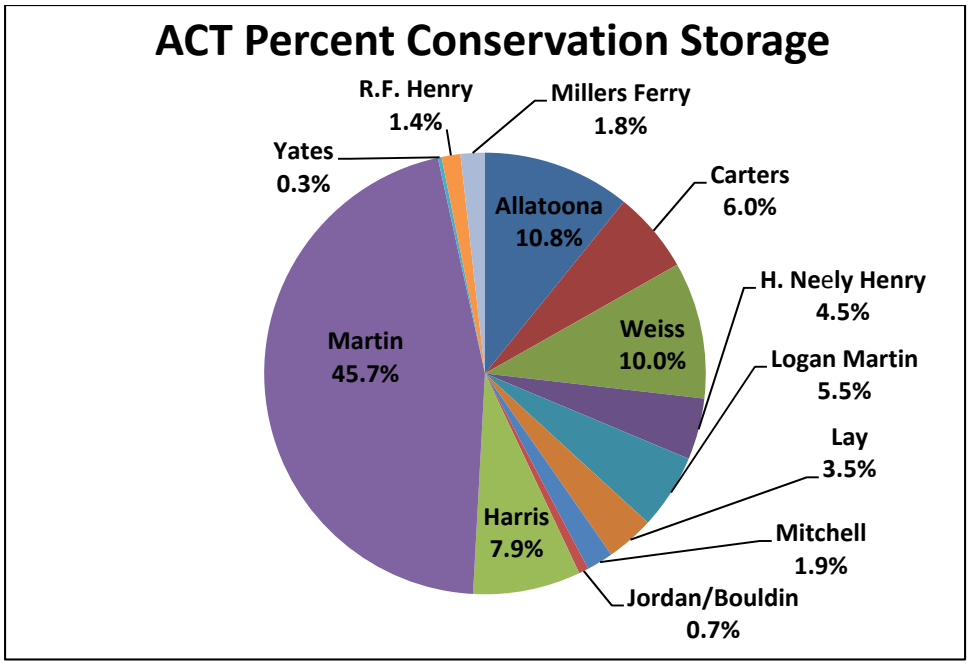


Figure 1. ACT Percent Conservation Storage

A. General. Of the 16 reservoirs (considering Jordan Dam and Lake and Bouldin Dam as one reservoir and Carters Lake and Carters Reregulation Dam as one reservoir), Lake Martin on the Tallapoosa River has the greatest amount of storage, containing 45.7 percent of the conservation storage in the ACT Basin. Allatoona Lake, R.L. Harris Lake, Weiss Lake, and Carters Lake are the next four largest reservoirs respectively, in terms of storage. APC controls approximately 80 percent of the available conservation storage; Corps projects (Robert F. Henry Lock and Dam, Millers Ferry Lock and Dam, Allatoona Lake, and Carters Lake) control 20 percent. The two most upstream Corps reservoirs, Allatoona Lake and Carters Lake, account for 16.8 percent of the total basin conservation storage.

Figure 2. Alabama-Coosa-Tallapoosa River Basin Project Location Map

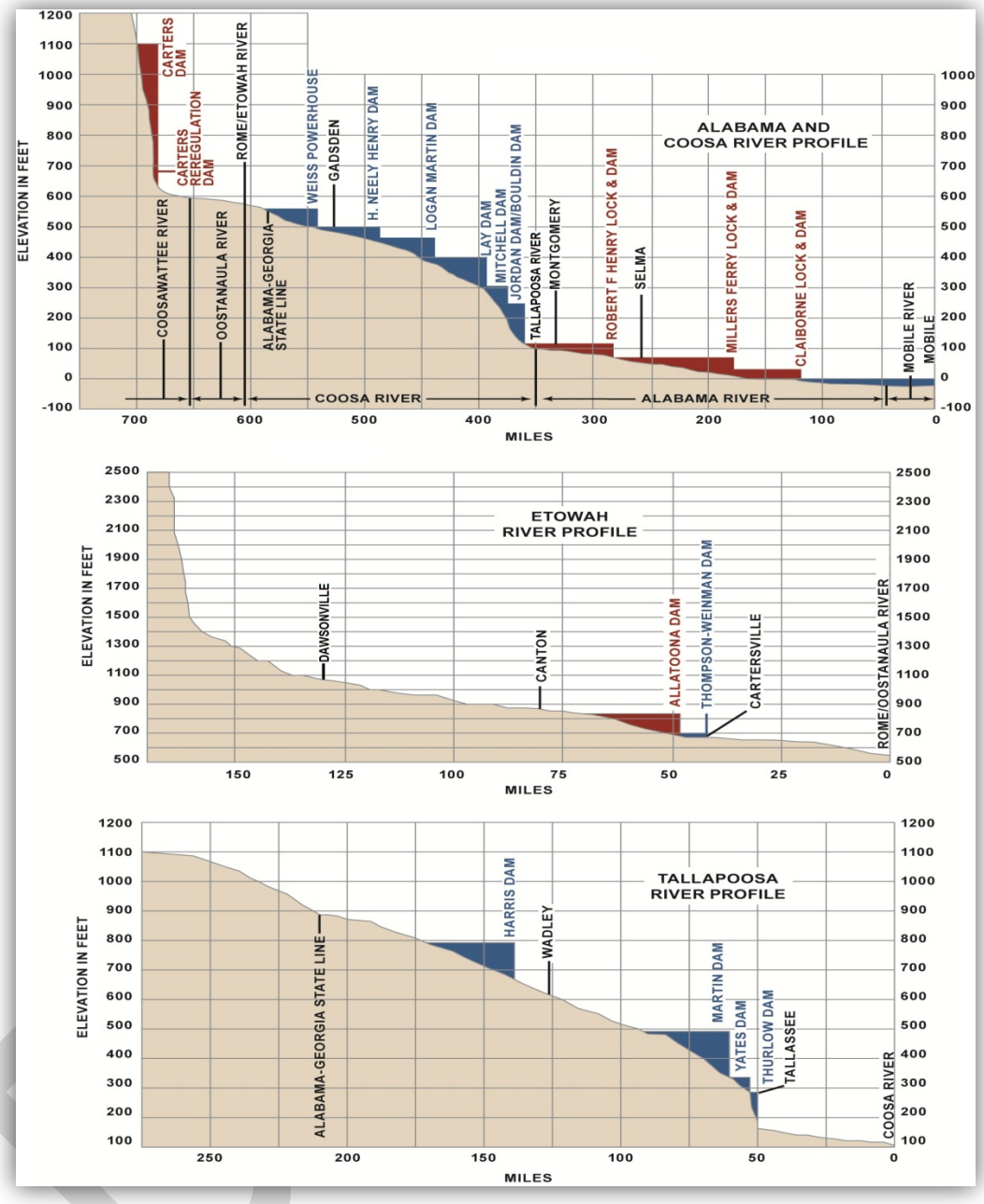


Figure 3. Alabama-Coosa-Tallapoosa River Basin Profile Map

B. Allatoona Dam and Lake. The Allatoona Dam on the Etowah River creates the 11,862 acre Allatoona Lake. The project's authorization, general features, and purposes are described in the Allatoona Dam and Lake Water Control Manual. The Allatoona Lake top of conservation pool is elevation 840 feet NGVD29 during the late spring and summer months (May through August); transitions to elevation 835 feet NGVD29 in the fall (October through mid-November); transitions to a winter drawdown to elevation 823 feet NGVD29 (1-15 January); and refills back to elevation 840 feet NGVD29 during the winter and spring wet season as shown in the water control plan guide curve (Figure 4). However, the lake level may fluctuate significantly from the guide curve over time, dependent primarily upon basin inflows but also influenced by project operations, evaporation, withdrawals, and return flows. A minimum flow of about 240 cfs is continuously released through a small unit, which generates power while providing a constant flow to the Etowah River downstream. Under drier conditions when basin inflows are reduced, project operations are adjusted to conserve storage in Allatoona Lake while continuing to meet project purposes in accordance with four action zones as shown on Figure 4.

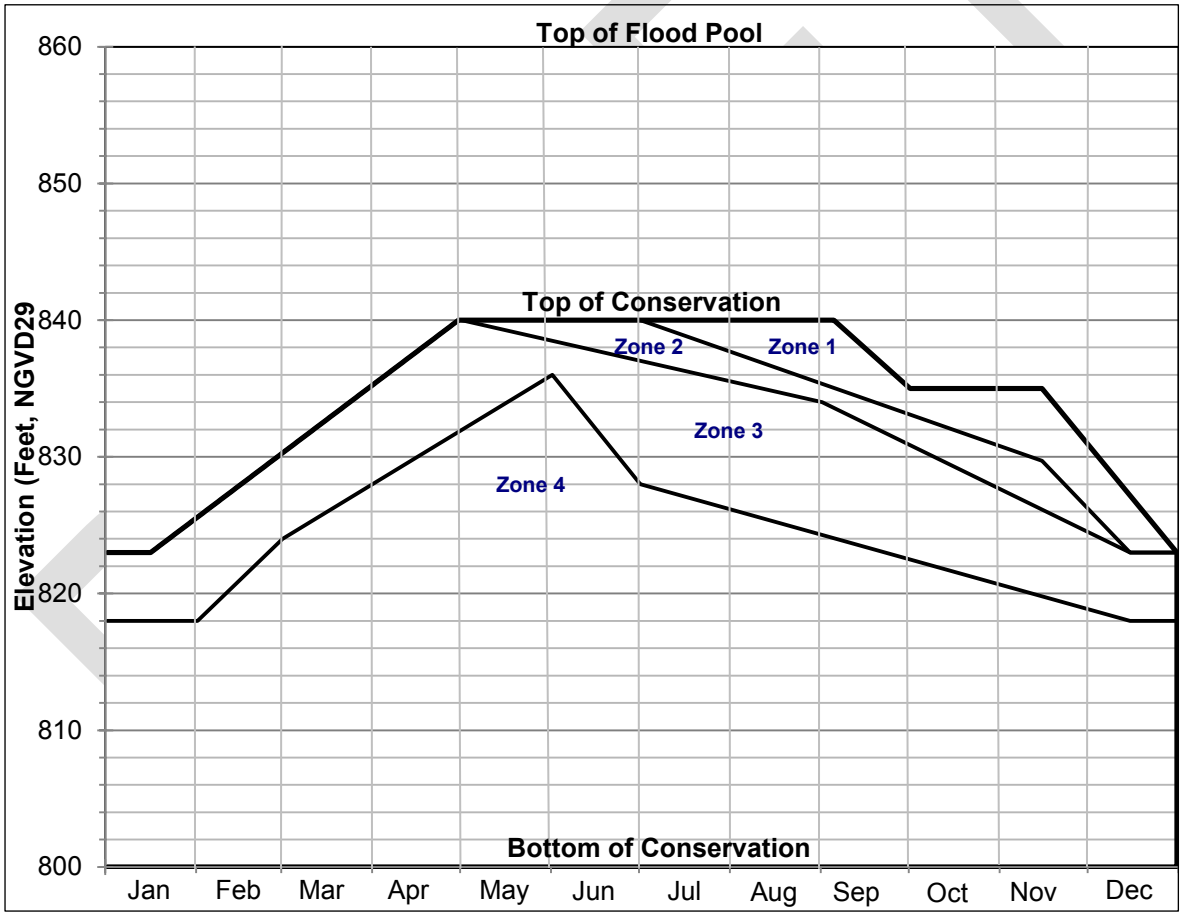


Figure 4. Allatoona Lake Guide Curve and Action Zones

C. Carters Dam and Lake and Reregulation Dam. Carters Lake is formed by Carters Dam, a Corps' reservoir on the Coosawattee River in northwest Georgia upstream of Rome, Georgia. The Carters project is a pumped-storage peaking facility that utilizes a Reregulation Dam and storage pool in conjunction with the main dam and lake. The project's authorization, general

features, and purposes are described in the Carters Dam and Lake and Regulation Dam water control manual. The Carters Lake top of conservation pool is elevation 1,074 feet NGVD29 from 1 May to 1 November; transitioning to elevation 1,072 feet NGVD29 between 1 November and 1 December; remains at elevation 1,072 feet NGVD 29 from 1 December to April; then transitioning back to 1,074 feet NGVD29 between 1 April and 1 May. This is shown in the water control plan guide curve (Figure 5). As expected with a peaking/pumped storage operation, both Carters Lake and the reregulation pool experience frequent elevation changes. Typically, water levels in Carters Lake vary no more than 1 to 2 feet per day. The reregulation pool will routinely fluctuate by several feet (variable) daily as the pool receives peak hydropower discharges from Carters Lake and serves as the source for pumpback operations into Carters Lake during non-peak hours. The reregulation pool will likely reach both its normal maximum elevation of 696 feet NGVD29 and minimum elevation of 677 feet NGVD29 at least once each week. However, the general trend of the lake level may fluctuate significantly from the guide curve over time, dependent primarily upon basin inflows but also influenced by project operations and evaporation. Carters Regulation Dam provides a seasonal varying minimum release to the Coosawattee River for downstream fish and wildlife conservation. Under drier conditions when basin inflows are reduced, project operations are adjusted to conserve storage in Carters Lake while continuing to meet project purposes in accordance with action zones as shown on Figure 5. In Zone 2, Carters Regulations Dam releases are reduced to 240 cfs.

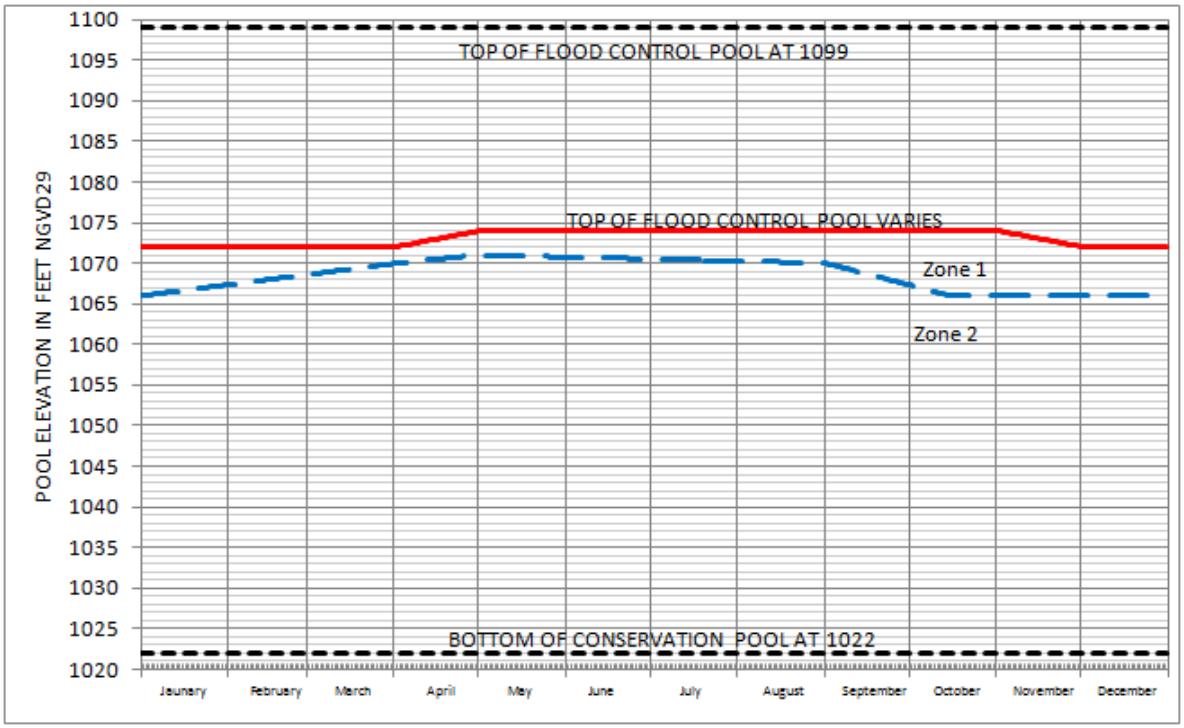


Figure 5. Carters Lake Guide Curve and Action Zones

D. APC Coosa River Projects. APC owns and operates the Coosa Hydro system of projects at Weiss Lake, H. Neely Henry Lake, Logan Martin Lake, Lay Lake, Mitchell Lake, and Jordan/Bouldin Dam and Lake on the Coosa River in the ACT Basin. APC Coosa River projects

function mainly to generate electricity by hydropower. In addition, the upper three projects (Weiss, H. Neely Henry, and Logan Martin) operate pursuant to Public Law 83-436 regarding the requirement for the projects to be operated for flood risk management and navigation in accordance with reasonable rules and regulations of the Secretary of the Army. The rules and regulations are addressed in a memorandum of understanding between the Corps and APC (Exhibit B of the *Master Water Control Manual, Alabama-Coosa-Tallapoosa (ACT) River Basin, Alabama, Georgia*), in individual water control manuals for the three projects, and in this ACT Basin DCP. The Weiss Lake is on the Coosa River in northeast Alabama, about 80 mi northeast of Birmingham, Alabama, and extends into northwest Georgia for about 13 miles upstream on the Coosa River. The dam impounds a 30,027 acres reservoir (Weiss Lake) at the normal summer elevation of 564 feet NGVD29 as depicted in the regulation guide curve shown in Figure 6 (source APC). The H. Neely Henry Lake is on the Coosa River in northeast Alabama, about 60 miles northeast of Birmingham, Alabama. The dam impounds an 11,200 acres reservoir at the normal summer elevation of 508 feet NGVD29 as depicted in the regulation guide curve shown in Figure 7 (source APC). The Logan Martin Lake is in northeast Alabama on the Coosa River, about 40 miles east of Birmingham, Alabama. The dam impounds a 15,269-acre reservoir at the normal summer elevation of 465 feet NGVD29 as depicted in the regulation guide curve shown in Figure 8 (source APC). The projects' authorizations, general features, and purposes are described in the Weiss, H. Neely Henry, and Logan Martin water control manual appendices to the ACT Basin Master Water Control Manual.

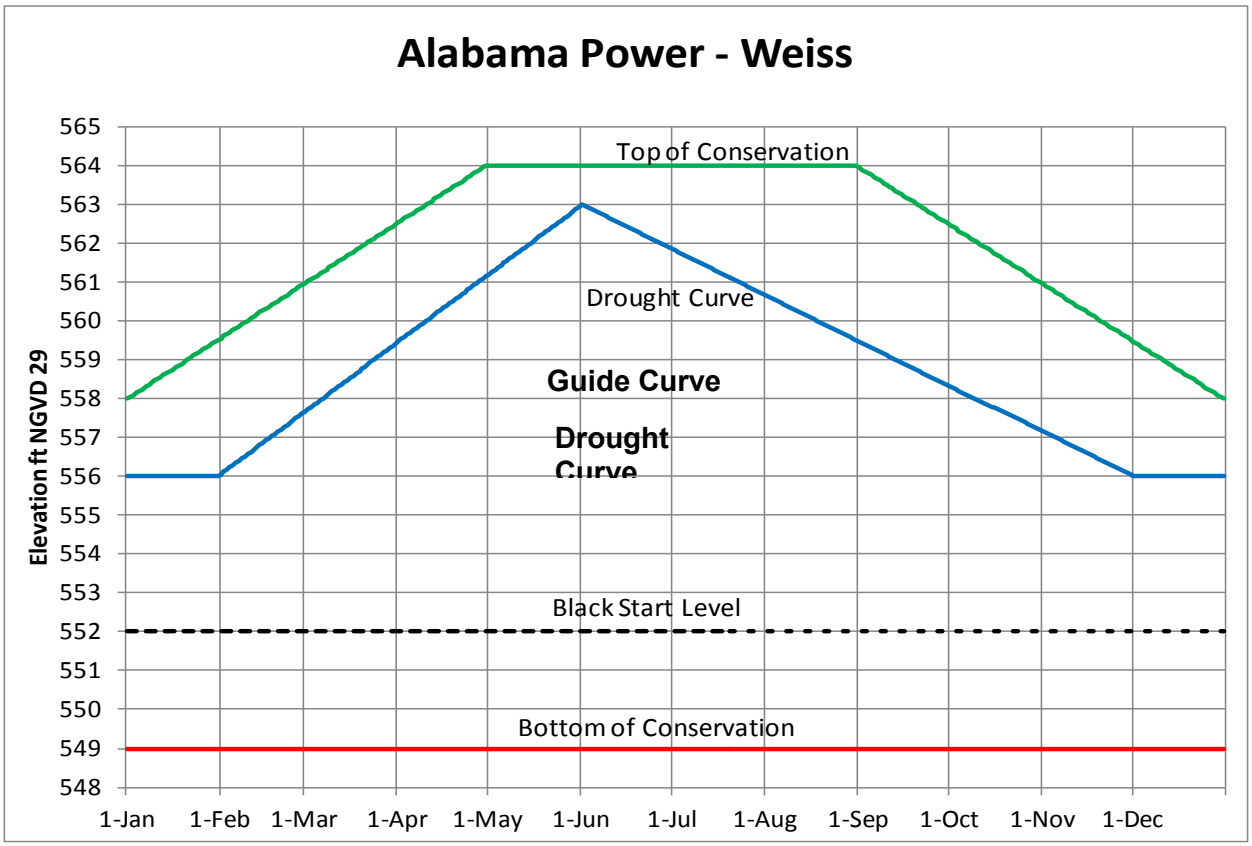


Figure 6. Weiss Lake Guide Curve

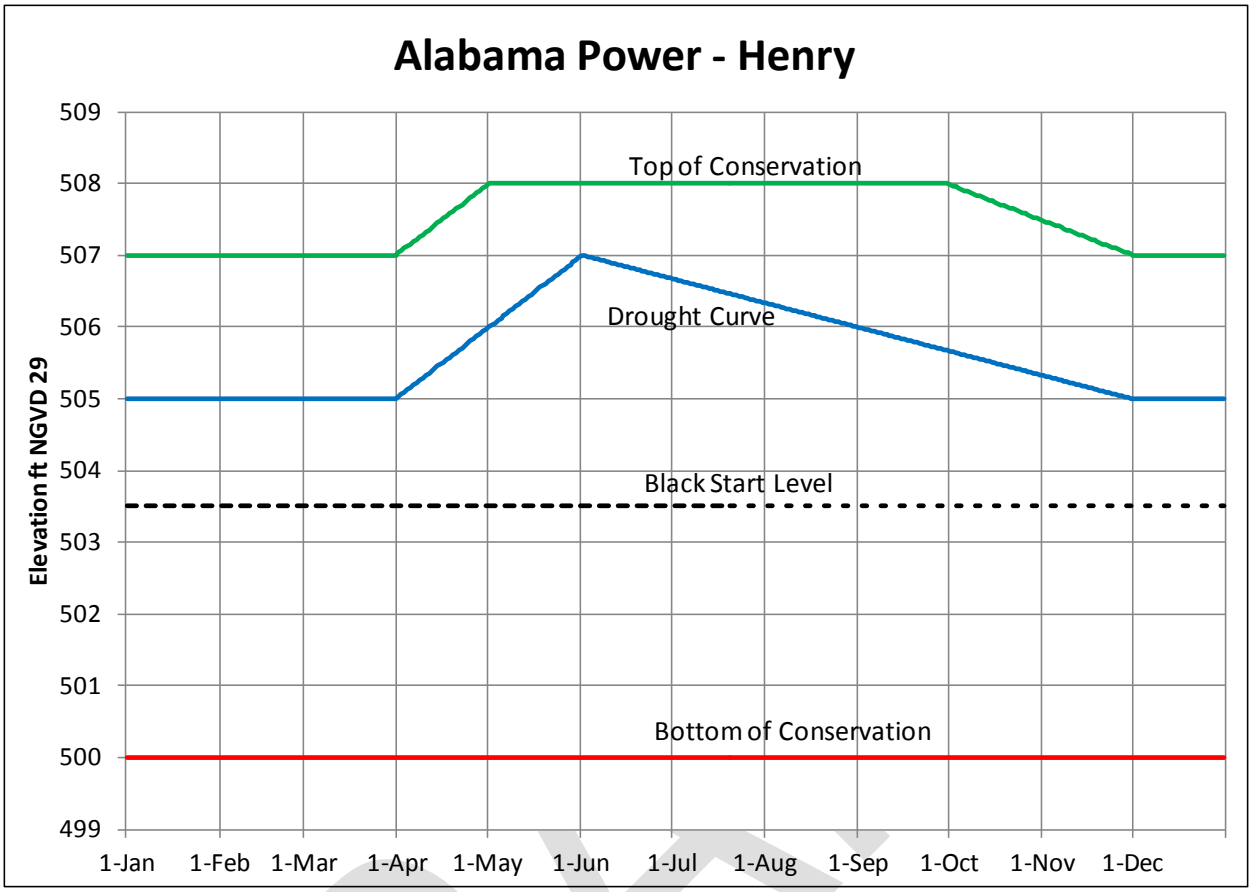


Figure 7. H. Neely Henry Lake Guide Curve

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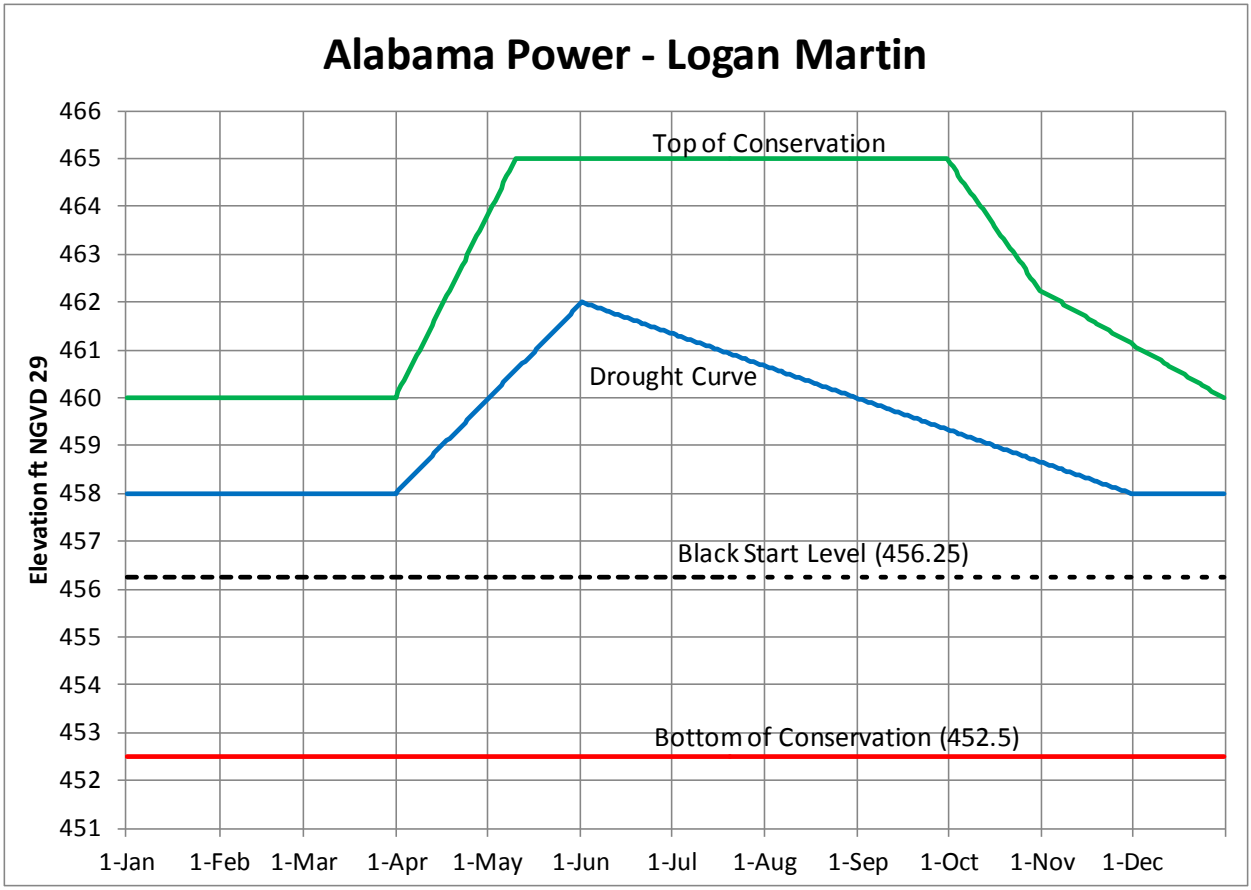

Figure 8. Logan Martin Lake Guide Curve

The downstream Coosa River APC run-of-river hydropower projects (Lay Dam and Lake, Mitchell Dam and Lake, and Jordan/Bouldin Dams and Lake) have no appreciable storage and are operated in conjunction with the upstream Coosa projects to meet downstream flow requirements and targets in support of the ACT Basin Drought Plan and navigation.

E. APC Tallapoosa River Projects. APC owns and operates the Tallapoosa River system of projects at Harris Dam and Lake, Martin Dam and Lake, Yates Dam, and Thurlow Dam in the ACT Basin. APC Tallapoosa River projects function mainly to generate electricity by hydropower. In addition, the Robert L. Harris Project operates pursuant to 33 CFR, Chapter II, Part 208, Section 208.65 regarding the requirement for the project to be operated for flood risk management and navigation in accordance with reasonable rules and regulations of the Secretary of the Army. The rules and regulations prescribed are described in a memorandum of understanding between the Corps and APC, individual water control manuals for the APC projects, and this DCP.

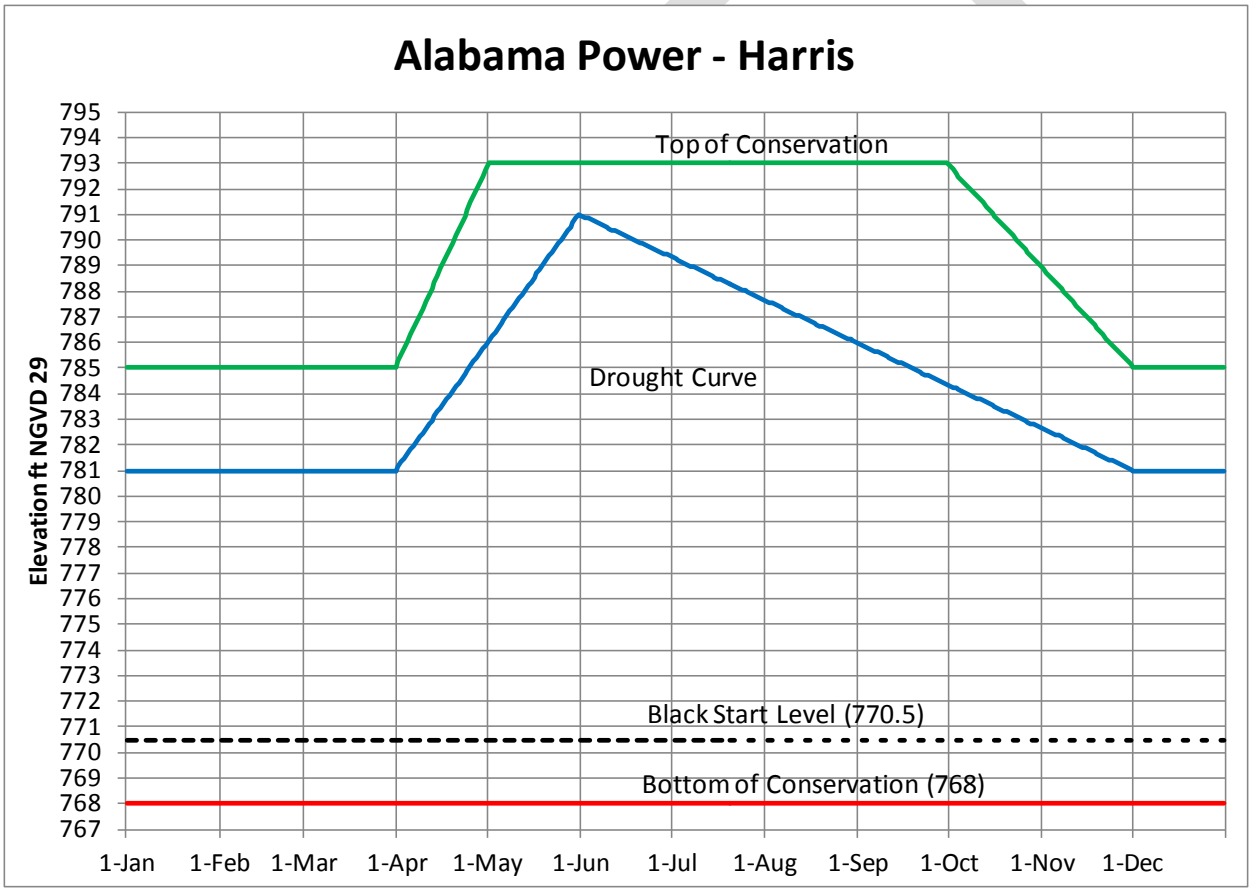

Figure 9. Robert L. Harris Lake Guide Curve

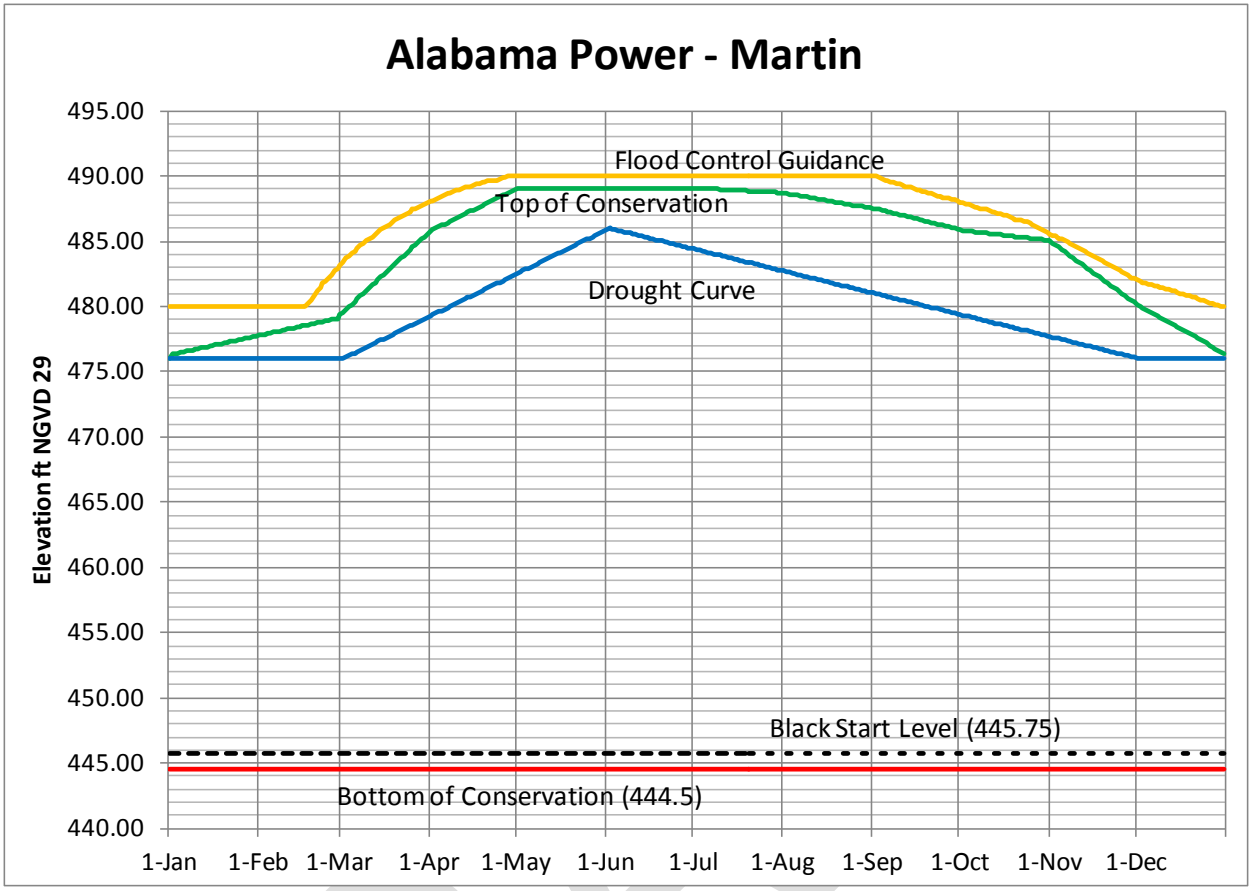

Figure 10. Martin Lake Guide Curve

F. Corps Alabama River Projects. The Corps operates three run-of-river lock and dam projects (Robert F. Henry, Millers Ferry, Claiborne) on the Alabama River in the lower ACT Basin to support commercial navigation. Claiborne Lake, together with R.E. "Bob" Woodruff Lake and William "Bill" Dannelly Lake, are collectively referred to as the Alabama River Lakes. The primary location used for communicating the available reliable navigation depth is the Claiborne Lock and Dam tailwater elevation. The water surface elevation is related to the available navigation depth based on the latest hydrographic surveys of the lower Alabama River reach downstream of Claiborne.

(1) Robert F. Henry. The R.E. "Bob" Woodruff Lake is created by the Robert F. Henry Lock and Dam on the Alabama River at river mile 236.3. R.E. "Bob" Woodruff Lake extends from the Robert F. Henry Lock and Dam upstream to the Walter Bouldin Dam. In addition to hydropower and navigation, R.E. "Bob" Woodruff Lake provides recreation and fish and wildlife conservation. R.E. "Bob" Woodruff Lake is 77 miles long and averages 1,300 feet wide. It has a surface area of 12,510 acres and a storage capacity of 234,200 acre-feet at a normal pool elevation of 126 feet NGVD29. Lake levels are typically fairly stable with minimal fluctuation between the operating pool elevation limits, 123 feet NGVD29 to 126 feet NGVD29. The emergency drawdown pool elevation is 122 feet NGVD29. An authorized 9-foot-deep by 200-foot-wide navigation channel exists over the entire length of the lake. The Jones Bluff

hydropower plant generating capacity is 82 MW (declared value). The lake is a popular recreation destination, receiving up to two million visitors annually.

(2) Millers Ferry. The William "Bill" Dannelly Lake is created by the Millers Ferry Lock and Dam on the Alabama River at river mile 133. William "Bill" Dannelly Lake is 103 miles long and averages almost 1,400 feet wide. The reservoir has a surface area of 18,500 acres and a storage capacity of 346,254 acre-feet at a normal full pool elevation of 80 feet NGVD29. Lake levels remain fairly stable on a day-to-day basis with minimal fluctuation between the operating pool elevation limits, 79 feet NGVD29 to 80 feet NGVD29. It has an authorized 9-foot-deep by 200-foot-wide navigation channel which extends the entire length of the reservoir. The facility is a multipurpose reservoir constructed by the Corps for both navigation and hydropower. The reservoir also provides recreational benefits and has lands managed for wildlife mitigation. The Millers Ferry hydropower plant generating capacity is 90 MW (declared value). The reservoir provides ample recreation opportunities. Recreation visitors number three million annually.

(3) Claiborne. Claiborne Lake is created by the Claiborne Lock and Dam on the Alabama River at river mile 72.5. The lake is similar to a wide river, averaging about 800 feet wide, with a surface area of 5,930 acres. Claiborne Lake extends 60 miles upstream to the Millers Ferry Lock and Dam. Storage capacity in the lake is 96,360 acre-feet at a normal pool elevation of 35 feet NGVD29. The operating pool elevation limits are between 32 feet NGVD29 and 36 feet NGVD29. The lake has an authorized 9-foot-deep, 200-foot-wide navigation channel extending its entire length. The primary purpose of the Corps project is navigation. No hydropower generating capability exists at the project. The lake also provides recreation benefits and lands managed for wildlife mitigation.

G. As other ACT water management objectives are addressed, lake levels might decline during prime recreation periods. Drought conditions will cause further drawdowns in lake levels. While lake levels will be slightly higher than what would naturally occur if no specific drought actions are taken, reservoir levels will decline thus triggering impacts associated with reaching initial recreation and water access limited levels. Large reservoir drawdowns impact recreational use: access to the water for boaters and swimmers is inhibited; submerged hazards (e.g., trees, shoals, boulders) become exposed or nearly exposed, posing safety issues; and exposed banks and lake bottoms become unsightly and diminish the recreation experience. Consequently certain levels are identified in each Corps impoundment at which recreation would be affected. The *Initial Impact level* (IIL) represents the level at which recreation impacts are first observed (i.e., some boat launching ramps are unusable, most beaches are unusable or minimally usable, and navigation hazards begin to surface). The *Recreation Impact level* (RIL) defines the level at which major impacts on concessionaires and recreation are observed (more ramps are not usable, all beaches are unusable, boats begin having problems maneuvering in and out of marina basin areas, loss of retail business occurs). The level at which severe impacts are observed in all aspects of recreational activities is called the *Water Access Limited level* (WAL). At this point, all or almost all boat ramps are out of service, all swimming beaches are unusable, major navigation hazards occur, channels to marinas are impassable and/or wet slips must be relocated, and a majority of private boat docks are unusable. The individual project water control manuals describe the specific impact levels at each project and provide information regarding the effects of the water control plans on recreation.

V – WATER USES AND USERS

5-01. Water Uses and Users.

A. Uses – The ACT Basin rivers and lakes provide for wastewater dilution, M&I water supply, fish and wildlife propagation, hydropower generation, and recreational boating and fishing.

B. Users – The following tables list the surface water uses and water users within Georgia and Alabama in the ACT Basin.

Table 2. Surface water use: ACT Basin (Georgia 2005)

Water use category	Quantity (mgd)	% of total
Total Use	788.98	100%
Public Supply	154.78	19.6%
Domestic and Commercial	0.30	0.0%
Industrial and Mining	32.49	4.1%
Irrigation	11.31	1.4%
Livestock	16.18	2.1%
Thermoelectric Power Generation	573.92	72.8%

Table 3. M&I surface water withdrawal permits in the ACT Basin (Georgia)

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Coosa River Basin (Georgia)—upstream counties to downstream counties						
Coosa	Dalton Utilities, Conasauga R	155-1404-01	Whitfield	Conasauga River	49.400	40.300
Coosa	Dalton Utilities, Mill Creek	155-1404-02	Whitfield	Mill Creek	13.200	7.500
Coosa	Dalton Utilities, Coahulla Cr	155-1404-03	Whitfield	Coahulla Creek	6.000	5.000
Coosa	Dalton Utilities, Freeman Sprngs	155-1404-04	Whitfield	Freeman Springs	2.000	1.500
Coosa	Dalton Utilities - River Road	155-1404-05	Whitfield	Conasauga River	35.000	18.000
Coosa	Chatsworth WW Commission	105-1405-01	Murray	Holly Creek	1.100	1.000
Coosa	Chatsworth WW Commission	105-1405-02	Murray	Eton Springs	1.800	1.800
Coosa	Chatsworth WW Commission	105-1409-01	Murray	Carters Lake	2.550	2.300
Coosa	Chatsworth, City of	105-1493-02	Murray	Coosawattee River	2.200	2.000
Coosa	Ellijay, City of - Ellijay R	061-1407-01	Gilmer	Ellijay River	0.550	0.450
Coosa	Ellijay - Gilmer County W & S Authority	061-1408-01	Gilmer	Cartecay River	4.000	4.000
Coosa	Calhoun, City of	064-1411-03	Gordon	Big Spring	7.000	6.000
Coosa	Calhoun, City of	064-1412-01	Gordon	City Of Calhoun Spring	0.638	0.537
Coosa	Calhoun, City of	064-1492-02	Gordon	Oostanaula River	6.200	3.000

Table 3 (continued). M&I surface water withdrawal permits in the ACT Basin (Georgia)

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Coosa	Calhoun, City of	064-1493-01	Gordon	Coosawattee River	18.000	16.000
Coosa	Jasper, City of	112-1417-02	Pickens	Long Swamp Creek	1.000	1.000
Coosa	Bent Tree Community, Inc.	112-1417-03	Pickens	Chestnut Cove Creek and unnamed creek	0.250	0.230
Coosa	Bent Tree Community, Inc.	112-1417-04	Pickens	Lake Tamarack	0.250	0.230
Coosa	Big Canoe Utilities Company, Inc.	112-1417-05	Pickens	Lake Petit	1.000	1.000
Coosa	Big Canoe Utilities Company, Inc.	112-1417-06	Pickens	Blackwell Creek	2.650	2.650
Coosa	Etowah Water & Sewer Authority	042-1415-01	Dawson	Etowah River	5.500	4.400
Coosa	Cherokee County Water & Sewerage Auth	028-1416-01	Cherokee	Etowah River	43.200	36.000
Coosa	Gold Kist, Inc	028-1491-03	Cherokee	Etowah River	5.000	4.500
Coosa	Canton, City of	028-1491-04	Cherokee	Etowah River	23.000	18.700
Coosa	Canton, City of (Hickory Log Creek)	028-1491-05	Cherokee	Etowah River	39.000	39.000
Coosa	Bartow County Water Department	008-1411-02	Bartow	Bolivar Springs	0.800	0.800
Coosa	Adairsville, City of	008-1412-02	Bartow	Lewis Spring	5.100	4.100
Coosa	New Riverside Ochre Company, Inc.	008-1421-01	Bartow	Etowah River	5.000	5.000
Coosa	New Riverside Ochre Company, Inc.	008-1421-02	Bartow	Etowah River	6.000	6.000
Coosa	Emerson, City of	008-1422-02	Bartow	Moss Springs	0.630	0.500
Coosa	Gerdau AmeriSteel US, Inc. – Cartersville Steel Mill	008-1423-01	Bartow	Pettit Creek	2.000	1.500
Coosa	Baroid Drilling Fluids, Inc.	008-1423-02	Bartow	Etowah River	3.400	2.500
Coosa	Cartersville, City of	008-1423-04	Bartow	Etowah River	26.420	23.000
Coosa	Georgia Power Co. - Plant Bowen	008-1491-01	Bartow	Etowah River	520.000	85.000
Coosa	CCMWA	008-1491-05	Bartow	Allatoona Lake	86.000	78.000
Coosa	Cartersville, City of	008-1491-06	Bartow	Allatoona Lake	21.420	18.000
Coosa	La Fayette, City of Dry Creek	146-1401-01	Walker	Dry Creek	1.000	0.900
Coosa	La Fayette, City of Big Spring	146-1401-02	Walker	Big Spring	1.650	1.310
Coosa	Mount Vernon Mills - Riegel Apparel Div.	027-1401-03	Chattooga	Trion Spring	9.900	6.600
Coosa	Summerville, City of	027-1402-02	Chattooga	Raccoon Creek	3.000	2.500
Coosa	Summerville, City of	027-1402-04	Chattooga	Lowe Spring	0.750	0.500
Coosa	Mohawk Industries, Inc.	027-1402-05	Chattooga	Chattooga R./ Raccoon Cr.	4.500	4.000
Coosa	Oglethorpe Power Corp.	057-1402-03	Floyd	Heath Creek	3,838.000	3,030.000
Coosa	Floyd County - Brighton Plant	057-1414-02	Floyd	Woodward Creek	0.800	0.700

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Table 3 (continued). M&I surface water withdrawal permits in the ACT Basin (Georgia)

River basin	Permit holder	Permit number	County	Source water	Permit limit max day (mgd)	Permit limit monthly average (mgd)
Coosa	Cave Spring, City of	057-1428-06	Floyd	Cave Spring	1.500	1.300
Coosa	Floyd County	057-1428-08	Floyd	Old Mill Spring	4.000	3.500
Coosa	Berry Schools, The (Berry College)	057-1429-01	Floyd	Berry (Possum Trot) Reservoir	1.000	0.700
Coosa	Inland-Rome Inc.	057-1490-01	Floyd	Coosa River	34.000	32.000
Coosa	Georgia Power Co. - Plant Hammond	057-1490-02	Floyd	Coosa River	655.000	655.000
Coosa	Rome, City of	057-1492-01	Floyd	Oostanaula & Etowah R	18.000	16.400
Coosa	Rockmart, City of	115-1425-01	Polk	Euharlee Creek	2.000	1.500
Coosa	Vulcan Construction Materials, L.P.	115-1425-03	Polk	Euharlee Creek	0.200	0.200
Coosa	Cedartown, City of	115-1428-04	Polk	Big Spring	3.000	2.600
Coosa	Polk County Water Authority	115-1428-05	Polk	Aragon, Morgan, Mulco Springs	1.600	1.100
Coosa	Polk County Water Authority	115-1428-07	Polk	Deaton Spring	4.000	4.000
Tallapoosa River Basin (Georgia)						
Tallapoosa	Haralson County Water Authority	071-1301-01	Haralson	Tallapoosa River	3.750	3.750
Tallapoosa	Bremen, City of	071-1301-02	Haralson	Beech Creek & Bremen Reservoir (Bush Creek)	0.800	0.580
Tallapoosa	Bowdon, City of Indian	022-1302-01	Carroll	Indian Creek	0.400	0.360
Tallapoosa	Southwire Company	022-1302-02	Carroll	Buffalo Creek	2.000	1.000
Tallapoosa	Villa Rica, City of	022-1302-04	Carroll	Lake Paradise & Cowens Lake	1.500	1.500
Tallapoosa	Carrollton, City of	022-1302-05	Carroll	Little Tallapoosa River	12.000	12.000
Tallapoosa	Bowdon, City of Lake Tysinger	022-1302-06	Carroll	Lake Tysinger	1.000	1.000

Source: GAEPD 2009a

Table 4. M&I surface water withdrawals in the ACT Basin (Georgia)

Basin (subbasin)	Withdrawal by	County	Withdrawal (mgd)
Coosa River Basin (Georgia)			
Coosa (Conasauga)	Dalton Utilities	Whitfield	35.38
Coosa (Conasauga)	City of Chatsworth	Murray	1.26
Coosa (Coosawattee)	Ellijay-Gilmer County Water System	Gilmer	3.12
Coosa (Coosawattee)	City of Fairmount	Gordon	0.06
Coosa (Oostanaula)	City of Calhoun	Gordon	9.10
Coosa (Etowah)	Big Canoe Corporation	Pickens	0.48
Coosa (Etowah)	City of Jasper	Pickens	1.00
Coosa (Etowah)	Bent Tree Community	Pickens	0.07
Coosa (Etowah)	Lexington Components Inc (Rubber)	Pickens	0.01
Coosa (Etowah)	Etowah Water and Sewer Authority	Dawson	1.50
Coosa (Etowah)	Town of Dawsonville	Dawson	0.10
Coosa (Etowah)	City of Canton	Cherokee	2.83
Coosa (Etowah)	Cherokee County Water System	Cherokee	15.81
Coosa (Etowah)a	Gold Kist, Inc.	Cherokee	1.94

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Table 4 (continued). M&I surface water withdrawals in the ACT Basin (Georgia)

Basin (subbasin)	Withdrawal by	County	Withdrawal (mgd)
Coosa (Etowah)	City of Cartersville	Bartow	13.26
Coosa (Etowah)	New Riverside Ochre Company, Inc (Chemicals)	Bartow	1.67
Coosa (Etowah)	Gerdau AmeriSteel US, Inc. – Cartersville Steel Mill (Primary metals)	Bartow	0.16
Coosa (Etowah)	Georgia Power Co – Plant Bowen	Bartow	38.92
Coosa (Etowah)	CCMWA	Bartow	44.42
Coosa (Upper Coosa)	City of Lafayette	Walker	1.20
Coosa (Upper Coosa)	City of Summerville	Chattooga	2.05
Coosa (Upper Coosa)	Mount Vernon Mills – Riegel Apparel Division (Textiles)	Chattooga	2.74
Coosa (Oostanaula)	City of Cave Spring (Domestic/Commercial)	Floyd	0.30
Coosa (Etowah / Oostanaula)	City of Rome	Floyd	9.98
Coosa (Upper Coosa)	Floyd County Water System	Floyd	2.57
Coosa (Upper Coosa)	Inland-Rome Inc. (Paper)	Floyd	25.74
Coosa (Upper Coosa)	Georgia Power Co - Plant Hammond	Floyd	535.00
Coosa (Upper Coosa)	Polk County Water Authority	Polk	2.22
Coosa (Etowah)	Vulcan Construction Materials	Polk	0.09
Tallapoosa River Basin (Georgia)			
Tallapoosa (Upper)	City of Bremen	Haralson	0.32
Tallapoosa (Upper)	Haralson County Water Authority	Haralson	2.05
Tallapoosa (Upper)	City of Bowdon	Carroll	0.75
Tallapoosa (Upper)	Southwire Company	Carroll	0.09
Tallapoosa (Upper)	City of Carrollton	Carroll	5.37
Tallapoosa (Upper)	City of Temple	Carroll	0.26
Tallapoosa (Upper)	City of Villa Rica	Carroll	0.58
Tallapoosa (Upper)	Carroll County Water System	Carroll	4.08

Table 5. Surface water use - ACT Basin (Alabama, 2005) (mgd)

ACT subbasin	HUC	Public supply	Industrial	Irrigation	Livestock	Thermo-electric	Total, by Subbasin
Upper Coosa	03150105	2.12	0	3.10	0.40	0	5.62
Middle Coosa	03150106	33.24	65.83	7.91	0.87	142.68	250.53
Lower Coosa	03150107	10.96	0.89	5.10	0.35	812.32	829.62
Upper Tallapoosa	03150108	0.90	0	0.15	0.40	0	1.45
Middle Tallapoosa	03150109	19.09	0	0.52	0.32	0	19.93
Lower Tallapoosa	03150110	38.22	2.23	4.22	0.28	0	44.95
Upper Alabama	03150201	10.40	30.63	3.84	0.84	4.14	49.85
Cahaba	03150202	52.90	0	3.49	0.25	0	56.64
Middle Alabama	03150203	0	21.04	1.73	0.48	0	23.25
Lower Alabama	03150204	0	54.61	0.64	0.02	0	55.27
Total - By Use Category		167.83	175.23	30.70	4.21	959.14	1337.11

Source: Hutson et al. 2009

Table 6. M&I surface water withdrawals in the ACT Basin (Alabama)

Basin (subbasin)	Withdrawal by	County	Withdrawal (mgd)
Coosa River Basin (Alabama)			
Coosa (Upper)	Centre Water Works & Sewer Board	Cherokee	1.19
Coosa (Upper)	Piedmont Water Works & Sewer Board	Calhoun	0.93
Coosa (Middle)	Jacksonville Water Works & Sewer Board	Calhoun	1.34
Coosa (Middle)	Anniston Water Works & Sewer Board	Calhoun	0.08
Coosa (Middle)	Fort Payne Water Works Board	DeKalb	8.10
Coosa (Middle)	Goodyear Tire and Rubber Company	Etowah	9.87
Coosa (Middle)	Gadsden Water Works & Sewer Board	Etowah	14.86
Coosa (Middle)	Alabama Power Co – Gadsden Steam Plant	Etowah	142.68
Coosa (Middle)	SIC 32 – Unnamed Stone, Glass, Clay, and/or Concrete Products	St. Clair	3.49
Coosa (Middle)	Talladega/Shelby Water Treatment Plant	Talladega	6.44
Coosa (Middle)	Talladega County Water Department	Talladega	0.81
Coosa (Middle)	Talladega Water Works & Sewer Board	Talladega	1.62
Coosa (Middle)	Bowater Newsprint, Coosa Pines Operation	Talladega	52.47
Coosa (Lower)	Sylacauga Utilities Board	Talladega	3.25
Coosa (Lower)	SIC 22 – Unnamed Textile	Talladega	0.89
Coosa (Lower)	Goodwater Water Works & Sewer Board	Coosa	0.46
Coosa (Lower)	Alabama Power Co – E.C. Gaston Plant	Shelby	812.32
Coosa (Lower)	Clanton Waterworks & Sewer Board	Chilton	1.79
Coosa (Lower)	Five Star Water Supply	Elmore	5.46
Tallapoosa River Basin (Alabama)			
Tallapoosa (Upper)	Heflin Water Works	Cleburne	0.51
Tallapoosa (Upper)	Wedowee Gas, Water, and Sewer	Randolph	0.39
Tallapoosa (Middle)	Roanoke Utilities Board	Randolph	1.29
Tallapoosa (Middle)	Clay County Water Authority	Clay	1.87
Tallapoosa (Middle)	Lafayette	Chambers	0.53
Tallapoosa (Middle)	Central Elmore Water & Sewer Authority	Elmore	4.83
Basin (subbasin)	**Withdrawal by**	**County**	**Withdrawal (mgd)**
Tallapoosa (Middle)	Alexander City Water Department	Tallapoosa	10.57
Tallapoosa (Lower)	West Point Home, Inc	Lee	2.23
Tallapoosa (Lower)	Opelika Water Works Board	Lee	2.61
Tallapoosa (Lower)	Auburn Water Works Board	Lee	5.75
Tallapoosa (Lower)	Tallassee	Tallapoosa	1.98
Tallapoosa (Lower)	Tuskegee Utilities	Macon	2.71
Tallapoosa (Lower)	Montgomery Water Works & Sewer Board	Montgomery	25.17
Alabama River Basin			
Alabama (Upper)	Montgomery Water Works & Sewer Board	Montgomery	10.40
Alabama (Upper)	International Paper	Autauga	30.63
Alabama (Upper)	Southern Power Co – Plant E. B. Harris	Autauga	4.14
Alabama (Cahaba)	Birmingham Water Works & Sewer Board	Shelby	52.90
Alabama (Middle)	International Paper – Pine Hill	Wilcox	21.04
Alabama (Lower)	Alabama River Pulp Company	Monroe	54.61

Source: Hutson et al. 2009

VI. – CONSTRAINTS

6-01. General. The availability of water resources in the ACT Basin is constrained by existing water supply storage contracts, Corps water control manuals, minimum flow requirements from Allatoona and Carters Dams, APC FERC licenses, Corps-APC Memorandum of Understanding, and industrial water quality flow needs. Existing water supply storage contracts do not include the use of the inactive storage pool and would require developing and implementing an emergency storage contract in order to access this water resource. Each Corps project has a water control manual that specifies operational requirements for varying basin conditions and requires a deviation approval to operate outside the parameters established by the manual. The Allatoona Project has a minimum flow release requirement of 240 cfs for downstream purposes. The Carters Project has a seasonally varying minimum flow release requirement that

ranges from 250 – 865 cfs during normal conditions and a minimum of 240 cfs during low flow conditions. The APC projects are operated under FERC licenses which define specific operational requirements for each project and require approval from FERC and possibly the Corps and State agencies before any revised operations could be implemented. The Corps and APC projects are also operated under the rules and regulations found in the Corps-APC Memorandum of Understanding, which describes operational requirements for flood conditions and navigation within the ACT Basin. Some industrial NPDES permits within the ACT Basin have water quality discharge limitations which are impacted by the volume of water flow in the river.

VII – DROUGHT MANAGEMENT PLAN

7-01. General. The Drought Contingency Plan (DCP) for the ACT Basin implements drought conservation actions on the basis of composite system storage, state line flows, and basin inflow as triggers to drive drought response actions. The DCP also recognizes that a basin-wide drought plan must incorporate variable hydropower generation requirements from its headwater projects in Georgia (Allatoona Dam and Carters Dam), a reduction in the level of navigation service provided on the Alabama River as storage across the basin declines, and that environmental flow requirements must still be met to the maximum extent practicable. The Act basin-wide drought plan is composed of three components — Headwater regulation at Allatoona Lake and Carters Lake in Georgia; Regulation at APC projects on the Coosa and Tallapoosa Rivers; and Downstream Alabama River regulation at Corps projects downstream of Montgomery, Alabama.

A. Headwater Regulation for Drought at Allatoona Lake and Carters Lake. Drought regulation at Allatoona Lake and Carters Lake consists of progressively reduced hydropower generation as pool levels decline in accordance with the conservation storage action zones established in the projects' water control plans. For instance, when Allatoona Lake is operating in normal conditions (Conservation storage Zone 1); hydropower generation typically ranges from 0 to 4 hours per day. However, as the pool drops to lower action zones during drought conditions, generation could be reduced to 0 to 2 hours per day. As Carters Lake pool level might drop into a conservation storage Zone 2, seasonal varying minimum target flows would be reduced to 240 cfs. The water control manual for each project describes the drought water control regulation plan in more detail.

B. Drought Regulation at APC Projects on the Coosa, Tallapoosa, and Alabama River. Regulation guidelines for the Coosa, Tallapoosa, and Alabama Rivers have been defined in a drought regulation matrix (Table 7) on the basis of a Drought Intensity Level (DIL). The DIL is a drought indicator, ranging from one to three. The DIL is determined on the basis of three basin drought criteria (or triggers). A DIL from 1 to 3 indicates some level of drought conditions. The DIL increases as more of the drought indicator thresholds (or triggers) occur. The drought regulation matrix defines minimum average daily flow requirements on a monthly basis for the Coosa, Tallapoosa, and Alabama Rivers as a function of the DIL and time of year. The combined occurrences of the drought triggers determine the DIL. Three intensity levels for drought operations are applicable to APC projects.

DIL 1 — (moderate drought) 1 of 3 triggers occur
DIL 2 — (severe drought) 2 of 3 triggers occur
DIL 3 — (exceptional drought) all 3 triggers occur

(1) Drought Indicators. The indicators used to determine drought intensity include the following:

1. **Low basin inflow**. The total basin inflow needed is the sum of the total filling volume plus 4,640 cfs. The total filling volume is defined as the volume of water required to return the pool to the top of the conservation guide curve and is calculated using the area-capacity tables for each project. Table 8 lists the monthly low basin inflow criteria. The basin inflow value is computed daily and checked on the first and third Tuesday of the month. If computed basin inflow is less than the value required, the low basin inflow indicator is triggered. The basin inflow is total flow above the APC projects excluding Allatoona Lake and Carters Lake. It is the sum of local flows, minus lake evaporation and diversions. Figure 11 illustrates the local inflows to the Coosa and Tallapoosa Basins. The basin inflow computation differs from the navigation basin inflow, because it does not include releases from Allatoona Lake and Carters Lake. The intent is to capture the hydrologic condition across APC projects in the Coosa and Tallapoosa Basins.

Table 7. ACT Basin Drought Regulation Plan Matrix

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought Level Response[a]	Normal Operations											
	DIL 1: Low Basin Inflows or Low Composite or Low State Line Flow											
	DIL 2: DIL 1 criteria + (Low Basin Inflows or Low Composite or Low State Line Flow)											
	DIL 3: Low Basin Inflows + Low Composite + Low State Line Flow											
Coosa River Flow[b]	Normal Operation: 2,000 cfs			4,000 (8,000)		4,000 – 2,000	Normal Operation: 2,000 cfs					
	Jordan 2,000 +/-cfs			4,000 +/- cfs		6/15 Linear Ramp down	Jordan 2,000 +/-cfs			Jordan 2,000 +/-cfs		
	Jordan 1,600 to 2,000 +/-cfs			2,500 +/- cfs		6/15 Linear Ramp down	Jordan 2,000 +/-cfs			Jordan 1,600 to 2,000 +/-cfs		
	Jordan 1,600 +/-cfs			Jordan 1,600 to 2,000 +/-cfs			Jordan 2,000 +/-cfs			Jordan 1,600 to 2,000 +/-cfs		Jordan 1,600 +/-cfs
Tallapoosa River Flow[c]	Normal Operations: 1200 cfs											
	Greater of: 1/2 Yates Inflow or 2 x Heflin Gage(Thurlow Lake releases > 350 cfs)				1/2 Yates Inflow					1/2 Yates Inflow		
	Thurlow Lake 350 cfs				1/2 Yates Inflow					Thurlow Lake 350 cfs		
	Maintain 400 cfs at Montgomery WTP (Thurlow Lake release 350 cfs)						Thurlow Lake 350 cfs			Maintain 400 cfs at Montgomery WTP (Thurlow Lake release 350 cfs)		
Alabama River Flow[d]	Normal Operation: Navigation or 4,640 cfs flow											
	4,200 cfs (10% Cut) - Montgomery				4,640 cfs - Montgomery					Reduce: Full – 4,200 cfs		
	3,700 cfs (20% Cut) - Montgomery					4,200 cfs (10% Cut) - Montgomery				Reduce: 4,200 cfs-> 3,700 cfs Montgomery (1 week ramp)		
	2,000 cfs Montgomery				3,700 cfs Montgomery		4,200 cfs (10% Cut) - Montgomery			Reduce: 4,200 cfs -> 2,000 cfs Montgomery (1 month ramp)		
Guide Curve Elevation	Normal Operations: Elevations follow Guide Curves as prescribed in License (Measured in Feet)											
	Corps Variances: As Needed; FERC Variance for Lake Martin											
	Corps Variances: As Needed; FERC Variance for Lake Martin											
	Corps Variances: As Needed; FERC Variance for Lake Martin											

a. Note these are based on flows that will be exceeded when possible.
b .Jordan flows are based on a continuous +/- 5% of target flow.
c. Thurlow Lake flows are based on continuous +/- 5% of target flow: flows are reset on noon each Tuesday based on the prior day's daily average at Heflin or Yates.
d. Alabama River flows are 7-Day Average Flow.

Table 8. Low Basin Inflow Guide (in cfs-days)

Month	Coosa Filling Volume	Tallapoosa Filling Volume	Total Filling Volume	Minimum JBT Target Flow	Required Basin Inflow
Jan	628	0	628	4,640	5,268
Feb	626	1,968	2,594	4,640	7,234
Mar	603	2,900	3,503	4,640	8,143
Apr	1,683	2,585	4,269	4,640	8,909
May	248	0	248	4,640	4,888
Jun			0	4,640	4,640
Jul			0	4,640	4,640
Aug			0	4,640	4,640
Sep	–612	–1,304	–1,916	4,640	2,724
Oct	–1,371	–2,132	–3,503	4,640	1,137
Nov	–920	–2,748	–3,667	4,640	973
Dec	–821	–1,126	–1,946	4,640	2,694

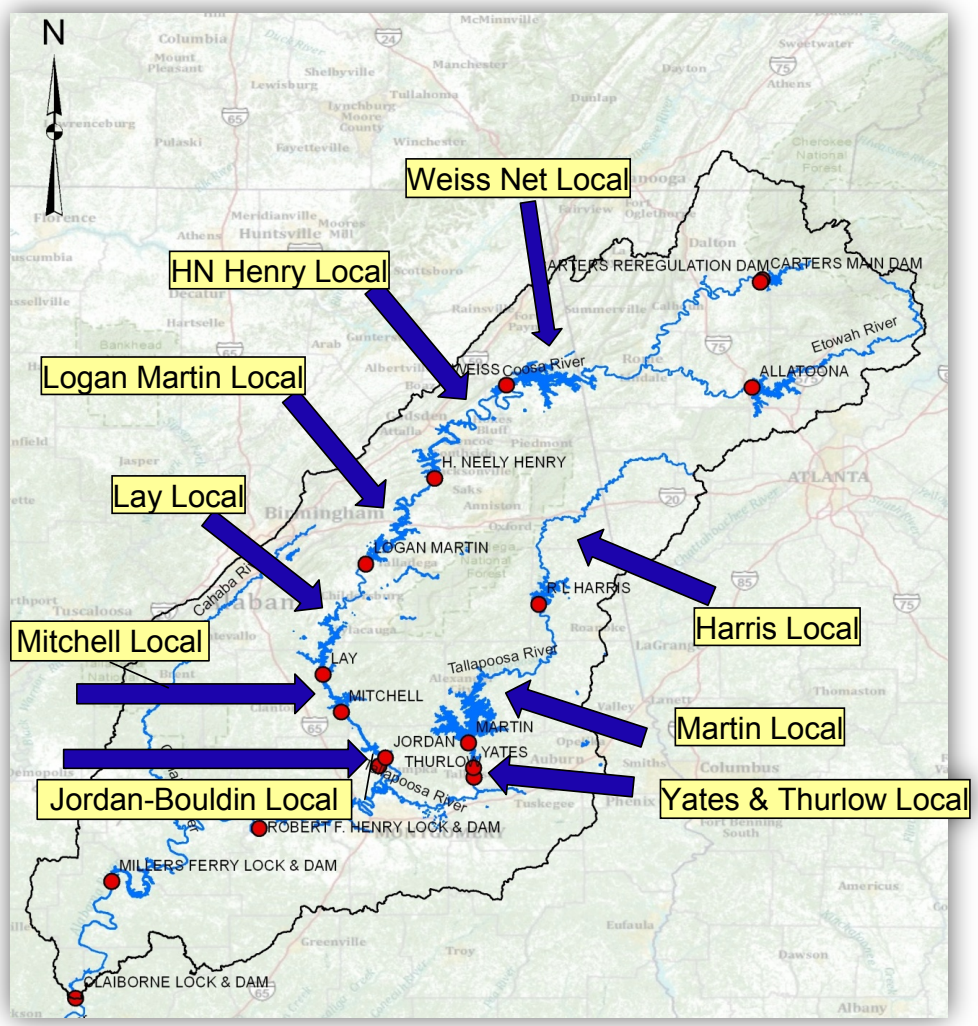

Figure 11. ACT Basin Inflows

2. **Low composite conservation storage**. Low composite conservation storage occurs when the APC projects' composite conservation storage is less than or equal to the storage available within the drought contingency curves for the APC reservoirs. Composite conservation storage is the sum of the amounts of storage available at the current elevation for each reservoir down to the drought contingency curve at each APC major storage project. The reservoirs considered for the trigger are R.L. Harris Lake, H. Neely Henry Lake, Logan Martin Lake, Lake Martin, and Weiss Lake. Figure 12 plots the APC composite zones. Figure 13 plots the APC low composite conservation storage trigger. If the actual active composite conservation storage is less than or equal to the active composite drought zone storage, the low composite conservation storage indicator is triggered. That computation is performed on the first and third Tuesday of each month, and is considered along with the low state line flow trigger and basin inflow trigger.

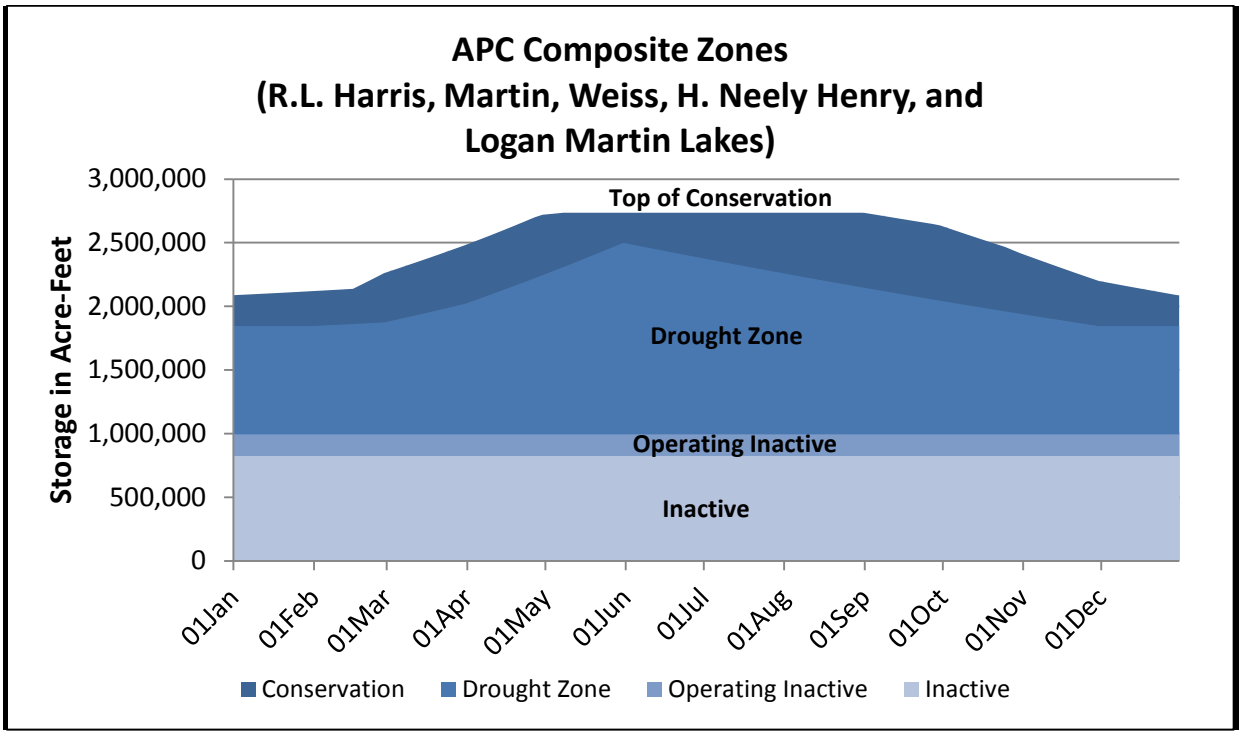

Figure 12. APC Composite Zones

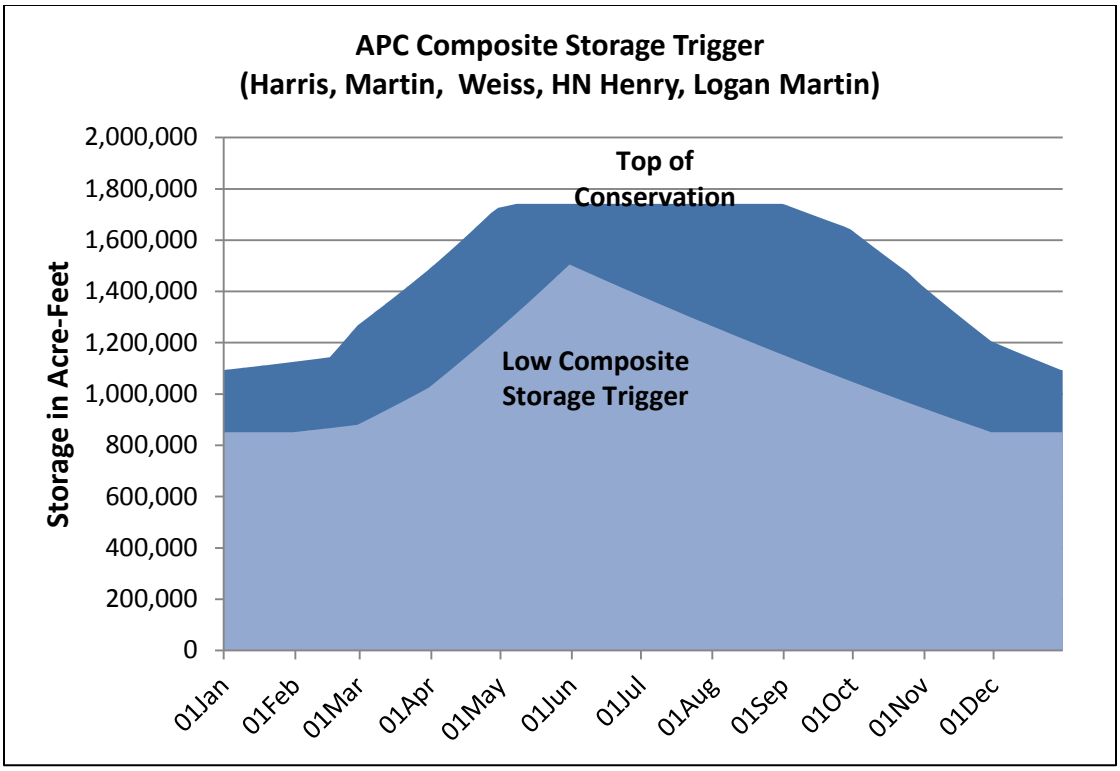

Figure 13. APC Low Composite Conservation Storage Drought Trigger

3. **Low state line flow**. A low state line flow trigger occurs when the Mayo's Bar USGS gage measures a flow below the monthly historical 7Q10 flow. The 7Q10 flow is defined as the lowest flow over a 7-day period that would occur once in 10 years. Table 9 lists the Mayo's Bar 7Q10 value for each month (determined from observed flows from 1949 – 2006). The lowest 7-day average flow over the past 14 days is computed and checked at the first and third Tuesday of the month. If the lowest 7-day average value is less than the Mayo's Bar 7Q10 value, the low state line flow indicator is triggered. If the result is greater than or equal to the trigger value from Table 9, the flow is considered normal, and the state line flow indicator is not triggered. The term state line flow is used in developing the drought management plan because of the proximity of the Mayo's Bar gage to the Alabama-Georgia state line and because it relates to flow data upstream of the Alabama-based APC reservoirs. State line flow is used only as a source of observed data for one of the three triggers and does not imply that flow targets exist at that geographic location. The ACT Basin drought matrix does not include or imply any Corps regulation that would result in water management decisions at Carters Lake or Allatoona Lake.

Table 9. State Line Flow Triggers

Month	Mayo's Bar (7Q10 in cfs)
Jan	2,544
Feb	2,982
Mar	3,258
Apr	2,911
May	2,497
Jun	2,153
Jul	1,693
Aug	1,601
Sep	1,406
Oct	1,325
Nov	1,608
Dec	2,043

Note: Based on USGS Coosa River at Rome Gage (Mayo's Bar, USGS 02397000) observed flow from 1949 to 2006

(2) Drought Regulation. The DIL is computed on the first and third Tuesday of each month. Once a drought operation is triggered, the DIL can only recover from drought condition at a rate of one level per period. For example, as the system begins to recover from an exceptional drought with DIL 3, the DIL must be stepped incrementally back to zero to resume normal operations. In that case, even if the system triggers return to normal quickly, it will still take at least a month before normal operations can resume - conditions can improve only to DIL 2 for the next 15 days, then DIL 1 for the next 15 days, before finally returning to normal operating conditions.

For normal operations, the matrix shows a Coosa River flow between 2,000 cfs and 4,000 cfs with peaking periods up to 8,000 cfs occurring. The required flow on the Tallapoosa River is a constant 1,200 cfs throughout the year. The navigation flows on the Alabama River are applied to the APC projects. The required navigation depth on the Alabama River is subject to the basin inflow.

For DIL 1, the Coosa River flow varies from 2,000 cfs to 4,000 cfs. On the Tallapoosa River, the required flow is the greater of one-half of the inflow into Yates Lake or twice the Heflin USGS gage from January thru April. For the remainder of the year, the required flow is one-half of Yates Lake inflow. The required flows on the Alabama River are reduced from the amounts required for DIL 0.

For DIL 2, the Coosa River flow varies from 1,800 cfs to 2,500 cfs. On the Tallapoosa River, the minimum is 350 cfs for part of the year and one-half of Yates Lake inflow for the remainder of the year. The requirement on the Alabama River is between 3,700 cfs and 4,200 cfs.

For DIL 3, the flows on the Coosa River range from 1,600 cfs to 2,000 cfs. A constant flow of 350 cfs on the Tallapoosa River is required. It is assumed an additional 50 cfs will occur between Thurlow Lake and the City of Montgomery water supply intake. Required flows on the Alabama River range from 2,000 cfs to 4,200 cfs

In addition to the flow regulation for drought conditions, the DIL affects the flow regulation to support navigation operations. Under normal operations, the APC projects are operated to meet the needed navigation flow target or 4,640 cfs flow as defined in the navigation measure section. Once drought operations begin, flow regulation to support navigation operations is suspended.

7-02. Extreme Drought Conditions. An extreme drought condition exists when the remaining composite conservation storage is depleted, and additional emergency actions may be necessary. When conditions have worsened to this extent, utilization of the inactive storage must be considered. Such an occurrence would typically be contemplated in the second or third year of a drought. Inactive storage capacities have been identified for the two federal projects with significant storage (Figures 14 and 15). The operational concept established for the extreme drought impact level and to be implemented when instituting the use of inactive storage is based on the following actions:

(1) Inactive storage availability is identified to meet specific critical water use needs within existing project authorizations.

(2) Emergency uses and users will be identified in accordance with emergency authorizations and through stakeholder coordination. Typical critical water use needs within the basin are associated with public health and safety.

(3) Weekly projections of the inactive storage water availability to meet the critical water uses in the ACT Basin will be utilized when making water control decisions regarding withdrawals and water releases from the federal reservoirs.

(4) The inactive storage action zones will be developed and instituted as triggers to meet the identified priority water uses (releases will be restricted as storage decreases).

(5) Dam safety considerations will always remain the highest priority. The structural integrity of the dams due to static head limitations will be maintained.

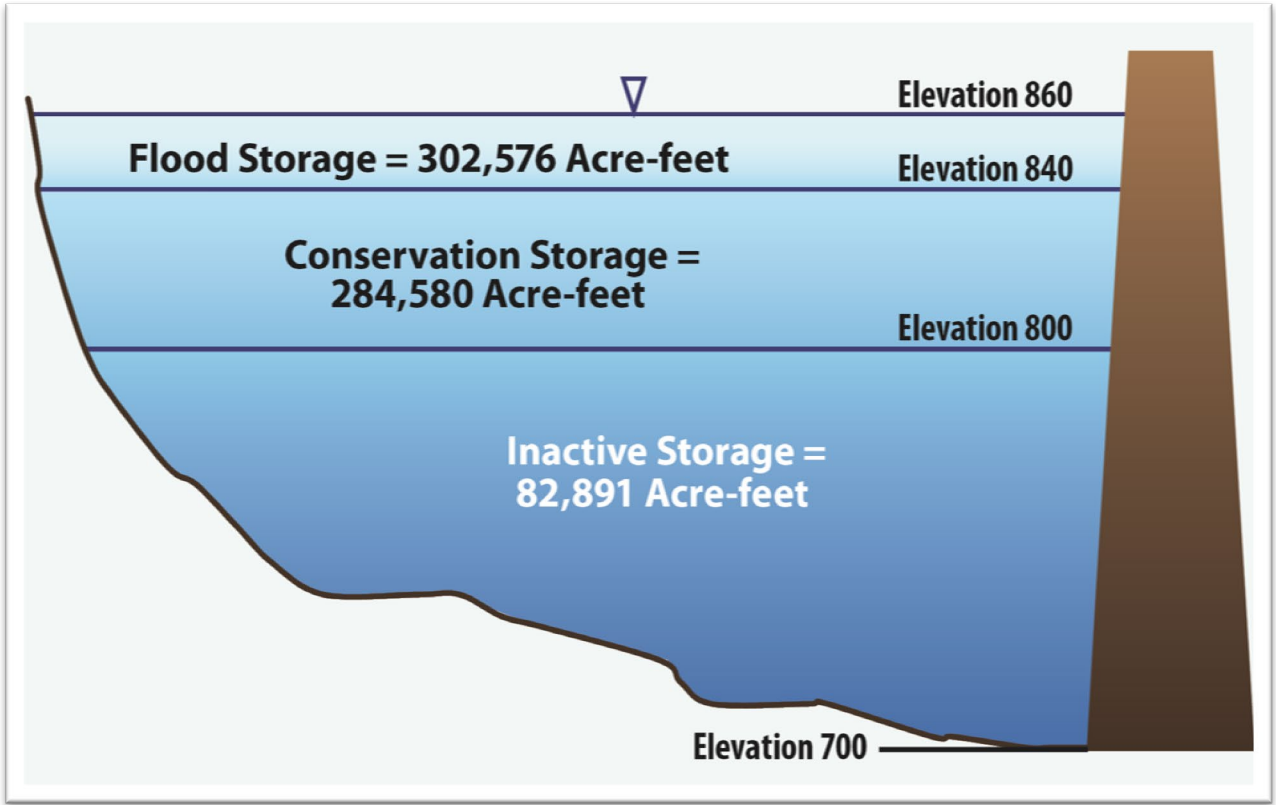

Figure 14. Storage in Allatoona Lake

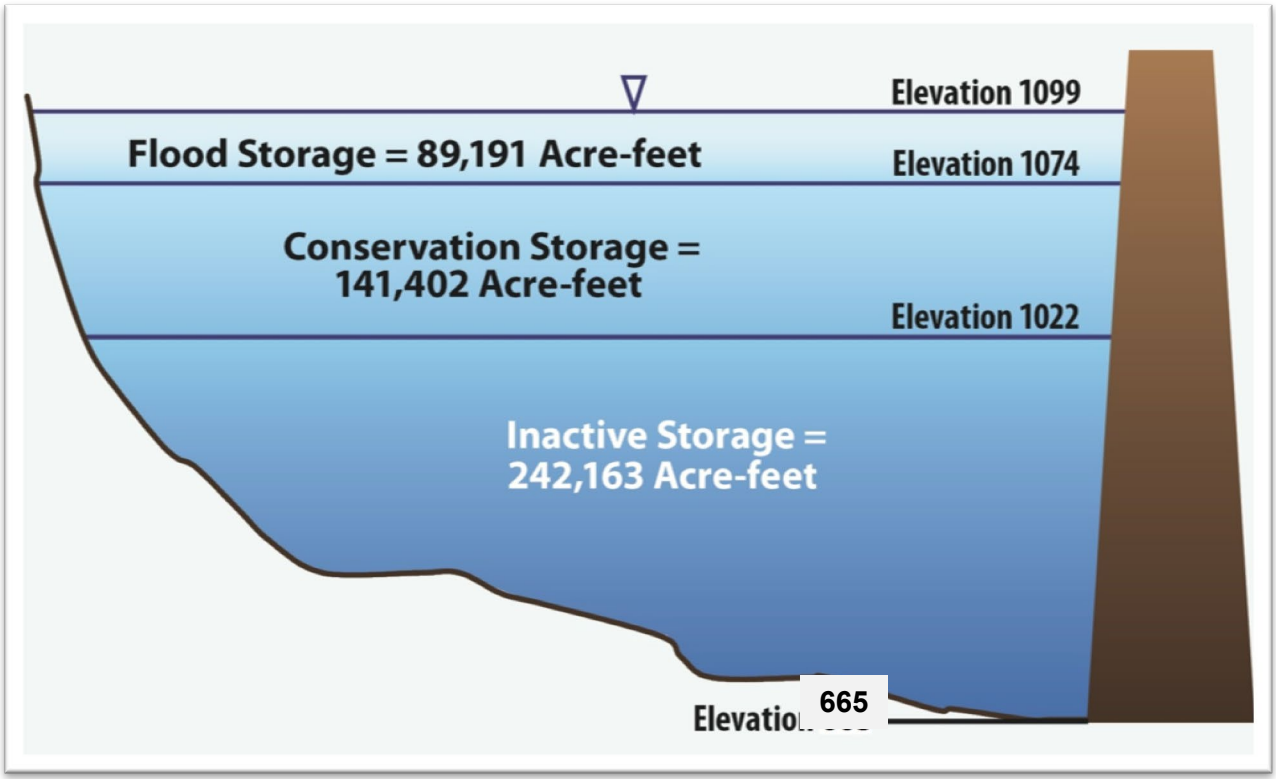

Figure 15. Storage in Carters Lake (excluding reregulation pool)

VIII – DROUGHT MANAGEMENT COORDINATION AND PROCEDURES

8-01. USACE Coordination. It is the responsibility of the Mobile District Water Management Section and APC to monitor climatological and hydrometeorological conditions at all times to make prudent water management decisions. The Water Management Section makes daily decisions and coordinates with APC every two weeks or more often if conditions warrant and with other district representatives from the various areas for which the river systems are operated -- hydropower, recreation, navigation, environmental, and others to exchange information concerning the operation of the river system. This coordination includes conducting weekly meetings with these other district elements. Daily water management decisions regarding water availability, lake level forecasts, and storage forecasts are determined using the information obtained along with current project and basin hydrometeorological data. A weekly District River System Status report is prepared that summarizes the conditions in each of the river basins. When conditions become evident that normal low flow conditions are worsening, the Water Management Section will elevate the district coordination to a heightened awareness. When drought conditions are imminent, Emergency Management representatives will be notified of the conditions and will be included in the regular coordination activities.

8-02. Interagency Coordination. The Water Management Section will support the environmental team regarding actions that require coordination with the U.S. Fish and Wildlife Service (USFWS) for monitoring threatened and endangered species and with the Environmental Protection Agency (EPA), Georgia Environmental Protection Division (GAEPD), and Alabama Department of Environmental Management (ADEM) regarding requests to lower minimum flow targets below Claiborne Dam.

8-03. Public Information and Coordination. When conditions determine that a change in the water control actions from normal regulation to drought regulation is imminent, it is important that various users of the system are notified so that any environmental or operational preparations can be completed prior to any impending reduction in reservoir discharges, river levels, and reservoir pool levels. In periods of severe drought within the ACT Basin it will be within the discretion of the Division Commander to approve the enactment of ACT Basin Water Management conference calls. The purposes of the calls are to share ongoing water management decisions with basin stakeholders and to receive stakeholder input regarding needs and potential impacts to users within the basin. Depending upon the severity of the drought conditions, the calls will be conducted at regular monthly or bi-weekly intervals. Should issues arise, more frequent calls would be implemented.

a. Local Press and Corps Bulletins. The local press consists of periodic publications in or near the ACT Basin. Montgomery, Columbus, and Atlanta have some of the larger daily papers. The papers often publish articles related to the rivers and streams. Their representatives have direct contact with the Corps through the Public Affairs Office. In addition, they can access the Corps Web pages for the latest project information. The Corps and the Mobile District publish e-newsletters regularly which are made available to the general public via email and postings on various websites. Complete, real-time information is available at the Mobile District's Water Management homepage http://water.sam.usace.army.mil/. The Mobile District Public Affairs Office issues press releases as necessary to provide the public with information regarding Water Management issues and activities and also provides information via the Mobile District web site.

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EXHIBIT E

EMERGENCY CONTACT INFORMATION

Emergency Contact Information

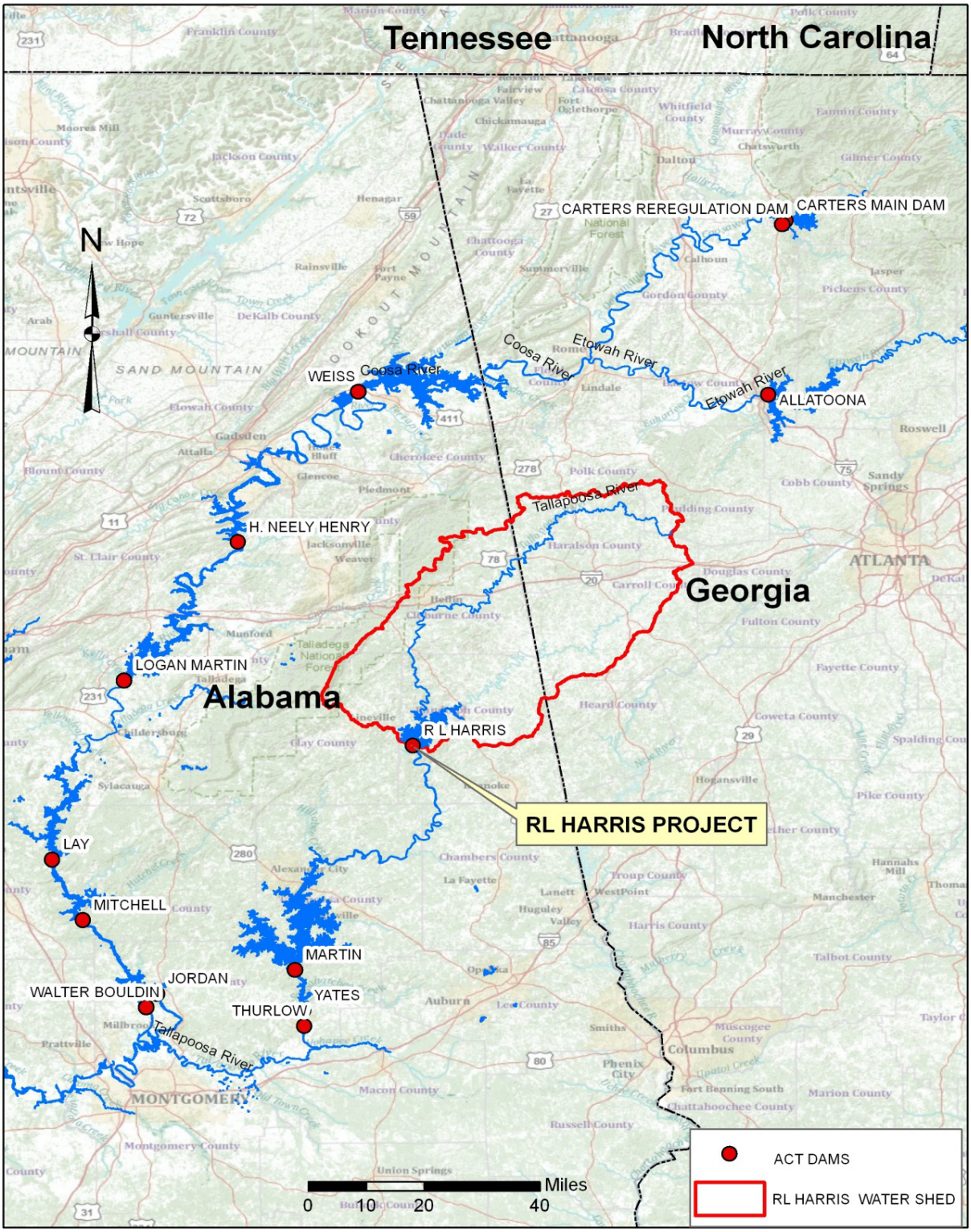
Alabama Power Company:

Reservoir Operations Supervisor	(205) 257-1401
Reservoir Operations Supervisor Alternate Daytime	(205) 257-4010
Reservoir Operations Supervisor After-Hours	(205) 257-4010

US Army Corps of Engineers:

Water Management Section	(251) 690-2737
Chief of Water Management	(251) 690-2730 or (251) 509-5368
R. L. Harris Powerhouse	(256) 396-0081

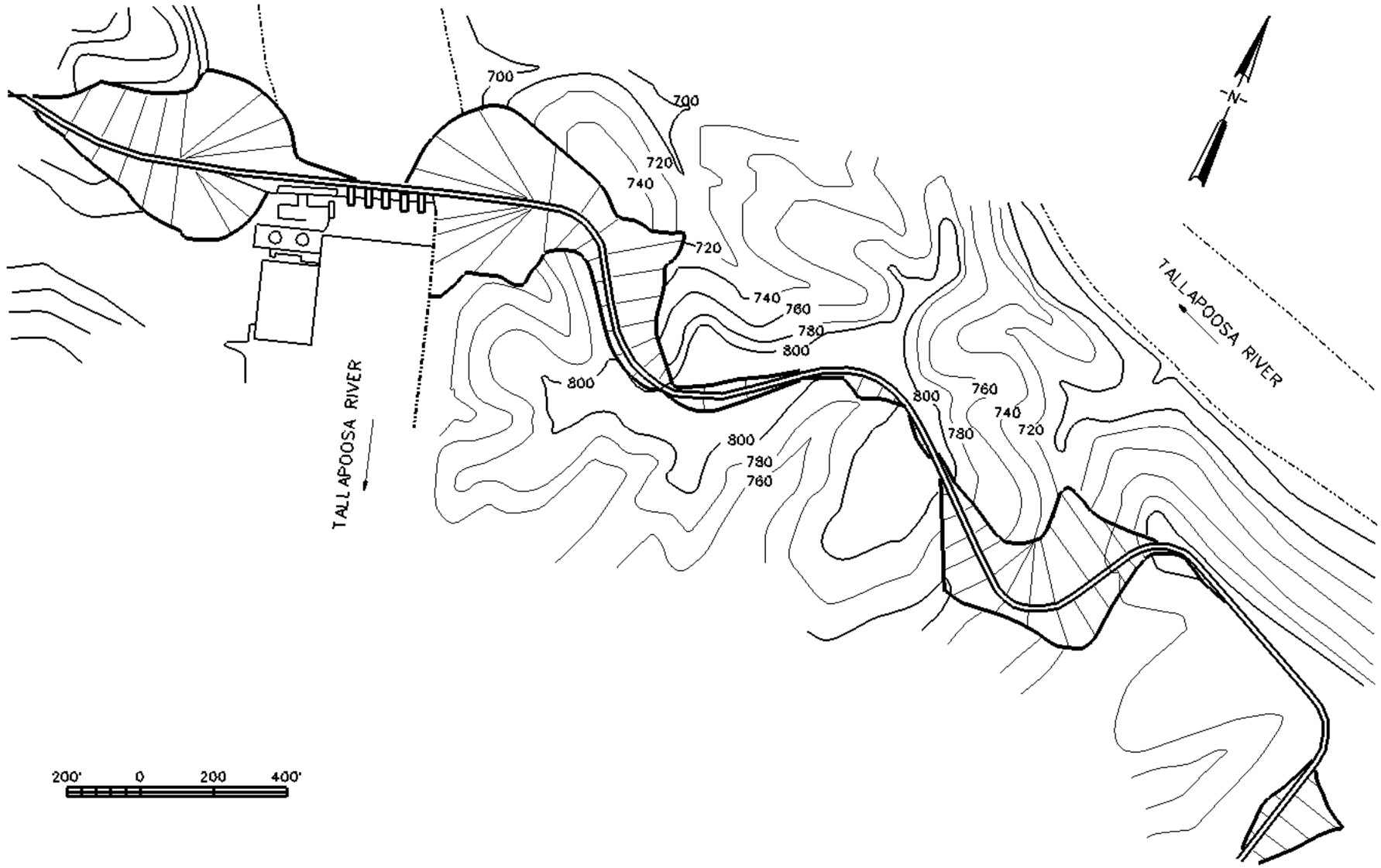
PLATES



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

LOCATION MAP

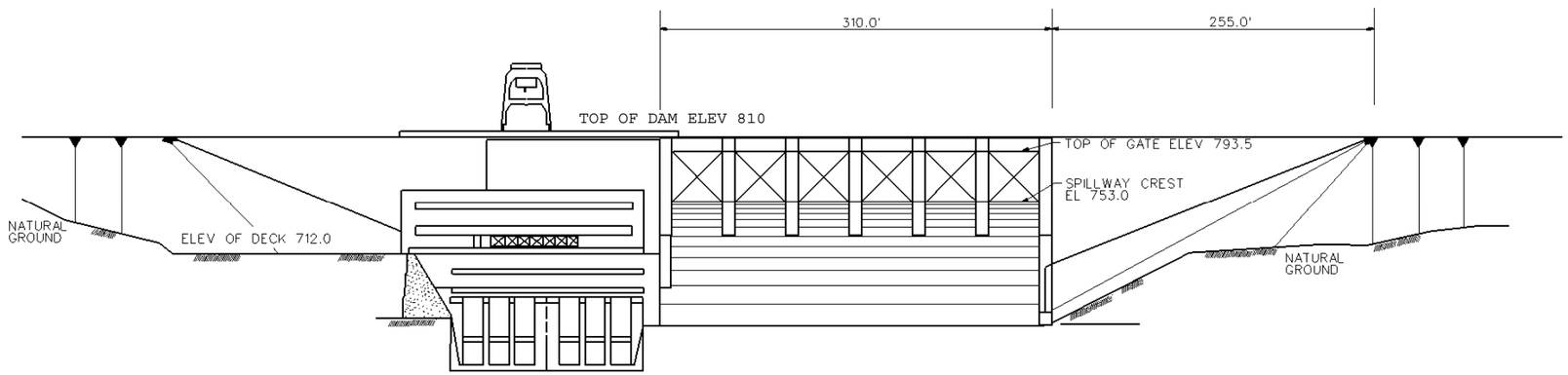


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

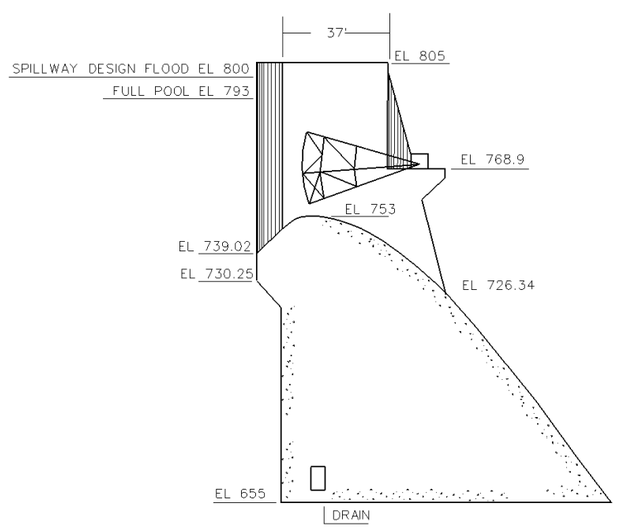
WATER CONTROL MANUAL

R.L. HARRIS DAM AND LAKE

PLAN



DOWNSTREAM ELEVATION

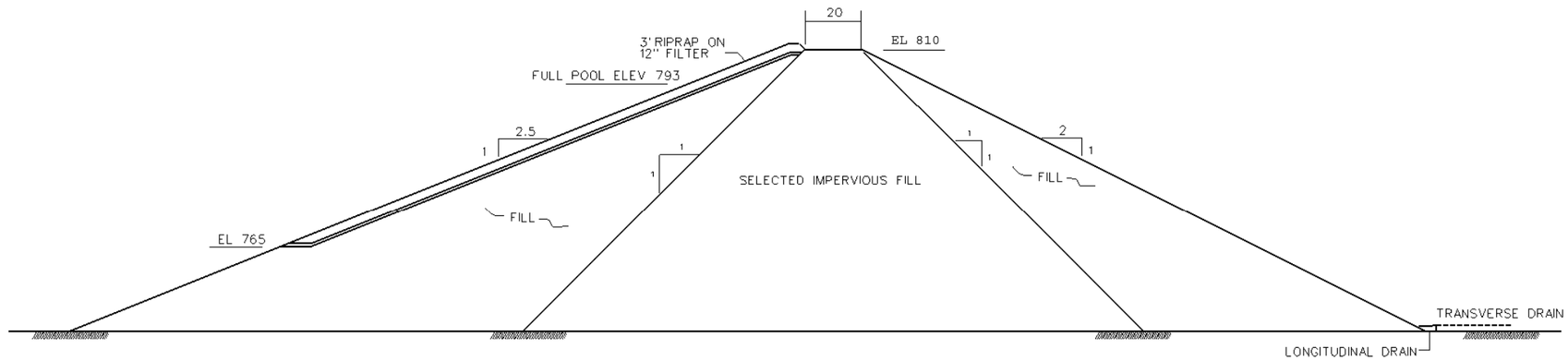


SPILLWAY SECTION

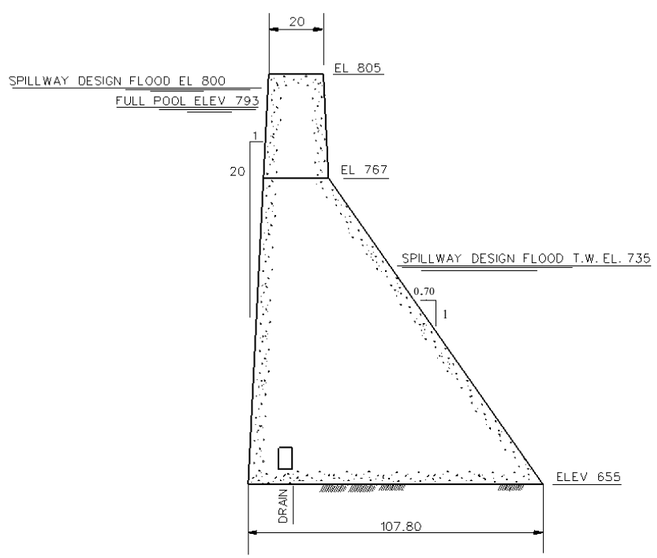
ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

SPILLWAY ELEVATION AND SECTION



TYPICAL EARTH DIKE SECTION

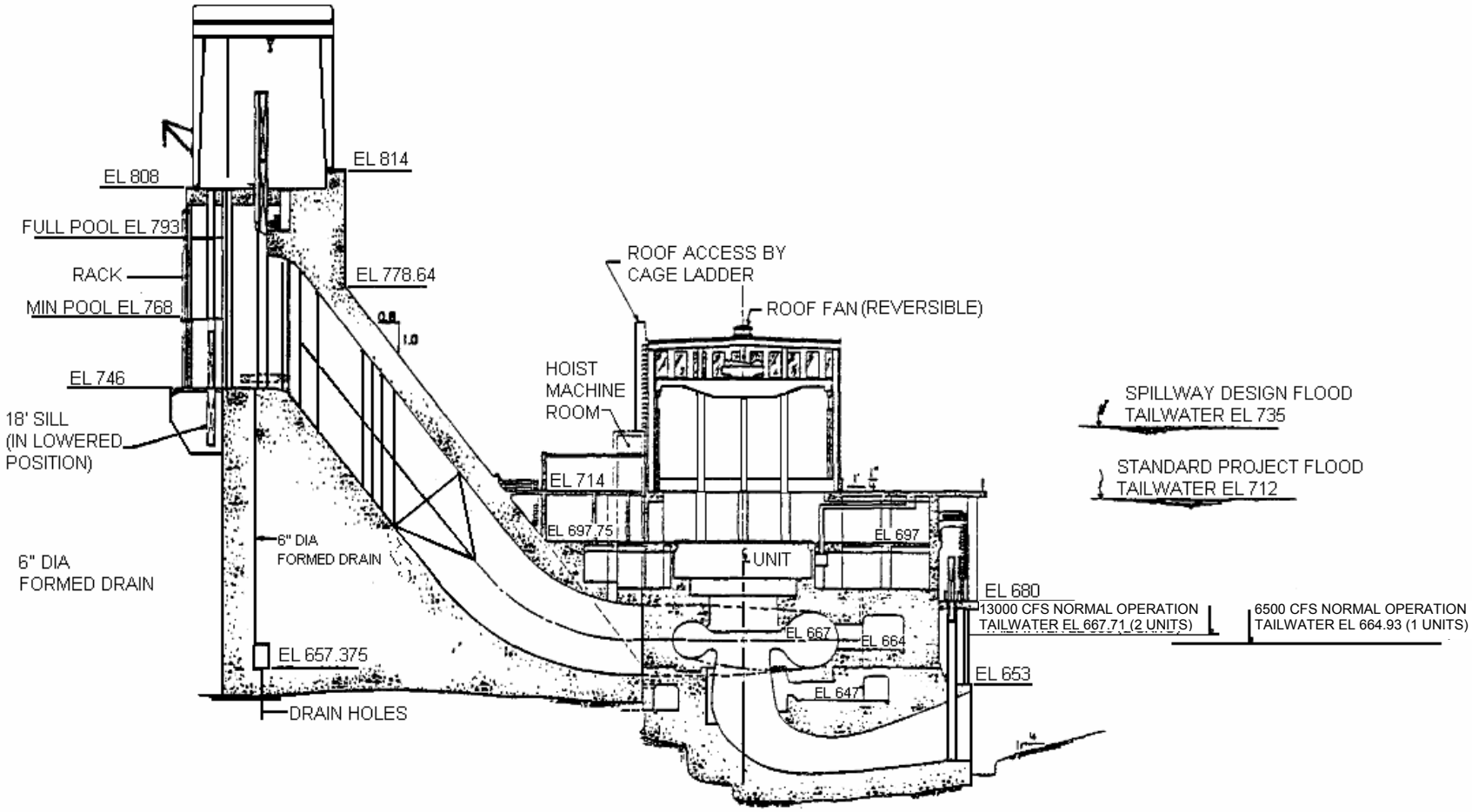


NON-OVERFLOW SPILLWAY SECTION

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DIKE AND NON-OVERFLOW SPILLWAY SECTION



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

POWERHOUSE SECTION

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
1	0	1	0	0	0	0	542	551	560	568	576	584	592	600	608	616	624	631	639	639	639	639	639
2	0	1	1	0	0	0	1084	1102	1120	1136	1152	1168	1184	1200	1216	1232	1248	1262	1278	1278	1278	1278	1278
3	0	1	1	1	0	0	1626	1653	1680	1704	1728	1752	1776	1800	1824	1848	1872	1893	1917	1917	1917	1917	1917
4	0	1	1	1	1	0	2168	2204	2240	2272	2304	2336	2368	2400	2432	2464	2496	2524	2556	2556	2556	2556	2556
5	1	1	1	1	1	0	2710	2755	2800	2840	2880	2920	2960	3000	3040	3080	3120	3155	3195	3195	3195	3195	3195
6	1	1	1	1	1	1	3252	3306	3360	3408	3456	3504	3552	3600	3648	3696	3744	3786	3834	3834	3834	3834	3834
7	1	2	1	1	1	1	4210	4279	4348	4411	4475	4537	4600	4662	4724	4786	4847	4903	4964	4964	4964	4964	4964
8	1	2	2	1	1	1	5168	5252	5336	5414	5494	5570	5648	5724	5800	5876	5950	6020	6094	6094	6094	6094	6094
9	1	2	2	2	1	1	6126	6225	6324	6417	6513	6603	6696	6786	6876	6966	7053	7137	7224	7224	7224	7224	7224
10	1	2	2	2	2	1	7084	7198	7312	7420	7532	7636	7744	7848	7952	8056	8156	8254	8354	8354	8354	8354	8354
11	2	2	2	2	2	1	8042	8171	8300	8423	8551	8669	8792	8910	9028	9146	9259	9371	9484	9484	9484	9484	9484
12	2	2	2	2	2	2	9000	9144	9288	9426	9570	9702	9840	9972	10104	10236	10362	10488	10614	10614	10614	10614	10614
13	2	3	2	2	2	2	9960	10120	10280	10434	10593	10741	10893	11040	11187	11333	11473	11613	11753	11753	11753	11753	11753
14	2	3	3	2	2	2	10920	11096	11272	11442	11616	11780	11946	12108	12270	12430	12584	12738	12892	12892	12892	12892	12892
15	2	3	3	3	2	2	11880	12072	12264	12450	12639	12819	12999	13176	13353	13527	13695	13863	14031	14031	14031	14031	14031
16	2	3	3	3	3	2	12840	13048	13256	13458	13662	13858	14052	14244	14436	14624	14806	14988	15170	15170	15170	15170	15170
17	3	3	3	3	3	2	13800	14024	14248	14466	14685	14897	15105	15312	15519	15721	15917	16113	16309	16309	16309	16309	16309
18	3	3	3	3	3	3	14760	15000	15240	15474	15708	15936	16158	16380	16602	16818	17028	17238	17448	17448	17448	17448	17448
19	3	4	3	3	3	3	15722	15979	16235	16485	16734	16978	17216	17453	17689	17920	18145	18369	18593	18593	18593	18593	18593
20	3	4	4	3	3	3	16684	16958	17230	17496	17760	18020	18274	18526	18776	19022	19262	19500	19738	19738	19738	19738	19738

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
21	3	4	4	4	3	3	17646	17937	18225	18507	18786	19062	19332	19599	19863	20124	20379	20631	20883	20883	20883	20883	20883
22	3	4	4	4	4	3	18608	18916	19220	19518	19812	20104	20390	20672	20950	21226	21496	21762	22028	22028	22028	22028	22028
23	4	4	4	4	4	3	19570	19895	20215	20529	20838	21146	21448	21745	22037	22328	22613	22893	23173	23173	23173	23173	23173
24	4	4	4	4	4	4	20532	20874	21210	21540	21864	22188	22506	22818	23124	23430	23730	24024	24318	24318	24318	24318	24318
25	4	5	4	4	4	4	21497	21856	22209	22556	22896	23236	23570	23897	24219	24540	24855	25164	25473	25473	25473	25473	25473
26	4	5	5	4	4	4	22462	22838	23208	23572	23928	24284	24634	24976	25314	25650	25980	26304	26628	26628	26628	26628	26628
27	4	5	5	5	4	4	23427	23820	24207	24588	24960	25332	25698	26055	26409	26760	27105	27444	27783	27783	27783	27783	27783
28	4	5	5	5	5	4	24392	24802	25206	25604	25992	26380	26762	27134	27504	27870	28230	28584	28938	28938	28938	28938	28938
29	5	5	5	5	5	4	25357	25784	26205	26620	27024	27428	27826	28213	28599	28980	29355	29724	30093	30093	30093	30093	30093
30	5	5	5	5	5	5	26322	26766	27204	27636	28056	28476	28890	29292	29694	30090	30480	30864	31248	31248	31248	31248	31248
31	5	6	5	5	5	5	27288	27750	28206	28655	29092	29528	29958	30377	30795	31206	31612	32011	32410	32410	32410	32410	32410
32	5	6	6	5	5	5	28254	28734	29208	29674	30128	30580	31026	31462	31896	32322	32744	33158	33572	33572	33572	33572	33572
33	5	6	6	6	5	5	29220	29718	30210	30693	31164	31632	32094	32547	32997	33438	33876	34305	34734	34734	34734	34734	34734
34	5	6	6	6	6	5	30186	30702	31212	31712	32200	32684	33162	33632	34098	34554	35008	35452	35896	35896	35896	35896	35896
35	6	6	6	6	6	5	31152	31686	32214	32731	33236	33736	34230	34717	35199	35670	36140	36599	37058	37058	37058	37058	37058
36	6	6	6	6	6	6	32118	32670	33216	33750	34272	34788	35298	35802	36300	36786	37272	37746	38220	38220	38220	38220	38220
37	6	7	6	6	6	6	33084	33654	34217	34769	35309	35842	36369	36889	37403	37906	38407	38897	39386	39386	39386	39386	39386
38	6	7	7	6	6	6	34050	34638	35218	35788	36346	36896	37440	37976	38506	39026	39542	40048	40552	40552	40552	40552	40552
39	6	7	7	7	6	6	35016	35622	36219	36807	37383	37950	38511	39063	39609	40146	40677	41199	41718	41718	41718	41718	41718
40	6	7	7	7	7	6	35982	36606	37220	37826	38420	39004	39582	40150	40712	41266	41812	42350	42884	42884	42884	42884	42884
41	6	8	7	7	7	6	36945	37588	38220	38844	39456	40058	40653	41238	41816	42386	42949	43503	44052	44052	44052	44052	44052

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
42	6	8	8	7	7	6	37908	38570	39220	39862	40492	41112	41724	42326	42920	43506	44086	44656	45220	45220	45220	45220	45220
43	6	8	8	8	7	6	38871	39552	40220	40880	41528	42166	42795	43414	44024	44626	45223	45809	46388	46388	46388	46388	46388
44	6	8	8	8	8	6	39834	40534	41220	41898	42564	43220	43866	44502	45128	45746	46360	46962	47556	47556	47556	47556	47556
45	6	9	8	8	8	6	40792	41512	42217	42914	43598	44271	44935	45589	46232	46867	47497	48116	48726	48726	48726	48726	48726
46	6	9	9	8	8	6	41750	42490	43214	43930	44632	45322	46004	46676	47336	47988	48634	49270	49896	49896	49896	49896	49896
47	6	9	9	9	8	6	42708	43468	44211	44946	45666	46373	47073	47763	48440	49109	49771	50424	51066	51066	51066	51066	51066
48	6	9	9	9	9	6	43666	44446	45208	45962	46700	47424	48142	48850	49544	50230	50908	51578	52236	52236	52236	52236	52236
49	6	10	9	9	9	6	44619	45418	46201	46973	47730	48473	49209	49934	50646	51349	52045	52731	53406	53406	53406	53406	53406
50	6	10	10	9	9	6	45572	46390	47194	47984	48760	49522	50276	51018	51748	52468	53182	53884	54576	54576	54576	54576	54576
51	6	10	10	10	9	6	46525	47362	48187	48995	49790	50571	51343	52102	52850	53587	54319	55037	55746	55746	55746	55746	55746
52	6	10	10	10	10	6	47478	48334	49180	50006	50820	51620	52410	53186	53952	54706	55456	56190	56916	56916	56916	56916	56916
53	6	11	10	10	10	6	48426	49302	50168	51014	51847	52666	53474	54269	55053	55825	56591	57342	58086	58086	58086	58086	58086
54	6	11	11	10	10	6	49374	50270	51156	52022	52874	53712	54538	55352	56154	56944	57726	58494	59256	59256	59256	59256	59256
55	6	11	11	11	10	6	50322	51238	52144	53030	53901	54758	55602	56435	57255	58063	58861	59646	60426	60426	60426	60426	60426
56	6	11	11	11	11	6	51270	52206	53132	54038	54928	55804	56666	57518	58356	59182	59996	60798	61596	61596	61596	61596	61596
57	6	12	11	11	11	6	52223	53181	54127	55053	55963	56859	57741	58611	59468	60312	61145	61965	62780	62780	62780	62780	62780
58	6	12	12	11	11	6	53176	54156	55122	56068	56998	57914	58816	59704	60580	61442	62294	63132	63964	63964	63964	63964	63964
59	6	12	12	12	11	6	54129	55131	56117	57083	58033	58969	59891	60797	61692	62572	63443	64299	65148	65148	65148	65148	65148
60	6	12	12	12	12	6	55082	56106	57112	58098	59068	60024	60966	61890	62804	63702	64592	65466	66332	66332	66332	66332	66332
61	6	13	12	12	12	6	56028	57074	58101	59109	60099	61075	62036	62980	63913	64830	65738	66630	67514	67514	67514	67514	67514
62	6	13	13	12	12	6	56974	58042	59090	60120	61130	62126	63106	64070	65022	65958	66884	67794	68696	68696	68696	68696	68696

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
63	6	13	13	13	12	6	57920	59010	60079	61131	62161	63177	64176	65160	66131	67086	68030	68958	69878	69878	69878	69878	69878
64	6	13	13	13	13	6	58866	59978	61068	62142	63192	64228	65246	66250	67240	68214	69176	70122	71060	71060	71060	71060	71060
65	6	14	13	13	13	6	59803	60937	62050	63145	64216	65273	66311	67335	68345	69338	70319	71284	72239	72239	72239	72239	72239
66	6	14	14	13	13	6	60740	61896	63032	64148	65240	66318	67376	68420	69450	70462	71462	72446	73418	73418	73418	73418	73418
67	6	14	14	14	13	6	61677	62855	64014	65151	66264	67363	68441	69505	70555	71586	72605	73608	74597	74597	74597	74597	74597
68	6	14	14	14	14	6	62614	63814	64996	66154	67288	68408	69506	70590	71660	72710	73748	74770	75776	75776	75776	75776	75776
69	6	15	14	14	14	6	63541	64765	65969	67149	68305	69445	70565	71669	72759	73828	74886	75926	76952	76952	76952	76952	76952
70	6	15	15	14	14	6	64468	65716	66942	68144	69322	70482	71624	72748	73858	74946	76024	77082	78128	78128	78128	78128	78128
71	6	15	15	15	14	6	65395	66667	67915	69139	70339	71519	72683	73827	74957	76064	77162	78238	79304	79304	79304	79304	79304
72	6	15	15	15	15	6	66322	67618	68888	70134	71356	72556	73742	74906	76056	77182	78300	79394	80480	80480	80480	80480	80480
73	6	16	15	15	15	6	67238	68557	69850	71119	72363	73586	74792	75978	77148	78294	79431	80545	81650	81650	81650	81650	81650
74	6	16	16	15	15	6	68154	69496	70812	72104	73370	74616	75842	77050	78240	79406	80562	81696	82820	82820	82820	82820	82820
75	6	16	16	16	15	6	69070	70435	71774	73089	74377	75646	76892	78122	79332	80518	81693	82847	83990	83990	83990	83990	83990
76	6	16	16	16	16	6	69986	71374	72736	74074	75384	76676	77942	79194	80424	81630	82824	83998	85160	85160	85160	85160	85160
77	6	17	16	16	16	6	70890	72302	73688	75049	76382	77695	78984	80256	81507	82735	83949	85143	86324	86324	86324	86324	86324
78	6	17	17	16	16	6	71794	73230	74640	76024	77380	78714	80026	81318	82590	83840	85074	86288	87488	87488	87488	87488	87488
79	6	17	17	17	16	6	72698	74158	75592	76999	78378	79733	81068	82380	83673	84945	86199	87433	88652	88652	88652	88652	88652
80	6	17	17	17	17	6	73602	75086	76544	77974	79376	80752	82110	83442	84756	86050	87324	88578	89816	89816	89816	89816	89816
81	6	18	17	17	17	6	74492	76001	77483	78937	80362	81761	83141	84495	85831	87145	88440	89714	90972	90972	90972	90972	90972
82	6	18	18	17	17	6	75382	76916	78422	79900	81348	82770	84172	85548	86906	88240	89556	90850	92128	92128	92128	92128	92128
83	6	18	18	18	17	6	76272	77831	79361	80863	82334	83779	85203	86601	87981	89335	90672	91986	93284	93284	93284	93284	93284

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
84	6	18	18	18	18	6	77162	78746	80300	81826	83320	84788	86234	87654	89056	90430	91788	93122	94440	94440	94440	94440	94440
85	6	19	18	18	18	6	78045	79655	81234	82784	84303	85794	87263	88706	90129	91525	92904	94259	95597	95597	95597	95597	95597
86	6	19	19	18	18	6	78928	80564	82168	83742	85286	86800	88292	89758	91202	92620	94020	95396	96754	96754	96754	96754	96754
87	6	19	19	19	18	6	79811	81473	83102	84700	86269	87806	89321	90810	92275	93715	95136	96533	97911	97911	97911	97911	97911
88	6	19	19	19	19	6	80694	82382	84036	85658	87252	88812	90350	91862	93348	94810	96252	97670	99068	99068	99068	99068	99068
89	6	20	19	19	19	6	81572	83287	84968	86615	88233	89818	91379	92914	94423	95907	97371	98811	100230	100230	100230	100230	100230
90	6	20	20	19	19	6	82450	84192	85900	87572	89214	90824	92408	93966	95498	97004	98490	99952	101392	101392	101392	101392	101392
91	6	20	20	20	19	6	83328	85097	86832	88529	90195	91830	93437	95018	96573	98101	99609	101093	102554	102554	102554	102554	102554
92	6	20	20	20	20	6	84206	86002	87764	89486	91176	92836	94466	96070	97648	99198	100728	102234	103716	103716	103716	103716	103716
93	6	21	20	20	20	6	85069	86893	88681	90430	92145	93830	95484	97112	98713	100286	101838	103365	104869	104869	104869	104869	104869
94	6	21	21	20	20	6	85932	87784	89598	91374	93114	94824	96502	98154	99778	101374	102948	104496	106022	106022	106022	106022	106022
95	6	21	21	21	20	6	86795	88675	90515	92318	94083	95818	97520	99196	100843	102462	104058	105627	107175	107175	107175	107175	107175
96	6	21	21	21	21	6	87658	89566	91432	93262	95052	96812	98538	100238	101908	103550	105168	106758	108328	108328	108328	108328	108328
97	6	22	21	21	21	6	88505	90441	92334	94191	96007	97792	99544	101268	102962	104627	106268	107880	109472	109472	109472	109472	109472
98	6	22	22	21	21	6	89352	91316	93236	95120	96962	98772	100550	102298	104016	105704	107368	109002	110616	110616	110616	110616	110616
99	6	22	22	22	21	6	90199	92191	94138	96049	97917	99752	101556	103328	105070	106781	108468	110124	111760	111760	111760	111760	111760
100	6	22	22	22	22	6	91046	93066	95040	96978	98872	100732	102562	104358	106124	107858	109568	111246	112904	112904	112904	112904	112904
101	6	23	22	22	22	6	91876	93924	95927	97892	99813	101699	103554	105375	107165	108923	110656	112357	114038	114038	114038	114038	114038
102	6	23	23	22	22	6	92706	94782	96814	98806	100754	102666	104546	106392	108206	109988	111744	113468	115172	115172	115172	115172	115172
103	6	23	23	23	22	6	93536	95640	97701	99720	101695	103633	105538	107409	109247	111053	112832	114579	116306	116306	116306	116306	116306
104	6	23	23	23	23	6	94366	96498	98588	100634	102636	104600	106530	108426	110288	112118	113920	115690	117440	117440	117440	117440	117440

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
105	6	24	23	23	23	6	95177	97340	99459	101532	103562	105553	107508	109429	111316	113170	114996	116790	118562	118562	118562	118562	118562
106	6	24	24	23	23	6	95988	98182	100330	102430	104488	106506	108486	110432	112344	114222	116072	117890	119684	119684	119684	119684	119684
107	6	24	24	24	23	6	96799	99024	101201	103328	105414	107459	109464	111435	113372	115274	117148	118990	120806	120806	120806	120806	120806
108	6	24	24	24	24	6	97610	99866	102072	104226	106340	108412	110442	112438	114400	116326	118224	120090	121928	121928	121928	121928	121928
109	6	25	24	24	24	6	98403	100689	102924	105108	107250	109349	111406	113428	115415	117366	119288	121177	123039	123039	123039	123039	123039
110	6	25	25	24	24	6	99196	101512	103776	105990	108160	110286	112370	114418	116430	118406	120352	122264	124150	124150	124150	124150	124150
111	6	25	25	25	24	6	99989	102335	104628	106872	109070	111223	113334	115408	117445	119446	121416	123351	125261	125261	125261	125261	125261
112	6	25	25	25	25	6	100782	103158	105480	107754	109980	112160	114298	116398	118460	120486	122480	124438	126372	126372	126372	126372	126372
113	6	26	25	25	25	6	101554	103962	106315	108618	110873	113081	115246	117372	119460	121512	123530	125513	127470	127470	127470	127470	127470
114	6	26	26	25	25	6	102326	104766	107150	109482	111766	114002	116194	118346	120460	122538	124580	126588	128568	128568	128568	128568	128568
115	6	26	26	26	25	6	103098	105570	107985	110346	112659	114923	117142	119320	121460	123564	125630	127663	129666	129666	129666	129666	129666
116	6	26	26	26	26	6	103870	106374	108820	111210	113552	115844	118090	120294	122460	124590	126680	128738	130764	130764	130764	130764	130764
117	6	27	26	26	26	6	104622	107159	109636	112056	114427	116748	119022	121253	123446	125601	127717	129799	131849	131849	131849	131849	131849
118	6	27	27	26	26	6	105374	107944	110452	112902	115302	117652	119954	122212	124432	126612	128754	130860	132934	132934	132934	132934	132934
119	6	27	27	27	26	6	106126	108729	111268	113748	116177	118556	120886	123171	125418	127623	129791	131921	134019	134019	134019	134019	134019
120	6	27	27	27	27	6	106878	109514	112084	114594	117052	119460	121818	124130	126404	128634	130828	132982	135104	135104	135104	135104	135104
121	6	28	27	27	27	6	107609	110278	112880	115422	117909	120346	122733	125073	127373	129630	131849	134029	136176	136176	136176	136176	136176
122	6	28	28	27	27	6	108340	111042	113676	116250	118766	121232	123648	126016	128342	130626	132870	135076	137248	137248	137248	137248	137248
123	6	28	28	28	27	6	109071	111806	114472	117078	119623	122118	124563	126959	129311	131622	133891	136123	138320	138320	138320	138320	138320
124	6	28	28	28	28	6	109802	112570	115268	117906	120480	123004	125478	127902	130280	132618	134912	137170	139392	139392	139392	139392	139392
125	6	29	28	28	28	6	110511	113313	116044	118714	121319	123873	126376	128828	131234	133598	135919	138202	140449	140449	140449	140449	140449

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
126	6	29	29	28	28	6	111220	114056	116820	119522	122158	124742	127274	129754	132188	134578	136926	139234	141506	141506	141506	141506	141506
127	6	29	29	29	28	6	111929	114799	117596	120330	122997	125611	128172	130680	133142	135558	137933	140266	142563	142563	142563	142563	142563
128	6	29	29	29	29	6	112638	115542	118372	121138	123836	126480	129070	131606	134096	136538	138940	141298	143620	143620	143620	143620	143620
129	6	30	29	29	29	6	113144	116264	119128	121926	124656	127330	129950	132515	135033	137502	139931	142315	144662	144662	144662	144662	144662
130	6	30	30	29	29	6	113650	116986	119884	122714	125476	128180	130830	133424	135970	138466	140922	143332	145704	145704	145704	145704	145704
131	6	30	30	30	29	6	114156	117708	120640	123502	126296	129030	131710	134333	136907	139430	141913	144349	146746	146746	146746	146746	146746
132	6	30	30	30	30	6	114662	118430	121396	124290	127116	129880	132590	135242	137844	140394	142904	145366	147788	147788	147788	147788	147788
133	6	31	30	30	30	6	114662	118867	122130	125058	127916	130712	133452	136133	138764	141342	143879	146368	148816	148816	148816	148816	148816
134	6	31	31	30	30	6	114662	119304	122864	125826	128716	131544	134314	137024	139684	142290	144854	147370	149844	149844	149844	149844	149844
135	6	31	31	31	30	6	114662	119741	123598	126594	129516	132376	135176	137915	140604	143238	145829	148372	150872	150872	150872	150872	150872
136	6	31	31	31	31	6	114662	120178	124332	127362	130316	133208	136038	138806	141524	144186	146804	149374	151900	151900	151900	151900	151900
137	6	32	31	31	31	6	114662	120178	124755	128109	131096	134020	136880	139679	142426	145117	147762	150359	152912	152912	152912	152912	152912
138	6	32	32	31	31	6	114662	120178	125178	128856	131876	134832	137722	140552	143328	146048	148720	151344	153924	153924	153924	153924	153924
139	6	32	32	32	31	6	114662	120178	125601	129603	132656	135644	138564	141425	144230	146979	149678	152329	154936	154936	154936	154936	154936
140	6	32	32	32	32	6	114662	120178	126024	130350	133436	136456	139406	142298	145132	147910	150636	153314	155948	155948	155948	155948	155948
141	6	33	32	32	32	6	114662	120178	126024	130729	134196	137248	140230	143153	146017	148823	151578	154283	156944	156944	156944	156944	156944
142	6	33	33	32	32	6	114662	120178	126024	131108	134956	138040	141054	144008	146902	149736	152520	155252	157940	157940	157940	157940	157940
143	6	33	33	33	32	6	114662	120178	126024	131487	135716	138832	141878	144863	147787	150649	153462	156221	158936	158936	158936	158936	158936
144	6	33	33	33	33	6	114662	120178	126024	131866	136476	139624	142702	145718	148672	151562	154404	157190	159932	159932	159932	159932	159932
145	6	34	33	33	33	6	114662	120178	126024	131866	136866	140396	143507	146554	149538	152458	155329	158143	160912	160912	160912	160912	160912
146	6	34	34	33	33	6	114662	120178	126024	131866	137256	141168	144312	147390	150404	153354	156254	159096	161892	161892	161892	161892	161892

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WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																								
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																	
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
147	6	34	34	34	33	6	114662	120178	126024	131866	137646	141940	145117	148226	151270	154250	157179	160049	162872	162872	162872	162872	162872
148	6	34	34	34	34	6	114662	120178	126024	131866	138036	142712	145922	149062	152136	155146	158104	161002	163852	163852	163852	163852	163852
149	6	35	34	34	34	6	114662	120178	126024	131866	138036	143086	146707	149879	152984	156024	159011	161938	164816	164816	164816	164816	164816
150	6	35	35	34	34	6	114662	120178	126024	131866	138036	143460	147492	150696	153832	156902	159918	162874	165780	165780	165780	165780	165780
151	6	35	35	35	34	6	114662	120178	126024	131866	138036	143834	148277	151513	154680	157780	160825	163810	166744	166744	166744	166744	166744
152	6	35	35	35	35	6	114662	120178	126024	131866	138036	144208	149062	152330	155528	158658	161732	164746	167708	167708	167708	167708	167708
153	6	36	35	35	35	6	114662	120178	126024	131866	138036	144208	149390	153127	156357	159518	162622	165665	168655	168655	168655	168655	168655
154	6	36	36	35	35	6	114662	120178	126024	131866	138036	144208	149718	153924	157186	160378	163512	166584	169602	169602	169602	169602	169602
155	6	36	36	36	35	6	114662	120178	126024	131866	138036	144208	150046	154721	158015	161238	164402	167503	170549	170549	170549	170549	170549
156	6	36	36	36	36	6	114662	120178	126024	131866	138036	144208	150374	155518	158844	162098	165292	168422	171496	171496	171496	171496	171496
157	6	37	36	36	36	6	114662	120178	126024	131866	138036	144208	150374	155807	159655	162940	166164	169323	172426	172426	172426	172426	172426
158	6	37	37	36	36	6	114662	120178	126024	131866	138036	144208	150374	156096	160466	163782	167036	170224	173356	173356	173356	173356	173356
159	6	37	37	37	36	6	114662	120178	126024	131866	138036	144208	150374	156385	161277	164624	167908	171125	174286	174286	174286	174286	174286
160	6	37	37	37	37	6	114662	120178	126024	131866	138036	144208	150374	156674	162088	165466	168780	172026	175216	175216	175216	175216	175216
161	6	38	37	37	37	6	114662	120178	126024	131866	138036	144208	150374	156674	162326	166290	169634	172911	176129	176129	176129	176129	176129
162	6	38	38	37	37	6	114662	120178	126024	131866	138036	144208	150374	156674	162564	167114	170488	173796	177042	177042	177042	177042	177042
163	6	38	38	38	37	6	114662	120178	126024	131866	138036	144208	150374	156674	162802	167938	171342	174681	177955	177955	177955	177955	177955
164	6	38	38	38	38	6	114662	120178	126024	131866	138036	144208	150374	156674	163040	168762	172196	175566	178868	178868	178868	178868	178868
165	6	39	38	38	38	6	114662	120178	126024	131866	138036	144208	150374	156674	163040	168954	173033	176433	179765	179765	179765	179765	179765
166	6	39	39	38	38	6	114662	120178	126024	131866	138036	144208	150374	156674	163040	169146	173870	177300	180662	180662	180662	180662	180662
167	6	39	39	39	38	6	114662	120178	126024	131866	138036	144208	150374	156674	163040	169338	174707	178167	181559	181559	181559	181559	181559

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
168	6	39	39	39	39	6	114662	120178	126024	131866	138036	144208	150374	156674	163040	169530	175544	179034	182456	182456	182456	182456	182456
169	6	40	39	39	39	6	114662	120178	126024	131866	138036	144208	150374	156674	163040	169530	175747	179883	183336	183336	183336	183336	183336
170	6	40	40	39	39	6	114662	120178	126024	131866	138036	144208	150374	156674	163040	169530	175950	180732	184216	184216	184216	184216	184216
171	6	40	40	40	39	6	114662	120178	126024	131866	138036	144208	150374	156674	163040	169530	176153	181581	185096	185096	185096	185096	185096
172	6	40	40	40	40	6	114662	120178	126024	131866	138036	144208	150374	156674	163040	169530	176356	182430	185976	185976	185976	185976	185976
173	7	40	40	40	40	6	115628	121162	127025	132885	139073	145262	151445	157761	164143	170650	177491	183581	187142	187142	187142	187142	187142
174	8	40	40	40	40	6	116591	122144	128025	133903	140109	146316	152516	158849	165247	171770	178628	184734	188310	188310	188310	188310	188310
175	9	40	40	40	40	6	117549	123122	129022	134919	141143	147367	153585	159936	166351	172891	179765	185888	189480	189480	189480	189480	189480
176	10	40	40	40	40	6	118502	124094	130015	135930	142173	148416	154652	161020	167453	174010	180902	187041	190650	190650	190650	190650	190650
177	11	40	40	40	40	6	119450	125062	131003	136938	143200	149462	155716	162103	168554	175129	182037	188193	191820	191820	191820	191820	191820
178	12	40	40	40	40	6	120403	126037	131998	137953	144235	150517	156791	163196	169666	176259	183186	189360	193004	193004	193004	193004	193004
179	13	40	40	40	40	6	121349	127005	132987	138964	145266	151568	157861	164286	170775	177387	184332	190524	194186	194186	194186	194186	194186
180	14	40	40	40	40	6	122286	127964	133969	139967	146290	152613	158926	165371	171880	178511	185475	191686	195365	195365	195365	195365	195365
181	15	40	40	40	40	6	123213	128915	134942	140962	147307	153650	159985	166450	172979	179629	186613	192842	196541	196541	196541	196541	196541
182	16	40	40	40	40	6	124129	129854	135904	141947	148314	154680	161035	167522	174071	180741	187744	193993	197711	197711	197711	197711	197711
183	17	40	40	40	40	6	125033	130782	136856	142922	149312	155699	162077	168584	175154	181846	188869	195138	198875	198875	198875	198875	198875
184	18	40	40	40	40	6	125923	131697	137795	143885	150298	156708	163108	169637	176229	182941	189985	196274	200031	200031	200031	200031	200031
185	19	40	40	40	40	6	126806	132606	138729	144843	151281	157714	164137	170689	177302	184036	191101	197411	201188	201188	201188	201188	201188
186	20	40	40	40	40	6	127684	133511	139661	145800	152262	158720	165166	171741	178377	185133	192220	198552	202350	202350	202350	202350	202350
187	21	40	40	40	40	6	128547	134402	140578	146744	153231	159714	166184	172783	179442	186221	193330	199683	203503	203503	203503	203503	203503
188	22	40	40	40	40	6	129394	135277	141480	147673	154186	160694	167190	173813	180496	187298	194430	200805	204647	204647	204647	204647	204647

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
189	23	40	40	40	40	6	130224	136135	142367	148587	155127	161661	168182	174830	181537	188363	195518	201916	205781	205781	205781	205781	205781
190	24	40	40	40	40	6	131035	136977	143238	149485	156053	162614	169160	175833	182565	189415	196594	203016	206903	206903	206903	206903	206903
191	25	40	40	40	40	6	131828	137800	144090	150367	156963	163551	170124	176823	183580	190455	197658	204103	208014	208014	208014	208014	208014
192	26	40	40	40	40	6	132600	138604	144925	151231	157856	164472	171072	177797	184580	191481	198708	205178	209112	209112	209112	209112	209112
193	27	40	40	40	40	6	133352	139389	145741	152077	158731	165376	172004	178756	185566	192492	199745	206239	210197	210197	210197	210197	210197
194	28	40	40	40	40	6	134083	140153	146537	152905	159588	166262	172919	179699	186535	193488	200766	207286	211269	211269	211269	211269	211269
195	29	40	40	40	40	6	134792	140896	147313	153713	160427	167131	173817	180625	187489	194468	201773	208318	212326	212326	212326	212326	212326
196	30	40	40	40	40	6	135298	141618	148069	154501	161247	167981	174697	181534	188426	195432	202764	209335	213368	213368	213368	213368	213368
197	31	40	40	40	40	6	135298	142055	148803	155269	162047	168813	175559	182425	189346	196380	203739	210337	214396	214396	214396	214396	214396
198	32	40	40	40	40	6	135298	142055	149226	156016	162827	169625	176401	183298	190248	197311	204697	211322	215408	215408	215408	215408	215408
199	33	40	40	40	40	6	135298	142055	149226	156395	163587	170417	177225	184153	191133	198224	205639	212291	216404	216404	216404	216404	216404
200	34	40	40	40	40	6	135298	142055	149226	156395	163977	171189	178030	184989	191999	199120	206564	213244	217384	217384	217384	217384	217384
201	35	40	40	40	40	6	135298	142055	149226	156395	163977	171563	178815	185806	192847	199998	207471	214180	218348	218348	218348	218348	218348
202	36	40	40	40	40	6	135298	142055	149226	156395	163977	171563	179143	186603	193676	200858	208361	215099	219295	219295	219295	219295	219295
203	37	40	40	40	40	6	135298	142055	149226	156395	163977	171563	179143	186892	194487	201700	209233	216000	220225	220225	220225	220225	220225
204	38	40	40	40	40	6	135298	142055	149226	156395	163977	171563	179143	186892	194725	202524	210087	216885	221138	221138	221138	221138	221138
205	39	40	40	40	40	6	135298	142055	149226	156395	163977	171563	179143	186892	194725	202716	210924	217752	222035	222035	222035	222035	222035
206	40	40	40	40	40	6	135298	142055	149226	156395	163977	171563	179143	186892	194725	202716	211127	218601	222915	222915	222915	222915	222915
207	40	40	40	40	40	7	136264	143039	150227	157414	165014	172617	180214	187979	195828	203836	212262	219752	224081	224081	224081	224081	224081
208	40	40	40	40	40	8	137227	144021	151227	158432	166050	173671	181285	189067	196932	204956	213399	220905	225249	225249	225249	225249	225249
209	40	40	40	40	40	9	138185	144999	152224	159448	167084	174722	182354	190154	198036	206077	214536	222059	226419	226419	226419	226419	226419

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
210	40	40	40	40	40	10	139138	145971	153217	160459	168114	175771	183421	191238	199138	207196	215673	223212	227589	227589	227589	227589	227589
211	40	40	40	40	40	11	140086	146939	154205	161467	169141	176817	184485	192321	200239	208315	216808	224364	228759	228759	228759	228759	228759
212	40	40	40	40	40	12	141039	147914	155200	162482	170176	177872	185560	193414	201351	209445	217957	225531	229943	229943	229943	229943	229943
213	40	40	40	40	40	13	141985	148882	156189	163493	171207	178923	186630	194504	202460	210573	219103	226695	231125	231125	231125	231125	231125
214	40	40	40	40	40	14	142922	149841	157171	164496	172231	179968	187695	195589	203565	211697	220246	227857	232304	232304	232304	232304	232304
215	40	40	40	40	40	15	143849	150792	158144	165491	173248	181005	188754	196668	204664	212815	221384	229013	233480	233480	233480	233480	233480
216	40	40	40	40	40	16	144765	151731	159106	166476	174255	182035	189804	197740	205756	213927	222515	230164	234650	234650	234650	234650	234650
217	40	40	40	40	40	17	145669	152659	160058	167451	175253	183054	190846	198802	206839	215032	223640	231309	235814	235814	235814	235814	235814
218	40	40	40	40	40	18	146559	153574	160997	168414	176239	184063	191877	199855	207914	216127	224756	232445	236970	236970	236970	236970	236970
219	40	40	40	40	40	19	147442	154483	161931	169372	177222	185069	192906	200907	208987	217222	225872	233582	238127	238127	238127	238127	238127
220	40	40	40	40	40	20	148320	155388	162863	170329	178203	186075	193935	201959	210062	218319	226991	234723	239289	239289	239289	239289	239289
221	40	40	40	40	40	21	149183	156279	163780	171273	179172	187069	194953	203001	211127	219407	228101	235854	240442	240442	240442	240442	240442
222	40	40	40	40	40	22	150030	157154	164682	172202	180127	188049	195959	204031	212181	220484	229201	236976	241586	241586	241586	241586	241586
223	40	40	40	40	40	23	150860	158012	165569	173116	181068	189016	196951	205048	213222	221549	230289	238087	242720	242720	242720	242720	242720
224	40	40	40	40	40	24	151671	158854	166440	174014	181994	189969	197929	206051	214250	222601	231365	239187	243842	243842	243842	243842	243842
225	40	40	40	40	40	25	152464	159677	167292	174896	182904	190906	198893	207041	215265	223641	232429	240274	244953	244953	244953	244953	244953
226	40	40	40	40	40	26	153236	160481	168127	175760	183797	191827	199841	208015	216265	224667	233479	241349	246051	246051	246051	246051	246051
227	40	40	40	40	40	27	153988	161266	168943	176606	184672	192731	200773	208974	217251	225678	234516	242410	247136	247136	247136	247136	247136
228	40	40	40	40	40	28	154719	162030	169739	177434	185529	193617	201688	209917	218220	226674	235537	243457	248208	248208	248208	248208	248208
229	40	40	40	40	40	29	155428	162773	170515	178242	186368	194486	202586	210843	219174	227654	236544	244489	249265	249265	249265	249265	249265
230	40	40	40	40	40	30	155934	163495	171271	179030	187188	195336	203466	211752	220111	228618	237535	245506	250307	250307	250307	250307	250307

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

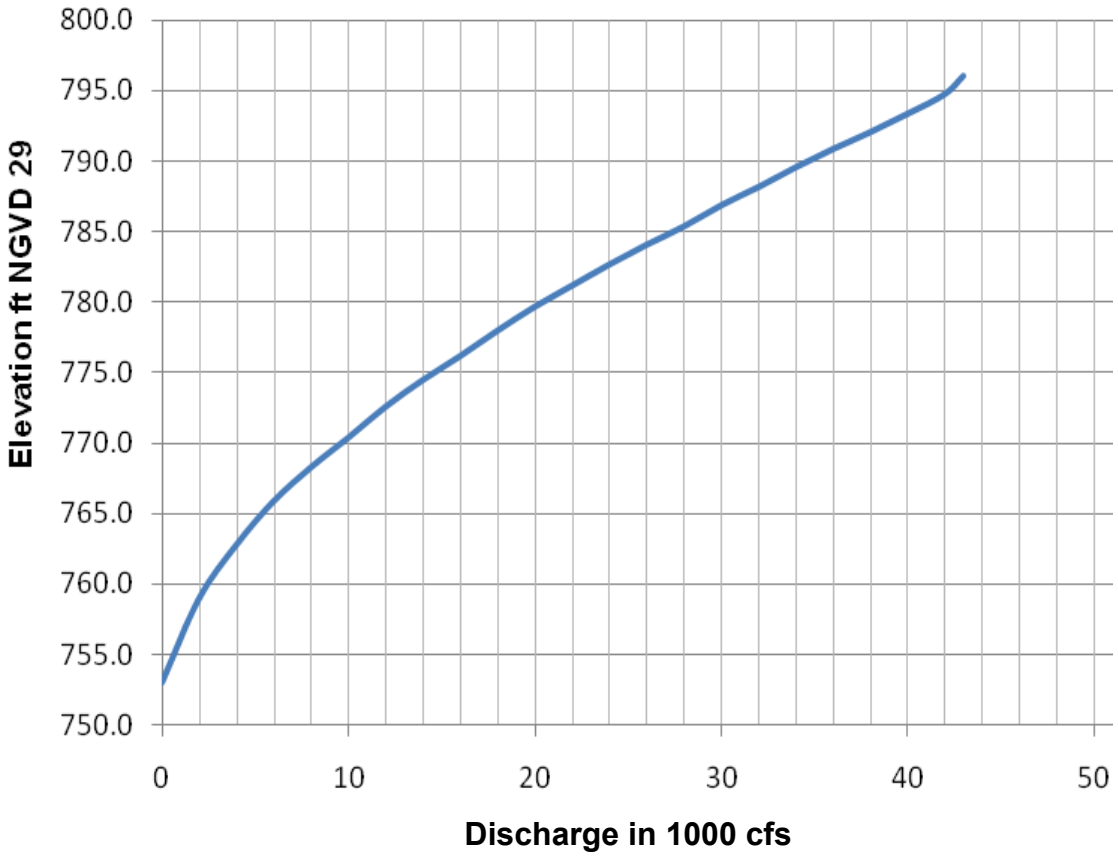
GATE OPENING SCHEDULE																							
	GATE NUMBER						POOL ELEVATION (FT NGVD 29)																
GATE STEP	1	2	3	4	5	6	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
	GATE POSITION						SPILLWAY DISCHAGE (CFS)																
231	40	40	40	40	40	31	155934	163932	172005	179798	187988	196168	204328	212643	221031	229566	238510	246508	251335	251335	251335	251335	251335
232	40	40	40	40	40	32	155934	163932	172428	180545	188768	196980	205170	213516	221933	230497	239468	247493	252347	252347	252347	252347	252347
233	40	40	40	40	40	33	155934	163932	172428	180924	189528	197772	205994	214371	222818	231410	240410	248462	253343	253343	253343	253343	253343
234	40	40	40	40	40	34	155934	163932	172428	180924	189918	198544	206799	215207	223684	232306	241335	249415	254323	254323	254323	254323	254323
235	40	40	40	40	40	35	155934	163932	172428	180924	189918	198918	207584	216024	224532	233184	242242	250351	255287	255287	255287	255287	255287
236	40	40	40	40	40	36	155934	163932	172428	180924	189918	198918	207912	216821	225361	234044	243132	251270	256234	256234	256234	256234	256234
237	40	40	40	40	40	37	155934	163932	172428	180924	189918	198918	207912	217110	226172	234886	244004	252171	257164	257164	257164	257164	257164
238	40	40	40	40	40	38	155934	163932	172428	180924	189918	198918	207912	217110	226410	235710	244858	253056	258077	258077	258077	258077	258077
239	40	40	40	40	40	39	155934	163932	172428	180924	189918	198918	207912	217110	226410	235902	245695	253923	258974	258974	258974	258974	258974
240	40	40	40	40	40	40	155934	163932	172428	180924	189918	198918	207912	217110	226410	235902	245898	254772	259854	259854	259854	259854	259854

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GATE OPENING SCHEDULE

Discharge in 1000 cfs	Elevation ft NGVD 29
0	753.0
2	759.0
4	762.8
6	765.9
8	768.3
10	770.4
12	772.6
14	774.5
16	776.2
18	778.0
20	779.7
22	781.2
24	782.7
26	784.1
28	785.4
30	786.9
32	788.2
34	789.6
36	790.9
38	792.1
40	793.4
42	794.8
43	796.1

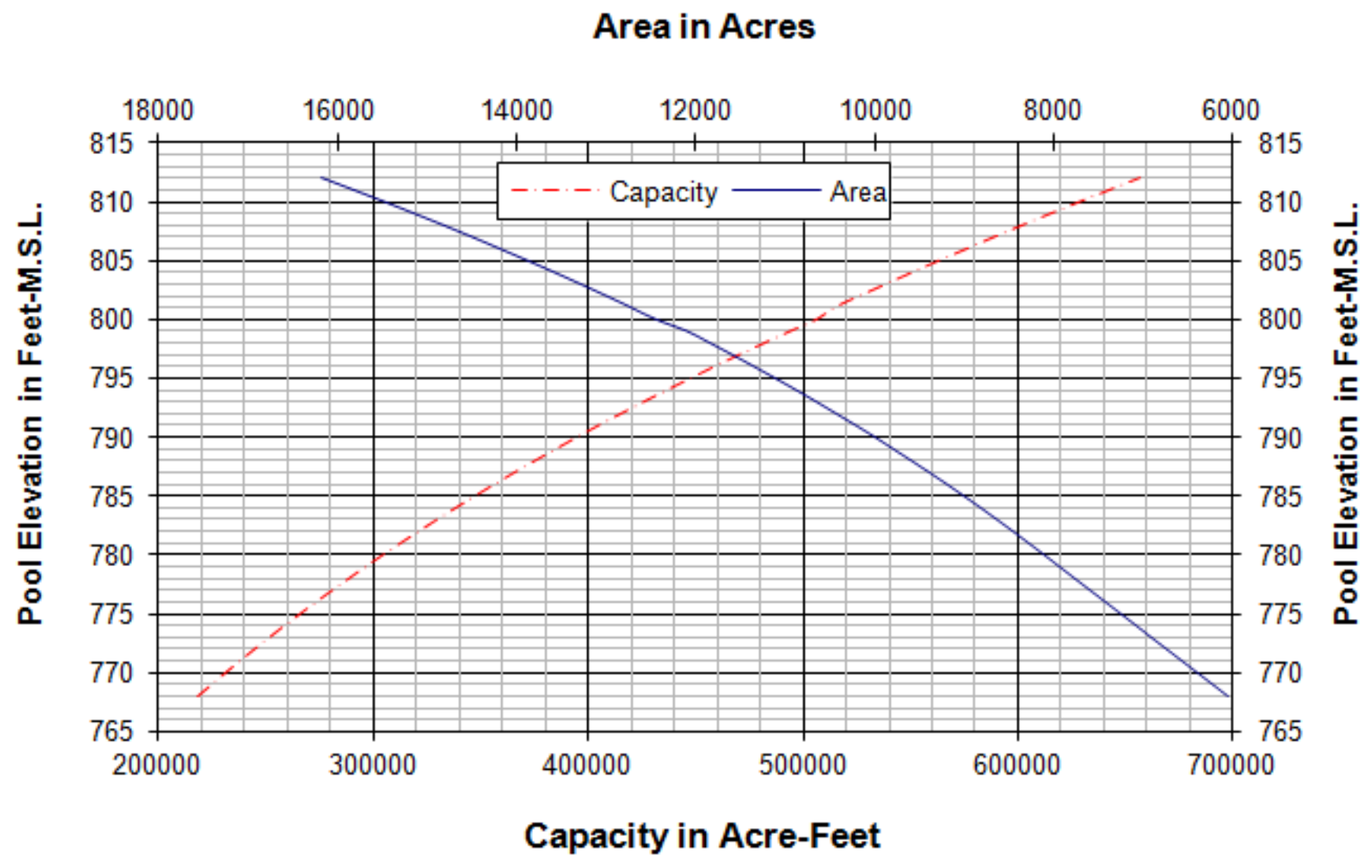


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

SPILLWAY DISCHARGE RATING FOR A SINGLE GATE

Pool Elev	Total Area	Total Storage	Pool Elev	Total Area	Total Storage
768	6060	218403	790	10007	394724
769	6231	224770	791	10220	404840
770	6402	231276	792	10440	415170
771	6573	237901	793	10660	425721
772	6745	244685	794	10886	436495
773	6916	251607	795	11120	447501
774	7087	258688	796	11360	458742
775	7258	265928	797	11602	470222
776	7429	273306	798	11852	481951
777	7600	280844	799	12108	493933
778	7772	288540	800	12454.67	506171
779	7943	296394	801	12730	514403
780	8113	304436	802	13011	526323
781	8288	312637	803	13298	538436
782	8462	321012	804	13592	550745
783	8641	329564	805	13892	563250
784	8823	338298	806	14199	575954
785	9012	347216	807	14512	588858
786	9202	356324	808	14833	601964
787	9397	365625	809	15160	615273
788	9597	375122	810	15495	628787
789	9801	384821	811	15837	642507
			812	16187	656437

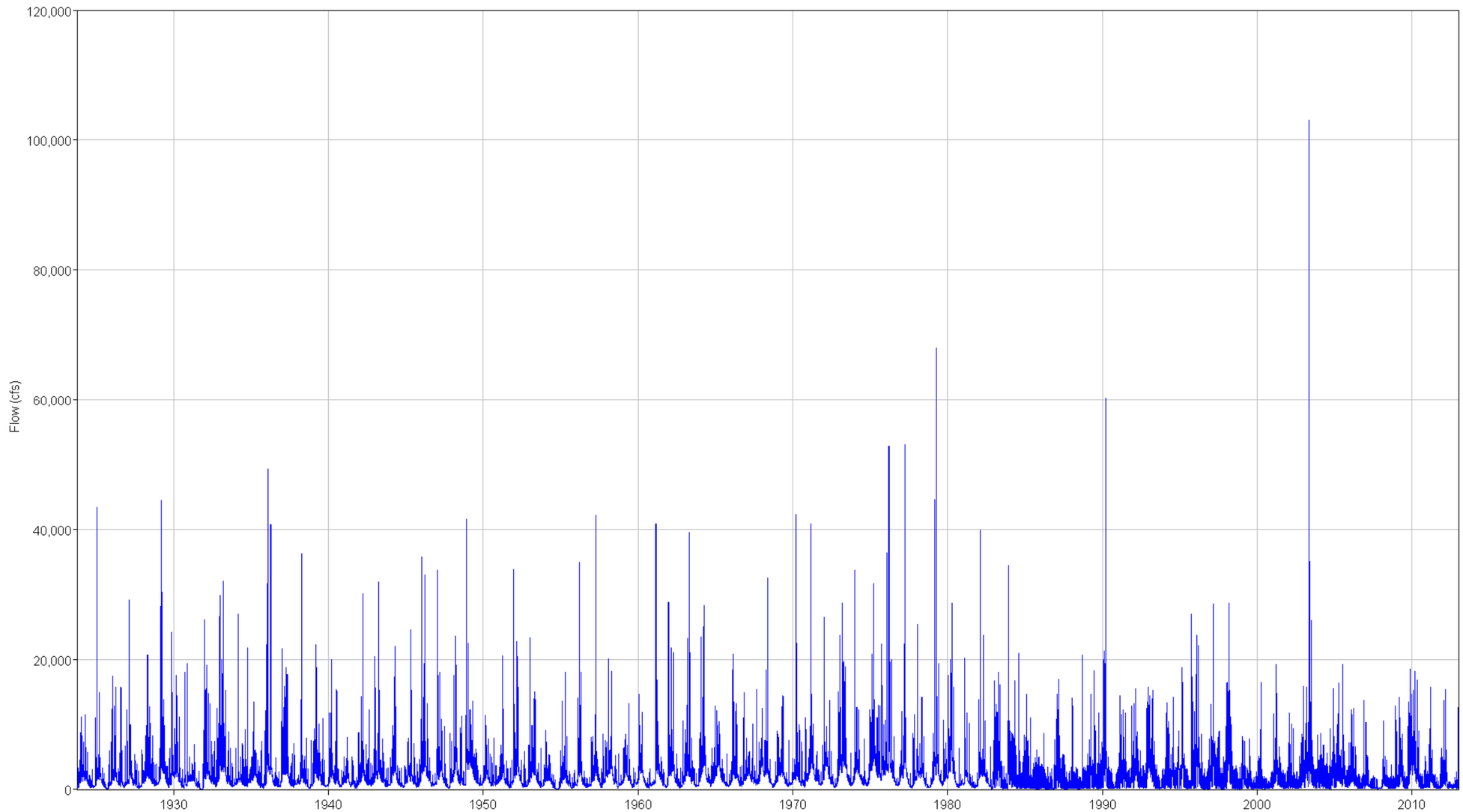


[1] Top of flood control
[2] Top of conservation
[3] Minimum conservation
[4] Spillway crest elevation
[5] Top of gates – closed position

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

AREA CAPACITY CURVES

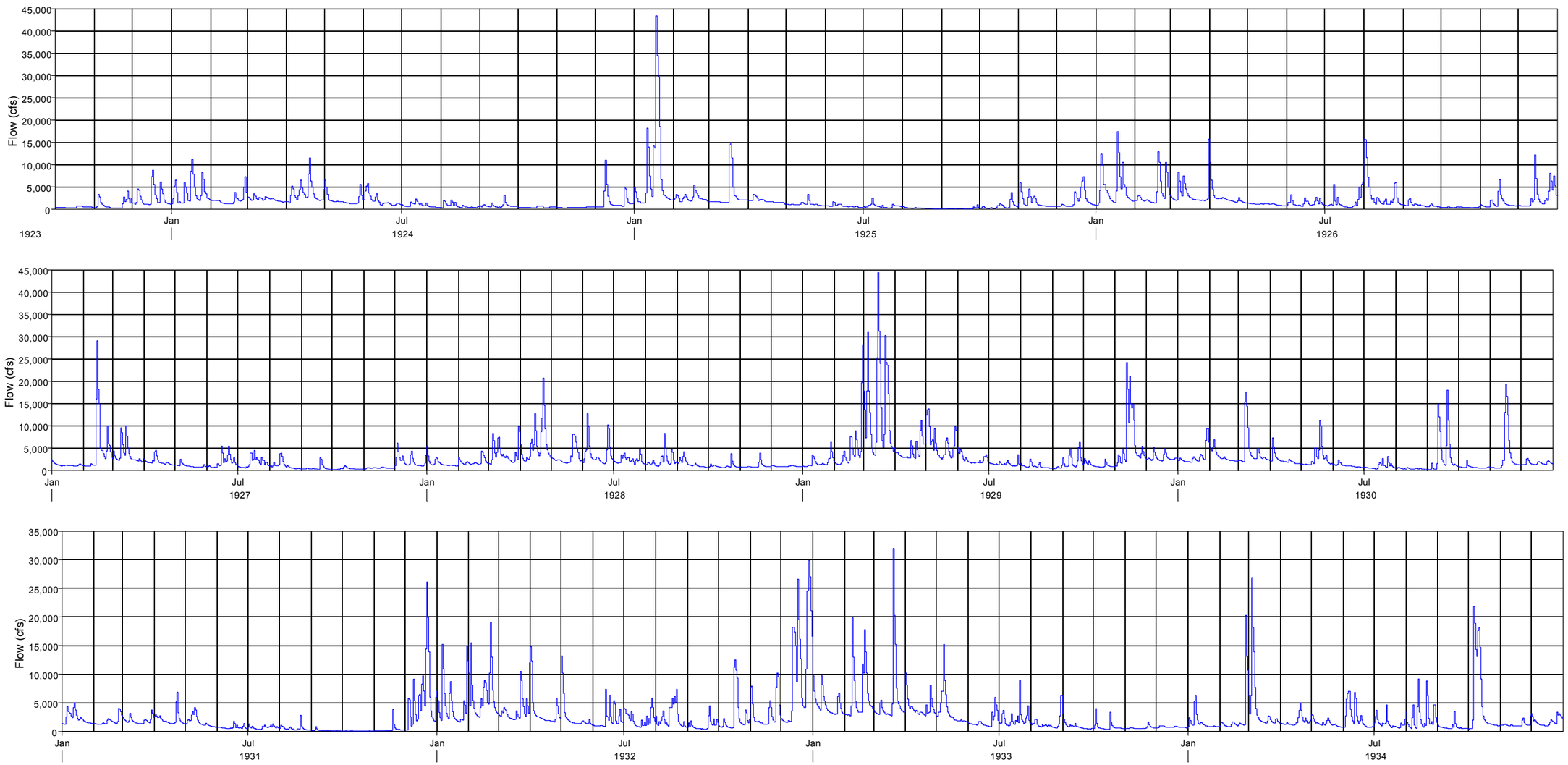


MEAN DAILY FLOW (USGS GAGE 02414500)
TALLAPOOSA RIVER AT WADLEY AL ABAMA
1 OCT 1923 TO 31 DEC 2012

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE HYDROGRAPHS
USGS GAGE 02414500

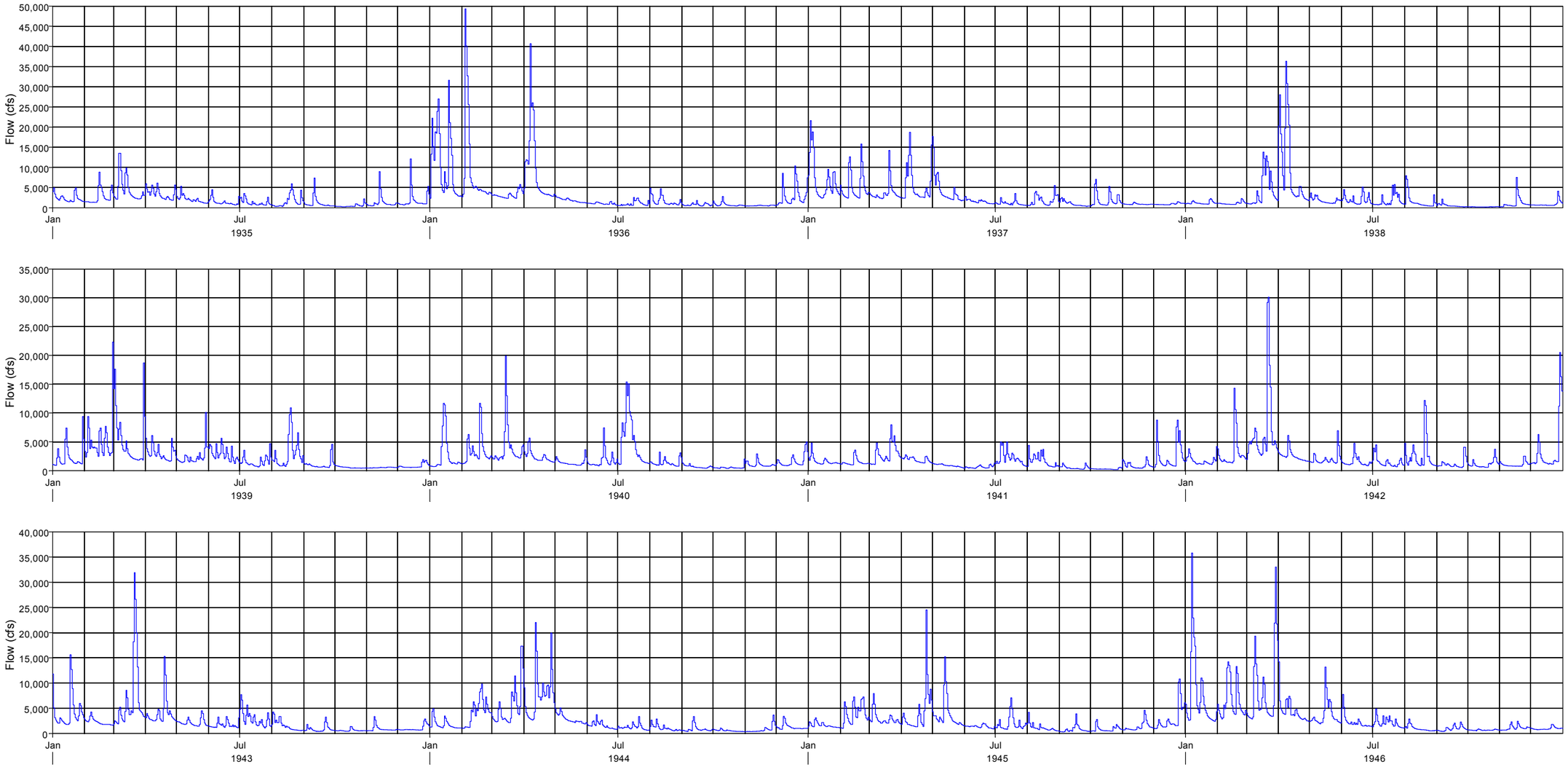


MEAN DAILY FLOW (USGS GAGE 02414500) TALLAPOOSA RIVER AT WADLEY AL ABAMA

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE HYDROGRAPHS
USGS GAGE 02414500

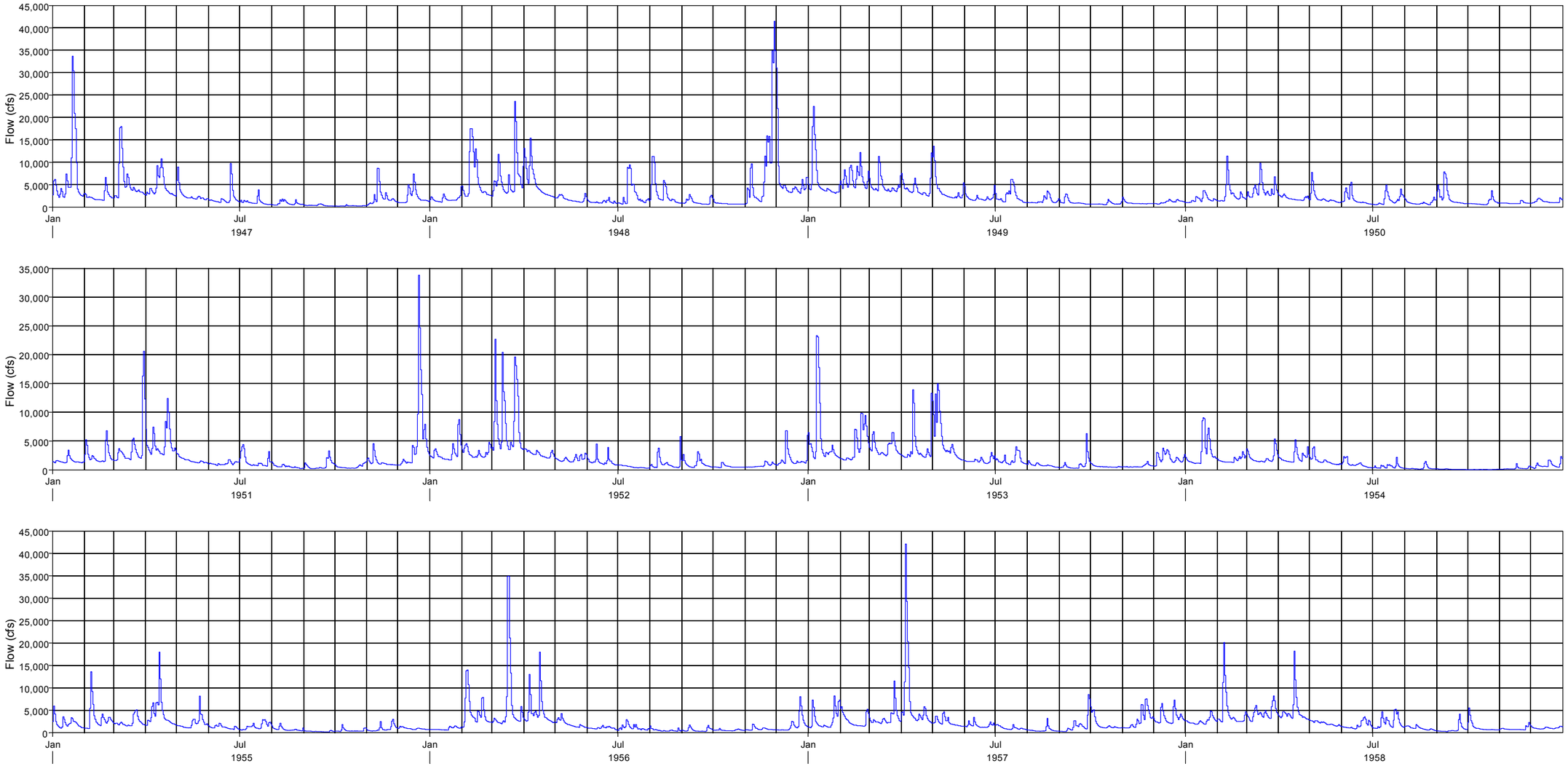


MEAN DAILY FLOW (USGS GAGE 02414500) TALLAPOOSA RIVER AT WADLEY AL ABAMA

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE HYDROGRAPHS
USGS GAGE 02414500

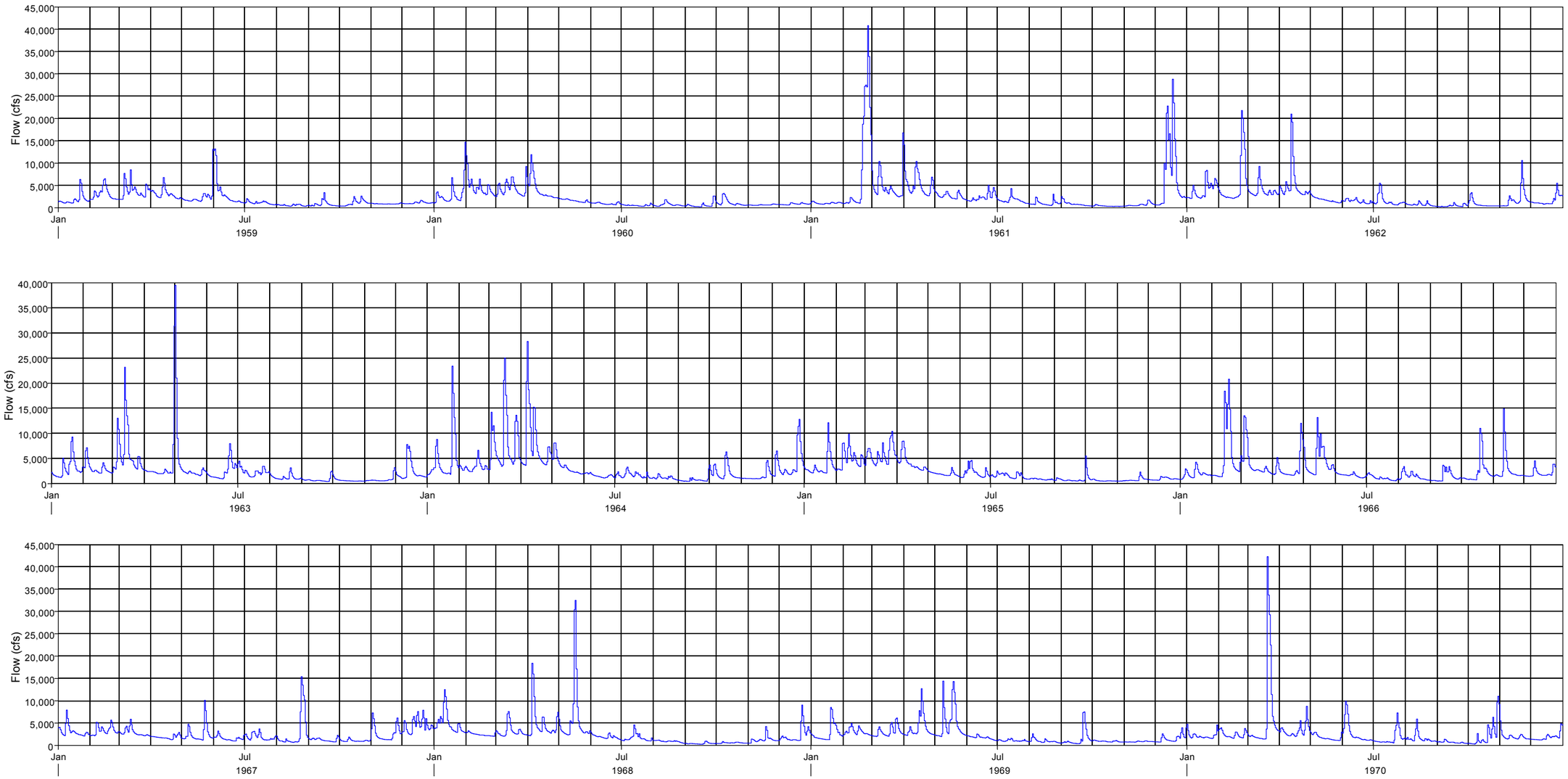


MEAN DAILY FLOW (USGS GAGE 02414500) TALLAPOOSA RIVER AT WADLEY AL ABAMA

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE HYDROGRAPHS
USGS GAGE 02414500

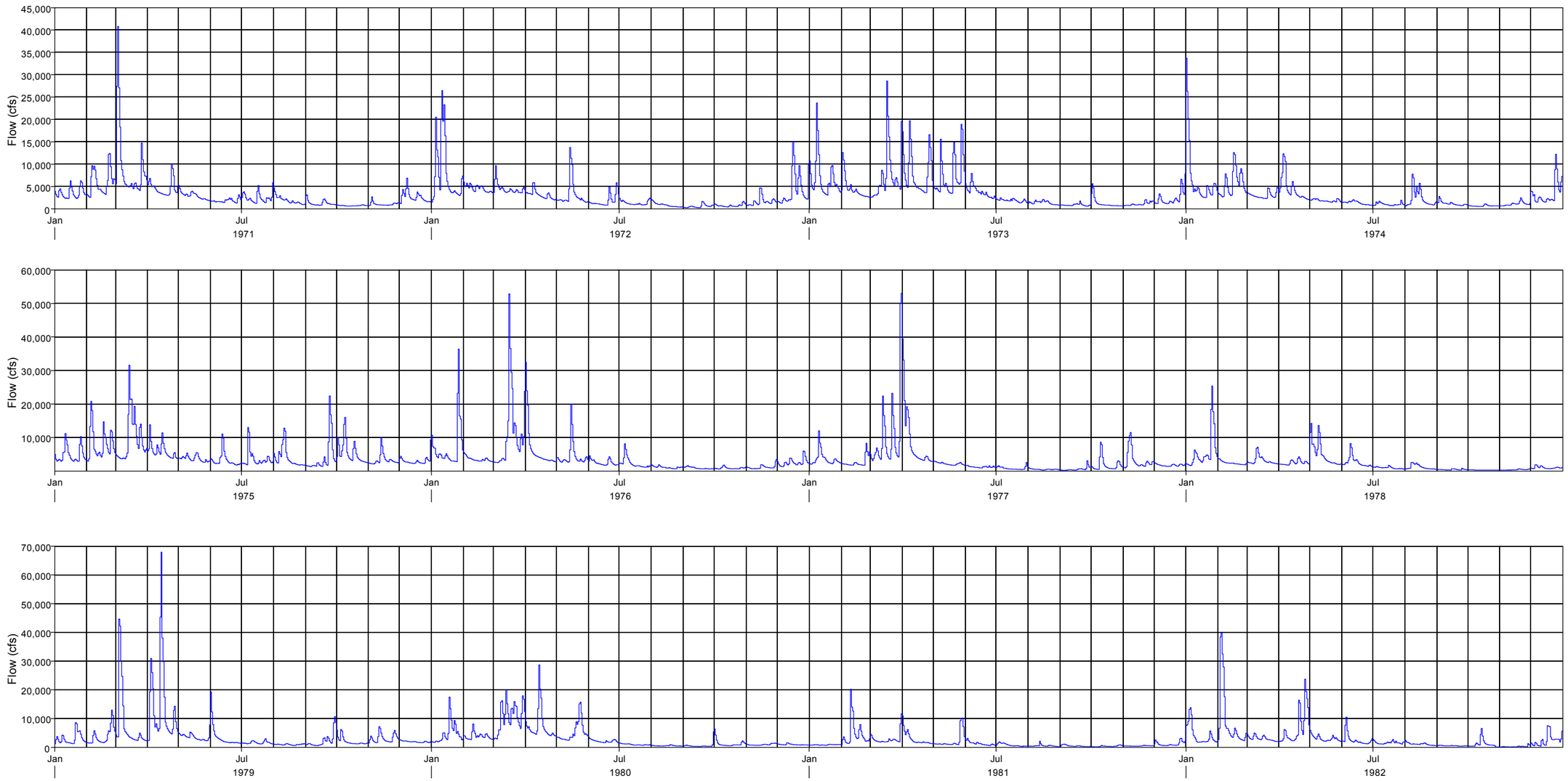


MEAN DAILY FLOW (USGS GAGE 02414500) TALLAPOOSA RIVER AT WADLEY AL ABAMA

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE HYDROGRAPHS
USGS GAGE 02414500

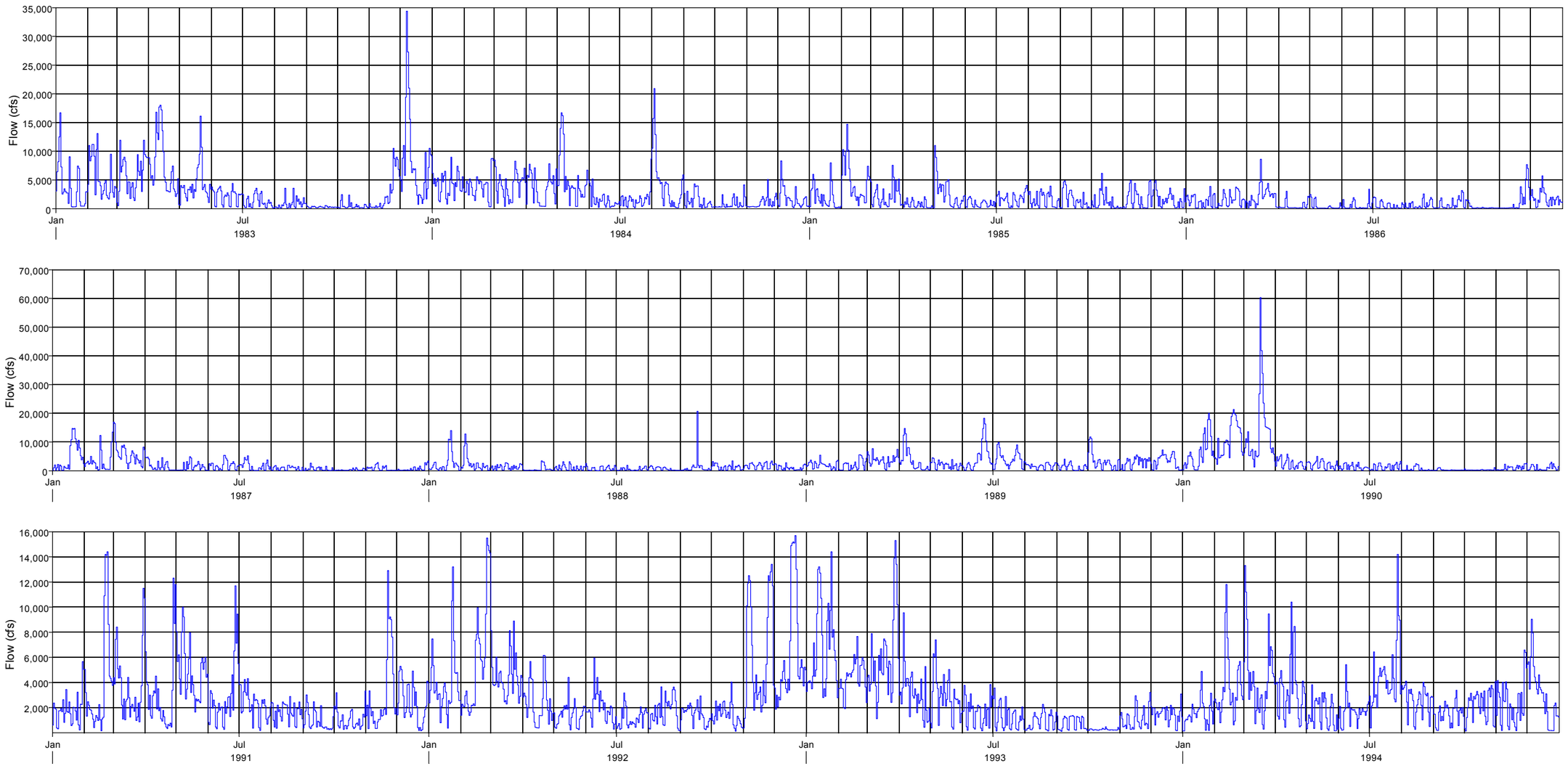


MEAN DAILY FLOW (USGS GAGE 02414500) TALLAPOOSA RIVER AT WADLEY AL ABAMA

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE HYDROGRAPHS
USGS GAGE 02414500

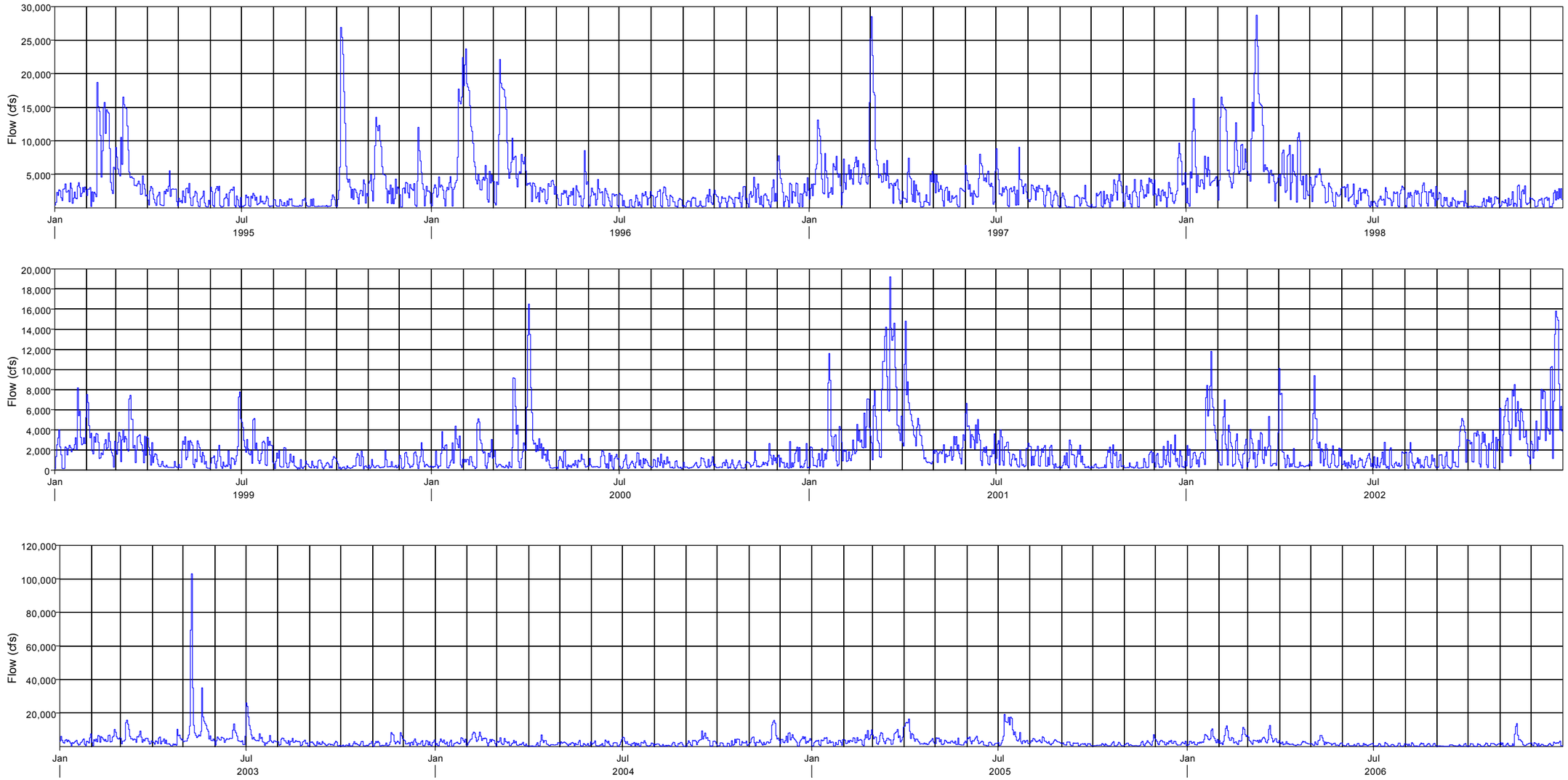


MEAN DAILY FLOW (USGS GAGE 02414500) TALLAPOOSA RIVER AT WADLEY AL ABAMA

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE HYDROGRAPHS
USGS GAGE 02414500

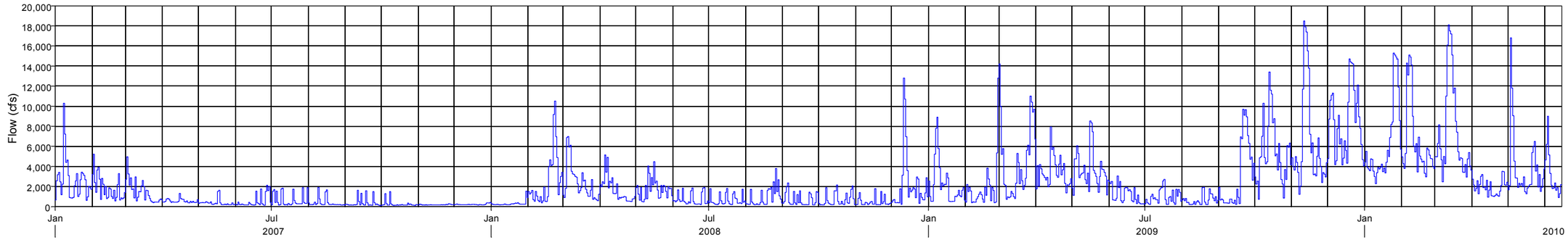


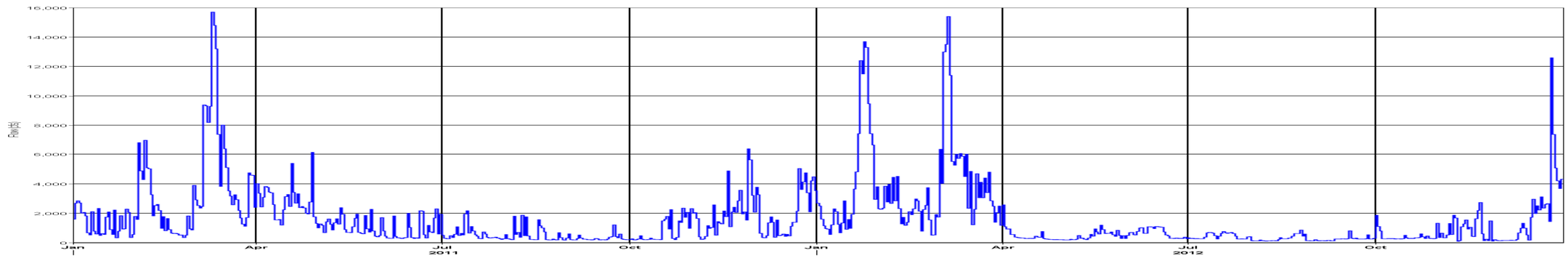
MEAN DAILY FLOW (USGS GAGE 02414500) TALLAPOOSA RIVER AT WADLEY AL ABAMA

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE HYDROGRAPHS
USGS GAGE 02414500





MEAN DAILY FLOW (USGS GAGE 02414500) TALLAPOOSA RIVER AT WADLEY AL ABAMA

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE HYDROGRAPHS
USGS GAGE 02414500

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Ann	Max Monthly	Min Monthly	Max Daily	Min Daily
1924	3828	2148	2239	3668	2113	1950	883	755	800	435	395	1818	1753	3828	395	11500	280
1925	8240	2570	3105	1886	1141	721	689	224	160	682	1592	1883	1908	8240	160	43400	60
1926	4618	3679	3470	2563	1084	1384	1588	3478	924	418	1364	2844	2285	4618	418	17400	300
1927	1200	5260	3635	1904	998	1834	1709	1089	527	357	507	2040	1755	5260	357	29100	180
1928	1597	1916	3790	5886	3025	3859	2347	2186	1459	970	987	889	2409	5886	889	20700	580
1929	1842	4850	14087	4426	5977	2435	1444	900	1657	1183	6562	2820	4015	14087	900	44400	350
1930	3082	3143	4354	2332	2804	1042	939	366	3459	703	3301	1612	2261	4354	366	19300	150
1931	2313	1824	1928	2209	1679	730	735	562	182	85	363	5892	1542	5892	85	26100	70
1932	4844	6454	3859	3316	2485	2155	2220	2527	1107	2699	3353	11211	3853	11211	1107	29900	380
1933	4696	6553	5615	4229	3510	1762	2179	1484	905	839	645	786	2767	6553	645	32000	380
1934	1518	2644	4190	1798	1427	2511	1422	2528	777	5151	1221	1778	2247	5151	777	26900	380
1935	2394	2724	4562	3467	2056	1414	1308	1630	1134	508	1331	1927	2038	4562	508	13500	225
1936	10809	9381	3221	9214	1889	1049	1054	1669	775	777	527	2936	3608	10809	527	49300	405
1937	6903	5280	3676	5565	4355	1571	1133	1831	969	1879	896	930	2916	6903	896	21600	355
1938	1215	1108	4339	9696	1836	1974	1726	1553	548	224	1178	929	2194	9696	224	36300	166
1939	2346	5109	5217	3068	2406	2856	1550	2980	1051	564	524	827	2375	5217	524	22300	429
1940	2578	3492	3962	2400	1408	1716	4980	1397	697	532	1061	1647	2156	4980	532	19900	382
1941	1660	1467	2938	1914	896	647	2160	1703	529	300	902	2510	1469	2938	300	8760	200
1942	1728	3066	6889	2536	1979	1500	1469	2624	1178	1131	1076	3596	2398	6889	1076	30100	542
1943	4268	2279	6840	4061	2163	1690	2929	1530	905	611	918	1025	2435	6840	611	31900	404
1944	1794	4278	5364	7847	2877	1596	1251	1084	890	558	816	1273	2469	7847	558	22000	360
1945	1647	3910	2911	4238	3752	1384	1939	1135	815	894	1343	2921	2241	4238	815	24500	308
1946	7515	6538	8494	4475	3688	2311	2109	976	967	677	1121	990	3322	8494	677	35800	410
1947	7000	2410	5385	4499	2643	1996	1123	862	400	287	2234	2230	2589	7000	287	33700	231
1948	1803	6202	6619	5455	1793	1172	2800	3129	1212	785	9649	5898	3876	9649	785	41500	615
1949	5829	6551	4798	4267	3811	2099	2425	1483	1123	786	910	1158	2937	6551	786	22500	548
1950	1777	2920	3857	2016	1995	1712	1653	999	2257	1010	915	1285	1866	3857	915	11400	536
1951	1558	2515	4031	4749	1646	1125	1507	581	795	564	1375	5467	2159	5467	564	33800	231
1952	3007	3008	8288	2793	1890	1514	523	1151	1078	589	765	1958	2214	8288	523	22700	300
1953	5245	4247	3825	3804	5241	1656	1719	805	925	594	653	2045	2563	5245	594	23300	284
1954	2998	1761	2122	2172	1552	990	590	322	111	65	274	831	1149	2998	65	9080	45
1955	2124	3255	2345	4296	2132	1209	1454	776	287	507	930	909	1685	4296	287	18000	162
1956	888	4735	6185	4780	1970	1039	1141	535	623	545	833	1745	2085	6185	535	34900	269
1957	2846	2698	3279	7007	2330	1658	1048	597	1615	1860	2921	3409	2606	7007	597	42100	251
1958	2591	4601	4413	4773	2086	1653	2308	986	745	1185	888	1046	2273	4773	745	20100	201
1959	1844	3092	3813	3098	2380	3267	1125	554	834	1094	885	1106	1924	3813	554	13200	330
1960	3067	4613	4424	4046	1616	959	546	688	641	1125	651	838	1935	4613	546	14700	212
1961	1057	9562	4752	5402	2682	2403	1662	1059	881	397	700	7318	3156	9562	397	40800	316

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

SUMMARY FLOW DATA
USGS GAGE 02414500
TALLAPOOSA R. AT WADLEY, AL

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Ann	Max Monthly	Min Monthly	Max Daily	Min Daily
1962	3949	5321	3762	5285	1781	1469	1541	727	462	814	1992	1619	2394	5321	462	21800	230
1963	3028	3108	6224	3422	4419	2419	2380	1234	747	649	779	2393	2567	6224	649	39500	411
1964	4824	3306	8349	8237	3446	1599	1737	1189	722	2207	1457	3860	3411	8349	722	28300	430
1965	3435	4939	5801	4112	1964	2165	1683	894	674	887	772	935	2355	5801	674	12100	477
1966	1911	5643	4114	3203	4511	1654	1114	1448	1405	2356	2771	2081	2684	5643	1114	20800	477
1967	3156	3362	2905	1850	2551	1582	1901	2899	1273	1060	2676	4545	2480	4545	1060	15400	663
1968	4934	2447	3167	4971	6084	1947	1680	890	434	561	1305	2363	2565	6084	434	32500	264
1969	2735	3083	3128	4026	4937	1752	1077	999	1476	908	830	1582	2211	4937	830	14400	385
1970	2204	2454	6637	3333	1785	2671	1584	1570	690	2427	1956	1880	2433	6637	690	42300	318
1971	3554	6056	9305	4661	2953	1845	2468	1921	1294	721	1071	2655	3209	9305	721	40800	624
1972	8142	4601	4479	3153	3187	1843	1337	858	585	754	1639	4268	2904	8142	585	26500	253
1973	6905	4466	7335	8059	7447	3888	1875	1375	869	1266	1098	2344	3911	8059	869	28600	592
1974	6786	5731	3077	4484	1851	1337	1036	2275	1183	676	1101	3489	2752	6786	676	33700	544
1975	4801	8101	9576	6021	3717	3285	3616	3906	3977	5455	3315	3074	4904	9576	3074	31600	1330
1976	7131	3552	11143	6439	4521	2539	2319	1124	916	887	1183	2607	3697	11143	887	52800	600
1977	3588	2715	10518	8720	2211	1240	860	522	609	1849	3168	1767	3147	10518	522	53000	214
1978	5668	2421	3138	2489	5024	2671	985	1170	462	307	414	1023	2148	5668	307	25400	275
1979	3018	3872	7985	14755	3635	3362	1620	971	2298	2086	3187	1965	4063	14755	971	67900	574
1980	4682	3886	10641	7506	5268	2174	974	560	610	1282	951	968	3292	10641	560	28700	260
1981	868	4552	2905	2916	2265	1340	805	553	498	390	496	1227	1568	4552	390	20200	182
1982	4199	9219	3071	6748	3098	2576	1622	1140	539	1154	283	2490	3012	9219	283	39800	92
1983	3678	5556	5925	7390	4249	2252	1226	900	301	500	2707	8336	3585	8336	301	34400	104
1984	4286	3971	4191	3560	5111	1415	1604	4331	1362	840	1058	1740	2789	5111	840	20900	151
1985	1902	4752	2267	723	2703	892	1773	1533	1556	1135	1766	1593	1883	4752	723	14700	94
1986	1248	1607	2175	542	444	521	612	639	876	234	1313	1790	1000	2175	234	8610	70
1987	4628	3169	5848	1647	1305	1819	1596	872	594	313	767	729	1941	5848	313	17000	41
1988	2545	2437	1294	595	988	788	527	678	1384	1298	1832	1029	1283	2545	527	20700	54
1989	2023	1999	3727	3442	2073	4664	4066	1686	1271	3334	2833	3276	2866	4664	1271	18300	114
1990	6109	10893	13267	2472	2143	1283	1302	585	320	321	1009	967	3389	13267	320	60300	133
1991	1856	3927	3753	2995	4891	2960	2239	1634	920	1059	3030	2402	2639	4891	920	14400	151
1992	3945	5698	4515	2409	1443	1994	1160	1719	1481	1433	6246	6366	3201	6366	1160	15700	123
1993	6757	4491	6086	3159	2906	1693	1229	910	783	253	1091	1514	2573	6757	253	15300	106
1994	1553	3630	4410	3406	1529	1707	4497	2635	1498	2256	2381	3040	2712	4497	1498	14200	133
1995	2241	7359	6281	1910	1361	1542	922	629	504	5599	4946	3018	3026	7359	504	26900	94
1996	5257	8423	8557	2792	2081	1633	1051	1289	859	1374	1666	2592	3131	8557	859	23700	92
1997	4979	5220	7003	2280	2210	3644	2963	1955	894	1771	2227	3000	3179	7003	894	28500	74
1998	4868	8274	9682	5031	2829	1862	1495	1733	893	625	1184	1205	3307	9682	625	28700	89
1999	2616	2770	2992	816	1459	1549	2310	724	597	510	458	872	1473	2992	458	8180	109

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

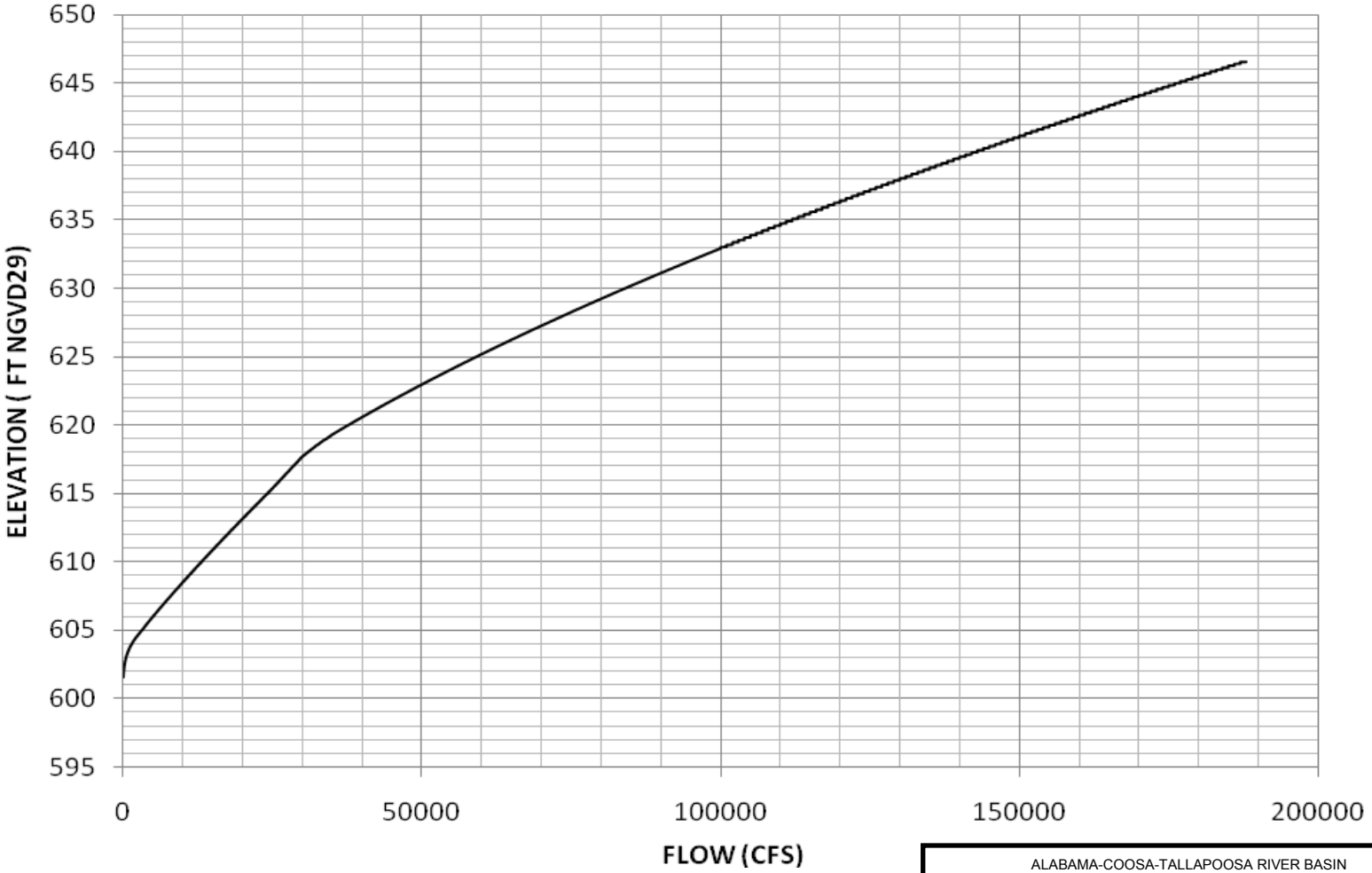
SUMMARY FLOW DATA
USGS GAGE 02414500
TALLAPOOSA R. AT WADLEY, AL

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Ann	Max Monthly	Min Monthly	Max Daily	Min Daily
2000	1452	1581	1745	3337	716	799	668	573	534	450	813	902	1131	3337	450	16500	111
2001	2379	2763	7440	3875	1882	2689	1465	1270	976	778	556	1114	2266	7440	556	19200	178
2002	3115	2106	1801	1455	2013	721	860	866	1585	2353	4471	6179	2294	6179	721	15800	126
2003	2926	4722	5426	3051	14319	4819	6027	2628	1548	1126	2652	2151	4283	14319	1126	103000	187
2004	2233	4159	1931	1494	1545	1560	1728	972	3180	1719	4493	3919	2411	4493	972	15500	105
2005	2555	4164	5128	5162	2526	2575	7058	3030	1418	952	1661	2198	3202	7058	952	19200	283
2006	3615	5104	4152	1638	2177	915	789	902	482	984	2599	1297	2055	5104	482	13700	137
2007	2624	1846	1466	555	381	538	651	383	375	254	185	220	790	2624	185	10300	96
2008	299	2581	2439	1656	1794	715	648	936	721	665	466	2183	1259	2581	299	12800	163
2009	2213	1819	4482	3435	3661	1199	979	655	3092	5477	6436	8426	3490	8426	655	18500	197
2010	6255	6638	7483	1956	3772	2158	1136	628	432	965	1259	1142	2819	7483	432	18100	173
2011	1417	2189	5305	2828	1148	886	585	574	325	818	2037	1993	1675	5305	325	15700	186
2012	4093	2327	5135	476	482	674	455	284	265	450	820	2165	1469	5135	265	15400	104
Average	**3485**	**4183**	**5024**	**3966**	**2776**	**1845**	**1710**	**1345**	**1019**	**1161**	**1743**	**2483**	**2562**	**6629**	**642**	**26278**	**279**

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

SUMMARY FLOW DATA
USGS GAGE 02414500
TALLAPOOSA R. AT WADLEY, AL



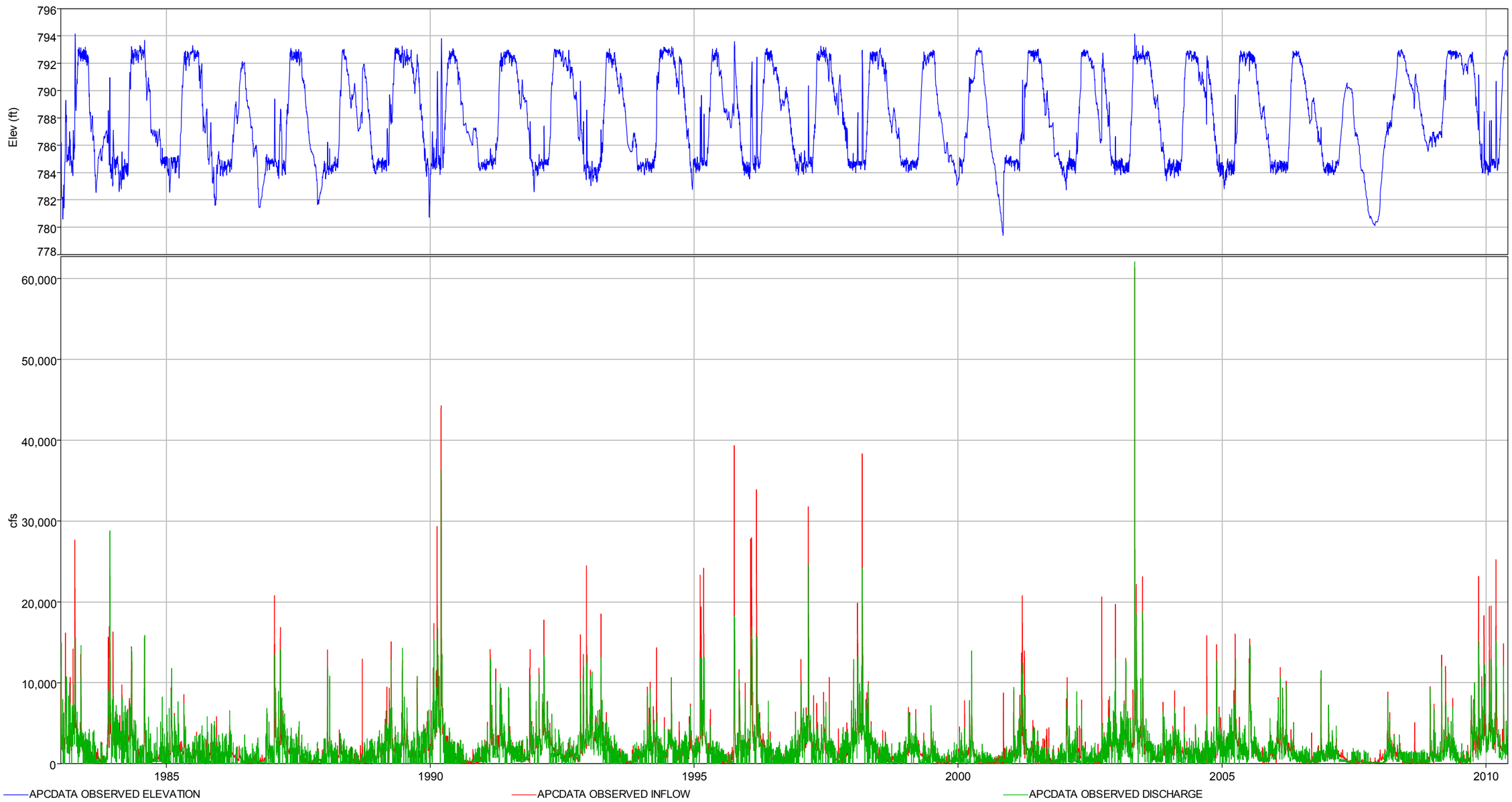
Rating Curve updated October 11, 2012

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

RATING CURVE

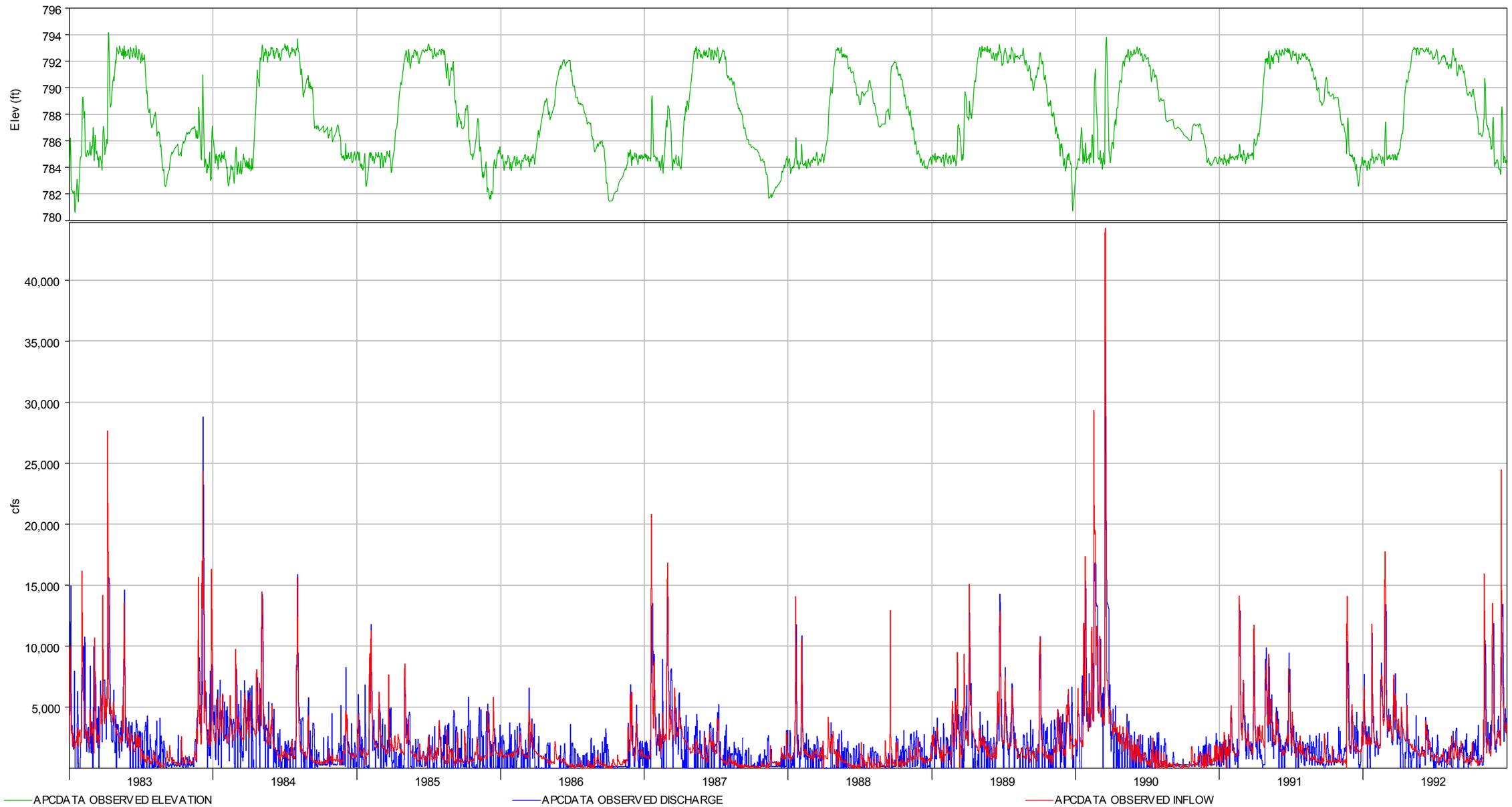
AT USGS 02414500 GAGE AT WADLEY, AL



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

INFLOW-OUTFLOW-POOL HYDROGRAPHS

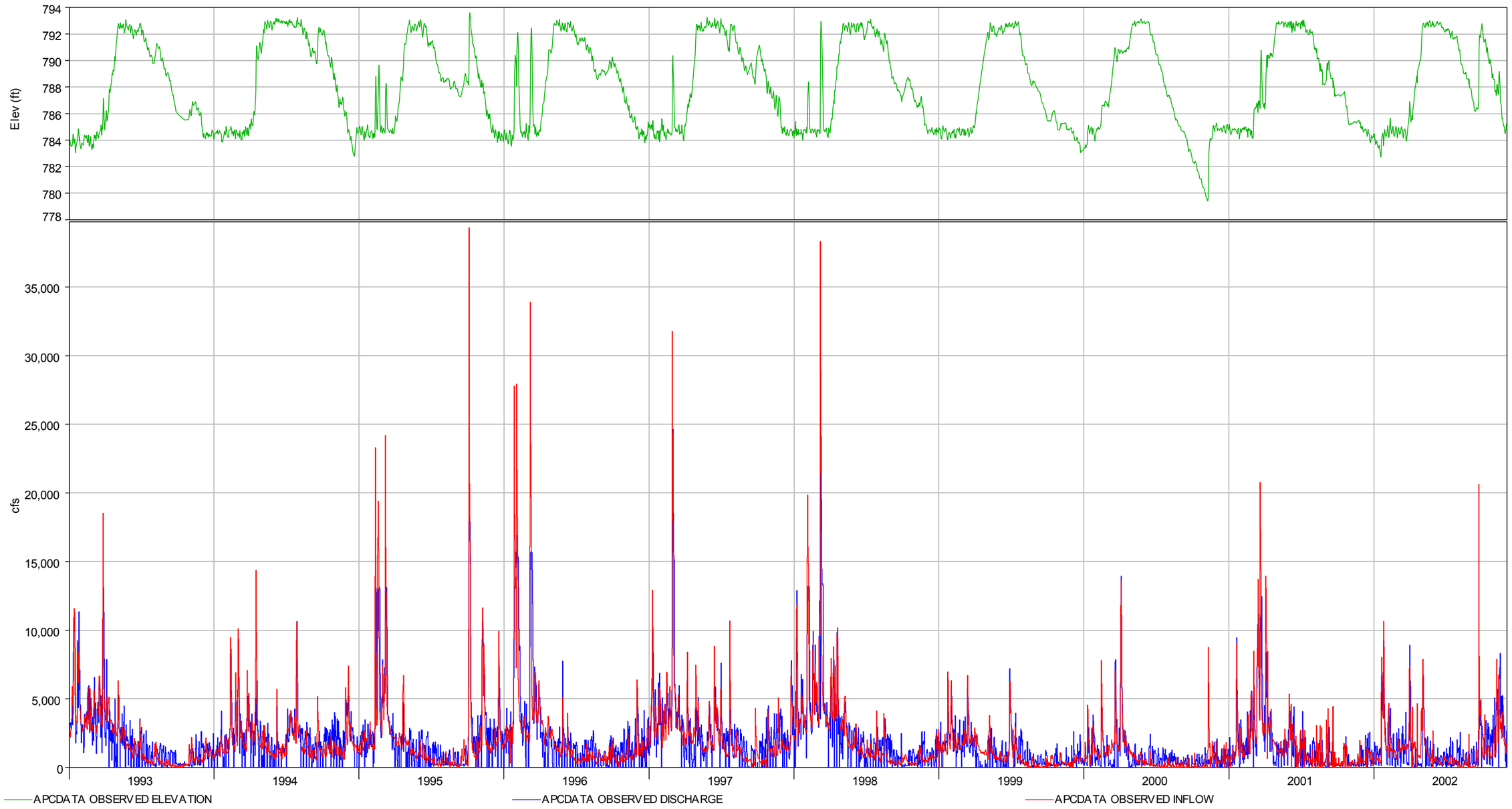


*Hydrographs represent daily midnight values

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

INFLOW-OUTFLOW-POOL HYDROGRAPHS

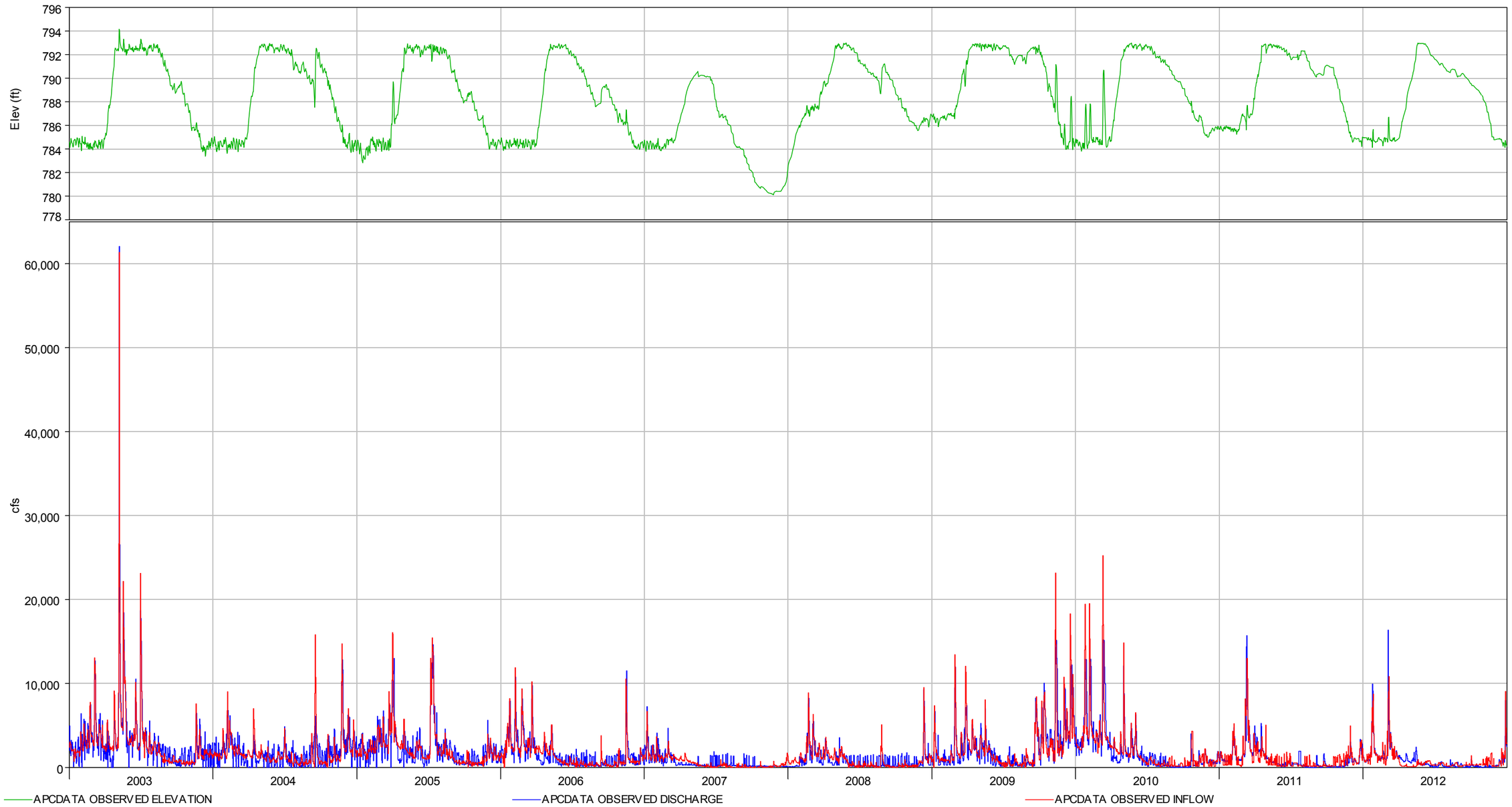


*Hydrographs represent daily midnight values

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

INFLOW-OUTFLOW-POOL HYDROGRAPHS

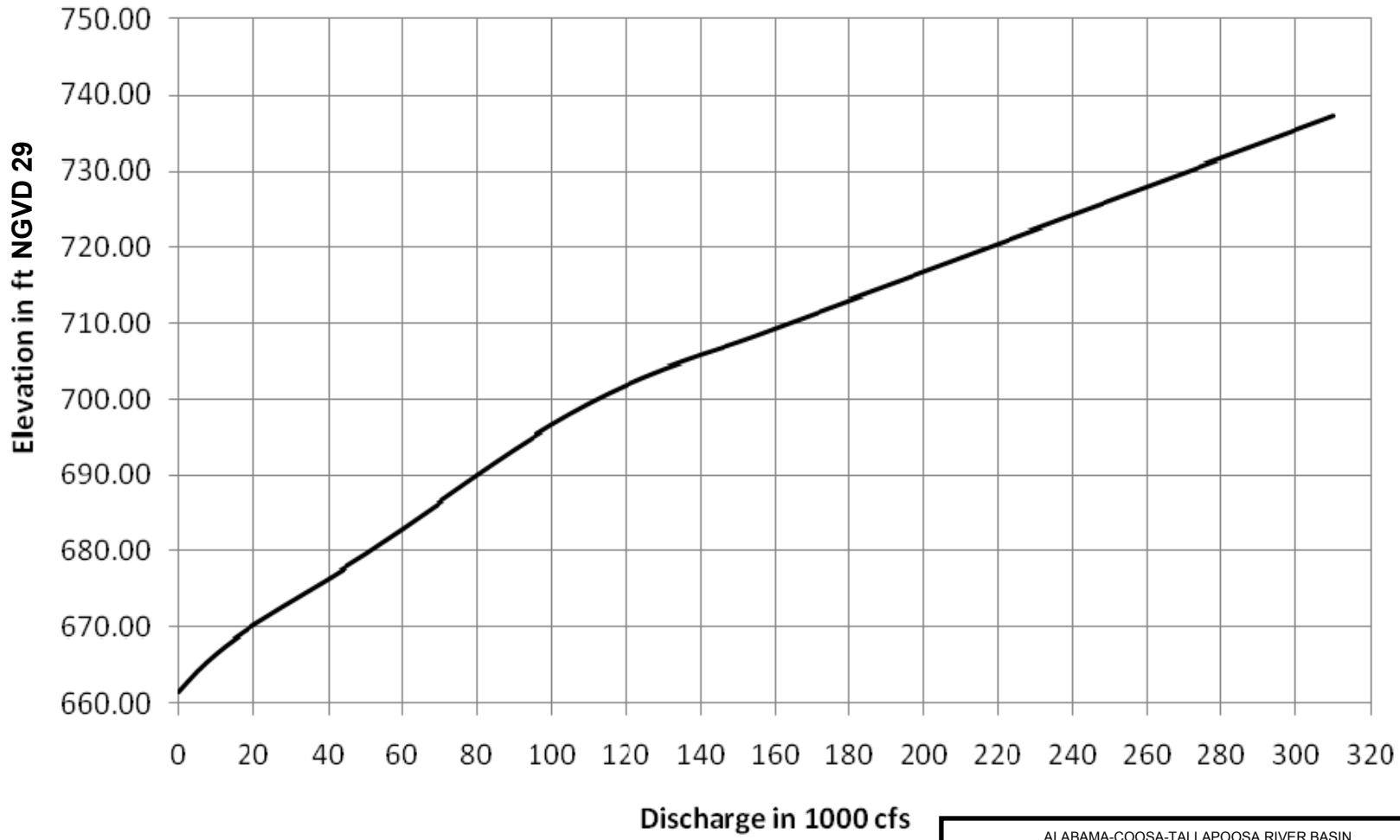


*Hydrographs represent daily midnight values

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

INFLOW-OUTFLOW-POOL HYDROGRAPHS



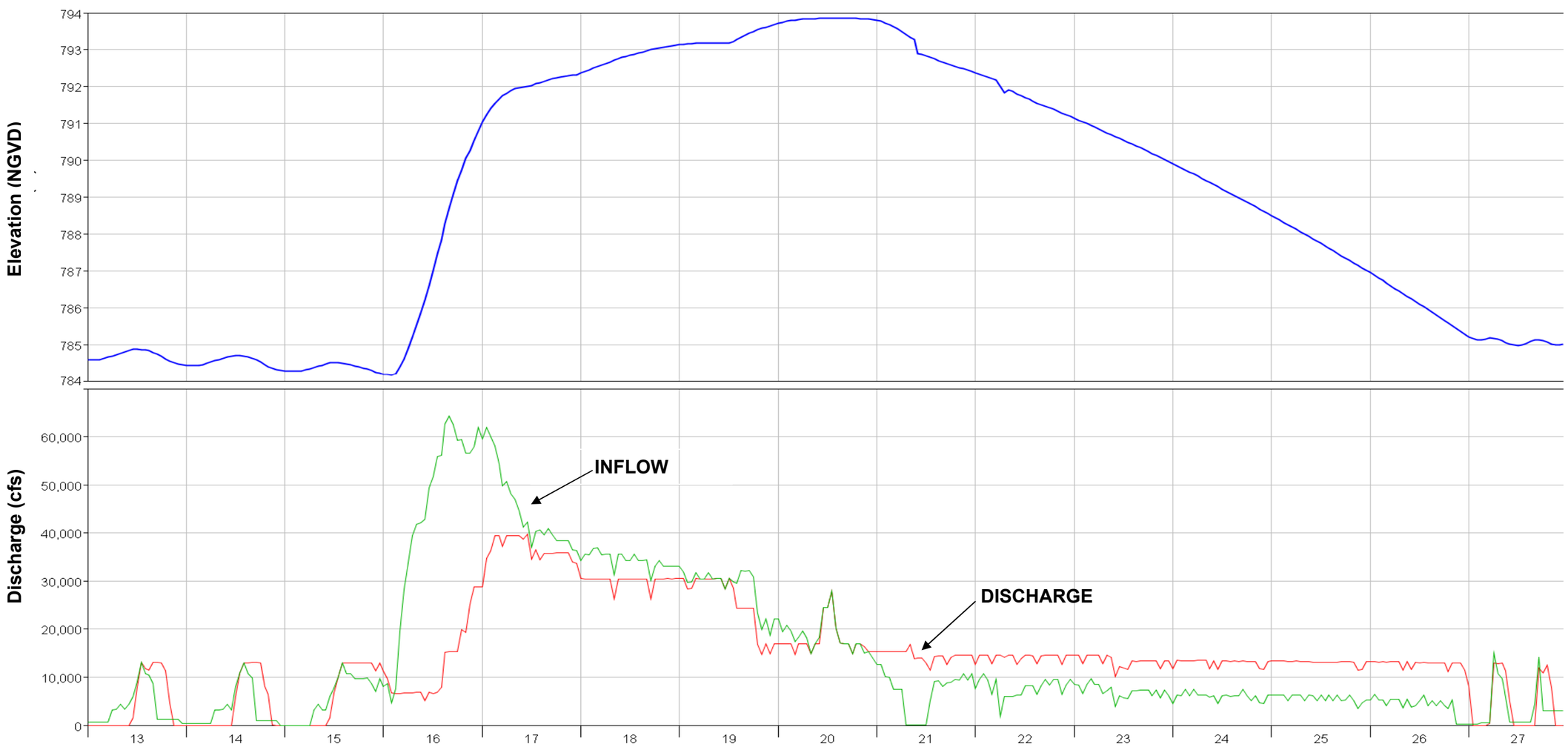
* *Data provided to Alabama Power to support ResSim model development*

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

TAILWATER RATING CURVE

FLOW, DISCHARGE, AND POOL FOR MARCH 1990 FLOOD

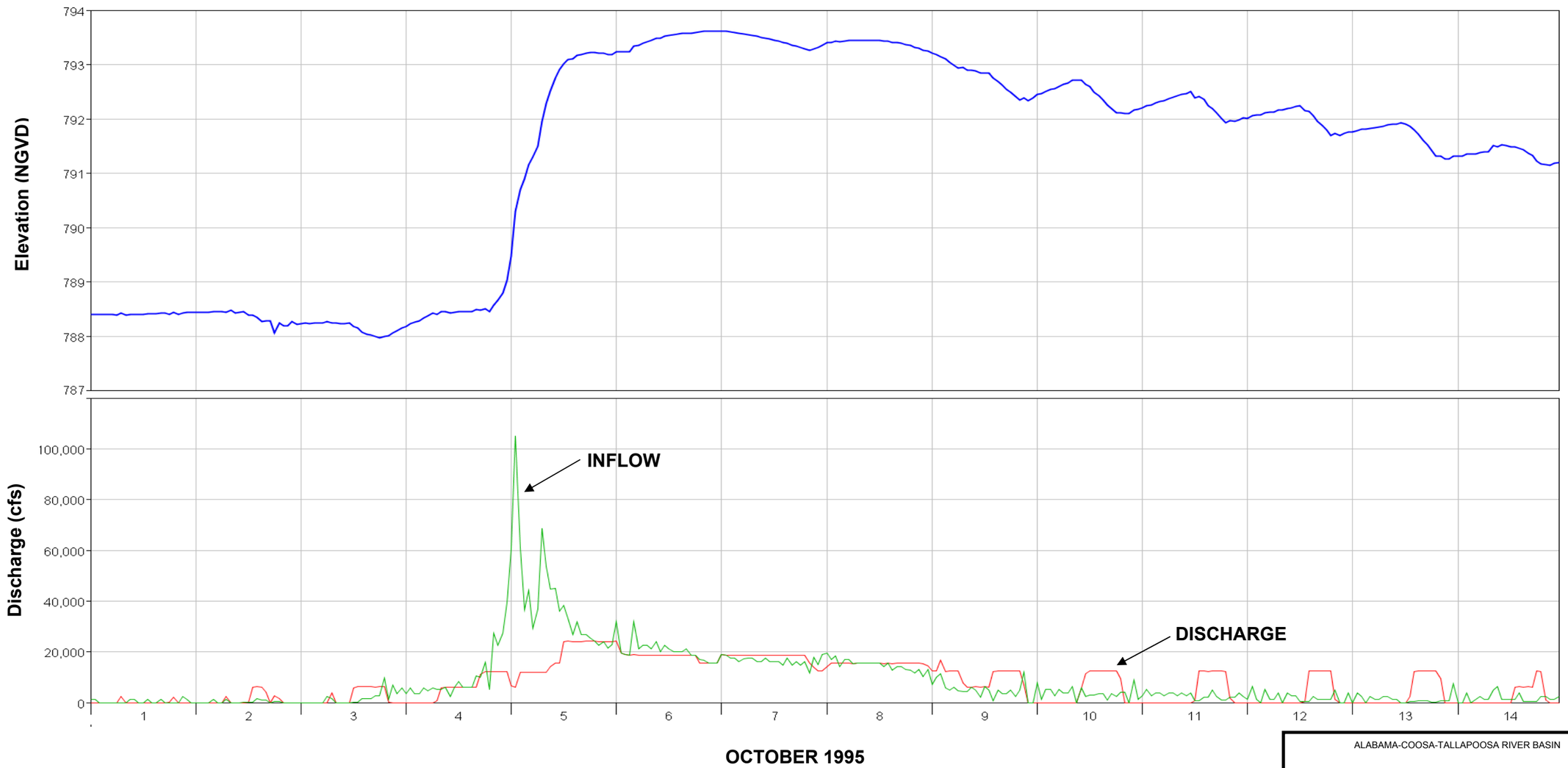


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

MARCH 1990 FLOOD
FLOW, DISCHARGE, AND POOL

FLOW, DISCHARGE, AND POOL FOR OCTOBER 1995 FLOOD

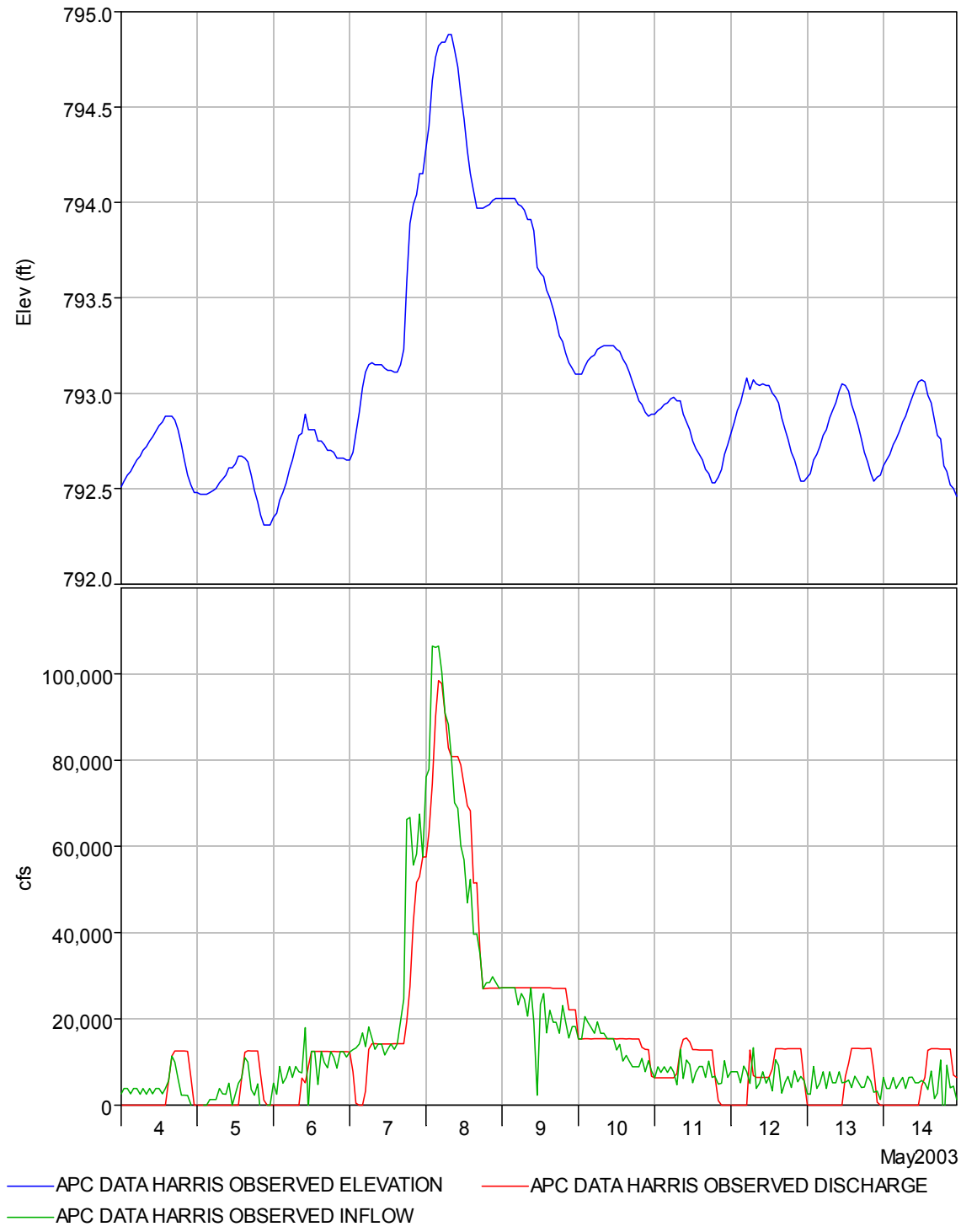


APC Hourly data

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

OCTOBER 1995 FLOOD
FLOW, DISCHARGE, AND POOL

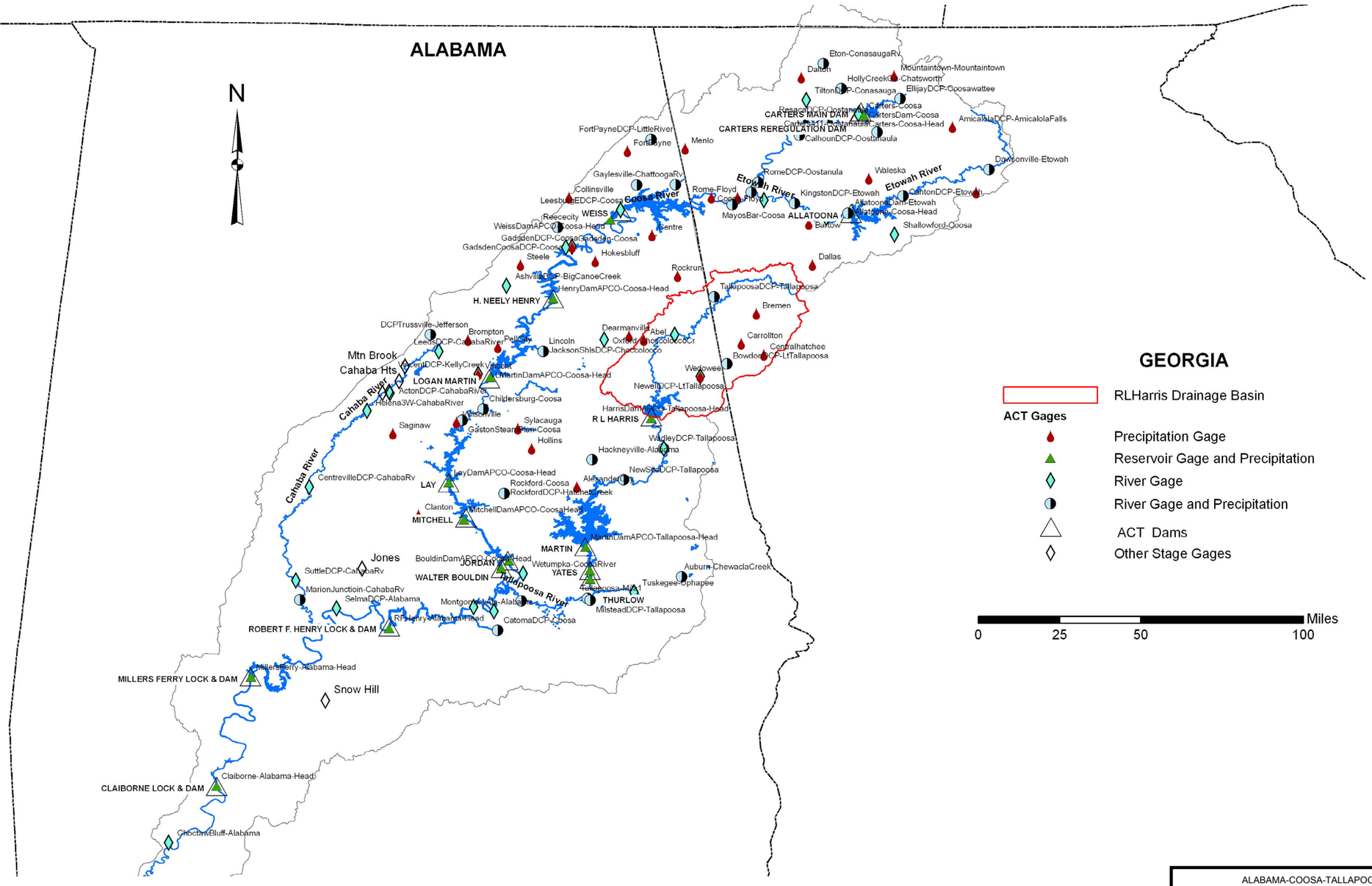


Data from APC hourly values

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

FLOOD OF 2003
INDUCED SURCHARGE REGULATION
HOURLY VALUES

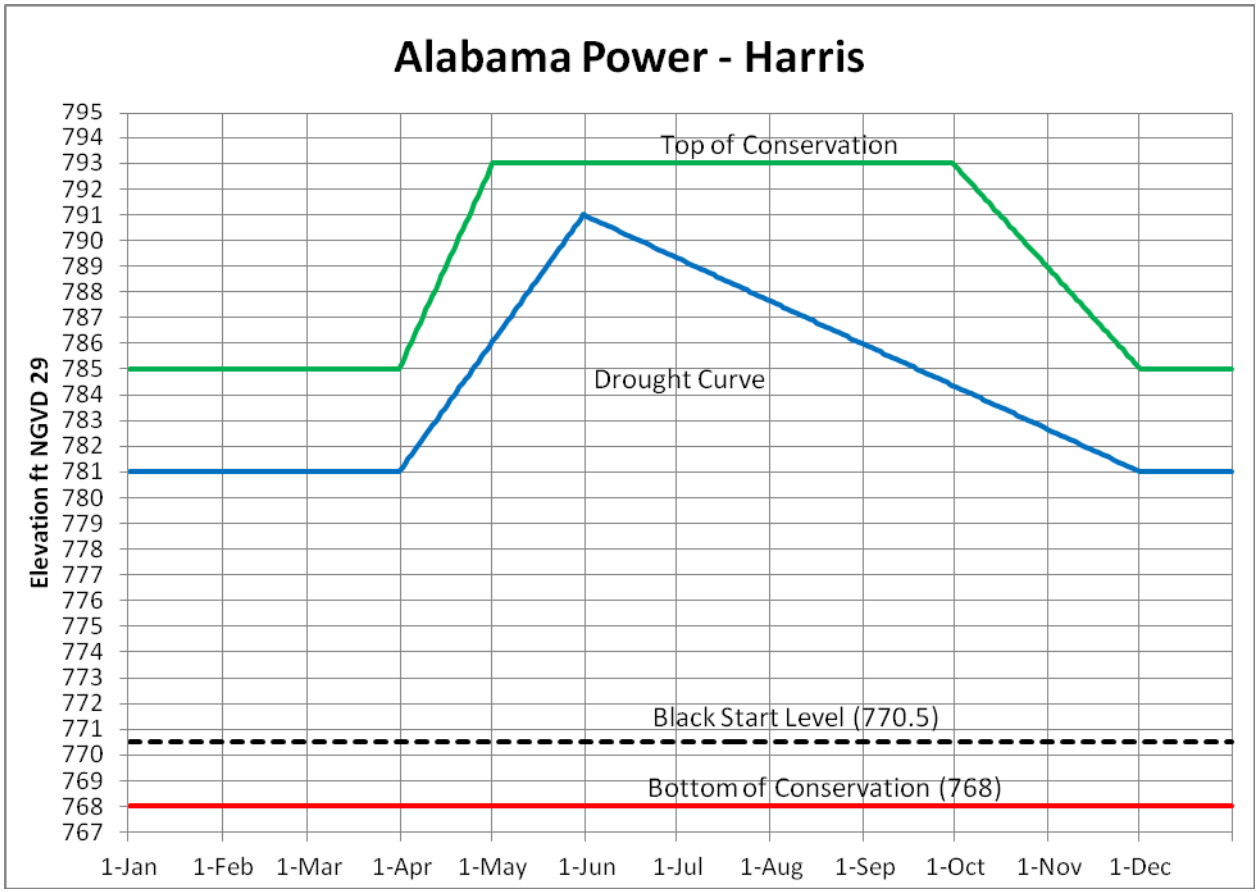


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

ACT REPORTING STATIONS

Guide Curve Elevation ft NGVD 29	Date Month*
785	J
785	F
785	M
785	A
793	M
793	J
793	J
793	A
793	S
793	O
789	N
785	D
785	J

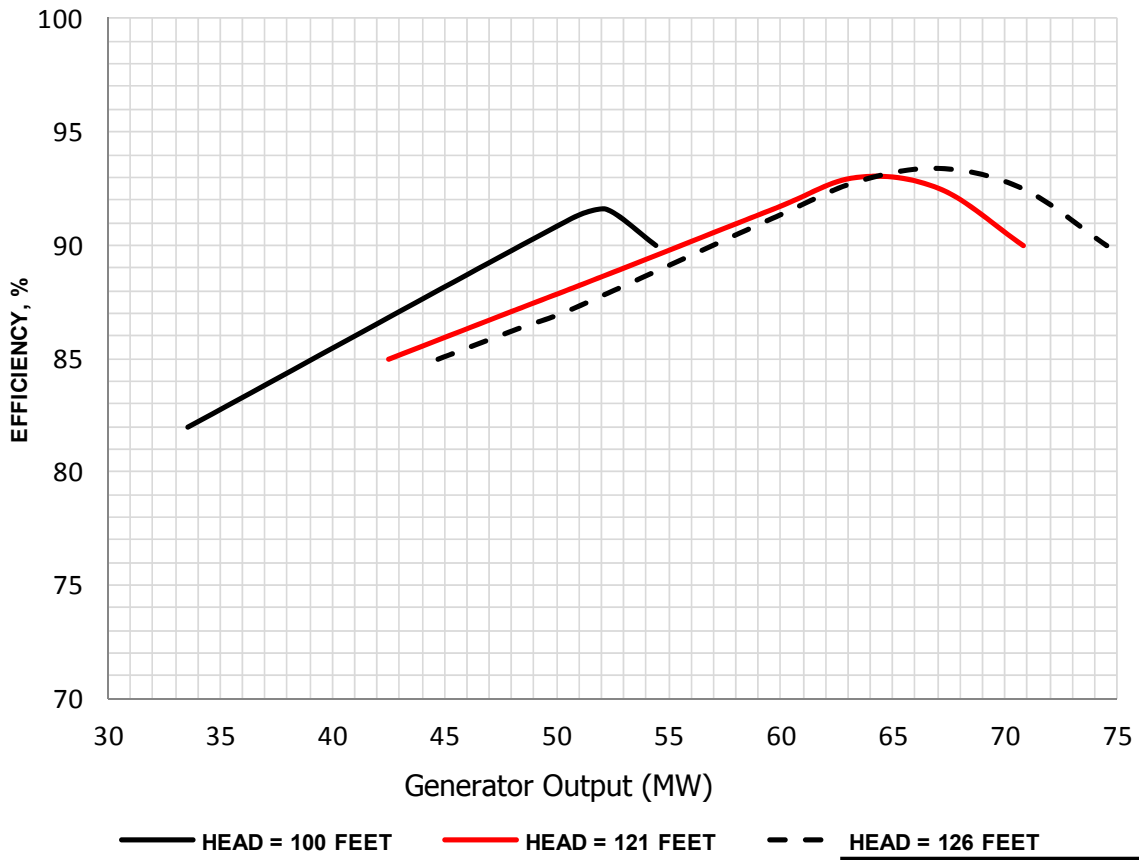


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

GUIDE CURVE

GUARANTEED HYDROPOWER PERFORMANCE CURVES



ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

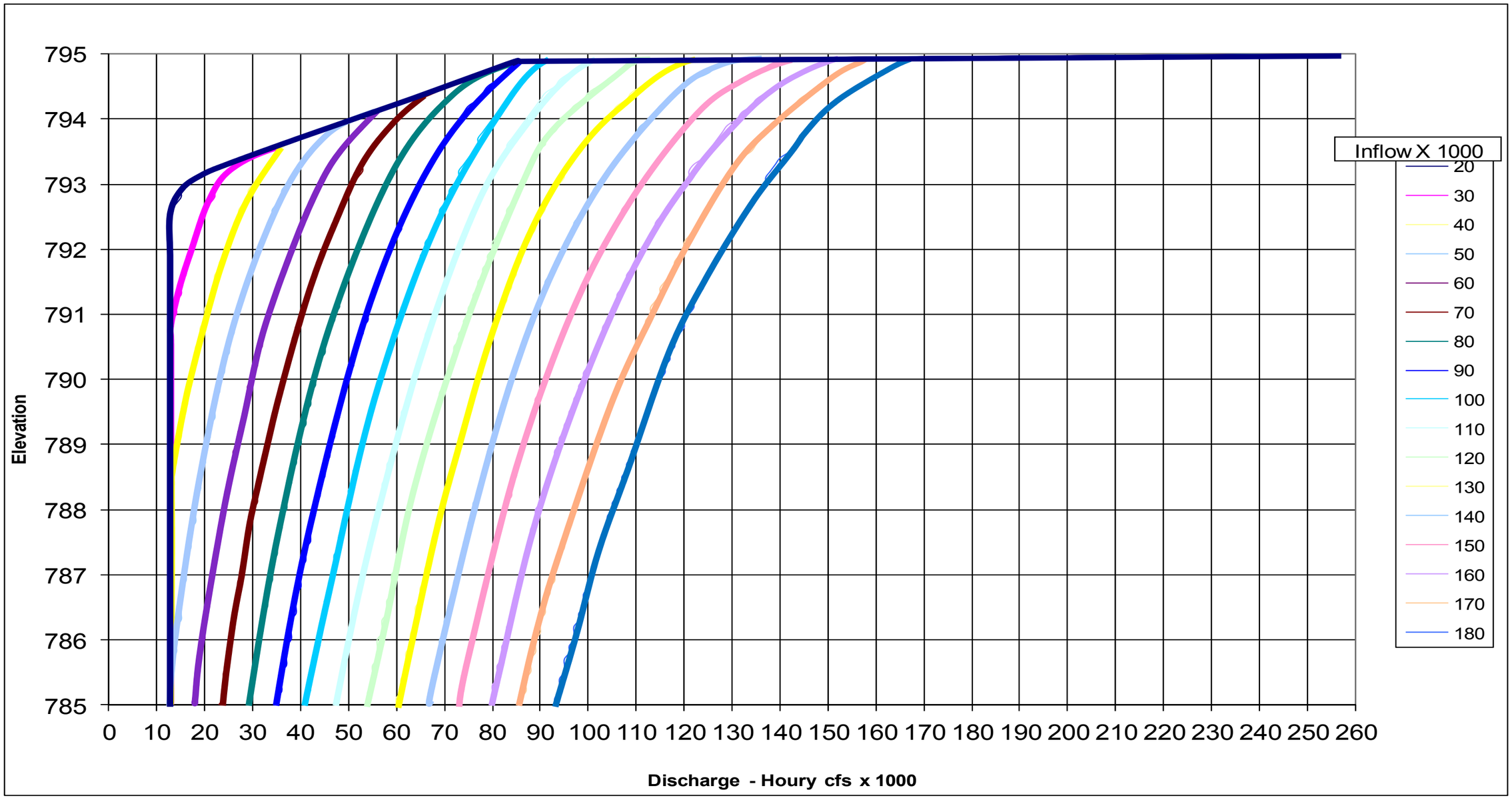
HYDROPWER PERFORMANCE CURVES

Rule	Condition	Harris Outflow	Operation
1	Below Guide Curve		Operate power plant to satisfy system load requirements.
2	At or above Guide Curve and below elev. 790.00	13,000 cfs or less depending on Wadley stage	Operate to discharge 13,000 cfs or an amount that will not cause the gage at Wadley to exceed 13.0 feet, unless greater discharge amounts are required by the Induced Surcharge Schedule. Discharge rates determined by the Harris real-time water control model may be substituted for those indicated by the Induced Surcharge Curves. If the model produces outflows in excess of those identified by the Induced Surcharge Schedule for three (3) consecutive periods, the operator shall notify the Water Management Section before making any further gate movements.
3	Above Guide Curve and rising	16,000 cfs or greater	Discharge 16,000 cfs or greater if required by the Induced Surcharge Curves Releases may be made through the spillway gates or powerhouse or a combination of both. Discharge rates determined by the Harris real-time water control model may be substituted for those indicated by the Induced Surcharge Curves. If the model produces outflows in excess of those identified by the Induced Surcharge Schedule for three (3) consecutive periods, the operator shall notify the Water Management Section before making any further gate movements.
4	Above Guide Curve and falling		When the reservoir begins to fall, maintain current gate settings and power- house discharge until the pool recedes to the Guide Curve, then return to normal operation.

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

FLOOD CONTROL REGULATION SCHEDULE



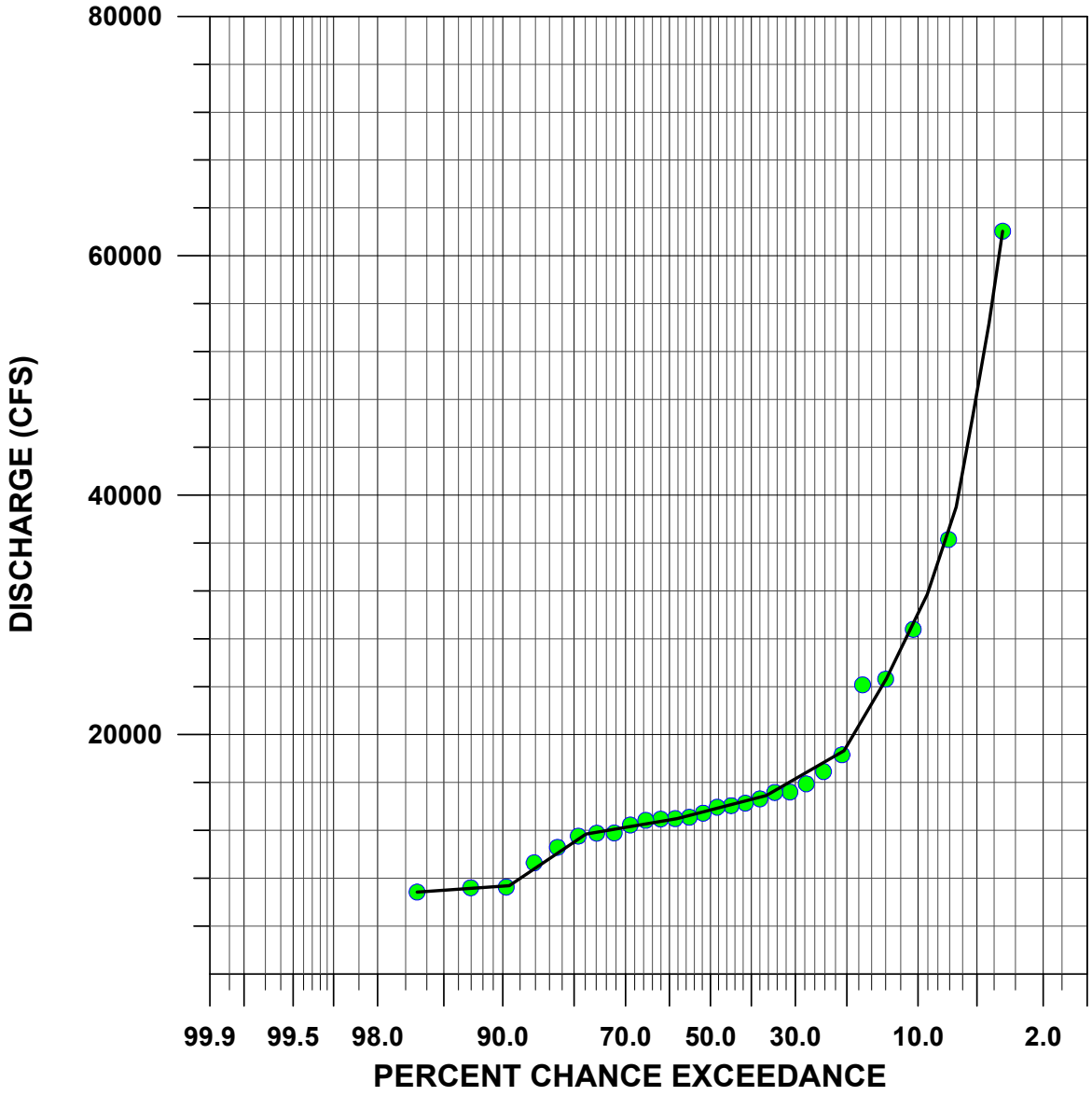
Operating Instructions:

1. Follow regular flood control regulation as shown on Plate 7-3 until releases are required by this schedule.
2. Adjust the outflow hourly based on the average inflow for the preceding three hours and the current reservoir level as indicated by these curves.
3. When the reservoir level begins to fall maintain the current gate openings and power plant discharge in effect at that time until the reservoir recedes to the top of the Power Guide Curve, then follow regular flood regulations.
4. The Spillway Gate will be opened in accordance with the gate opening schedule to produce a discharge as near as practical to those prescribed under this schedule.

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

INDUCED SURCHARGE CURVES

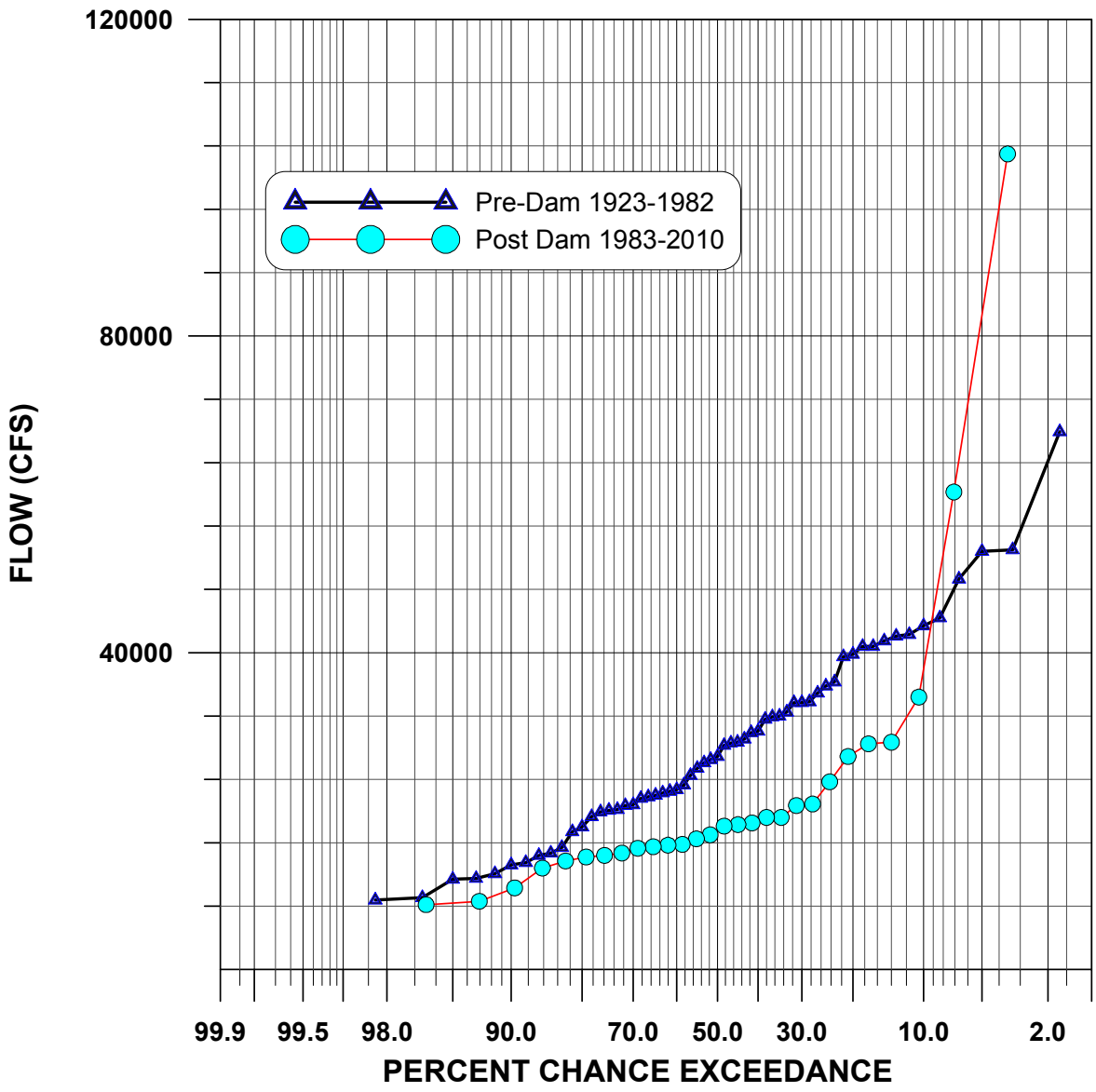


Developed from ave daily data from APC for period 1983 – 2010

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE FREQUENCY
AT R.L. HARRIS DAM

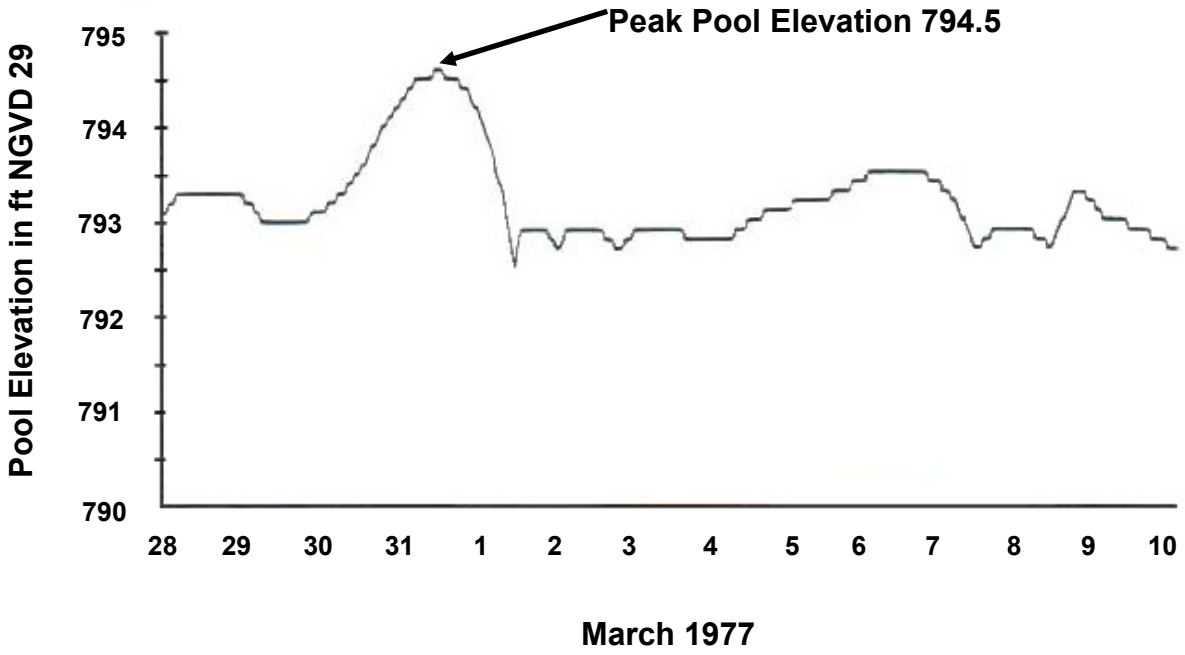


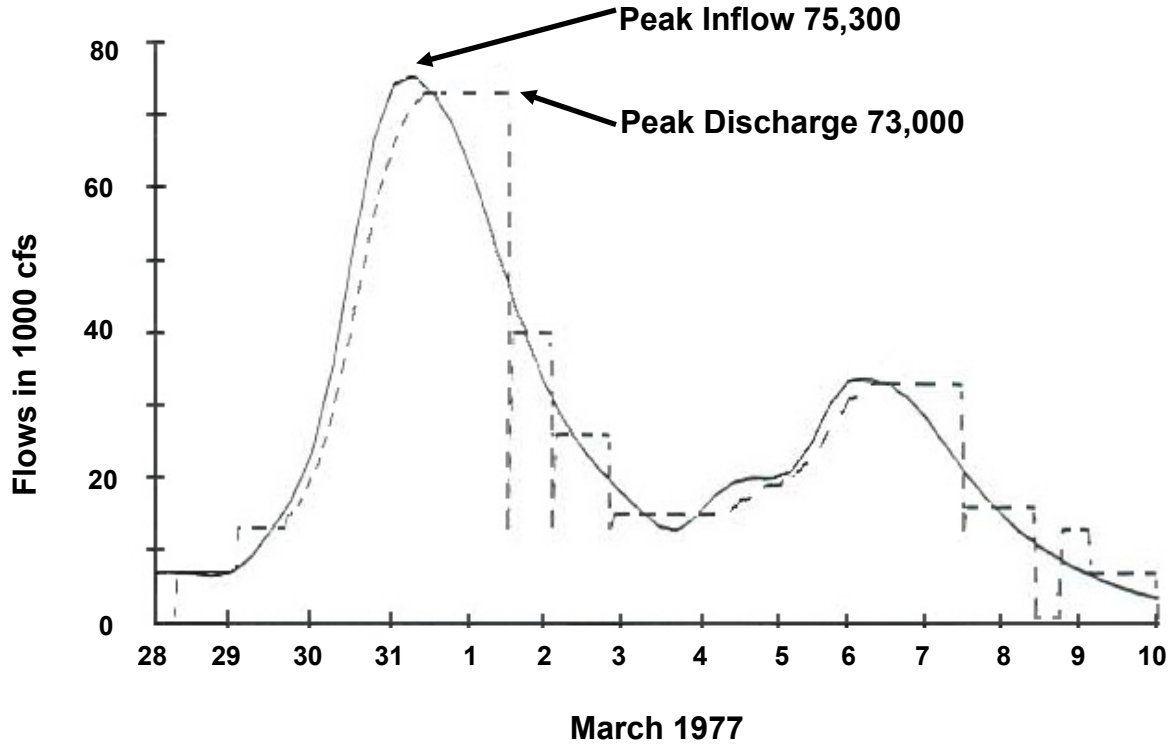
Data from average daily data at
USGS gage 02414500

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

DISCHARGE FREQUENCY
AT USGS GAGE 02414500 AT WADLEY, AL

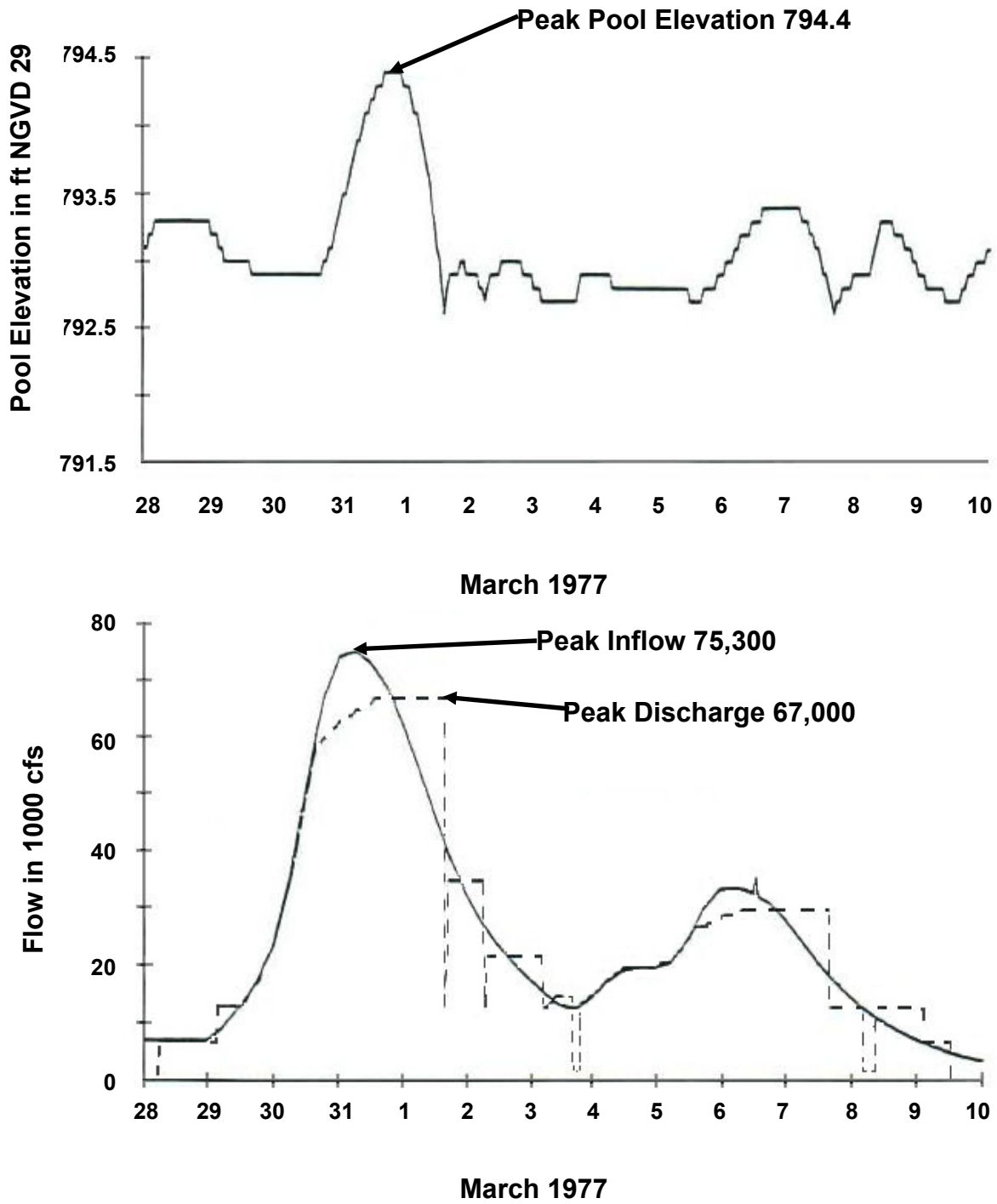




ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

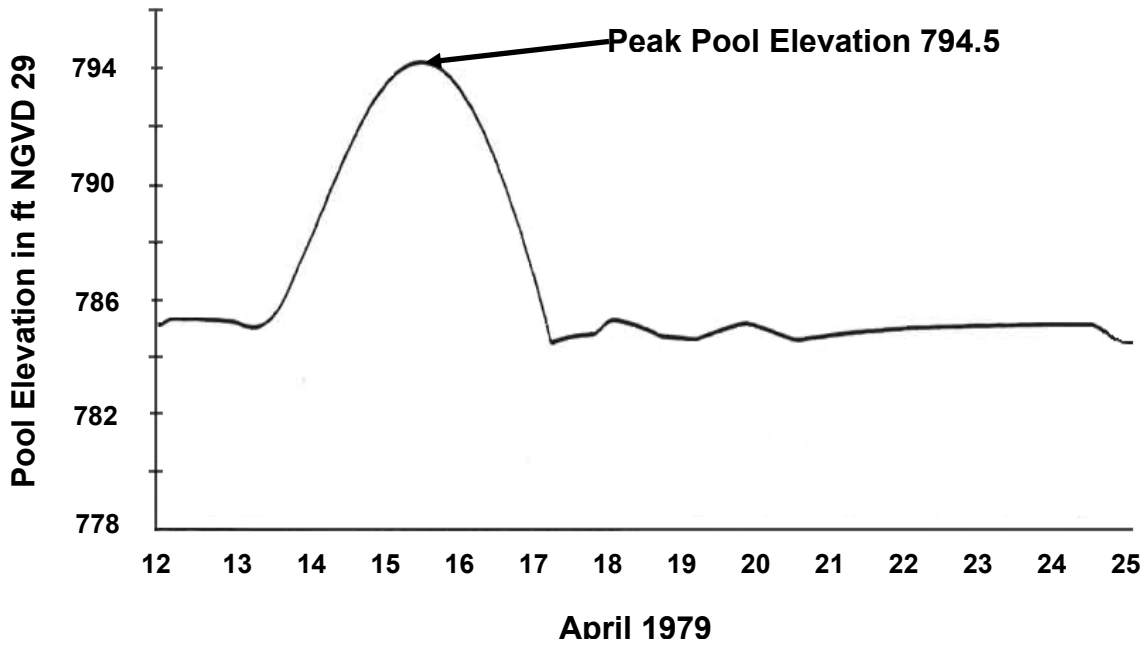
1977 FLOOD
INDUCED SURCHARGE REGULATION

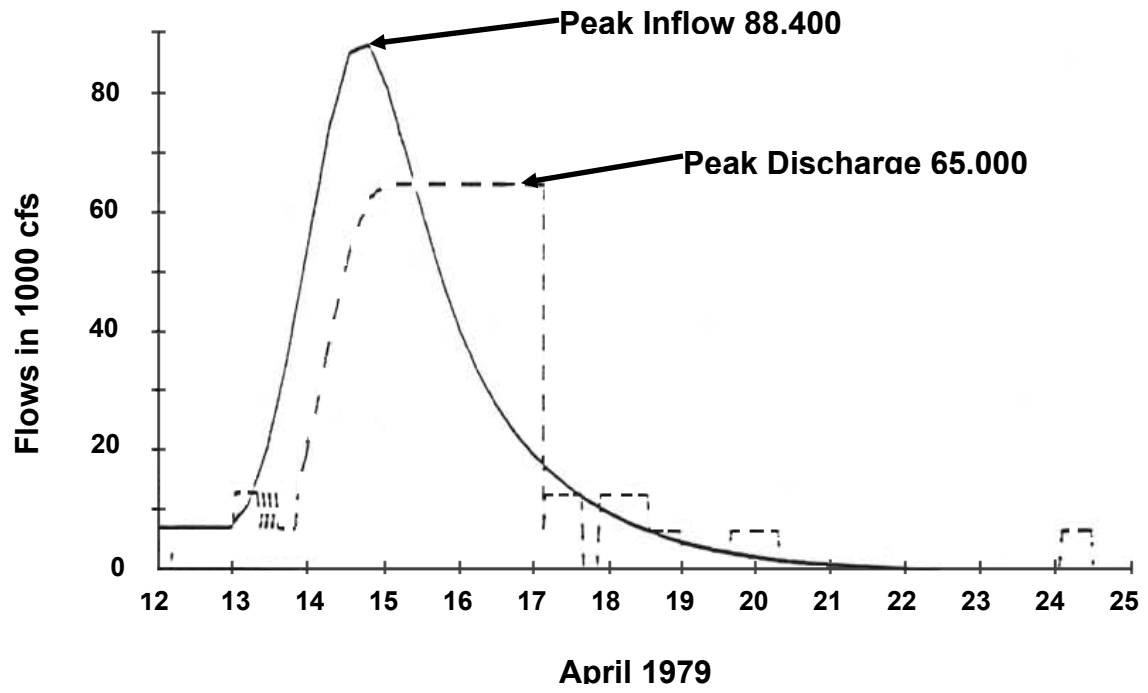


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

FLOOD OF 1977
BASIN MODEL REGULATION

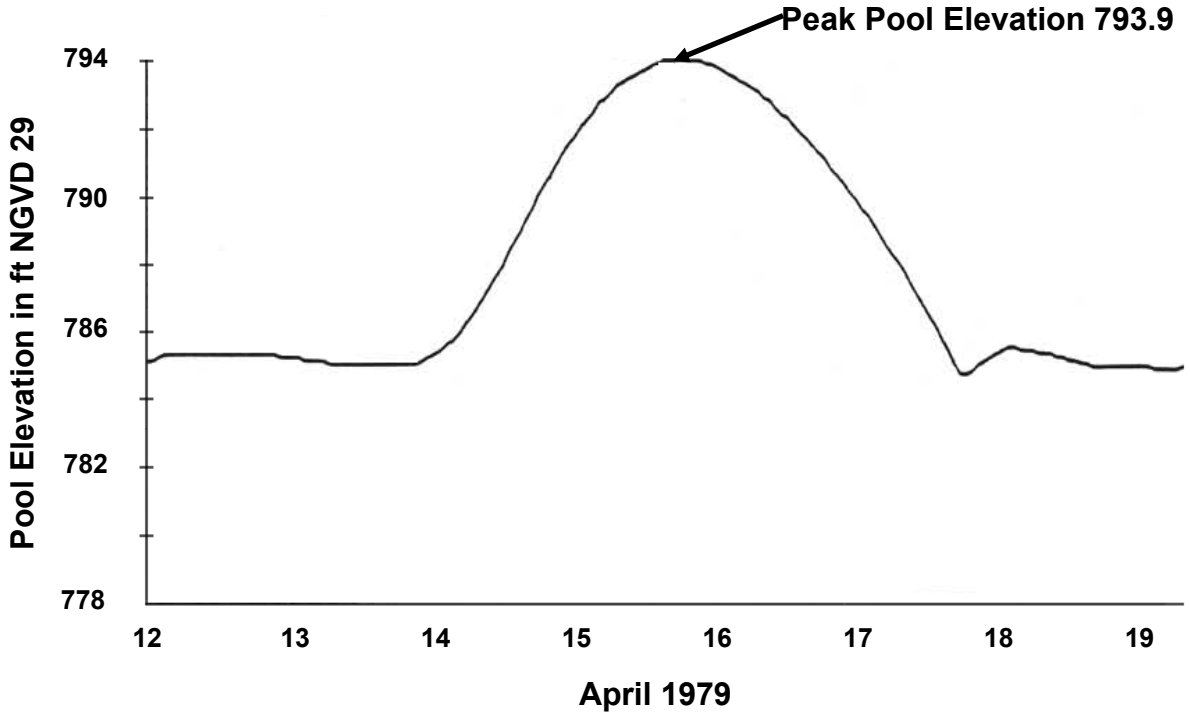


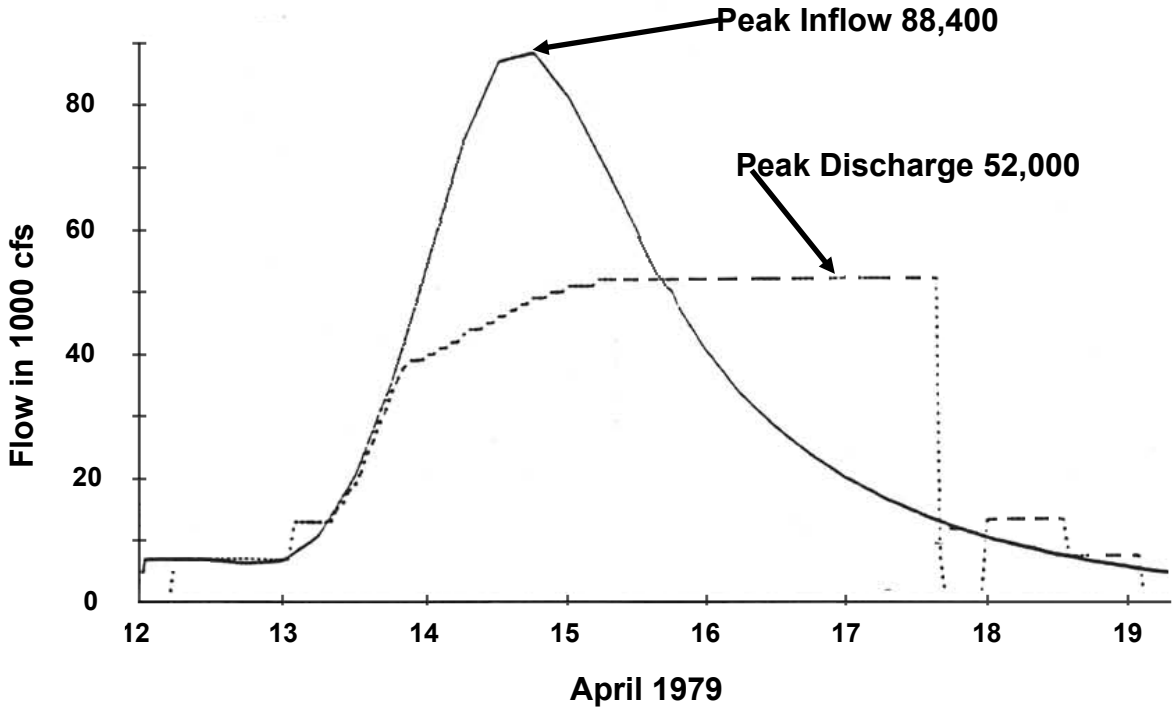


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

FLOOD OF 1979
INDUCED SURCHARGE REGULATION

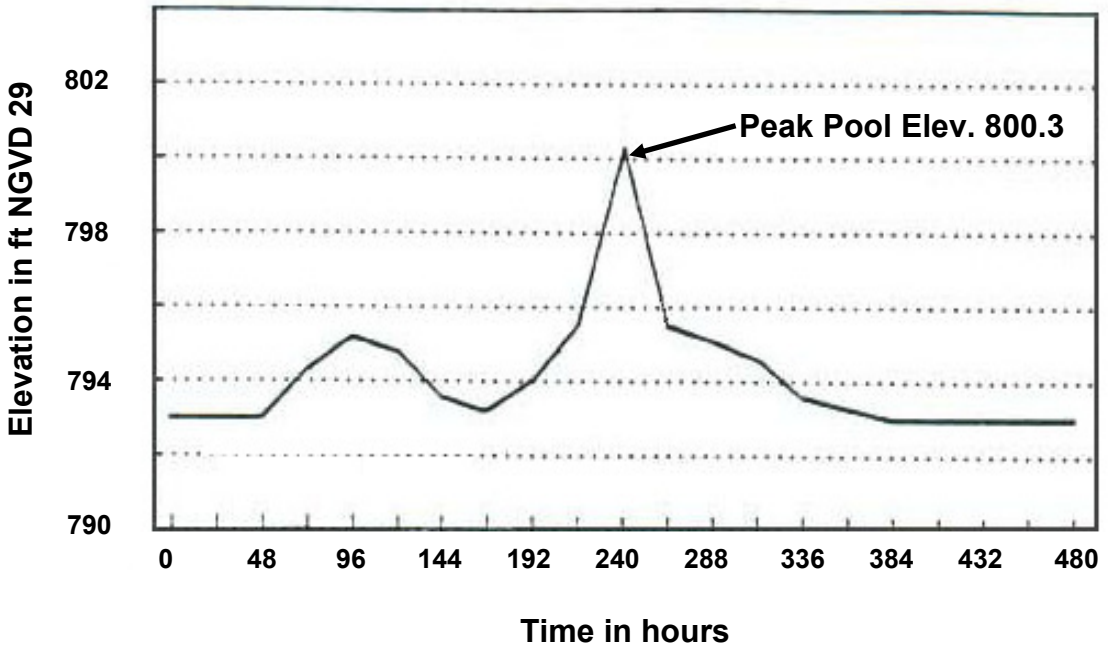


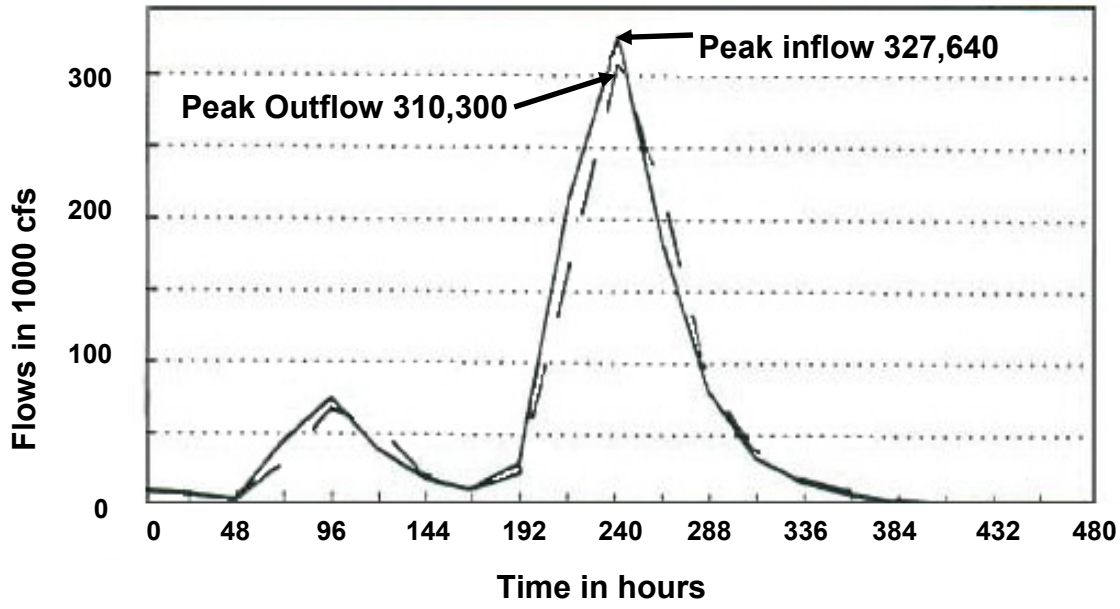


ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

FLOOD OF 1979
BASIN MODEL REGULATION

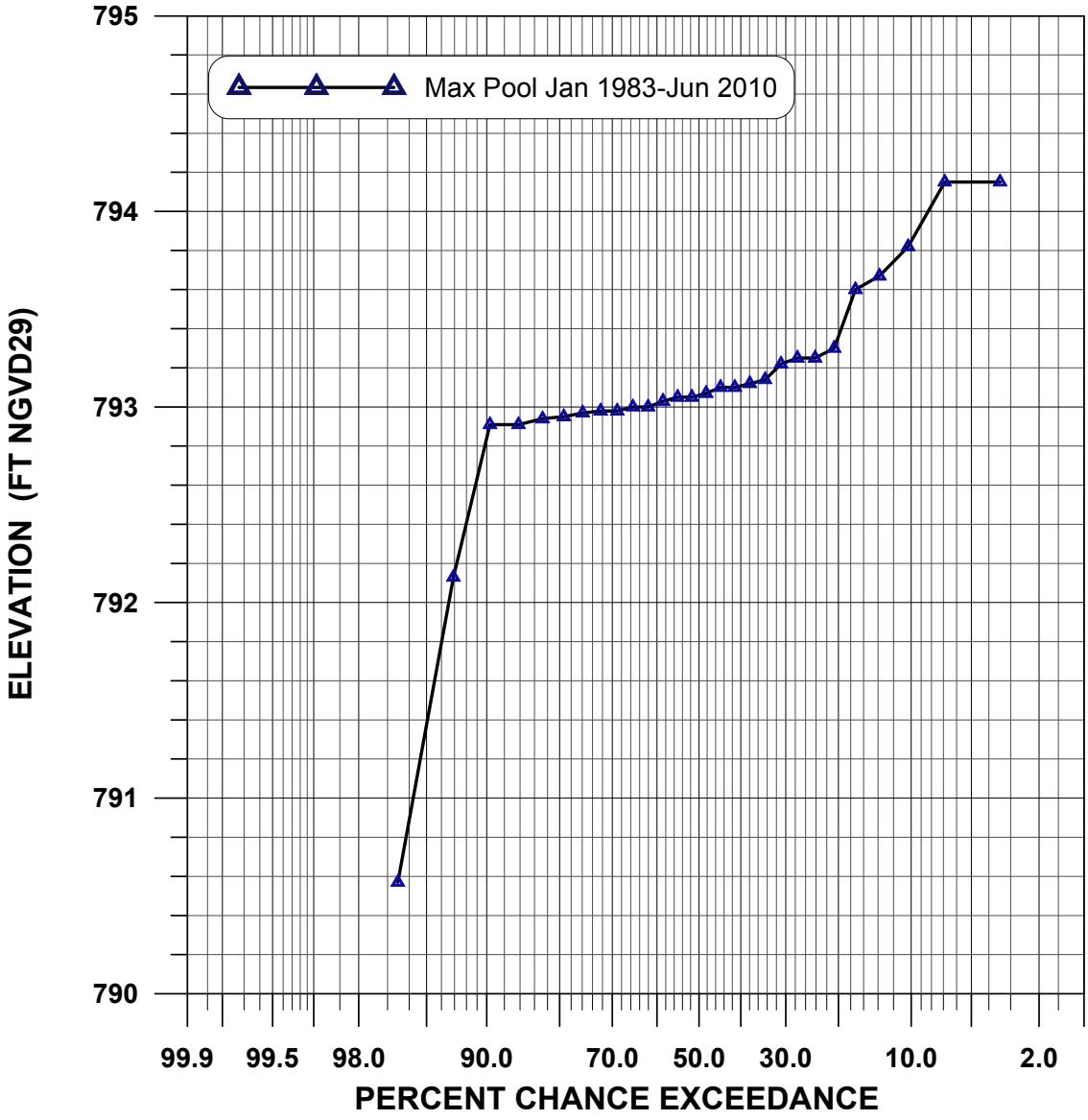




ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

PROBABLE MAXIMUM FLOOD

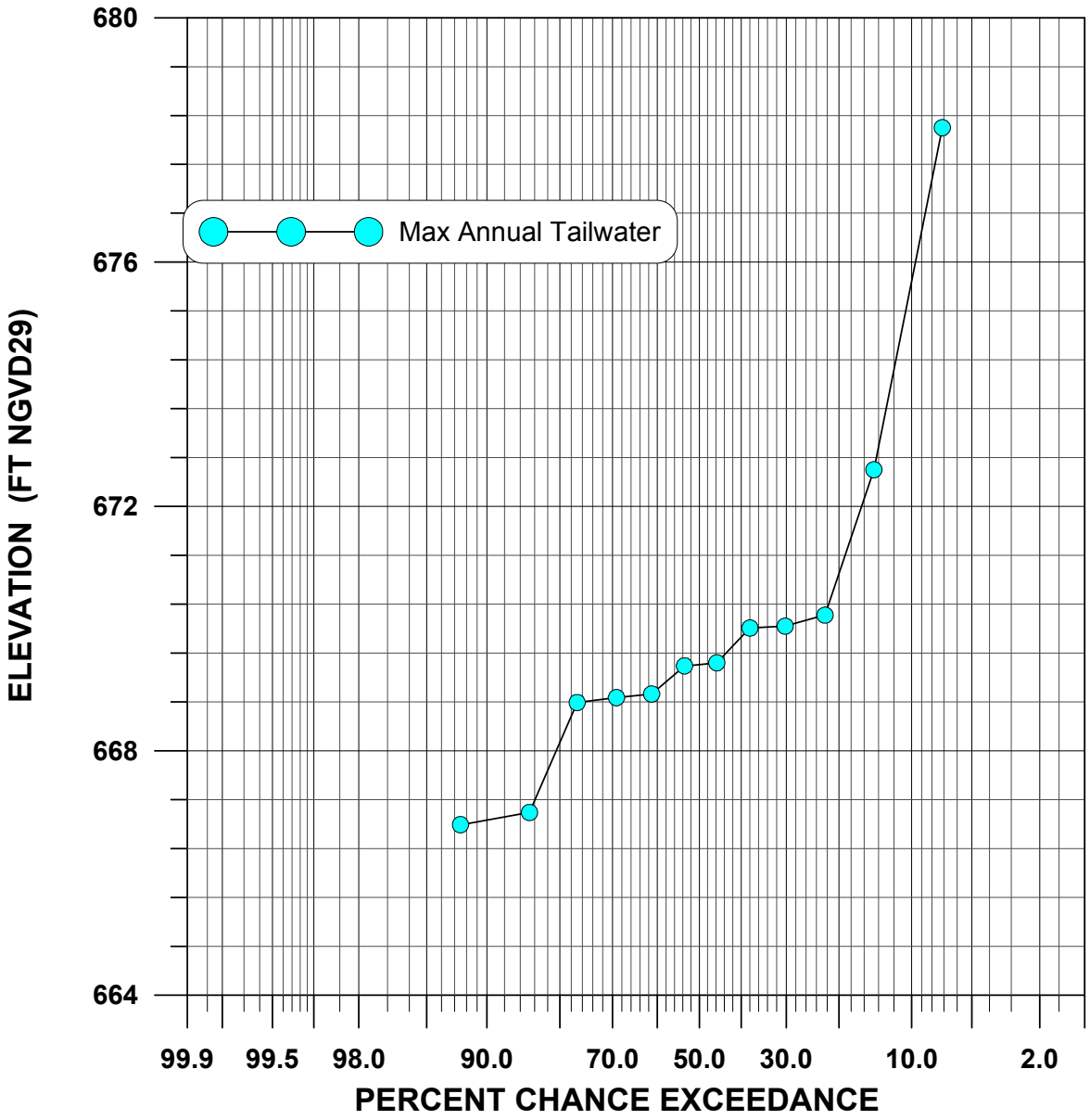


Data from APC
Midnight Readings

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

HEADWATER FREQUENCY CURVE



Data from APC
Midnight Readings
1999, 2000 - June 2010

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN

WATER CONTROL MANUAL
R.L. HARRIS DAM AND LAKE

TAILWATER FREQUENCY CURVE