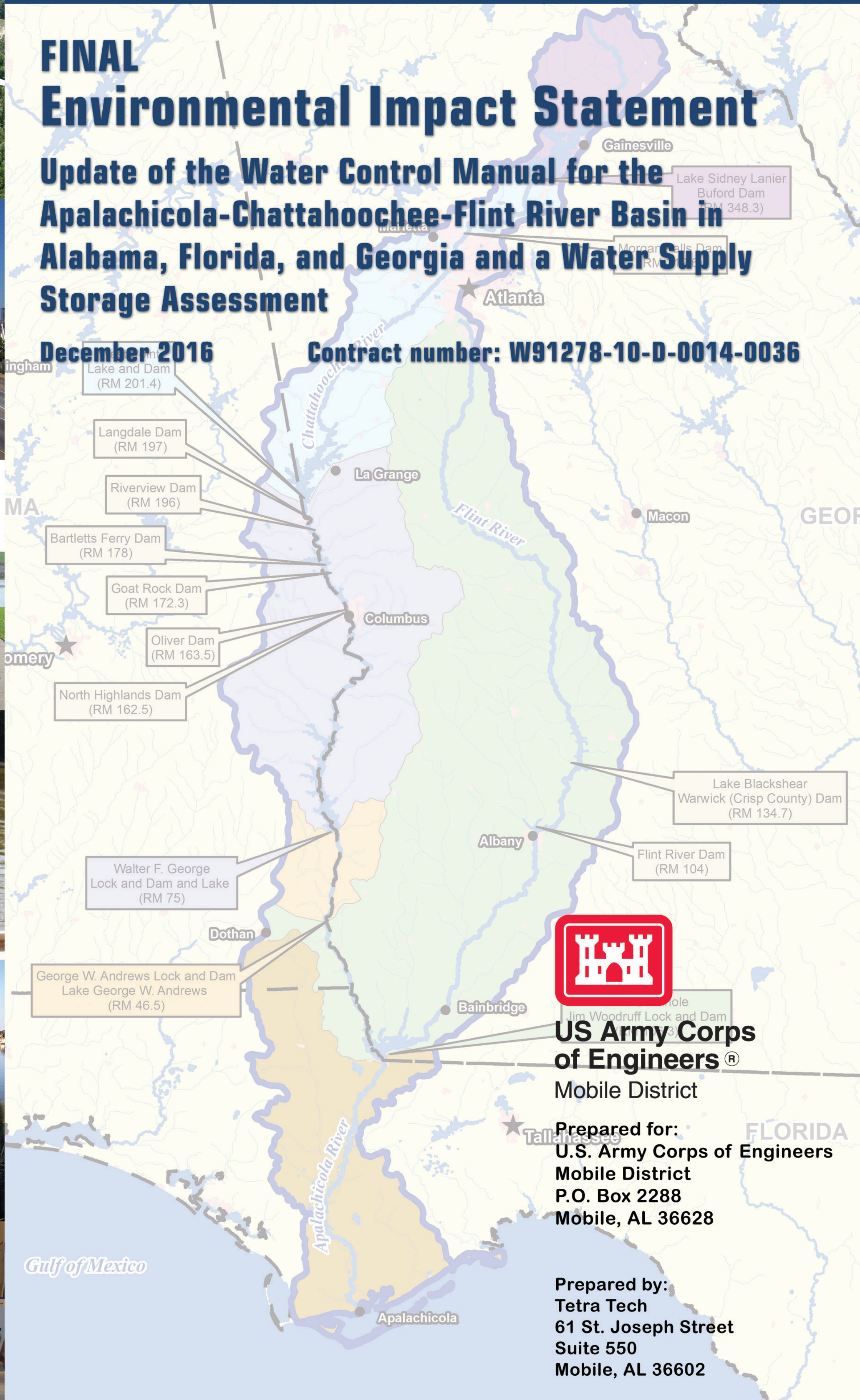





FINAL
Environmental Impact Statement

Update of the Water Control Manual for the Apalachicola-Chattahoochee-Flint River Basin in Alabama, Florida, and Georgia and a Water Supply Storage Assessment

December 2016 **Contract number: W91278-10-D-0014-0036**



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WATER CONTROL MANUAL

APPENDIX D

GEORGE W. ANDREWS LOCK AND DAM AND LAKE GEORGE W. ANDREWS

CHATTAHOOCHEE RIVER
GEORGIA AND ALABAMA

U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
MOBILE, ALABAMA

APRIL 1965

Revised February 1978, November 1996, and XXX 2016

George W. Andrews Lock and Dam

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, the following contact information can be used:

- Mobile District Water Management Section Chief (251) 690-2737 (office), (251) 509-5368 (cell)
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- Mobile District Engineering Division Chief (251) 690-2709 (office), (251) 656-2178 (cell)
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- ACF Project Management Office (334) 232-4542 during regular duty hours
- George W. Andrews Lock Master (229) 723-3482 during regular duty hours.

METRIC CONVERSION

Although values presented in the text are shown in English units only, a conversion table is listed in Exhibit B for your convenience.

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 or NGVD). It is the U.S. Army Corps of Engineers (herein referred to as USACE or Corps) policy that the designed, constructed, and maintained elevation grades of projects be reliably and accurately referenced to a consistent nationwide framework, or vertical datum - i.e., the National Spatial Reference System (NSRS) or the National Water Level Observation Network (NWLON) maintained by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration. The current orthometric vertical reference datum within the NSRS in the continental United States is the North American Vertical Datum of 1988 (NAVD88). The current NWLON National Tidal Datum Epoch is 1983–2001. The relationships among existing, constructed, or maintained project grades that are referenced to local or superseded datums (e.g., NGVD29, msl), the current NSRS, and/or hydraulic/tidal datums, have been established per the requirements of Engineer Regulation 1110-2-8160 and in accordance with the standards and procedures as outlined in Engineer Manual 1110-2-6056. A Primary Project Control Point (PPCP) has been established at this project and linked to the NSRS. Information on the PPCP, designated 12-1G, and the relationship between current and legacy datums are in Exhibit B.

WATER CONTROL MANUAL

APPENDIX D

GEORGE W. ANDREWS LOCK AND DAM AND LAKE GEORGE W. ANDREWS
CHATTAHOOCHEE RIVER, GEORGIA AND ALABAMA

CONTENTS

CONTENTS (Cont'd)

CONTENTS (Cont'd)

CONTENTS (Cont'd)

CONTENTS (Cont'd)

LIST OF TABLES

CONTENTS (Cont'd)

LIST OF FIGURES

LIST OF EXHIBITS

CONTENTS (Cont'd)

LIST OF PLATES

PERTINENT DATA

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

GENERAL

Damsite, miles above mouth of Chattahoochee River	46.5
Drainage area above damsite – square miles	8,210
Drainage area between damsite and Walter F. George Dam – square miles	750

RESERVOIR

Length – river miles	28.3
Minimum operating pool elevation, feet NGVD29	96.0
Normal operating pool elevation, feet, NGVD29	102.0
Maximum operating pool elevation, feet NGVD29	103.0
Peak flood for standard project flood, feet, NGVD29	130.2
Peak pool for spillway design flood, feet, NGVD29	135.5
Area at static full pool (elev. 102) – acres	1,540
Total volume at static full pool (elev. 102) – acre-feet	18,180
Shore line length at static full pool – miles	65

TAILWATER ELEVATIONS (feet above NGVD29)

Highest observed elevation at site (18 Mar 1929, peak flow – 203,000 cfs)	125.8
Capacity at headwater elevation 102 (43,600 cfs)	100.7
Capacity at headwater elevation 96 (30,800 cfs)	94.5
Bankfull capacity for downstream reach (40,000 cfs, approx.)	99.7
Minimum tailwater (at zero discharge)	76.0

DAM AND SPILLWAY

Total length – feet	620
Fixed-crest length – feet	340
Fixed-crest elevation – feet, NGVD29	102.0
Type of gates	Tainter
Size of gates – feet	60 x 21
Top of gate elevation (closed) – feet, NGVD29	103
Number of gates	4

LOCK

Static full upper pool elevation – feet, NGVD29	102
Normal lower pool elevation – feet, NGVD29	77
Maximum lift – feet	25
Chamber nominal length x width – feet	450 x 82
Elevation of top of lock walls – feet, NGVD29	115
Elevation top of upper sill – feet, NGVD29	83
Elevation of top of lower sill – feet, NGVD29	63
Elevation of floor – feet, NGVD29	60
Type of gates	Miter

I - INTRODUCTION

1-01. Authorization. Section 7 of the Flood Control Act of 1944 instructed the Secretary of the Army to prescribe regulations for the use of storage allocated for flood control (now termed flood risk management) or navigation at all U.S. Army Corps of Engineers (Corps) reservoirs. Therefore, this water control manual has been prepared as directed in the Corps' Water Management Regulations, specifically Engineer Regulation (ER) 1110-2-240, *Water Control Management (30 May 2016)*. That regulation prescribes the policies and procedures to be followed in carrying out water management activities, including establishment and updating of water control plans for Corps and non-Corps projects, as required by Federal laws and directives. This manual is also prepared in accordance with pertinent sections of the Corps' Engineer Manual (EM) 1110-2-3600, *Management of Water Control Systems (30 November 1987)*; under the format and recommendations described in ER 1110-2-8156, *Preparation of Water Control Manuals (31 August 1995)*; and ER 1110-2-1941, *Drought Contingency Plans (15 September 1981)*. Revisions to this manual are to be processed in accordance with ER 1110-2-240. Section 310.(b) of the Water Resources Development Act of 1990 expanded the requirements for public meetings and public involvement in preparing water control plans.

1-02. Purpose and Scope. This individual project manual presents the water control plan for the George W. Andrews Lock and Dam and Lake George W. Andrews (George W. Andrews) Project. 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. The George W. Andrews Project water control regulations must be coordinated with the multiple projects in the Apalachicola-Chattahoochee-Flint (ACF) Basin to ensure consistency with the purposes for which the system was authorized. In conjunction with the *ACF Basin Master Water Control Manual*, this manual provides a general reference source for George W. Andrews' water control regulation. It is intended for use in day-to-day, real-time water management decision making and for training new personnel.

1-03. Related Manuals and Reports

Other manuals related to the George W. Andrews Project water control regulation activities include the *Operation and Maintenance Manual* for the project and the *ACF Basin Master Manual*.

One master manual and five individual project manuals, which are incorporated as appendices, compose the complete set of water control manuals for the ACF Basin:

Appendix A - Jim Woodruff Lock and Dam and Lake Seminole

Appendix B - Buford Dam and Lake Sidney Lanier

Appendix C - Walter F. George Lock and Dam and Lake

Appendix D - George W. Andrews Lock and Dam and Lake George W. Andrews

Appendix E - West Point Dam and Lake

The original water control manual for George W. Andrews Lock and Dam (then Columbia Lock and Dam) was published in 1965. A revised *Gate Operating Schedule* was published in August 1967, a revised water control manual was published in February 1978, and a revised *Gate Operating Schedule* was published in November 1996. This revision supersedes any prior editions.

The George W. Andrews emergency action plan (EAP) entitled *Emergency Action Plan, G.W. Andrews* serves to consolidate guidance documents regarding actions to be taken by project personnel should a emergency situation be identified. Guidance includes training for identification of indicators, notification procedures, remedial action scenarios, reservoir dewatering procedures, inventory of emergency repair equipment, and a list of local repair forces. Definite project reports and design memoranda (see Section 3-02 for listing of design memoranda) also contain useful information.

Prior to the issuance of the ACF Basin Master Manual and the individual water control plans as appendices, the Corps considered the environmental impacts of its revised operations with the preparation of an Environmental Impact Statement (EIS). The EIS was prepared in compliance with the National Environmental Policy Act (1969), Council on Environmental Quality guidelines, and Corps implementing regulations. Access to the final document is available by request from the Mobile District.

1-04. Project Owner. The George W. Andrews Lock and Dam and Lake George W. Andrews are a Federally-owned project entrusted to the Corps, South Atlantic Division (SAD), Mobile District.

1-05. Operating Agency. The George W. Andrews Lock and Dam Project is operated by the Corps, Mobile District. The project's operation and maintenance are under the supervision of Operations Division and the direction of the project's Operations Project Manager in Eufaula, Alabama, and the project's Site Manager at Fort Gaines, Georgia.

1-06. Regulating Agencies. Authority for water control regulation of the George W. Andrews Project has been delegated to the SAD Commander. Water control regulation activities are the responsibility of the Mobile District, Engineering Division, Water Management Section (Mobile District). Water control actions for the George W. Andrews Project are regulated in a system-wide, balanced approach to meet the Federally authorized purposes. It is the responsibility of the Mobile District to develop water control regulation procedures for the ACF Basin Federal projects. The regulating instructions presented in the basin water control plan are prepared by the Mobile District with approval of the SAD. The Mobile District monitors the project for compliance with the approved water control plan and makes water control regulation decisions on the basis of that plan. The Mobile District advises project personnel on an as-needed basis regarding water control regulation procedures to perform during normal, as well as abnormal or emergency situations.

II - DESCRIPTION OF PROJECT

2-01. Location. The George W. Andrews Project is on the Chattahoochee River, 46.5 miles above its mouth, two miles south of Columbia, Alabama, and about 17 miles east of Dothan, Alabama. The west abutment is in Houston County, Alabama, and the east abutment is in Early County, Georgia. The drainage area above the dam is 8,210 square miles. The project location is indicated on Plates 2-1 to 2-3.

2-02. Purpose. The George W. Andrews Lock and Dam was originally authorized under the River and Harbors Acts of 1945 and 1946 (under the original name of Columbia Dam) to be operated in conjunction with the other Federal works of improvement in the ACF Basin for the authorized system purposes. The George W. Andrews Project is operated to provide benefits for authorized purposes of navigation, water quality, recreation, and fish and wildlife conservation. The plan of operation for the George W. Andrews Project, as described in Exhibit C and Chapter VII of this water control manual, is intended to reregulate the erratic inflows caused by peaking hydropower operations at the Walter F. George Project.

2-03. Physical Components. The George W. Andrews Project, Figure 2-1, consists of a lock with lock control stations, a gated spillway and a fixed-crest spillway, all made of concrete and steel. The reservoir extends up the Chattahoochee River to the Walter F. George Lock and Dam. The lock and control station are in Georgia on the east overbank of the Chattahoochee River. The gated portion of the spillway abuts the lock control station, extending into the river to the fixed-crest spillway section. The fixed-crest spillway extends into Alabama on the west bank of the river. The reservoir provides navigable depths of 9 feet for navigation to the Walter F. George Lock and Dam, 28.3 miles upstream. The principal features of the lock and dam are described in detail in subsequent paragraphs, and plan and sections are shown in Plate 2-4.

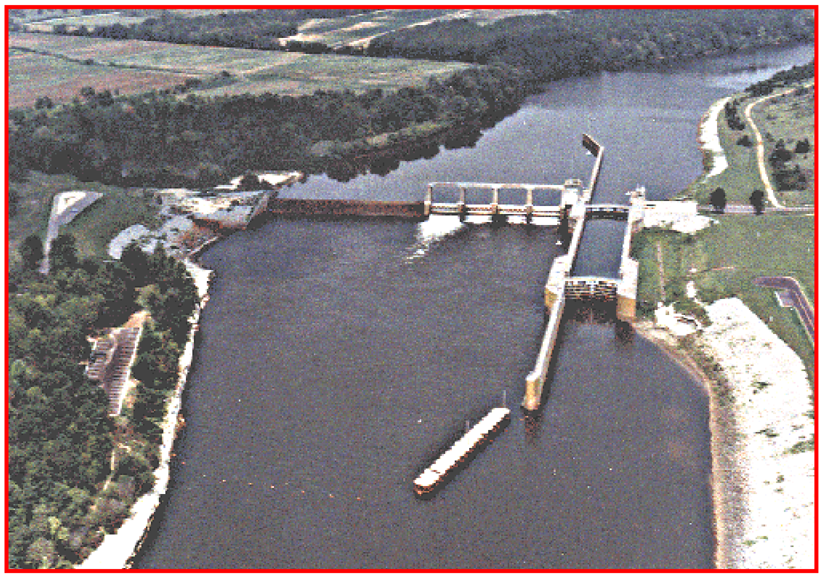


Figure 2-1. George W. Andrews Lock and Dam

a. Lock. The lock, Figure 2-2, on the east bank, has a chamber 82 feet wide with a usable length of 450 feet. The maximum lift is 25 feet, from the normal upper pool at the Jim Woodruff Project, elevation 77 feet National Geodetic Vertical Datum (NGVD29) to the full pool at George W. Andrews, elevation 102 feet NGVD29. The top of the lower miter sill is at elevation 64 feet NGVD29, which is 13 feet below the normal Jim Woodruff reservoir pool, and the top of the upper miter sill is at elevation 83 feet NGVD29 providing a depth of 13 feet below elevation 96 feet NGVD29, the lower limit of allowable drawdown of the upper pool. Top of the lock walls are at elevation 115 feet NGVD29, and the lock will be inoperative when the upper pool exceeds elevation 114 feet NGVD29. When the river stage rises above elevation 112 feet NGVD29 and is forecast to go higher, consideration must be given to removing handrails, lights and other exposed equipment to prevent undue damage and to aid in later cleanup operations. The lock emptying and filling systems consist of six side-intake ports in each wall above the upper gate, a 10-foot square culvert, 10 side ports in each chamber wall, and a discharge system with two outlet ports on the river side of the lock below the lower gate. Flow in the culvert is controlled by two reverse tainter valves in each chamber wall. A section through the lock is shown on Plate 2-4.

Figure 2-2. George W. Andrews Lock

b. Lock Control Station. The lock control station, a three-story building of reinforced concrete, is on the lock monolith abutting the gated spillway. All lock operating machinery and equipment that would be damaged by floods are on the second floor, at elevation 129.9 feet NGVD29. The third floor, at elevation 142 feet NGVD29, contains the operating controls for the gated spillway and the lock and provides access to the gated spillway bridge.

c. Gated Spillway. The gated spillway is located between the lock and the fixed-crest spillway. The gated spillway can be remotely operated from the Walter F. George powerhouse or locally by George W. Andrews Project personnel. It is composed of four tainter gates, 60 feet wide by 21 feet high, mounted between 8-foot-wide concrete piers, which support a steel service bridge with the deck at elevation 142 feet NGVD29. The spillway crest is at elevation 82 feet NGVD29 and the top of the gates in closed position is at elevation 103 feet NGVD29. Discharge capacity at normal upper pool, elevation 102 feet NGVD29, is 43,600 cubic feet per second (cfs) and at elevation 96 feet NGVD29, the lower limit of allowable drawdown, 30,800 cfs. The gate operating schedule and spillway discharge values are shown on Plates 2-5 and 2-6.

d. Fixed-Crest Spillway. The fixed-crest spillway is between the gated spillway and the west river bank. It is a concrete gravity section, 340 feet long with crest at elevation 102 feet NGVD29. Discharge values for the gated spillway as a function of gate openings for the pool elevations 103 feet NGVD29 and lower are shown in Plates 2-5 and 2-6. A rating curve for total spillway discharge (fixed-crest plus gated spillway) is shown in Plate 2-8. Plate 2-8 also shows a tailwater rating curve for tailwater elevations above 102 feet NGVD29.

e. Reservoir. The reservoir at full pool, elevation 102 feet NGVD29 covers an area of 1,540 acres and has a total storage of 18,180 acre-feet. It extends up the Chattahoochee River 28.3 miles to the Walter F. George Lock and Dam. The entire reservoir is confined in the relatively high banks of the riverbed. Plate 2-7 shows area and capacity curves and selected area-capacity values.

2-04. Related Control Facilities. The gated spillway can be remotely operated from the Walter F. George powerhouse or locally by George W. Andrews Project personnel. The remote control is accomplished through a microwave network between the George W. Andrews and Walter F. George Projects.

2-05. Real Estate Acquisition. The guide line for taking in fee was based on the flood of November 1948 which has a frequency of about 7 years. The guide line for taking in easement was the flood of March 1929 which has a frequency of about 130 years. A total of 3,403.36 acres was acquired for the George W. Andrews Project; 1,195.54 acres by fee, 2,191.05 acres by easement, and 16.77 acres by license.

2-06. Public Facilities. The Preliminary Master Plan, dated February 1961, provided for the acquisition of six areas for public use, three in Georgia and three in Alabama, in addition to the east and west bank damsite areas. A total of 1,195 land acres and 1,540 water acres are available along with 65 miles of shoreline, access ramps, and boat dock concessions. In addition, 12 areas with 153 acres, are all at the intersection of tributary streams with the main channel of the reservoirs, which provide safe harbors for small boats. Access to those areas is by boat only and provides for bank tie-up, fishing and camping. The Corps has developed the east bank damsite area for the public and facilities consist of an overlook building with sanitary facilities. In addition, the Corps has built access roads, launching ramps, parking areas, and picnic facilities at six other sites, three on each side of the reservoir. The recreational development plan in Plate 2-10 shows the distribution of recreational areas around the reservoir.

III - HISTORY OF PROJECT

3-01. Authorization. The Corps first considered navigation locks and dams for the Apalachicola River Basin in the early 1930s in a report on the Apalachicola River System in accordance with House Document No. 308, 69th Congress, First Session. The report, which had a general plan for the overall development of the basin was submitted to Congress in 1934 but was immediately recalled to consider additional information.

The Rivers and Harbors Act of 1945 approved the general plan presented in House Document No. 342, 76th Congress, First Session, and authorized the initiation and partial accomplishment of that plan by constructing two dams in the Apalachicola River Basin. The Rivers and Harbors Act of 1946 modified the general plan to include improvements consisting of Buford Dam, Fort Benning Lock and Dam, and the Upper Columbia and Jim Woodruff multiple purpose developments.

A letter report dated 29 November 1952, subject: *Report on Development of Chattahoochee River between Upper Limits of Jim Woodruff Pool and Columbus, Georgia*, prepared by the Mobile District, presented several plans for developing the Chattahoochee River below Columbus. The letter report recommended the adoption of the plan consisting of a low navigation dam near Columbia, Alabama, and a high navigation power dam near Fort Gaines, Georgia, in lieu of the Fort Benning Lock and Dam and Upper Columbia development in the authorizing document. The Chief of Engineers approved the plan as the basis for further studies in an endorsement dated 16 January 1953, and on 19 May 1953, the Committee on Public Works of the House of Representatives approved the changes as recommended in the report.

In February 1972, the 92nd Congress enacted Public Law 92-229, which provided that the Columbia Lock and Dam on the Chattahoochee River, Alabama, be known and designated as the George W. Andrews Lock and Dam and the reservoir formed by such dam be known and designated as Lake George W. Andrews. The President approved the bill on 15 February 1972.

3-02. Planning and Design. Design Memorandum No. 1, Determination of Site Location and Reservoir Level, was submitted on 7 May 1954, and the location was approved in the second endorsement by the Chief of Engineers dated 19 August 1954. The reservoir level, however, was not approved until 26 July 1956 when a conference was held in Mobile, Alabama, attended by representatives of the Mobile District and the SAD. At the conference, the full pool was established at elevation 102 feet NGVD29 and the minimum pool at elevation 96 feet NGVD29. Also discussed at the conference were the spillway discharge requirements and the type of spillway gates to be considered. A tabulation of reports and design memoranda prepared for the George W. Andrews Project follows:

3-03. Construction. Construction started in July 1959, under a contract awarded to Cook Construction Company for the excavation for the lock chamber. On 2 May 1960, the contract for construction of the lock and dam was awarded to Winston Brothers Company, Green Construction Company, and Tecon Corporation. Construction of the lock and dam began in late May 1960 (Figures 3-1, 3-2 and 3-3). Upon completion of the lock and dam in August 1963, the project was essentially completed at a cost of approximately $13 million.

Table 3-1 Design Memoranda

Letter Report - Report on Development of Chattahoochee River Between Upper Limits of Jim Woodruff Pool and Columbus, GA	November 29, 1952
Design Memorandum No. 1 - Determination of Site Location and Reservoir Level	May 7, 1954
Design Memorandum No. 2 - Geology and Foundation	October 15, 1953
Design Memorandum No. 3 (Revised May 1958); General Design	June 19, 1958
Design Memorandum No. 4 - Design of Spillway, Lock, Approach Channels and Access Road	July 3, 1958
Design Memorandum No. 5 - Real Estate Memorandum - Damsite and Access Road	October 27, 1958
Design Memorandum No. 6 - Real Estate Memorandum - (Reservoir)	February 13, 1961
Design Memorandum No. 8 - Appendix Power Wave Regulation, (Appendix Electric Computer Program)	March 11, 1960
Design Memorandum No. 8 - Power Wave Regulation	June 30, 1961
Design Memorandum No. 9 - Reservoir Clearing, Mosquito Control and Floatage Removal	March 9, 1962
Design Memorandum No. 10 - Relocation, Columbia Sewage System	March 31, 1961
Design Memorandum No. 12-A - Preliminary Master Plan	February 7, 1961
Design Memorandum No. 12-B (c-1) -Public Use and Administrative Facilities	March 23, 1962

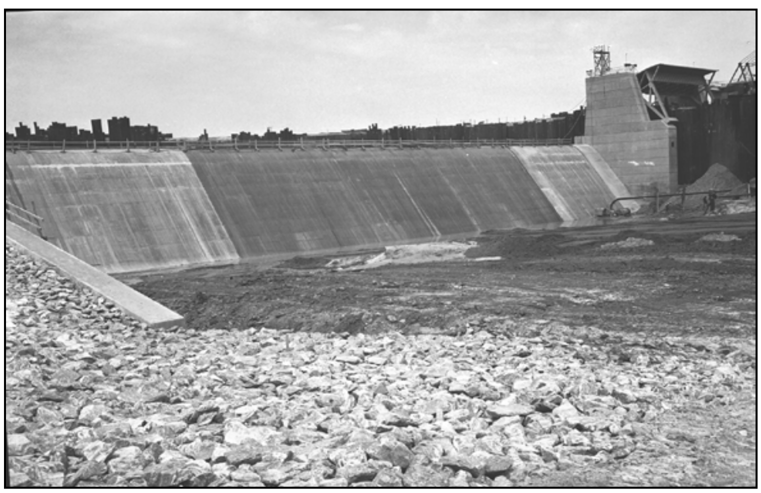


Figure 3-1. Dam Under Construction, Circa 1962-63

Figure 3-2. Gate Supports, Circa 1961-62

Figure 3-3. Foundation for Miter Gate, Circa 1961-62

3-04. Related Projects. George W. Andrews Lock and Dam is one of five Corps reservoir projects in the ACF Basin. Buford Dam, West Point Dam, and Walter F. George Lock and Dam are upstream, while Jim Woodruff Lock and Dam is downstream of the project. The Corps reservoirs on the Chattahoochee River are operated as a system to accomplish authorized functions as described in the *ACF Basin Master Water Control Manual (with Appendices)*. Outflows from George W. Andrews Dam are influenced by the Master Manual and requirements at other Corps projects. One function of the George W. Andrews Project is to reregulate peaking hydropower releases from the upstream Walter F. George powerhouse. The reregulation assists in the daily operations of Jim Woodruff Lock and Dam.

In addition, six privately owned dams are upstream on the Chattahoochee River in the vicinity of Columbus, Georgia, between Walter F. George Dam and West Point Dam. The privately owned reservoirs on the Chattahoochee River are primarily run-of-river projects containing very little storage capacity and, consequently, do not significantly influence flows in the river or the operation of the Corps projects. These projects reregulate the hydropower releases from West Point Dam in a manner similar to the way George W. Andrews Project re-regulates the hydropower discharges from Walter F. George Dam.

3-05. Modifications to Regulations. From the time the George W. Andrews Project became operational in 1963, changes in needs and conditions in the ACF Basin have led to modifications to the water control regulation of the project as described below:

a. Pre-Drawdown of Lake Andrews. In October 1967, the Mobile District conducted a test to investigate operating Lake Andrews at a constant elevation of 102 feet NGVD29. At this time, the regulation plan called for a pre-drawdown of Lake Andrews beginning 90 minutes prior to the start of the Walter F. George generation schedule. By comparing similar Walter F. George generation schedules with and without the pre-drawdown of Lake Andrews, it was observed that there was very little affect on river velocity and about a one foot difference in the tailwater elevation below Andrews Lock and Dam. At that time, it was determined that more tests needed to be conducted before making a recommendation to abandon the pre-drawdown at Andrews, however, some minor changes were made to hold the Andrews pool at elevation 101 feet NGVD29 during the later portion of the Walter F. George generation schedule. In the 1996 George A. Andrews' manual revision, pre-drawdown of Lake Andrews was abandoned. In addition, the lake would now be operated at elevation 102.5 feet NGVD29 when there was no release scheduled from Walter F. George as long as head limits at the dam were not violated.

b. Revised Interim Operating Plan. The Revised Interim Operating Plan (RIOP) was implemented in June 2008 and modified in May 2012. The purpose of the RIOP was to support compliance with the Endangered Species Act of 1973 for Federally listed threatened and endangered species and their Federally designated critical habitat in the Apalachicola River and to avoid or minimize potential adverse effects associated with discretionary operations at Jim Woodruff Lock and Dam. The RIOP directly affected flows and fall rates in the Apalachicola River and prescribed the minimum flow releases to be made from Jim Woodruff Dam under specific hydrologic conditions. However, the releases made from Jim Woodruff Dam in accordance with the RIOP used the composite conservation storage of all the upstream reservoirs in the ACF System. The Corps operates five Federal reservoirs on the ACF as a system, and releases made from Jim Woodruff Dam under the RIOP reflected the downstream end-result for system wide operations measured by daily releases from Jim Woodruff Dam into the Apalachicola River. The RIOP did not describe operational specifics at any of the four Federal reservoirs upstream of Jim Woodruff Lock and Dam or other operational parameters at those reservoirs. Instead, the RIOP described the use of the composite conservation storage of the system and releases from the upstream reservoirs as necessary to assure that the releases made from Jim Woodruff Dam would comply with the Endangered Species Act of 1973 by minimizing effects on Federally listed threatened and endangered species and Federally designated critical habitat.

3-06. Principal Regulation Problems. The principal regulation problem at George W. Andrews Dam is the head limitation that, by design, must not exceed 25 feet. Special attention is required to prevent exceeding the head limitation during periods of low inflow, when the upstream Walter F. George power plant is shut down over weekends or other extended periods. When the George W. Andrews pool falls below elevation 102 feet NGVD29, the allowable structural head limitation increases to 26 feet. The operational constraints because of head limitations at George W. Andrews Dam and at Walter F. George Dam and Jim Woodruff Dam are described in detail in Chapter VII of this manual. These head limitations require a focused coordinated effort in the operation of the Jim Woodruff, George W. Andrews, and Walter F George projects, especially during low-flow conditions.

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Chattahoochee River drainage basin above George W. Andrews Lock and Dam has a long, narrow shape with an average width of 28 miles and a maximum width of 55 miles. The drainage area for the entire Chattahoochee River Basin is 8,708 square miles of which 8,210 square miles are above George W. Andrews Lock and Dam. The Chattahoochee River is formed in the Blue Ridge Mountains of north Georgia near the westernmost tip of South Carolina. The river flows southwest for 235 miles to West Point, Georgia, on the Alabama-Georgia line. Turning south there, it continues to the George W. Andrews Lock and Dam, constituting the boundary between Georgia on the east and Alabama on the west. From Columbus, Georgia, to the mouth of the Chattahoochee River at Jim Woodruff Lock and Dam and the Florida state line, the slope varies from 1.2 to 0.6 feet per mile. The average slope is about 0.9 feet per mile for the river in the vicinity of the George W. Andrews Project. The entire ACF Basin is shown on Plate 2-1.

4-02. Topography. The George W. Andrews Project is in the Coastal Plain south of the Fall Line, but much of the drainage area is in the Piedmont Region. The Piedmont Region consists of moderate- to high-grade metamorphic rocks, such as schists, amphibolites, gneisses and migmatites, and igneous rocks like granite. Topographically, the Piedmont Region mostly consists of rolling hills, although faulting has produced the impressive ridge of Pine Mountain near Warm Springs, Georgia. The Coastal Plain Region consists of Cretaceous and Cenozoic sedimentary rocks and sediments. Those strata dip toward the southeast, and so they are younger nearer the coast. Near the Fall Line, they are underlain by igneous and metamorphic rocks like those of the Piedmont. The sedimentary rocks of the Coastal Plain partly consist of sediment eroded from the Piedmont over the last 100 million years, and partly of limestones generated by marine organisms and processes at sea.

4-03. Geology and Soils. Soils in the Coastal Plain are often porous permitting flow through the ground. Geologic hazards in the Coastal Plain are sinkholes and coastal erosion. Sinkholes can form in areas of limestone bedrock when subsurface dissolution of rock leads to collapse of the earth surface. There is some evidence that Lake Seminole contributes significant inflow to the groundwater and to downstream flows. Limestone caves were discovered during construction near the eastern side of the dam.

A major geologic resource in the Coastal Plain is groundwater. The less porous rocks of the northern regions provide less groundwater, but the aquifers of the Coastal Plain provide groundwater for domestic consumption, for industry, and for agricultural irrigation. The USGS actively monitors groundwater conditions in Georgia.

Limestone is quarried in southwest Georgia. However, its quality as aggregate is not as high as that of the limestone in the Valley and Ridge. The reasons are largely because of the greater porosity of the relatively Coastal Plain limestones, whereas the older limestones of the Valley and Ridge have lost nearly all their fine-scale porosity.

4-04. Sediment. 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. Plans have been developed to measure the reservoir effects of sedimentation and retrogression at each of the government dams.

In 1960, the Corps established sedimentation and retrogression ranges at the George W. Andrews Project to monitor changes in reservoir and downstream channel conditions. Those serve as a baseline to measure changes in the reservoir volume and channel degradations. Reservoirs tend to slow river flow and accelerate deposition. Irregular releases for peaking power often have an erosive effect downstream. The history of the surveys and the number of ranges surveyed are shown in Table 4-1. The locations of the ranges are shown in Plate 4-1, Sedimentation/Retrogression Ranges Map. Those ranges also serve as retrogression ranges for the Walter F. George Project.

Table 4-1. Sedimentation Surveys

Year Surveyed	No. of Ranges Surveyed	Total No. of Ranges Established
1960	0	16
1963	16	16
1981	15	16
2009	Hydrographic bathymetric surface	N/A

The hydrographic bathymetric survey of the entire lake conducted in 2009 allowed all previously established sedimentation ranges to be analyzed. Descriptive analyses are performed to determine the level of sedimentation occurring in the main body of the reservoir and to examine shoreline erosion. Detailed reports are written after each re-survey to determine changes in reservoir geometry. Those reports include engineering analysis of the range cross-sections to estimate reservoir storage loss by comparing to the earlier surveys of the existing ranges. The data provide the ability to compute new area/capacity curves for the reservoirs. This sediment range data has not resulted in revised area/capacity curves for Lake George W. Andrews.

Maintenance of the sedimentation and retrogression ranges typically occurs when they are re-surveyed. That could involve reestablishing a range because of obliterated corners. It could also include relocating ranges because of new construction in the previously established range. Sediment data collection and results are discussed further in Section 5-03, Sediment Stations.

4-05. Climate. Chief factors that control the climate of the ACF 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 normal annual temperature for the Chattahoochee River Basin above and adjacent to the George W. Andrews Project is 66.1 degrees Fahrenheit (°F). That is based on an arithmetic mean of the normal annual temperature at six stations in or near the basin for the period 1981 – 2010. The average monthly normals vary from a low of 48.7 °F in January to a high of 81.2 °F in July. Table 4-2 shows the monthly and annual normals for each station. The stations are Enterprise and Headland in Alabama; and Bainbridge International Paper Company, Blakely, Colquitt, and Cuthbert in Georgia. 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 temperature events at six of those stations are presented in Table 4-3. Recorded temperatures have been as low as –2 °F at Cuthbert, Georgia, to as high as 110 °F at Blakely, Georgia.

b. Precipitation. The Chattahoochee River Basin above the George W. Andrews Project is in a region of heavy rainfall that is fairly well-distributed throughout the year. The average normal annual precipitation in the vicinity of the George W. Andrews Project is 53.44 inches of which 25 percent occurs in the spring, 27 percent in the winter, 28 percent in the summer, and 20 percent in the fall. Normal monthly and annual precipitation for selected stations in or near the basin is shown in Table 4-4. Light snowfall can occur in the basin during November through March but seldom covers the ground for more than a few days and has never been a contributing factor in any major flood.

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 4-5 presents extreme rainfall events of record for six stations in or near the basin. Shown are the highest monthly rainfall, the lowest monthly rainfall, and the one-day highest rainfall. Annual values are also included.

Table 4-2. Normal Mean Temperature (1981 – 2010)

Station		(°F)												
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Enterprise 4W/5NNW, AL (012675)		49.0	53.0	59.5	65.7	73.7	79.5	81.4	81.0	76.9	68.0	59.3	51.4	66.6
Headland, AL (013761)		48.5	52.4	59.4	65.9	74.3	80.0	81.8	80.9	76.5	67.3	58.7	50.8	66.4
Bainbridge Intl Paper C., GA (090586)		49.8	53.4	59.8	65.4	73.8	79.7	81.6	81.2	77.3	68.6	59.8	52.3	66.9
Blakely, GA (090979)		48.0	51.7	57.9	64.6	72.9	79.0	81.0	80.6	76.1	67.1	58.3	50.0	65.7
Colquitt 2W, GA (092153)		50.9	53.8	60.4	65.5	73.8	79.8	81.4	81.1	76.5	68.1	59.5	52.8	67.0
Cuthbert, GA (092450)		45.8	49.1	55.5	62.8	71.0	77.4	79.9	79.3	74.6	64.8	55.6	47.6	63.7
Average		48.7	52.2	58.8	63.3	73.3	79.2	81.2	80.7	76.3	67.3	58.5	50.8	66.1

Table 4-3. Extreme Temperatures in the Basin (°F)

ENTERPRISE, ALABAMA (06/1966-04/2012)							
	Monthly Averages			Daily Extremes			
	Max	Min.	Mean	High	Date	Low	Date
Jan	57.6	37.3	47.5	80	29/1974	-1	21/1985
Feb	61.3	39.7	50.5	82	28/1981	10	05/1996
Mar	69.7	46.9	58.3	88	15/1973	17	03/1980
Apr	77.1	53.6	65.3	93	23/1987	30	01/1987
May	83.1	61.0	72.0	99	11/2011	40	04/1971
Jun	89.0	68.0	78.5	104	04/2011	49	01/1972
Jul	90.4	70.4	80.4	104	15/1980	56	15/1967
Aug	89.6	70.0	79.8	102	01/2010	59	29/1968
Sep	86.5	65.6	76.0	100	08/1980	39	29/1967
Oct	77.8	55.2	66.5	92	18/1972	32	20/1989
Nov	68.7	46.6	57.7	87	02/1971	18	24/1970
Dec	61.5	40.8	51.2	82	13/1971	6	25/1983
Annual	**76.0**	**54.6**	**65.3**	**104**	**07/15/1980**	**-1**	**01/21/1985**
Winter	60.1	39.3	49.7	82	12/13/1971	-1	01/21/1985
Spring	76.6	53.8	65.2	99	05/11/2011	17	03/03/1980
Summer	89.6	69.5	79.6	104	07/15/1980	49	06/01/1972
Fall	77.7	55.8	66.7	100	09/08/1980	18	11/24/1970

HEADLAND, ALABAMA (4/1950-4/2012)							
	Monthly Averages			Daily Extremes			
	Max.	Min.	Mean	High	Date	Low	Date
Jan	58.3	36.3	47.3	84	04/1955	0	21/1985
Feb	62.7	39.6	51.1	87	18/1956	10	05/1996
Mar	70.0	46.3	58.2	89	11/1974	12	03/1980
Apr	78.2	53.6	65.8	94	23/1987	30	01/1987
May	85.1	61.6	73.3	100	28/1953	41	26/1979
Jun	90.2	67.8	79.0	104	27/1952	50	02/1956
Jul	91.3	69.9	80.6	103	25/1952	51	15/1967
Aug	91.0	69.1	80.0	102	20/1990	54	30/1986
Sep	87.3	64.9	76.1	100	16/1980	39	30/1967
Oct	78.7	53.6	66.1	96	02/1952	30	28/1957
Nov	69.3	44.8	57.0	88	02/1971	15	25/1970
Dec	61.3	38.7	50.0	83	17/1971	5	13/1962
Annual	**77.0**	**53.8**	**65.4**	**104**	**06/27/1952**	**0**	**01/21/1985**
Winter	60.8	38.2	49.5	87	02/18/1956	0	01/21/1985
Spring	77.8	53.8	65.8	100	05/28/1953	12	03/03/1980
Summer	90.8	68.9	79.9	104	06/27/1952	50	06/02/1956
Fall	78.4	54.4	66.4	100	09/16/1980	15	11/25/1970

BANBRIDGE INTL PAPER COMPANY, GEORGIA (10/1977-3/2012)							
	Monthly Averages			Daily Extremes			
	Max.	Min.	Mean	High	Date	Low	Date
Jan	61.9	36.8	49.3	83	31/2002	3	21/1985
Feb	65.9	40.3	53.1	85	27/1985	13	05/1996
Mar	72.9	46.7	59.8	89	22/1982	17	03/1980
Apr	79.4	52.1	65.6	94	25/1999	30	01/2003
May	86.4	60.4	73.4	102	24/1996	41	01/1996
Jun	90.5	67.9	79.2	105	23/1998	46	01/1984
Jul	92.5	70.8	81.6	103	07/1998	58	16/2007
Aug	92.0	70.4	81.2	102	23/1980	58	30/1992
Sep	88.6	66.2	77.5	100	21/1997	44	25/1990
Oct	81.1	54.8	67.9	94	02/1986	32	21/1989
Nov	73.3	47.0	60.1	89	02/1996	23	22/2000
Dec	64.6	40.3	52.5	83	08/1978	10	25/1983
Annual	**79.1**	**54.5**	**66.8**	**105**	**06/23/1998**	**3**	**01/21/1985**
Winter	64.1	39.1	51.6	85	02/27/1985	3	01/21/1985
Spring	79.6	53.1	66.3	102	05/24/1996	17	03/03/1980
Summer	91.6	69.7	80.7	105	06/23/1998	46	06/01/1984
Fall	81.0	56.0	68.5	100	09/21/1997	23	11/22/2000

BLAKELY, GEORGIA (9/1889-4/2012)							
	Monthly Averages			Daily Extremes			
	Max.	Min.	Mean	High	Date	Low	Date
Jan	61.0	39.3	50.2	85	22/1911	6	06/1924
Feb	63.9	41.0	52.4	85	18/1911	-1	13/1899
Mar	71.3	47.1	59.1	96	21/1907	17	03/1980
Apr	78.6	53.5	66.1	97	30/1906	30	06/1920
May	85.9	61.2	73.5	102	28/1904	34	04/1903
Jun	91.1	68.0	79.6	108	16/1911	47	01/1984
Jul	91.5	70.3	80.9	107	11/1930	50	04/1901
Aug	91.5	70.0	80.8	105	07/1911	56	31/1986
Sep	88.2	65.9	77.0	110	05/1925	40	29/1967
Oct	79.9	55.3	67.7	101	06/1911	29	24/1917
Nov	69.9	45.5	57.7	92	09/1986	15	25/1950
Dec	62.5	40.0	51.2	89	17/1906	6	13/1962
Annual	**77.9**	**54.8**	**66.4**	**110**	**19250905**	**-1**	**02/13/1899**
Winter	62.5	40.1	51.3	89	12/17/1906	-1	02/13/1899
Spring	78.6	53.9	66.2	102	05/28/1904	17	03/03/1980
Summer	91.4	69.4	80.4	108	06/16/1911	47	06/01/1984
Fall	79.4	55.5	67.5	110	09/05/1925	15	11/25/1950

COLQUITT, GEORGIA (3/1956-4/2012)							
	Monthly Averages			Daily Extremes			
	Max.	Min.	Mean	High	Date	Low	Date
Jan	61.3	38.1	49.8	85	30/1957	2	21/1985
Feb	65.6	40.9	53.1	87	27/1962	12	05/1996
Mar	72.7	46.8	59.7	90	28/1986	17	03/1980
Apr	80.3	53.5	66.9	94	25/1958	31	05/1992
May	86.3	60.7	73.4	99	24/1960	41	13/1960
Jun	90.8	67.6	79.3	104	30/1978	48	01/1984
Jul	92.4	70.4	81.4	105	13/1980	54	16/1967
Aug	91.8	69.9	80.8	105	01/1986	56	30/1992
Sep	88.7	66.0	77.3	100	17/1980	37	30/1967
Oct	80.8	54.8	67.8	97	02/1959	31	26/1968
Nov	72.3	46.4	59.4	89	04/1961	16	25/1970
Dec	64.5	40.0	52.2	88	14/1984	9	25/1983
Annual	**79.0**	**54.6**	**66.8**	**105**	**07/13/1980**	**2**	**01/21/1985**
Winter	63.8	39.7	51.7	88	12/14/1984	2	01/21/1985
Spring	79.7	53.7	66.7	99	05/24/1960	17	03/03/1980
Summer	91.7	69.3	80.5	105	07/13/1980	48	06/01/1984
Fall	80.6	55.7	68.2	100	09/17/1980	16	11/25/1970

CUTHBERT, GEORGIA (11/1904-4/2012)							
	Monthly Averages			Daily Extremes			
	Max.	Min.	Mean	High	Date	Low	Date
Jan	60.4	38.5	49.4	84	12/1949	-2	21/1985
Feb	63.3	40.3	51.8	85	28/1962	9	05/1996
Mar	71.6	46.6	59.1	93	21/1907	15	03/1980
Apr	79.0	53.4	66.2	95	23/1976	29	18/2001
May	85.7	61.6	73.7	100	28/1962	42	18/2011
Jun	90.6	68.3	79.4	105	04/1984	49	03/1956
Jul	91.8	70.7	81.3	105	14/1980	57	25/1911
Aug	91.6	70.3	80.9	104	23/1968	56	16/2000
Sep	87.5	66.0	76.8	103	04/1951	41	29/1967
Oct	79.1	55.2	67.2	100	05/1954	25	20/2009
Nov	69.6	46.0	57.9	91	01/1951	13	25/1950
Dec	61.9	40.1	51.0	82	07/1978	5	13/1962
Annual	**77.7**	**54.8**	**66.2**	**105**	**07/14/1980**	**-2**	**01/21/1985**
Winter	61.9	39.6	50.7	85	02/28/1962	-2	01/21/1985
Spring	78.8	53.9	66.3	100	05/28/1962	15	03/03/1980
Summer	91.3	69.8	80.5	105	07/14/1980	49	06/03/1956
Fall	78.8	55.8	67.3	103	09/04/1951	13	11/25/1950

Table 4-4. Normal Rainfall (1981 – 2010) (inches)

Station		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Enterprise, AL (012675)		5.31	4.60	5.85	3.99	3.59	5.00	5.99	4.52	3.84	3.03	4.11	4.48	54.31
Headland, AL (013761)		5.39	5.49	5.14	5.10	5.42	4.35	4.60	3.47	4.20	3.75	5.03	4.92	56.86
Bainbridge Intl. Paper Company, GA (090586)		4.93	4.93	5.49	3.52	3.55	5.64	5.68	4.81	3.96	3.45	3.49	3.64	53.09
Blakely, GA (090979)		5.50	4.82	5.32	3.51	3.33	5.09	4.16	4.53	3.86	2.67	3.75	4.51	51.05
Colquitt, GA (092153		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cuthbert, GA (092450)		4.86	4.78	5.10	3.66	2.95	4.90	6.77	4.61	3.55	2.75	3.51	4.46	51.90
Average		5.20	4.92	5.38	3.96	3.77	5.00	5.44	4.39	3.88	3.13	3.98	4.40	53.44

Table 4-5. Extreme Rainfall in and near the Basin (inches)

	ENTERPRISE, ALABAMA (012675)						
	Record: 06/1966 – 4/2012						
	Mean	High	Year	Low	Year	1 Day Max.	
January	5.69	15.32	1991	1.77	1981	6.24	01/1974
February	4.70	9.21	1982	0.00	2010	4.97	06/1985
March	6.23	16.22	1973	1.38	1967	4.55	31/1993
April	3.46	7.43	1979	0.00	2009	3.55	04/1974
May	4.70	14.30	1973	0.92	2011	6.78	27/1973
June	4.86	11.48	1970	0.93	1984	6.35	04/1970
July	6.19	28.01	1994	1.94	1990	9.27	04/1994
August	4.11	8.03	1969	1.28	1980	3.01	02/1983
September	3.27	8.16	1988	0.42	1972	2.91	21/1969
October	2.86	11.87	1995	0.11	1991	8.34	04/1995
November	4.09	11.07	1992	1.38	1981	2.55	22/1991
December	4.80	13.76	1973	1.01	1980	5.89	26/1973
Annual	**54.94**	**89.24**	**1973**	**38.48**	**1968**	**9.27**	**07/04/1994**
Winter	15.18	33.23	1974	6.31	1989	6.24	01/01/1974
Spring	14.39	36.52	1973	5.43	1967	6.78	05/27/1973
Summer	15.16	40.86	1994	6.82	1980	9.27	07/04/1994
Fall	10.22	21.65	1995	4.27	1984	8.34	10/04/1995

	HEADLAND, ALABAMA (013761)						
	Record: 04/1950 – 04/2012						
	Mean	High	Year	Low	Year	1 Day Max.	
January	5.55	13.69	1991	1.35	1954	5.25	06/1962
February	5.06	9.75	1974	0.71	1951	5.95	11/1981
March	5.60	15.39	1980	0.63	1955	6.70	28/2009
April	4.03	11.78	1975	0.32	1987	7.30	10/1975
May	4.00	10.68	1969	0.13	1962	4.70	27/1973
June	4.57	11.57	1989	0.89	1950	5.75	20/1972
July	6.08	19.42	1994	1.87	2010	9.08	06/1994
August	4.79	13.13	1996	0.69	1955	5.20	31/1996
September	3.87	11.63	1996	0.04	1972	4.00	24/1956
October	2.78	8.69	1996	0.00	1961	6.81	03/1996
November	3.37	11.53	1992	0.48	1956	6.65	09/1989
December	4.60	14.66	1953	0.61	1955	5.46	26/1964
Annual	**54.28**	**79.02**	**1964**	**31.99**	**1954**	**9.08**	**07/06/1994**
Winter	15.20	31.35	1974	7.39	1951	5.95	02/11/1981
Spring	13.63	29.01	1980	6.23	1954	7.30	04/10/1975
Summer	15.43	32.44	1994	7.10	1990	9.08	07/06/1994
Fall	10.02	22.61	1996	2.74	1952	6.81	10/03/1996

	BAINBRIDGE INTL PAPER CO, GEORGIA (090586)						
	Record: 10/1977 – 3/2012						
	Mean	High	Year	Low	Year	1 Day Max.	
January	5.00	14.60	1991	0.67	1989	3.49	11/1991
February	4.76	9.72	1986	1.26	2001	4.27	19/1988
March	5.88	13.34	2005	0.54	2004	5.95	06/1984
April	4.09	9.06	2005	0.58	1999	4.40	03/2009
May	3.56	13.55	1991	0.34	1998	3.00	29/1992
June	5.75	11.93	1989	0.60	2007	5.12	09/1989
July	5.61	13.52	2005	0.00	2009	3.40	30/2005
August	5.25	16.58	2008	2.10	1980	5.89	23/2008
September	4.29	15.90	1998	0.09	2009	4.57	03/1998
October	2.89	11.02	1994	0.02	1978	5.29	03/1994
November	3.24	9.06	1985	0.56	2007	7.10	22/1985
December	3.42	7.80	1982	0.32	1980	2.65	24/1978
Annual	**53.74**	**73.68**	**1994**	**37.84**	**1990**	**7.10**	**11/22/1985**
Winter	13.17	22.34	1984	4.31	1989	4.27	02/19/1988
Spring	13.53	29.03	1991	5.74	1986	5.95	03/06/1984
Summer	16.61	33.38	2005	6.78	2007	5.89	08/23/2008
Fall	10.42	19.11	2004	3.13	1991	7.10	11/22/1985

	BLAKELY, GEORGIA (090979)						
	Record: 9/1889 – 4/2012						
	Mean	High	Year	Low	Year	1 Day Max.	
January	4.95	14.10	1925	0.40	1909	5.57	19/1936
February	5.27	12.35	1939	0.77	1980	4.57	19/1962
March	5.64	15.86	1929	0.10	2006	10.88	15/1929
April	4.43	14.85	1928	0.24	1967	5.17	23/1928
May	3.87	12.66	1976	0.15	1965	5.69	25/1961
June	4.53	11.65	1965	0.72	1931	7.00	12/1906
July	6.48	30.23	1916	0.00	1900	9.90	08/1916
August	5.47	14.64	2008	0.96	1914	5.90	24/2008
September	3.95	14.54	1957	0.10	1904	7.50	10/2006
October	2.40	8.68	1959	0.00	1961	5.80	08/1894
November	3.03	10.11	1947	0.02	1931	4.76	01/1932
December	4.60	12.92	1953	0.55	1946	8.50	11/2008
Annual	**54.62**	**81.94**	**1948**	**28.74**	**1954**	**10.88**	**03/15/1929**
Winter	14.82	27.73	1973	5.88	1950	8.50	12/11/2008
Spring	13.93	28.25	1947	5.20	1925	10.88	03/15/1929
Summer	16.48	37.79	1916	7.46	2006	9.90	07/08/1916
Fall	9.38	24.43	1957	1.19	1931	7.50	09/10/2006

	COLQUITT, GEORGIA (092153))						
	Record: 03/1956 – 4/2012						
	Mean	High	Year	Low	Year	1 Day Max.	
January	5.13	13.60	1991	0.83	1969	5.62	25/1978
February	4.68	10.16	1986	0.56	2001	3.60	14/2009
March	5.78	13.22	1980	0.00	2006	7.75	28/2009
April	3.84	11.52	1975	0.33	1972	6.76	10/1975
May	3.44	12.18	1976	0.10	1965	4.06	03/2010
June	4.92	12.33	1989	0.49	1970	5.90	05/1995
July	5.08	12.46	1998	0.99	1977	3.29	21/1961
August	4.73	12.99	2003	1.09	2000	4.50	08/1970
September	4.35	17.46	1998	0.61	1985	9.80	15/2002
October	2.54	9.90	1959	0.00	1961	4.04	03/1994
November	3.14	8.77	1992	0.00	1959	5.30	22/1985
December	3.99	9.22	1982	0.32	1984	6.70	11/2008
Annual	**51.63**	**71.16**	**1975**	**36.44**	**2001**	**9.80**	**09/15/2002**
Winter	13.81	21.88	1964	5.45	1957	6.70	12/11/2008
Spring	13.06	27.03	2009	3.28	1986	7.75	03/28/2009
Summer	14.73	25.52	1989	7.40	1973	5.90	06/05/1995
Fall	10.03	21.63	1998	2.78	1991	9.80	09/15/2002

	CUTHBERT, GEORGIA (092450)						
	Record: 11/1904 – 4/2012						
	Mean	High	Year	Low	Year	1 Day Max.	
January	4.70	13.35	1991	0.30	2003	7.60	06/1962
February	4.70	10.51	1998	0.36	2009	4.60	11/1995
March	5.24	12.16	1980	0.29	2004	7.25	27/2005
April	4.16	12.43	1912	0.27	1986	5.20	16/1910
May	3.64	10.05	1953	0.03	2000	5.18	21/1987
June	4.39	11.89	1991	0.80	1968	4.90	09/1990
July	6.18	31.46	1994	1.58	1972	8.74	04/1994
August	4.21	11.14	2008	0.52	1954	4.90	08/2010
September	3.77	12.69	1998	0.18	1978	5.00	29/1998
October	2.42	9.97	1959	0.00	1961	6.00	01/1989
November	3.19	10.14	1992	0.15	2010	5.53	04/1977
December	4.74	17.04	2009	0.01	2010	6.70	11/2008
Annual	**51.34**	**78.62**	**1994**	**26.77**	**1954**	**8.74**	**07/041994**
Winter	14.14	34.07	2010	6.82	2002	7.60	01/06/1962
Spring	13.04	22.62	1947	5.45	2007	7.25	03/27/2005
Summer	14.78	40.61	1994	5.21	1986	8.74	07/041994
Fall	9.37	20.69	1976	2.28	1909	6.00	10/01/1989

4-06. Storms and Floods. 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. The autumn months are usually dryer but flood producing storms can occur any time of the year. Two of the major floods before construction of George W. Andrews Lock and Dam are the July 1916 and the March 1929 events.

The storm of 5-10 July 1916, resulted from a tropical hurricane, which formed in the Caribbean Sea and moved northwest across the Gulf of Mexico to enter the United States east of the mouth of the Mississippi River on the evening of 5 July. The disturbance continued inland across western Mississippi, turned eastward on the 7th and from the 8th to the 10th moved northeastward across Alabama. The heavy precipitation covered a remarkably large area. The 9-inch isohyet on the total-storm isohyetal map includes practically all of Alabama, the northwestern part of Florida, and large areas in Mississippi and Georgia. At the center of greatest intensities, the following amounts of precipitation were recorded over a 3½-day period: Bonifay, Florida, 24 inches; Robertsdale, Alabama, 22.6 inches; and Clanton, Alabama, 18.6 inches. The storm produced general flood conditions throughout the southeastern states and, because it occurred during the middle of the growing season, caused significant damage. The heaviest recorded rainfall in the ACF Basin was 23 inches at Blakeley, Georgia. A total of 22.7 inches fell at Alaga, Alabama, where 12.7 inches were recorded in one day. Flood stages were exceeded throughout the basin.

The March 1929 storm resulted from a widely extending low pressure area that developed over eastern Colorado. The system moved rapidly to the east causing heavy rainfall in Mississippi, Alabama, and Georgia. Some areas experienced nearly 30 inches of rain in a 3-day period. The March 1929 flood is discussed further in the *ACF Master Water Control Manual*.

A significant flood after construction of George W. Andrews Lock and Dam was the flood of July 1994. Tropical Storm Alberto formed in the Southeastern Gulf of Mexico between the Yucatan Peninsula and the western tip of Cuba on 30 June 1994. Alberto was near hurricane strength when it made landfall near Ft. Walton on 3 July. The storm moved to the Atlanta area and then meandered southward. Up to 26 inches of rainfall occurred in areas between the Chattahoochee River and the Flint River. Record stages were recorded on some streams. The Mobile District Office (MDO) prepared a special report on the storm titled, *Flood of July 1994 Apalachicola-Chattahoochee-Flint River Basin*. The *ACF Master Water Control Manual* also describes the storm.

4-07. Runoff Characteristics. In the ACF 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 that runs into the 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 average monthly rainfall and average stream flow entering the river as measured at Columbus, Georgia, are presented in Figure 4-1 to demonstrate the average variation in runoff. This information was computed by comparing flows with rainfall over the basin using the unimpaired flow dataset from 1939 to 2011. The percent of rainfall appearing as stream runoff is presented for each month.

While commonly referred to as observed data, reservoir inflows are actually calculated from pool elevations and project discharges. A reservoir elevation-storage relationship results in an inflow calculated for a given pool level change and outflow (total discharge) by using the continuity relationship. The reservoir continuity equation described below maintained the flow volume:

INFLOW = OUTFLOW + CHANGE IN STORAGE
where: INFLOW is in units of cfs/day
OUTFLOW is in units of cfs/day
CHANGE OF STORAGE is in units of cfs/day

The reservoir discharge value, OUTFLOW, is the total discharge from turbines, sluice gates, or spillway gates. Its associated value comes from rating tables for these structures. The CHANGE IN STORAGE comes from subtracting the daily storage on day two from day one as seen below.

CHANGE IN STORAGE = $STORAGE_{i}$ – $STORAGE_{i-1}$
where: $STORAGE_{i}$ = storage at midnight of the current day in units of cfs/day
$STORAGE_{i-1}$ = storage at midnight of the previous day in units of cfs/day

The daily storage value comes from the storage-elevation tables using the adjusted midnight pool elevation for each day. Negative inflow calculations can occur when there is a decrease in storage which exceeds the project's outflow. Evaporative losses, direct reservoir withdrawals, wind affecting the lake level reading, and losses to groundwater are several causes of negative inflow calculations.

Streamflow has been measured in the vicinity of George W. Andrews' damsite since 1928. The U.S. Geological Survey (USGS) has continuous records available at Alaga, Alabama, from May 1938 through December 1944, and near Columbia, Alabama, from October 1975 to the present. The Corps has constructed flow records for the site since 1939 using upstream and downstream stations. The Corps-developed flows are called unimpaired flows. For this manual, the USGS flows are used when available, and the missing data are filled in using the flows developed by the Corps. Mean monthly and annual flows are tabulated in Plates 4-2 and 4-3. Plate 4-4 has daily flows plotted for the entire period of record for a general display of the flow pattern. Plates 4-5 through 4-17 show the daily flows on a larger scale for more detail.

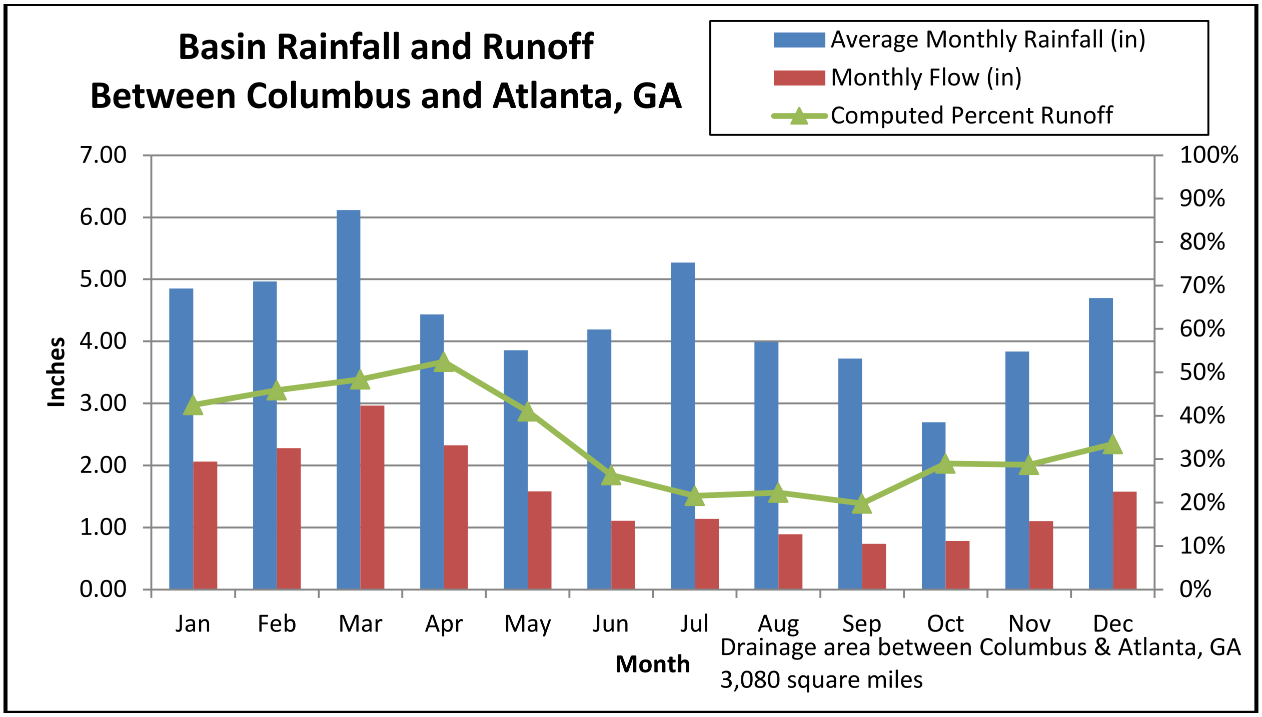


Figure 4-1. Basin Rainfall and Runoff Between Columbus and Atlanta, Georgia

4-08. Water Quality. According to Georgia's 2014 draft integrated 305(b)/303(d) list of impaired waters, Lake George W. Andrews is not supporting its designated water quality use for fishing for dissolved oxygen. This is a new designation for 2014 and no TMDL studies have been conducted; however, the state has set a 2017 priority for this non-supporting parameter. Georgia Environmental Protection Division (GAEPD) does not have a regularly monitored compliance station in the lake as it does with other reservoirs in the ACF Basin. Georgia has not developed site-specific water quality criteria for the reservoir. The Corps monitors water quality in the headwaters of the lake for planning purposes to ensure the Corps that sustainability is met.

4-09. Channel and Floodway Characteristics

a. General. The Chattahoochee River both upstream and downstream from George W. Andrews is controlled by reservoirs. The river is relatively stable except during flood events. Upstream, the lake extends to Walter F. George Lock and Dam. Downstream is Lake Seminole, formed by the Jim Woodruff Dam. A spillway rating curve for the tailwater at George W. Andrews Dam and a rating curve for pool elevation above 103.0 feet NGVD29 and tailwater elevations above 102 feet NGVD29are shown in Plate 2-8, Headwater-Tailwater Ratings. Tailwater rating for tailwater elevations below 102 are shown in Plate 2-9. A tabulation of the spillway gate rating is shown on Plates 2-5 and 2-6, Gated Spillway Rating.

b. Damage Centers and Key Control Points. The George W. Andrews Project was designed and built to operate in conjunction with the Walter F. George Project upstream and the Jim Woodruff Project downstream. Each of the projects raises the water surface elevation sufficiently to provide navigation depths to points upstream. In addition, the project is operated to reregulate outflows from the Walter F. George powerhouse.

Flooding and flood damages also occur at George W. Andrews Lock and Dam. Extensive lowland flooding begins at elevation 113 feet NGVD29. At elevation 115 feet NGVD29, water reaches the top of the lock walls, and George W. Andrews Lock and Dam is evacuated.Significant erosion can be expected at elevation 118 feet NGVD29 and above. Roads near Southern Pacific Paper Mill are flooded at elevation 119 feet NGVD29. Above elevation 125 feet NGVD29, railroad tracks between George W. Andrews and the railroad bridge are flooded. Above elevation 130 feet NGVD29, Georgia Highway 62 is flooded. Table 4-6 lists the historical peak river stages at George W. Andrews Lock and Dam damsite.

Table 4-6. Historical Crests at the George W. Andrews L&D Damsite

(1) 128.28 ft on 03/18/1929
(2) 123.98 ft on 07/07/1994
(3) 122.10 ft on 03/19/1990
(4) 121.80 ft on 12/03/1948
(5) 121.80 ft on 12/01/1948
(6) 121.70 ft on 03/24/1943
(7) 119.40 ft on 12/01/1964
(8) 118.90 ft on 04/12/1936
(9) 118.60 ft on 01/20/1943
(10) 118.12 ft on 01/27/1929
(11) 117.28 ft on 10/02/1929

4-10. Upstream Structures. In the drainage area above George W. Andrews Lock and Dam are nine power developments and three multiple-purpose dams. The Georgia Power Company owns and operates seven of the power projects. They are Morgan Falls, Langdale, Riverview, Bartletts Ferry, Goat Rock, Oliver, and North Highlands. The Habersham Mill Dam is a small project above Buford Dam. Buford, West Point, and Walter F. George Dams are Federal projects operated by the Corps and are multiple-purpose dams that provide flood risk management, production of hydroelectric power, water supply, recreation, water quality, fish and wildlife conservation, and navigation during low-flow seasons. The locations of these projects are shown on Plate 2-1.

4-11. Downstream Structures. George W. Andrews Lock and Dam is the middle structure in the navigation network for the ACF River System. The system provides navigable depths to Columbus, Georgia. The system consists of three lock and dams - Jim Woodruff Lock and Dam on the Apalachicola River; and George W. Andrews Lock and Dam, and Walter F. George Lock and Dam, both on the Chattahoochee River.

4-12. Economic Data. The watershed above and the river basin below George W. Andrews Lock and Dam are largely rural. The relatively small watershed above George W. Andrews Lock and Dam extends to Walter F. George Dam and Reservoir in the Chattahoochee River Basin and consists of Early County Georgia Henry County Alabama. The river basin below George W. Andrews Lock and Dam consists of Seminole County Georgia and Houston County Alabama, which compose the Chattahoochee River watershed of the downstream Jim Woodruff reservoir.

a. Population. The 2010 population of the five counties composing the George W. Andrews Lock and Dam watershed and basin below totaled 138,586 persons. The City of Dothan, in Houston County, Alabama, has a population of 65,496 and is the only major city in the watershed or basin. Table 4-7 shows the 2010 population and the 2010 per capita income for each county.

Table 4-7. Population and per Capita Income

County	2010 Population	2010 Per Capita Income
Alabama		
Henry	17,302	$ 19,716
Houston	101,547	22,725
Georgia		
Early	11,008	$ 15,989
Seminole	8,729	19,263
Total Population	138,586	
Source: U.S. Census Bureau, 2010		

b. Agriculture. The George W. Andrews watershed and basin below consist of approximately 2,600 farms averaging 316 acres per farm. In 2012 the agricultural production in the area totaled $740 million in farm products sold (including livestock). Agriculture in the George W. Andrews Lock and Dam watershed and basin consists primarily of row crops, which account for 69 percent of the value of farm products sold. Cotton, peanuts, soybeans, and corn are the principle row crops. Livestock production consists primarily of beef cattle operations.

c. Industry. The leading industrial sectors that provide non-farm employment are wholesale and retail trade, services, and manufacturing. Those sectors account for a combined 66.1 percent of the non-farm employment in the basin. The remaining non-farm employment is provided by construction, finance, insurance, real estate, transportation, and public utilities. In 2005 the George W. Andrews Lock and Dam area counties had 151 manufacturing establishments that provided 8,036 jobs with total earnings of more than $400 million. Additionally, the value added by the area manufactures totaled nearly $1.1 billion. Table 4-8 shows information on the manufacturing activity for each of the counties in the George W. Andrews Lock and Dam watershed and basin below.

Table 4-8. Manufacturing Activity

County	No. of Manufacturing Establishments	Total Manufacturing Employees	Total Earnings ($1,000)	Value Added by Manufactures ($1,000)
Alabama				
Henry, AL	20	1,418	62,988	106,061
Houston, AL	118	5,637	255,879	626,169
Georgia				
Early, GA	13	981	$ 87,631	$ 356,744
Seminole, GA	(NA)	(D)	(D)	(NA)
Totals	151	8,036	$ 406,498	$ 1,088,974

(NA) Data not available
(D) Data withheld to avoid disclosure

Source: U.S. Census Bureau, County and City Data Book: 2007

d. Employment. According to the 2012 American Community Survey, more than 95 percent of all jobs in the GW Andrews Project area are provided by the private sector. The primary sources of employment are management and professional occupations and sales and office occupations; together, they account for, on average, over 50 percent of the total employment in the project area. Henry and Seminole Counties have manufacturing establishments that provide approximately 15 percent of the employment in the counties. Table 4-9 gives information on the employment by county for each county in the George W. Andrews Lake watershed and basin below.

Table 4-9. Employment

	Percent distribution by occupation					**Percent in selected industries**		**Percent govern-ment workers (local state, or Federal)**
	Manage-ment, profes-sional, and related occupa-tions	**Service occupa-tions**	**Sales and office occupa-tions**	**Con-struction, extraction, and main-tenance occupa-tions**	**Production, trans-portation, and material moving occupa-tions**	**Agricul-ture, forestry, fishing and hunting**	**Manu-facturing**	
Alabama								
Henry	28.6	17.5	23.8	12.6	17.5	3.9	16.5	3.8
Houston	29.5	18	27	11	14.6	1.2	9.5	4.6
Georgia								
Early	29.1	18.3	20.9	11.6	20.1	4.5	18	7
Seminole	23.4	21.7	25.5	13.5	15.9	7.8	14.4	4.2

e. Flood Risk Management. George W. Andrews Lock and Dam is a run-of-the-river navigation project; therefore, it does not contain any flood risk management storage, nor in any other way does it provide flood risk management for downstream areas. The floodplain of the Chattahoochee River downstream of George W. Andrews Lock and Dam is largely undeveloped and primarily consists of agricultural lands and forested areas in the natural floodplain of the river.

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological Stations

a. Facilities. Management of water resources requires continuous, real-time knowledge of hydrologic conditions. The Mobile District contracts out the majority of basin data collection and maintenance to the U.S. Geological Survey (USGS) and National Weather Service (NWS) through cooperative stream gaging and precipitation network programs. The USGS, in cooperation with other Federal and state agencies, maintains a network of real-time gaging stations throughout the ACF Basin. The stations continuously collect various types of data including stage, flow, and precipitation. The data are stored at the gage location and are transmitted to orbiting satellites. 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. The gage locations are discussed in Chapter VI related to hydrologic forecasting.

Reservoir project data are obtained through each project's Supervisory Control and Data Acquisition (SCADA) system and provided to the Mobile District both daily and in real-time.

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

Through the Corps-USGS Cooperative stream gage program, the Mobile District and the USGS operate and maintain stream gages throughout the ACF Basin. The Mobile District also partners with the USGS and the NWS for the majority of basin data collection and gage maintenance.

Tables 5-1 and 5-2 list the stations along with pertinent information. Plate 5-1 displays the location of the gages.

Table 5-1. Rainfall Only Reporting Network, George W. Andrews

Station	Agency Station ID	Latitude	Longitude	Elevation (ft NGVD29)
W.F. George L&D	FOGGI	31°38’	85°05’	162
Clayton, AL	11725	31 53’	85 28’	500
Eufaula Wildlife Refuge, AL	12730	32 00’	85 05’	215
Cuthbert, GA	92450	31 46’	84 47’	461
Abbeville, AL	10008	31°35’	85°15’	465
Headland, AL	13761	31°21’	85°20’	370
Andrews L&D	COLAI	31°15’	85°07’	176

Table 5-2. River-Stage and Rainfall Reporting Network, George W. Andrews

Stream	Station	Station number	River miles above mouth	Drainage area (sq. mi.)	Gage zero (ft. NGVD29)	Flood stage (ft.)	Operating Agency	Rain Gage
Chattahoochee River	W. F. George tailwater	2343241	75.1	7,460	0	134	USGS	N
Chattahoochee River	Ft. Gaines	23432415	73.38	7,460	0		USGS	N
Chattahoochee River	Lake George Andrews and tailwater	2343801	46.53	8,210	0	113	USGS	Y
Chattahoochee River	Columbia	2343805	46.5	8,213	0		USGS	N
Sawhatchee Creek	Cedar Springs	2343940	35.27	64.2	109.9		USGS	Y
Chattahoochee	Lake Seminole	2357500	107.58	17,164	0		USGS	Y

b. Reporting. The Mobile District operates and maintains a Water Control Data System (WCDS) 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 and retrieval to best meet all Corps water management activities. Much of the historic and current project hydrologic data are available to the public via the Mobile District website.

Data are collected at Corps sites and throughout the ACF 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. The 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 Data Collection System (DCS) 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 operates and maintains a Local Readout Ground Station (LRGS), which collects the data collection platform-transmitted, real-time data from the DOMSAT. Figure 5-3 depicts a typical schematic of how the system operates.

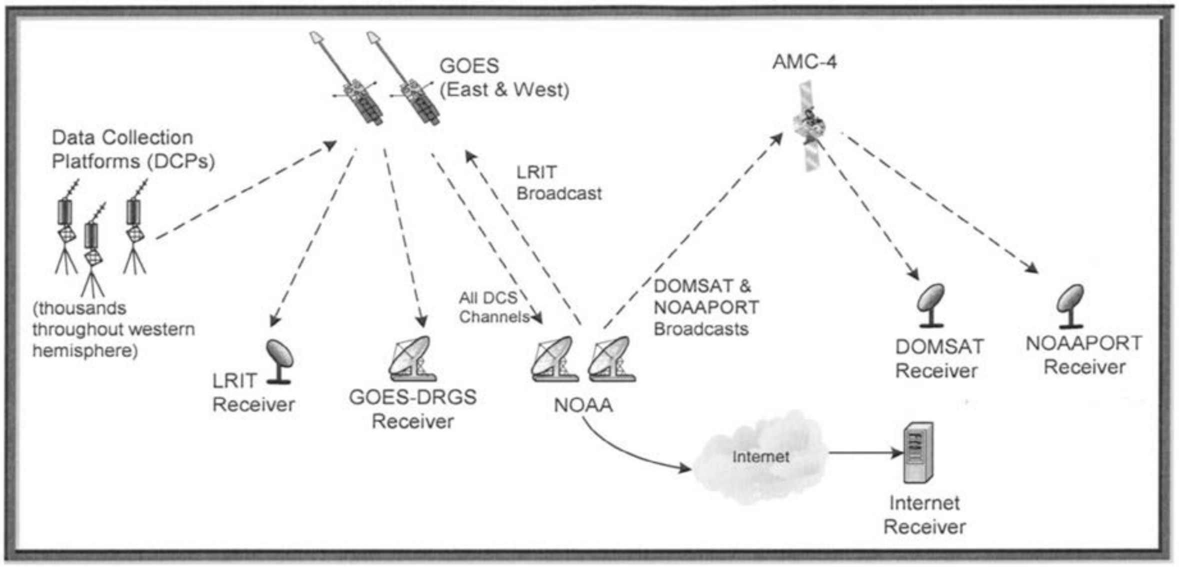


Figure 5-3. Typical configuration of the GOES System

Typically, reporting stations log 15-minute data that are transmitted every hour. A few remaining gages report every 4 hours, but they are being transitioned to the hourly increment. All river stage and precipitation gages equipped with a data collection platform and GOES antenna are capable of being part of the reporting network.

Other reservoir project data are obtained directly at a project is collected through each project's SCADA system. The Mobile District downloads the data both daily and hourly through the Corps' server network.

c. Maintenance. Maintenance of data reporting equipment is a cooperative effort among the Corps, the USGS, and the NWS. The USGS, in cooperation with other Federal and state agencies, maintains a network of real-time data collection platform stream gaging stations throughout the ACF Basin. The USGS is responsible for the supervision and maintenance of the real-time data collection platform gaging stations and the collection and distribution of streamflow data. In addition, the USGS maintains a systematic measurement program at the stations so the stage-discharge relationship for each station is current. Through cooperative arrangements with the USGS, discharge measurements at key ACF Basin locations are made to maintain the most current stage-discharge relationships at the stations. The NWS also maintains precipitation data for the flood control precipitation (FC-1) network.

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

U.S. Army Corps of Engineers, Mobile District, 109 Saint Joseph Street, Mobile, AL 36602-3630
Phone: (251) 690-2737 Web: http://water.sam.usace.army.mil

USGS South Atlantic Water Science Center - Georgia, 1770 Corporate Dr., Suite 500, Norcross, GA 30093; Phone: (678) 924-6700 Web: http://ga.water.usgs.gov

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

USGS Florida Water Science Center, 4446 Pet Lane, Suite 108, Lutz, FL 33559,
Phone: (813) 498-5000 Web: http://fl.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/

5-02. Water Quality Stations. Water quality monitoring by the Corps is limited in the ACF Basin. In most cases, other Federal and state agencies maintain water quality stations for general water quality monitoring within the ACF Basin. In addition, real-time water quality parameters are collected at some stream gage locations maintained by the USGS.

5-03. Sediment Stations. In order to provide an adequate surveillance of sedimentation, a network of sediment ranges were established for Lake George W. Andrews in 1960. Quantitative computations can be made from these ranges to determine the extent and degree of sedimentation and erosion. General conditions and changes have been measured and recorded using this network. The network of sediment stations is shown on Plate 4-1.

Sediment surveys were conducted in 1963, 1981, and 2009. Tetra Tech, Inc. was retained to conduct an analysis of the data and determine the extent and degree of sedimentation and erosion that has occurred in the lake and its tributaries over the years, and where appropriate, to speculate on the causes of those changes. This analysis and results are presented in a report entitled; "Sedimentation and Erosion Analysis for Lake George W. Andrews".

George W. Andrews Dam is a run-of-river project and the lake is essentially confined within the banks of the Chattahoochee River. The Walter F. George Lock and Dam is located immediately upstream on the Chattahoochee. The impoundment behind the dam serves to trap sediment supplied from the drainage basin. All sediment coarser than fine sand, and a large portion of silt and clay, is likely prevented from passing the dam into Lake George W. Andrews. In this environment, the primary sediment source is via bank erosion from Lake George W. Andrews and from tributaries to Lake George W. Andrews. In general, Lake George W. Andrews has undergone sedimentation processes typical of a river bounded by a dam at both the upstream and downstream ends; i.e., bed scour near the upstream end, stable bed along the middle, and bed deposition near the downstream end. Bank erosion has been moderate to acute at most range line ends with the higher erosion rates occurring prior to 1981.

5-04. Recording Hydrologic Data. The WCDS/CWMS is an integrated system of computer hardware and software packages readily usable by water managers and operators as an aid for making and implementing decisions. An effective decision support system requires efficient data input, storage, retrieval, and capable information processing. Corps-wide standard software and database structure are used for real-time water control. Time series hydrometeorological data are stored and retrieved using the CWMS Oracle database. In the event this database is unavailable, data can alternately be stored in the Hydrologic Engineering Center Data Storage System (HEC-DSS).

To provide stream gage and precipitation data needed to support proper analysis, a DOMSAT Receive Station (DRS) is used to retrieve DCP data from gages throughout the ACF Basin. The DRS equipment and software then receives the DOMSAT data stream, decodes the DCPs of interest and reformats the data for direct ingest into a HEC-DSS database. Reservoir data is received through a link with the SCADA system which monitors and records reservoir conditions and operations in real time.

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, 1 hour, or other time 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 supporting 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.

5-05. Communication Network. The global network of the Corps consists of Voice over IP (VoIP) connections between every division and district office worldwide. The VoIP allows all data and voice communications to transverse through the Corps' internet connection. The reliability of the Corps' network is considered a command priority and, as such, supports a dedicated 24-hours-per-day Network Operations Center. Additionally, the use of satellite data acquisition makes for a very reliable water control network infrastructure.

The Mobile District has a critical demand for emergency standby for operation of the ACF Basin and to ensure that data acquisition and storage remain functional. Water Management must be able to function in cases of flooding or other disasters, which typically are followed by the loss of commercial electricity. The WCDS/CWMS servers and LRGS each have individual uninterruptable power supply (UPS) and a large UPS unit specifically for the portion of MDO in which Water Management resides to maintain power for operational needs.

In the event of a catastrophic incident that causes loss of communication or complete loss of access to the MDO and the WCDS and CWMS servers located on site, a Continuity of Operations Program (COOP) site is being set up as a backup to these systems. This site will have servers that mirror the WCDS and CWMS servers located at the MDO allowing Water Managers to continue operating with no interruption or loss of data. It is currently planned that the COOP site will be located at the SAD office in Atlanta, Georgia.

The primary communication network of the George W. Andrews Project is a SCADA system network. The SCADA network is owned and operated by USACE and includes a microwave link between Walter F. George, George W. Andrews, and West Point Dam. Computer servers at Walter F. George are connected to the Mobile District through the Corps Network, permitting George W. Andrews data transfer at any time. The data include physical conditions at each of the reservoirs such as pool elevations, outflow, spillway gate openings, river stages, generation, and rainfall. Special instructions or deviations are usually transmitted by e-mail, telephone, or fax.

Emergency communication is available at the following numbers:

Water Management Section	251-690-2737
Chief of Water Management	251-690-2730 or 251-509-5368
Walter F. George Powerhouse	229-768-2635
ACF Project Management Office	334-232-4542
George W. Andrews Lockmaster	229-723-3482

5-06. Communication with Project

a. Regulating Office with Project Office. The Water Management Section is the regulating office for the Corps' projects in the ACF Basin. Electronic mail, telephone, and facsimile are used daily for routine communication with the projects. If loss of network communication occurs, orders can be given via telephone.

During critical reservoir regulation periods and to ensure timely response, significant coordination is often conducted by telephone between the project office and the Mobile District. That direct contact ensures that issues are completely coordinated, and concerns by both offices are presented and considered before final release decisions are made. The Chief of the Water Management Section is available by cell phone during critical reservoir operation periods.

b. <u>Between Project Office and Others</u>. Each reservoir project office is generally responsible for local notification and for maintaining lists of those individuals who require notification under various project regulation changes. In addition, the project office is responsible for notifying the public using project recreation areas, campsites, and other facilities that could be affected by various project conditions.

5-07. Project Reporting Instructions. In addition to automated data, project operators maintain record logs of gate position, water elevation, and other relevant hydrological information including inflow and discharge. That information is stored and available to the Mobile District through the Corps' network. Operators have access to Mobile District Water Managers via email, land line and cell phone and notify the Mobile District if changes in conditions occur. Unforeseen or emergency conditions at the project that require unscheduled manipulations of the reservoir should be reported to the Mobile District as soon as possible.

If the automatic data collection and transfer are not working, projects are required to fax or email daily or hourly project data to the Mobile District. Water Management staff will manually input the information into the database. In addition, Mobile District Power Projects must verify pool level gage readings each week, in accordance with *Standard Operating Procedure, Weekly Verification of Gauge Readings, Mobile District Power Projects* dated 19 February 2008, and CESAD SOP 1130-2-6 dated 21 July 2006. Those procedures require that project personnel check the accuracy of pool monitoring equipment by verifying readings of the equipment against gage readings at each plant. That information is logged into the Official Log when completed and furnished to the master waterplant. A Trouble Report to management communicates any discrepancies with the readings. Operations Division, Hydropower Section will be notified by e-mail when verification is complete. The e-mail notification will include findings of the verification.

5-08. 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 that agency will have the lead role for disseminating the information. For emergencies involving the George W. Andrews Project, the operator on duty should notify the Water Management Section, Operations Division, and the Walter F. George Site Manager. A coordinated effort among those offices and the District's Emergency Management Office will develop notifications for local law enforcement, government officials, and emergency management agencies. The Water Management Section should then notify the Mobile District Chief of Engineering and the Hydraulics and Hydrology Branch Chief. The District Water Management staff should also notify the SAD Water Management staff as soon as possible.

The Emergency Action Plan (EAP) for George Andrews Dam identifies the notification for rapid dissemination of emergency actions to take place prior to and/or following the failure of the George Andrews Project. Refer to the EAP for specific details.

5-09. Role of Regulating Office. The Water Management Section of the MDO is responsible for developing operating procedures for both flood and non-flood conditions. Plans are developed to most fully use the water resources potential of each project to meet the authorized purposes. Those plans are presented in water control manuals such as this one. Water control manual preparation and updating is a routine operation of the Mobile District. In addition, the Mobile District maintains information on current and anticipated conditions, precipitation, and river-stage data to provide the background necessary for best overall operation. The Mobile District arranges the communication channels to the Power Project Manager (at Walter F. George) and other necessary personnel. Instructions pertaining to reservoir regulation are issued to the Power Project Manager; however, routine instructions are normally issued directly to George W. Andrews Project Manager's office and/or the powerhouse operator on duty at Walter F. George.

5-10. Role of Power Project Manager. The Power Project Manager (at Walter F. George) should be completely familiar with the approved operating plan for the George W. Andrews Project. The Power Project Manager is responsible for implementing actions under the approved water control plan and carrying out special instructions from the Mobile District. The Power Project Manager is expected to maintain and furnish records requested from him by the Mobile District. Training sessions should be held as needed to ensure that an adequate number of personnel are informed of proper operating procedures for reservoir regulation. Unforeseen or emergency conditions at the project that require unscheduled manipulation of the reservoir should be reported to the Mobile District as soon as practicable.

VI - HYDROLOGIC FORECASTS

6-01. General. Reservoir operations are scheduled by the Mobile District in accordance with forecasts of reservoir inflow and pool stages. The NWS's River Forecast Center prepares river forecasts for the general public and for use by the Corps. In addition, the Mobile District maintains the capability to prepare forecasts for internal use only. Because the five Federally-owned reservoirs in the ACF Basin are operated as a system for conservation purposes, knowledge of total basin inflow is required.

ACF Basin inflow is computed by summing the daily local flow into the four Federal reservoirs: Lake Sidney Lanier, West Point Lake, Walter F. George Lake, and Lake Seminole. Basin inflow is not the natural flow into the ACF Basin because basin inflow incorporates influences of reservoir evaporative losses, inter-basin water transfers, and consumptive water uses, such as municipal water supply and agricultural irrigation.

Expressed as a mathematical formula, the ACF Basin Inflow = Buford Local Flow + West Point Local Flow + Walter F. George Local Flow + Jim Woodruff Local Flow

"Local Flow" = Computed Inflow – Upstream Dam Discharge (with appropriate time lag)
"Computed Inflow" = Dam Discharge + Change in Reservoir Storage

Buford Local Flow $_{i}$ = Buford Computed Inflow $_{i}$
West Point Local Flow $_{i}$ = West Point Computed Inflow $_{i}$ – Buford Discharge $_{i-3}$
Walter F. George Local Flow $_{i}$ = Walter F. George Computed Inflow $_{i}$ – West Point Discharge $_{i-2}$
Jim Woodruff Local Flow $_{i}$ = Jim Woodruff Computed Inflow $_{i}$ – Walter F. George Discharge $_{i-1}$

where i is the current daily time step.

Because the George W. Andrews Project is located immediately downstream of the Walter F. George Project, a good estimate of expected inflows can be made using the discharge from the Walter F. George Project.

Flow requirements at the lower end of the basin, below Jim Woodruff Lock and Dam, are determined by conditions in the basin. On the Chattahoochee River, the observed inflows and outflows of upstream projects provide an estimate of future flows and requirements in the Apalachicola River. The Flint River is less developed, and a continuous monitoring of river gages and rainfall is necessary to predict total flow for that river. Authorized navigation functions require knowledge of river depths (or stages) at Blountstown, Florida. During stable flow conditions, accurate forecasts permit relatively uniform releases into the Apalachicola River. In addition, rapid decreases in river stages are to be avoided to prevent stranding endangered species. That requires forecasting the recession of high-flow events.

The Corps has developed techniques to conduct forecasting in support of the regulation of the ACF Basin. In addition, the Corps has a strong reliance on other Federal agencies such as the NWS and the USGS to help maintain accurate data and forecast products to aid in making the most prudent water management decisions. The regulation of multipurpose projects requires scheduling releases and storage on the basis of both observed and forecasted hydrologic events throughout the basin. The existing conditions include current inflows to the project, current lake elevation and current releases. The forecasted future conditions include future inflows from water which is already on the ground, future operations of upstream projects, and future expected releases all of which contribute to the future expected lake elevation. Meteorological and hydrologic forecasts can influence the projected release forecasts that are adjusted based on actual observed conditions.

During both normal and below-normal runoff conditions, releases through the power plants are scheduled on the basis of water availability, to the extent reasonably possible, during peak periods to enhance revenue returned to the Federal Government. The release level and schedules are dependent on current and anticipated hydrologic events. The most efficient use of water is always a goal, especially during the course of a hydrologic cycle when below-normal streamflow is occurring. Reliable forecasts of reservoir inflow and other hydrologic events that influence streamflow are critical to efficiently regulate the ACF Basin.

a. Role of the Corps. The Water Management Section maintains real-time observation of river and weather conditions data in the Mobile District. The Mobile District has capabilities to make forecasts for several areas in the ACF Basin. Observation of real-time stream conditions guides the accuracy of the forecasts. The Corps maintains contact with the River Forecast Center to receive forecast and other data as needed. Daily operation of the ACF River Basin during normal, flood risk management, and drought conservation regulation requires accurate, continual short-range and long-range elevation, streamflow, and river-stage forecasting. These short-range inflow forecasts are used as input in computer model simulations so that project release determinations can be optimized to achieve the regulation objectives stated in this manual. The Mobile District continuously monitors the weather conditions occurring throughout the basin and the weather and hydrologic forecasts issued by the NWS. The Mobile District then develops forecasts to meet the regulation objectives of the ACF projects. The Mobile District prepares 5-week inflow and lake elevation forecasts weekly based on estimates of rainfall and historical observed data in the basin. These projections assist in maintaining system balance and providing project staff and the public lake level trends based on the current hydrology and operational goals of the period. In addition, the Mobile District provides weekly hydropower generation forecasts based on current power plant capacity, latest hydrological conditions, and system water availability.

b. Role of Other Agencies. The NWS is responsible for the preparation and public dissemination of forecasts relating to precipitation, temperatures, and other meteorological elements in the ACF Basin. The Mobile District use the NWS weather forecasts as a key source of information considered critical to its water resources management mission. The 24- and 48-hour Quantitative Precipitation Forecasts (QPFs) are invaluable in providing guidance for basin release determinations. The use of precipitation forecasts and subsequent runoff directly relates to project release decisions.

The SERFC is responsible for the supervision and coordination of streamflow and river-stage forecasting services provided by the NWS Weather Service Forecast Office in Peachtree City, Georgia, and Tallahassee, Florida. The SERFC routinely prepares and distributes 5-day streamflow and river-stage forecasts at key gaging stations along the Chattahoochee, Flint, and Apalachicola Rivers. Streamflow forecasts are available at additional forecast points during periods above normal rainfall. In addition, the SERFC provides a revised regional QPF on the basis of local expertise beyond the NWS Hydrologic Prediction Center QPF. The SERFC also provides the Mobile District with flow forecasts for selected locations on request. The SERFC prepares 7-day and longer forecasts for Bainbridge, Georgia, on the Flint River and for George W. Andrews on the Chattahoochee River and Blountstown, Florida, on the Apalachicola River. These forecasts can be compared to those prepared by the Mobile District.

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 the SERFC. Taking release decision data coupled with local inflow forecasts at forecast points along the ACF Basin, the SERFC can provide inflow forecasts into Corps projects. Having revised inflow forecasts from the SERFC, the Corps has up-to-date forecast data to make the following day's release decisions. The Mobile District monitors observed conditions and routinely adjust release decisions based on observed data.

The USGS is responsible for maintaining and operating the network of river based gages that measure stage, flow, rainfall and often other parameters essential for the operation and monitoring of the ACF River Basin. This includes the critical gages at all flood risk management locations as well as all gages located at the Federal projects on the ACF. The gage data is provided by the USGS through their website which updates each gage hourly. The Corps also retrieves USGS gage data directly from the gage DCP through the GOES system discussed in Chapter V of this manual. The Corps uses this near real-time data to make decisions on operations ranging from flood releases to daily hydropower releases during normal conditions. This data is also used by the Corps and SERFC in model calibration for forecasting flood releases and river stages.

The USGS office in Norcross, Georgia, is responsible for the maintenance of the gages located in the George W. Andrews Project area. In the event that a gage becomes inoperable, the Corps will inform the USGS office of responsibility by phone or email. The USGS will then deploy a team to perform maintenance on the gage, if they have not already done so. When any gage associated with flood risk management operations or a critical gage at a Federal storage project malfunctions, the USGS will usually send a team to perform maintenance immediately upon becoming aware of the malfunction.

6-02. Flood Condition Forecasts. During flood conditions, forecasts are made for two conditions: rainfall that has already fallen, and for potential rainfall (or expected rainfall). Decisions can be made on the basis of known events and *what if* scenarios. The Mobile District prepares forecasts and receives the official forecasts from SERFC.

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* scenarios.

b. Methods. The most important factor in determining flood conditions at George W. Andrews Lock and Dam is the discharge out of Walter F. George Lock and Dam. Because the basin that George W. Andrews serves is so small, the Walter F. George discharge is usually a good estimate of inflow to the project. The Mobile District uses various methods to relate the discharge out of Walter F. George Project to the tailwater at George W. Andrews and provide forecasts when needed. The tailwater rating curve for elevations above 102 at George W. Andrews is shown on Plate 2-8. The tailwater rating curve for elevations below 102 at George W. Andrews is shown on Plate 2-9.

For short-range flood forecasting the Water Management Section has begun utilizing the Corps Water Management System (CWMS) models developed to perform short term forecasts for the ACF Basin. The CWMS model suite includes hydrologic modeling system (HEC-HMS) and reservoir simulation (HEC-ResSim) models to determine the anticipated reservoir operations based on the QPF provided by the SERFC. It also includes the capability to estimate inundation at downstream flood damage reduction locations using HEC-RAS (River Analysis System) and the ability to estimate damages at those locations using HEC-FIA (Flood Impact Analysis).

The Corps provides a link to the NWS website so that the Mobile District, 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 ACF 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 risk management 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 Mobile District 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.

6-03. Conservation Purpose Forecasts. The George W. Andrews Project is a run-of-the-river project and has no practical conservation storage in the reservoir. Therefore, it is unnecessary to forecast for conservation purposes at this project.

6-04. Long-Range Forecasts

a. Requirements. The Corps utilizes available information from the NWS to develop long-range forecasts to aid in the operation of the system and for planning purposes. These projections can vary from a 5-week forecast to a 6-month forecast.

b. Methods. During normal conditions, the current long-range outlook produced by the Corps is a 5-week forecast. For normal operating conditions, a forecast longer than this incorporates a greater level of uncertainty and reliability. In extreme conditions, 3-month and 6-month forecasts can be produced based on observed hydrology and comparative percentage hydrology inflows into the ACF Basin. One-month and three-month outlooks for temperature and precipitation produced by the NWS Climate Prediction Center are used in long-range planning for prudent water management of the ACF reservoir projects.

6-05. Drought Forecast

a. Requirements. ER1110-2-1941, *Drought Contingency Plans*, dated 15 September 1981, called for developing drought contingency plans for Corps' reservoirs. Drought recognition and drought forecast information can be used in conjunction with the drought contingency plan, which is further discussed in Chapter VII.

b. Methods. Various products are used to detect the extent and severity of basin drought conditions. One key indicator is the U.S. Drought Monitor. The Palmer Drought Severity Index is also used as a regional drought indicator. The index is a soil moisture algorithm calibrated for relatively homogeneous regions and may lag emerging droughts by several months. The Alabama Office of State Climatologist also produces a Lawn and Garden Index which gives a basin-wide ability to determine the extent and severity of drought. The runoff forecasts developed for both short and long-range time periods reflect drought conditions when appropriate. There is also a heavy reliance on latest ENSO (El Niño/La Niña-Southern Oscillation) forecast modeling to represent the potential impacts of La Nina on drought conditions and spring inflows. Long-range models are used with greater frequency during drought conditions to forecast potential impacts to 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 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. Models using data of previous droughts or a percent of current to mean monthly flows with several operational schemes have proven helpful in planning. Other parameters are the ability of Lake George W. Andrews to meet the demands placed on its storage, the probability that Lake George W. Andrews pool elevation will return to normal seasonal levels, the conditions at other basin impoundments, basin streamflows, basin groundwater table levels, and the total available storage to meet hydropower marketing system demands.

c. Drought Analysis: Not applicable to the George W. Andrews Project due to the lack of storage in Lake George W. Andrews.

d. Reference Documents. The drought contingency plan for the George W. Andrews Project is summarized in Section 7-12 below. The complete ACF Drought Contingency Plan is provided in Exhibit D.

VII - WATER CONTROL PLAN

7-01. General Objectives. The original congressionally authorized purpose for the George W. Andrews Lock and Dam as contained in its authorizing legislation was navigation. Several other project purposes have been added at George W. Andrews through nationwide authorizing legislation. Those purposes are water quality, recreation, and fish and wildlife conservation and conservation of Federally listed threatened and endangered species and their critical habitat. The George W. Andrews spillway is operated to provide navigation depths upstream to Walter F. George Lock and Dam and to reregulate the outflow from peaking power operations at the Walter F. George powerhouse. The regulation plan seeks to meet the needs of all project purposes at the George W. Andrews Project.

7-02. Constraints. There are limiting conditions of headwater and tailwater elevations at George W. Andrews Dam and limitations on maximum head at Walter F. George Dam and Jim Woodruff Dam that could affect regulation of the George W. Andrews reservoir. Those conditions are discussed in the following paragraphs.

a. Limitation on Maximum Head at George W. Andrews Dam. The major operating constraint that must take precedent over all others is structural head limitations—the difference between the headwater and tailwater—which must not exceed 25.0 feet any time the pool is above 102 feet NGVD29. This head limitation increases to 26 feet NGVD29 any time the George W. Andrews pool is below the fixed crest spillway elevation of 102 feet NGVD29. Head limits should cause no difficulties during the recovery and stabilizing phases of normal peaking regulation, when tailwater elevations will still be fairly high from the large spillway discharges during the drawdown period. However, special attention will be required to prevent exceeding the head limitation during periods of low inflow, when the Walter F. George power plant is shut down over weekends or other extended periods.

b. Tailwater Elevations at Walter F. George Dam. The tailwater at Walter F. George Dam must not, at any time, be more than 88 feet below the headwater, so as not to exceed the project design-head limitation. In particular, the Walter F. George tailwater must not be allowed to fall below elevation 102 feet NGVD29 when the headwater is at or above the summer operating pool elevation of 190 feet NGVD29. A tailwater elevation at Walter F. George of 102 feet NGVD29 is also required to provide a controlling navigation depth of 9 feet (with normal maintenance dredging) in the upper reaches of Lake George W. Andrews. It is important that operators coordinate any drawdown of the George W. Andrews pool with releases through the Walter F. George powerhouse to prevent excessive lowering of the Walter F. George tailwater and thereby increasing the net head at Walter F. George above 88 feet and also impacting navigation between George W. Andrews and Walter F. George.

c. Maximum Drawdown and Recovery at George W. Andrews Dam. The headwater at George W. Andrews Dam will not be drawn down below elevation 96 feet NGVD29 and will not be allowed to recover above elevation 103 feet NGVD29 during reregulation of peaking power releases. The routine operations described on Exhibit C is designed to permit drawdown and recovery within those limits, but headwater elevations will be observed at frequent intervals during such operations, and gates will be adjusted the minimum amount necessary to avoid exceeding the drawdown and recovery limits.

d. Limitation on Maximum Head at Jim Woodruff Dam. A similar head limitation at the Jim Woodruff Project requires that fairly high outflows be maintained when that pool is at or above elevation 77 feet NGVD29. During periods of low inflow to the Jim Woodruff pool, that requirement results in a rather rapid drawdown and consequent reduction of the George W.

Andrews tailwater. To prevent excessive lowering of the George W. Andrews tailwater during such periods of low inflow, the Jim Woodruff pool should be filled to the highest practicable level before any extended shutdown at the Walter F. George power plant. If it is impossible to maintain the George W. Andrews tailwater at elevation 77 feet NGVD29 or higher by such means, limited operation of the Walter F. George power plant or equivalent spillway discharges may be required. Without such supporting inflows, operation of the George W. Andrews spillway to meet the head limitation will result in a temporary drawdown of the pool and below minimum navigation depths at Walter F. George. The operators at Walter F. George powerhouse must be notified when the Jim Woodruff pool is to be drawn down below elevation 77 feet NGVD29.

7-03. Overall Plan for Water Control. The George W. Andrews Project is a run-of-river project, meaning that it does not store inflows except to reregulate them over a short period. The purpose of the project is to reregulate flows downstream for navigation and to maintain a steady pool at Jim Woodruff. Because of that, the overall plan for the operation of George W. Andrews is not considered in the system operations of the other four Corps ACF Basin projects other than to maintain the pool and tailwater within acceptable limits for Walter F. George and Jim Woodruff as discussed above. The following paragraphs outline methods for regulating the pool under various conditions.

a. Operation during normal daily/weekend shutdowns of Walter F. George. During extended shutdown periods at the Walter F. George power plant, such as overnight and on weekends, the George W. Andrews pool will become nearly flat and stable at elevation 102 feet NGVD29. During such periods of shutdown, the George W. Andrews spillway gates will normally be adjusted only as required to compensate for changes in local inflow while maintaining the static-full-pool elevation.

(1) For normal daily peaking operation at the Walter F. George powerhouse, the George W. Andrews gate setting required for reregulation will be determined by the existing George W. Andrews flow conditions, the scheduled amount of generation, and the number of generating units available at Walter F. George. The gates will be opened in step increments as shown in Plates 2-5 and 2-6 at the rate of one step each six minutes. When the required setting has been attained, the gates will be held in that position, except for any necessary minor adjustments as described below, while the headwater drops to its lowest point and then recovers to the full-pool elevation.

(2) The George W. Andrews headwater will not be drawn down below elevation 96 feet NGVD29 and will not be allowed to rise above elevation 103 feet NGVD29 during operation for reregulation of peaking power releases. Changes in the prescribed gate settings might be required to prevent exceeding those limitations.

(3) After the minimum elevation has been reached and the pool begins to recover, the gates will be adjusted to allow the pool to gradually recover to about elevation 101 feet NGVD29. The pool will then be held near elevation 101 feet NGVD29 as long as generation is continuing at Walter F. George powerhouse. When generation ceases, the gates at George W. Andrews will be adjusted the minimum amount necessary to bring the pool level up to 102 feet NGVD29. After recovery to that elevation, the headwater could continue to rise for a time and should peak between elevations 102 and 103 feet NGVD29. Gates will be opened additional steps, if required, to prevent the pool elevation from exceeding 103 feet NGVD29. After the pool has peaked on recovery and drops to elevation 102.5 feet NGVD29, gates will be closed in one-step increments, in reverse order from opening, to slow the rate of fall and stabilize the pool

near elevation 102 feet NVGD. As long as pool elevation is 102.5 feet NGVD29 or greater, all gates will be opened a minimum of one-half foot.

b. Andrews Operation with No Release at Walter F. George Powerhouse. The George W. Andrews spillway will be operated to maintain navigation depths throughout the reservoir as long as such operation is consistent with the 25-foot limitation on headwater-tailwater differential. For navigation purposes, the static full pool has been established as elevation 102 feet NGVD29. During extended periods of shutdown at the Walter F. George powerhouse, the George W. Andrews spillway gates will be operated to pass the inflow and hold the pool at that elevation, with all gate settings made in accordance with the gate operating schedule, Plates 2-5 and 2-6. If the Jim Woodruff pool is below elevation 77 feet NGVD29 and the local inflow to George W. Andrews Dam is small, it might become necessary to raise the tailwater by increasing the gate openings to avoid exceeding the 25-foot head limitation. That will result in a drawdown below elevation 102 feet NGVD29 in the George W. Andrews pool. When such a drawdown is required, the power project superintendent or operator in charge at Walter F. George powerhouse will evaluate the situation and decide if emergency releases from the power plant or spillway at Walter F. George are necessary. The extent to which the George W. Andrews pool can be drawn down will depend on channel conditions, traffic on the waterway, and the expected generation schedules. The powerhouse operator will immediately notify the Mobile District when it is decided that emergency releases from Walter F. George reservoir will be required to prevent an excessive drawdown of the George W. Andrews pool.

c. Andrews Operation to Re-regulate Power Releases from Walter F. George Powerhouse. When the Walter F. George powerhouse is used for peaking generation, the George W. Andrews reservoir will follow Exhibit C. The gates will be operated in accordance with the instructions, and in the order of gate openings shown in Plates 2-5 and 2-6. When generation is scheduled with a shutdown period of four hours or longer during the day, each generation period will be treated as a separate operation. The gates will then be adjusted at the rate of four gate steps each 20 minutes until the desired gate setting is achieved. When the required gate setting has been achieved, the gates will be left in that position as the George W. Andrews headwater drops to its lowest elevation and then begins recovery, except that gates will be closed the minimum amount necessary to prevent a drawdown below elevation 96 feet NGVD29 if such drawdown appears likely to occur. When the George W. Andrews pool begins to rise above the maximum drawdown, the gates will remain in the last drawdown setting until the pool recovers to between elevations 100.0 and 101.0 feet NGVD29. The gates will then be adjusted in accordance with instructions in Plates 2-5 and 2-6 to hold the pool near elevation 101.0 feet NGVD29 until generation is scheduled to cease at Walter F. George. The gates will then be operated to raise the pool level to elevation 102.0 feet NGVD29. During and after recovery, the spillway gates at George W. Andrews will be operated to prevent the pool level from exceeding elevation 103.0 feet NGVD29 by checking the pool as often as necessary.

7-04. Standing Instructions to Damtender. Exhibit C contains general instructions for operation of the George W. Andrews reservoir. The instructions when used in conjunction with the gate operating schedule shown on Plates 2-5 and 2-6 should be sufficient for practically any conditions encountered. They will be followed at all times unless the Mobile District issues special instructions.

If sustained failure of communications occurs between Walter F. George and George W. Andrews, personnel at George W. Andrews will operate the spillway gates, and the Mobile District will be notified for further operating instructions. If such contact is also impossible, the operators will maintain the pool at elevation 102.0 feet NGVD29 until communication is reestablished. If flood flow should occur during a communications failure, the spillway gates will be operated in accordance with instructions in Case III of Exhibit C. All changes in gate setting will be made in one-step increments, or less, in the order shown on the gate operating schedule, Plates 2-5 and 2-6.

7-05. Flood Risk Management. When the inflow to the full Walter F. George pool increases to 25,000 cfs or more, the power plant will be operated continuously, and when the inflow exceeds full plant capacity (about 30,000 cfs), the power releases will be supplemented by spillway discharges. Under those conditions, the George W. Andrews spillway will be operated to pass the inflow, with the headwater not exceeding elevation 102 feet NGVD29, until all gates are opened clear. The discharge with pool elevation 102 feet NGVD29 and all gates open will be approximately 43,600 cfs, and the tailwater elevation will be about 100 feet NGVD29 feet. For flows greater than 43,600 cfs, the pool elevation will rise with increase in flow. The gates will remain in the full-open position until the headwater crests and then recedes to elevation 102.5 feet NGVD29, after which the gates will be operated to slow the rate of fall and stabilize the pool at elevation 102 feet NGVD29 until peaking operations are resumed at the powerhouse. Headwater and tailwater rating curves for headwater elevations above 103 NGVD29 and tailwater elevations above 102 NGVD29 are shown in Plate 2-8. The tailwater rating curve for elevations below 102 NGVD29 are shown on plate 2-9.

Operation during flood conditions or continuous generation at Walter F. George Powerhouse. During periods of continuous generation at Walter F. George powerhouse, the George W. Andrews pool will be maintained between elevations 100.0 and 101.0 feet NGVD29 until generation has been cancelled. The pool level will then be raised to elevation 102.0 feet NGVD29 as quickly as practicable. When flood flows at George W. Andrews exceeds the gated spillway capacity at normal operating levels, the spillway gates will remain fully open as the pool level rises with increasing inflow. After the pool level has peaked, the gates will remain fully open until the pool level recedes to an elevation about one-half foot above the operating level (102.0 feet NGVD29 if not generating at Walter F. George, 100.0 to 101.0 feet NGVD29 if generating continuously). The gates will then be adjusted as rapidly as necessary to maintain the pool level as near that operating level as practicable.

7-06. Recreation. Most recreational activities at Lake George W. Andrews occur during the summer months. Because George W. Andrews operates to maintain a generally stable pool, access to recreational areas such as swimming beaches and boat ramps are generally not limited. Other recreational opportunities at George W. Andrews are hiking trails, picnic areas, a fishing deck, and camping.

The resource manager will be responsible for contacting various lakeshore interests and keeping the public informed of lake conditions during drawdown periods. The resource manager will close beaches and boat ramps as necessary, patrol the lake, mark hazards, and perform other necessary tasks to mitigate the effects of low lake levels.

7-07. Water Quality. Water control regulation of the ACF projects is not performed to meet specific water quality standards. However, specific minimum releases and other incidental releases are made that provide benefits to water quality in the basin and support the USACE goal of supporting and sustaining water quality. Mobile District operates a water quality monitor in the headwaters above the George W. Andrews Dam, which measures dissolved oxygen, temperature, pH, and conductivity. The data collected from the monitoring system can be used to evaluate any future water quality management plan.

7-08. Fish and Wildlife. Operations for fish and wildlife do not supersede the normal operating procedures of maintaining the pool within the top of conservation.

Game fish in Lake George W. Andrews include largemouth bass, white bass, hybrids, crappie, channel catfish and bream. Alabama and Georgia have a reciprocal agreement concerning fishing licenses, with each State accepting the use of a current license from either state on the lake. The Corps and the Georgia Department of Natural Resources have maintained a series of fish attractors in Georgia waters for better fishing.

7-09. Water Supply. No major users of water are at the George W. Andrews pool. The City of Columbia, Alabama, has a wastewater return on the George W. Andrews pool.

Two major industries withdraw water for plant process purposes and discharge wastewater back into the Chattahoochee River just downstream of the George W. Andrews Dam (headwaters of Lake Seminole). The Georgia Pacific Corporation Plant is on the Chattahoochee River near Cedar Springs, in Early County, Georgia, below the George W. Andrews Dam. The plant uses six pumps with an intake elevation of 72.67 feet NGVD29. Pumping capacity is reduced at pool elevations below 75 feet NGVD29. The GAEPD permit specifies a daily maximum withdrawal of 144 million gallons per day (mgd), with a monthly average of 115 mgd. The wastewater discharge from this plant is approximately 72 mgd. The Farley Nuclear Power Plant is on the west bank of the Chattahoochee River near Columbia, Houston County, Alabama, below George W. Andrews Dam. The Alabama Department of Environmental Management permit specifies a withdrawal of 105.36 mgd for the Farley Plant. The plant becomes severely affected when the pool elevation at Lake Seminole drops below elevation 75.0 feet NGVD29. Southern Nuclear defines a flow 2,000 cfs and an elevation 74.5 feet NGVD29 as minimum conditions for long-term operation of the Farley Plant. The Farley Plant can and has historically operated for short periods with flows below 2,000 cfs. Extended operation of flows lower than 2,000 cfs and a river elevation below 74.5 feet NGVD29 would require evaluation to determine the potential environmental and operations impacts.

7-10. Hydroelectric Power. No hydroelectric power facilities are at George W. Andrews Lock and Dam.

7-11. Navigation. No storage is provided in the George W. Andrews pool for navigation; however, because navigation is one of the purposes of the project, it is discussed in detail in Paragraph 7-03, *Overall Plan for Water Control*, earlier in this chapter.

7-12. Drought Contingency Plans. No storage is provided in the George W. Andrews pool for regulating releases during periods of low inflow. The regulation plan will tend to smooth out peaking releases from the Walter F. George powerhouse and give a lower George W. Andrews outflow of somewhat longer duration than would occur with constant-pool operation. During extended periods of powerhouse shutdown or low-capacity generation, the George W. Andrews spillway will be operated to pass the inflow, with pool held constant at elevation 102 feet NGVD29. Any regulating releases from upstream projects will thus be expedited through the George W. Andrews pool.

7-13. Flood Emergency Action Plans. The Corps is responsible for developing Flood Emergency Action Plans for the ACF System, in accordance with ER 1110-2-1156, *Engineering and Design Safety of Dams – Policy and Procedures*, 31 March 2014. The George W. Andrews Project Emergency Action Plan, undated, is a stand-alone document maintained in hard copy in the MDO and on site in the lock control station, in Eufaula, Alabama, and electronic copies are maintained on the site Local Area Network. Example data available in the Emergency Action Plan are dam incident assessment, emergency contact information, flood inundation information, management responsibilities and response, and procedures for use of the plan.

7-14. Other. Other considerations, in addition to the authorized project purposes, may be accommodated on an as needed basis. Adjustments are made to system regulation at times for downstream construction, to aid in rescue or recovery from drowning accidents, environmental studies, or cultural resource investigations.

a. Operation for Passing Drift. Occasional operation of the spillway gates will be required for passing accumulations of drift. Instructions and limitations for that type of operation are described in the *Operation and Maintenance Manual* for the George W. Andrews Project. Because the permissible gate openings increase with tailwater elevations, such an operation will usually be performed during the reregulation of peaking power releases. Such manipulation of gates within the prescribed limits should not materially affect the drawdown or recovery operation.

b. Correlation with Other Projects. The correlation of operations at the George W. Andrews and Walter F. George Projects has been described in Paragraph 7-03, "Overall Plan for Water Control". Operation of the George W. Andrews spillway will also be correlated with the operation of Jim Woodruff reservoir to the extent that the latter affects tailwater elevations at George W. Andrews Dam during periods of low inflow. The George W. Andrews spillway must always be operated in such manner that the difference between headwater and tailwater elevations does not exceed 25 feet when the George W. Andrews pool elevation is above 102 feet NGVD29 and 26 feet when it is below 102 feet NGVD29. Because that condition is most likely to occur with a low tailwater elevation, the operators at Walter F. George will always be notified when the Jim Woodruff pool is to be drawn down below elevation 77.

c. High Water Action Plan. During periods of high inflow when the pool is expected to exceed its top of conservation, certain actions are taken by the project staff to prepare areas around the project for rising pool levels and to ensure public safety. In the event abnormally high releases (usually exceeding Walter F. George turbine capacity) are forecast to be made from the project, the project staff will also notify the downstream interests of potential flooding as a result of operations at the dam. Critical elevations and releases are discussed in detail in the High Water Action Plan provided in Exhibit E.

7-15. Deviation from Normal Regulation. Water management inherently involves adapting to unforeseen conditions. The development of water control criteria for the management of water resource systems is carried out throughout all phases of a water control project. The water control criteria are based on sound engineering practice utilizing the latest approved models and techniques for all foreseeable conditions. There may be further refinements or enhancements of the water control procedures, in order to account for changed conditions resulting from unforeseen conditions, new requirements, additional data, or changed social or economic goals. However, it is necessary to define the water control plan in precise terms at a particular time in order to assure carrying out the intended functional commitments in accordance with the authorizing documents (EM 1110-2-3600 Management of Water Control Systems). Adverse impacts of the water control plan may occur due to unforeseen conditions. When this occurs, actions will be taken within applicable authority, policies, and coordination to address these conditions when they occur through the implementation of temporary deviations to the water control plan, such as interim operation plans. Such deviations may require additional environmental compliance prior to implementation.

The Corps is occasionally requested to deviate from the water control plan. Prior approval for a deviation is required from the Division Commander except as noted in subparagraph a. deviation requests usually fall into the following categories:

a. Emergencies. Examples of some emergencies that can be expected to occur at a project are drowning and other accidents, failure of the operation facilities, chemical spills, treatment plant failures, and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. The Mobile District will notify the division office as soon as practicable.

b. Unplanned Deviations. Unplanned instances can create a temporary need for deviations from the normal regulation plan. Unplanned deviations may be classified as either major or minor but do not fall into the category of emergency deviations. Construction accounts for many of the minor deviations and typical examples include utility stream crossings, bridge work, and major construction contracts. Minor deviations can also be necessary to carry out maintenance and inspection of facilities. The possibility of the need for a major deviation mostly occurs during extreme flood events. Requests for changes in release rates generally involve periods ranging from a few hours to a few days, with each request being analyzed on its own merits. In evaluating the proposed deviation, consideration must be given to impacts on project and system purposes, upstream watershed conditions, potential flood threat, project condition, and alternative measures that can be taken. Approval for unplanned deviations, either major or minor, will be obtained from the division office by telephone or electronic mail prior to implementation.

c. Planned Deviations. Each condition should be analyzed on its merits. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the district recommendation, will be presented by letter or electronic mail to the division for review and approval.

7-16. Rate of Release Change. There are no restrictions on releases from George W. Andrews during normal operations. There are restrictions on the rate of change below Jim Woodruff that could require releases from George W. Andrews. During high flows, it is desirable to uniformly lower discharge downstream as allowable by conditions and equipment to lessen the impacts of the erosive nature of high flows.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. George W. Andrews Lock and Dam was authorized as part of the general plan for the full development of the ACF River Basin by the Rivers and Harbors Acts of 1945 and 1946, in accordance with the general plan presented in House Document No. 300, 80th Congress, First Session. The George W. Andrews Project is operated to provide benefits for authorized purposes including navigation, water quality, recreation, and fish and wildlife conservation.

The impacts of the *ACF Master Water Control Manual* and its Appendices, including this water control plan have been fully evaluated in an Environmental Impact Statement (EIS) that was published on (date). A Record of Decision (ROD) for the action was signed on (date). 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 was coordinated with Federal and state agencies, environmental organizations, Indian 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. George W. Andrews Lock and Dam does not contain reservoir flood risk management storage; therefore, the project has no flood risk management capabilities.

a. Spillway Design Flood. Spillway Design Flood (SDF) is the criteria used by the Corps to design the spillway on a dam to prevent its overtopping due to the occurrence of an extremely rare flood event. The basis of the SDF is the Probable Maximum Precipitation (PMP) centered and oriented in a manner that produces maximum runoff. This flood is also often referred to as the Probable Maximum Flood (PMF). The SDF for George A. Andrews is the transposed March 1929 storm based on the observed rainfall, selected centering and orientation, and adjusted runoff volume to provide a flood that was considered to be of Probable Maximum Flood magnitude. Due to the close proximity to Walter F. George, George A. Andrews and Walter F George both have the same storm with the same centering and orientation for their SDF. The SDF cannot be assigned a frequency of occurrence and was not used in any frequency analysis. The George W. Andrews Dam Spillway Design Flood is shown on Plate 8-1. The storm had an average storm depth of 15.7 inches with 12.9 inches of runoff volume over the 8,210 square mile basin. The duration of the SDF is approximately 10 days with a peak inflow of 630,600 cfs and peak outflow of 630,000 cfs. Lake levels rise about 11 feet per day and peak at 135.5 feet NGVD29. Effects of the reservoir regulation of the SDF are depicted on Plate 8-1 and summarized in Table 8-1. Updated guidance requires the PMP be developed using Hydrometerological Report (HMR) 51 and 52 and that the SDF be routed with an antecedent pool elevation at the top of the flood risk management pool or by routing the Standard Project Flood five days before the SDF. The SDF is currently being reevaluated using this guidance and any changes to the SDF will be incorporated into the water control manual when available.

b. The Standard Project Flood. The Standard Project Flood (SPF) is a theoretical flood, based on rainfall criteria, that would be reasonably possible and has been used in hydrologic analyses of reservoirs and river reaches. The SPF cannot be assigned a frequency of occurrence and was not used in any discharge-frequency analysis. The SPF is shown in Plate 8-2. The SPF would cause a peak pool elevation of 130.2 feet NGVD29 and a maximum discharge of 291,800 cfs. Peak inflow is 293,100 cfs. Effects of the reservoir regulation of the standard project flood are depicted in Plate 8-2 and summarized in Table 8-1.

Table 8-1. Flood Events

Flood Event	Reservoir Inflow (cfs)	Reservoir Outflow (cfs)	Peak Pool Elevation (ft. NGVD29)
Spillway Design	630,600	630,000	135.5
Standard Project	293,100	291,800	130.2

c. Historic Floods. Significant floods since 1938 that produced average daily flows of 100,000 cfs at the George W. Andrews damsite are listed in Table 8-2.

Table 8-2. Significant floods at George W. Andrews Lock and Dam Damsite

Daily flow (cfs)	Date		Daily flow (cfs)	Date
195,000	8 July 1994		108,025	6 March 1971
191,000	20 March 1990		108,000	11 April 1964
138,000	10 March 1998		107,000	28 November 1992
129,000	28 January 1978		103,000	2 March 1961
115,248	3 December 1948		102,000	7 March 1966
112,000	25 March 1943		100,679	15 January 1972

8-03. Recreation. The George W. Andrews Project is an important recreational resource, providing both economic and social benefits for the region and the nation. The project contains 1,540 acres of water at normal pool elevation of 102.0 feet, plus an additional 1,195 acres of land, most of which is available for public use. A wide variety of opportunities are provided at the lake's 7 parks and 2 campgrounds (OMBIL 2016) including boating, fishing, camping, picnicking, water skiing, hiking, and sightseeing. Mobile District park rangers and other project personnel conduct numerous environmental and historical education tours and presentations, as well as water safety instructional sessions each year for the benefit of area students and project visitors. The George W. Andrews Project received more than 221,000 recreational visitors during 2012. The local and regional economic benefits of recreation at George W. Andrews are significant. Annual recreational visitor spending within 30 miles of the project totals more than $8.4 million.

8-04. Water Quality. The Corps operates George W. Andrews Project for the objective of water quality. The George W. Andrews Project operates as a run-of-the-river project, in which inflows to the project are continuously released downstream. The continuous releases provide a benefit for maintaining downstream water quality. Lake George W. Andrews is supporting its designated water quality use for fishing for all parameters except dissolved oxygen, according to GAEPD.

8-05. Fish and Wildlife. The relatively stable pool of Lake George W. Andrews is beneficial to a variety of fish and wildlife species. Stable pool levels in the spring help to prevent stranding of fish eggs in shallow water and to reduce the inundation of wildlife nests established around the shoreline of the project.

8-06. Water Supply. No M&I water supply withdrawals are made from the George W. Andrews Project, nor are water releases made for downstream M&I water supply purposes. The George W. Andrews Project reregulates the power waves from Walter F. George Project to some extent and provides a more uniform flow for existing M&I water supply users downstream of the project.

8-07. Hydroelectric Power. George W. Andrews Lock and Dam has no hydropower units.

8-08. Navigation. The George W. Andrews Lock and Dam Project provides a 9-foot navigation channel and a single-lift lock with chamber dimensions of 82 feet by 450 feet. The project passes inflows from the upstream reservoir projects to serve the authorized navigation purpose of the ACF System. Table 8-3 contains calendar years 2005-2013 lock usage from the Corps' Lock Performance Monitoring System regarding navigation activity through George W. Andrews Lock and Dam. The Lock Performance Monitoring System data contain the number of lockages of commercial and non-commercial vessels and tonnages of various commodities passing through the lock.

Table 8-3. Navigation Activity at George W. Andrews Lock and Dam

Lockages/vessels (number)	CY2013	CY2012	CY2011	CY2010	CY2009	CY2008	CY2007	CY2006	CY2005
Barges Empty	0	0	0	0	0	0	0	0	5
Barges Loaded	0	0	1	0	0	1	0	0	5
Commercial Lockages	0	0	2	0	0	2	0	0	5
Commercial Vessels	0	0	8	1	16	8	1	2	6
Non-Commercial Lockages	8	8	10	29	21	14	9	7	14
Non-Commercial Vessels	8	8	10	29	21	14	9	7	14
Recreational Lockages	117	143	173	239	194	158	183	255	371
Recreational Vessels	261	383	427	533	446	307	420	392	604
Total Lockages	125	151	183	268	215	174	192	262	390
Total Vessels	271	391	437	562	483	329	430	401	624
Commodities (tons)	0	0	0	0	0	0	0	0	0
Crude Material Except Fuels	0	0	0	0	0	0	0	0	0
Equipment and Machinery	0	0	0	0	0	50	0	0	1,315
Total, All Commodities	0	0	0	0	0	50	0	0	1,315

Coordination with the previous waterway users in the ACF Basin identified the need for changes in the Corps' water control operations to provide a more reliable flow regime, without dredging, to support at least a 7.0-foot navigation channel in the Apalachicola River. Based upon Apalachicola River navigation channel surveys, a flow of 16,200 cfs at the Blountstown gage, about 20 miles below Jim Woodruff Lock and Dam, is required to provide for a 7.0-foot channel. This flow requirement assumes no maintenance dredging is performed in the navigation channel. Through an iterative hydrologic modeling process, it was determined that a 5-month navigation season, January thru May of each year, could be provided that would improve navigation reliability without significantly affecting other project purposes. The 5-month navigation season recommended for implementation on the ACF Waterway can, in the absence of maintenance dredging, improve the total reliability of a 7.0-foot navigation channel in the Apalachicola River from 21 percent to as much as 42 percent. For a 7.0-foot channel that is at least 90 percent reliable for any single navigation season, the total reliability over the period of record would improve from the present 36 percent to 54 percent during the navigation season.

8-09. 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 system might not be able to fully support all project purposes. Several drought periods have occurred since construction of George W. Andrews Dam in 1963. 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 1980s, and most of the time period between late1998 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 West Point Dam and conservation efforts strengthen the ability to supply water supply needs.

For the George W. Andrews Project, the Corps will coordinate water management during a drought with other Federal agencies, private power companies, navigation interests, the states, and other interested state and local parties as necessary. Drought operations will be in compliance with the plan for the entire ACF Basin.

8-10. Flood Emergency Action Plans. Normally, all flood risk management operations are directed by the MDO. If, however, a storm of flood-producing magnitude occurs and all communications are disrupted between the district office and project personnel at the George W. Andrews Project or the Walter F. George powerhouse, emergency operating procedures, as described in Exhibit C, Standing Instructions to Damtenders for Water Control, will begin. If communication is broken after some instructions have been received from the district office, those instructions will be followed for as long as they are applicable.

Flood emergency operations at George W. Andrews Dam are the responsibility of the Walter F. George Site Manager and the powerhouse operators at the Walter F. George Project. It is their responsibility to follow the Emergency Action Plan for the George W. Andrews Project. The plans are intended to serve only as temporary guidance for operating a project in an emergency until Mobile District staff can assess the results of real-time hydrologic model runs and issue more detailed instructions to project personnel. The benefits of Flood Emergency Action Plans are to minimize uncertainties in how to operate a project in a flood emergency, to facilitate quick action to mitigate the adverse effects of a flood event, and to provide for emergency action exercises to train operating personnel on how to respond in an actual emergency flood situation.

Since the George W. Andrews Project is not a flood risk management project, no major water management actions occur related to flood risk management.

8-11. Frequencies

a. Peak Inflow Probability. The annual peak inflow frequency curve for Lake George W. Andrews, based on peak annual calculated project inflows from 1975 - 2013, is shown on Figure 8-1.

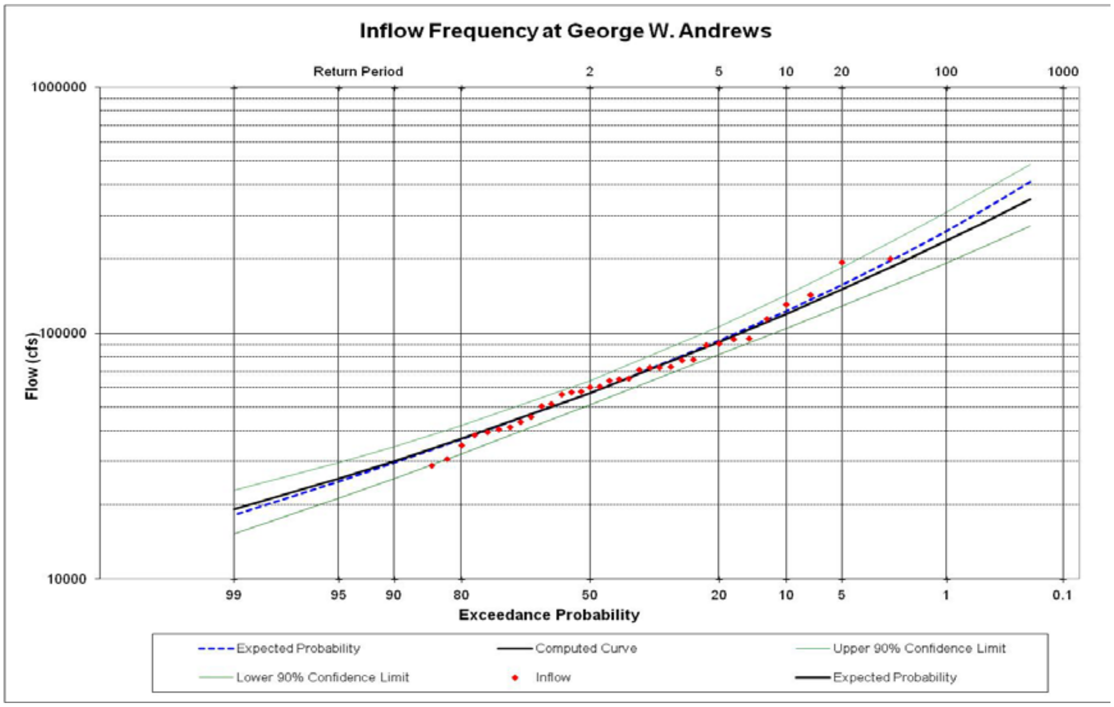


Figure 8-1. George W. Andrews Annual Peak Inflow Frequency Based on Observed Data (1975-2013)

b. Pool Elevation Duration and Frequency. The Water Control Plan for the ACF Basin has only a small influence on the pool levels at Lake George W Andrews. The lake operates near elevation 102 feet NGVD29 except during high inflow events when the pool rises uncontrolled. Figure 8-2 shows the annual pool elevation duration. Two lines are presented: they are the model results from the previous water control plan and the updated water control plan presented in this manual. The almost identical lines illustrate the limited effect that the water control plan has on pool elevations.

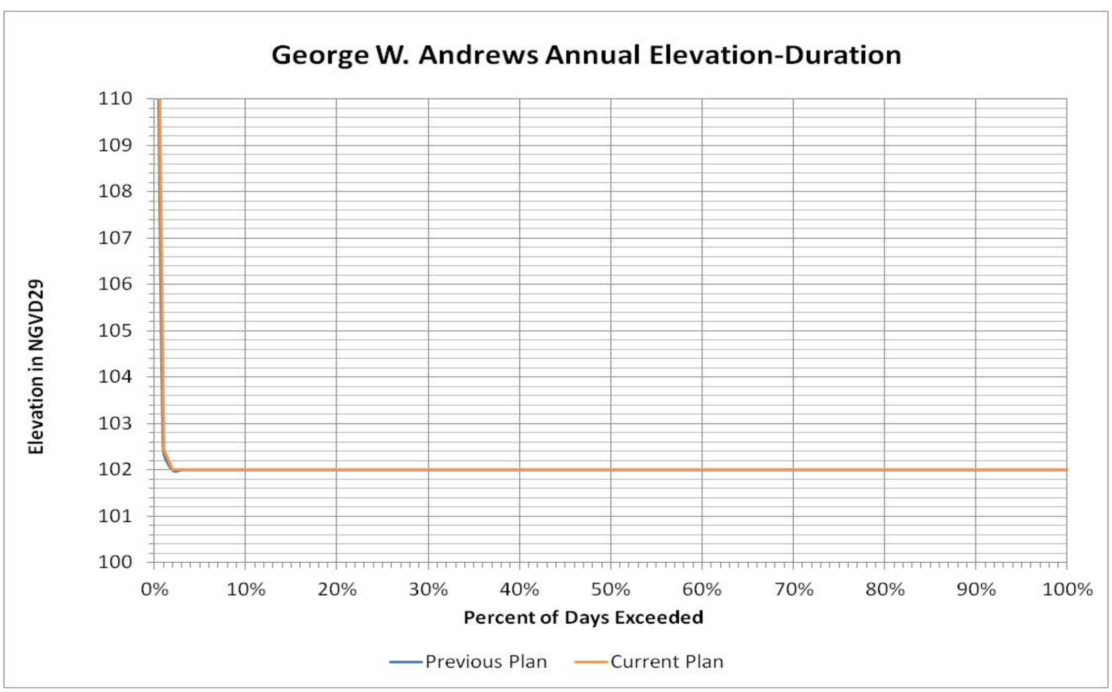


Figure 8-2. George W. Andrews Annual Pool Duration Based on Modeled Data (1939-2011)

8-12. Other Studies - Examples of Regulation. The daily river flow at the George W. Andrews Dam is plotted on Plates 4-4 through 4-17. An examination of the information presented reveals the daily and seasonal variability associated with “run-of-the-river”-type projects like George W. Andrews.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization. Responsibilities for developing and monitoring water resources and the environment at the George W. Andrews Lock and Dam Project are shared by many Federal and state agencies including 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. Interested state agencies include GAEPD, Georgia Wildlife Resources Division, Alabama Department of Environmental Management (ADEM), Alabama Office of Water Resources (OWR), Northwest Florida Water Management District, Florida Department of Environmental Protection, and Florida Fish and Wildlife Conservation Commission.

a. U.S. Army Corps of Engineers. Authority for water control regulation of the George W. Andrews Lock and Dam Project has been delegated to the SAD Commander. The responsibility for day-to-day water control regulation activities has been entrusted to the Mobile District Water Management Section. Water control actions for George W. Andrews are regulated to meet its Federally authorized project purposes in coordination with other authorized projects in the ACF Basin. It is Mobile District's responsibility to develop water control regulation procedures for the George W. Andrews Project. Water Management monitors the project for compliance with the approved water control plan. In accordance with the water control plan, Mobile District performs water control regulation activities that include: determining project water releases, declaring water availability for authorized purposes daily, projecting daily and weekly reservoir pool levels and releases, preparing weekly river basin status reports, tracking and projecting basin composite conservation storage, determining and monitoring daily and 7-day basin inflow, managing high-flow regulation and coordinating internally within the Mobile District and externally with basin stakeholders. The project may be tended by lock operators located at the dam; however, the project is normally operated remotely by the powerhouse operator located at Walter F. George. Both the powerhouse operator at Walter F. George and the lock operator at George A. Andrews are under the direct supervision of the Walter F. George Operations Project Manager in Eufaula, Alabama and the Site Manager in Fort Gaines, Georgia. When necessary, Water Management communicates directly with and instructs the lock operator at George A. Andrews or the powerhouse operator at Walter F. George regarding normal water control regulation procedures, as well as abnormal or emergency situations, such as floods. In the event of an abnormal or emergency situation it is also the responsibility of Water Management to inform the Operations Project Manager and the Site Manager of any abnormal operation that has been provided to the lock operator at George A. Andrews or the powerhouse operator at Walter F. George. The Mobile District is responsible for collecting historical project data, such as lake levels, flow forecasts and weekly basin reports with other Federal, state, and local agencies; and the general public. The Mobile District website where this data is provided at: http://www.sam.usace.army.mil/.

b. Other Federal Agencies

1) National Weather Service (NWS). The NWS is the Federal agency in NOAA that is responsible for weather warnings and weather forecasts. With support from the Corps-NWS Cooperative Gaging Program, the NWS forecast offices, along with the Southeast River Forecast Center (SERFC), maintain a network of rainfall and flood reporting stations throughout the ACF Basin. NWS continuously provides current weather conditions and forecasts. The SERFC prepares river forecasts for many locations throughout the ACF Basin and provides the official flood stage forecasts along the ACF Rivers. Often, the SERFC prepares predictions on the basis of *what if scenarios*, such as Quantitative Precipitation Forecasts (QPFs). The QPF is

a prediction of the spatial precipitation across the United States and the region. The Corps, NWS, and SERFC share information regarding rainfall, project data, and streamflow forecasts. In addition, the NWS provides information on hurricane forecasts and other severe weather conditions. They monitor drought conditions and provide the information to the public. The National Integrated Drought Information System is available for the ACF Basin at website www.drought.gov. This website provides a single source of information regarding drought conditions by sharing information gathered from the NOAA Climate Prediction Center, the Corps, state agencies, universities, and other pertinent sources of data through the drought portal.

2) U.S. Geological Survey (USGS). The USGS is a 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 Corps USGS Cooperative Gaging program, the USGS maintains a comprehensive network of gages in the ACF Basin. The USGS Water Science Centers in Alabama, Florida, and Georgia publish real-time reservoir levels, river and tributary stages, and flow data through the USGS National Weather Information Service Web site. The Mobile District uses the USGS to operate and maintain project water level gaging stations at each Federal reservoir to ensure the accuracy of the reported water levels.

3) 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 their 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 & Wildlife Coordination Act. The Corps, Mobile District, with support from the Water Management Section, coordinates water control actions and management with USFWS in accordance with both laws.

Other Federal agencies work closely with the Corps to provide their agency support for the project purposes of George W. Andrews Lock and Dam 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.

c. State 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 Environment Management (ADEM) 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.

iii. The Alabama Department of Conservation and Natural Resources has responsibility for both freshwater and saltwater fisheries in the state.

2) Georgia. The Department of Natural Resources (GADNR) has statewide responsibilities for the management and conservation of Georgia's natural and cultural resources. Within GADNR, the 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 prepare recommended Water Development and Conservation Plans. Those regional plans promote the sustainable use of Georgia's waters through the selection of 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. Georgia Wildlife Resources Division protects non-game and endangered wildlife in the state.

3) Florida. The Northwest Florida Water Management District stretches from the St. Marks River Basin in Jefferson County to the Perdido River in Escambia County. The district is one of five water management districts in Florida created by the Water Resources Act of 1972. In the district's 11,305-square-mile area are several major hydrologic (or drainage) basins: Perdido River and Bay System, Pensacola Bay System (Escambia, Blackwater, and Yellow rivers), Choctawhatchee River and Bay System, St. Andrew Bay System, Apalachicola River and Bay System, and St. Marks River Basin (Wakulla River). The district is a cooperating agency with the Corps and USGS for operating and maintaining the Apalachicola River at Chattahoochee, Florida stream gage downstream of the Jim Woodruff Project.

i. The Florida Department of Environmental Protection has the primary role of regulating public water systems in Florida.

ii. The Florida Fish and Wildlife Conservation Commission has responsibility for both freshwater and saltwater fisheries in the state.

d. Stakeholders. Many non-Federal stakeholder interest groups are active in the ACF 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 these interest groups, state and Federal agencies, and others is accomplished as required on an ad-hoc basis and on regularly scheduled water management teleconferences that occur during unusual flood or drought conditions to share information regarding water control regulation actions and gather stakeholder feedback. The Master Manual includes a list of state and Federal agencies and active stakeholders in the ACF Basin that have participated in the ACF Basin water management teleconferences and meetings.

9-02. Interagency Coordination

Local Press and Corps Bulletins. The local press includes any periodic publications in or near the George W. Andrews Watershed and the ACF Basin. Dothan, Alabama, and Albany, Georgia, have some of the larger daily newspapers which often publish articles related to the rivers and streams in the vicinity of the project. Their representatives have direct contact with the Corps through the Public Affairs Office. The Corps and the Mobile District publish e-newsletters regularly which are made available to the general public via email and postings on various web sites. 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.

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 George W. Andrews Project and other ACF 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 evaluation of reservoir regulations and systems to ensure their most efficient use. Within the constraints of congressional authorizations and engineer 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 SAD can be implemented to provide the most efficient regulation while balancing the multiple purposes of the ACF Basin-wide System.

9.04. Non-Federal Hydropower. The Federal Power Act allows for the development of non-Federal hydropower at Federal projects subject to the granting of a license by the Federal Energy Regulatory Commission (FERC). In the past, several private entities have shown an interest in developing hydropower at the George W. Andrews Project by preparing studies, designs, and FERC license applications. However, to date, FERC has not granted a license for non-Federal hydropower development at George W. Andrews.

9-05. Reports. There are various monthly charts, short-term hydrologic reports, emergency regulation reports, graphical and tabular summaries, flood situation reports and other quarterly, seasonal, or annual reports that are developed and used in the management of the water resources in the ACF Basin. Many of these reports are available on the Mobile District's water management website at http://water.sam.usace.army.mil/. Examples of reports and data used by water management personnel are shown in Table 9-1 below:

Table 9-1. Reports and Data Used in Water Management

Today's Project Data	Lake Elevation and Five Week Forecast
Hourly Stage, Chattahoochee and Flint Rivers	Average Daily Inflow to Lakes by Month
ACF Basin 7-Day Average Inflow	ACF Basin Conservation Storage Chart
Historic Project Data	Record Levels for Rivers and Lakes
Mobile District River Bulletin	Hydropower Generation Schedule
After Action Flood Reports	District River System Status
Annual Flood Damage Reduction Report	

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

GENERAL

Damsite, miles above mouth of Chattahoochee River	46.5
Drainage area above damsite – square miles	8,210
Drainage area between damsite and Walter F. George Dam – square miles	750

RESERVOIR

Length – river miles	28.3
Minimum operating pool elevation, feet NGVD29	96.0
Normal operating pool elevation, feet, NGVD29	102.0
Maximum operating pool elevation, feet NGVD29	103.0
Peak flood for standard project flood, feet, NGVD29	130.2
Peak pool for spillway design flood, feet, NGVD29	135.5
Area at static full pool (elev. 102) – acres	1,540
Total volume at static full pool – acre-feet	18,180
Shore line length at static full pool – miles	65

STREAM FLOW AT DAMSITE

Average annual flow, (May 1938 – Sep 2013) – cfs	10,767
Minimum mean daily, 30 Jan 1989 (May 1938 – Sep 2013) – cfs	498
Maximum mean daily, 8 July 1994 (May 1938 – Sep 2013) – cfs	195,000
Maximum known, 18 Mar 1929 – cfs	203,000
Bankfull (approx.) for downstream reach – cfs	40,000
Minimum mean monthly flow, Oct 1954 – cfs	1,376
Maximum mean monthly flow, Mar 1990 (1938 – 2009) – cfs	45,879
Maximum known mean monthly flow, Mar 1929 – cfs	99,600
Standard project flood peak inflow – cfs	293,100
Spillway design flood peak inflow – cfs	630,000

TAILWATER ELEVATIONS (feet above NGVD29)

Highest observed elevation at site (18 Mar 1929, peak flow – 203,000 cfs)	125.8
Selected spillway discharges:	
Capacity at headwater elevation 102 (43,600 cfs)	100.7
Bankfull capacity for downstream reach (40,000 cfs, approx.)	99.7
Capacity at headwater elevation 96 (30,800 cfs)	94.5
Full Walter F. George power operation, best gate, no reregulation (25,000 cfs, approx.)	92.5
Peaking operation Walter F. George power plant:	
Reregulated peak discharge, 20,000 cfs	87.9
Reregulated peak discharge 15,000 cfs	84.8
Reregulated peak discharge 10,000 cfs	81.8
Minimum tailwater (zero discharge)	76.0

DAM AND SPILLWAY

Total length – feet	620
Fixed-crest length – feet	340
Fixed-crest elevation – feet, NGVD29	102.0
Gated length – feet	280
Gated crest elevation – feet, NGVD29	82
Gated net length – feet	240
Number of piers	5
Width of piers – feet	8
Service bridge elevation – feet, NGVD29	142
Type of gates	Tainter
Size of gates – feet	60 x 21
Top of gate elevation (closed) – feet, NGVD29	103
Number of gates	4
Capacity of gated spillway at pool elevation 102 – cfs	43,600
Capacity of gates spillway at pool elevation 96 – cfs	30,800
Apron Elevation	Varies
Apron length below gated section – feet	34

LOCK

Static full upper pool elevation – feet, NGVD29	102
Normal lower pool elevation – feet, NGVD29	77
Maximum lift – feet	25
Chamber width – feet	82
Nominal chamber length – feet	450
Distance between pintles – feet	505
Elevation of top of lock walls – feet, NGVD29	115
Elevation top of upper sill – feet, NGVD29	83
Elevation of top of lower sill – feet, NGVD29	63
Elevation of floor – feet, NGVD29	60
Type of gates	Miter
Height of lower gate – feet	51
Height of upper gate – feet	32
Types of valves	Tainter
Culvert size – feet	10 x 10
Freeboard when lock becomes inoperative – feet	1
Percent of time inoperative	58

1

EXHIBIT B

UNIT CONVERSIONS
AND
VERTICAL DATUM CONVERSION INFORMATION

AREA CONVERSION

UNIT	m²	km²	ha	in²	ft²	yd²	mi²	ac
1 m²	1	10^{-6}	10^{-4}	1550	10.76	1.196	3.86×10^{-7}	2.47×10^{-4}
1 km²	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 in²	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 ft²	0.0929	9.29×10^{-8}	9.29×10^{-6}	144	1	0.111	3.59×10^{-8}	2.3×10^{-5}
1 yd²	0.8361	8.36×10^{-7}	8.36×10^{-5}	1296	9	1	3.23×10^{-7}	2.07×10^{-4}
1 mi²	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	0.0001	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	m³/s	m³/day	l/s	ft³/s	ft³/day	ac-ft/day	gal/min	gal/day	mgd
m³/s	1	86,400	1000	35.31	3.05×10^{6}	70.05	1.58×10^{4}	2.28×10^{7}	22.824
m³/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}
ft³/s	0.0283	2446.6	28.32	1	8.64×10^{4}	1.984	448.8	6.46×10^{5}	0.646
ft³/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	m³	in³	ft³	gal	ac-ft	million gal
liters	1	0.001	61.02	0.0353	0.264	8.1×10^{-7}	2.64×10^{-7}
m³	1000	1	61,023	35.31	264.17	8.1×10^{-4}	2.64×10^{-4}
in³	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}
ft³	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 cfs for one year.

VERTICAL DATUM CONVERSION INFORMATION

George A. Andrews Coordinate Comparisions

Mobile District Survey No. 09-027

Note: All State Plane Coordinates are in the North American Datum of 1983 (NAD83), Georgia West Zone, U.S. Survey Foot

Designation	OPUS Results						from NGS Data Sheets			PICES	USGS	USCOE	Desc.
	Northing	Easting	NAVD 88 Elev.				Northing	Easting	NAVD 88 Elev.	NGVD 29 Elev.	NGVD 29 Elev.	NGVD 29 Elev.	
12-1G	459267.366	2002396.215	166.755										SBD COE
12-1H	457887.362	2003024.780	162.434										SBD COE
12-503	458957.885	2000837.327	114.649										FAD COE
GWA LL C15	458827.534	2002055.888	114.793									114.990	FBC
GWA UL	459407.477	2001813.454	114.767									114.920	FBC
GWA UR			114.640									114.870	FBC
GWA LR			114.590									114.920	FBC
PL-10			176.620							176.834			FCM COE
Gage Information													
Upper Pool			102.3								102.5	102.5	Normal Elev.
Lower Pool			77.3								77.5	77.5	Normal Elev.
NGS Control Information													
34 10				477094.428	2002352.690	200.737	477094.538	2002352.695					FCM AIDOT
G 395				445316.659	1987776.950	213.064			212.962				FCM USCGS
Nobles Az Mk				443553.589	1962945.962	304.524	443553.703	1962945.966	304.274				FCM USCGS

Legend

SBD COE= Set Brass Disc, US Army Corps of Engineers
SBC = Set Brass Cap, GCT LB3501
FBDWD = Found War Department Brass Disc
FBC = Found Brass Cap, Deformation Monitoring Station
FAD COE = Found Aluminum Disc, US Army Corps of Engineers
FBD COE = Found Brass Disc, US Army Corps of Engineers
FCM COE = Found Concrete Monument, US Army Corps of Engineers
FCM USCGS = Found Concrete Monument, United States Coast & Geodetic Survey
FSR USCGS = Found Stainless Steel Rod, United States Coast & Geodetic Survey
FCM Jack = Found Concrete Monument, Jackson County, FL

Geomap Technologies, Inc. / GCT, Inc. *11/24/2009*

SURVEY DATASHEET (Version 1.0)

PID: BBBL67
Designation: 12-1G
Stamping: 12-1G 2009
Stability: Monument will probably hold position well
Setting: Mat foundation or concrete slab other than pavement
Description: 12-1G, Begin at U.S. Post Office, Columbia, AL; go easterly along Hwy. No.52 Â±1.3 miles to Lower River Rd. on right; thence southerly along said road Â±1.4 miles to Andrews Dam Lane on right; thence go westerly along said Lane Â±0.6 miles to paved road to parking area on left; thence proceed southerly then easterly to restroom structure. Station is standard COE disc set in SE corner of concrete base of Deformation Pillar D-1 located Â±30' sw of sw corner of restroom.
Observed: 2009-09-16T15:28:00Z
Source: OPUS - page5 0909.08

Close-up View

REF_FRAME: NAD_83 (CORS96)	EPOCH: 2002.0000	SOURCE: NAVD88 (Computed using GEOID03)	UNITS: m	SET PROFILE	DETAILS

LAT:	31° 15' 33.69587"	± 0.015	m
LON:	-85° 6' 29.49538"	± 0.015	m
ELL HT:	23.487	± 0.049	m
X:	465355.043	± 0.019	m
Y:	-5437267.580	± 0.046	m
Z:	3290520.527	± 0.024	m
ORTHO HT:	50.827	± 0.065	m

	UTM 16	**SPC** 1002(GA W)
NORTHING:	3459889.579m	139984.973m
EASTING:	680127.912m	610331.587m
CONVERGENCE:	0.98194761°	-0.48860287°
POINT SCALE:	1.00000022	0.99999914
COMBINED FACTOR:	0.99999653	0.99999545

CONTRIBUTED BY

wwalker
GCT, Inc.

Horizon View

The numerical values for this position solution have satisfied the quality control criteria of the National Geodetic Survey. The contributor has verified that the information submitted is accurate and complete.

George W. Andrews Lock and Dam

EXHIBIT C

STANDING INSTRUCTIONS TO THE DAMTENDERS FOR WATER CONTROL

GEORGE W. ANDREWS LOCK AND DAM

GENERAL INSTRUCTIONS FOR OPERATION OF GATED SPILLWAY

(See Plates 2-5 and 2-6)

CASE I – NO RELEASE AT WALTER F. GEORGE:

A. ANDREWS TAILWATER ABOVE 77.5. The Andrews locktender will open or close gates as necessary to maintain the upper pool as near elevation 102.5 as practicable. However, whenever the pool is above 102.5 the minimum gate opening will be step 4.

B. ANDREWS TAILWATER BELOW 77.5. When the Andrews tailwater is lower than elevation 77.5 the locktender will raise or lower gates to maintain a difference between pool and tailwater of 25 feet when the Andrews pool elevation is above 102 feet NGVD29. This maximum difference increases to 26 feet when the Andrews pool is below 102 feet NGVD29. The locktender will notify the power project operator at Walter F. George that a head-water difference operation has begun.

C. MINIMUM GATE STEP. In either case above the minimum gate opening will be step 1 (one gate at .5 foot opening).

CASE II – WITH PEAKING OPERATIONS AT WALTER F. GEORGE POWERHOUSE:

A. INITIAL OPENINGS. There will be no pre-drawdown of the Andrews pool level. The locktender will begin opening spillway gates at the same time that generation starts at Walter F. George Powerhouse. At the time that generation begins, the Andrews locktender will open gates to gate step 4 (all gates open .5 feet). After the initial opening, the locktender will open spillway gates 4 gate steps every 20 minutes until the target gate step in paragraph II-B. below is reached.

B. TARGET OPENINGS. The initial target opening will depend upon the maximum number of turbines which will be releasing water during scheduled generation at W.F. George.

1 unit	2 units	3 units	4 units
Step 8	step 16	step 20	step 24

C. MINIMUM GATE POOL. The opening sequence in II-A and II-B above should lower the Andrews pool down from 102 to between 101 to 99.0 before the arrival of flow from W. F. George. However, in no case should the pool be lowered below 96.0 without first consulting the Mobile District.

D. GATE ADJUSTMENTS DURING INFLOW. As the inflow from W. F. George begins to raise the Andrews pool, additional gates will be opened (or closed) as necessary to maintain the pool between 100, and 101. In general, the gates should be opened or closed no more than 2 steps every 20 minutes.

E. GATE ADJUSTMENTS AFTER W.F. GEORGE SHUTDOWN. At the end of the George generation schedule, the gates at Andrews will be gradually closed at a rate not exceeding closing two gate steps every 20 minutes above gate step 24 and not exceeding four gate steps every 20 minutes below step 24. Gates will be closed to allow the pool to rise to an elevation between 102 and 103. However, whenever the pool is above 102.5, the minimum gate opening will be step 4 (4 gates open .5 feet).

F. UNUSUAL CONDITIONS. (Opening gates) Gates may be opened more rapidly than described in paragraphs II-A, II-B, and II-D to prevent the pool rising above elevation 103. (Closing gates) The locktender may close gates more rapidly than two steps every 20 minutes in the case of downstream emergencies or in the case of unexpected or unforeseen shutdown of Walter F. George generation. In any such case the gates will be closed no more than to the minimum gate step for the current pool elevation at Andrews as discussed in both Case I and Case II of this exhibit.

CASE III – FLOOD CONDITIONS AND/OR CONTINUOUS GENERATION AT WALTER F. GEORGE POWERHOUSE:

During periods of continuous generation at Walter F. George powerhouse, the George W. Andrews pool will be maintained between elevations 100.0 and 101.0 feet NGVD29 until generation has been cancelled. The pool level will then be raised to elevation 102.0 feet NGVD29 as quickly as practicable. When flood flows at George W. Andrews exceeds the spillway capacity at normal operating levels, the spillway gates will remain fully open as the pool level rises with increasing inflow. After the pool level has peaked, the gates will remain fully open until the pool level recedes to an elevation about one-half foot above the operating level (102.0 feet NGVD29 if not generating at Walter F. George, 100.0 to 101.0 feet NGVD29 if generating continuously). The gates will then be adjusted as rapidly as necessary to maintain the pool level as near that operating level as practicable. At a discharge of greater than about 40,000 cfs, maintaining the pool within these elevations will not be possible and there is no restriction on the rate of opening or closing gates under flood conditions.

CASE IV – EMERGENCIES:

In the case of vessel groundings, spills, or other emergencies, the locktender will contact the Water Management Section for specific guidance.

EXHIBIT D

DROUGHT CONTINGENCY PLAN

(See Master Manual for draft DCP. Will be added to each appendix before final printing)

EXHIBIT E

HIGH WATER ACTION PLAN

GEORGE W. ANDREWS
PLAN FOR HIGH WATER LEVELS
April 2013

1. **Purpose:** This plan identifies actions necessary to help ensure the public's safe access to the resources and recreational facilities located at George W. Andrews, during periods of high water.

2. **Recreation Facilities:** Seven public recreation areas surround the reservoir, including four leased areas, one small campgrounds, and five public boat launching ramps. Four of these recreation areas are Corps operated. There are less than 50 privately-owned boat docks on the reservoir.

3. **Significant Reservoir Levels:** Water levels considered to adversely affect recreational use of. Lake George W. Andrews, are as follows:

   a. WFG Tail Race Pool Elevation -115 ft., NGVD29
   b. WFG Tail Race Pool Elevation -118 ft., NGVD29
   c. WFG Tail Race Pool Elevation >118 ft., NGVD29

4. Potential adverse effects to swimming areas, campgrounds, marinas, boat launching ramps, navigation, and private boat docks, with actions to be taken at each of these pool elevations follow:

   a. <u>Pool Elevation 115 ft. NGVD29</u>

Recreational impacts caused by high river levels become significant at or near this level. Actions to be taken primarily involve cautioning the public about potential hazards and preparation for worsening conditions.

Conditions	Actions
1. Fishing areas and ramps impacted by rising water levels	1. Notify lessees of water level forecast, in coordination with Water Management Officials in District Office. Issue news releases as appropriate.
2. Unmarked navigation hazards such as logs, damaged docks, etc. may be dislodged into the waters.	2. Continue to monitor project area. Mark hazards as necessary.
3. Franklin Landing is unusable at this elevation. Fish decks and safe access begin to be impacted.	3. Monitor conditions at all boat ramps. Close ramps and post closure notices as appropriate. Close Franklin Landing and monitor fishing areas for closure due to safe access concerns. Expand distribution for news releases beyond local area. Stress available recreation activities and access points, along with the need for caution, in releases.

b. <u>Pool Elevation 118 ft. NGVD29</u>

Adverse affects to recreation and public safety increase at this level, and actions are to be taken to identify hazards and inform the public of potentially dangerous conditions.

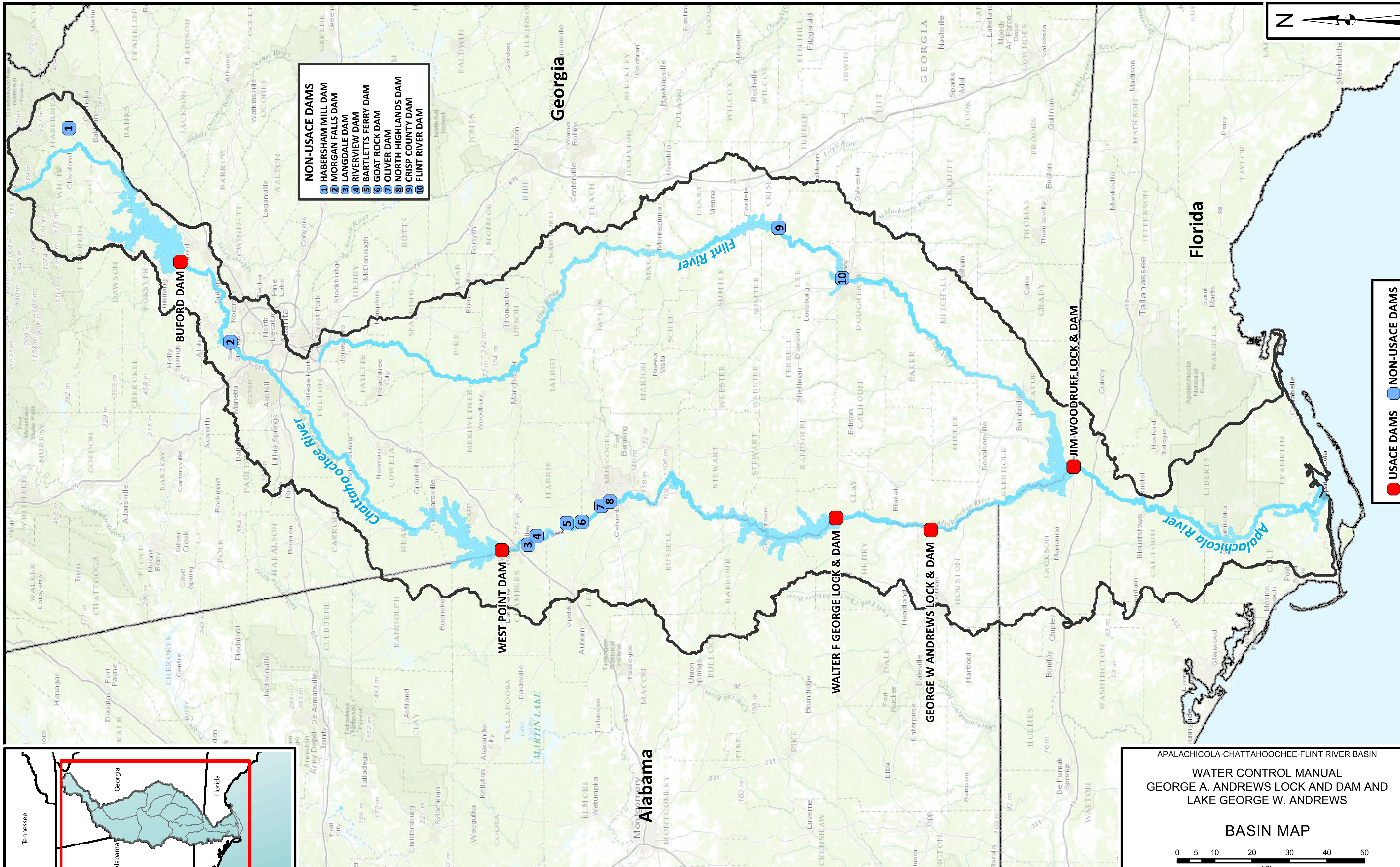
Conditions	Actions
1. Fishing decks and platforms areas affected. Waters deeper and currents strong.	1. Continue to monitor areas for hazards and advise visitors to use caution. Close all fishing areas as current increases and levels rise.
2. Unmarked navigation hazards such as logs, damaged docks, etc. may be dislodged into the waters.	2. Continue to monitor project area. Mark hazards as necessary.
3. Some boat ramps may need to be closed due to water levels.	3. Monitor conditions at all boat ramps. Close ramps and post closure notices as appropriate. Abbie Creek and East Bank ramps closed at this elevation. Expand distribution for news releases beyond local area. Stress available recreation activities and access points, along with the need for caution, in releases. Notify local EMAs and leasees to monitor leased areas.

c. <u>Pool Elevation >118 ft. NGVD29</u>

Conditions worsen at this elevation, severely restricting boat ramp use, camping, and water-related recreation activities. Access to the river may be limited.

Conditions	Actions
1. More fishing areas may be affected. Waters may be deeper and currents may be strong.	1. Continue to monitor areas for hazards and advise visitors to use caution.
2. Unmarked navigation hazards such as logs, damaged docks, etc. may be dislodged into the waters.	2. Continue to monitor project area. Mark hazards as necessary.
3. All Corps operated boat ramps closed due to water levels. Leased area impacted and should be closed.	3. Monitor conditions at all boat ramps. Close ramps and post closure notices as appropriate. Expand distribution for news releases beyond local area. Advise local EMAs and leasees.

PLATES



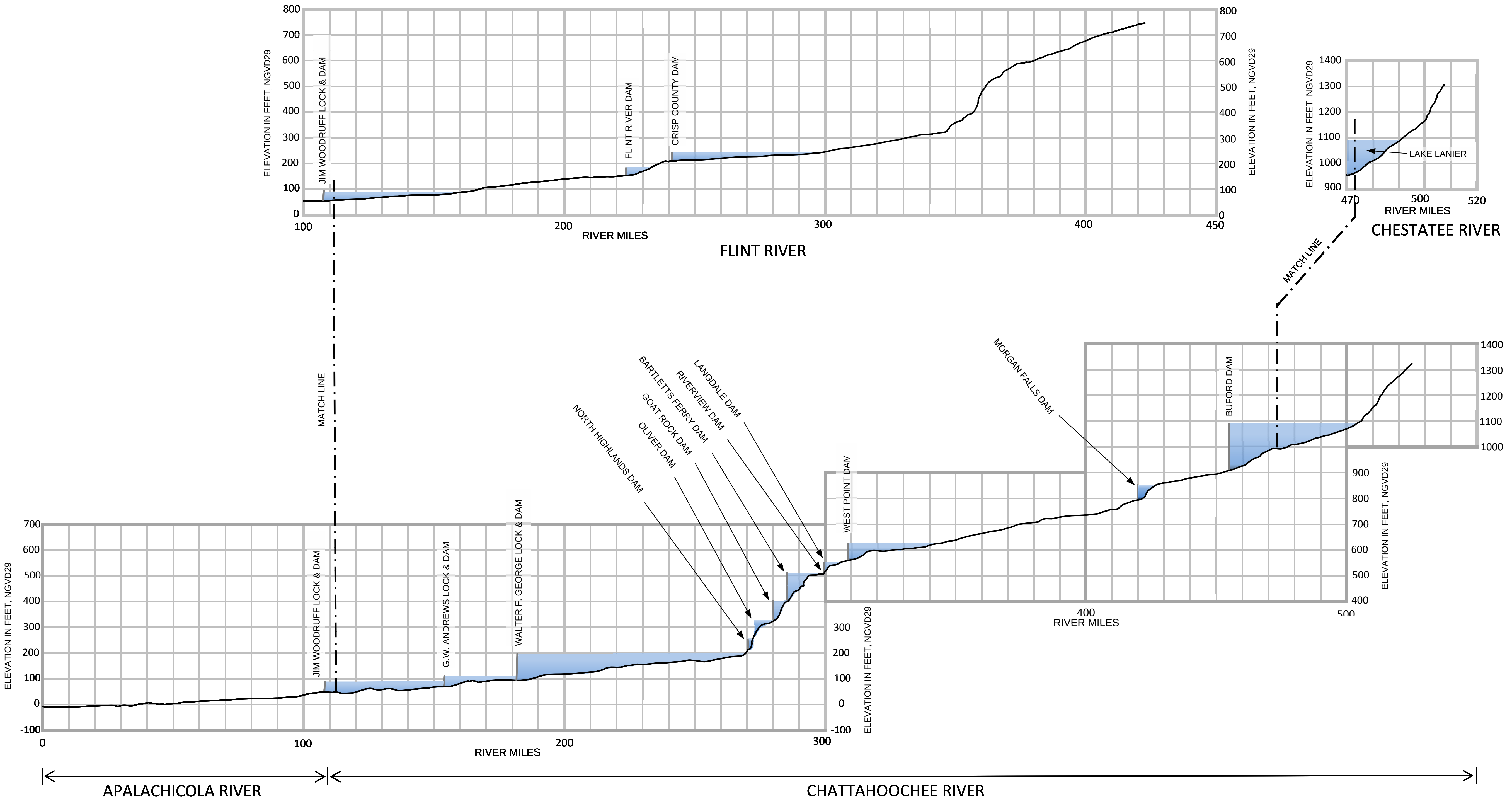
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

BASIN MAP

0 5 10 20 30 40 50
Miles

R004_28JULY10_BASIN_MAP_11X17.mxd



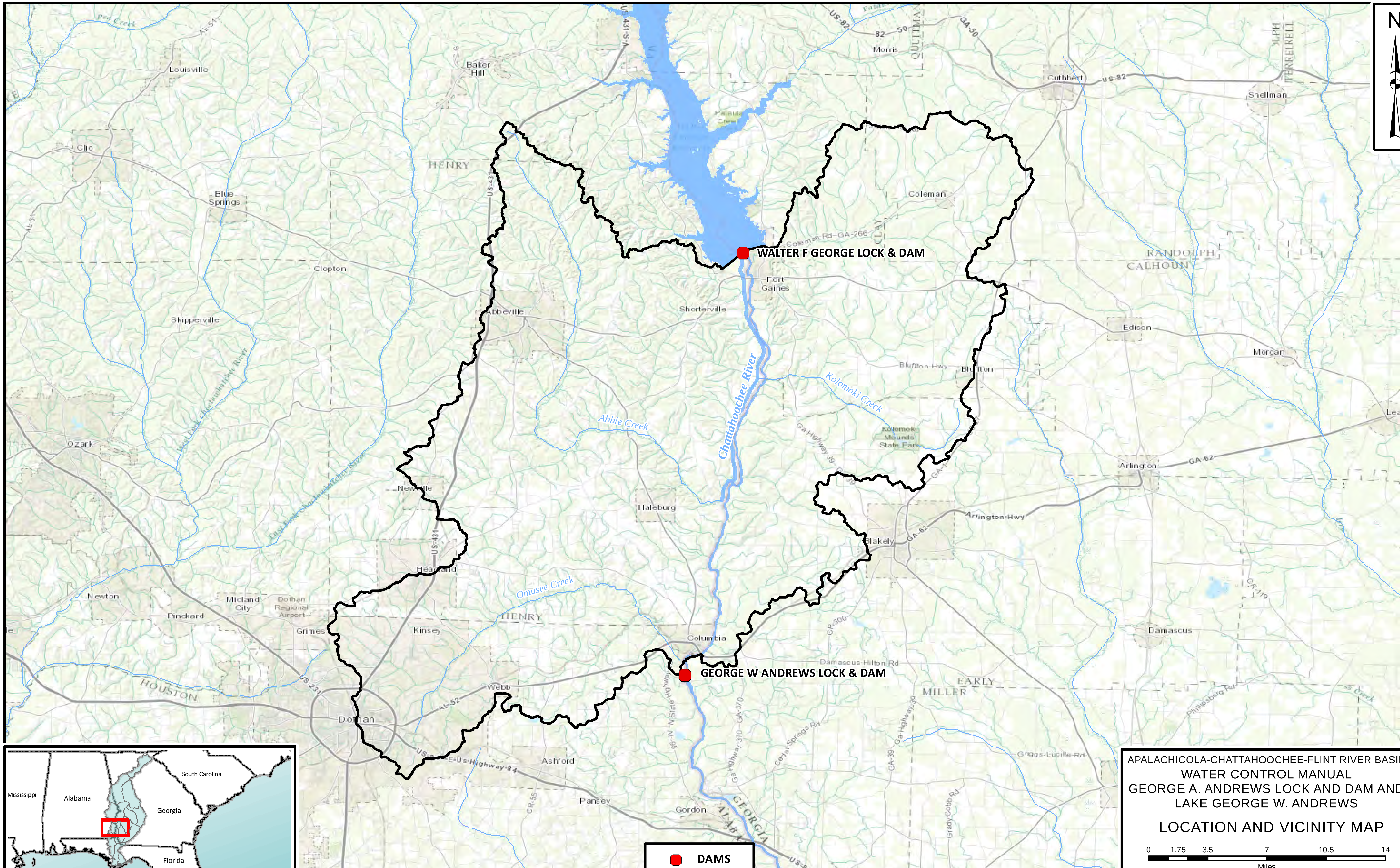
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL

GEORGE W. ANDRES LOCK AND DAM AND LAKE

GEORGE AW. ANDREWS

RIVER PROVILE AND RESERVOIR DEVELOPMENT

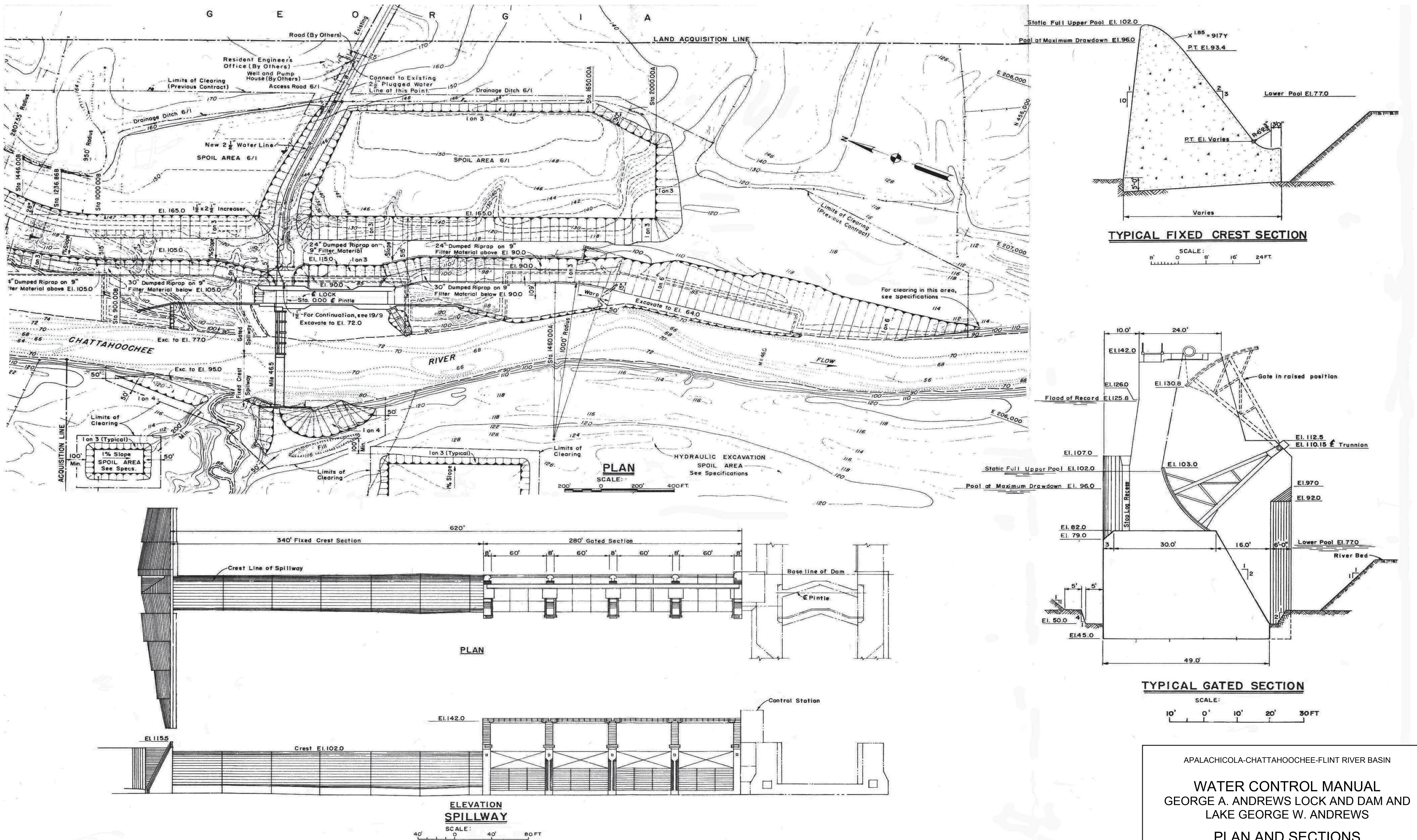


APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN
WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

LOCATION AND VICINITY MAP

0 1.75 3.5 7 10.5 14
Miles

R004_28JULY10_RAINGAUGE_11X17.mxd



APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

PLAN AND SECTIONS

STEP NUMBER	GATE OPENING IN FEET				SPILLWAY DISCHARGE IN CFS														
	GATE NUMBER				POOL ELEVATION														
	1	2	3	4	103	102.5	102	101.5	101	100.5	100	99.5	99	98.5	98	97.5	97	96.5	96
0	0	0	0	0	1,025*	340*	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0.5	1,865	1,170	820	810	795	785	770	760	745	730	715	700	680	660	640
2	0.5	0	0	0.5	2,705	2,000	1,640	1,620	1,590	1,570	1,540	1,520	1,490	1,460	1,430	1,400	1,360	1,320	1.28
3	0.5	0.5	0	0.5	3,545	2,830	2,460	2,430	2,385	2,355	2,310	2,280	2,235	2,190	2,145	2,100	2,040	1,980	1,920
4	0.5	0.5	0.5	0.5	4,385	3,660	3,280	3,240	3,180	3,140	3,080	3,040	2,980	2,920	2,860	2,800	2,720	2,640	2,560
5	0.5	0.5	0.5	1	5,215	4,480	4,090	4,035	3,970	3,915	3,845	3,790	3,715	3,640	3,565	3,485	3,385	3,285	3,185
6	1	0.5	0.5	1	6,045	5,300	4,900	4,835	4,760	4,695	4,610	4,540	4,455	4,365	4,270	4,170	4,055	3,935	3,810
7	1	1	0.5	1	6,875	6,120	5,710	5,630	5,550	5,470	5,375	5,290	5,190	5,085	4,975	4,855	4,720	4,580	4,435
8	1	1	1	1	7,705	6,940	6,520	6,430	6,340	6,250	6,140	6,040	5,930	5,810	5,680	5,540	5,390	5,230	5,060
9	1	1	1	1.5	8,525	7,750	7,320	7,220	7,115	7,010	6,890	6,775	6,650	6,515	6,375	6,215	6,050	5,870	5,675
10	1.5	1	1	1.5	9,350	8,565	8,120	8,010	7,895	7,775	7,640	7,515	7,375	7,225	7,070	6,890	6,710	6,510	6,290
11	1.5	1.5	1	1.5	10,170	9,375	8,920	8,800	8,670	8,535	8,390	8,250	8,095	7,930	7,765	7,565	7,370	7,150	6,905
12	1.5	1.5	1.5	1.5	10,995	10,190	9,720	9,590	9,450	9,300	9,140	8,990	8,820	8,640	8,460	8,240	8,030	7,790	7,520
13	1.5	1.5	1.5	2	11,800	10,980	10,505	10,360	10,210	10,050	9,880	9,715	9,530	9,335	9,140	8,905	8,675	8,415	8,125
14	2	1.5	1.5	2	12,605	11,775	11,290	11,130	10,970	10,800	10,620	10,440	10,240	10,030	9,820	9,575	9,325	9,045	8,730
15	2	2	1.5	2	13,410	12,565	12,075	11,900	11,730	11,550	11,360	11,165	10,950	10,725	10,500	10,240	9,970	9,670	9,335
16	2	2	2	2	14,215	13,360	12,860	12,670	12,490	12,300	12,100	11,890	11,660	11,420	11,180	10,910	10,620	10,300	9,940
16 ½	2	2	2	2.5	15,015	14,145	13,630	13,430	13,235	13,030	12,820	12,590	12,355	12,100	11,840	11,560	11,250	10,910	10,525
17	2	2	2	3	15,815	14,935	14,405	14,190	13,980	13,765	13,540	13,295	13,045	12,775	12,505	12,205	11,880	11,520	11,110
17 ½	2.5	2	2	3	16,615	15,725	15,175	14,950	14,725	14,500	14,260	14,000	13,740	13,450	13,170	12,850	12,510	12,130	11,695
18	3	2	2	3	17,420	16,515	15,950	15,710	15,475	15,230	14,980	14,710	14,430	14,130	13,830	13,500	13,140	12,740	12,280
18 ½	3	2.5	2	3	18,220	17,300	16,720	16,470	16,220	15,960	15,700	15,420	15,120	14,810	14,490	14,150	13,770	13,350	12,865
19	3	3	2	3	19,020	18,090	17,495	17,230	16,965	16,695	16,420	16,125	15,815	15,485	15,155	14,795	14,400	13,960	13,450
19 ½	3	3	2.5	3	19,825	18,880	18,265	17,990	17,710	17,425	17,140	16,830	16,510	16,160	15,820	15,440	15,030	14,570	14,035
20	3	3	3	3	20,625	19,670	19,040	18,750	18,460	18,160	17,860	17,540	17,200	16,840	16,480	16,090	15,660	15,180	14,620
20 ½	3	3	3	3.5	21,195	20,315	19,790	19,485	19,180	18,875	18,560	18,225	17,870	17,495	17,120	16,710	16,260	15,760	15,180
21	3	3	3	4	21,765	20,960	20,540	20,220	19,900	19,590	19,260	18,910	18,540	18,150	17,760	17,330	16,860	16,340	15,740
21 ½	3.5	3	3	4	22,280	21,430	21,000	20,660	20,360	20,095	19,855	19,555	19,210	18,810	18,400	17,950	17,460	16,920	16,300
22	4	3	3	4	22,800	21,900	21,450	21,100	20,820	20,600	20,450	20,200	19,880	19,460	19,040	18,570	18,060	17,500	16,860
22 ½	4	3.5	3	4	23,265	22,520	22,075	21,735	21,435	21,225	21,025	20,750	20,440	20,055	19,680	19,190	18,660	18,080	17,420
23	4	4	3	4	23,730	23,140	22,700	22,370	22,050	21,850	21,600	21,300	21,000	20,650	20,320	19,810	19,260	18,660	17,980
23 ½	4	4	3.5	4	24,140	23,630	23,250	22,935	22,650	22,445	22,200	21,925	21,645	21,310	20,960	20,430	19,860	19,240	18,540
24	4	4	4	4	24,550	24,120	23,800	23,500	23,250	23,040	22,800	22,550	22,290	21,970	21,600	21,050	20,460	19,820	19,100
24 ½	4	4	4	5	25,350	24,885	24,500	24,160	23,875	23,620	23,375	23,135	22,895	22,725	22,300	21,855	21,355	20,785	20,140
25	4	4	4	6	26,150	25,650	25,200	24,820	24,500	24,200	23,950	23,720	23,500	23,480	23,000	22,660	22,250	21,750	21,180

NOTES:
1. Gates will be opened in order shown except as provided in (2) and (3) below, and will close in reverse order.
2. Half-steps will be used only as required for the last setting in the drawdown operation (e.g. an operation requiring 18 ½ steps will proceed from step 16 to 17 to 18 to 18 ½).
3. When finer adjustments of outflow are required, any opening smaller than the indicated step or half-step may be used on the gate last operated.
4. These spillway discharges are based on results of model tests published in July 1961.
5. * Discharge over fixed-crest only.

APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND LAKE GEORGE W. ANDREWS

GATED SPILLWAY RATING
PAGE 1 OF 2 PAGES

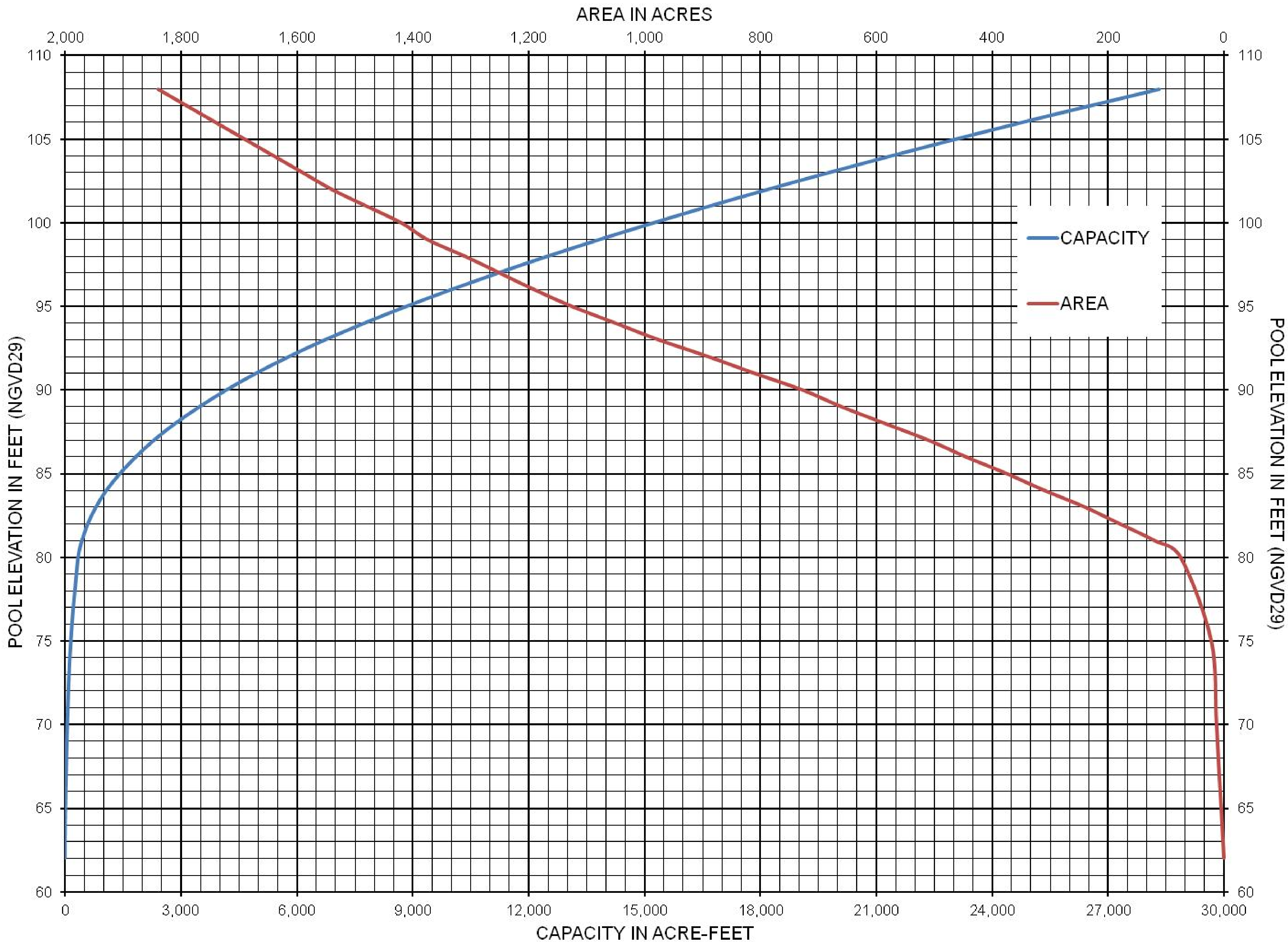
STEP NUMBER	GATE OPENING IN FEET				SPILLWAY DISCHARGE IN CFS														
	GATE NUMBER				POOL ELEVATION														
	1	2	3	4	103	102.5	102	101.5	101	100.5	100	99.5	99	98.5	98	97.5	97	96.5	96
25 ½	5	4	4	6	26,950*	26,425*	26,000	25,670	25,355	25,060	24,775	24,485	24,200	24,015	23,600	23,260	22,885	22,475	21,805
26	6	4	4	6	27,750	27,200	26,800	26,520	26,210	25,920	25,600	25,250	24,900	24,550	24,200	23,860	23,520	23,200	22,450
26 ½	6	5	4	6	28,375	27,775	27,350	27,095	26,805	26,550	26,225	25,835	25,405	24,975	24,550	24,180	23,835	23,535	23,050
27	6	6	4	6	29,000	28,310	27,900	27,670	27,400	27,180	26,850	26,420	25,910	25,400	24,900	24,500	24,150	23,870	23,650
27 ½	6	6	5	6	29,525	28,795	28,400	28,165	27,910	27,650	27,275	26,800	26,255	25,710	25,200	24,800	24,465	24,200	24,000
28	6	6	6	6	30,050	29,280	28,900	28,660	28,420	28,120	27,700	27,180	26,600	26,020	25,500	25,100	24,780	24,530	24,350
28 ½	6	6	6	7	30,775	29,950	29,575	29,335	29,060	28,705	28,225	27,625	27,050	26,510	26,000	25,625	25,265	24,965	24,700
29	6	6	6	8	31,500	30,620	30,250	30,010	29,700	29,290	28,750	28,070	27,500	27,000	26,550	26,150	25,750	25,400	25,050
29 ½	7	6	6	8	32,150	31,260	30,850	30,555	30,230	29,780	29,200	28,500	27,925	27,425	26,975	26,600	26,220	25,875	25,525
30	8	6	6	8	32,800	31,900	31,450	31,110	30,760	30,270	29,650	28,930	28,350	27,850	27,400	27,045	26,690	26,350	26,000
31	8	8	6	8	34,000	33,250	32,600	32,150	31,680	31,120	30,450	29,730	29,120	28,600	28,150	27,700	27,350	26,950	26,600
32	8	8	8	8	35,000	34,250	33,600	33,060	32,500	31,850	31,150	30,400	29,800	29,270	28,800	28,340	27,920	27,530	27,150
33	8	8	8	10	36,000	35,350	34,700	34,000	33,300	32,600	31,900	31,270	30,700	30,180	29,700	29,250	28,800	28,400	28,000
34	10	8	8	10	36,850	36,320	35,700	34,950	34,200	33,400	32,600	31,880	31,250	30,740	30,300	29,850	29,450	29,080	28,750
35	10	10	8	10	37,700	37,130	36,450	35,550	34,750	33,950	33,200	32,550	32,000	31,450	30,900	30,450	30,000	29,550	29,150
36	10	10	10	10	38,500	37,920	37,200	36,350	35,450	34,610	33,850	33,080	32,400	31,800	31,350	30,800	30,350	29,920	29,500
37	10	10	10	12	39,200	38,610	37,850	36,850	36,000	35,250	34,600	34,000	33,420	32,850	32,200	31,500	30,870	30,270	29,700
38	12	10	10	12	39,800	39,150	38,400	37,450	36,650	36,000	35,400	34,900	34,310	33,650	32,950	32,150	31,350	30,600	29,850
39	12	12	10	12	40,350	39,650	38,900	38,170	37,450	36,750	36,050	35,480	34,800	34,050	33,200	32,400	31,550	30,750	30,000
40	12	12	12	12	40,850	40,150	39,400	38,750	38,100	37,400	36,700	36,000	35,220	34,450	33,600	32,730	31,850	31,000	30,150
41	12	12	12	Full	42,650	42,000	41,250	40,480	39,600	38,700	37,700	36,700	35,700	34,750	33,800	32,920	32,050	31,150	30,300
42	Full	12	12	Full	44,000	43,200	42,300	41,420	40,450	39,420	38,400	37,200	36,100	35,100	34,050	33,100	32,200	31,300	30,450
43	Full	Full	12	Full	44,900	43,950	43,000	42,050	41,050	39,950	38,850	37,600	36,400	35,300	34,250	33,300	32,380	31,480	30,650
44	Full	Full	Full	Full	45,650	44,600	43,600	42,590	41,550	40,430	39,250	38,000	36,780	35,580	34,450	33,430	32,500	31,650	30,800

NOTES:
1. Gates will be opened in order shown except as provided in (2) and (3) below, and will close in reverse order.
2. Half-steps will be used only as required for the last setting in the drawdown operation (e.g. an operation requiring 28 ½ steps will proceed from step 26 to 27 to 28 to 28 ½).
3. When finer adjustments of outflow are required, any opening smaller than the indicated step or half-step may be used on the gate last operated.
4. These spillway discharges are based on results of model tests published in July 1961.
5. * Discharge over fixed-crest only.

APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND LAKE GEORGE W. ANDREWS

GATED SPILLWAY RATING
PAGE 2 OF 2 PAGES



Note: Area-Capacity curves as presented in the April1965 George W. Andrews water control manual.

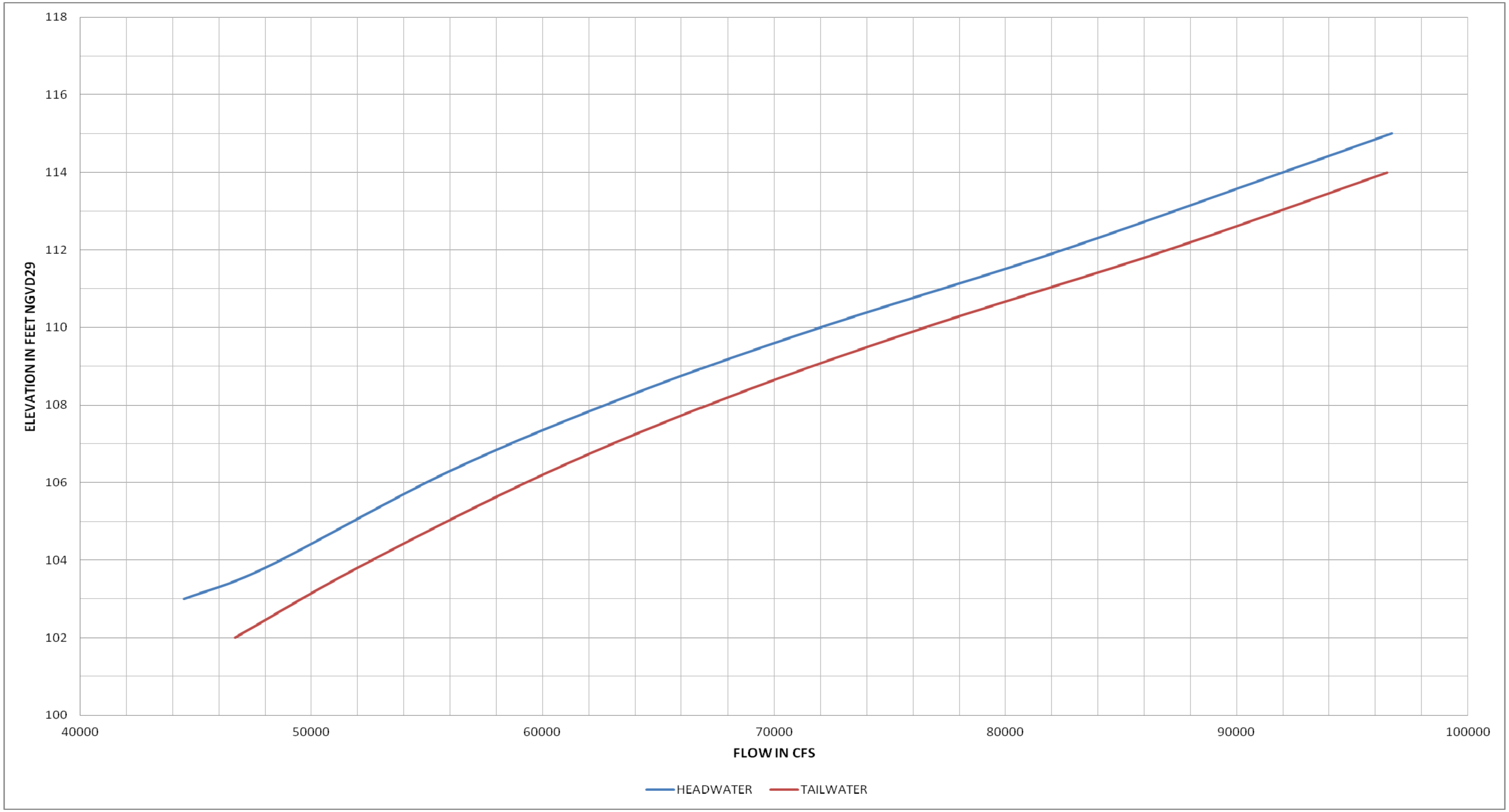
Area-Capacity Table

Elevation (ft, NGVD 29)	Total Area (acres)	Total Storage (ac-ft)
62	0	0
65	5	10
70	13	60
75	22	150
80	75	340
81	120	440
82	180	590
83	240	800
84	310	1,070
85	375	1,420
86	445	1,830
87	510	2,300
88	585	2,850
89	660	3,480
90	727	4,170
91	810	4,940
92	890	5,790
93	975	6,720
94	1,050	7,740
95	1,125	8,820
96	1,190	9,980
97	1,250	11,200
98	1,310	12,480
99	1,375	13,820
100	1,420	15,220
101	1,480	16,670
102	1,540	18,180
103	1,590	19,750
104	1,640	21,360
105	1,690	23,030
106	1,740	24,740
107	1,790	26,510
108	1,840	28,320

APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

AREA – CAPACITY CURVE



NOTES:
These curves are based on total discharge from fixed-crest spillway and gated spillway with all gates clear.

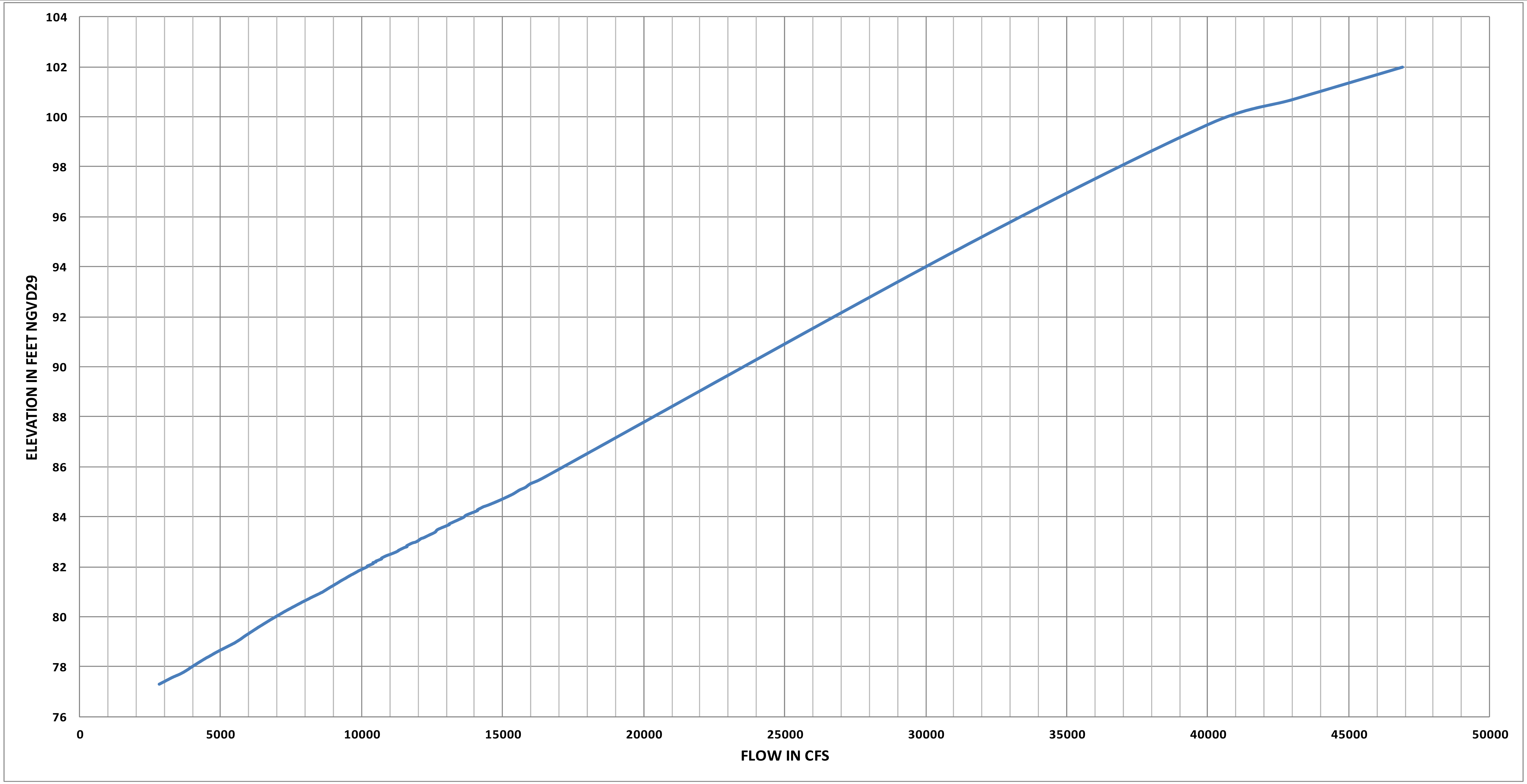
Gated spillway equipped with 4 gates 60' wide. Elevation of crest 82.0 feet NGVD29.

Fixed-crest spillway length 340'. Elevation of crest 102.0 feet NGVD29.

APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

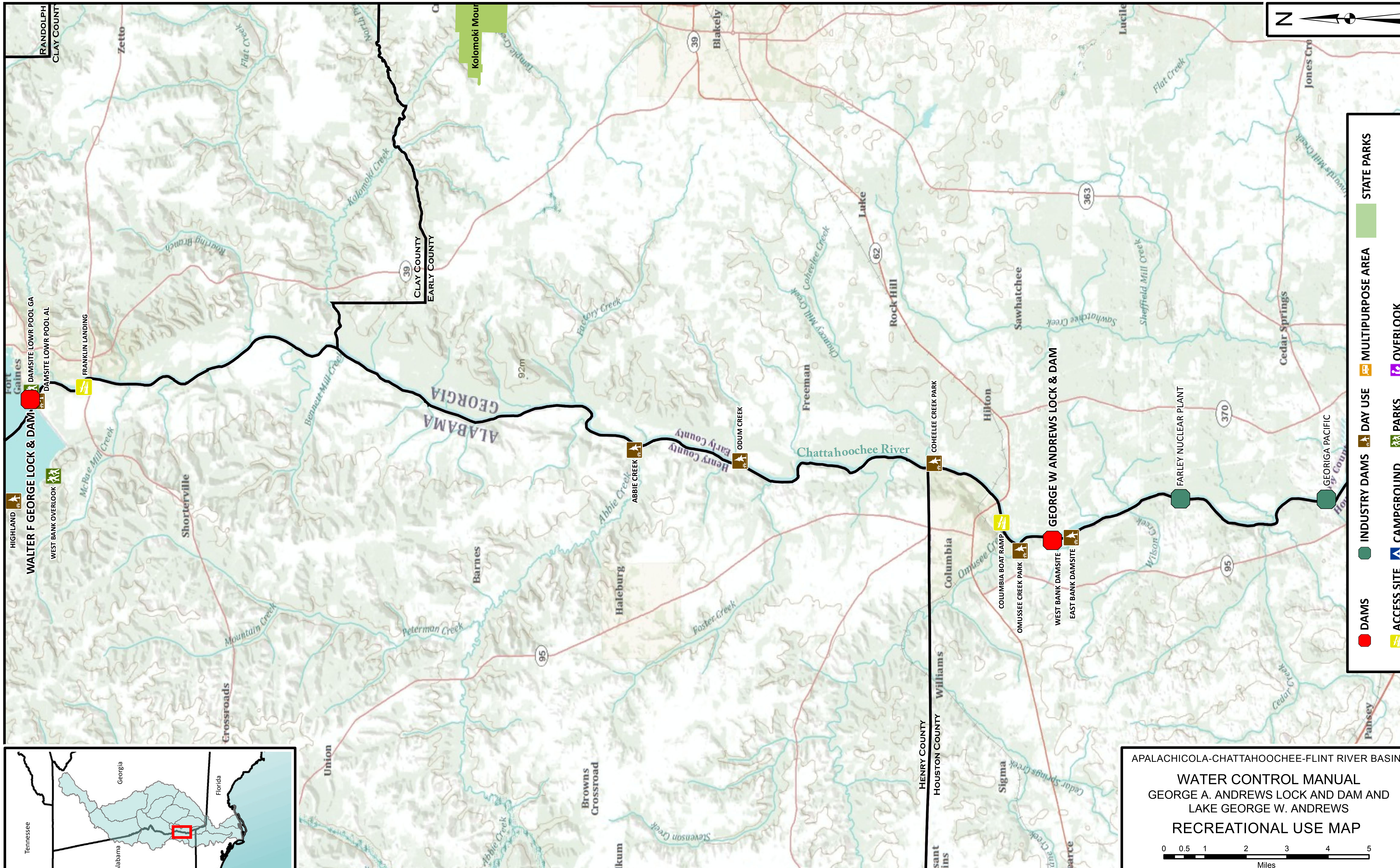
HEADWATER-TAILWATER RATINGS
FOR POOL ABOVE ELEVATION 103 FEET
NGVD29



APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

TAILWATER RATING
FOR TAILWATER ELEVATION BELOW 102
FEET NGVD29



APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL

GEORGE A. ANDREWS LOCK AND DAM AND LAKE GEORGE W. ANDREWS

RECREATIONAL USE MAP

0 0.5 1 2 3 4 5 Miles

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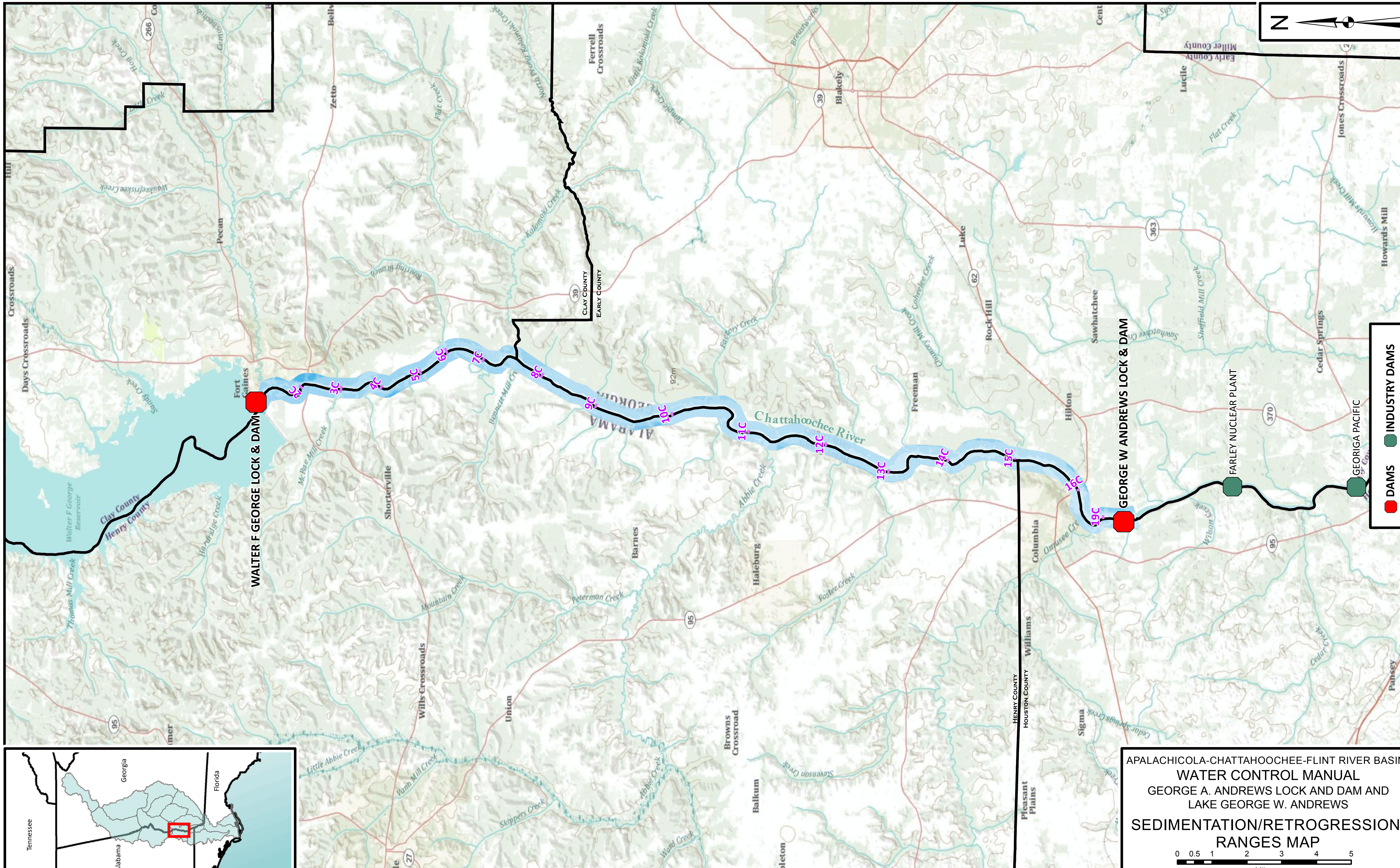

APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL

GEORGE A. ANDREWS LOCK AND DAM AND LAKE GEORGE W. ANDREWS

SEDIMENTATION/RETROGRESSION RANGES MAP

0 0.5 1 2 3 4 5 Miles

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George W Andrews Average Monthly Flows Period of Record (Cubic feet per second)																Daily minimum		Daily maximum	
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	Min	Max	Date	Flow	Date	Flow
1938					7,981	6,830	11,222	7,310	4,656	3,359	3,507	4,155	6,128	3,359	11,222	11/16/38	2,700	07/28/38	42,600
1939	6,663	18,402	24,632	16,093	9,402	10,098	6,622	14,685	6,769	4,328	3,747	4,731	10,514	3,747	24,632	10/26/39	3,200	03/04/39	74,000
1940	10,428	17,371	13,896	11,979	6,781	5,728	18,226	6,821	4,536	2,763	4,275	6,804	9,134	2,763	18,226	11/11/40	2,410	02/20/40	46,300
1941	8,338	7,042	10,014	7,741	4,260	2,751	7,336	5,604	3,324	2,437	2,073	10,492	5,951	2,073	10,492	10/30/41	1,420	12/28/41	45,400
1942	10,743	15,515	27,008	12,179	6,798	9,571	7,218	8,369	5,866	5,537	5,217	9,658	10,307	5,217	27,008	09/24/42	3,600	03/26/42	79,700
1943	28,284	15,234	38,021	16,527	12,734	7,740	9,470	8,065	4,272	3,713	5,084	5,469	12,884	3,713	38,021	11/04/43	3,200	03/25/43	112,000
1944	11,415	14,369	32,653	40,455	18,081	8,726	7,102	7,397	6,923	4,650	4,333	6,874	13,582	4,333	40,455	11/02/44	3,700	05/01/44	92,000
1945	8,231	17,199	13,008	14,909	14,365	5,730	7,639	7,059	7,151	5,782	7,409	16,603	10,424	5,730	17,199	10/18/45	2,823	04/29/45	58,346
1946	34,431	25,339	24,500	23,640	19,320	12,709	9,459	10,604	6,025	5,370	5,294	5,120	15,151	5,120	34,431	10/09/46	3,658	01/12/46	80,162
1947	23,788	11,669	22,259	20,921	12,703	10,633	7,414	6,226	3,760	3,506	12,371	15,651	12,575	3,506	23,788	10/02/47	2,406	01/25/47	66,208
1948	10,628	25,656	30,189	21,626	8,338	7,725	22,549	14,028	8,240	7,295	20,497	36,835	17,801	7,295	36,835	07/09/48	4,865	12/03/48	115,248
1949	22,905	28,640	18,441	18,230	21,091	11,872	16,662	11,916	11,675	7,454	7,500	8,501	15,407	7,454	28,640	11/23/49	5,581	05/04/49	72,130
1950	9,772	11,521	16,408	11,681	8,440	9,649	6,774	5,655	8,290	5,119	4,193	6,209	8,643	4,193	16,408	10/19/50	2,905	03/19/50	26,558
1951	7,489	7,276	9,761	15,604	6,405	4,839	5,397	2,974	3,495	2,968	5,507	14,920	7,220	2,968	15,604	09/07/51	1,539	12/26/51	43,609
1952	10,575	14,484	35,753	15,395	9,886	7,659	3,597	5,030	4,473	2,671	3,416	6,178	9,926	2,671	35,753	10/23/52	2,137	03/28/52	67,439
1953	17,316	18,207	17,025	15,619	26,132	7,631	10,943	5,234	5,655	5,467	4,231	22,087	12,962	4,231	26,132	09/20/53	2,582	05/06/53	80,769
1954	17,601	10,957	12,850	10,697	6,832	5,120	3,932	2,638	1,559	1,376	2,372	3,911	6,654	1,376	17,601	09/20/54	1,213	01/27/54	30,157
1955	7,883	12,764	7,601	12,479	6,749	3,812	6,224	4,357	2,266	2,075	2,791	3,169	6,014	2,075	12,764	09/26/55	1,530	04/17/55	35,509
1956	3,111	12,322	16,668	14,669	7,127	3,875	4,725	2,460	6,330	4,553	3,154	10,854	7,487	2,460	16,668	09/23/56	1,661	03/20/56	48,784
1957	10,149	11,254	13,101	23,796	12,068	6,662	5,327	3,496	3,804	6,594	11,406	12,154	9,984	3,496	23,796	08/15/57	749	04/09/57	72,884
1958	9,842	16,305	24,931	20,209	9,617	6,937	12,093	6,924	4,962	4,942	3,834	5,179	10,481	3,834	24,931	09/10/58	2,757	03/12/58	63,828
1959	9,609	19,074	20,519	14,080	8,453	17,437	7,606	4,720	5,937	8,938	7,240	7,942	10,963	4,720	20,519	10/08/59	1,547	06/06/59	50,007
1960	14,510	26,052	18,981	30,039	9,937	6,482	5,701	7,217	5,600	7,193	5,887	6,901	12,042	5,600	30,039	07/21/60	2,408	04/07/60	79,816
1961	7,161	25,018	26,587	32,825	13,977	9,586	10,895	8,083	6,219	3,960	4,974	19,735	14,085	3,960	32,825	10/17/61	2,870	03/02/61	103,000
1962	19,437	19,993	23,716	29,802	8,872	6,618	5,580	4,401	4,307	3,884	7,300	6,840	11,729	3,884	29,802	10/30/62	1,230	04/16/62	65,600
1963	15,347	14,830	9,658	11,115	11,837	9,037	7,346	5,792	5,328	3,596	5,263	10,582	9,144	3,596	15,347	08/24/63	1,310	01/23/63	54,500
1964	22,468	22,532	31,505	41,756	27,138	8,072	11,755	12,921	8,180	19,877	11,890	22,295	20,032	8,072	41,756	09/07/64	3,130	04/11/64	108,000
1965	18,042	24,769	24,719	19,138	8,297	10,779	6,524	5,236	6,211	8,680	7,141	8,916	12,371	5,236	24,769	07/12/65	2,420	02/20/65	52,300
1966	18,636	29,816	33,977	11,866	15,413	10,804	7,663	9,943	7,049	7,245	13,767	10,949	14,761	7,049	33,977	10/15/66	1,760	03/07/66	102,000
1967	22,935	16,935	12,390	7,339	7,062	9,616	12,666	10,123	12,671	8,603	11,326	21,228	12,741	7,062	22,935	06/05/67	2,720	01/04/67	66,400
1968	20,266	10,131	18,099	12,059	8,599	7,050	5,236	6,749	5,580	4,597	6,662	8,128	9,430	4,597	20,266	10/04/68	2,560	03/15/68	63,900
1969	10,644	11,557	14,055	18,279	12,761	7,960	6,542	6,751	7,595	7,261	7,558	8,785	9,979	6,542	18,279	05/05/69	2,380	04/21/69	67,200
1970	10,207	12,107	19,934	13,516	6,076	8,266	6,927	10,074	9,479	5,800	8,111	8,270	9,897	5,800	19,934	10/07/70	1,089	03/25/70	72,700
1971	16,314	20,467	35,995	15,726	14,247	7,023	10,798	14,401	7,920	5,300	5,987	13,963	14,012	5,300	35,995	10/10/71	2,942	03/06/71	108,025
1972	27,661	18,444	15,980	10,651	11,858	8,940	6,190	5,872	3,826	4,278	6,030	19,832	11,630	3,826	27,661	10/23/72	1,977	01/15/72	100,679
1973	23,593	23,440	22,901	38,273	20,527	18,691	10,384	7,855	6,095	5,705	5,663	10,371	16,125	5,663	38,273	10/31/73	2,824	04/03/73	86,169
1974	26,767	26,747	13,008	20,925	10,100	7,683	6,070	8,211	6,359	6,404	11,272	10,672	12,852	6,070	26,767	10/07/74	2,596	01/05/74	53,708
1975	16,229	26,334	29,567	25,207	13,378	10,714	10,669	11,440	7,842	16,690	13,557	12,836	16,205	7,842	29,567	12/15/75	1,010	02/19/75	91,643

APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

AVERAGE MONTHLY FLOWS

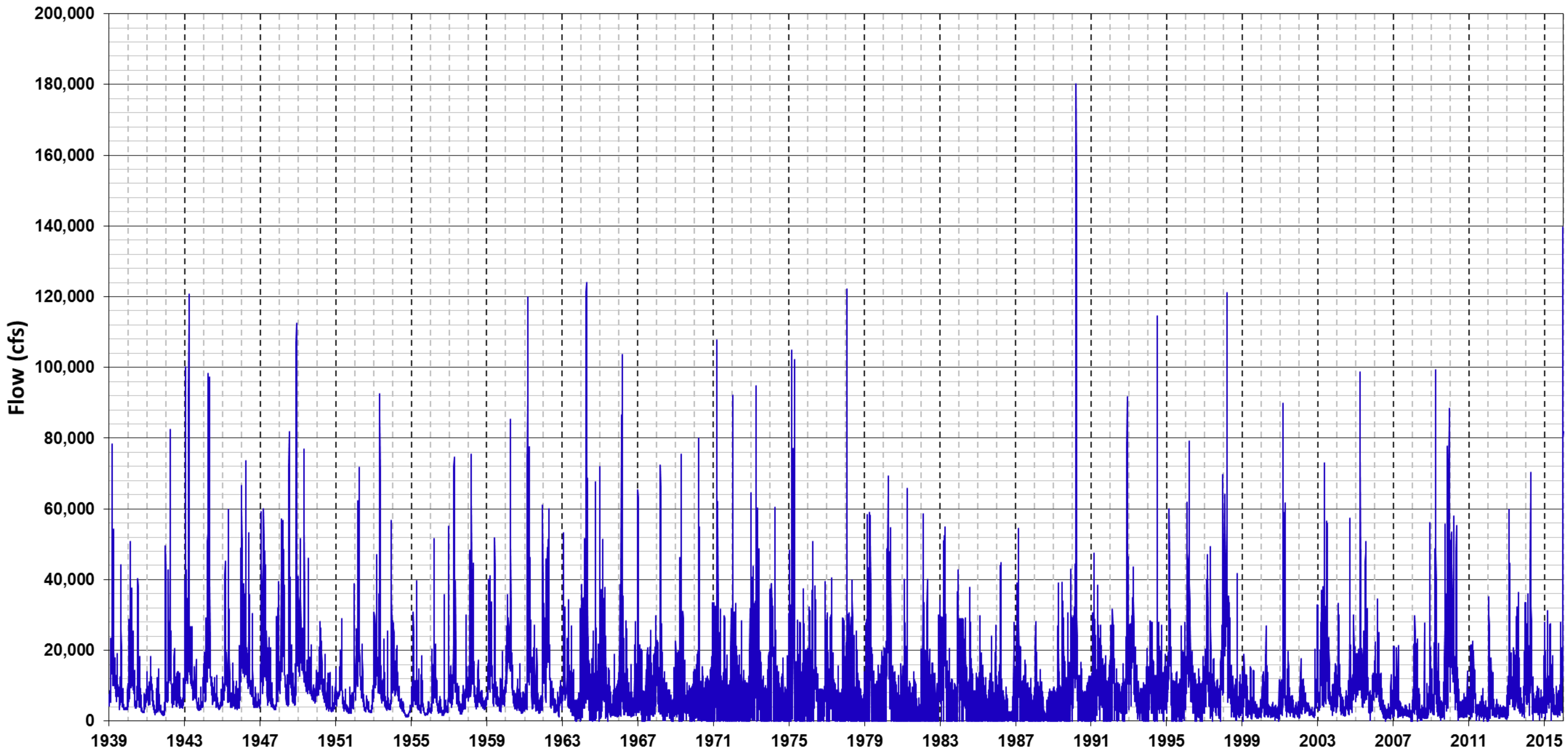
George W Andrews Average Monthly Flows Period of Record (Cubic feet per second)

																Daily minimum		Daily maximum	
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	Min	Max	Date	Flow	Date	Flow
1976	17,509	16,496	21,114	15,680	15,732	13,639	10,199	7,417	6,789	6,471	9,729	20,173	13,412	6,471	21,114	09/13/76	848	04/02/76	44,500
1977	16,222	8,865	23,545	20,253	8,424	6,499	5,405	6,655	6,310	5,865	16,025	11,497	11,297	5,405	23,545	10/17/77	778	04/04/77	37,000
1978	31,211	18,198	21,139	11,121	18,242	8,877	6,013	11,785	7,852	5,932	4,528	5,378	12,523	4,528	31,211	12/04/78	793	01/28/78	129,000
1979	12,007	22,796	21,021	32,990	12,815	8,312	6,368	7,264	7,557	7,899	11,075	8,976	13,257	6,368	32,990	06/18/79	762	02/26/79	74,600
1980	12,002	14,034	34,163	28,588	20,028	8,735	7,619	7,566	5,978	5,061	5,079	4,682	12,795	4,682	34,163	12/01/80	847	04/01/80	75,800
1981	4,794	15,909	7,102	13,312	5,033	5,175	5,529	6,253	5,067	3,436	2,970	3,849	6,536	2,970	15,909	09/21/81	841	04/04/81	69,600
1982	14,692	25,816	10,332	13,824	8,435	6,411	6,507	8,852	5,974	5,559	5,781	20,904	11,091	5,559	25,816	06/14/82	519	02/05/82	68,800
1983	16,150	19,945	26,317	26,945	9,046	8,501	7,735	6,723	6,391	6,611	7,143	24,124	13,803	6,391	26,945	05/16/83	643	03/29/83	56,100
1984	19,184	15,857	21,477	14,733	15,396	7,299	7,278	14,604	7,851	5,010	5,207	7,375	11,773	5,010	21,477	09/24/84	759	08/04/84	38,700
1985	6,041	14,899	9,956	7,338	4,393	4,738	4,573	8,332	7,336	6,019	3,784	8,453	7,155	3,784	14,899	01/28/85	796	02/07/85	33,900
1986	7,176	9,872	13,181	5,409	4,912	3,922	4,700	2,361	2,234	2,381	7,482	10,633	6,189	2,234	13,181	03/04/86	499	03/16/86	48,500
1987	16,401	15,379	19,474	10,415	5,937	9,586	9,640	5,512	5,682	5,527	3,058	4,853	9,289	3,058	19,474	10/25/87	533	03/03/87	54,300
1988	9,645	10,912	7,665	7,381	6,461	4,658	2,466	2,010	4,276	5,683	6,282	5,671	6,093	2,010	10,912	08/29/88	689	01/23/88	29,000
1989	5,661	4,892	8,490	15,294	6,986	11,763	15,343	8,435	8,159	10,886	11,504	19,622	10,586	4,892	19,622	01/30/89	498	04/12/89	38,800
1990	25,366	29,734	45,879	14,173	8,801	9,060	5,099	5,340	4,689	4,543	5,731	5,149	13,630	4,543	45,879	10/01/90	537	03/20/90	191,000
1991	7,534	12,467	16,994	9,549	18,725	11,288	10,048	9,014	10,220	8,199	5,328	8,917	10,690	5,328	18,725	11/04/91	847	03/04/91	62,400
1992	12,937	17,541	16,142	8,739	6,998	5,153	6,862	6,352	8,358	6,939	22,891	24,782	11,975	5,153	24,782	01/06/92	1,010	11/28/92	107,000
1993	22,723	16,274	23,134	16,265	10,677	6,282	5,767	6,633	5,137	5,453	6,015	7,451	10,984	5,137	23,134	12/20/93	743	04/02/93	45,700
1994	8,455	16,697	15,096	10,117	7,414	5,557	37,693	12,161	11,663	9,856	10,016	13,011	13,145	5,557	37,693	01/17/94	989	07/08/94	195,000
1995	11,876	26,018	22,360	8,076	7,171	4,698	5,893	6,580	5,615	8,620	12,851	12,352	11,009	4,698	26,018	12/04/95	771	02/20/95	70,300
1996	15,647	27,645	30,167	13,734	10,344	7,032	7,370	6,488	6,289	6,964	5,469	8,822	12,164	5,469	30,167	07/01/96	662	03/10/96	86,100
1997	13,922	21,222	18,446	10,347	10,347	10,324	9,686	7,080	7,302	6,085	10,478	23,147	12,366	6,085	23,147	06/01/97	1,070	12/27/97	74,900
1998	22,055	33,659	38,997	20,594	12,823	6,214	7,385	6,370	5,736	5,220	6,447	5,695	14,266	5,220	38,997	11/01/98	1,550	03/10/98	138,000
1999	6,786	11,314	8,924	5,058	4,578	7,643	4,836	7,322	3,887	2,982	3,065	3,667	5,839	2,982	11,314	01/18/99	1,080	02/07/99	19,300
2000	5,894	8,885	6,763	9,542	5,230	3,969	3,092	3,555	3,025	2,727	3,276	5,859	5,151	2,727	9,542	12/10/00	887	04/05/00	26,600
2001	7,399	6,038	28,604	12,964	5,386	9,800	4,590	4,549	3,029	2,688	2,796	3,029	7,573	2,688	28,604	09/17/01	1,110	03/06/01	69,700
2002	4,297	7,590	7,168	6,891	3,923	3,347	3,280	2,906	2,591	2,319	6,601	10,837	5,146	2,319	10,837	01/13/02	1,300	12/28/02	30,500
2003	6,095	12,310	20,501	13,606	22,753	19,531	19,026	10,741	5,983	5,684	7,338	9,329	12,741	5,684	22,753	10/07/03	1,980	05/12/03	60,500
2004	10,229	15,981	6,386	5,383	3,795	3,701	5,797	4,890	13,740	6,945	12,752	13,994	8,633	3,701	15,981	06/08/04	1,890	09/19/04	48,800
2005	10,576	13,899	23,285	25,419	8,454	12,889	23,170	16,020	6,867	4,070	6,295	9,632	13,381	4,070	25,419	10/14/05	1,490	03/30/05	92,400
2006	12,317	12,115	13,410	7,935	7,689	3,668	3,325	2,576	3,392	3,079	6,564	5,259	6,777	2,576	13,410	07/09/06	842	02/28/06	35,100
2007	10,451	7,735	9,274	6,335	4,020	2,873	2,564	3,120	2,708	2,722	2,539	2,192	4,711	2,192	10,451	12/24/07	696	04/17/07	23,200
2008	5,436	12,680	8,840	7,528	4,087	2,312	2,465	6,404	2,570	3,467	5,449	13,678	6,243	2,312	13,678	07/07/08	779	12/13/08	65,700
2009	8,722	4,524	23,590	24,259	9,974	5,359	3,405	3,819	14,799	14,771	22,993	43,377	14,966	3,405	43,377	09/14/09	1,500	03/31/09	89,200
2010	27,390	27,293	22,400	8,466	14,167	5,793	4,129	3,906	2,634	4,056	3,687	6,125	10,837	2,634	27,390	9/14/2010	1,360	1/23/2010	57,700
2011	5,518	10,877	14,471	11,413	4,167	3,172	3,780	3,580	4,313	3,885	4,166	2,509	5,988	2,509	14,471	12/18/2011	745	2/7/2011	24,800
2012	7,536	6,068	9,129	5,816	2,889	3,008	3,735	2,642	2,772	2,931	3,240	2,808	4,381	2,642	9,129	1/9/2012	719	1/26/2012	28,300
2013	5,524	26,953	13,196	9,737	12,749	8,811	20,020	13,975	5,465	4,337	4,512	17,790	11,922	4,337	26,953	1/1/2013	1,140	2/14/2013	64,100
2014	14,020	16,523	12,490	29,356	9,459	4,869	4,576	4,278	4,159	5,040	4,251	7,679	9,725	4,159	29,356	9/24/2014	709	4/9/2014	72,300
2015	11,657	9,750	10,315	14,659	8,691	7,482	4,810	4,969	4,770	5,756	14,649	39,148	11,388	4,770	39,148	9/5/2015	1,030	12/27/2015	160,000
Avg	13,746	16,694	19,367	16,056	10,395	7,731	8,208	7,124	6,018	5,662	7,191	11,362	10,752	4,393	24,371				
Min	3,111	4,524	6,386	5,058	2,889	2,312	2,465	2,010	1,559	1,376	2,073	2,192	4,381	1,376	9,129				
Max	34,431	33,659	45,879	41,756	27,138	19,531	37,693	16,020	14,799	19,877	22,993	43,377	20,032	8,072	45,879				

APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

AVERAGE MONTHLY FLOWS

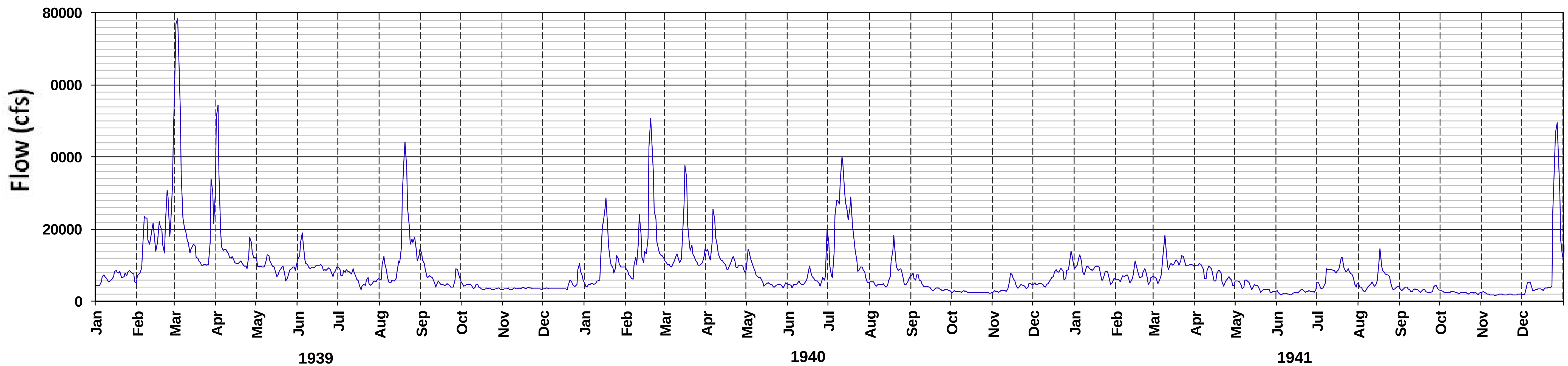


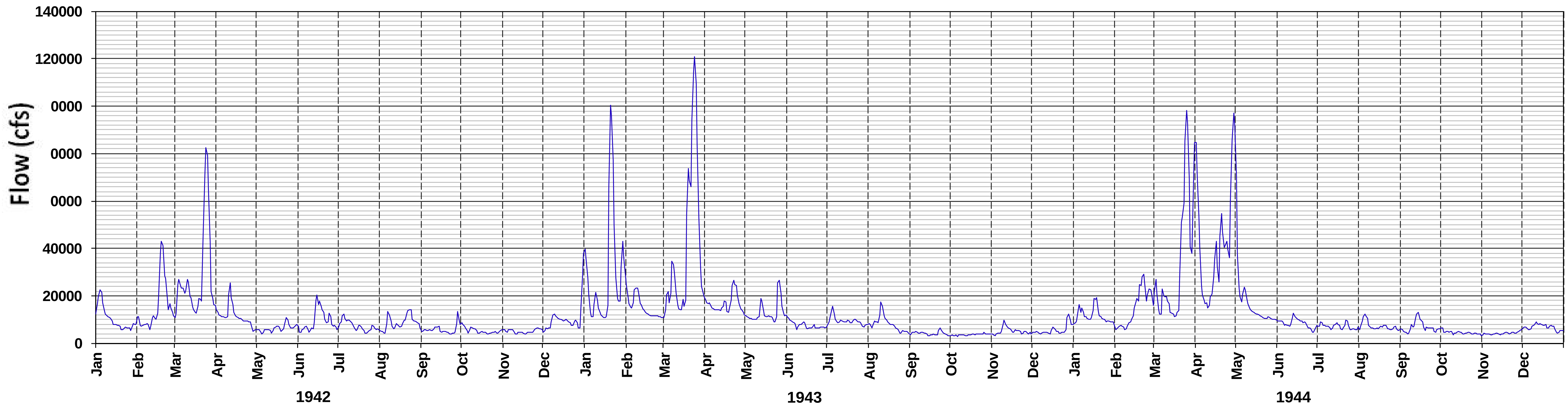
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS (Period of Record)

PAGE 1 OF 14



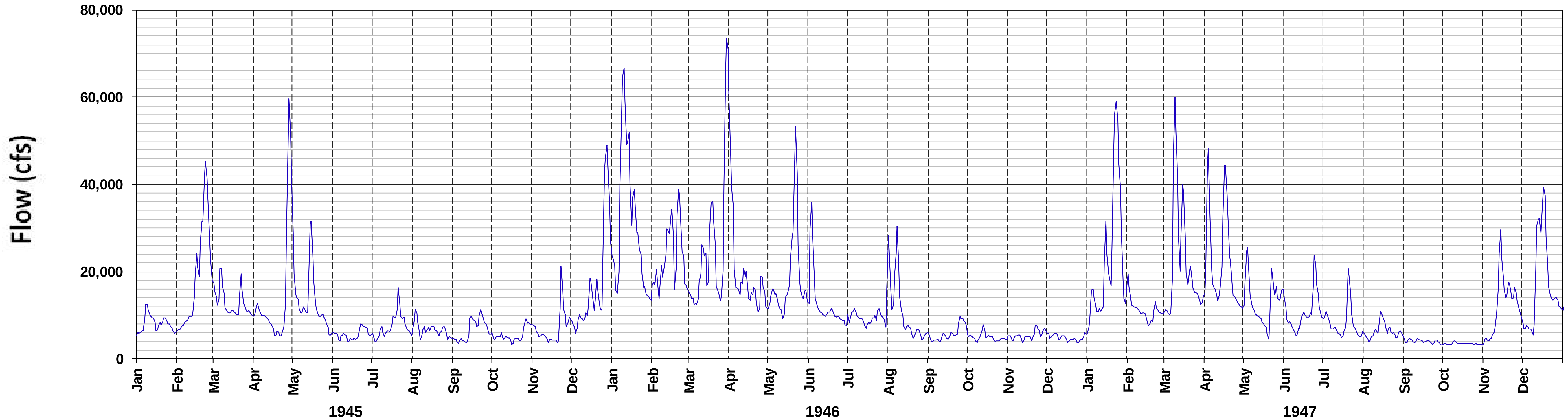


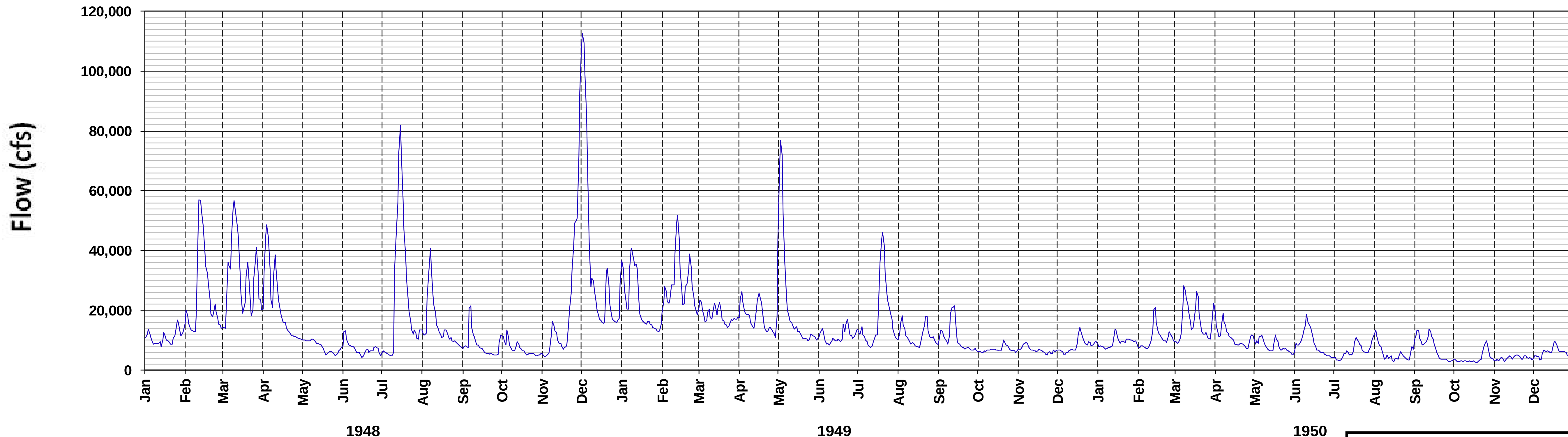
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 2 OF 14



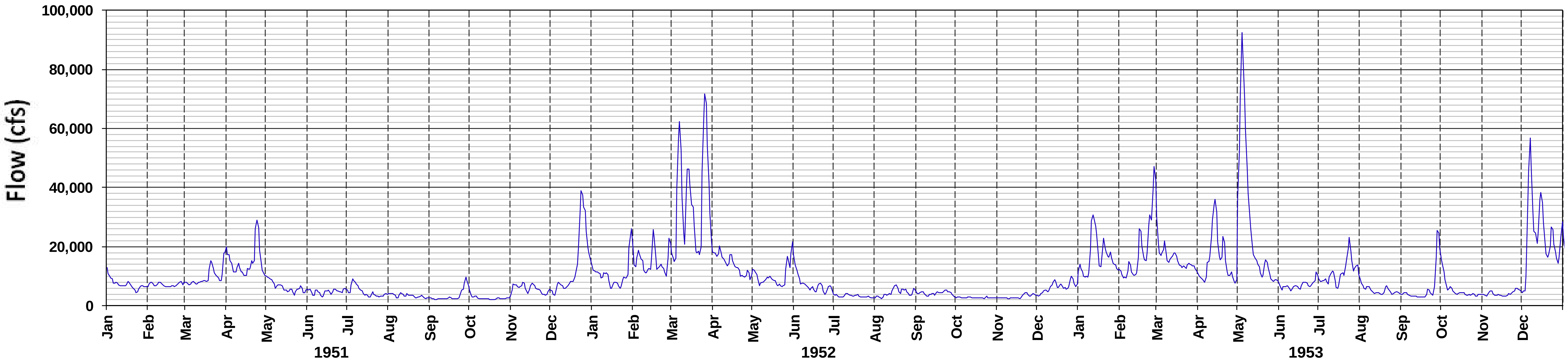


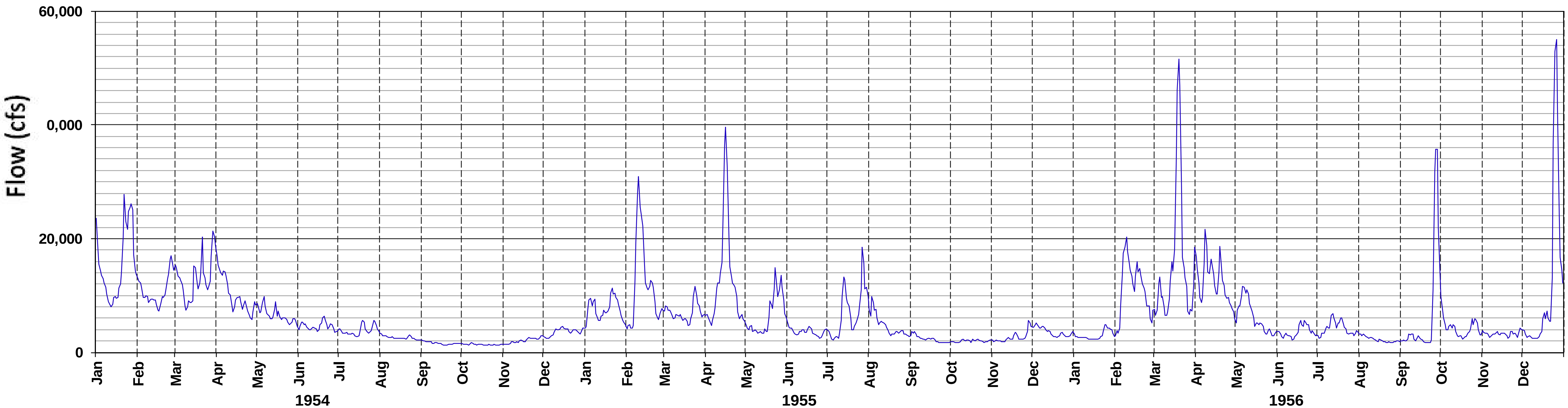
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 3 OF 14



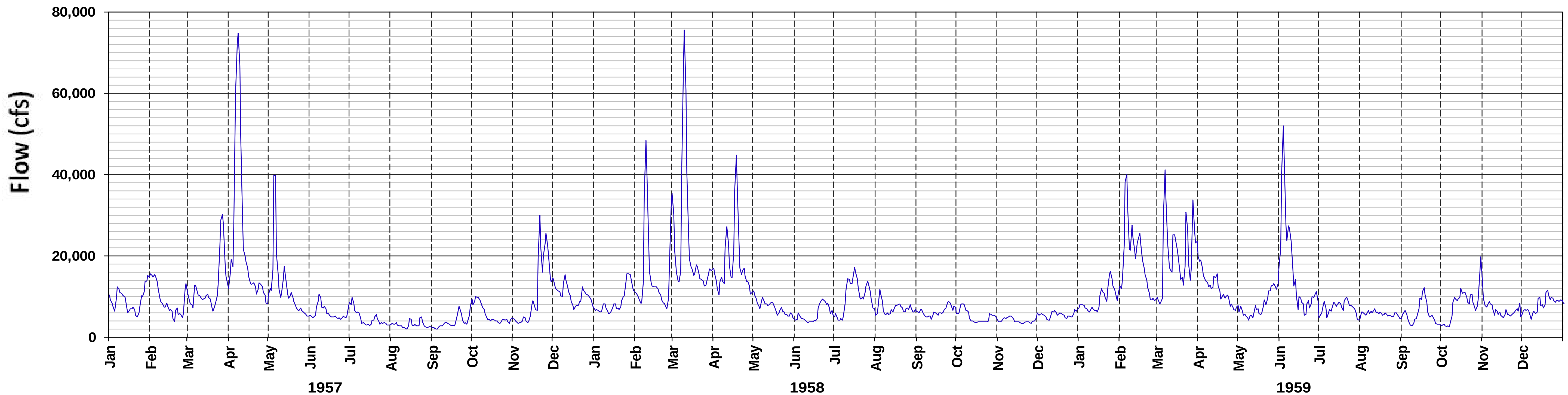


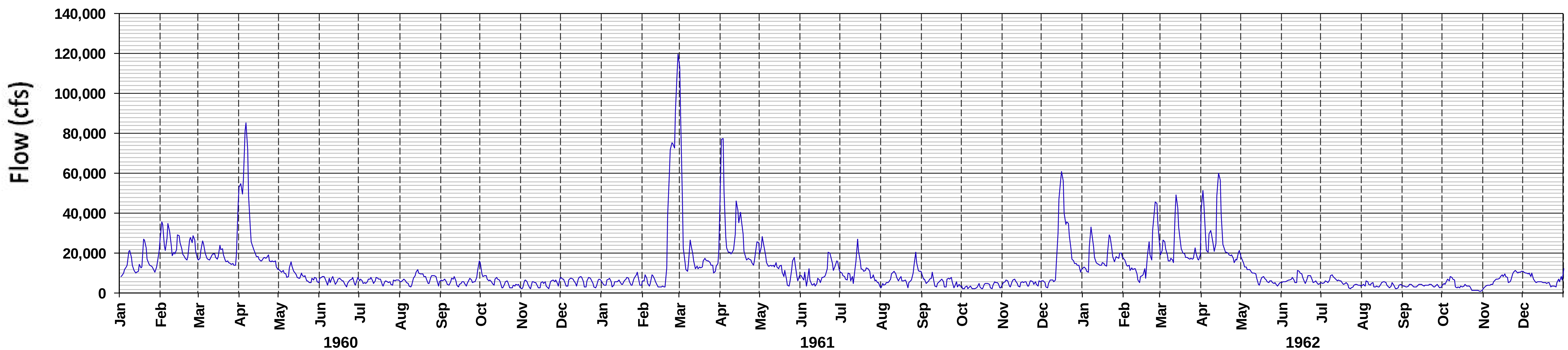
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 4 OF 14

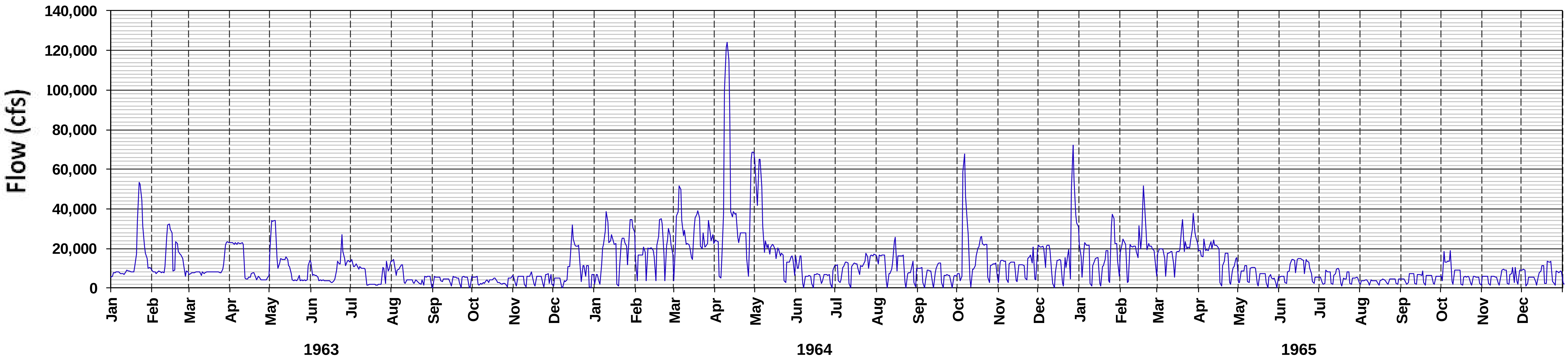


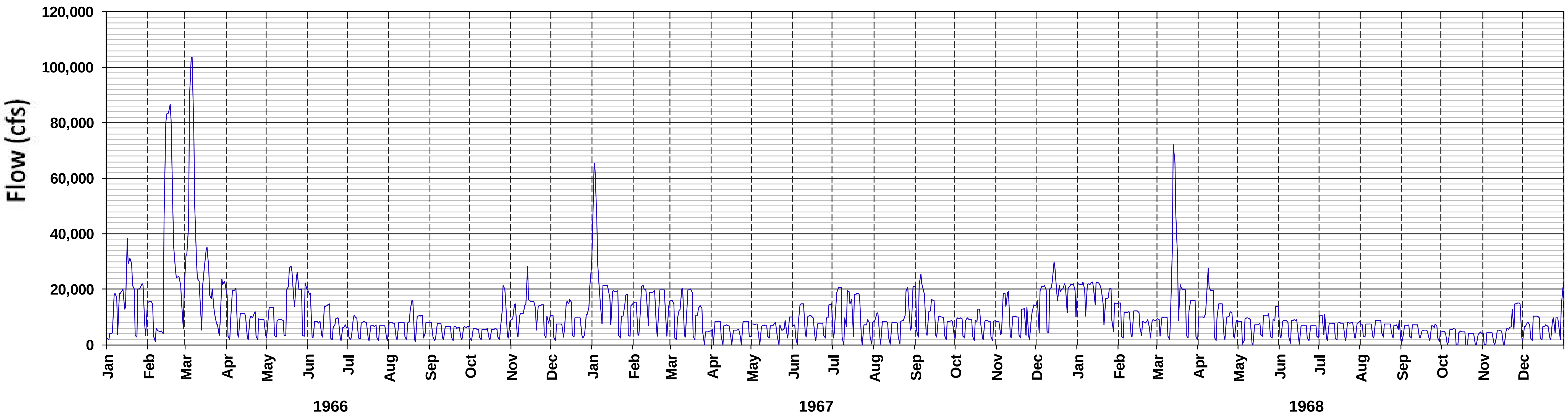


APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS



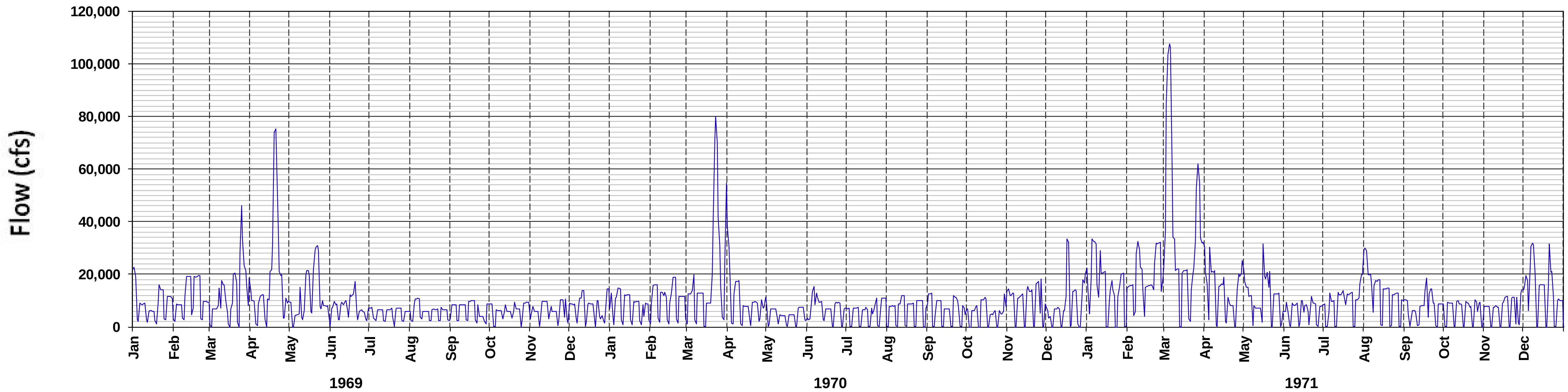


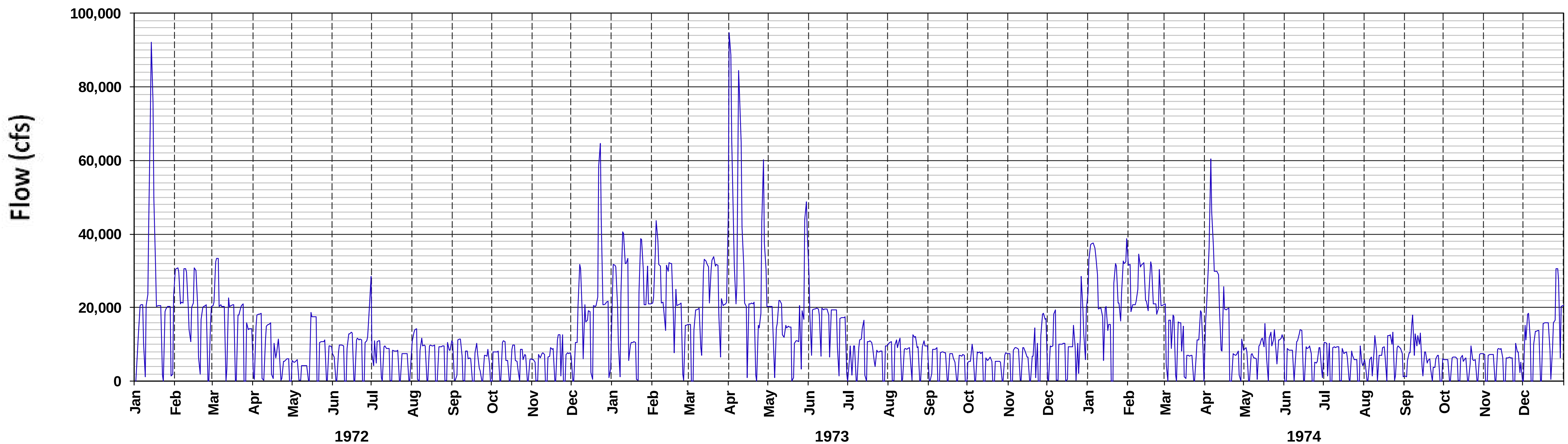
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 6 OF 14

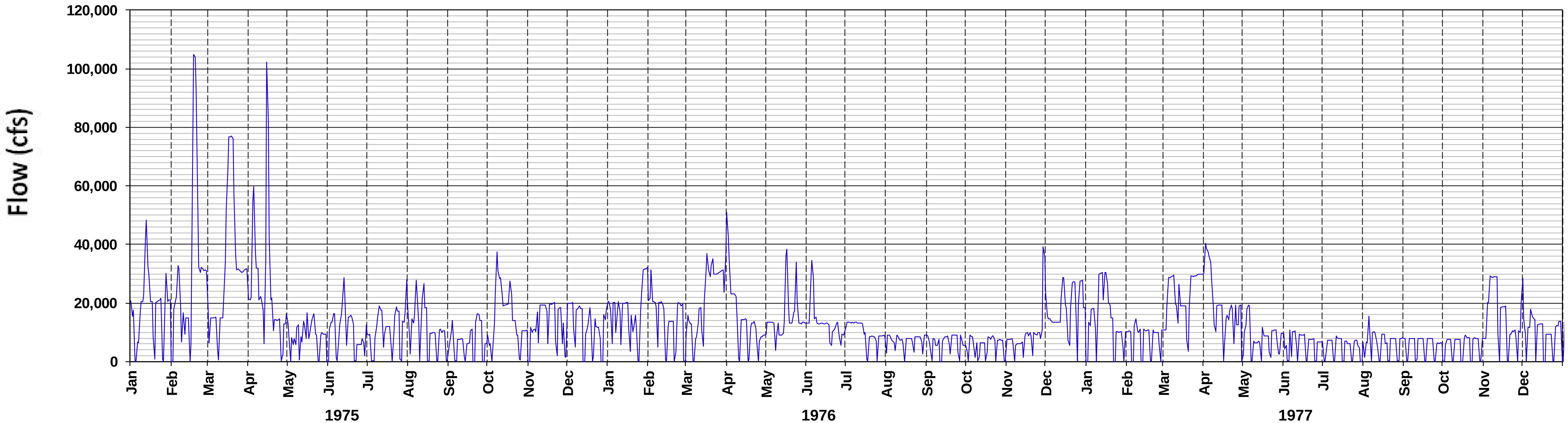


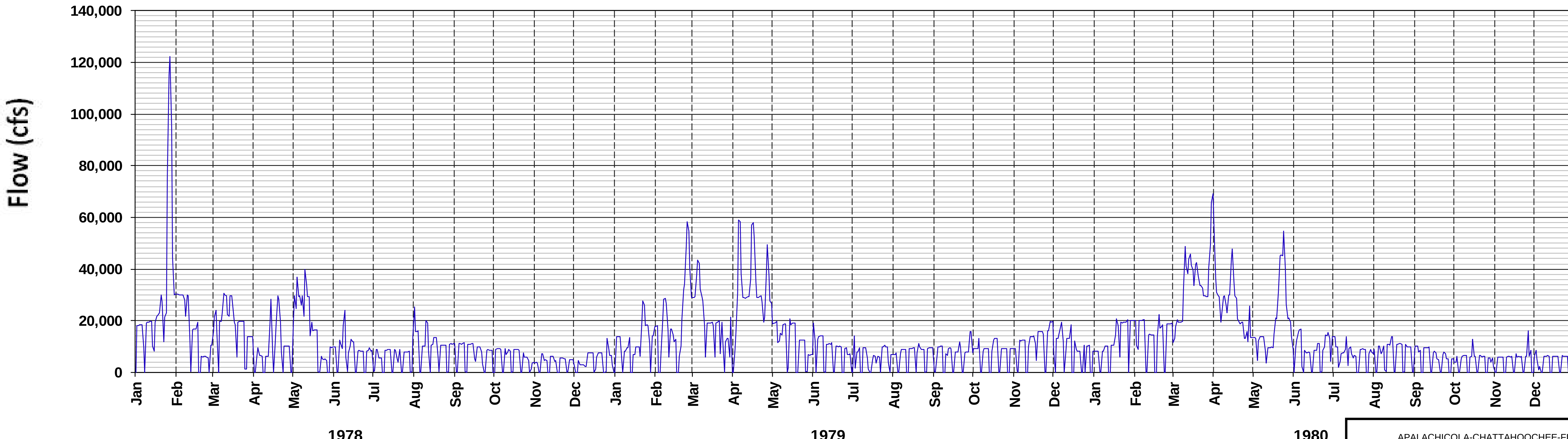


APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

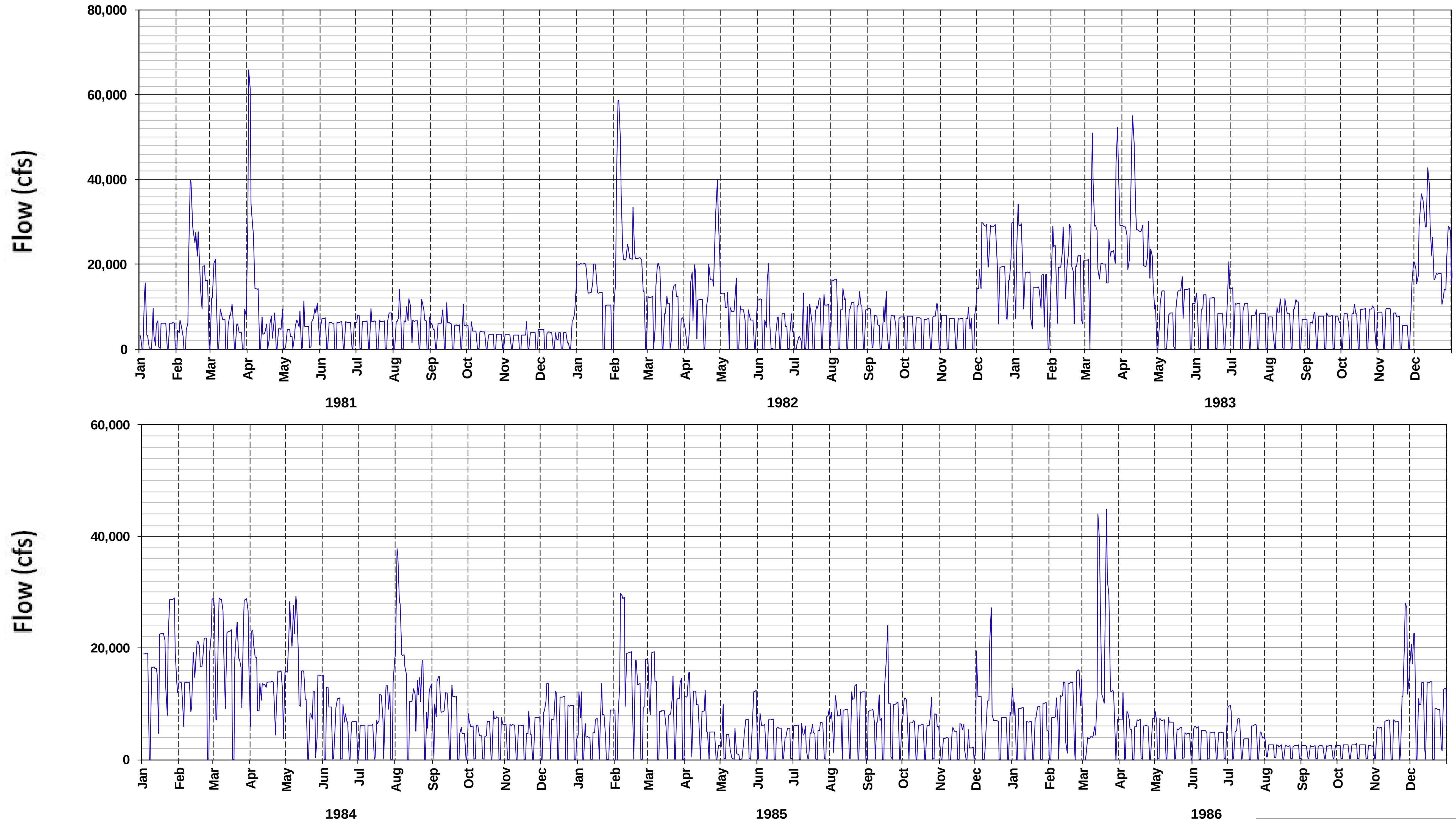




APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

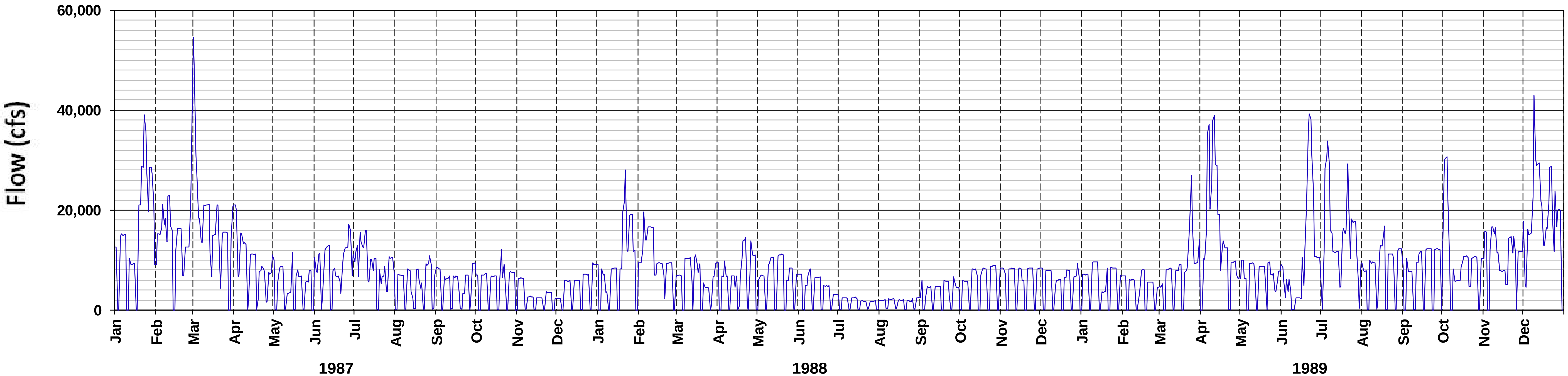


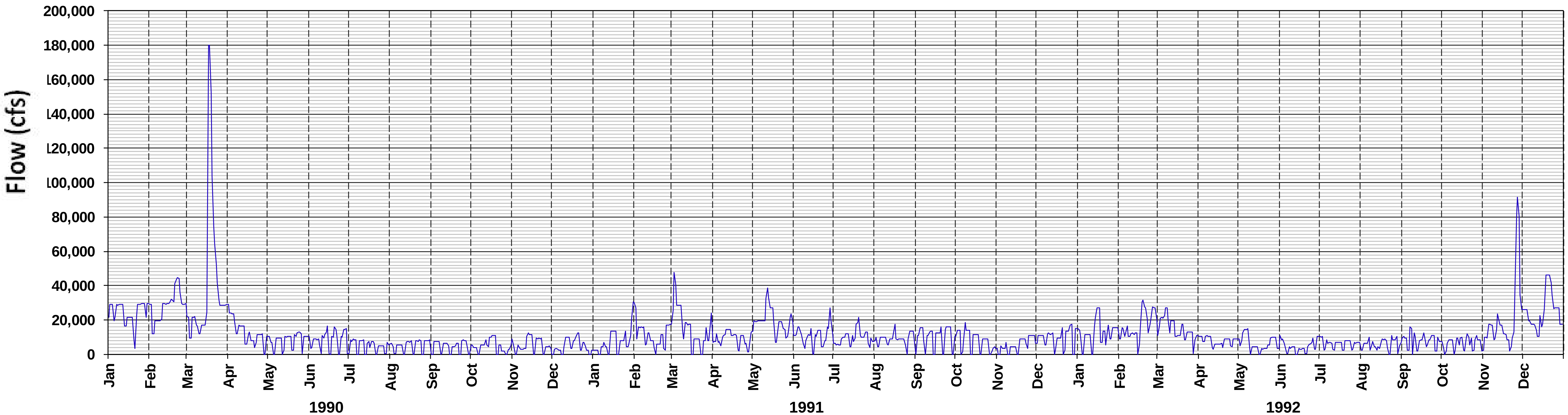
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 9 OF 14



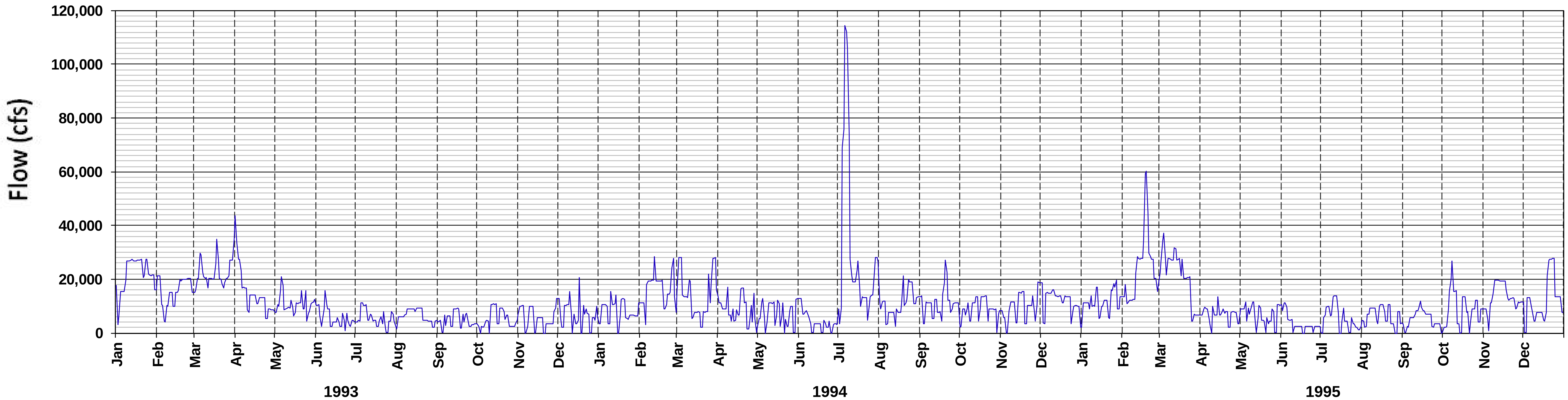


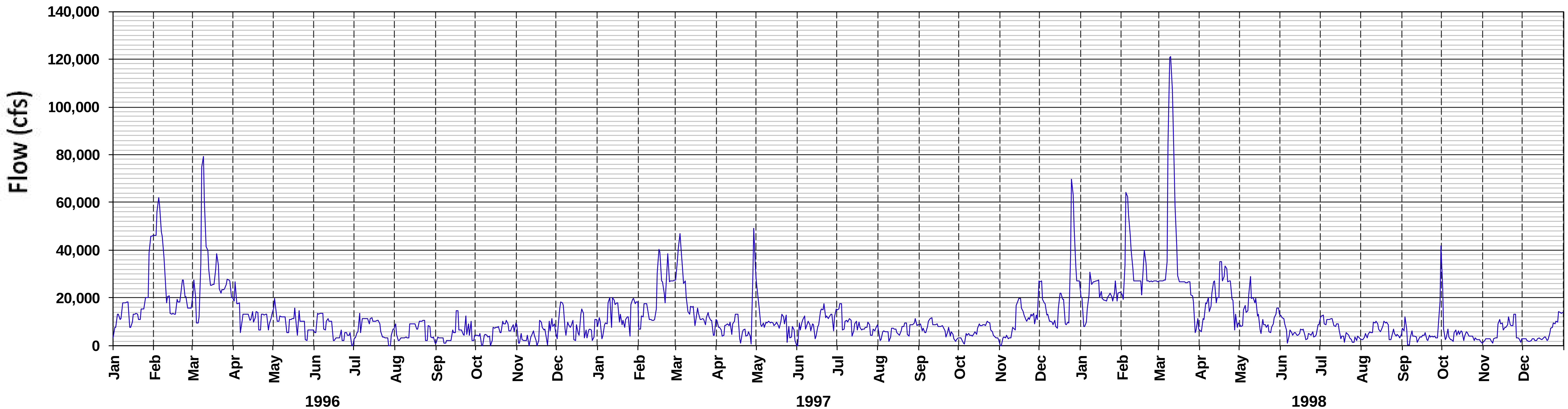
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 10 OF 14



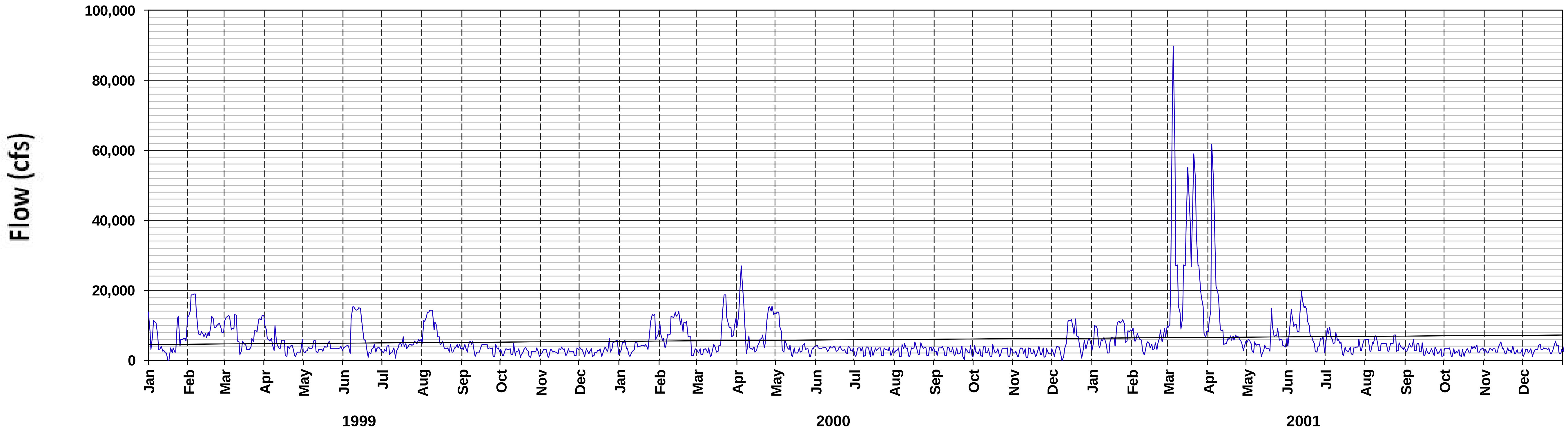


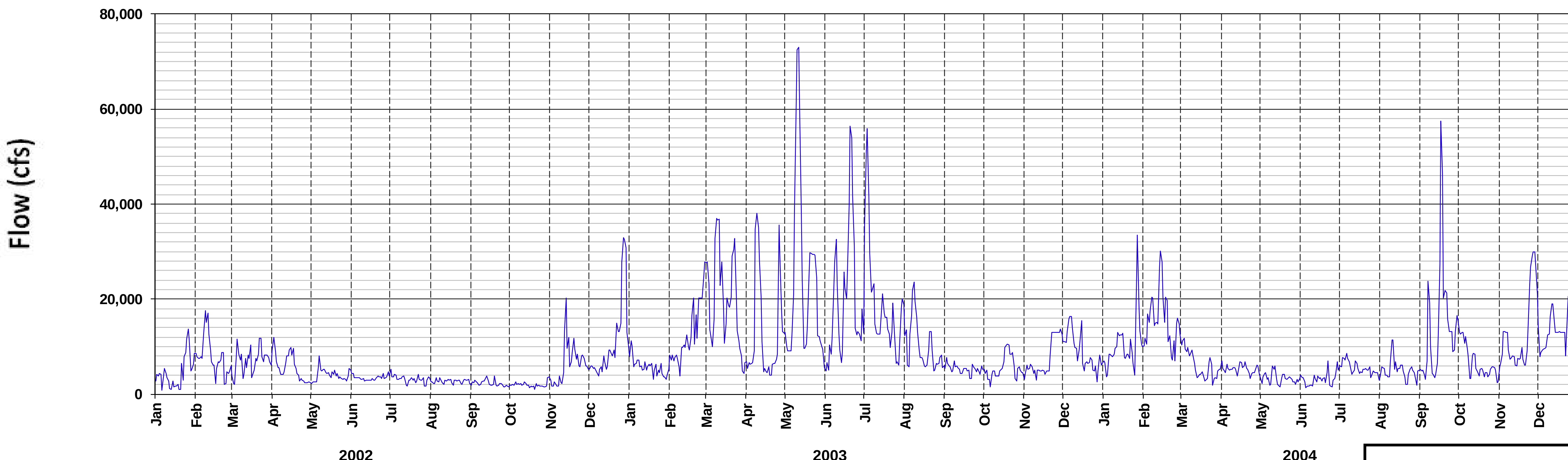
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 11 OF 14



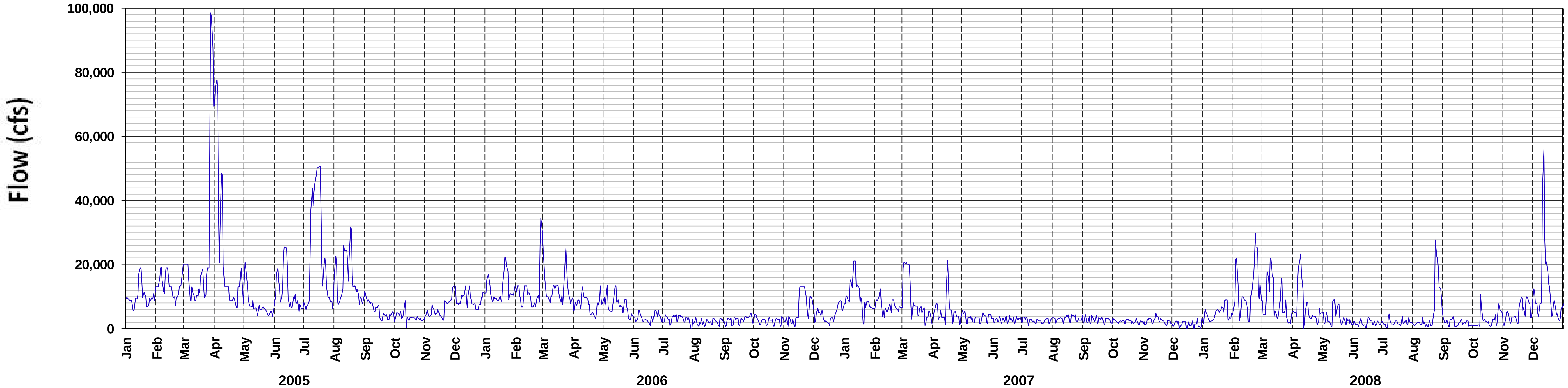


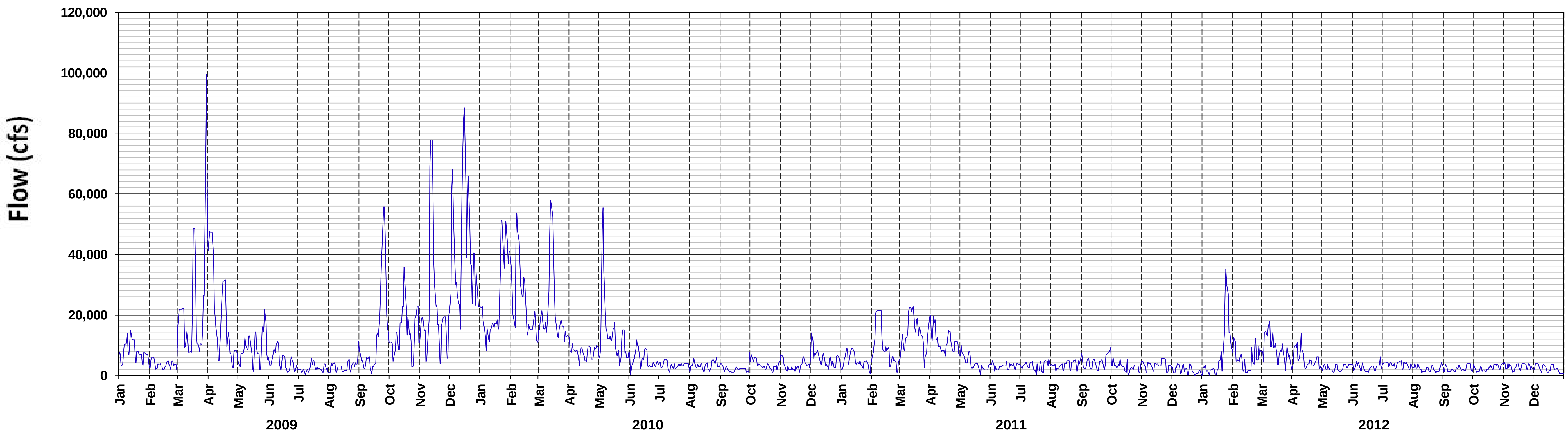
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 12 OF 14



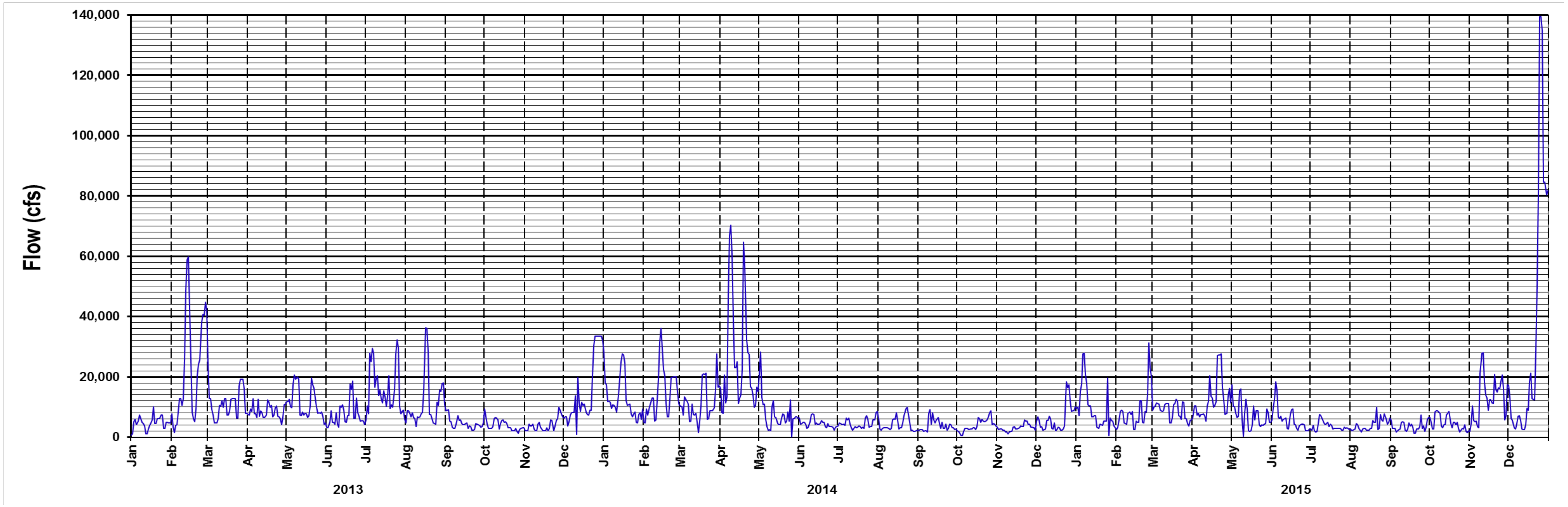


APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 13 OF 14

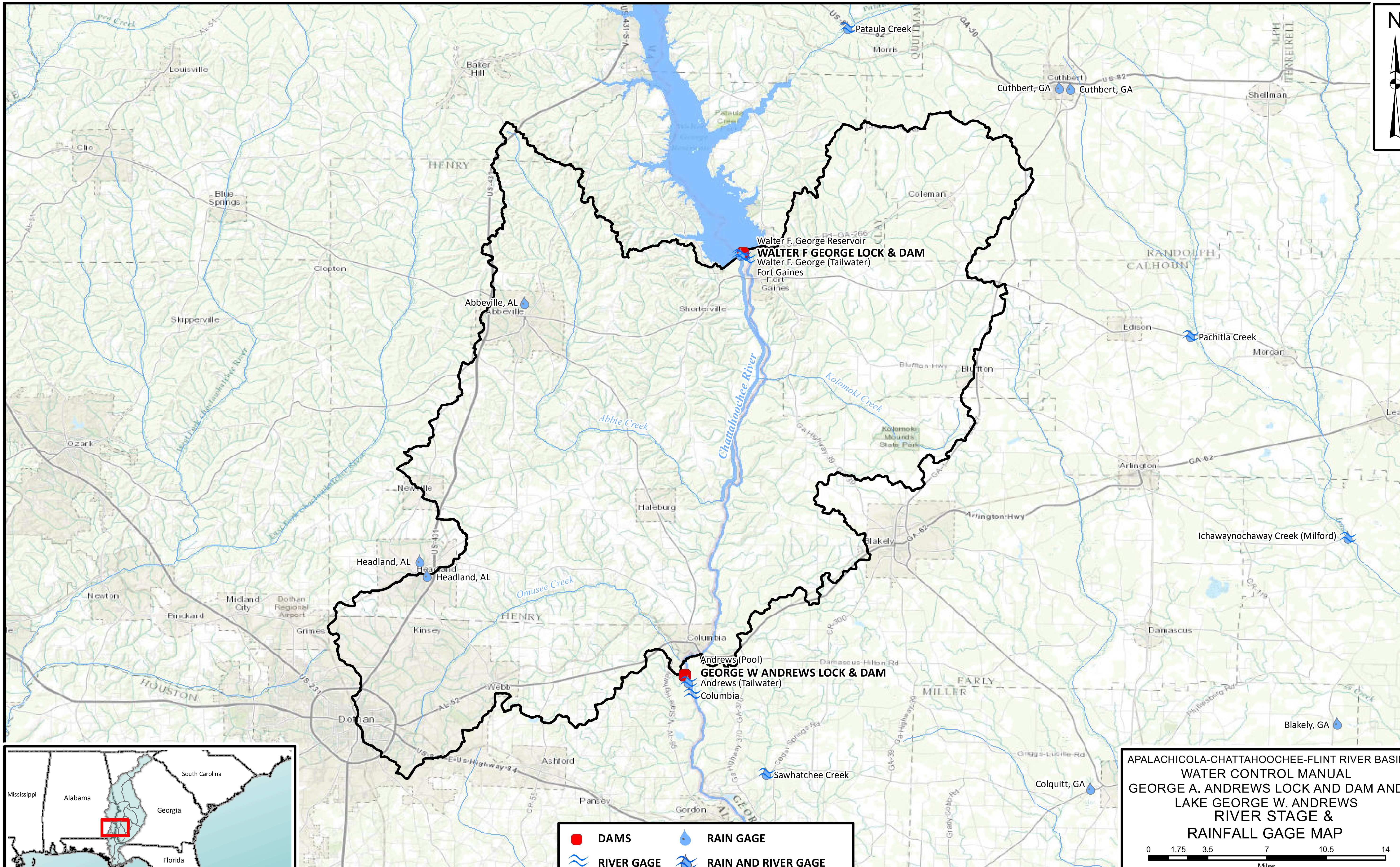


APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

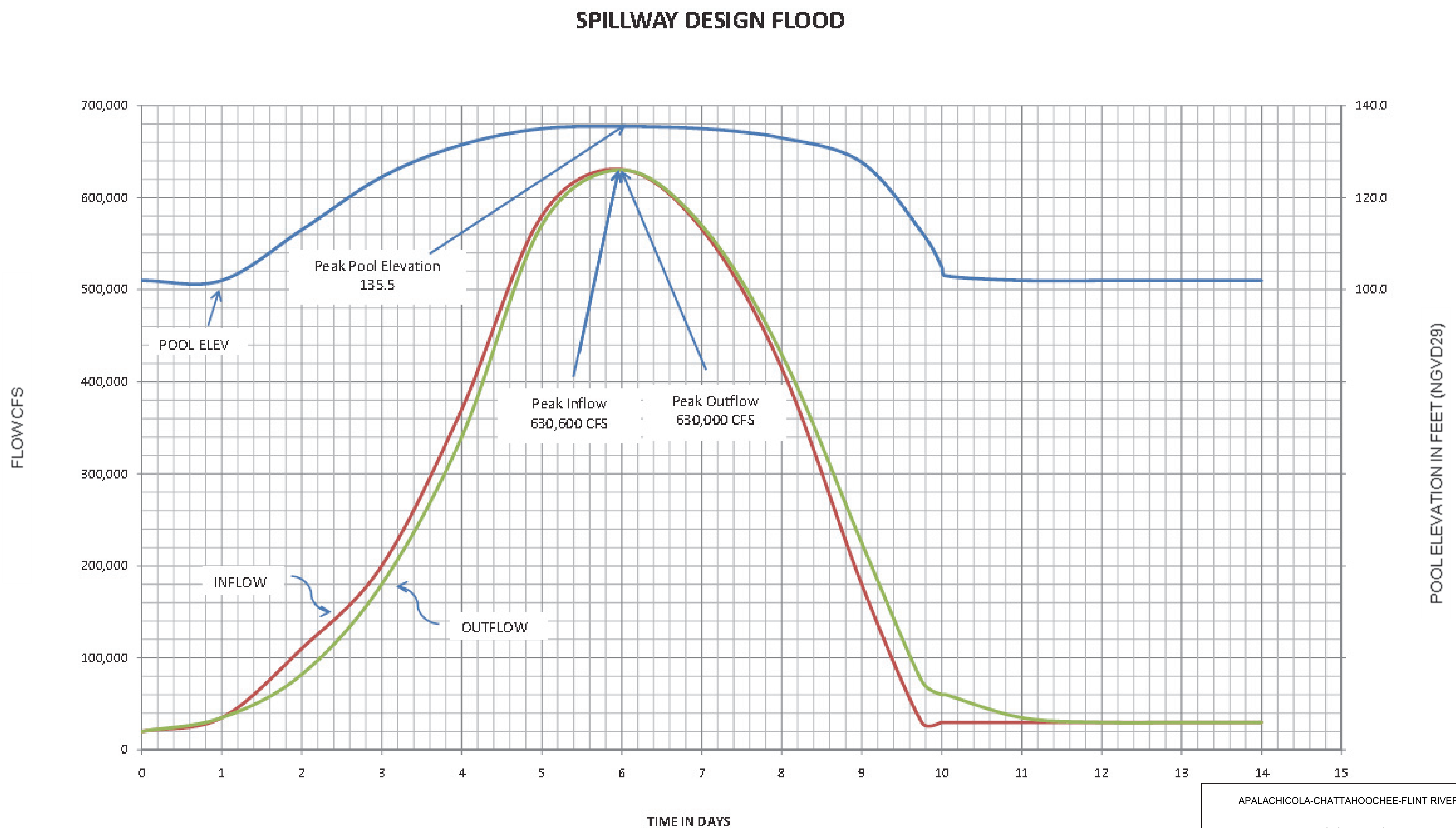
WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

DAILY FLOWS
OBSERVED FLOWS

PAGE 14 OF 14



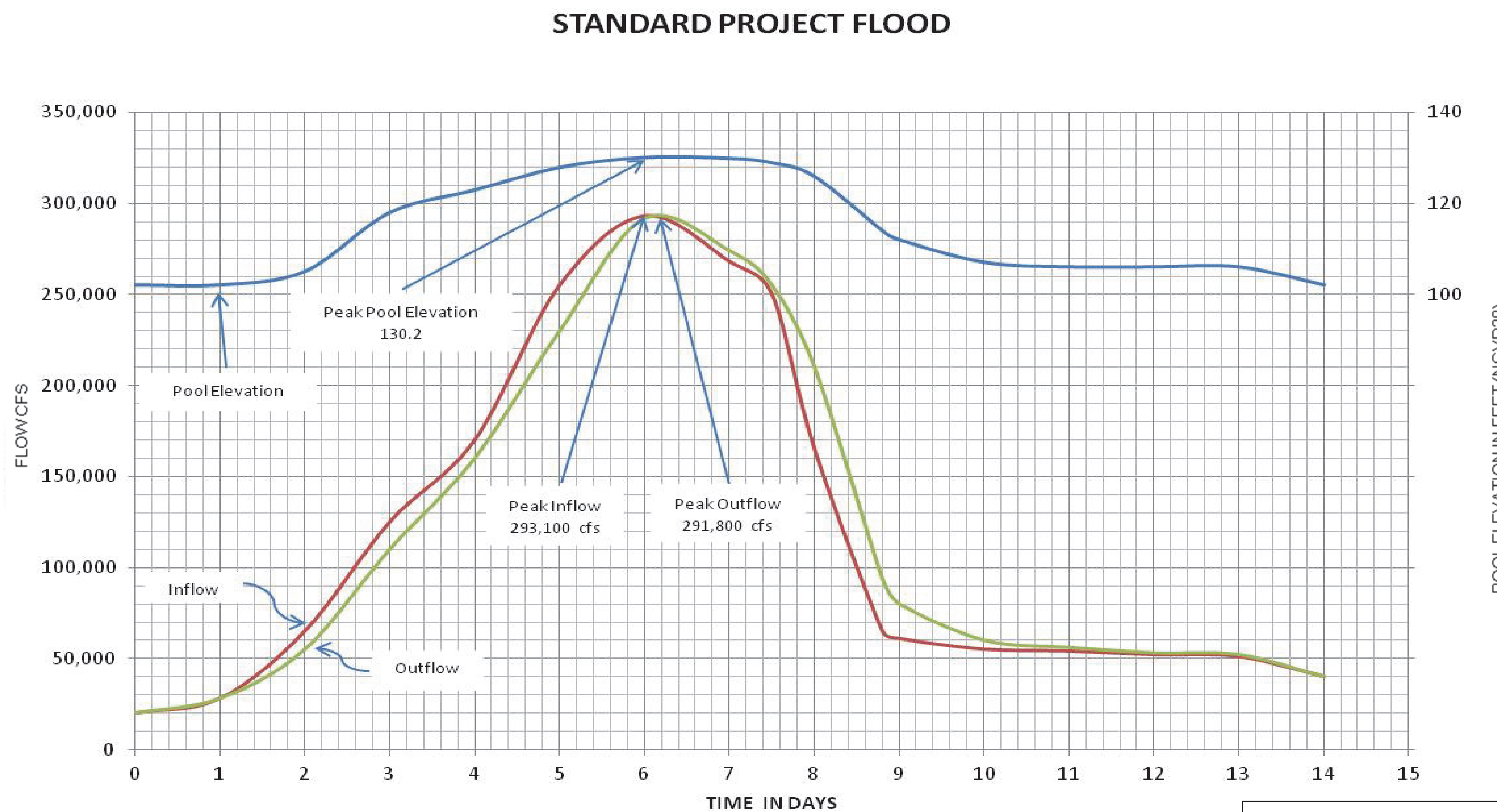
APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN
WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS
RIVER STAGE &
RAINFALL GAGE MAP



APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

SPILLWAY DESIGN FLOOD



APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

WATER CONTROL MANUAL
GEORGE A. ANDREWS LOCK AND DAM AND
LAKE GEORGE W. ANDREWS

STANDARD PROJECT FLOOD