US Army Corps of Engineers ®
Mobile District

ALABAMA-COOSA-TALLAPOOSA RIVER BASIN WATER CONTROL MANUAL

Final Draft
APPENDIX G

ROBERT F. HENRY LOCK AND DAM (R. E. “BOB” WOODRUFF LAKE)

ALABAMA RIVER, ALABAMA

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

SEPTEMBER 1974
REVISED XXX 2013

Robert F. Henry Lock and Dam
Alabama River, Alabama

NOTICE TO USERS OF THIS MANUAL

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

REGULATION ASSISTANCE PROCEDURES

If unusual conditions arise, contact can be made with the Water Management Section, Mobile District Office by phoning (251) 690-2730, during regular duty hours and (251) 509-5368 during non-duty hours. R. F. Henry Project personnel can be reached at (334) 875-4400 or (334) 872-4017.

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). It is the U.S. Army Corps of Engineer's 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 The relationships among existing, constructed, or maintained project grades that are referenced to local or superseded datums (e.g., NGVD29, MSL), the current NSRS, and/or hydraulic/tidal datums, have been established per the requirements of Engineering Regulation 1110-2-8160 and in accordance with the standards and procedures as outlined in Engineering Manual 1110-2-6056. A Primary Project Control Point has been established at this project and linked to the NSRS. Information on the Primary Project Control Point, designated 8A-10D, and the relationship between current and legacy datums are in Exhibit B.

ROBERT F. HENRY LOCK AND DAM

WATER CONTROL MANUAL
ALABAMA RIVER, ALABAMA
U.S. Army Corps of Engineers, Mobile District, South Atlantic Division

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

CONTENTS (Cont'd)

LIST OF TABLES

LIST OF FIGURES

CONTENTS (Cont'd)

LIST OF FIGURES

LIST OF EXHIBITS

CONTENTS (Cont'd)

LIST OF PLATES

PERTINENT DATA

GENERAL

Location – Autauga, Lowndes, Montgomery, and Elmore Counties, Alabama; Alabama River, river mile 236.3

Dam site. Miles above mouth of Alabama River	236.30
Total drainage area above dam site – sq. mi.	16,233

RESERVOIR

Length at elevation 126.0 feet NGVD29 – miles	81.1
Maximum Pool elevation – feet NGVD29	126
Area at pool elevation 126.0 – acres	13,500
Total volume at elevation 126.0 – acre-feet	247,210

GATED SPILLWAY

Total length, including end piers – feet	646
Number of piers, including end piers	12
Elevation of crest – NGVD29	91.0
Type and number of gates	Tainter – 11 gates
Size of gates – feet	50x35
Elevation of top of gates in closed position – NGVD29	126.0

EARTH OVERFLOW DIKES

Right Bank Dike	
Total length – feet	2,661
Top elevation – NGVD29	135.0
Top width – feet	32
Side slopes	1v on 8h
Left Bank Dike	
Total length including lock mound – feet	12,639
Top elevation – NGVD29	143.0
Top width – feet	32
Side slopes	1v on 2.5h

LOCK

Maximum lift – feet	47.0
Chamber size, length by width – feet	600 x 84

POWER PLANT

Number of Units	4
Generator rating, 4 units @ 20,500 each – kW	82,000
Plant output at rated net head	
Installed capacity at rated power factor – kW	82,000
Installed capacity at unity power factor – kW	
Maximum Static Head (feet)	47

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. This water control manual has been prepared as directed in the Corps' Engineering Regulation (ER) 1110-2-240, *Water Control Management, dated 8 October 1982*. This 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. This manual is also prepared under the format and recommendations described in ER 1110-2-8156, *Preparation of Water Control Manuals, dated 31 August 1995*; and ER 1110-2-1941, *Drought Contingency Plans, dated 15 September 1981*.

1-02. Purpose and Scope. The primary purpose of this manual is to document the water control plan for the Robert F. (R. F.) Henry Lock and Dam Project. Details of the coordinated reservoir regulation plan for R. F. Henry Lock and Dam within the multiple project system of the Alabama River are presented which insure optimum benefits consistent with the physical characteristics and purposes for which the system was authorized. Included are descriptions of physical components of the lock and dam, operating procedures, historical facts, and other pertinent data. Also presented are general characteristics of the area including flood frequencies, meteorology, and a discussion on river forecasting. In conjunction with the ACT Basin master water control manual, this manual provides a general reference source for R. F. Henry 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. The Alabama-Coosa-Tallapoosa River Basin Water Control Manual, of which this is Appendix G, contains general information for the entire basin. Appendices to the basin master manual are prepared for all reservoir projects within the basin when one or more project functions are the responsibility of the Corps. Other manuals published for use by project personnel include R. F. Henry Lock and Dam Operation and Maintenance Manual, and CESAM Plan 500-1-4, Emergency Notification Procedures. A list of all the appendices for the Alabama-Coosa-Tallapoosa (ACT) Basin and the master manual are listed below.

Alabama-Coosa-Tallapoosa River Basin Master Manual

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

1-04. Project Owner. The R. F. Henry Lock and Dam Project is a federally-owned project entrusted to the Corps, South Atlantic Division (SAD), Mobile District.

1-05. Operating Agency. The Corps' Mobile District operates the R. F. Henry Lock and Dam Project. Reservoir operation and maintenance are under the supervision of Operations Division. The project falls under the direction of the Operations Project Manager located at Tuscaloosa, Alabama. Maintenance staff duty hours at the R. F. Henry Powerhouse, known primarily as the Jones Bluff Powerhouse, are Monday – Thursday from 6:00 AM to 4:30 PM. The phone number is (334) 875-4400 during duty hours. The powerhouse can be operated at the R. F. Henry site or via remote control from the Millers Ferry Lock and Dam Project. The Millers Ferry Powerhouse can be called at (334) 682-9124. The lock is tended from 6:00 AM to 4:00 PM by operators under the direct supervision of a lock supervisor. Commercial traffic only may make arrangements for lock operation any time of the day or night by furnishing sufficient prior notice. The office phone number of the lock is (334) 872-9525.

1-06. Regulating Agencies. Authority for the water control regulation of the R. F. Henry Project has been delegated to the SAD Commander. Water control regulation activities are the responsibility of the Mobile District, Engineering Division, Water Management Section. When necessary, the Water Management Section instructs the powerhouse operators and lockmaster regarding normal procedures and emergencies for unusual circumstances.

II - DESCRIPTION OF PROJECT

2-01. Location. The R. F. Henry Lock and Dam Project is located in the south central part of the State of Alabama on the Alabama River at a point 236.3 miles above its mouth. It is approximately 15 miles east-southeast of Selma and 35 miles west of Montgomery, Alabama. The dam and the first 32.9 miles of the R. E. "Bob" Woodruff Lake are in Autauga County, which is along the right side of the river, and Lowndes County, which is along the left side of the river. For the next 9.7 miles the right side of the lake is still in Autauga County but the left side is in Montgomery County. The remainder of the lake is in Elmore County on the right side and Montgomery County on the left side. The location of the project is shown on Plate 2-1 and in Figure 2-1.

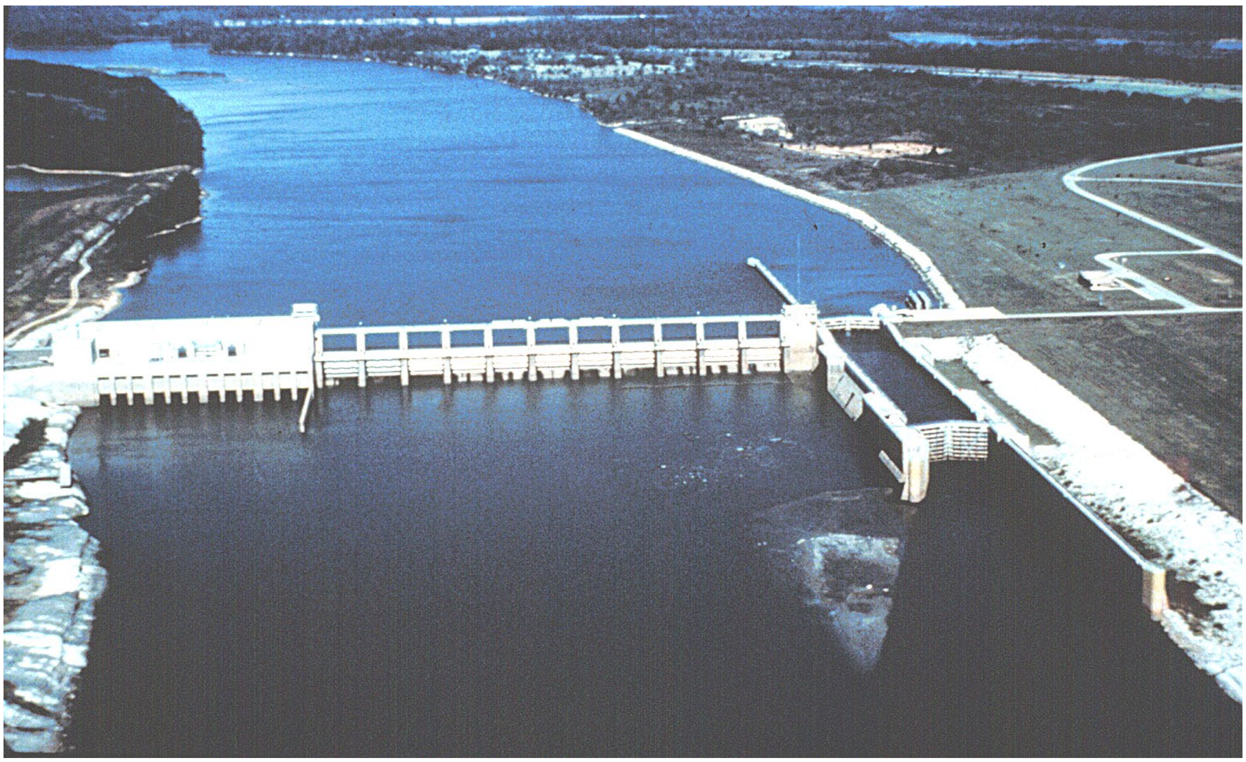


Figure 2-1. R. F. Henry Lock and Dam

2-02. Purpose. R. F. Henry Lock and Dam is a multiple purpose project. The River and Harbor Act of 1945, Public Law (P. L.) 79-14, authorized flood risk management, navigation, and hydropower. The operating purposes include navigation and hydropower. The minimum pool elevation of 123.0 feet National Geodetic Vertical Datum (NGVD29) provides for navigation to Wetumpka, Alabama 80 miles upstream. There is no flood risk management storage in this project; flood risk management was deleted from the project plan prior to construction. Several other project purposes have been added through general authorizations including water quality, recreation, and fish and wildlife conservation and mitigation. Access and facilities are provided for recreation, but water is not normally controlled for that purpose.

2-03. Physical Components. The R. F. Henry Project consists of a gravity-type dam with gated spillway supplemented by earth dikes, a navigation lock and control station, and an 82,000 kilowatt (kW) power plant. At full pool elevation 126.0 feet NGVD29, the reservoir formed by the dam extends upstream a maximum distance of approximately 81.1 miles to

Wetumpka on the Coosa River. Principal features of the project are described in detail in subsequent paragraphs. Sections, plan, and elevations of the dam and other features are shown on Plates 2-2 and 2-3.

a. Spillway. The spillway is a concrete-gravity structure equipped with 11 tainter gates 50 feet long and 35 feet high. The gate adjacent to the powerhouse is equipped with a trash gate that accommodates the passing of trash accumulations at the powerhouse and spillway. The spillway crest is at elevation 91.0 feet NGVD29. The top of gates in the closed position is elevation 126.0 feet NGVD29. The overall spillway length is 646 feet. The net length is 550 feet. The gates are mounted between 8-feet wide piers and are operated by individual hydraulically operated ratchet gear hoists that are located on top of the piers. A bridge for pedestrian traffic spans the top of the piers. The spillway joins the lock abutment on the left side and the powerhouse on the right side. The spillway stilling basin is a horizontal concrete apron with a 5-feet high sloping end sill. The basin extends downstream a maximum distance of 100 feet from the spillway gate seal, and the apron is stepped in a transverse direction from elevation 73.0 feet NGVD29 down to elevation 63.0 feet NGVD29.

b. Reservoir. The R. F. Henry Dam creates the R. E. "Bob" Woodruff Lake, which covers an area of 13,500 acres at pool elevation 126.0 feet NGVD29. The impounded water at pool elevation 126.0 feet NGVD29 has a total volume of 247,210 acre-feet. The maximum length of the reservoir at elevation 126.0 feet NGVD29 is 81.1 miles which consists of 69.0 miles up the Alabama River to its head at the confluence of the Coosa and Tallapoosa Rivers, then up the Coosa River 12.1 miles to Wetumpka. The lake at elevation 126.0 feet NGVD29 also extends to the tailrace of the Alabama Power Company's (APC) Walter Bouldin Dam that is located in a canal which runs from Jordan Lake to the Coosa River below Wetumpka. The reservoir also extends approximately 10 miles up the Tallapoosa River. Area and capacity curves are shown on Plate 2-4, and selected area and capacity values are tabulated on Table 2-1.

c. Earth Dikes. The earth dike on the right overbank is 2,661 feet long and connects the powerhouse with high ground to the northwest. A roadway along the dike provides access to the powerhouse. The top of the dike is at elevation 135.0 feet NGVD29 except the portion which slopes upward to the level of the switchyard at elevation 143.0 feet NGVD29. Floods of sufficient magnitude to overtop the dike have a recurrence frequency of once in nine years. Both the upstream and downstream slopes of the dike are protected with grouted riprap against high velocities that occur during overtopping. The dike on the left overbank is a non-overflow section with a top elevation of 143.0 feet NGVD29 and has an access road along its entire length. Considering the distance across the lock esplanade and an adjacent spoil area as part of the dike the total length is 12,639 feet. The top elevation of 143.0 feet NGVD29 is slightly above the computed headwater elevation of the standard project flood series. No riprap is provided on the slopes of this dike since the base is above the maximum pool level, elevation 126.0 feet NGVD29.

d. Lock. The lock is located in the left bank between the spillway and the left overbank earth dike. The lock chamber is 84 feet wide and is 655 feet long between gate pintles. The usable length is slightly over 600 feet. The top of the upper gate blocks and the top of the upstream miter gate are at elevation 143.0 feet NGVD29. The top of all other walls and the downstream miter gate are at elevation 132.0 feet NGVD29. The top of the upper miter sill is at elevation 109.0 feet NGVD29, 17 feet below the full upper pool elevation 126.0 feet NGVD29. The top of the lower miter sill is at elevation 67.0 feet NGVD29, 13.8 feet below the Millers Ferry full pool elevation 80.8 feet NGVD29. The lock filling and emptying system consists of two intake ports in the riverside face of the upper gate block, a longitudinal culvert in each of the chamber walls, a system of floor culvert in the chamber, and a discharge system that empties outside the lower approach. Reverse-tainter valves control flow in the culverts. The volume of water discharged in acre-feet for each time the lock is emptied can be determined by multiplying the gross head by 1.264.

Table 2-1. R. E. "Bob" Woodruff Lake Area and Capacity

POOL ELEV. (FEET NGVD29)	TOTAL AREA (ACRES)	TOTAL STORAGE (ACRE-FEET)		POOL ELEV. (FEET NGVD29)	TOTAL AREA (ACRES)	TOTAL STORAGE (ACRE-FEET)
64	0	0		[2]122	10,470	200,030
65	10	10		[3]123	10,990	210,760
70	80	200		124	11,700	222,100
75	240	970		125	12,510	234,210
80	600	2,970		[4,5]126	13,500	247,210
85	1,280	7,550		127	14,580	261,250
90	2,150	16,140		128	15,640	276,360
[1]91	2,320	18,370		129	16,650	292,510
95	2,970	28,590		130	17,730	309,700
100	3,900	46,040		131	19,150	328,140
105	5,260	68,880		132	20,550	347,990
110	6,660	98,740		133	22,300	369,410
115	8,110	135,700		134	24,050	392,590
116	8,400	143,950		[6]135	26,380	417,800
117	8,690	152,500		136	28,800	445,390
118	9,000	161,340		137	31,500	475,470
119	9,310	170,500		138	33,700	507,990
120	9,630	179,970		139	36,000	542,840
121	10,010	189,790		140	38,400	580,040

[1] Spillway crest
[2] Emergency drawdown elevation
[3] Maximum allowable drawdown
[4] Maximum operating pool elevation
[5] Top-of-gates - closed position
[6] Crest of free overflow dike

e. Lock Control Station. The control station is located between the spillway and lock adjacent to the upper gate block of the lock. The building is of reinforced concrete construction three stories high. It contains an office and the mechanical and electrical equipment necessary for operation of the lock and spillway. The third floor provides access to the spillway bridge.

f. Powerhouse. The powerhouse at the R. F. Henry Dam retained its original name as the Jones Bluff Powerhouse. It is situated in the right bank of the river adjoining the switchyard and parking area mound to the west. It joins the end of the spillway section to the east or river-side. The building is a reinforced concrete structure, 375 feet long and 160 feet wide. It consists of four generation bays and one erection bay. The generation bays each contain a fixed-blade propeller-type turbine rated at 23,480 horsepower at a head of 28.2 feet. The turbine is connected to a vertical-shaft generator rated at 20,500 kW. The intake is an integral part of the powerhouse structure and is positioned on the axis of the spillway.

g. Switchyard. The switchyard is located on the west side of the powerhouse which is the right bank of the river. It is joined on the west by the right overbank dike. The top elevation of the switchyard mound is 143.0 feet NGVD29. The principle structure in the switchyard is the main takeoff for the outgoing lines. There are other structures for busses, disconnecting switches, and potential transformers.

2-04. Related Control Facilities. The Jones Bluff Powerhouse can be operated remotely from the Millers Ferry Powerhouse and the Millers Ferry Powerhouse from Jones Bluff.

2-05. Real Estate Acquisition. Land acquisition authorization for the R. F. Henry Project was enacted under P.L. No.14, dated 2 March 1945. The acreage acquired for all project purposes totals 19,318.980 acres. Of that total acreage, 5,407.200 acres were acquired in fee and 13,911.780 acres were acquired by perpetual easement.

The acquisition guide lines for flowage easements were based upon backwater computations with the acquisition limits being established at the elevation where the backwater effect with the dam in place is less than one foot. The profiles were developed using flows from 75,000 cfs to 125,400 cfs. The highest flows were for a natural recurrence frequency of once every 1.5 years. The acquisition guide line thus adopted begins at elevation 127.0 feet NGVD29 at the dam, mile 236.3, and continues at that elevation to mile 242.4; then on a uniform slope to elevation 130.5 feet NGVD29 at mile 254.9; then to elevation 131.0 feet NGVD29 at mile 261.9; and then to elevation 139.5 feet NGVD29 at mile 305.3, at the junction of the Coosa and Tallapoosa Rivers. There are a total 12 Real Estate Segment Maps traversing Autauga, Elmore, Lowndes, and Montgomery Counties, which depict the 527 tracts acquired and the final acquisition limits based on the aforementioned elevations. An overview of the real estate acquisition areas are shown on Plates 2-5 and 2-6.

2-06. Public Facilities. R. E. “Bob” Woodruff Lake, impounded by R. F. Henry Lock and Dam, greatly enhances the opportunities for water-oriented recreation. The lake offers such activities as fishing, boating, water skiing, picnicking, camping, swimming, and hiking. The project features 17 primary recreation facilities that are rustic but well facilitated for visitors. Fifteen of the sites are operated by the Corps and have approximately 3,978 total acres. The Fort Toulouse National Historic Park is operated and maintained by the State of Alabama and has approximately 183 total acres. Powder Magazine is operated by the city of Montgomery and has approximately 58 total acres. Conveniences at the parks include beaches, campgrounds, picnic areas, trails, and boat launching ramps. Since the first park was constructed in 1975, annual attendance has risen to over two million. Public facilities at Woodruff Lake are listed in Table 2-2 below and are shown on Plate 2-7. The phone number for the Resource Managers Office for the Alabama River Lakes, at the R. F. Henry site is (334) 872-8210.

Table 2-2. R. E. "Bob" Woodruff Lake Public Facilities

	Boat Launch	Marina	Camping	Play Ground	Picnic	Swimming Beach	Trails
Benton	y				y		
Cooters Pond	y						
Damsite East Bank							
Damsite West Bank							
Ft. Toulouse	y		y		y		
Gunter Hill Campground	y		y	y	y		y
Holy Ground Battlefield Park	y				y	y	y
Montgomery Marina		y					
Powder Magazine	y	y					
Prairie Creek	y		y	y	y		y
Swift Creek	y						

III - HISTORY OF PROJECT

3-01. Authorization. The original project for the improvement of the Alabama River was authorized by Congress on 18 June 1878 to provide for a navigation channel four feet deep and 200 feet wide from the mouth to Wetumpka and was modified on 13 July 1892 to provide a 6-feet channel. Subsequent acts approved in 1905 and 1910 provided for a channel 4-foot deep at low water from the mouth to Wetumpka by the use of contracting dikes and dredging. This project was 62 percent complete in 1942, the last year that any new work was performed. The 9-foot navigation channel was authorized by the River and Harbor Act of March 2, 1945 (P. L. 79-14). The authorization refers to House Document 77-414. The House Document recommended the authorization of a general plan for the basin "...in accordance with plans being prepared by the Chief of Engineers." The basin plan at that time contemplated a 9-foot deep navigable channel from the mouth of the Alabama River to Rome, Georgia, to be achieved by open river works and locks and dams.

3-02. Planning and Design

The first comprehensive report on the optimum use of the water resources of the basin was prepared by the Corps in 1934, and was printed as House Document No. 66, 74th Congress, 1st session (308 Report). The plan contemplated five navigation dams on the Alabama River.

A resolution of the Committee on Rivers and Harbors, House of Representatives, passed on 28 April 1936, requested that a review be made to determine if changes in economic conditions might warrant modification of the recommendations in House Document No. 66, 74th Congress, with regard to the Alabama River. A resolution of the Committee on Commerce, U. S. Senate, adopted 18 January 1939, requested a review to determine the advisability of constructing reservoirs on the Alabama-Coosa Rivers and tributaries for development of hydroelectric power and improvement for navigation

The Chief of Engineers in a report submitted on 15 October 1941 and printed as House Document No. 414, 77th Congress, 1st Session recommended a general plan for the development of the basin. Congress authorized in the River and Harbor Act of 2 March 1945 (P. L. 14, 79th Congress) the initial and partial accomplishment of this plan. Planning studies for the initially authorized projects on the Alabama River to provide navigation facilities with the maximum hydroelectric power feasible began in 1945.

A site selection report for the entire Alabama River was submitted on I0 December 1945, which determined that the overall project for the Alabama River should consist of dredging in the lower river, and navigation dams and locks at Claiborne, Millers Ferry and Jones Bluff upstream with power plants added to the latter two projects. The first design memorandum for Jones Bluff presenting "Basic Hydrology" was submitted on 30 April 1963. It was followed by the "General Design" on 16 March 1964 and then by 19 design memoranda for particular features of the project during the next eight years.

3-03. Construction

The first phase of construction placed under contract at the R. F. Henry Project was the lock excavation, which commenced on 7 February 1966, and was completed on 1 October 1966. No other work was contracted because of delays in funding until 1968. The Dravo Corporation was awarded a contract for construction of the lock, nine gate-bays of the spillway, the earth overbank dikes, the access roads, and the lock mound on 17 April 1968. The work under that contract was completed 15 October 1971 at a total cost of $16,417,377.38.

The second-stage cofferdam was completed in October 1970, which closed the river channel. The reservoir was not filled at the time because of reservoir clearing operations under way in the lower reaches. The river flow was passed through the gate bays in the completed portion of the spillway. In November 1971 filling was begun in conjunction with clearing operations in the upper reaches of the reservoir. When clearing was completed in December 1971 the reservoir was filled to pool elevation 125.0 feet NGVD29. The first navigation through the lock was allowed in January 1972 and the facility was officially opened to navigation on 15 April 1972.

A contract for construction of the powerhouse and the last two gate bays of the spillway was awarded on 23 June 1972 to Peter Kiewlt and Sons along with Standard Construction Company as a joint venture. The power units were placed in operation in 1975 at approximately three month intervals for each unit.

Spillway Gate No. 1 was modified in 1990 to include a trash gate which accommodates the passing of trash accumulations at the powerhouse and spillway. As shown in Figure 3-1, hydraulic arms are used to slide the upper portion of the spillway gate down which allows trash and water to spill over the top of the gate.

Figure 3-1. Trash Gate at R. F. Henry Dam

3-04. Related Projects. The R. F. Henry Lock and Dam Project is the third major unit of the navigation system developed on the Alabama River by the Corps. Millers Ferry Lock and Dam, located downstream at river mile 133.0, also has hydropower capability. Claiborne Lock and Dam is located downstream of Millers Ferry at river mile 72.5.

3-05. Modifications to Regulations

P.L. 94-538 [S.2533]; October 18, 1976, designated "the lake formed by the lock and dam referred to as the "Jones Bluff lock and dam" on the Alabama River, Alabama, as 'R. E. "Bob" Woodruff Lake'."

P. L. 97-383 [S. 2034]; December 22, 1982, renamed the Jones Bluff Lock and Dam to the "Robert F. Henry Lock and Dam." The original name of the powerhouse, "Jones Bluff Powerhouse", was retained.

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

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Alabama-Coosa-Tallapoosa River System drains a small portion of Tennessee, northwestern Georgia, and northeastern and east-central Alabama. The Alabama River Basin has its source in the Blue Ridge Mountains of northwest Georgia. The main headwater tributaries are the Oostanaula and Etowah Rivers, which join near Rome, Georgia, to form the Coosa River. The Coosa River in turn joins the Tallapoosa River near Wetumpka, Alabama, approximately 14 miles above Montgomery, Alabama, to form the Alabama River. Plate 2-1 shows a map of the ACT River Basin.

The drainage basin is approximately 330 miles in length, and averages 70 miles wide with a maximum width of about 125 miles. The basin has a total drainage area of 22,500 square miles of which 16,233 square miles are above R. F. Henry Lock and Dam. In the early 1990's the Alabama-Coosa River Basin became more widely known as the Alabama-Coosa-Tallapoosa, or ACT River Basin.

4-02. Topography. The ACT River Basin is composed of an unusually wide range of topographic areas. The location of the river basin is within parts of five physiographic provinces: the Blue Ridge Province; the Valley and Ridge Province; the Piedmont Plateau; the Cumberland Plateau; and, the Coastal Plain. Each of these physiographic sub-divisions influences drainage patterns. High rounded mountains and steep narrow valleys characterize the northeastern portion of the basin in the Blue Ridge Province. Overburden is sparse except in the valley flood plains. The topography of the Valley and Ridge Province is alternating valleys and ridges with altitudes varying from approximately 600 to 1,600 feet. The dominant characteristics of the Cumberland Plateau are flat plateaus ranging in altitude from 1,500 to 1,800 feet that bound narrow, northeast-southwest trending valleys. Rolling hills and occasional low mountains topographically characterize the Piedmont Province. Altitudes range from 500 to 1,500 feet. Low hills with gentle slopes and broad shallow valleys that contain slow-moving meandering streams with wide floodplains characterize the topography of the Coastal Plain. The Alabama River flows through a broad lowland valley that varies in width from three to 10 miles throughout the length of the R. F. Henry Lock and Dam Project. To the south the river borders the Black Belt, a prairie land so named for its rich, black soil and flat to gently rolling prairie land developed over the Selma Chalk Formation. The northern side of the river is bounded by stable formations that are more resistant to erosion. Exposed hillsides with a greater relief are characteristic of this northern side. The river strikes a broad, meandering, westerly course through the valley falling at a rate of 0.5-foot per mile. Normal river elevation is below the floodplain. There are numerous tributaries entering the river from both sides and are rather evenly distributed between the upper and lower limits of the lake.

4-03. Geology and Soils.

The ACT River Basin covers an unusually wide range of geologic conditions. The location of the river basin is within parts of five physiographic provinces: the Blue Ridge Province; the Valley and Ridge Province; the Piedmont Plateau; the Cumberland Plateau; and, the Coastal Plain. Each of these physiographic sub-divisions influences drainage patterns. Rugged crystalline rocks characterize the northeastern portion of the basin in the Blue Ridge Province. Folded limestone, shale, and sandstone compose the Valley and Ridge Province. The axes of the folds that trend northeast-southwest influence the course of the streams in that they tend to flow southwestward along the alignment of the geologic structure. Like the Valley and Ridge Province -- folded, faulted, and thrusted rocks form the Cumberland Plateau -- with the deformation being less than the Valley and Ridge rocks. The east-central portions of the basin are in the Piedmont Province, characterized by sequences of metamorphic and igneous rocks. Prominent topographic features generally reflect the erosional and weathering resistance of quartzite, amphibolite, and plutonic rocks. The residual soils are predominately red sandy clays and gray silty sand derived from the weathering of the underlying crystalline rocks. The more recent sedimentary formations of the Coastal Plain underlie the entire southern portion of both river basins. The contact between the Coastal Plain on the south and the previously described physiographic provinces to the north is along a line that crosses the Cahaba River near Centreville, Alabama; the Coosa River near Wetumpka, Alabama; and the Tallapoosa River near Tallassee, Alabama. As the rivers leave the hard rocks above this line and enter the softer formations of the Coastal Plain, the erosion properties change, resulting in the formation of rapids. This line is a geological divide commonly known as the "fall line". The rocks of the Coastal Plain are typically poorly consolidated marine sediments.

Overlying the bedrock at the R. F. Henry Lock and Dam site are layers of fine and coarse grained soils that average 30 feet in thickness. The fine-grained soils consist of silty clay, silty sand and fat clay. The clays were deposited in depressions and range in thickness up to 25 feet. Below the fine grained soils is a layer of poorly graded sand and poorly graded gravel that averages 20 feet in thickness. Underlying the sand and gravel is a soft, residual layer of clay overlying bedrock that generally slopes towards the river channel.

Two geologic formations exist at the project. The Selma Chalk Formation comprises the upper rock section and ranges in thickness from 100 to 135 feet. The Selma Chalk Formation is composed of gray, calcareous chalk, siltstone and claystone with thin layers of green clay. The Eutaw Sand Formation underlies the Selma Formation and ranges in thickness up to 400 feet. The sand is fine to medium grained, green to gray, micaceous and fossiliferous. The Eutaw Formation contains groundwater under artesian pressure.

The geologic structure at the project is a monocline dipping about 35 feet per mile in a southwesterly direction. The Selma Chalk Formation thickens in the downstream direction and includes about 1000 feet of calcareous rocks at full thickness.

4-04. Sediment. Sedimentation ranges were established for the entire reservoir length and the original surveys were made in 1974. The ranges were resurveyed in 1982, 1988, and again in 2009. Key ranges are resurveyed at regular intervals for any appreciable changes in channel geometry. The latest survey was in 2009 and is retained in the Hydraulic Data and Sedimentation Unit at the Mobile District Office. Sedimentation range locations are shown on Plates 4-1.

Based on the 2009 survey data, the R.E. “Bob” Woodruff Lake has heavy deposition and acute right bank erosion on the Tallapoosa River arm at range 16A and slight to moderate erosion on the Coosa River arm at range 17A. The Alabama River ranges appear relatively stable. Shoreline conditions are fairly uniform along the length of the lake with about two-thirds of the shorelines experiencing erosion and the remaining one-third being depositional.

4-05. Climate

a. <u>Temperature</u>. The ACT Basin area has long, warm summers, and relatively short, mild winters. In the southern end of the basin, the average annual temperature is 64 degrees Fahrenheit (°F) with a mean monthly range from 45 °F in January to 80 °F in July and August. In the northern end, the average annual temperature is 60 °F with a mean monthly range from

40 °F in January to 78 °F in July. Extreme temperatures recorded in the basin range from a low of minus 17 °F at Lafayette, Georgia, in January 1940 to a high of 112 °F at Centreville, Alabama, in September 1925. The frost-free season varies from about 200 days in the northern valleys to about 260 days in the southern part of the basin. The maximum, minimum, and mean monthly and annual temperatures for locations in or near the R. F. Henry watershed are shown on Table 4-1. Extremes and average temperature data at six representative stations throughout the basin are shown on Plate 4-2. The location of the stations is shown on Plate 4-3.

Table 4-1. Normal 30-year Air Temperature for Selected Sites in/near R. F. Henry Basin
(Based on 1981 to 2010 Normals published by National Weather Service)

Normal Temperature Based on 30-Year Period – 1981 Through 2010 (degrees Fahrenheit)														
Station		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**ANNUAL**
Martin Dam (015140)	Max	55.2	59.6	67.5	74.3	81.5	87.9	90.6	89.1	84.6	76.0	66.1	57.4	74.2
	Mean	44.7	47.8	54.5	61.2	69.3	76.4	79.5	78.8	73.8	63.8	54.6	46.6	62.7
	Min	34.2	36.0	41.5	48.1	57.2	64.8	68.4	68.5	63.0	51.5	43.1	35.7	51.1
Montgomery (015553)	Max	57.5	62.1	69.6	76.6	84.2	89.1	91.8	91.3	86.0	77.6	69.0	60.1	76.3
	Mean	46.3	50.5	57.1	63.7	71.8	78.3	80.9	80.6	75.0	64.7	56.2	48.4	64.5
	Min	35.1	38.9	44.7	50.9	59.5	67.4	70.1	70.0	64.0	51.9	43.4	36.6	52.8
Wetumpka (018859)	Max	56.1	60.5	68.7	75.1	82.3	87.7	90.3	89.8	86.1	76.5	67.5	58.2	75.0
	Mean	45.5	49.5	56.5	62.5	71.0	77.6	80.6	80.1	75.7	65.3	55.6	47.8	64.0
	Min	34.9	38.5	44.2	49.8	59.6	67.5	70.8	70.4	65.3	54.0	43.7	37.3	53.1
Selma (017366)	Max	57.4	61.5	69.6	76.4	84.0	89.8	92.0	91.6	86.9	77.7	68.6	59.1	76.3
	Mean	46.4	50.2	57.1	63.7	72.3	79.1	81.7	81.3	76.2	65.9	56.2	48.2	64.9
	Min	35.4	38.9	44.7	51.0	60.5	68.3	71.3	70.9	65.5	54.0	43.7	37.3	53.5
R. F. Henry Basin	Max	56.6	60.9	68.9	75.6	83.0	88.6	91.2	90.5	85.9	77.0	65.3	58.7	75.5
	Mean	45.7	49.5	56.3	62.8	71.1	77.9	80.7	80.2	75.2	64.9	55.7	47.8	64.0
	Min	34.9	38.1	43.8	50.0	59.2	67.0	70.2	70.0	64.5	52.9	43.5	36.7	52.6

b. Precipitation. The ACT Basin lies in a region of heavy annual rainfall which is fairly well distributed throughout the year. The normal annual precipitation for the R. F. Henry Project area is 50.69 inches. Fifty-eight percent of the rainfall occurs during the winter and spring months, 23 percent in the summer, and 19 percent in the fall. The average monthly and annual precipitations for various reporting stations near the R. F. Henry Project are shown on Table 4-2. The locations of the stations are the same as the temperature stations with the exception of Jordan Dam precipitation which is provided due to the lack of precipitation data at the Martin Dam location. Station locations are shown on Plate 4-3. The maximum calendar year rainfall over the ACT Basin was 78 inches in 1929 and the minimum annual was 32 inches in 1954. The highest annual station rainfall recorded in the ACT Basin was 104.03 inches at Flat Top, Georgia, in 1949; the lowest recorded was 22.00 inches at Primrose Farm, Alabama, in 1954. The light snowfall that occasionally occurs seldom covers the ground for more than a few days and has never affected any major flood in the basin. Precipitation extremes and averages for the basin are shown on Plate 4-4.

Table 4-2. Normal 30-year Precipitation for Selected Sites in/near R. F. Henry Basin
(Based on 1981 to 2010 Normals published by National Weather Service)

Normal Precipitation Based on 30-Year Period – 1981 Through 2010 (inches)														
Station		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
Jordan Dam (014306)	Mean	4.11	5.10	4.23	4.02	3.32	3.85	4.72	3.10	3.62	2.94	4.30	4.26	47.57
Montgomery (015553)	Mean	4.62	5.08	5.47	3.97	3.65	4.62	5.27	4.22	3.64	3.05	4.67	4.54	52.80
Wetumpka (018859)	Mean	4.45	5.27	5.66	3.88	3.37	4.22	4.93	4.30	3.37	2.90	4.20	4.74	51.29
Selma (017366)	Mean	4.75	5.03	5.47	3.93	3.26	4.07	4.72	4.42	3.32	2.68	4.55	4.89	51.09
R. F. Henry Basin	Mean	4.48	5.12	5.21	3.95	3.40	4.19	4.91	4.01	3.49	2.89	4.43	4.61	50.69

4-06. Storms and Floods

a. General. Flood-producing storms may occur over the basin anytime but are more frequent during the winter and early spring. These storms are usually of the frontal variety lasting two to four days. Summer storms are the convective type thundershowers with high intensity rainfall over small areas which produce local floods. In the fall, occasional heavy rains may accompany dissipating tropical cyclones.

b. Record Floods. A major storm system in the spring of 1990 produced record floods on the Alabama River. On 16 March 1990, with the river still high from previous rains, the entire basin received very heavy rainfall for two days. For the two-day total R. F. Henry reported nine inches, Millers Ferry reported 6.75 inches and Claiborne had 9.5 inches. The upper basin received an average of six to seven inches during this period. R. F. Henry discharged a record-breaking 220,000 cfs on 20 March 20 1990, producing a record tailwater of 135.4 feet NGVD29. The largest known flood for the entire period of record is the historical flood of February-March 1961 with a peak discharge of 283,200 cfs. Another significant flood occurred on 11-16 March 1929, when 10 inches of rainfall over a period of three days was recorded in the vicinity of Auburn, Alabama. A peak discharge was not recorded for the historical flood of April 1886, which is the greatest flood on record for the Millers Ferry Project downstream of R. F. Henry.

4-07. Runoff Characteristics. The tributaries contributing flow to the Alabama River above the R. F. Henry Dam exhibit wide variations in runoff characteristics. They range from very flashy in the mountainous regions of the Coosa Basin above Rome, Georgia, to very slow rising and falling in the lower reaches. The mean annual discharge for the period January 1929 through December 1999 is 23,386 cfs or about 1.3 cfs per square mile.

The average daily discharges shown on Plates 4-5 through 4-11 and the mean monthly and annual flows on Plates 4-12 through 4-13 were developed from data for the USGS gages at Selma and Montgomery, Alabama, and at the R. F. Henry Project. The data at Selma and Montgomery, Alabama, were adjusted using area ratios to the R. F. Henry site. The data was extended to 1939 to provide the same coverage as was in the previous water control manual. All three gages were needed to provide complete coverage.

4-08. Water Quality. Generally, the surface waters of the Alabama River Basin are of good chemical quality. Overall, the water quality of the R. E. "Bob" Woodruff Lake is adequate. Water quality in Woodruff Lake is influenced by physical dynamics (depth, temperature, flow, etc.) Stratification and turnover are not significant issues due to generally shallow depth. There are also various sources of pollutant loads to the lake including tributaries and upstream contributions, both point and non-point. Upstream sources are dominated by those pollutants entering directly via the Alabama River. Point sources are generally municipal and industrial discharges regulated by the Alabama Department of Environmental Management (ADEM) and agricultural practices contribute the largest percentage of non-point pollutants.

The reservoir has not been identified by ADEM in its 2012 Draft 303(d) list as violating State water quality standards. ADEM has not set a standard for chlorophyl*l a* in the lake. The average chlorophyll *a* measured in mid lake by ADEM during the 2005 wet year was 12.83 µg/L and in the 2000 dry year 18.6 µg/L. The ADEM standard for dissolved oxygen is a minimum 5.0 mg/L. Dissolved oxygen levels generally remain above 6.0 mg/L in mid-lake. The ADEM standard for water temperature is a maximum 90 °F. Temperatures in Woodruff reservoir range generally from 50 °F to 86 °F with occasional peaks of about 90 °F. In shallower embayments there are greater fluctuations in these parameters and occasionally the standards are not met.

4-9. Channel and Floodway Characteristics. The navigation channel from the mouth of the Alabama River to Montgomery, Alabama has an authorized depth of nine feet and a width of 200 feet. There are no major flood damage centers immediately downstream of the R. F. Henry Project.

4-10. Upstream Structures. Above R. F. Henry Lock and Dam are APC hydroelectric projects on the Coosa and Tallapoosa Rivers and two Corps projects, Allatoona and Carters, located above the APC Coosa projects. The Hickory Log Creek Project was constructed in 2007 by the city of Canton, Georgia and Cobb County–Marietta Water Authority (CCMWA), and is located approximately 25 miles northeast of Allatoona Dam. Table 4-3 shows these upstream projects and their drainage areas as well as data for R. F. Henry and downstream projects, Millers Ferry, and Claiborne.

4-11. Downstream Structures. Below R. F. Henry Lock and Dam are two Corps projects, Millers Ferry and Claiborne Locks and Dams. Millers Ferry has a drainage area of 4,404 square miles from R. F. Henry to Millers Ferry. Claiborne has a drainage area of 836 square miles from Millers Ferry to Claiborne.

Table 4-3. COE, APC, and Canton/CCMWA Projects in the ACT

Agency	Alabama River Projects	Drainage Area sq. mi.
COE	**Claiborne	21,473
COE	**Millers Ferry	20,637
COE	RF Henry	16,233
	Coosa River Projects	
APC	*Jordan/Bouldin	10,165
APC	Mitchell	9,830
APC	Lay	9,087
APC	Logan Martin	7,700
APC	Henry	6,600
APC	Weiss	5,273
COE	Allatoona	1,122
COE	Carters	374
Canton/CCMWA	***Hickory Log Creek	8
	Tallapoosa Projects	
APC	Thurlow	3,325
APC	Yates	3,250
APC	Martin	3,000
APC	Harris	1,453

* Jordan Dam is located on the Coosa River at river mile 18.9. Walter Bouldin Dam is located on a by-pass of the Jordan Dam and discharges into a canal which enters the Woodruff Lake at Coosa River mile 4.2.
** Downstream projects
*** Water is pumped directly from the Etowah River to support project, thus such a small drainage area.

4-12. Economic Data. The watershed surrounding the R. F. Henry Project consists of Autauga and Lowndes Counties within Alabama. The watershed includes both developed urban and residential land uses and rural land uses within the watershed.

a. Population. The 2010 population of the two counties bordering the R. F. Henry Project totaled 65,870. The city of Prattville, located in Autauga County, has a population of 33,960. This accounts for more than half the population within the counties. The income data for each county is shown in Table 4-4.

Table 4-4. Income Data per County

County	Population (2010)	Per Capita Income	Persons living below poverty
Autauga County	54,571	24,568	10.6%
Lowndes County	11,299	16,524	27.3%
Total	65,870	41,092	

b. Agriculture. The R. F. Henry watershed and basin below consist of approximately 800 farms averaging 393 acres per farm. In 2005, the agricultural production in the area totaled $148 million in farm products sold and total farm earnings of $17 million. Agriculture in the R. F. Henry watershed consists primarily of livestock, which accounts for 71 percent of the value of farm products sold. Table 4-5 contains agricultural production information and farm earnings for each of the counties within the R. F. Henry watershed and basin below.

Table 4-5. Agricultural Production and Income per County

County	2005 Farm Earnings ($1,000)	Number of Farms	Total Farm Acres (1,000)	Acres Per Farm	Value of Farm Products Sold ($1,000)	Percent Sold From	
						Crops	Livestock
Alabama							
Autauga County	$7,902	373	118	318	$49,871	43.70%	56.30%
Lowndes County	$10,736	420	197	468	$98,862	15.00%	85.00%
Totals	$18,638	793	315	393	$148,733	29.35%	70.65%
Source: U.S. Census Bureau, County and City Data Book: 2007							

c. Industry. The leading industrial sectors that provide non-farm employment are wholesale and retail trade, services, and manufacturing. In 2005, the R. F. Henry Project area counties had 41 manufacturing establishments that provided 3,032 jobs with total earnings of more than $182 million. Table 4-6 shows information on the manufacturing activity for each of the counties in the R. F. Henry Project watershed and basin below.

Table 4-6. Manufacturing Activity per County

County	No. of Manufacturing Establishments	Total Manufacturing Employees	Total Earnings ($1,000)	Value Added by Manufactures ($1,000)
Alabama				
Autauga County	29	1,827	116,715	(D)
Lowndes County	12	1,205	66,046	106,061
Totals	41	3,032	182,761	

(D)-Data withheld to avoid disclosure *Source: U.S. Census Bureau, County and City Data Book: 2007*

d. Flood Damages. Because the dam is considered a run-of-the-river project, with very little storage, there are no quantifiable flooding impacts from the project. A table of water surface elevations at R. F. Henry and associated impacts is shown on Table 4-7.

Table 4-7. Flooding Impacts and Associated R. F. Henry Gage Elevation

R. F. HENRY GAGE HT	Flooding Impacts
(FEET NGVD29)	
122	Flooding of agricultural land begins
127	Widespread flooding of farmlands and of some homes and trailers along the river occurs.
132	Portions of Benton begin to flood. Numerous house trailers along the river become flooded if not moved to higher ground.
134	Portions of Autaugaville begin to flood. In addition sections of the western railway of Alabama Railroad begin to flood at this level. At 135 feet NGVD29 considerable flooding occurs in Benton.
138	There is considerable flooding in Autaugaville. In addition most of Benton is flooded at this level.

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 ACT 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 Water Management Section both daily and in real-time.

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

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

The Water Management Section employs a staff of hydrologic field technicians and contract work to USGS to operate and maintain Corps' gages throughout the ACT Basin. Corps personnel also maintain precipitation gages at project locations over the ACT Basin.

All rainfall gages equipped as DCPs are capable of being part of the reporting network. Data is received from 22 stations in and around the Alabama River Basin from Montgomery, Alabama, to Millers Ferry Lock and Dam. The data are recorded in 15-minute intervals and these data are reported hourly. The 10 stations listed in Table 5-1 are considered the rainfall reporting network for the R. F. Henry, Millers Ferry, and Claiborne Projects. The locations of these rainfall stations are shown on Plate 5-1. River conditions above Montgomery, Alabama, are reflected in outflows from Jordan-Bouldin Dam on the Coosa River, and the Thurlow Dam on the Tallapoosa River.

Rainfall and upstream conditions are updated regularly throughout the day. Forecast of runoff are prepared and compared to those prepared by the River Forecast Center.

Table 5-1. Rainfall Reporting Network for the Alabama River Basin

LOCATION	STREAM	LATITUDE	LONGITUDE
Montgomery (at US 31)	Alabama River	32.411389	-86.408333
Catoma Creek	Catoma Creek	32.307222	-86.299444
R. F. Henry L&D	Alabama River	32.316667	-86.783333
Selma	Alabama River	32.405556	-87.018611
Centreville	Cahaba River	32.945	-87.139167
Suttle	Cahaba River	32.529167	-87.198889
Marion Junction	Cahaba River	32.443889	-87.180278
Millers Ferry L&D	Alabama River	32.1	-87.398056
Claiborne-L&D	Alabama River	31.615	-87.550556
Choctaw Bluff	Alabama River	31.363611	-87.765

All river stage gages equipped as DCPs are capable of being part of the reporting network. Data is available from many stations in and adjacent to the ACT Basin. The river stage gages listed in the section of Table 5-2 titled “River Stage Gages in the Daily Hydrologic Network” are used to plan operations at the R. F. Henry Project. All of these stage gages are not required for daily operations but the information is available when desired. The locations of these and other river stage gages are shown on Plate 5-2. In addition, river stage gages listed in the section of Table 5-2 titled “Other River Stage Gages Within the Alabama River Basin” are available if necessary, but do not report daily.

In addition to the automated reporting stations, stage and flow data at APC projects are furnished to the Corps, Mobile District daily by the APC Birmingham office. The APC also receives DCP transmissions directly from gages throughout the ACT Basin.

Data from the river-stage station at R. F. Henry can be received at any time by contacting personnel at the project. Pool and tailwater elevations as well as inflow and outflow at R. F. Henry, Millers Ferry, and Claiborne are reported each morning to the Water Management Section. Most of stations within the basin are maintained by the USGS.

Table 5-2. Reporting Stage Gages Used for Lower Alabama River

Location	Station No.	Stream	River Mi. Above Mouth	Drainage Area (mi2)	Gage Zero Elev. (Feet NGVD29)	Flood Stage (Feet)	Servicing Agency
River Stage Gages in the Daily Hydrologic Network							
Montgomery	02420000	Alabama R.	287.6	15,087	97.90		USGS
Montgomery	02421000	Catoma Ck.	16.1	290	151.02	20	USGS
R. F. Henry (HW)	02421350	Alabama R.	236.3	16,233	0.00		USGS
R. F. Henry (TW)	02421351	Alabama R.	236.3	16,233	0.00	122	USGS
Selma	02423000	Alabama R.	214.8	17,095	61.8	45	USGS
Centreville	02424000	Cahaba R.	81.2	1,027	180.74	23	USGS
Suttle	02424590	Cahaba R.	31.0	1,480	97.64		USGS
Marion Junction	02425000	Cahaba R.	21.4	1,766	86.72	36	USGS
Millers Ferry (HW)	02427505	Alabama R.	133.0	20,637	0.00		USGS
Millers Ferry (TW)	02427506	Alabama R.	133.0	20,637	0.00	66	USGS
Claiborne (HW)	02428400	Alabama R.	72.5	21,473	0.00		USGS
Claiborne (TW)	02428401	Alabama R.	72.5	21,473	0.00	42	USGS
Other River Stage Gages Within the Alabama River Basin							
Jones	02422500	Mulberry Ck.	11.0	203	165.23		USGS
Mtn. Brook	02423380	Cahaba R.	153.6	140	443.85		USGS
Cahaba Hts.	02423425	Cahaba R.	144.9	201	410.00		USGS
Hoover	02423496	Cahaba R.	138.9	226	379.56		USGS
Acton	02423500	Cahaba R.	136.8	230	375.00		USGS
Snow Hill	02427250	Pine Barren Ck.	4.0	261	126.60		USGS

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

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

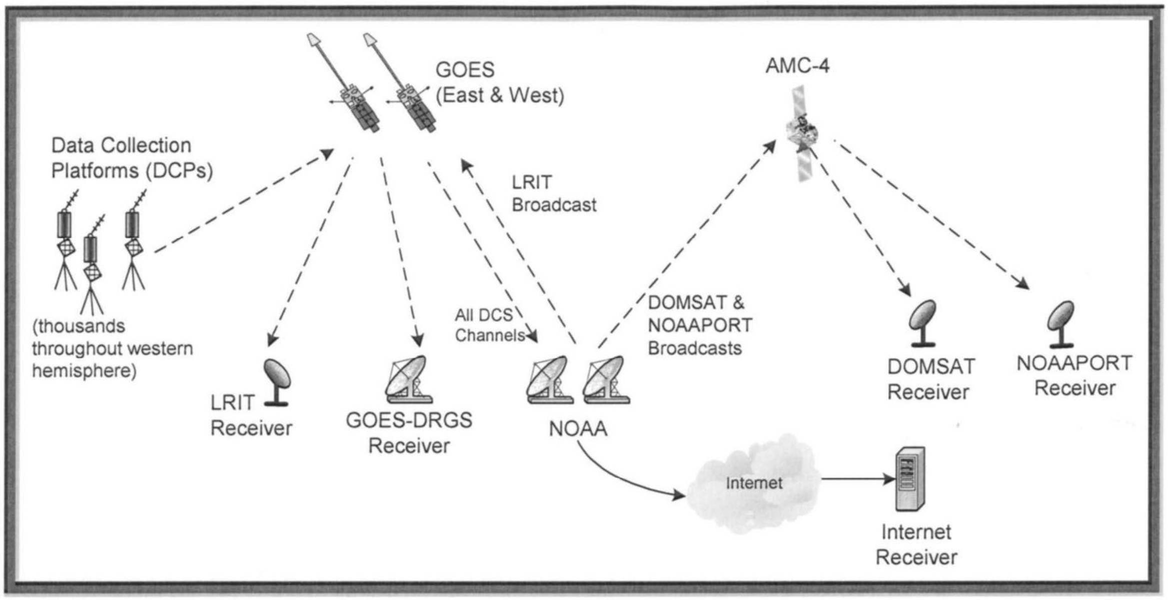


Figure 5-3. Typical configuration of the GOES System

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

The power plant at R. F. Henry Project can be operated locally or remotely from the control room at the Millers Ferry Dam powerhouse via a microwave link between the two projects. The remote system also produces visual observations of the project. Data from R. F. Henry Dam are automatically collected at the project and transmitted through the project's SCADA system and the internet to Millers Ferry Dam and the Mobile District. Telephone is an option for other communications. Data for the project and the DCPs are downloaded both daily and hourly through the Corps' server network to the Water Management Section.

c. Maintenance. The Corps, Mobile District has a cooperative program with the USGS and their office in Montgomery, Alabama for both maintenance and the exchange of data for the gages identified in the above paragraphs. Maintenance of the gages is accomplished by the USGS according to the program. 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) 690-2730 Web: http://water.sam.usace.army.mil

USGS Alabama Water Science Center, 75 Technacenter Drive, Montgomery, AL 36117

Phone: (334) 395-4120 Web: http://al.water.usgs.gov

5-02. Water Quality Stations. There are no Corps operated or maintained water quality stations in the R. F. Henry Project area. However, there are some real-time water quality parameters collected at several of the stream gages maintained by the USGS for general water quality monitoring purposes. The data for these stations can be obtained from the USGS yearly publication, ***Water Resources Data Alabama***. The Alabama Department of Environmental Management also periodically samples water quality throughout the Alabama portion of the basin on a rotating schedule.

5-03. Sediment Stations. In order to provide an adequate surveillance of sedimentation, a network of sediment ranges were established for R. E. "Bob" Woodruff Lake in 1974. 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 1982, 1988, 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 Alabama River Lakes". Sedimentation and erosion classifications were developed for each range. Based on the percentage change for the entire cross section, range cross sections were classified for sedimentation as "Heavy" (greater than 15% change), "Medium" (5 to 15% change), "Light" (0 to 5%), and "None" (0 or negative change). Erosion classifications were also developed from bank retreat and advance rates. A bank retreat or advance rate is the average change in location, measured in feet, of the shoreline. It is the area bounded between two cross section profiles at the shore erosion zone (square-feet) divided by the height of shore erosion zone (feet). The shorelines were separated into two groups, erosional and depositional. The erosional group was further divided into three classes by percentile. The 25% of shorelines showing the greatest bank retreat were classed as "Acute," the middle 50% in bank retreat were classes as "Moderate," and the 25% with the least bank retreat were classes as "Slight." Shorelines in the depositional group were classes as "Deposition."

R. E. "Bob" Woodruff above R. F. Henry Lock and Dam is the upstream most segment of the Alabama River which is formed at the confluence of the Coosa and Tallapoosa Rivers. The Alabama River portion is represented by 15 sedimentation ranges, and the Coosa and Tallapoosa Rivers are represented by one range each near their mouths. Results are displayed in Table 5-3.

Each of the 2009 range datasets were impacted by discrepancies. Data gaps and misalignment/ mislocation along the stationing were pervasive. Neither the data gaps nor the misalignment/ mislocations could be corrected, thus the quantitative analysis was limited to the historical data, and only five of the seventeen ranges were analyzed qualitatively with the 2009 data.

Table 5-3. Sedimentation Range Results for R.E. "Bob" Woodruff Lake

Rangeline	Location	Qualitative Sedimentation Classification: 1988 to 2009	Sedimentation Classification: 1974 to 1988	Shoreline Erosion Classification: 1974 to 1988	
				Left Bank	Right Bank
1A	Alabama River	Light	Light	Deposition	Deposition
2A	Alabama River		Heavy	Deposition	Deposition
3A	Alabama River		Light	Moderate	Moderate
4A	Alabama River	None/Scour	None	Deposition	Deposition
5A	Alabama River		None	Slight	Acute
6A	Alabama River	None/Scour	None	Acute	Moderate
7A	Alabama River		Medium	Slight	Moderate
8A	Alabama River	None/Scour	None	Slight	Moderate
9A	Alabama River	None/Scour	None	Slight	Acute
10A	Alabama River		None	Acute	Deposition
11A	Alabama River	None/Scour	None	Deposition	Moderate
12A	Alabama River		None	Moderate	Moderate
13A	Alabama River		None	Moderate	Acute
14A	Alabama River		Medium	Deposition	Deposition
15A	Alabama River		None	Deposition	Moderate
16A	Tallapoosa River		Heavy	Deposition	Acute
17A	Coosa River		None	Slight	Moderate

Unclassified range – no analysis

Although the discrepancies in the 2009 data were so great that the ranges could not even be evaluated qualitatively, observations made during the site visit indicated that the trends shown in the analysis from 1974 to 1988 are ongoing with heavy deposition and acute right bank erosion on the Tallapoosa River at 16A and slight to moderate erosion on the Coosa River at range 17A. The Alabama River ranges appear relatively stable in terms of sedimentation. All are classed as "None" or "Light" with the exception of ranges 07A and 14A are each classed as "Medium." Range 14A appears to be located at one of the most active sections of the river, immediately downstream of the Tallapoosa River Lower confluence, thus the degree of sedimentation indicated by the analysis is not unexpected. The more typical ranges show relatively stable beds from 1974 to 1988 with little deposition or scour. Shoreline conditions are fairly uniform along the entire length with about two-thirds of the shorelines classed as erosional and the remaining one-third classed as depositional.

5-04. Recording Hydrologic Data.

The Water Control Data Support System (WCDSS) 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 Hydrologic Engineering Center (HEC) Data Storage System (DSS) databases and programs.

To provide the data needed to support proper analysis, a DOMSAT Receive Station (DRS) is used to retrieve DCP data from gages throughout the ACT 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.

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 intervals. Reservoir data are examined and recorded in water control models every morning (or other times when needed). The data are automatically transferred to forecast models.

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

5-05. Communication Network.

The global network of the Corps consists of private, dedicated, leased lines between every Division and District office worldwide. Those lines are procured through a minimum of two General Services Administration-approved telephone vendors, and each office has a minimum of two connections, one for each vendor. The primary protocol of the entire Corps network is Ethernet. The reliability of the Corps' network is considered a command priority and, as such, supports a dedicated 24 hours per day Network Operations Center. The use of multiple telephone companies supplying the network connections minimizes the risk of a one cable cut causing an outage for any office. Such dual redundancy, plus the use of satellite data acquisition, makes for a very reliable water control network infrastructure.

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

The primary communication network of the R. F. Henry Project is a SCADA system network. The SCADA network includes a microwave link between R. F. Henry and Milllers Ferry Dam. The SCADA network also monitors powerhouse conditions and digitally records real-time project data hourly. The data include physical conditions at the reservoir such as pool elevations, outflow, 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 (cell)
R. F. Henry Powerhouse*	334-875-4400

5-06. Communication With Project Office

a. Regulating Office with Project Office. Communication between the Water Management Section and R. F. Henry Lock and Dam is by commercial telephone and computer network. The Water Management Section can transfer current data files from the Millers Ferry computer at any time using the Local Data Server (LDS) using the File Transfer Protocol (FTP). During emergencies, a two-way voice radio in the Readiness Branch of Operations Division can be used for communication with Millers Ferry only. For powerhouse and spillway operations, communication is between Water Management Section and powerhouse operating personnel at either Jones Bluff or Millers Ferry. Millers Ferry communicates with R. F. Henry lock tenders by Private Access Exchange (PAX) or Southern Link Radio System. The equipment is located in the powerhouse at both projects.

b. Between Project Office and Others. The Water Management Section communicates daily with the NWS and APC to exchange data and forecasting information. The data exchange is made by computer and is supplemented by telephone and facsimile when necessary. The Water Management Section also has a computer link with the NWS's Advanced Weather Interactive Processing System (AWIPS) communication system via the River Forecast Center in Atlanta, Georgia. The Water Management Section, Millers Ferry, and Claiborne all use a telephone auto-answer recorded message to provide daily information to the public. R. F. Henry data is provided via the Millers Ferry recording. Water resources information is available to the public at the Corps' website, http://water.sam.usace.army.mil. The site contains real-time information, historical data and general information that may be of interest to the public.

5-07. Project Reporting Instructions. R. F. Henry and Millers Ferry Powerhouse data is automatically recorded hourly. A file containing the data is sent to the LDS system every four hours. The information includes pool elevations, megawatt loading of the units, turbine and spillway discharges, gate step settings and inflows. At 6:00 AM every morning a water management report is sent to the LDS. It includes rainfall, 24-hour discharges and inflows, projected generation and other pertinent information.

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 R. F. Henry Project, the operator on duty should notify the Water Management Section, Operations Division and the Operations Project Manager at the project. A coordinated effort among those offices and the District's Emergency Management Office will develop notifications to make available to local law enforcement, government officials and emergency management agencies.

5-09. Role of Regulating Office. The Water Management Section of the Mobile District Office 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 with the constraints of authorized functions. Those plans are presented in water control manuals such as this one. Water control manual preparation and updating is a routine operation of the Water Management Section. In addition, the Water Management Section maintains information on current and anticipated conditions, precipitation, and river-stage data to provide the background necessary for best overall operation. The Water Management Section arranges communication channels to the Power Project Manager and other necessary personnel. Instructions pertaining to reservoir regulation are issued to the Power Project Manager; however, routine instructions are normally issued directly to the powerhouse operator on duty.

5-10. Role of Power Project Manager. The Power Project Manager should be completely familiar with the approved operating plans for the R. F. Henry and Millers Ferry Projects. The Power Project Manager is responsible for implementing actions under the approved water control plans and carrying out special instructions from the Water Management Section. The Power Project Manager is expected to maintain and furnish records requested from him by the Water Management Section. 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 Water Management Section as soon as practicable.

VI - HYDROLOGIC FORECASTS

6-01. General. Two forecasts are available for locations along the Alabama River. The NWS's River Forecast Center prepares river forecasts for the general public and for use by the Corps. In addition, the Water Management Section prepares forecasts for internal use. All features of the forecasting procedure are subject to modification and refinement as additional data and operating experience dictate. In general, forecasts are made for Corps projects and control points along the river. Inflows and outflows are estimated for R. F. Henry, Millers Ferry, and Claiborne Projects.

a. Role of Corps. The Water Management Section maintains real-time observation of river and weather conditions in the Mobile District. The Water Management Section has capabilities to make forecasts for several areas in the ACT Basin. Those areas include all the federal projects and other locations. Observation of real-time stream conditions provides guidance of 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 ACT 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 Water Management Section continuously monitors the weather conditions occurring throughout the ACT Basin and the forecasts issued by the NWS. Whenever possible, the NWS weather and hydrologic forecasts are used. The Water Management Section develops forecasts that are used to meet the regulation objectives of the Corps ACT Reservoirs. In addition, the Water Management Section provides weekly hydropower generation forecasts using current power plant capacity, latest hydrological conditions, and system water availability.

b. Role of Other Agencies. The NWS is responsible for preparing and disseminating all public forecasts relating to precipitation, temperatures, and other meteorological elements related to weather and weather-related forecasting in the ACT Basin. The Water Management Section uses the NWS as a key source of information for weather forecasts. The meteorological forecasting provided by the NWS is considered critical to the Corps' water resources management mission. The 24- and 48-hour Quantitative Precipitation Forecasts (QPFs) are invaluable in providing guidance for basin release determinations. Using precipitation forecasts and subsequent runoff directly relates to project release decisions.

(1) The NWS is the federal agency responsible for preparing and issuing streamflow and river-stage forecasts for public dissemination. That role is the responsibility of SERFC co-located in Peachtree City, Georgia with the Peachtree City Weather Forecast Office (WFO). SERFC is responsible for the supervision and coordination of streamflow and river-stage forecasting services provided by the NWS WSFOs in Peachtree City, Georgia, and Birmingham, Alabama. SERFC routinely prepares and distributes 5-day streamflow and river-stage forecasts at key gaging stations along the Coosa, Tallapoosa, and Alabama Rivers. Streamflow forecasts are available at additional forecast points during periods above normal rainfall. In addition, SERFC provides a revised regional QPF based on local expertise beyond the NWS Hydrologic Prediction Center QPF. SERFC also provides the Water Management Section with flow forecasts for selected locations upon request. Table 6-1 lists the forecast stations in the Alabama River Basin.

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

(3) Alabama Power Company (APC) provides hourly discharge data from APC's Jordan, Bouldin, and Thurlow projects and provides a 7-day forecast of average daily releases from Jordan, Bouldin, and Thurlow projects.

Table 6-1. Southeast River Forecast Center Forecast Locations for Alabama River Basin

Daily Stage/Elevation Forecasts (Feet NGVD29)				
	Station	**Station ID**	**Action Stage***	**Flood Stage****
	Montgomery	MGMA1	26	35
	R. F. Henry TW	TYLA1	122	122
	Millers Ferry TW	MRFA1	61	66
	Claiborne TW	CLBA1	35	42
Daily 24-hour Inflow in Morning (10 a.m.) State Forecast Discussion				
Reservoir		**Station ID**		
R. F. Henry		TYLA1		
Millers Ferry		MRFA1		
Additional Stage Forecasts Only for Significant Rises				
River/Creek	**Station**	**Station ID**	**Action Stage**	**Flood Stage**
Coosa	Weiss Dam	CREA1		564
Coosa	Gadsden	GAPA1		511
Coosa	Logan Martin Dam	CCSA1		465
Coosa	Childersburg	CHLA1		402
Coosa	Wetumpka	WETA1	40	45
Tallapoosa	Wadley	WDLA1		13
Tallapoosa	Milstead	MILA1	15	40
Tallapoosa	Tallapoosa Wt Pit	MGYA1	15	25
Catoma Creek	Montgomery	CATA1	16	20
Alabama	Selma	SELA1	30	45
Cahaba	Cahaba Hts	CHGA1		14
Cahaba	Centreville	CKLA1	20	23
Cahaba	Suttle	SUTA1	28	32
Cahaba	Marion Junction	MNJA1	15	36

* Action Stage – The stage which some type of mitigation action in preparation for possible significant hydrologic activity occurs.
** Flood Stage – The stage for which a rise in water surface level begins to impact lives, property, or commerce.

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 Water Management Section 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. For determining flood conditions at the R. F. Henry Project, the observed hourly discharges out of APC's Jordan, Bouldin, and Thurlow projects along with the APC's daily 7-day forecast for the Coosa and Tallapoosa Rivers are used.

6-03. Conservation Purpose Forecasts. The R. F. Henry Project is essentially 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 Alabama River Projects are modified run-of-the-river projects and have no practical conservation storage in the reservoirs. However, the Corps does utilize available information from the NWS and projected release forecast from Alabama Power Company projects on the Coosa and Tallapoosa Rivers to aid in the operation of the system and for planning studies.

b. Methods. In extreme conditions, three-month and six-month forecasts can be produced based on observed hydrology and comparative percentage hydrology inflows into the ACT 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 ACT Projects.

6-05. Drought Forecast.

a. Requirements. Engineering Regulation (ER) 1110-2-1941, Drought Contingency Plans, dated 15 September 1981, called for developing drought contingency plans for all Corps' reservoirs. Drought recognition and drought forecast information can be used in conjunction with the drought contingency plan.

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 drought reference. However, the index requires detailed data and cannot reflect an operation of a reservoir system. 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, 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.

c. Reference Documents. The drought contingency plan for the R. F. Henry Project is summarized in Section 7-12 below. The complete ACT Drought Contingency Plan is provided in the *Master Water Control Manual for the ACT River Basin, Exhibit C*.

VII - WATER CONTROL PLAN

7-01. General Objectives. The Congressionally authorized purposes for the R. F. Henry Lock and Dam Project as contained in its authorizing legislation were flood risk management (flood control), navigation and hydropower. Flood risk management was deleted from the project prior to construction. The R. F. Henry Dam is operated as part of the Alabama Rivers project to provide navigation depths upstream to Montgomery, Alabama. Several other project purposes have been added through general authorizations including water quality, recreation, and fish and wildlife conservation and mitigation. The regulation plan seeks to balance the needs of all project purposes at the R. F. Henry Project and at other projects in the ACT Basin and is intended for use in day-to-day, real-time water management decision making and for training new personnel.

7-02. Constraints

a. Full Discharge Capacity. The full discharge capacity of the spillway at elevation 125.0 feet NGVD29 is 124,500 cfs, the equivalent of a flood which may be expected to occur once in 1.5 years. Once the spillway capacity is reached a free overflow condition will prevail. There will be little difference in the water surface upstream and downstream of the dam. The river may continue to rise just as it would in the absence of any structure.

b. Head limitation. Design criteria for stability against overturning and sliding of the R. F. Henry structures make it imperative that the head, or difference between headwater and tailwater, does not exceed 47 feet at any time. All operational planning has been based on this strict limitation.

c. Gate Opening Schedule. During construction, eight gates were built by one contractor, and the other three built by another contractor. Since the beginning of operation, gates 1-3 vibrated at low flows. Therefore these gates are not to be used until all the gates can be opened to step 5. This corresponds to a tailwater elevation of 98 feet NGVD29.

7-03. Overall Plan for Water Control. The reservoir level will be maintained between elevations 123.0 feet NGVD29 and 126.0 feet NGVD29 by passing the inflow through the power plant and/or the spillway gates until the powerhouse becomes inoperative. Discharges above approximately 112,000 cfs will cause the power plant to be nonproductive because of the high tailwater, so that for higher flows no outflow will pass through the turbines. With turbines out of service, spillway gates will be opened to lower and maintain the pool between elevations 123.0 feet NGVD29 and 126.0 feet NGVD29. When the inflow exceeds approximately 125,000 cfs, the spillway capacity will be reached, and there will be no control over the outflow. At such high flow, there will be little difference in the water level above and below the dam, and the flow condition will be that of a natural river in flood. The gates will remain in the full open position until the pool peaks and recedes. As the pool level recedes, spillway gates will be lowered to maintain the elevation between 123.0 feet NGVD29 and 126.0 feet NGVD29. When the tailwater is sufficiently low to restart the powerhouse, the spillway gates will be lowered, and the power plant and spillway gates will be used to maintain the elevation between 123.0 feet NGVD29 and 126.0 feet NGVD29. Gate operating instructions are given in a subsequent paragraph. Any departures from this operating schedule will be made only as directed by the Water Management Section. Plate 7-1 shows total spillway and overbank discharge for pool levels above elevation 125.0 feet NGVD29. The tailwater rating curve is shown in Plate 7-2. In periods when flow is less than powerhouse capability, peaking power releases will be made as described in Paragraph 7-10.b. More detailed instructions for water control operations are given in the following paragraphs.

Operation of Spillway Gates. The spillway gates will be operated as directed by the Power Project Manager in order to maintain the pool between elevations 123.0 feet NGVD29 and 126.0 feet NGVD29 except during floods with inflows in excess of spillway capacity (see Constraints Paragraph 7-02(c) above). When inflow and pool conditions require operation of the spillway, the gates will be operated in the order and increments of openings shown on Plates 7-4 through 7-11. The 11 spillway gates are numbered in sequence beginning at the right bank or west end of the spillway, adjacent to the powerhouse. Gate adjustments will be made as necessary and as specified by the above mentioned plates to maintain the pool between limiting elevations 123.0 feet NGVD29 and 126.0 feet NGVD29. For inflows in excess of spillway capacity the gates will be left in the fully open position until the pool has peaked and recedes to elevation 125.0 feet NGVD29. When this elevation is reached the operator will begin closing gates to pass the inflow, in excess of power plant and lock operation discharge, necessary to keep the pool within the established limits.

7-04. Standing Instructions to Powerhouse Operator. Exhibit C, Standing Instructions to the Powerhouse Operator for Water Control, describes the operator's responsibilities considered necessary for reservoir regulation. These duties include reservoir operating procedures, data collecting, and data reporting.

7-05. Flood risk management. There is no flood risk management storage in the R. F. Henry Project. Flowage easements have been obtained encompassing all lands subjected to an increased frequency of flooding from the operation of the project. Paragraph 2-05 describes the real estate acquisition lines.

7-06. Recreation. Most recreational activities at R. E. "Bob" Woodruff Lake occur during the summer months. Because R. F. Henry 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 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. Paragraph 2-06 describes the public facilities available at the project. Occasionally, releases may be scheduled for special recreational events such as river float trips.

7-07. Water Quality. Flows from R. F. Henry Dam are used downstream to provide the 7Q10 flow of 6,600 cfs below Claiborne. Several industries on the Alabama River have designed effluent discharges and have State discharge permits based on this dilution flow. Whenever flows recede to this level, conditions will be closely monitored so adequate warning can be given if it is necessary to reduce the flows even further. Section 7-10 explains the procedures to be followed should the outflow drop to a level which is not sufficient enough to provide enough flow downstream.

7-08. Fish and Wildlife. The impoundment is favorable for the establishment of a sports fishery. The pool will be maintained at a fairly constant level except during floods when high inflows cause a rise in the reservoir level. This relatively stable pool during the spring spawning season is beneficial to the production of crappie, largemouth and smallmouth bass, shellcracker, warmouth, and sunfishes. However, due to the relatively thin layer of conservation storage and static head limitations of the project, it will generally not be possible to maintain a fairly constant pool level to support optimum fish spawning conditions.

When Alabama River flow and project conditions allow, the Corps operates the lock from February through May to facilitate downstream/upstream passage of migratory fishes. While there can be slight differences in the locking technique each year, generally two fish locking cycles are performed each day between 8:00 AM and 4:00 PM, depending on facility staffing; one in the morning and one in the afternoon.

7-09. Water Supply. Based upon information provided by the Alabama Office of Water Resource in 2010, there are two major withdrawals that occur from R.E. "Bob" Woodruff Lake; International Paper at Prattville, and the E. B. Harris Southern Company Plant. There are also two minor irrigation withdrawals from the lake by Benton Farms and River Bend Sod. Also, the International Paper (Riverdale Mill) located below the R. F. Henry Project requests a minimum average of six hours of operation from Robert F. Henry.

7-10. Hydroelectric Power. The Jones Bluff Powerhouse is operated as a run-of-river hydropower plant for the production of hydroelectric energy and capacity. Depending upon flow, the plant is either continuously running (high flow) or peaking (low flow) on a seven-day basis. The output from the plant is marketed by the Southeastern Power Administration (SEPA) in accordance with provisions in the Flood Control Act of 1944. The responsibility under this Act for determining the amount of power that can be produced from this project has been delegated to the Mobile District Commander. The District Commander relies on the Water Management Section to make weekly and daily determinations of hydropower that can be generated.

a. Normal Operation. The powerhouse at R. F. Henry Dam is operated to furnish peak energy. The energy is marketed to the government’s preference customers under terms of contracts negotiated and administered by SEPA. The generation (and water release) is based on a declaration of energy and capacity available that is prepared weekly by the Mobile District on the basis of the ACT Water Control Plan. The declarations, which are designed to keep the pools within the established seasonal and pondage limits, where practicable, are prepared by the Water Management Section of the Mobile District and furnished to the South Atlantic Division (SAD) office for coordination of the hydropower projects within the Alabama-Georgia-South Carolina power marketing system. Actual daily and hourly scheduling of generation is coordinated by the Water Management Section, SEPA, and the hydropower customers. Local restraints can dictate generation during certain hours. Performance curves which indicate the discharge capacity and power output capability at various operating heads for a single turbogenerator unit are shown on Plate 7-3.

b. High-Flow Operation. During periods when the reservoir inflow is equal to or greater than the capacity of the turbines, the power plant will be operated at full capacity around the clock. As the flow increases, rising tailwater elevations will reduce the head and the power output. When the head decreases to approximately 15.3 feet, the units will be shut down.

c. Low-Flow Operation. The hydropower operation during extended low-flow or drought periods is slightly different from the normal operation. The maximum allowable drawdown is elevation 123.0 feet NGVD29. Provisions have been made for an emergency drawdown elevation of 122.0 feet NGVD29. During extended low-flow periods the Water Management Section will establish a target tailwater elevation at Claiborne Lock and Dam. The Water Management Section will schedule sufficient daily generation and discharge from R. F. Henry and Millers Ferry to maintain the target tailwater elevation. If the generation schedule causes the pool to drop to elevation 122.5 feet NGVD29, the Project Operator for water control will notify the Water Management Section. In no case will releases be made if the pool falls to elevation 122.0 feet NGVD29 unless specifically directed by the Water Control Manager. Because the upstream APC projects do not normally release as much water on weekends as weekdays, the R. F. Henry pool can be expected to be at its lowest level on Monday and highest level on Friday during the period.

7-11. Navigation.

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

When supported by maintenance dredging, ACT Basin reservoir storage, and hydrologic conditions, adequate flows will provide a reliable navigation channel. In so doing, the goal of the water control plan is to ensure a predictable minimum navigable channel in the Alabama River for a continuous period that is sufficient for navigation use. Figure 7-1 shows the effect of dredging on flow requirements for different navigation channel depths during normal hydrologic conditions (1992 - 1994). As shown on Figure 7-1, pre-dredging conditions exist between November and April; dredging occurs between May and August; and post-dredging conditions exist from September through October, until November rainfall causes shoaling to occur somewhere along the navigation channel.

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

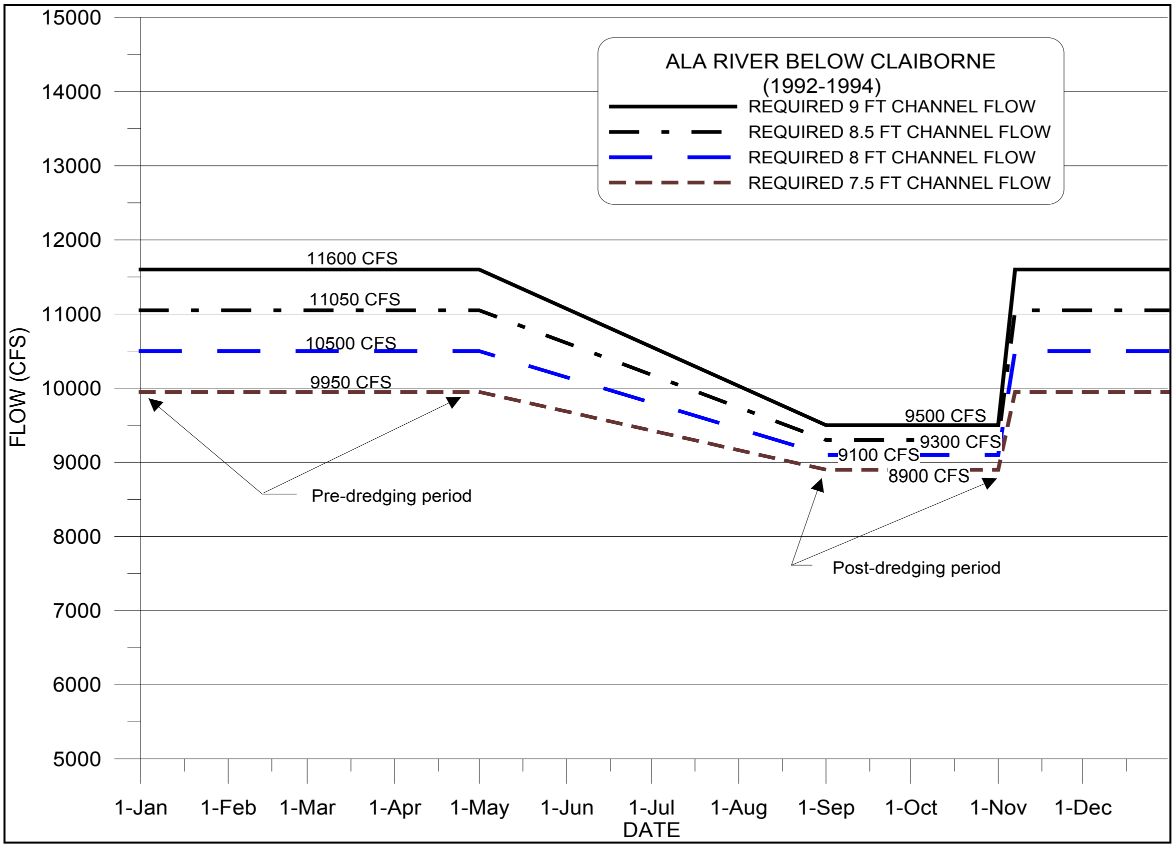


Figure 7-1. Flow-Depth Pattern (Navigation Template) During Normal Hydrologic Conditions (1992–1994)

Flow releases from upstream APC projects have a direct influence on flows needed to support navigation depths on the lower Alabama River. Flows for navigation are most needed in the unregulated part of the lower Alabama River below Claiborne Lock and Dam. When flows are available, R. F. Henry, Millers Ferry, and Claiborne Projects are regulated to maintain stable pool levels, coupled with the necessary channel maintenance dredging, to support sustained use of the authorized navigation channel and to provide the full navigation depth of 9 feet. When river conditions or funding available for dredging of the river indicates that project conditions (9-foot channel) will probably not be attainable in the low water season, the three Alabama River projects are operated to provide flows for a reduced project channel depth as determined by surveys of the river. APC operates its reservoirs on the Coosa and Tallapoosa Rivers (specifically flows from their Jordan, Bouldin, and Thurlow (JBT) projects) to provide a minimum navigation flow target in the Alabama River at Montgomery, Alabama. The monthly minimum navigation flow targets are shown in Table 7-1. However, flows may be reduced if conditions warrant in accordance with the navigation plan memorandum of understanding between the Corps and APC (see *ACT River Basin Master Water Control Manual, Exhibit B*). Additional intervening flow or drawdown discharge from the R. F. Henry and Millers Ferry Projects must be used to provide a usable depth for navigation and/or meet the 7Q10 flow of 6,600 cfs below Claiborne Dam. However, the limited storage afforded in both the R. E. “Bob” Woodruff and William “Bill” Dannelly Lakes can only help meet the 6,600 cfs level at Claiborne Lake for a short period. As local inflows diminish or the storage is exhausted, a lesser amount would be released depending on the amount of local inflows. Table 7-2 and Figure 7-2 show the required basin inflow for a 9.0-foot channel; Table 7-3 and Figure 7-3 show the required basin inflow for a 7.5-foot channel.

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

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

The ACT Basin navigation regulation plan is based on storage and flow/stage/channel depth analyses using basin inflows and average storage usage by APC (e.g., navigation operations would not be predicated on use of additional storage) during normal hydrologic conditions. Under that concept, the Corps and APC make releases that support navigation when basin inflows meet or exceed seasonal targets for either the 9.0-foot or 7.5-foot channel templates. Triggers are also identified (e.g., when basin inflow are less than required natural flows) to change operational goals between the 9.0-foot and 7.5-foot channels. Similarly, basin inflow triggers are identified when releases for navigation are suspended and only 7Q10 (4,640 cfs) releases would occur. During drought operations, releases to support navigation are suspended until system recovery occurs as defined in the ACT Basin Drought Contingency Plan (*ACT River Basin Master Water Control Manual, Exhibit C*).

Table 7-1. Monthly Navigation Flow Target in CFS

Month	9.0-ft target below Claiborne Lake (cfs)	9.0-ft JBT goal (cfs)	7.5-ft target below Claiborne Lake (cfs)	7.5-ft JBT goal (cfs)
Jan	11600	9280	9950	7,960
Feb	11600	9280	9950	7,960
Mar	11600	9280	9950	7,960
Apr	11600	9280	9950	7,960
May	11100	8880	9740	7,792
Jun	10600	8480	9530	7,624
Jul	10100	8080	9320	7,456
Aug	9600	7680	9110	7,288
Sep	9100	7280	8900	7,120
Oct	9100	7280	8900	7,120
Nov	11600	9280	9950	7,960
Dec	11600	9280	9950	7,960

Table 7-2. Basin Inflow Above APC Projects Required To Meet A 9.0-Foot Navigation Channel

Month	APC navigation Target (cfs)	Monthly historic storage usage (cfs)	Required basin inflow (cfs)
Jan	9,280	–994	10,274
Feb	9,280	–1,894	11,174
Mar	9,280	–3,028	12,308
Apr	9,280	–3,786	13,066
May	8,880	–499	9,379
Jun	8,480	412	8,068
Jul	8,080	749	7,331
Aug	7,680	1,441	6,239
Sep	7,280	1,025	6,255
Oct	7,280	2,118	5,162
Nov	9,280	2,263	7,017
Dec	9,280	1,789	7,491

Table 7-3. Basin Inflow Above APC Projects Required To Meet A 7.5-Foot Navigation Channel

Month	APC navigation Target (cfs)	Monthly historic storage usage (cfs)	Required basin inflow (cfs)
Jan	7,960	–994	8,954
Feb	7,960	–1,894	9,854
Mar	7,960	–3,028	10,988
Apr	7,960	–3,786	11,746
May	7,792	–499	8,291
Jun	7,624	412	7,212
Jul	7,456	749	6,707
Aug	7,288	1,441	5,847
Sep	7,120	1,025	6,095
Oct	7,120	2,118	5,002
Nov	7,960	2,263	5,697
Dec	7,960	1,789	6,171

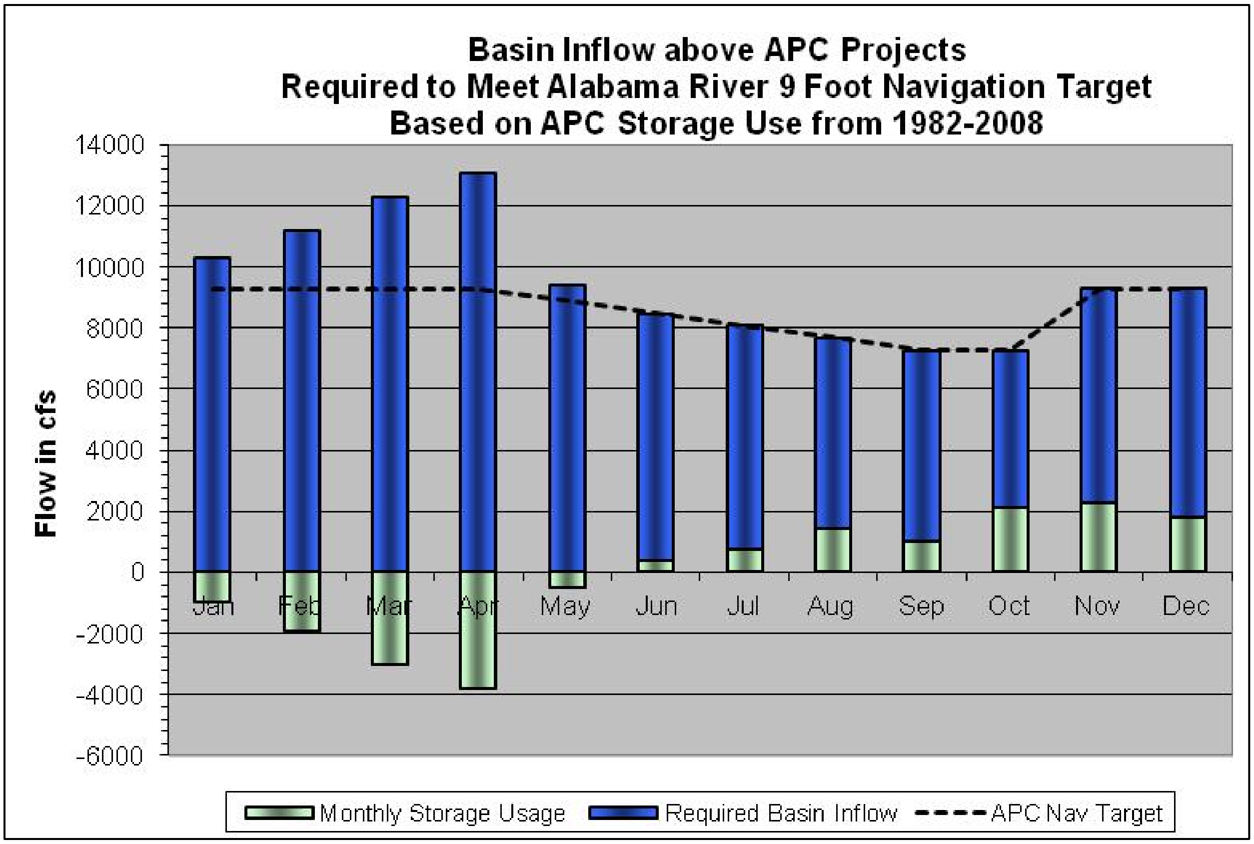


Figure 7-2. Flow Requirements From Rainfall (or Natural Sources) and Reservoir Storage To Achieve The JBT Goal For Navigation Flows For A 9-Foot Channel

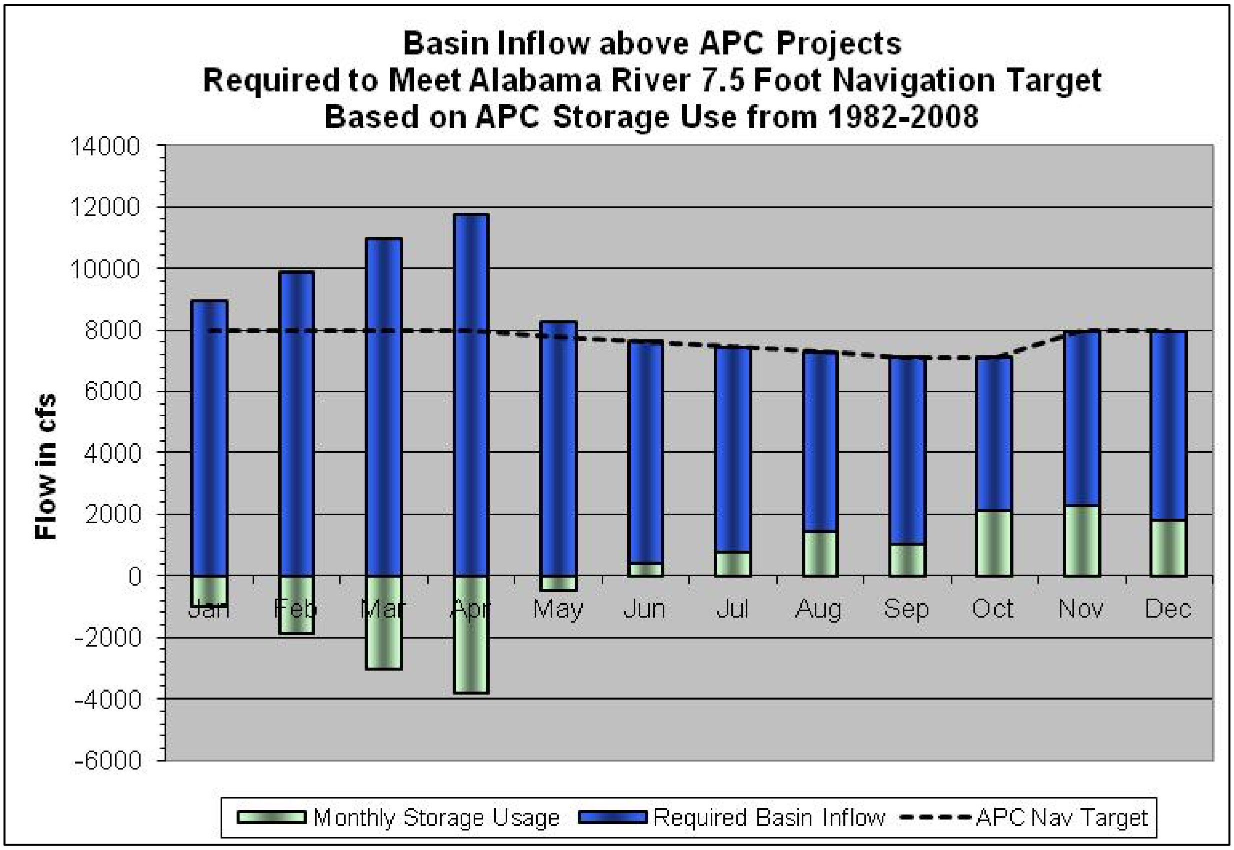


Figure 7-3. Flow Requirements From Rainfall (Or Natural Sources) And Reservoir Storage To Achieve The JBT Goal For Navigation Flows For A 7.5-Foot Channel

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

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

In the event that the Mobile District Water Management Section (EN-HW) determines upcoming reductions in water releases may impact the available navigation channel depth, they shall contact the Black Warrior/Tombigbee - Alabama/Coosa Project Office (OP-BA), and the Mobile District Navigation Section (OP-TN), to coordinate the impact. EN-HW shall provide the Claiborne tailwater gage forecast to OP-BA and OP-TN. Using this forecast and the latest available project channel surveys, OP-BA and OP-TN will evaluate the potential impact to available navigation depths. Should this evaluation determine that the available channel depth is adversely impacted, OP-BA and OP-TN will work together, providing EN-HW with their determination of the controlling depth. Thereafter, OP-BA and OP-TN will coordinate the issuance of a navigation bulletin. The notices will be issued as expeditiously as possible to give barge owners, and other waterway users, sufficient time to make arrangements to light load or remove their vessels before action is taken at upstream projects to reduce flows. The bulletin will be posted to the Mobile District Navigation website at

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

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

7-12. Drought Contingency Plan.

Flow in the Alabama River is largely controlled by APC impoundments on the Coosa and Tallapoosa Rivers above R. F. Henry Lock and Dam. Under normal flows the APC impoundments will provide sufficient releases from the Coosa and Tallapoosa Rivers to meet a continuous minimum seven-day average flow of 4,640 cfs (32,480 dsf/7 days). However, additional intervening flow or drawdown discharge from R. F. Henry and Millers Ferry Projects must be used to provide a usable depth for navigation or meet the 7Q10 flow of 6,600 cfs at Claiborne Lock and Dam.

In accordance with ER 1110-2-1941, Drought Contingency Plans, dated 15 September 1981, an ACT Basin Drought Contingency Plan (DCP) has been developed to implement water control regulation drought management actions. Drought operations will be in compliance with the plan for the entire ACT Basin as outlined in Exhibit C of the *Master Water Control Manual for the ACT River Basin* (“ACT Master Manual”). Pertinent requirements of the DCP relative to the R. F. Henry Project are summarized below.

Based upon experience gained during previous droughts, and in particular the 2006 - 2008 drought, a basin-wide DCP was developed and is comprised of three components - headwater operations at Allatoona Lake and Carters Lake in Georgia; operations at APC projects on the Coosa and Tallapoosa Rivers; and downstream operations at Corps projects below Montgomery, Alabama. Drought operations for the APC projects were initially developed as a separate plan by the APC (*A*PCDOP) in cooperation with the State of Alabama and the Corps as a result of the 2006 – 2008 drought. The specifics of the APCDOP, as incorporated into the overall ACT Basin DCP, are shown on Table 7-5.

Operational guidelines have been developed on the basis of a Drought Intensity Level (DIL). The DIL is a drought indicator, ranging from DIL 1 to DIL 3, determined by the combined number of drought triggers that occur. The three drought triggers are: (1) basin inflow; (2) composite conservation storage in APC reservoirs; and (3) state line flow. Additional information on the drought triggers can be found in Exhibit C of the ACT Master Manual. Drought management actions would become increasingly more austere when two triggers occur (Drought Level 2) or all three occur (Drought Level 3). Table 7-4 lists the three drought operation intensity levels applicable to APC projects.

Table 7-4. ACT Basin Drought Intensity Levels

Drought Intensity Level (DIL)	Drought Level	No. of Triggers Occurring
DIL 1	Moderate Drought	1
DIL 2	Severe Drought	2
DIL 3	Exceptional Drought	3

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

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

The headwater regulation component, as described in water control manuals for Allatoona and Carters Projects (Appendices A and H), includes water control actions in accordance with established action zones, minimum releases, and hydropower generation releases. Regulation of APC projects will be in accordance with Table 7-5 in which the drought response will be triggered by one or more of three indicators - state line flows, basin inflow, or composite conservation storage. Corps operation of its Alabama River projects downstream of Montgomery, Alabama, will respond to drought operations of the APC projects upstream.

No storage is provided in the R. E. “Bob” Woodruff pool for regulating releases during periods of low inflow. When drought conditions determine that a change in the operating guidelines is necessary private industries, state agencies and federal agencies with interests in the river system will be notified. Normally the agencies will be advised of any impending reductions well in advance, and their comment will be requested regarding any adverse impacts on the respective agency or industry.

362

Table 7-5. ACT Basin Drought Management Matrix

<table>
<tr><th></th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th colspan="2">Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="4">Drought Level Response[a]</td><td colspan="13">DIL 0 - Normal Operations</td></tr>
<tr><td colspan="13">DIL 1: Low Basin Inflows or Low Composite or Low State Line Flow</td></tr>
<tr><td colspan="13">DIL 2: DIL 1 criteria + (Low Basin Inflows or Low Composite or Low State Line Flow)</td></tr>
<tr><td colspan="13">DIL 3: Low Basin Inflows + Low Composite + Low State Line Flow</td></tr>
<tr><td rowspan="4">Coosa River Flow[b]</td><td colspan="3">Normal Operation: 2,000 cfs</td><td colspan="2">4,000 (8,000)</td><td colspan="2">4,000 – 2,000</td><td colspan="6">Normal Operation: 2,000 cfs</td></tr>
<tr><td colspan="3">Jordan 2,000 +/-cfs</td><td colspan="3">4,000 +/- cfs</td><td>6/15 Linear Ramp down</td><td colspan="3">Jordan 2,000 +/-cfs</td><td colspan="3">Jordan 2,000 +/-cfs</td></tr>
<tr><td colspan="3">Jordan 1,800 +/-cfs</td><td colspan="3">2,500 +/- cfs</td><td>6/15 Linear Ramp down</td><td colspan="3">Jordan 2,000 +/-cfs</td><td colspan="3">Jordan 1,800 +/-cfs</td></tr>
<tr><td colspan="3">Jordan 1,600 +/-cfs</td><td colspan="4">Jordan 1,800 +/-cfs</td><td colspan="3">Jordan 2,000 +/-cfs</td><td colspan="2">Jordan 1,800 +/-cfs</td><td>Jordan 1,600 +/-cfs</td></tr>
<tr><td rowspan="4">Tallapoosa River Flow[c]</td><td colspan="13">Normal Operations: 1200 cfs</td></tr>
<tr><td colspan="4">Greater of: 1/2 Yates Inflow or
2 x Heflin Gage(Thurlow releases > 350 cfs)</td><td colspan="6">1/2 Yates Inflow</td><td colspan="3">1/2 Yates Inflow</td></tr>
<tr><td colspan="4">Thurlow 350 cfs</td><td colspan="6">1/2 Yates Inflow</td><td colspan="3">Thurlow 350 cfs</td></tr>
<tr><td colspan="7">Maintain 400 cfs at Montgomery WTP
(Thurlow release 350 cfs)</td><td colspan="3">Thurlow 350 cfs</td><td colspan="3">Maintain 400 cfs at Montgomery WTP (Thurlow release 350 cfs)</td></tr>
<tr><td rowspan="4">Alabama River Flow[d]</td><td colspan="13">Normal Operation: Navigation or 7Q10 flow</td></tr>
<tr><td colspan="4">4,200 cfs (10% 7Q10 Cut) - Montgomery</td><td colspan="6">7Q10 - Montgomery (4,640 cfs)</td><td colspan="3">Reduce: Full – 4,200 cfs</td></tr>
<tr><td colspan="5">3,700 cfs (20% 7Q10 Cut) - Montgomery</td><td colspan="5">4,200 cfs (10% 7Q10 Cut) - Montgomery</td><td colspan="3">Reduce: 4,200 cfs-> 3,700 cfs
Montgomery (1 week ramp)</td></tr>
<tr><td colspan="4">2,000 cfs
Montgomery</td><td colspan="3">3,700 cfs
Montgomery</td><td colspan="3">4,200 cfs (10% 7Q10 Cut) -
Montgomery</td><td colspan="3">Reduce: 4,200 cfs -> 2,000 cfs
Montgomery (1 month ramp)</td></tr>
<tr><td rowspan="4">Guide Curve Elevation</td><td colspan="13">Normal Operations: Elevations follow Guide Curves as prescribed in License (Measured in Feet)</td></tr>
<tr><td colspan="13">Corps Variances: As Needed; FERC Variance for Lake Martin</td></tr>
<tr><td colspan="13">Corps Variances: As Needed; FERC Variance for Lake Martin</td></tr>
<tr><td colspan="13">Corps Variances: As Needed; FERC Variance for Lake Martin</td></tr>
</table>

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

7-13. Flood Emergency Action Plans. The Corps is responsible for developing Flood Emergency Action Plans for the ACT System. The plans are included in the Operations and Maintenance Manuals for each system project. Example data available are emergency contact information and flood inundation information.

7-14. Other

a. Passing Drift. In order to pass drift through the gated spillway, it may be necessary to occasionally raise the trash gate located within Gate 1. The time to raise the trash gate to pass the drift should be as short duration as practical to prevent unnecessary scouring of the channel below the spillway. The minimum tailwater elevation for passing drift is 123.0 feet NGVD29. The lockmaster should write all drift passing procedures on the Washing Drift Log Sheet and send a copy to the Water Management Section. A discharge-rating curve for the trash gate is shown on Plate 7-12.

b. Mosquito Control. Since the R. E. "Bob" Woodruff Lake is primarily for navigation, controlled fluctuation of the pool in excess of the power pondage is not desirable. Therefore water-level management is not considered as part of the mosquito control program. Mosquito control operations will consist primarily of clearing the reservoir of undesirable debris and vegetation, periodic inspections for adult mosquitoes and larva, the application of larvicides as necessary, aquatic plant control, and drift removal operations.

7-15. Deviation From Normal Regulation. The District Commander is occasionally requested to deviate from normal regulation. Prior approval for a deviation is required from the Division Engineer except as noted in subparagraph a below.

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 SAD 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 SAD for review and approval.

7-16. Rate of Release Change. There are no restrictions on releases from the R. F. Henry Project during normal operations. 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. R. F. Henry Lock and Dam is a run-of-the-river project with little storage capacity between the maximum and minimum operating pool elevations of 126.0 feet NGVD29 and 123.0 feet NGVD29. The project has a limited peaking hydropower capacity between elevations 123.0 feet NGVD29 to 126.0 feet NGVD29. The project's minimum reservoir level, elevation 123.0 feet NGVD29, provides navigation depths up to Montgomery, Alabama. Other purposes provided by the project include water quality, public recreation and fish and wildlife conservation and mitigation. While access and some facilities are available at the project for public recreation and fish and wildlife conservation and mitigation, water is typically not specifically managed for these purposes.

The impacts of the *ACT 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. R. F. Henry Lock and Dam Project does not contain reservoir flood risk management storage; therefore, the project has no flood risk management capabilities.

a. Spillway Design Flood. The duration of the spillway design flood is approximately 24 days with a peak inflow of 738,000 cfs. Peak outflow is 725,500 cfs. The peak elevation is 148 feet NGVD29. The effects of the spillway design flood are shown on Plate 8-1.

b. Standard Project Flood. The standard project flood would cause a peak pool elevation of 142.3 feet NGVD29 and a maximum discharge of 410,500 cfs. Peak inflow is 421,000 cfs. The effects of the standard project flood are shown on Plate 8-2.

c. Historic Floods. The impacts of the project on hydrographs for the flood of March 1990, and for the flood of record, February 1961, are shown on Plates 8-3 and 8-4.

8-03. Recreation. The R. F. Henry Lock and Dam Project is an important part of the Alabama River Lakes (ARL) recreational resource, providing both economic and social benefits for the region and the Nation. The ARL is composed of the Claiborne, Millers Ferry, and R. F. Henry Projects. The ARL contains 33,852 acres of land and 576 miles of shoreline, most of which is available for public use. A wide variety of recreational opportunities are provided at the lake including boating, fishing, camping, picnicking, water skiing, 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 ARL receives more than 3,400,000 recreational visitors per year. The local and regional economic benefits of recreation are significant. Annual recreational visitor spending within 30 miles of the project totals $88 million.

8-04. Water Quality. All the ACT Basin projects operate to meet the objective of maintaining water quality. The R. F Henry Project operates essentially as a run-of-the-river project providing a continual discharge of the inflows downstream. These discharges are used downstream to help provide the 7Q10 flow of 6,600 cfs downstream of Claiborne Lock and Dam. Several industries on the Alabama River have designed effluent discharges on the basis of that dilution flow. Whenever flows recede to that level, conditions are closely monitored so that adequate warning can be given if it is necessary to reduce the flows even further in response to extremely dry conditions. Aside from the minimum flow target downstream of Claiborne Lock and Dam, no other water management activities occur to specifically address water quality objectives.

8-05. Fish and Wildlife. The relatively stable pool at R. F. Henry Lock and Dam is beneficial to certain species of fish and wildlife. However, the project also creates a physical barrier to fish and other aquatic organisms' passage. The reservoir is relatively deep and slow moving compared to pre-impounded conditions. This results in a change in physical conditions, such as velocities, temperature, and substrate, as well as feeding and spawning habitat that cannot be tolerated by many species. The dam and reservoir along with other Corps and APC dams and reservoirs in the basin have resulted in declines in many fish and mussel populations. The described lockages in the Claiborne and Millers Ferry Appendices for fish passage are being implemented in order to provide improved opportunities for migration for many species.

8-06. Water Supply. There are no water storage contracts in place at the R. F. Henry Project. However, based on information provided by the Alabama Office of Water Resource in 2010, there are two major withdrawals that occur from R.E. "Bob" Woodruff Lake; International Paper at Prattville, and the E. B. Harris Southern Company Plant. There are also two minor irrigation withdrawals from the lake by Benton Farms and River Bend Sod. Also, the International Paper (Riverdale Mill) located below the R. F. Henry Project requests a minimum average of six hours of operation from Robert F. Henry.

The regulation and permitting of surface water withdrawals for M&I use is a state responsibility. No M&I water supply releases are made from R. F. Henry Dam specifically for downstream M&I water supply purposes. However, water released from R. F. Henry Dam for its authorized project purposes, particularly during dry periods, help to ensure a reasonably stable and reliable water flow in the river to the benefit of downstream water supply users.

8-07. Hydroelectric Power.

The R. F. Henry Hydropower Project, along with 23 other hydropower dams in the southeastern United States, composes the SEPA service area. SEPA sells hydroelectric power generated by Corps plants to a number of cooperatives and municipal power providers, referred to as preference customers. Hydroelectric power is one of the cheaper forms of electrical energy, and it can be generated and supplied quickly as needed in response to changing demand.

Hydropower is produced as peak energy at R. F. Henry, i.e., power is generated during the hours that the demand for electrical power is highest, causing significant variations in downstream flows. Daily hydropower releases from the dam vary from zero during off-peak periods to as much as 35,000 cfs, which is turbine capacity. Often, the weekend releases are lower than those during the weekdays. The R. F. Henry Project has a limited peaking hydropower capacity between elevations 123.0 feet NGVD29 to 126.0 feet NGVD29. The projects with hydropower capability provide three principal power generation benefits:

1. Hydropower helps to ensure the reliability of the electrical power system in the SEPA service area by providing dependable capacity to meet annual peak power demands. For most plants, that condition occurs when the reservoir is at its maximum elevation. Dependable capacity at hydropower plants reduces the need for additional coal, gas, oil, or nuclear generating capacity.

2. Hydropower projects provide a substantial amount of energy at a small cost relative to thermal electric generating stations, reducing the overall cost of electricity. Hydropower facilities reduce the burning of fossil fuels, thereby reducing air pollution. Between 2001 and 2010, R. F. Henry Project produced an average of 301,580 megawatt hours per fiscal year, with a minimum of 196,178 and a maximum of 417,933 MWH, dependent upon water availability.

3. Hydropower has several valuable operating characteristics that improve the reliability and efficiency of the electric power supply system, including efficient peaking, a rapid rate of unit unloading, and rapid power availability for emergencies on the power grid.

Hydropower generation by the R. F. Henry Dam hydropower plant, in combination with the other hydropower power projects in the ACT Basin, helps to provide direct benefits to a large segment of the basin's population in the form of relatively low-cost power and the annual return of revenues to the Treasury of the United States. Hydropower plays an important role in meeting the electrical power demands of the region.

8-08. Navigation.

The Alabama River from Montgomery, Alabama, downstream to the Mobile, Alabama, area provides a navigation route for commercial barge traffic, serving as a regional economic resource. A minimum flow is required to ensure usable water depths to support navigation. Congress has authorized continuous navigation on the river, when sufficient water is available. There are three locks and dams on the Alabama River, and a combination of dredging, river training works, and flow augmentation from upstream storage projects, which together support navigation depths on the river.

The Alabama River is a terminus on the inland waterway system. It is accessed by the Black Warrior Tombigbee Waterway and Mobile Harbor and the Gulf Intracoastal Waterway (GIWW). Its major value as a water transportation resource is its ability to carry traffic to and from inland waterway points in Mississippi, Louisiana, and Texas. Traffic on the Alabama River is linked to resources originating along the river, which makes barge transportation essential and convenient for moving these resources.

Because of river bends and shoaling at the bends, typical tow size is a four-barge tow, except during very low water conditions when tow sizes can be reduced to two barges.

Flows for navigation are most needed in the unregulated part of the lower Alabama River below Claiborne Lock and Dam. When flows are available, Claiborne Lock and Dam is operated to provide the full navigation depth of nine feet. When river conditions or funding available for dredging of the river indicates that project conditions (9-foot channel) will probably not be attainable in the low water season, the dam is operated to provide flows for a reduced project channel depth as determined by surveys of the river. In recent years funding for dredging has been cut resulting in higher flows or minimized channel (150 feet wide) being required to provide the design navigation depth. In addition to annual seasonal low flow impacts, droughts have a severe impact on the availability of navigation depths in the Alabama River.

A 9-foot deep by 200-foot wide navigation channel is authorized on the Alabama River to Montgomery, Alabama. A minimum depth of 7.5 feet can provide a limited amount of navigation. Under low-flow conditions, even the 7.5-foot depth has not been available at all times. Over the period from 1976 to 1993, based upon river stage, the 7.5-foot navigation channel was available 79 percent of the time and the 9-foot navigation channel was available 72 percent of the time. Since 1993, the percentage of time that these depths have been available has declined further. Full navigation channel availability on the Alabama River is dependent upon seasonal flow conditions and channel maintenance. The ACT Basin water control plan will provide a 9-foot channel, based upon river stage, approximately 90 percent of the time in January and over 50 percent of the time in September. A 7.5-foot channel, based upon river stage, is expected approximately 90 percent of the time in January and 56 percent of the time in September. Because of higher flows in the winter and spring, channel availability is much higher from December through May.

Figure 8-1 depicts the historic annual channel depth availabilities for the Alabama River below Claiborne Lock and Dam, based upon river stage, computed for 1970 - 2010.

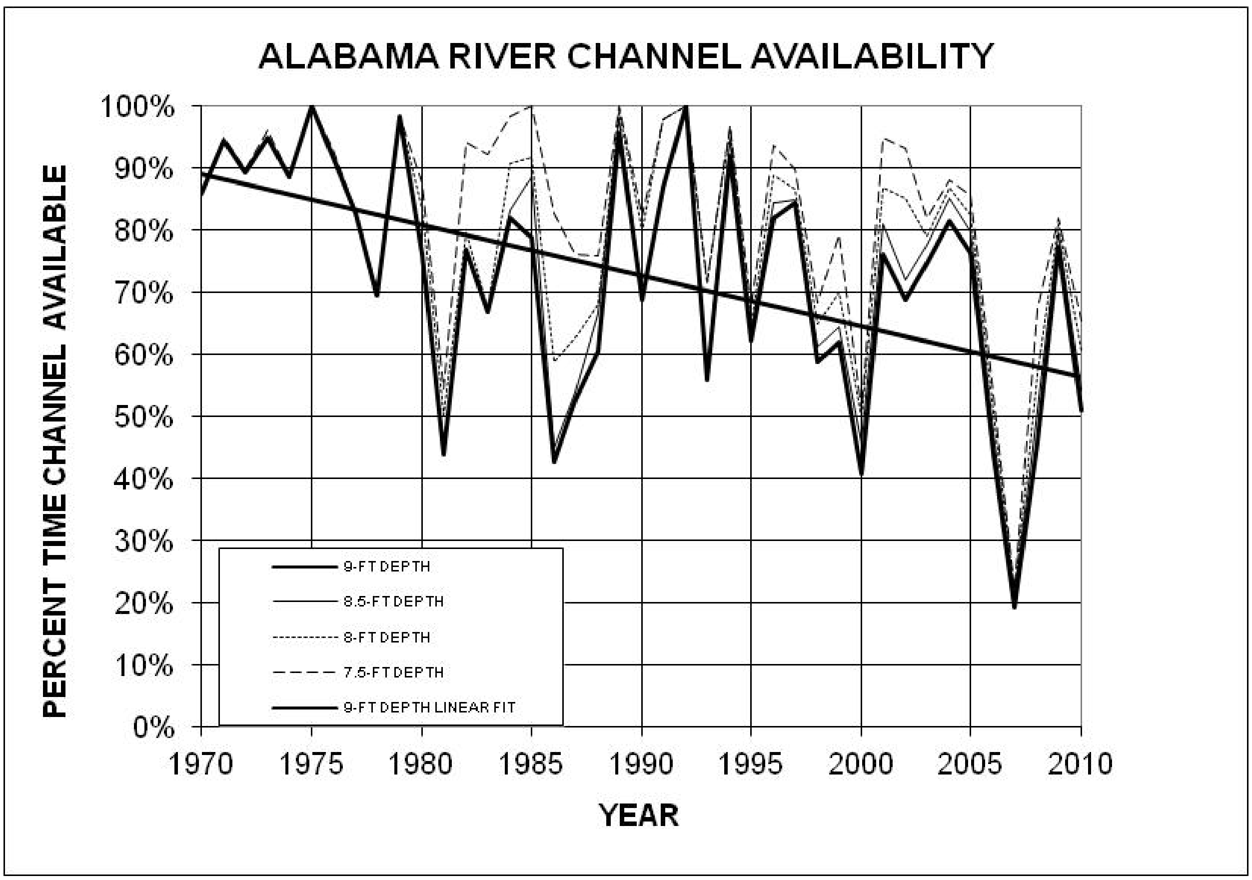


Figure 8-1. **Alabama River Channel Availability Below Claiborne, 1970 to 2010**

Extreme high-flow conditions also limit availability of the project for commercial navigation, principally related to the ability to use the navigation locks at the three locks and dams on the Alabama River. Those conditions are temporary and far more short-term (usually lasting no more than a few days) than low-water limitations resulting from extended periods of drought and low basin inflows. At R. F. Henry Lock and Dam, use of the navigation lock is discontinued when the headwater above the dam reaches elevation 131.0 feet NGVD29. That elevation equates to a flow of about 156,000 cfs, which occurs on average about once every three years. At Millers Ferry Lock and Dam, use of the navigation lock is discontinued when the tailwater below the dam reaches elevation 81.0 feet NGVD29. That tailwater elevation equates to a flow of about 220,000 cfs, which occurs on average about once every 18 years. At Claiborne Lake, use of the navigation lock is temporarily discontinued when the tailwater below the dam reaches elevation 47.0 feet NGVD29. That tailwater elevation equates to a flow of about 130,000 cfs, which occurs on average about once every 1.8 years.

8-09. Drought Contingency Plans. The development of drought plans has become increasingly important as more demands are placed on the water resources of the basin. During low-flow conditions, the system may not be able to fully support all project purposes. 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. Response to drought conditions involves all the Corps and APC projects in the basin. Certain flow rates into the Alabama River are prescribed in the Water Control Plan on the basis of available storage in the reservoirs, and other factors. The plan is described in Chapter VII of this appendix.

8-10. Flood Emergency Action Plans. Because the R. F. Henry Dam is not a flood risk management project, no major actions occur that are related to flood risk management. However, flowage easements have been obtained encompassing all lands subjected to an increased frequency of flooding from operation of the project. Normally, all operations are directed by the Mobile District Office. If a storm of flood-producing magnitude event occurs and all communications are disrupted between the district office and project personnel at the R. F. Henry Lock and Dam, emergency operating procedures, as previously described in Chapter VII of this appendix, 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.

8-11. Frequencies. The annual peak flow frequency curve at the R. F. Henry Project is plotted on Plate 8-5. The headwater and tailwater stage frequency curve is shown on Plate 8-6.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization. The R. F. Henry Project is a Federal structure operated by the Corps. It is part of the Alabama River Navigation System. Many agencies in Federal and State Governments are responsible for developing and monitoring water resources in the R. F. Henry Basin. Some of the Federal agencies are the Corps, U.S. Environmental Protection Agency, National Parks Service, U.S. Coast Guard, USGS, U.S. Department of Energy, U.S. Department of Agriculture, U.S. Fish and Wildlife, and NOAA. In addition to the Federal agencies, the State of Alabama is involved through the Alabama Department of Environmental Management, Alabama Office of Water Resources.

a. U.S. Army Corps of Engineers. Authority for water control regulation of the R. F. Henry Project has been delegated to the SAD Commander. The responsibility for water control regulation activities has been entrusted to the Mobile District, Engineering Division, Water Management Section. Water control actions for R. F. Henry are regulated to meet the federally authorized project purposes in coordination with federally authorized ACT Basin-wide System purposes. It is the responsibility of the Water Management Section to develop water control regulation procedures for the R. F. Henry Project, including all foreseeable conditions. The Water Management Section monitors the project for compliance with the approved water control plan. In accordance with the water control plan, the Water Management Section performs water control regulation activities that include determination of project water releases, daily declarations of water availability for hydropower generation and other purposes; daily and weekly reservoir pool elevation and release projections; weekly river basin status reports; tracking basin composite conservation storage and projections; determining and monitoring daily and seven-day basin inflow; managing high-flow operations and regulation; and coordination with other District elements and basin stakeholders. When necessary, the Water Management Section instructs the project operator regarding normal water control regulation procedures and emergencies, such as flood events. The project is tended by operators under direct supervision of the Power Project Manager and the R. F. Henry Site Manager. The Water Management Section communicates directly with the powerhouse operators at the R. F. Henry Powerhouse and with other project personnel as necessary. The Water Management Section is also responsible for collecting historical project data and disseminating water control information, such as historical data, lake level and flow forecasts, and weekly basin reports within the agency; to other Federal, State, and local agencies; and to the general public. The Jones Bluff Powerhouse is tended by operators who control both the power generation at Jones Bluff and the spillway gates. They can also remotely control the power generation at Millers Ferry. The Jones Bluff Powerhouse and spillway gates can also be remotely operated from the Millers Ferry Powerhouse. The Millers Ferry spillway gates can only be operated by the lock tender at Millers Ferry. The spillway gates and lock are tended by operators under direct supervision of a lock supervisor who in turn reports to the Project Manager at the Black Warrior Tombigbee/Alabama-Coosa Project Management Office in Tuscaloosa, Alabama.

b. Other Federal Agencies. Other Federal agencies work closely with the Corps to provide their agency support for the various project purposes of R. F. Henry 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. 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.

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

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.

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

e. Alabama Power Company. The APC owns and operates hydropower projects within the State, and controls most of the storage in the ACT Basin, as shown below in Table 9-1. The R. E. "Bob" Woodruff Lake controls approximately two percent of the conservation storage in the ACT Basin.

Table 9-1 ACT Basin Conservation Storage Percent by Acre-Feet

Project	Storage (acre-feet)	Percentage
* Allatoona	284,580	12%
* Carters	141,402	6%
Weiss	237,448	10%
H. Neely Henry	43,205	2%
Logan Martin	108,262	4%
Lay	77,478	3%
Mitchell	28,048	1%
Jordan	15,969	1%
Harris	191,129	8%
Martin	1,183,356	49%
Yates	5,976	0%
* R. F. Henry (R. E. "Bob" Woodruff)	36,450	2%
* Millers Ferry (William "Bill" Dannelly)	46,704	3%

* Federal project

R. F. Henry Project receives outflow from the APC dams, Jordan-Bouldin on the Coosa River and Thurlow on the Tallapoosa River, and schedules operation based on these releases and local or intervening flow. The scheduled outflows from these dams primarily determine the operation of R. F. Henry.

9-02. Interagency Coordination

a. Local Press and Corps Bulletins. The local press includes any periodic publications in or near the R. F. Henry Watershed and the ACT Basin. The cities of Montgomery, Prattville, Selma, Clanton, and Greenville, Alabama, are all in or near the R. F. Henry watershed and publish local newspapers. The papers often publish articles related to the rivers and streams. Their representatives have direct contact with the Corps through the Public Affairs Office. In addition, they can access the Corps web pages. The Corps and the Mobile District publish e-newsletters regularly which are made available to the general public via email and postings on various websites. Complete, real-time information is available at the Mobile Districts' Water Management homepage http://water.sam.usace.army.mil/.

b. National Weather Service. NWS is the Federal agency in NOAA that is responsible for weather and weather forecasts. The NWS along with its River Forecast Center maintains a network of reporting stations throughout the Nation. It continuously provides current weather conditions and forecasts. It prepares river forecasts for many locations including the ACT Basin. Often, it prepares predictions on the basis of *what if* scenarios. Those include rainfall that is possible but has not occurred. In addition, the NWS provides information on hurricane tracts and other severe weather conditions. It monitors drought conditions and provides the information. Information is available through the Internet, the news, and the Mobile District's direct access.

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

d. Southeastern Power Administration. SEPA was created in 1950 by the Secretary of the Interior to carry out the functions assigned to the secretary by the Flood Control Act of 1944. In 1977 SEPA was transferred to the newly created U.S. Department of Energy. SEPA, headquartered in Elberton, Georgia, is responsible for marketing electric power and energy generated at reservoirs operated by the Corps. The power is marketed to more than 491 preference customers in Georgia, Florida, Alabama, Mississippi, southern Illinois, Virginia, Tennessee, Kentucky, North Carolina, and South Carolina.

1. SEPA's objectives are to market electricity generated by the Federal reservoir projects, while encouraging its widespread use at the lowest possible cost to consumers. Power rates are formulated using sound financial principles. Preference in the sale of power is given to public bodies and cooperatives, referred to as preference customers. SEPA does not own transmission facilities and must contract with other utilities to provide transmission, or *wheeling* services, for the federal power.

2. SEPA's responsibilities include the negotiation, preparation, execution, and administration of contracts for the sale of electric power; preparation of repayment studies to set wholesale rates; the provision, by construction, contract or otherwise, of transmission and related facilities to interconnect reservoir projects and to serve

contractual loads; and activities pertaining to the operation of power facilities to ensure and maintain continuity of electric service to its customer.

3. SEPA schedules the hourly generation schedules for the R. F. Henry Hydropower Project at the direction of the Corps on the basis of daily and weekly water volume availability declarations and water release requirements.

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

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

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

GENERAL

Other names of project	Jones Bluff
Dam site location	
State	Alabama
Basin	Alabama-Coosa-Tallapoosa
River	Alabama
Miles above mouth of Alabama River	236.30
Total drainage area above dam site	
Square miles	16,233
1 inch of runoff equals - acre-feet	869,333
Type of project	Dam, Reservoir and Power plant
Objectives of regulation	Navigation, Power
Project Owner	United States of America
Operating Agency/ Regulating Agency	U. S. Army Corps of Engineers

STREAM FLOW AT DAM SITE (Dam in place)

Period of Record	1939-2009
Period of Record (Dam in place)	1975-2009
Average annual flow for period of record (1939-2009) – cfs	24,628
Minimum monthly flow in period of record (1939-2009) - cfs	2,256
Maximum monthly flow in period of record (1939-2009) - cfs	118,061
Minimum daily flow in period of record (1939-2009) - cfs	138
Maximum daily flow in period of record (1939-2009) - cfs	218,355
Peak flow during period of record, (Feb-Mar 1961 flood) - cfs	291,700
Peak stage during period of record, (Feb-Mar 1961 flood) – ft NGVD29	138.6

REGULATED FLOODS

Maximum flood of project record (Mar. 1990)	
Peak inflow - cfs	279,044
Peak outflow - cfs	220,000
Peak pool elevation – feet NGVD29	136.8
Maximum flood of continuous record (Feb. - Mar. 1961)	
Peak inflow - cfs	291,700
Regulated peak outflow - cfs	278,500
Regulated peak pool elevation - feet NGVD29	138.6
Standard project flood series	
Peak inflow - cfs	421,000
Regulated peak outflow - cfs	410,500
Regulated peak pool elevation - feet NGVD29	142.3

REGULATED FLOODS (CONT'D)

Spillway design flood series	
Peak inflow - cfs	738,000
Regulated peak outflow - cfs	725,500
Regulated peak pool elevation – feet NGVD29	148.0

RESERVOIR

Maximum operating pool elevation - feet NGVD29	126.0
Minimum operating pool elevation - feet NGVD29	123.0
Total drainage area above R. F. Henry dam site	
Square miles	16,233
1 inch of runoff equals - acre-feet	869,333
Area at pool elevation 126.0 - acres	13,500
Area acquired in fee simple - acres	5,407.2
Area acquired by easement - acres	13,911.78
Area cleared - acres	6,050
Maximum elevation of clearing - feet NGVD29	130.0
Total volume at elevation 126.0 - acre-feet	247,210
Length at elevation 126.0 - miles	81.1
Shoreline distance at elevation 126.0 - miles	397

LOCK

Nominal size of chamber - feet	84 x 600
Distance center to center of gate pintles - feet	655
Maximum lift - feet	47.0
Elevation of upper stop-log sill - feet NGVD29	109.0
Elevation of upper miter sill - feet NGVD29	109.0
Elevation of lower stop-log sill - feet NGVD29	67.0
Elevation of lower miter sill - feet NGVD29	67.0
Elevation of chamber floor - feet NGVD29	66.0
Elevation of top of floor culverts - feet NGVD29	66.0
Elevation of top of upper approach walls - feet NGVD29	132.0
Elevation of top of upper gate blocks - feet NGVD29	143.0
Elevation of top of chamber walls - feet NGVD29	132.0
Elevation of top of lower guide walls - feet NGVD29	132.0
Freeboard on guide walls when lock becomes inoperative - feet	1.0
Percent of time inoperative	0.4
Type of upper gate	horizontally framed miter
Height of upper gate – feet	34
Type of lower gate	horizontally framed miter
Height of lower gate – feet	65
Type of culvert valves	reverse tainter
Dimensions of culverts at valves – feet	10 x 10
Dimensions of culverts at laterals – feet	10 x 15.50
Elevation of culvert ceilings between valves - feet NGVD29	74.0
Minimum submergence of culvert valves - feet	5.0
Type of filling and emptying system	floor culverts
Type of emergency dams	stop logs

LOCK (CONT'D)

Elev. of top of upstream emergency dam (stoplogs) - feet NGVD29	126.7
Elevation of top of downstream emergency dam(stoplogs) - feet NGVD29	97.9
Type of operating machinery	hydraulic oil pressure

SPILLWAY

Type	concrete-gravity
Total length, including end piers - feet	646
Net length - feet	550
Elevation of crest – feet NGVD29	91.0
Number of piers, including end piers	12
Width of piers – feet	8
Type of gates	tainter
Number of gates	11
Length of gates – feet	50
Height of gates – feet	35
Maximum discharge capacity (pool elev. 125.0) - cfs	124,500
Elevation of top of gates in closed position – feet NGVD29	126.0
Elevation of top of gates in open position – feet NGVD29	168.25
Elevation of low steel of gates in fully open position – feet NGVD29	143.6
Elevation of trunnion – feet NGVD29	124.0
Elevation of access bridge – feet NGVD29	158.5
Elevation of stilling basin apron – feet NGVD29	66.0 to 81.0
Length of stilling basin – feet	62 to 72
Height of end sill – feet	5.0

EARTH OVERFLOW DIKES

Right Bank Dike	
Total length – feet	2,661
Top elevation – feet NGVD29	135.0
Top width – feet	32
Side slopes	1 on 8
Thickness of riprap on slopes – inches	24
Thickness of filter blanket – inches	9
Maximum swellhead when dike is overtopped – feet	1.4
Freeboard, top of dike above full upper pool – feet	9
Left Bank Dike	
Total length including lock mound – feet	12,639
Top elevation – feet NGVD29	143.0
Top width – feet	32
Side slopes	1 on 2.5
Freeboard, top of dike above full upper pool – feet	9
Freeboard, top of dike above headwater for Standard Project Flood series – feet	0.7
Recurrence interval of flood which will overtop dike (135 feet NGVD29) - yrs	9

POWER PLANT

Maximum power pool elevation – feet NGVD29	126.0
Maximum normal drawdown elevation – feet	123.0
Temporary/Emergency drawdown elevation – feet	122.0
Maximum static head – feet	47
Average operating head without spillway discharge – feet	29

POWER PLANT

Rated net head – feet	28.2
Operating head with one unit at full gate and pool elevation 126.0 feet	42.5
Minimum head for generation – feet	15.3
Length of powerhouse – feet	375
Width of powerhouse including intake structure – feet	160
Type of powerhouse construction	reinforced concrete
Type of intake gates	tractor
Number of intake gates	3/unit
Height of intake gates – feet	30
Width of intake gates – feet	17
Length of unit bay – feet	73
Number of units	4
Type of turbine	fixed blade
Maximum discharge per unit – cfs	8,800
Capacity of each turbine – hp	23,480
Elevation of centerline of distributor – feet NGVD29	96.0
Total installation – kW	82,000
Dependable plant output during critical period – kW	82,000
Generator rating – kva	20,500
Generator speed – rpm	73.5
Generator, electrical characteristics	3 phase, 60 Hertz 95 p.f.
Elevation of bottom of draft tube – feet NGVD29	39.0
Length of draft tube – feet	87
Type of draft tube gates	vertical slide
Number of draft tube gates	3/unit
Type of draft tube gate operation	positioned by gantry
Elevation of operating deck – feet NGVD29	143.0
Location of switchyard	right bank downstream
Elevation of switchyard and parking area – feet NGVD29	143.0
Transmission voltage – kv	115.0
Number of transformer bays	2
Number of 3-phase type transformers	2
Capacity of each transformer – kva	44,440
Average annual energy from plant – million kW-hr.	329.6

EXHIBIT B

UNIT CONVERSIONS

AREA CONVERSION

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

LENGTH CONVERSION

UNIT	cm	m	km	in.	ft	yd	mi
cm	1	0.01	0.0001	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	m^3/s	m^3/day	l/s	ft^3/s	ft^3/day	ac-ft/day	gal/min	gal/day	mgd
m^3/s	1	86,400	1000	35.31	3.05×10^6	70.05	1.58×10^4	2.28×10^7	22.824
m^3/day	1.16×10^{-5}	1	0.0116	4.09×10^{-4}	35.31	8.1×10^{-4}	0.1835	264.17	2.64×10^{-4}
l/s	0.001	86.4	1	0.0353	3051.2	0.070	15.85	2.28×10^4	2.28×10^{-2}
ft^3/s	0.0283	2446.6	28.32	1	8.64×10^4	1.984	448.8	6.46×10^5	0.646
ft^3/day	3.28×10^{-7}	1233.5	3.28×10^{-4}	1.16×10^{-5}	1	2.3×10^{-5}	5.19×10^{-3}	7.48	7.48×10^{-6}
ac-ft/day	0.0143	5.451	14.276	0.5042	43,560	1	226.28	3.26×10^5	0.3258
gal/min	6.3×10^{-5}	0.00379	0.0631	2.23×10^{-3}	192.5	4.42×10^{-3}	1	1440	1.44×10^{-3}
gal/day	4.3×10^{-8}	3785	4.38×10^{-4}	1.55×10^{-6}	11,337	3.07×10^{-6}	6.94×10^{-4}	1	10^{-6}
mgd	0.0438		43.82	1.55	1.34×10^5	3.07	694	10^6	1

VOLUME CONVERSION

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

COMMON CONVERSIONS

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

Station	NAVD88 Elevation (feet)	NGVD29 Elevation (feet)	Diff NAVD88 NGVD29 (feet)	Remarks
8A-10D	131.965			Set Corps of Engineers Brass Disk (Elevation obtain from OPUS DB)
8A-10E	143.082			Set Corps of Engineers Brass Disk
US Gauge	147.041			Shot on upstream gauge datum point. Digital readout 125.79, read 25.79 on metal tape. Both readings at 10:52 AM May 26, 2010
DS Gauge	146.968			Shot on downstream gauge datum point. Digital readout 81.13, read 81.23 on metal tape. Both readings at 9:33 AM May 26, 2010
Disk	143.076	143.014	0.062	USGS - RM 2 bronze tablet between pool and tail gages in transmitter room on floor. Elevation 143.014 feet, mean sea level.
RP1 (tail)	146.723	146.644	0.079	USGS - RP 1 [tail gage] penciled arrow on top of metal cover over pipe well, right of float tape indicator. Elevation 146.644 feet, mean sea level.
RP1 (pool)	146.715	146.651	0.064	USGS - RP 1 [pool gage] penciled arrow on top of metal cover over pipe well, right of float tape indicator. Elevation 146.651 feet, mean sea level.
TBM A	132.943			Chiseled "x" in top of bolt on base of light pole. Light pole is on left lock wall 18.20 feet south of hinges on gate leading to metal stair doing down inside of left lock wall
TBM B	159.193			Chiseled "x" in top of bolt of metal handrail base at metal stairs near power house on right side of dam.
TBM C	143.448			Chiseled "x" in base of downstream well pipe in transmitter room of power house.

SURVEY DATASHEET (Version 1.0)

PID: BBBZ02
Designation: 8A-10D
Stamping: 5A-10D
Stability: Monument will probably hold position well
Setting: Massive structures (other than listed below)
Description: LOCATED ON THE ALABAMA RIVER, AT THE ROBERT F. HENRY LOCK AND DAM, IN THE VICINTY OF THE DOWNSTREAM LEFT LOCK GATE AND NEAR THE DOWNSTREAM LEFT LOCK GATE. MONUMENT IS 14.10 FEET NORTHEAST OF A METAL CLEET, 13.00 FEET SOUTHEAST OF THE CONCRETE HANDRAIL, 10.00 FEET EAST OF THE CONCRETE HANDRAIL AND 12.40 FEET WEST OF THE THE CONCRETE HANDRAIL.
MONUMENT IS A STANDARD U.S. ARMY CORPS OF ENGINEERS BRASS DISK SET IN THE LOCK WALL.
Observed: 2010-06-22T13:08:00Z
Source: OPUS - page5 0909.08

Close-up View

REF_FRAME: NAD_83 (CORS96)	EPOCH: 2002.0000	SOURCE: NAVD88 (Computed using GEOID09)	UNITS: m	SET PROFILE	DETAILS

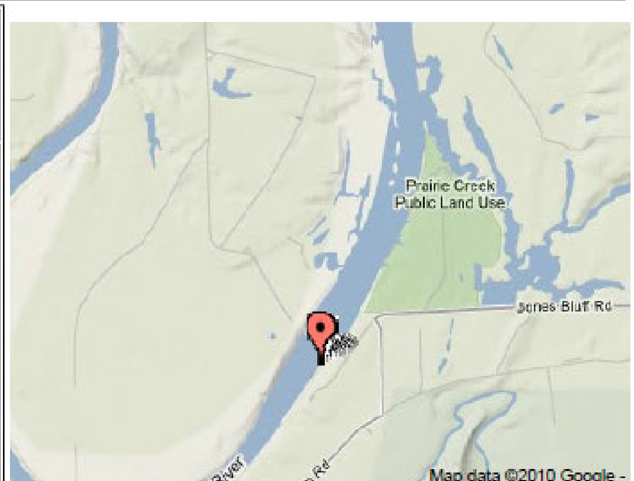
LAT:	32° 19' 19.03351"	± 0.037	m
LON:	-86° 47' 2.29515"	± 0.037	m
ELL HT:	12.413	± 0.029	m
X:	302667.607	± 0.036	m
Y:	-5386568.278	± 0.030	m
Z:	3390661.205	± 0.036	m
ORTHO HT:	40.223	± 0.029	m

	UTM 16	SPC 102(AL W)
NORTHING:	3576143.241m	257648.455m
EASTING:	520333.503m	667418.613m
CONVERGENCE:	0.11550603°	0.38285816°
POINT SCALE:	0.99960510	0.99998936
COMBINED FACTOR:	0.99960315	0.99998742

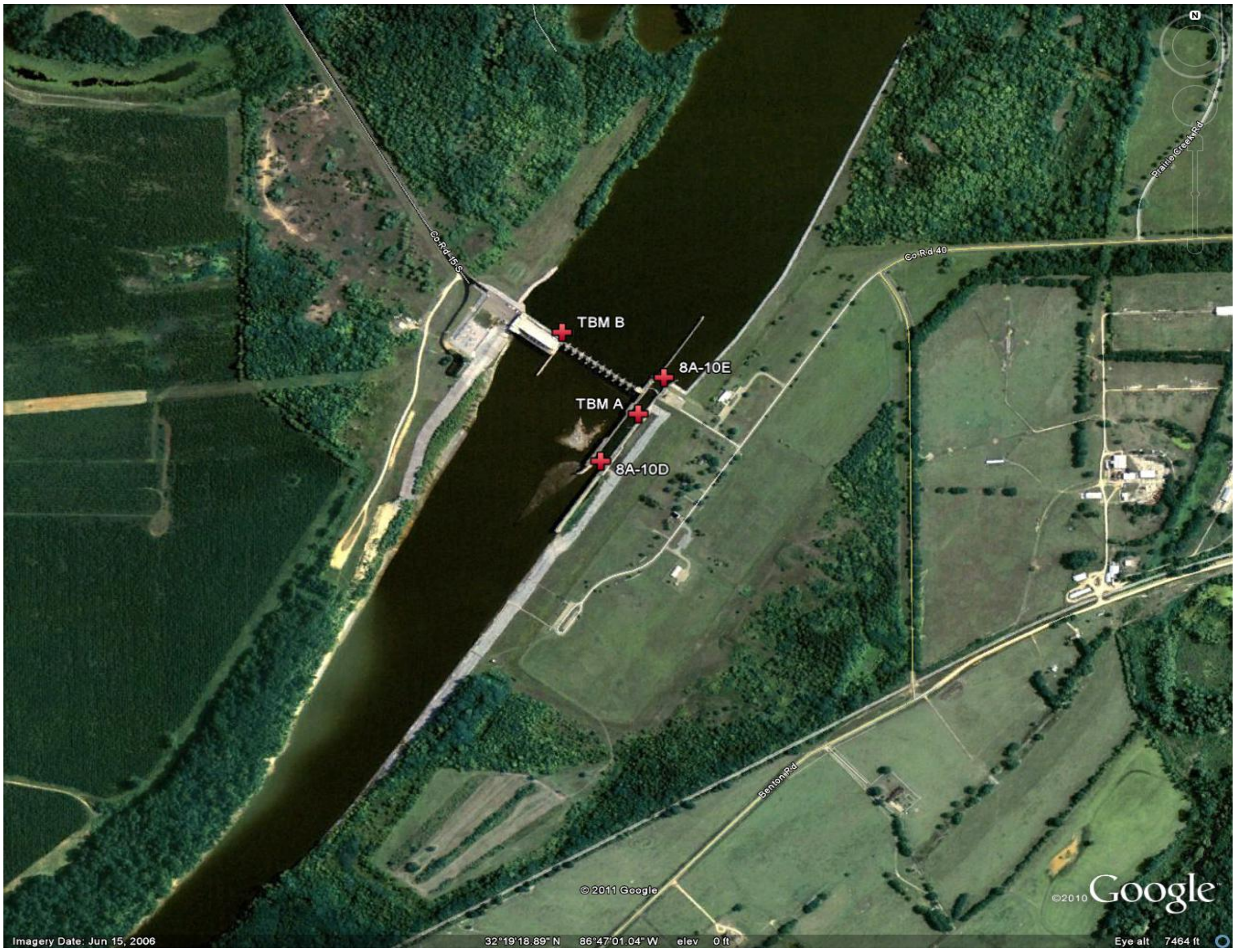
CONTRIBUTED BY

mchaney
Maptech 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.



R. F. Henry Lock and Dam

EXHIBIT C

STANDING INSTRUCTIONS TO THE PROJECT OPERATOR FOR WATER CONTROL

R. F. HENRY LOCK AND DAM

STANDING INSTRUCTIONS TO THE POWERHOUSE OPERATOR FOR WATER CONTROL

ROBERT F. HENRY LOCK AND DAM PROJECT

1. BACKGROUND AND RESPONSIBILITIES

a. General Information. These “Standing Instructions to the Powerhouse Operator for Water Control” are written in compliance with Paragraph 9-2 of EM-1110-2-3600 (Engineering and Design, *Management of Water Control Systems*, 30 November 1987) and with ER-1110-2-240 (Engineering and Design, *Water Control Management*, 8 October 1982). A copy of these Standing Instructions must be kept on hand at the project site at all times. Any deviation from the Standing Instructions will require approval of the District Commander.

(1) Project Purposes. The R. F. Henry Lock and Dam Project is operated for Hydropower and Navigation.

(2) Chain of Command. The Powerhouse Operator is responsible to the Water Control Manager for all water control actions.

(3) Structure. The R. F. Henry Dam is located at Alabama River mile 236.3, Autauga County, Alabama. The dam is a concrete-gravity structure with a concrete-gravity gated spillway. The Powerhouse is located on the right bank, joined to the spillway on the east or river side. The Lock is located in the left bank between the spillway and the left overbank earth dike.

(4) Operation and Maintenance (O&M). All O&M activities are the responsibility of the Corps.

b. Role of the Powerhouse Operator

(1) Normal Conditions (dependent on day-to-day instruction). The Water Control Manager will coordinate the daily water control actions with SEPA. The Powerhouse Operator will then receive instructions from SEPA. This communication will be increased to an hourly basis if the need develops.

(2) Emergency Conditions (flood, drought, or special operations). During emergency conditions, the Powerhouse Operator will be instructed by the Water Control Manager on a daily or hourly basis for all water control actions. In the event that communications with Water Management Section are cut off, the Powerhouse Operator will continue to follow the Water Control Plan and contact the Water Management Section as soon as communication is reestablished.

2. DATA COLLECTION AND REPORTING

a. General. R. F. Henry and Millers Ferry Powerhouse data is automatically recorded hourly. A file containing the data is sent to the LDS System every four hours. The information includes pool elevations, megawatt loading of the units, turbine and spillway discharges, gate step settings and inflows.

b. Normal Conditions. At 6:00AM every morning a water management report is sent to the LDS. It includes:

1. Midnight Pool Elevation (feet NGVD29)
2. 6AM Pool Elevation (feet NGVD29)
3. Midnight Tailwater Elevation (feet NGVD29)
4. 6AM Tailwater Elevation (feet NGVD29)
5. 24-Hour Average Inflow (cfs)
6. 1st 4-Hour Average Inflow (cfs)
7. 24-Hour Average Discharge (cfs)
8. 1st 4-Hour Average Discharge (cfs)
9. Gross Generation (mwh)
10. Estimated Generation (mwh)
11. Rainfall (hundredths of an inch)
12. 6AM Gatestep
13. 24-Hour Average Turbine Discharge (cfs)
14. Capacity (mw)
15. Project generation schedule.

c. Regional Hydro-meteorological Conditions. The Powerhouse Operator will be informed by the Water Control Manager of any regional hydro-meteorological conditions that may impact water control actions.

3. WATER CONTROL ACTION AND REPORTING

a. Normal Conditions. During normal conditions, all releases will be made through the turbine units. The Powerhouse Operator will follow the R. F. Henry Water Control Manual for normal water control actions and will report directly to the Water Control Manager.

b. Emergency Conditions. During high-flows, the Lock Operator at R. F. Henry will follow the instructions for spillway gate settings given by the Powerhouse Operator and according to the Gate Operating Schedule. The generating units will be shut down when the operating head decreases to approximately 15.3 feet. During low-flow conditions, the Powerhouse Operator will contact the Water Control Manager if the pool elevation reaches 122.5. If unable to reach Water Management Section, generating units will be shut down at elevation 122.0 feet NGVD29, and the Powerhouse Operator will notify Water Management and SEPA as soon as possible. In no case will releases be made when the pool is below elevation 122.0 feet NGVD29 unless specifically directed by the Water Management Section. The Powerhouse Operator will follow the R. F. Henry Water Control Manual for emergency water control actions and will follow the Emergency Action Plan for emergency notification procedures.

c. Inquiries. All significant inquiries received by the Powerhouse Operator from citizens, constituents, or interest groups regarding water control procedures or actions must be referred directly to the Water Control Manager.

d. Water Control Problems. The Powerhouse Operator must immediately notify the Water Control Manager, by the most rapid means available, in the event that an operational malfunction, erosion, or other incident occurs that could impact project integrity in general or water control capability in particular.