Nuclear Regulatory Commission
Exhibit # - NRC000039-00-BD01
Docket # - 05200011
Identified: 03/16/2009

Admitted: 03/16/2009 Withdrawn:
Rejected: Stricken:

NRC000039

DRAFT
ENVIRONMENTAL ASSESSMENT
AND
FINDING OF NO SIGNIFICANT IMPACT

TEMPORARY DEVIATION
DROUGHT CONTINGENCY PLAN
SAVANNAH RIVER BASIN

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

October 2008

TABLE OF CONTENTS

Page No.

ACRONYMS ..... **iv**

FINDING OF NO SIGNIFICANT IMPACT **1**

DRAFT ENVIRONMENTAL ASSESSMENT **3**

1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION **3**
- **1.1. INTRODUCTION** **3**
  - 1.1.1. History 3
  - 1.1.2. Requirement for Environmental Documentation 4
  - 1.1.3. General Objectives 5
- **1.2. PURPOSE AND NEED** **5**
- **1.3. SCOPE** **5**
- **1.4. STUDY METHODOLOGY** **5**

2.0 AFFECTED ENVIRONMENT **6**
- **2.1. DESCRIPTION OF THE SAVANNAH RIVER BASIN** **6**
- **2.2. DESCRIPTION OF CORPS PROJECTS** **7**
- **2.3. RECREATION** **8**
  - 2.3.1. Public Boat-Launching Ramps and Private Docks 8
  - 2.3.2. Swimming 11
- **2.4. WATER SUPPLY** **12**
- **2.5. HYDROPOWER AND PUMPED STORAGE** **12**
- **2.6. WATER QUALITY IN THE LAKES** **13**
- **2.7. WATER QUALITY IN THE SAVANNAH RIVER** **14**
- **2.8. BIOTIC COMMUNITIES AT THE LAKES** **16**
  - 2.8.1. Fishery Resources at Hartwell Lake 16
  - 2.8.2. Fishery Resources at RBR Lake 16
  - 2.8.3. Fishery Resources at JST Lake 17
  - 2.8.4. Aquatic Plants at Hartwell Lake 17
  - 2.8.5. Aquatic Plants at RBR Lake 18
  - 2.8.6. Aquatic Plants at JST Lake 18
  - 2.8.7. Aquatic Plants at New Savannah Bluff Lock and Dam 19
- **2.9. BIOTIC COMMUNITIES IN THE LOWER SAVANNAH RIVER** **19**
  - 2.9.1. Fish 19
  - 2.9.2. Wetlands 21
  - 2.9.3. Wildlife 22
  - 2.9.4. Endangered Species 23
  - 2.9.5. Special Biological Areas 27
- **2.10. SOCIOECONOMIC ISSUES** **27**
  - 2.10.1. Environmental Justice 27
  - 2.10.2. Protection of Children 27

3.0 DESCRIPTION OF THE PROPOSED ACTION AND OTHER ALTERNATIVES **28**
- **3.1. ALTERNATIVE FORMULATION** **28**
- **3.2. ALTERNATIVES ANALYSIS** **28**
  - 3.2.1. No Action Alternative 28

TABLE OF CONTENTS (continued)

Page No.
3.2.2. Alternative 1 31
3.2.3. Alternatives Considered But Eliminated From Detailed Consideration 32
3.2.4. Recommended Alternative 32

4.0 ENVIRONMENTAL AND SOCIO-ECONOMIC CONSEQUENCES 33
4.1. WATER QUALITY 33
4.2. BIOTIC COMMUNITIES-LAKES 41
4.2.1. Largemouth Bass Spawning 41
4.2.2. Aquatic Plants 41
4.3. BIOTIC COMMUNITIES-SHOALS 42
4.4. BIOTIC COMMUNITIES-FLOODPLAIN 43
4.5. BIOTIC COMMUNITIES-ESTUARY 43
4.6. THREATENED AND ENDANGERED SPECIES 47
4.7. ESSENTIAL FISH HABITAT 48
4.8. RECREATION 49
4.8.1. Boat-Launching Ramps and Private Docks 49
4.8.2. Swimming 49
4.9. WATER SUPPLY 49
4.10. COASTAL ZONE CONSISTENCY 51
4.11. HYDROPOWER 52
4.12. CULTURAL RESOURCES 52
4.13. ENVIRONMENTAL JUSTICE 52
4.14. PROTECTION OF CHILDREN 53
4.15. CUMULATIVE EFFECTS 53

5.0 CONCLUSIONS 54

6.0 RELATIONSHIP OF PROJECT TO FEDERAL AND STATE AUTHORITIES 58

7.0 COORDINATION 59

8.0 LITERATURE CONSULTED 59

LIST OF TABLES

Table 1: Hartwell Lake - Unusable Ramps by Lake Level 658 to 652 feet msl ----------9
Table 2: J.Strom Thurmond - Unusable Ramps by Lake Level 326 to 317 feet msl---------- 10
Table 3: Federal Endangered, Threatened and Candidate Species Likely to Occur in the Savannah River Basin Study Area ---------- 24
Table 4: Georgia and South Carolina Rare, Threatened and Endangered Species Occurring in Counties Adjacent to the Savannah River ---------- 25
Table 5: Hartwell Action Levels for the NAA ---------- 29
Table 6: J. Strom Thurmond Action Levels for the No Action Alternative ---------- 30
Table 7: Impact Summary ---------- 55
Table 8: Summary of Requirements---------- 57

TABLE OF CONTENTS (continued)

Page No.

LIST OF FIGURES

Figure 1 - Hartwell Action Levels for the NAA---------- 29
Figure 2 - Thurmond Action Level for the NAA ---------- 30
Figure 3 - Comparison of Alternatives----------32
Figure 4 - Calibration of Savannah River water quality model at River Mile 119 ----------34
Figure 5 - Calibration of Savannah River water quality model at River Mile 61---------- 35
Figure 6 - Dissolved oxygen at RM 119 ---------- 36
Figure 7 - Dissolved oxygen at RM 61----------36
Figure 8 - Simulated dissolved oxygen at RM 119 ----------37
Figure 9 - Simulated dissolved oxygen at RM 61---------- 37
Figure 10 – Salinity at I-95 Bridge ---------- 39
Figure 11 - Simulated surface dissolved oxygen in Savannah Harbor ---------- 40
Figure 12 – Salinity Modeling at I-95 Bridge ---------- 44
Figure 13 – Surface Salinity Modeling in the Estuary ---------- 46

LIST OF APPENDICES

Appendix A – Savannah River Basin Maps
Appendix B – Agency Proposal
Appendix C – GA DNR-EPD Request Letter
Appendix D – SC DHEC Request Letter
Appendix E – List of Preparers
Appendix F – Public Notice
Appendix G – Comments

ACRONYMS

CFR ---------- Code of Federal Regulations
cfs ---------- cubic feet per second
DHEC ---------- Department of Health and Environmental Control
DNR ---------- Department of Natural Resources
DO ---------- Dissolved Oxygen
EA---------- Environmental Assessment
EFM ---------- Ecosystems Function Model
EPA ---------- Environmental Protection Agency
EPD ---------- Environmental Protection Division
HEC---------- US Army Corps of Engineers Hydrologic Engineering Center
JST ---------- J. Strom Thurmond
msl ---------- mean sea level
NAA ---------- No Action Alternative
NEPA ---------- National Environmental Policy Act of 1969
NOAA ---------- National Oceanic and Atmospheric Administration
NSBL&D-------- New Savannah Bluff Lock and Dam
NWR---------- National Wildlife Refuge
PDT ---------- Project Delivery Team
RBR---------- Richard B. Russell
SEPA ---------- Southeastern Power Administration
SHPO ---------- State Historic Preservation Officer
SRBDCP -------- Savannah River Basin Drought Contingency Plan
USFWS---------- United States Fish and Wildlife Service
USGS ---------- United States Geologic Survey
WY---------- Water Year

FINDING OF NO SIGNIFICANT IMPACT

Name of Action: Drought Contingency Plan Temporary Deviation for the Savannah River Basin

1. Description of the Proposed Action

The proposed action consists of retaining the major components of the 1989 Savannah River Basin Drought Contingency Plan (SRBDCP) and temporarily adjust one feature. The minimum daily average release at J. Strom Thurmond Dam would be adjusted from 3,600 to 3,100 cubic feet per second (cfs) in drought Level 3 from November 1, 2008 through February 28, 2009. This change would preserve water in the US Army Corps of Engineers reservoirs and delay the time at which those reservoirs would reach the bottom of their conservation storage. The Corps would restore the water flows up to the 3,600 cfs per day daily average if requested by either the State of Georgia or South Carolina.

2. Other Alternatives Considered

Alternatives to the Proposed Action were developed as part of the planning process. The alternatives that were considered were as follows:

a. No Action Alternative (Continue with the 1989 Savannah River Basin Drought Contingency Plan (SRBDCP) as updated in 2006)

b. Alternative 1 (Selected Alternative): Retain the major components of the 1989 SRBDCP and temporarily adjust one feature. The minimum daily average release at Thurmond Dam would be adjusted from 3,600 to 3,100 cfs for the period November 1, 2008 through February 28, 2009 while in drought Level 3.

c. Alternatives Considered but Eliminated from Detailed Consideration: A preliminary alternative that was initially considered was similar to Alternative 1, with a daily average flow reduction to 3,300 cfs for the cooler months (October 1 to February 28). Under the recorded 2007 hydrology (with a 10% reduction in inflow), a release of 3,300 cfs from Thurmond Dam was found to not sufficiently stabilize the reservoir system and improve the reservoir refill probabilities.

3. Coordination

Savannah District coordinated this action with Federal, State and local agencies and issued a Notice of Availability to solicit comments from the public on the Draft Environmental Assessment.

4. Conclusion

Based on a review of the information contained in this Environmental Assessment (EA), I have determined that the preferred alternative is the best course of action. I have also determined that the Drought Contingency Plan Temporary Deviation for the Savannah River Basin is not a major Federal action within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. Accordingly, the preparation of an Environmental Impact Statement is not required. My determination was made considering the following factors discussed in the EA to which this document is attached:

a. The proposed action would not adversely affect any threatened or endangered species (may affect, but not likely to adversely affect shortnose sturgeon, manatee, and wood stork).

b. The proposed action would not adversely impact cultural resources.

c. The proposed action would not adversely impact air quality.

d. The proposed action complies with Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations."

e. The proposed action would not cause any significant long term adverse impacts to wetlands.

f. No unacceptable adverse cumulative or secondary impacts would result from the implementation of the proposed action.

5. Findings

The proposed action to temporarily deviate from the Drought Contingency Plan for the Savannah River Basin would result in no significant environmental impacts and is the alternative that represents sound natural resource management practices and environmental standards.

_____ _____

Date

Edward J. Kertis
Colonel, US Army
Commanding

DRAFT ENVIRONMENTAL ASSESSMENT

1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1. INTRODUCTION

1.1.1. History

The Savannah River Basin has been experiencing a drought since early 2006. Rainfall and resulting stream flow have been particularly low, causing the reservoirs to drop faster than during previous droughts. The current drought has become the new drought-of-record for the basin. Hartwell Lake is experiencing its lowest pool elevations since it was initially filled in 1962.

The Corps manages the three impoundments on the Savannah River as a system and uses a Water Control Manual to describe how it will operate those projects. The Drought Contingency Plan is a component of that Manual and was developed (1) to address the effects of the Corps' operation on those impoundments and the downstream portion of the river, and (2) to assist the States of Georgia and South Carolina in drought contingency planning in their water management responsibilities for the Savannah River Basin.

The Corps' 1989 Drought Contingency Plan (DCP) and a 2006 Environmental Assessment (EA) describe activities that would be conducted during four stages of a continuing drought. Those four stages correspond to different lake levels. When the reservoirs reach the Level 1 trigger elevation, the Corps issues a public safety advisory concerning recreational use of the reservoirs. The Corps also reduces discharges from the reservoirs when Levels 1-3 are reached. When Level 4 is reached, the conservation pools are empty. If drought conditions persist after Level 4 is reached, discharges are further reduced to the point where the outflow from the lakes equals the net inflow.

The actions the Corps would take surrounding the Level 4 trigger were never evaluated in detail when the plan was originally developed or during the 2006 Update. The Reservoir System Simulation modeling conducted to analyze the effects of the various operational scenarios during development of the 1989 DCP and its 2006 EA for the DCP Update always indicated that the lakes would not reach the bottom of conservation pool. This modeling was conducted using inflows that were the drought of record at that time. Sensitivity analyses revealed that the drought would need to extend three additional years to reach Level 4. Therefore, detailed consideration was never given for the best way to operate once that trigger was reached.

It should be noted that if/when a new drought of record occurs, the Corps' operational objective should always be to avoid ever reaching the bottom of the conservation pool. This requires a constant evaluation of the current operations and an update of the drought of record. If the current drought becomes the drought of record, then additional measures not included in the previous Manual or Drought Contingency Plan should be considered and evaluated to achieve this objective.

As the ongoing drought in the southeastern U.S. completed its third summer, the Savannah River reservoir system operated by the Army Corps of Engineers (hereafter referred to as the Savannah System) is experiencing extreme pressure and difficulties. As of July 23, 2008, the system has only 46% of its conservation storage remaining. Hartwell and Thurmond, the two large storage reservoirs, are approximately 12 feet below normal pool levels. Hartwell has less than 57% of its conservation storage left, and Thurmond has only 28% of its conservation storage remaining.

The spring 2008 recharge season has long gone, and the status of the system is of particular concern to many parties in both Georgia and South Carolina depending on the resources provided by the storage in these reservoirs. Low inflows to the system last year and early this year raised the prospect that the system storage could be exhausted and a consequent transition to Level 4 operations (only releasing inflow) may be on the horizon.

The severity of the drought created conditions which stressed the traditional management concepts followed in regulating the individual Corps impoundments and the integrated water management of the three lakes. Concerns and conflicts over competing water issues intensified as drought conditions became more severe and lake levels continued to fall. During 1986, the Savannah District developed a Short-Range Drought Water Management Strategy to address the worsening water shortage conditions in the Savannah River Basin. That document served as a guide for using the remaining storage in the Corps operated Savannah River impoundments for the duration of the drought. The short-range strategy also served as a prelude to the development of a long-term drought strategy, the Savannah River Basin Drought Contingency Plan (SRBDCP) of March 1989. That plan was modified in 2006 by the revision of actions that would occur at the various drought trigger levels. The intent of those modifications was to act earlier in a drought to preserve additional water in the lakes, thereby delaying the time when the conservation pools would be depleted and outflows would reflect only the inflows that the lakes received.

1.1.2. Requirement for Environmental Documentation

An Environmental Assessment (EA) is prepared in conformance with procedures established by the National Environmental Policy Act of 1969 (NEPA) to identify impacts expected to result from implementation of a proposed action. The assessment ensures that the decision-maker is aware of the environmental impacts of the action prior to the decision to proceed with its implementation. This Act requires the consideration of environmental impacts of a "Proposed Action" and its alternatives prior to implementing the action. This EA addresses proposed temporary revisions to the SRBDCP.

1.1.3. General Objectives

The objectives of the Proposed Action are:

- ⇨ Savannah River Basin – Reduce discharges from the Corps' reservoirs on the Savannah River Basin to maintain the conservation pool as long as possible. This would delay the time when Level 4 conditions would occur. This approach would preserve water supply for as many users as possible and minimize negative impacts to other users adversely affected by this action. Also, implementation of the proposed action would aid in the recovery of the system reservoirs by allowing more storage to be captured during this cool weather season.
- ⇨ Environmental Compliance - comply with all applicable environmental laws, regulations, and policies

1.2. Purpose and Need

The Savannah River Basin has been experiencing a drought since early 2006. Rainfall and resulting stream flow have been particularly low, causing the reservoirs to drop faster than during previous droughts. The SRBDCP was intended to be a dynamic document which could be changed as new drought periods occur. The purpose for the temporary reduction in flow from Thurmond to 3,100 cfs during the cooler months of November 1, 2008 through February 28, 2009 is to maintain the conservation pools within the Savannah System through at least 2011, and to decrease the recovery time to refill the reservoirs.

1.3. Scope

The scope of this EA is limited to assessing the potential environmental and socio-economic effects resulting from implementing the Proposed Action and the No Action Alternative (NAA). After eliminating alternatives that are not considered feasible or effective, the potential environmental impacts associated with the NAA are compared to the Proposed Action.

1.4. Study Methodology

Water managers in Georgia and South Carolina jointly performed a volume analysis of the storage remaining within the conservation pools of the three Corps' managed lakes on the Savannah River. They then considered several different drought hydrologic inflow and outflow scenarios. They performed computer modeling that focused on how long the conservation storage could be preserved within the three-lake system.

The States initially considered several hydrologic and operating scenarios. Among other factors, those scenarios reflected the range of potential inflow amounts that could be expected in the basin. Those alternatives and hydrologic conditions were refined after more data became available from the National Weather Service and lake levels declined over the course of the 2008 summer months. The hydrologic conditions they ultimately chose as inputs for the analysis were based on the 2007 inflows with a 10% reduction.

The goal of the alternatives analysis was to identify an operating approach that would allow the conservation storage within the lakes to decline at a slower rate, while still balancing the

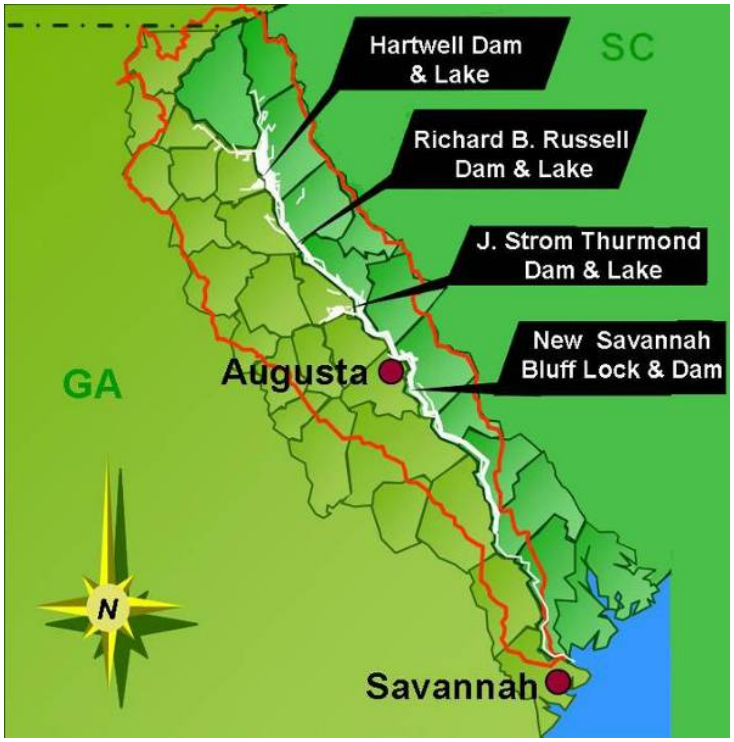
authorized project purposes of water supply, water quality, fish and wildlife, and hydropower. If such an alternative could be found, the point at which the conservation storage within the lakes would be depleted would be postponed, delaying Level 4 conditions.

Once the inflow set was chosen, several analyses were performed to identify the impacts of the outflow scenarios on the various project purposes. The proposed alternative consists of a targeted release of 3,100 cfs from Thurmond Dam for the cooler months of October through February when the lakes are in Drought Level 3. This release would be a temporary change to the Savannah River Basin Drought Contingency Plan. The States proposed a flow reduction starting on 1 October, but they did not submit the request to the Corps in time that allowed for evaluation and public comment. The proposal in this Draft EA is to begin the flow reduction on 1 November.

The No Action Alternative follows the water release procedures described in the previously-approved Savannah River Basin Drought Contingency Plan, including previously approved deviations.

2.0 AFFECTED ENVIRONMENT

2.1. DESCRIPTION OF THE SAVANNAH RIVER BASIN

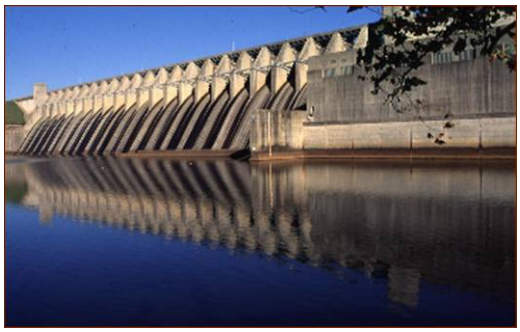


The Savannah River basin has a surface area of approximately 10,577 square miles, of which 5,821 square miles are in Georgia, 4,581 square miles are in South Carolina and 175 square miles are in North Carolina. The basin includes portions of 27 counties in Georgia, 13 counties in South Carolina and four counties in North Carolina. Although the basin is predominantly rural, metropolitan areas are experiencing significant growth and development pressures. The growth is occurring primarily in the areas of Augusta and Savannah, Georgia, although many smaller cities and towns are also growing. The study area drains portions of three physiographic provinces: the Blue Ridge Mountains, the Piedmont and the Coastal Plain. In its middle and upper reaches the river flow is regulated by several reservoirs, including three large multipurpose Corps projects (Hartwell Lake, Richard B. Russell (RBR) Lake and J. Strom Thurmond (JST) Lake) and two large private power reservoirs (Lakes Keowee and Jocassee). Other structures include the New Savannah Bluff Lock and Dam, the Stevens Creek Dam and the Old Lock and Dam at the Augusta Canal.

Water discharge in the Savannah River varies considerably both seasonally and annually, even though it is largely controlled by releases from the Corps' JST Dam located about 20 miles northwest of Augusta, Georgia. Discharge is typically high in winter and early spring and low in summer and fall, but regulation by upstream reservoirs has reduced natural flow variations. At the New Savannah Bluff Lock and Dam located 12 miles downstream of Augusta, average annual discharge is about 10,000 cfs. The range in water year 1998 was about 4,300 to 42,700 cfs. Average discharge at Clyo (Effingham County, Georgia) is 12,040 cfs, with a range for water year 1998 of 6,280 to 52,600 cfs (Cooney et al. 1999). Tidal effects extend upstream to approximately river mile 45 (Reconnaissance Planning Aid Report on the Savannah River Basin Study, US Fish and Wildlife Service, July 1999).

Hartwell Lake and Dam

R. B. Russell Lake and Dam


J. S. Thurmond Lake and Dam

New Savannah Bluff Lock and Dam

2.2. Description of Corps Projects

The Corps maintains and operates three large multipurpose projects in the basin. Hartwell Dam and Lake (55,950 acre summer pool) is located 89 miles upstream of Augusta and was filled in 1962. RBR Dam and Lake (26,650 acre summer pool) is located 59 miles upstream of Augusta and was filled in 1984. JST Dam and Lake (70,000-acre summer pool) is located 22 miles upstream of Augusta and was filled in 1954.

The authorized project for the Savannah River between Augusta and Savannah, Georgia, provides for a navigation channel 9 feet deep and 90 feet wide from the upper end of Savannah Harbor (mile 21.3) to the head of navigation just below the 13th Street bridge in Augusta (mile 202.2). This is a distance of 180.9 miles. The project also includes the lock and dam at New Savannah Bluff, located about 12 miles downstream from Augusta. Channel modifications, including deepening, widening, snagging, construction of bend cutoffs, and construction of pile dikes, were made on the river to provide the 9-foot depth. However, by 1980, shipping on the river had virtually ceased, and channel maintenance was discontinued.

The existing authorized Savannah Harbor Navigation Project provides a channel 44 feet deep and 600 feet wide across the ocean bar; 42 feet deep and 500 to 600 feet

wide to the vicinity of Kings Island Turning Basin; and 30 feet deep and 200 feet wide to a point l,500 feet below the Houlihan Bridge (US Highway 17). The terminus of the deep-draft channel in Savannah Harbor is at approximately river mile 21. The project provides turning basins for vessels at various locations in the harbor (Reconnaissance Planning Aid Report on the Savannah River Basin Study, US Fish and Wildlife Service, July 1999).

2.3. RECREATION

The lakes of the Savannah River Basin provide excellent opportunities for water resource-based recreation. However, in times of drought, when the lake levels of Hartwell and JST Lake drop 6 feet below summer pool, drought information sheets are disseminated to the public. These sheets instruct the public to only use marked navigation channels, since unmarked hazards become more prevalent increasing risks of boating accidents outside the channel. In addition, at 6 feet below summer pool, designated swimming areas become dry. However, adverse impacts become noticeable at designated swimming areas when lake levels drop below 3 feet.

According to the Savannah River Basin Water Use Data Collection Presentation of Findings, June 2004, conduct by Zapata Engineering. P.A., for the US Army Corps of Engineers, Savannah District, during periods of low water, approximately 39 percent of the recreational users surveyed said that they would make a water-based recreational trip to the same lake, 41 percent would make a water-based recreation trip elsewhere, and 20 percent would not make a water-based recreation trip. Therefore, during periods of drought, 61 percent of non-drought visitors do not make a water resource-based recreation trip to Hartwell and JST Lakes. Respondents of this survey also indicated that their recreational activities are seriously impacted when lake levels drop an average of 7.5 feet below full pool. According to some lake managers, water recreation is more difficult and less convenient during periods of drought because recreationists may have to travel further distances to a useable ramp for access to the lake, they may consider the lake aesthetically unpleasing and they may recognize the increased risk of damaging their boat and person.

2.3.1. Public Boat-Launching Ramps and Private Docks

Public boat-launching ramps and private docks provide recreational access to the lakes of the Savannah River Basin. The following paragraphs discuss the facilities that exist on the three Corps reservoirs.

Hartwell Lake

There are 95 public boat-launching ramps and marinas located on Hartwell Lake. From lake elevation 660 to 658.01 feet mean sea level (msl) all ramps are useable. At and below lake level 658 feet msl, the first 6 boat-launching ramps become unusable. At and below lake level 657 feet msl, 6 more or a total of 12 boat-launching ramps become unusable. At and below lake level 656 feet msl, one more or a total of 13 boat-launching ramps become unusable. At and below lake level 655 feet msl, 3 more or a total of 16 boat-launching ramps become unusable. At and below lake level 654 feet msl, 1 more or a total of 17 boat-launching ramps become unusable. At and below lake level 653 feet msl, 6 more or a total of 23 (24.2 percent) public boat ramps become unusable, but 72 (75.8 percent) remain serviceable. When lake levels drop

to 646 feet msl, 43 (45.2 percent) boat-launching ramps become unusable. If lake levels were to ever drop to 638 feet msl, all the ramps become unusable.

Table 1: Hartwell Lake - Unusable Ramps by Lake Level 658 to 652 feet msl

NAME OF BOAT RAMP	LAKE LEVEL RAMP BECOMES UNUSABLE (feet msl)
Sadlers Creek State Park.	658.0
Tugaloo State Lower	658.0
Jacks Landing, SC	658.0
Holders Access, SC	658.0
Lakeshore	658.0
Mountain Bay	658.0
Reed Creek, GA	657.5
Rocky Ford, GA	657.5
Brown Road, SC	657.0
Hurricane Creek, SC	657.0
Seneca Creek, SC	657.0
Walker Creek, GA	657.0
Cove Inlet, SC	656.5
Durham, SC	655.7
South Union, SC	655.5
Bradberry, GA	655.0
Timberland, SC	654.0
Darwin Wright City Park.	653.0
Tillies, SC	653.0
White City, SC	653.0
Barton Mill, SC	653.0
Port Bass, SC	653.0
Seymour, GA	653.0
Paynes Creek (inner right)	652.6
Paynes Creek (left)	652.6
Big Oak Left Lane (New)	652.5
Tabor, SC	652.5
Townville, SC	652.3
Twelve Mile (new left lane)	652.0
Eighteen Mile Creek	652.0

There are approximately 10,500 private boat dock permits issued on Hartwell Lake. This number is almost double of what was reported in the March 1989 SRBDCP. In that report, it was roughly estimated that about 50 percent of the docks were unusable below lake level 652 feet msl and about 90 percent were unusable at 643 feet msl. Even with the ability and willingness to chase the water, the percentage of docks now unusable at 652 feet msl would likely be greater than 50 percent, since more developments are located adjacent to shallow cove areas.

RBR Lake
There are approximately 30 public boat-launching ramps on RBR Lake. All of these ramps are useable until lake levels reach 466 feet msl. Lake levels at RBR Lake do not drop more than five feet below full pool. Therefore, public boat-launching ramps on RBR Lake were not adversely impacted during the drought of record.

JST Lake
There are 84 public boat-launching ramps and marinas located on JST Lake. Above lake elevation 326 feet msl to 330 feet msl all ramps are useable and allow for the launching of boats with up to 3 feet of draft. At and below lake level 326 feet msl, the first boat-launching ramp becomes unusable. At and below lake level 325 feet msl, 4 more or a total of 5 boat-launching ramps become unusable. At and below lake level 324 feet msl, 7 more or a total of 12 boat-launching ramps become unusable. At and below lake level 323 feet msl, 5 more or a total of 17 (20 percent) boat-launching ramps become unusable while 67 (80 percent) remain useable. At and below lake level 317 feet msl, 33 (39 percent) boat-launching ramps become unusable. At and below lake level 315 feet msl, 46 (55 percent) boat-launching ramps become unusable. All boat-launching ramps would become unusable at 306 feet msl.

Table 2: J.Strom Thurmond - Unusable Ramps by Lake Level 326 to 317 feet msl

NAME OF BOAT RAMP	LAKE LEVEL RAMP BECOMES UNUSABLE (feet msl)
Wildwood Park (5 ramps)	326.0
Hwy 28 Access Ramp	326.0
Long Cane Creek Ramp	325.7
Catfish Ramp	325.5
Calhoun Falls Ramp	325.0
Broad River Campground	325.0
Double Branches Ramp	324.8
Cherokee Recreation Area (2 lanes)	324.7
Mistletoe State Park (2 lanes)	324.2
Soap Creek Park	324.0
Little River Quarry Ramp	324.0
Scotts Ferry (New Ramp)	323.8
Leroys Ferry Campground	323.6
Clay Hill Campground	323.5
Winfield Subdivision (2 lanes)	323.1
Mt Pleasant Ramp	322.4
Bussey Point	321.0
Chamberlain Ferry Ramp	321.0
Modoc Campground	321.0
Murray Creek Ramp	321.0
Parkway Ramp	321.0
Fishing Creek/Hwy 79 Ramp	320.7
Soap Creek Subdivision	320.0

NAME OF BOAT RAMP	LAKE LEVEL RAMP BECOMES UNUSABLE (feet msl)
Scotts Ferry (New Ramp)	318.8
Wildwood Park	318.4
Cherokee Recreation Area (2 lanes)	318.2
Soap Creek Marina	318.0
Raysville Marina	317.6
Soap Creek/Hwy 220 Ramp	317.0

There are approximately 1,851 private boat docks on the JST Lake. This is a 25 percent increase from the SRBDCP report. In that report, at 322 feet msl, about 50 percent of the docks were considered unusable. At 313 feet msl, 95 percent of the private docks were considered as unusable. Even with the ability and willingness to chase the water, the percentage of docks now unusable at 322 feet msl would likely be greater than 50 percent, since newer developments are located in shallower coves.

2.3.2. Swimming

Swimming areas on the Corps reservoirs are mainly used from May through September. The following paragraphs discuss the facilities that exist on the three Corps reservoirs.

Hartwell Lake
At Hartwell Lake, there are 22 Corps of Engineers' operated swimming beach areas located in 13 recreation areas. When lake levels reach 654 feet msl, all designated swimming areas are dry. However, when the lake level drops below 657 feet msl, swimming areas become less desirable due to the reduced water area available for swimming. When this happens, swimming occurs outside the designated swimming area, increasing the risk of fatalities. During the 1986 drought, when swimming beaches were unusable, recreation fatalities for swimming activities increased from three to nine. They fell to zero when the beaches were back in service in 1987.

RBR Lake
At RBR, there are no Corps of Engineers' operated designated swimming areas.

JST Lake
At JST Lake, there are 18 Corps of Engineers' operated swimming beach areas. When lake levels reach 324 feet msl, the designated swimming areas are dry. However, when the lake level drops below 327 feet msl, swimming areas beaches become less desirable due to the reduced water area available for swimming. When this happens, swimming occurs outside the designated swimming area, increasing the risk of fatalities.

2.4. WATER SUPPLY

Hartwell Lake

There are 8 water supply users on Hartwell Lake. The highest intake elevation is 638.33 feet msl, while the lowest is 610.00 (SRBDCP, March 1989).

RBR Lake

There are 6 water supply users on RBR. The highest intake elevation is 457.5 feet msl, while the lowest is 454.75 (SRBDCP, March 1989).

JST Lake

There are 8 water supply users on JST Lake. The highest intake elevation is 318.0 feet msl, while the lowest is 307.0 (SRBDCP, March 1989).

Downstream of JST Lake

Sixteen major water supply users exist downstream of Thurmond Dam. The major municipal users occur at Augusta and near the coast. The City of Augusta operates and withdraws water from the Augusta Canal. The City of North Augusta withdraws water from the pool upstream of the New Savannah Bluff Lock and Dam (roughly river mile 187.5). The Beaufort-Jasper County Water Supply Authority withdraws water at river mile 39.3, while the City of Savannah's M&I Plant is located on Abercorn Creek, approximately river mile 29. The other municipal users consist of Columbia County and Edgefield County.

Industrial users with intakes in the New Savannah Bluff Lock and Dam (NSBL&D) pool include North Augusta, Mason's Sod, Kimberly Clark, Urquhart Station, PCS Nitrogen, DSM Chemical and General Chemical. Other users include South Carolina Electric and Gas, and International Paper. Users below NSBL&D include the Savannah River Site, Plant Vogtle, Savannah Electric – Plant McIntosh, Georgia-Pacific, and the Savannah National Wildlife Refuge.

2.5. HYDROPOWER AND PUMPED STORAGE

The Southeastern Power Administration (SEPA) markets hydropower generated at Hartwell, RBR and JST lakes and dams. SEPA markets the energy through contracts negotiated between SEPA and certain preference customers. There are ten hydropower facilities included in the contract that provide the energy and capacity requirements of the contract. These projects are located in the Savannah, Alabama-Coosa, and Apalachicola-Chattahoochee-Flint Basins. Under normal conditions, if a certain basin or portion of a basin is unable to meet the demands expected, then that shortage can usually be transferred to, or "made up" in, another basin. However, a drought of record situation that adversely impacts all three basins affects SEPA's ability to meet the minimum contract requirements. SEPA may purchase replacement energy for the system generation when the Corps does not generate enough power to meet the requirements of SEPA's contract. They purchased substantial amounts of power in 2007 and 2008 to meet their contract requirements.

The RBR Pumped Storage Project began commercial operation in July 2002. Current operation of the four pumped storage units includes several operational restrictions to minimize fish entrainment and fishery habitat impacts. These operational restrictions include:

- Pumped storage operations will occur only during the hours beginning one hour after official sunset to one hour before official sunrise.
- Pumped storage operations will include a maximum of one unit operation in March and no pumped storage operations in April (not applicable to Drought Level 2 and below).
- Pumped storage operations will include a maximum of one unit operation from May 1 to May 15; a maximum of one unit operation from May 16 to May 31, except when a Level I drought is declared in accordance with this plan, during which time a maximum of two pumped storage units may be used. There shall be no seasonal pumped storage operational restrictions when a Level II drought is declared in accordance with this plan.
- From May 16 to May 31, the District will conduct a minimum of six unit hours of generation, of not less than 60 megawatts, within the twelve hours preceding any two unit pumped storage operation. From June 1 to September 30, the District will conduct a minimum of six unit hours of generation, of not less than 60 megawatts, within the twelve hours preceding any pumped storage operation.

In addition to the restrictions above, all other operational and monitoring restrictions outlined in the August 1999, Final Environmental Assessment and FONSI for the Richard B. Russell Dam and Lake Project, Pumped Storage, will remain in effect.

2.6. WATER QUALITY IN THE LAKES

Generally, water quality in the lakes is at or above State Water Quality Standards. However, like most deep reservoirs in the southeastern United States, they experience thermal stratification. This natural phenomenon results from the difference in densities between the surface and subsurface water caused by the temperature variation in the water column. As the tributary and surface waters warm, the difference in density between the surface and bottom waters begins to restrict vertical circulation of the lake. The result of this restriction of circulation is the development of three layers of water: the epilimnion, the well-mixed surface layer which receives oxygen from interaction with the atmosphere; the hypolimnion, the bottom strata which is essentially stagnant water in which the dissolved oxygen (DO) is slowly depleted by the respiration and decomposition of organic matter; and the thermocline, which is the transition between the upper and lower strata and which exhibits the maximum temperature gradient.

The stability of the lake during stratification increases throughout the summer months as the density gradient intensifies. As winter approaches, cooling of the surface waters causes them to become denser. When temperatures are sufficiently reduced, these waters fall below the thermocline, thereby breaking the stratification. After the fall "overturn," the lake becomes isothermal, with free circulation of water throughout the lake (Hartwell Major Rehabilitation Program Evaluation Report, US Army Corps of Engineers, Savannah District, 1995).

For example, thermal stratification begins in Hartwell Lake in late April and early May of each year. The thermocline is established at a depth of about 30 feet and is maintained at that depth

through early August. The thermocline moves to a depth of about 40 feet in late August/early September and to about 50 feet in late September/early October. In late October/early November, as the lake "overturns," the thermocline moves to a depth of about 70 feet and the lake becomes isothermal by early December.

The hypolimnion is typically below the euphotic zone and, lacking free circulation with surface waters, has no potential to renew DO concentrations which are gradually exhausted through respiration and decomposition. As the DO concentrations decrease, a maximum DO gradient develops in the area of the thermocline.

The DO of the top layer remains relatively constant, about 7 mg/l, as the DO of the bottom layer decreases. The level of the maximum DO concentration gradient is established at a depth of about 30 feet in July, moves to a depth of about 40 feet in August, and to 55 or 60 feet in late September. By the first of August, there is usually a 3 mg/l difference between the DO in the upper and lower layers; and by the middle of September, the DO in the lower layer can range between 0 and 2 mg/l. The water quality of the lower layer continues to deteriorate until the fall "overturn" occurs. As "overturn" occurs, the level of the maximum DO concentration gradient falls to 80 feet in October and near the lake bottom in early December, after which the DO concentration is nearly the same at all levels until the following spring (Hartwell Major Rehabilitation Program Evaluation Report, US Army Corps of Engineers, Savannah District, 1995).

RBR Lake uses a hypolimnetic DO system that maintains DO concentrations at or above 5 mg/l throughout the year. Because water released through Hartwell Dam for hydropower comes from the low DO layer, negative effects on the aquatic environment in the Hartwell tailwater area can result. The Corps has installed modifications, referred to as “turbine venting”, that allow air to be diffused into the water as it flows past the turbines during generation. The result is a much needed increase of at least 2 mg/l in dissolved oxygen levels in the tailwater. DO concentrations of the release waters from Hartwell can be expected to be below 5 mg/l from late summer through early fall, with the lowest readings from August through September.

The turbines at Thurmond Dam were recently replaced during a major rehabilitation effort that began with the first new turbine being installed in 2002. The new turbines include a self-aspirating design that is a form of turbine venting. The new turbines now add as much as 3 mg/l of DO to the waters as they pass through the dam. Since the rehabilitation was complete in 2007, discharges from Thurmond Dam possess at least 3 mg/l of DO throughout the year. Construction of an oxygen injection system is underway at Thurmond Lake. Operation of this system will increase the DO of waters within the lake, as well as those which pass through the dam to flow downstream. When the DO injection system becomes operational in 2010, the release waters from Thurmond can be expected to possess at least 5 mg/l of DO throughout the year.

2.7. WATER QUALITY IN THE SAVANNAH RIVER

The Savannah River below JST Dam is classified as “Freshwater” by the South Carolina Department of Health and Environmental Control (DHEC) (Savannah Watershed Water Quality Assessment 2003). This designation is defined as:

> "Freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. These waters are suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. This class is also suitable for industrial and agricultural uses."

The Georgia Environmental Protection Division (EPD) of the Georgia Department of Natural Resources (DNR) has classified the designated use of the main river as "Fishing" waters. The water quality standards for dissolved oxygen, as stated in Georgia's Rules and Regulations for Water Quality Control (GA EPD, 2004), Chapter 391-3-6-.03(6)(c)(i), that this classification requires are:

> "A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish".

Aquatic life and recreational uses are generally fully supported along the main length of the Savannah River. South Carolina DHEC issued a fish consumption advisory in 1996 for the main Savannah River (Thurmond Dam to Interstate 95) because of concerns about mercury, Cesium-137, and Strontium-90. These concerns stemmed from historic methods of disposal of radioactive materials at the Savannah River Site.

Savannah District expects to complete installation of a DO injection system within Thurmond Lake in 2010. When this system becomes operational, discharges from Thurmond Dam are expected to contain at least 5 ppm of DO throughout the year. That level would meet both the Georgia and South Carolina standard for DO levels for those waters.

South Carolina DHEC classifies the estuarine portion of the river as SB: "Tidal saltwaters". This designation is defined as:

> "… suitable primarily for primary and secondary contact recreation, crabbing and fishing. These waters are not protected for harvesting of clams, mussels, or oysters for market purposes or human consumption. The waters are suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora."

The Georgia EPD has classified the designated use of the estuarine portion of the river as "Coastal Fishing."

Seasonal DO sags occur in the summer months in the estuarine portion of the river. In November 2006, the Environmental Protection Agency (EPA) finalized a Total Maximum Daily Load (TMDL) for dissolved oxygen in the Savannah River from Augusta to the coast. The TMDL calls for zero discharge of oxygen-depleting substances. The states are presently working with EPA to implement this requirement.

The State of South Carolina uses the current drought plan Level 3 flow of 3,600 cfs (Andrew Wachob, South Carolina DNR) at the Savannah River Augusta gage for the permitting of point source discharges in the Augusta area and this flow is adjusted upward to account for tributary input as one moves down the river. The State of Georgia uses the 7Q10 values of 3,800 cfs at the Augusta gage, 4,160 cfs further downstream at the Millhaven gage and 4,710 cfs at the Clyo gage in its decisions on the permitting of point source discharges (Paul Lamarre, Georgia EPD).

2.8. BIOTIC COMMUNITIES AT THE LAKES

2.8.1. Fishery Resources at Hartwell Lake

Hartwell Lake and its tailrace provide a vast habitat for both warmwater and coldwater fisheries. The lake area supports a large warmwater fishery including such species as white and striped bass, hybrid bass, largemouth bass, bluegill, pumpkinseed, redear sunfish, yellow perch, sauger, walleye, and catfish. Nongame species found within the lake include blueback herring, carp, longnose gar, redhorse and spotted sucker. The GADNR and SCDNR both actively stock, on average, 500,000 to 1,000,000 striped bass and hybrid bass in Hartwell Lake.

The Hartwell tailrace supports a coldwater put and take trout fishery that is supported by stocking from both States. The State of Georgia DNR-EPD classifies the Savannah River in Hart County (which includes the Hartwell tailrace) as Secondary Trout Waters. These waters are described as those waters in which there is no evidence of natural trout reproduction, but they are capable of supporting trout throughout the year. Striped bass and walleye are also found in this coldwater fishery.

Study findings indicate that blueback herring habitat becomes quite restricted during lake stratification due to the DO and temperature requirements of the fish. The results of these stratification conditions are the congregation of herring in the penstock area and fish kills from entrainment (Alexander, et.al., 1991). Operational procedures are followed by Savannah District to minimize this entrainment.

2.8.2. Fishery Resources at RBR Lake

The fishery resources of RBR have been extensively studied. Savannah District and the University of Georgia Cooperative Fish and Wildlife Research Unit (GA COOP), began baseline studies of fishery resources in RBR Lake in 1990. These studies included cove rotenone sampling, gill net sampling, electrofishing, and telemetry. Savannah District has also conducted hydroacoustic surveys of the fishery resources in the RBR tailrace since 1986, and lakewide hydroacoustic surveys of RBR Lake in 1997. South Carolina DNR has conducted fisherman creel surveys on RBR since 1991. Georgia DNR has conducted fisherman creel surveys in the RBR tailrace since 1988.

RBR Lake supports a wide variety of fish species. The more common species include; largemouth bass, spotted bass, redeye bass, threadfin shad, gizzard shad, blueback herring, bluegill, redear sunfish, channel catfish, brown bullhead, black crappie, yellow perch, white perch, spotted sucker and common carp. Small numbers of hybrid bass (striped bass x white bass) and striped bass are caught each year in RBR Lake.

2.8.3. Fishery Resources at JST Lake

The fishery resources of JST have been extensively studied. Savannah District and the GA COOP began baseline studies of fishery resources in JST Lake in 1986. These studies included cove rotenone sampling, gill net sampling, electrofishing, and telemetry. The Clemson University Cooperative Fish and Wildlife Research Unit (CU COOP) conducted a commercial creel estimate and a population estimate of blueback herring. Savannah District has conducted lakewide hydroacoustic surveys of the forage fish populations in 1996. South Carolina DNR has conducted fisherman creel surveys on JST since 1991.

The more common fish species in JST Lake include; largemouth bass, bluegill, redear sunfish, hybrid bass, striped bass, black crappie, brown bullhead, channel catfish, flathead catfish, white perch, yellow perch, threadfin shad, gizzard shad, and blueback herring. South Carolina DNR and Georgia DNR both actively stock hybrid bass and striped bass in JST Lake. On average, 750,000 to 1,000,000 striped and hybrid bass have been stocked annually in JST Lake.

The RBR tailrace supports a substantial fishery for striped bass, hybrid bass, and white perch. This area makes up only 2 percent of the surface area of JST Lake, but accounts for 9-11 percent of the total harvest of these species. Fish abundance in the RBR tailrace generally peaks in the summer and is lower in the winter. A commercial fishery for blueback herring exists in the RBR Tailwater. Blueback herring are used by fishermen as bait in both Georgia and South Carolina. Recreational fisherman also net blueback herring in the RBR tailrace and in JST Lake for their personal use as bait.

2.8.4. Aquatic Plants at Hartwell Lake

Aquatic plants have not become abundant in Hartwell Lake. However, there is concern that hydrilla will be moved from J. Strom Thurmond Lake or Keowee Lake into Hartwell Lake. Periodic boat surveys of the lake were performed throughout the 2007 growing season. The distribution and abundance of water primrose in Eighteen Mile Creek does not appear to have increased relative to previous years. During a routine patrol of the Seneca River, a small 4’ X 4’ patch of hydrilla was located between the Hwy 93 Bridge and Hwy 123 Bridge in Pickens County, SC. Due to dropping water levels the hydrilla was exposed within a week of it first being discovered and it was not treated. The area was monitored for several days and the hydrilla appeared to have died due to desiccation. The entire area between the two bridges was surveyed thoroughly and no additional hydrilla was found. Aquatic plant growth has not reached nuisance levels requiring treatment. Executive Order 13112-Invasive Species directs federal agencies to take actions, such as preventing the introduction of invasive species and controlling populations of the species in a cost-effective and environmentally sound manner.

2.8.5. Aquatic Plants at RBR Lake

Boat surveys are conducted periodically throughout the summer and fall to determine plant distribution and abundance. Hydrilla was discovered in Richard B. Russell Lake during the summer of 2002, but it has not reoccurred since that time. Approximately 20 acres of Brazilian elodea (Egeria densa) was present in 2005, with an increase in distribution and abundance from 2004. Approximately 5 acres were observed in 2006 in the Dry Fork Creek area of the Savannah River. Sparse patches were present on the Savannah River 1 to 2 miles below Hartwell Dam. This species was not as abundant in 2007 as it was in 2005 and 2006. Aquatic plant growth has not reached nuisance levels requiring treatment. Executive Order 13112-Invasive Species directs federal agencies to take actions, such as preventing the introduction of invasive species and controlling populations of the species in a cost-effective and environmentally sound manner.

2.8.6. Aquatic Plants at JST Lake

The Thurmond Project staff monitors the abundance and migration of hydrilla in the reservoir. One of two herbicides are selected and used for control based upon site location, desired level of control, and cost per acre. Changes in the proposed treatment program are coordinated with the GA DNR, SC DNR, and affected outgrantees prior to implementation.

Hydrilla is present along approximately 6,497 acres of shoreline, including approximately 372 miles of shoreline in Georgia (4,520 acres) and 164 miles of shoreline in South Carolina (1,978 acres). These estimates are based on the presence of infestations noted since the introduction of hydrilla and the annual survey of areas not previously impacted by hydrilla to determine the presence of additional infestations. This represents approximately 9.2 % of the total lake surface at normal summer elevation of 330 feet msl that may be impacted once the lake returns to normal level.

Hydrilla is present in areas of suitable substrate throughout Little River, GA from the confluence of the Savannah River to upstream of Raysville Campground including most tributaries. Along the Savannah River portion of the lake, hydrilla is present on the Georgia side from the dam to Elijah Clark State Park. On the South Carolina side, it is present from the dam to Hickory Knob Subdivision, including most tributaries. Hydrilla was found along both sides of Little River, SC from the Savannah River to below the Highway 378 bridge.

The growth rate and distribution of hydrilla was monitored throughout the summer. Through most of the growing season, the lake level was 3 to 9 feet below normal summer pool. The abundance of hydrilla varied greatly from area to area. Many areas that were previously heavily infested showed no or minimal re-growth. In a few areas, hydrilla was topped out in 2 to 10 feet of water.

Hydrilla was treated at seven boat ramps and/or marina basins to minimize user impacts. Seven permits were issued to adjoining property owners to treat hydrilla around their docks. A total of 8.5 acres was treated.

During late November 2007, with assistance from South Carolina Department of Natural Resources personnel, inspections of the shoreline areas were made in areas where hydrilla had not been previously found. The low lake level made it possible to locate new plant populations that have become established from 10 to 15 feet below the normal pool elevation. New infestations of hydrilla varied from small patches to well established populations. Significant new infestations of hydrilla were found in the following areas:

LOCATION	COUNTY	STATE
Along the Savannah River from Little River Subdivision to Savannah Lakes Marina	McCormick	SC
Benningsfield and Dordon Creeks	McCormick	SC
Hickory Knob State Park and Hickory Knob Subdivision	McCormick	SC
Soap Creek from Soap Creek Subdivision to Hwy 378 Bridge	Lincoln	GA
Wells Creek	Lincoln	GA
Mistletoe State Park / Cliett Creek	Columbia	GA

Executive Order 13112-Invasive Species directs federal agencies to take actions, such as preventing the introduction of invasive species and controlling populations of the species in a cost-effective and environmentally sound manner.

2.8.7. Aquatic Plants at New Savannah Bluff Lock and Dam

Aquatic plant populations in the upstream embayment were monitored periodically throughout the 2008 growing season. The following aquatic plants were identified: waterhyacinth, elodea, fanwart, pickerelweed, and cattail. None appeared to pose any problems to operation of the structure or uses of the area.

2.9. Biotic Communities in the Lower Savannah River

2.9.1. Fish

Riverine fish habitats in the Savannah River have been highly modified or converted to lacustrine habitat by construction of major dams and reservoirs that inundate the upper half of the River Basin. This large-scale habitat conversion has changed the relative abundance and diversity of fish species from a system dominated by migratory diadromous fish to more localized riverine and lacustrine-dominated fish communities. A comprehensive five-year fishery survey of existing coastal plain habitats concluded that the lower Savannah River supports an abundant, diversified fish community, but has a low to moderately used fishery (Schmitt and Hornsby 1985). Based on numbers and weight collected the most abundant game fish were largemouth bass, chain pickerel, black crappie, yellow perch, redbreast sunfish, bluegill, redear sunfish, warmouth, flier, and pumpkinseed. Important non-game fish include longnose gar, bowfin, white catfish, channel catfish, common carp, spotted sucker, silver redhorse, robust redhorse, striped mullet, and brown bullhead. In numerical terms the most

important forage fish are gizzard shad and a number of minnow species. Diadromous fishes inhabiting the lower Savannah River include striped bass, American shad, hickory shad, blueback herring, shortnose sturgeon, Atlantic sturgeon, and the catadromous American eel. The present-day Savannah River population of striped bass appears to be more riverine in its habitat use patterns than more northern populations that are truly anadromous.

Prior to construction of mainstem Savannah Dams from 1840 to 1984, diadromous fish migrations extended throughout the Piedmont. Historical records document the upstream migration of shad and striped bass to the headwaters of the Savannah River, through the Tugaloo River and up the Tallulah River to Tallulah Falls, Georgia, approximately 384 river miles from the ocean. Sturgeon is known to have migrated well into the Piedmont. After 1846, the Augusta Diversion Dam acted as a barrier to inland migration of diadromous species except during high flow periods when the Dam was overtopped, allowing fish to continue unimpeded migrations. Completion of the New Savannah Bluff Lock and Dam (NSBLD) in 1937 further restricted spawning migrations in many years to below river mile 265, with the exception of high flow periods during the spawning season in some years. During the late 1950's through the early 1960's, the Corps' Savannah River navigation project constructed 38 cuts across meander bends that shortened the river by 78 miles. Therefore, the NSBLD is now located at river mile 187.3. The Stevens Creek Dam, a South Carolina Electric and Gas hydroelectric project, was constructed upstream of the Augusta Diversion Dam in 1914, blocking all diadromous fish migrations past that point.

Although greatly reduced from former abundance, diadromous fish are an important and increasing component of the River's sport and commercial fisheries. American shad, blueback herring, and lesser numbers of striped bass and sturgeon migrate to the NSBLD facility, which is the first major obstruction to passage on the river. Some fish have continued to migrate to historical spawning grounds above the facility when flow conditions are suitable. The fish pass upstream by swimming through fully-opened dam gates at flows of 16,000 cfs or higher, and by swimming through the navigation lock when it is operated in a manner suitable for fish passage.

Presently the lower Savannah River provides extremely important striped bass habitat. Although the majority of historical upstream spawning habitat for striped bass has been inundated by major reservoirs, some remaining rocky rapids habitat exists in the Augusta Shoals from just below NSBLD up to Stevens Creek Dam. After construction of mainstem dams and prior to initiation of a Tidegate operation in 1977, the primary spawning area for striped bass in the Savannah River system was the tidal fresh water zone approximately 18-25 miles from the river mouth, specifically the Little Back River (McBay 1968; Rees 1974). Salinity changes due to the Tidegate operation (1977-1992) reduced the extent of this tidal freshwater zone. Studies indicated significant declines in numbers of striped bass eggs and larvae in the lower Savannah River system during this period. These declines were related to increased salinity and modified transport patterns caused by the Tidegate and associated hydrologic modifications (Van Den Avyle et al. 1990, Winger and Lasier 1990).

The Little Back River, adjacent to the lower Savannah River, had unique physical characteristics that made it the primary source in the Savannah River System for efficient collection of brood fish for the Georgia statewide propagation and stocking program of striped bass and hybrid bass

(white bass x striped bass). It has not served in that capacity since the 1980's. The GADNR adopted a striped bass harvest moratorium in 1988. In the early 1980's, an average of 4,291 kilograms of striped bass were harvested annually by sport fishermen in the Savannah River downstream of the NSBLD (Schmitt and Hornsby 1985). As a result of increasing numbers of mature striped bass being observed in the estuary, both SC and GA recently opened the fishery for that species in the estuary.

The Corps of Engineers, Georgia Department of Natural Resources, South Carolina Department of Natural Resources, US Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration Fisheries Service are actively coordinating with private sector partners to address enhancement and restoration of diadromous fisheries, wetlands, and other aquatic resources in the Savannah River.

2.9.2. Wetlands

Palustrine forested wetlands dominate the extensive alluvial plain of the Savannah River. The wettest parts of the flood plain, such as swales, sloughs, and back swamps are dominated by bald cypress, water tupelo, and swamp tupelo. Slightly higher areas, which are usually flooded for much of the growing season are often dominated by overcup oak and water hickory. Most of the Savannah River floodplain consists of low relief flats or terraces. These areas are flooded during most of the winter and early spring and one or two months during the growing season. Laurel oak is the dominant species on these flats and green ash, American elm, sweetgum, spruce pine, sugarberry, and swamp palm are often present. Swamp chestnut oak, cherrybark oak, spruce pine, and loblolly pine are found on the highest elevations of the flood plain, which are only flooded infrequently during the growing season.

On the Savannah River downstream of Interstate Highway 95, tidal palustrine emergent wetlands, also known as tidal freshwater marsh, become prevalent. Tidal palustrine emergent wetlands are flooded twice daily by tidal action in the study area. These marshes are vegetated with a diverse mixture of plants including giant cutgrass, spikerushes, and up to 58 other plant species (Pearlstine et al. 1990, Applied Technology and Management 1998).

In palustrine emergent wetlands, primary productivity is high, falling in the range of 500 to 2,000 grams/square meter/year (Odum et al. 1984). The quality of primary production is also high. Major primary producers in the salt marsh community are grasses that have little immediate nutritional value to fish and wildlife but support an important detritus based food web (Teal 1962). In contrast, the fleshy broad-leaf plants characteristic of fresh marshes generally are high in nitrogen and low in fiber content and there is a high incidence of direct grazing or feeding on these plants (Odum et al. 1984).

Freshwater marsh vegetation also contributes to the food web base that supports the study area's freshwater fishery. The leaves of the larger macrophytes in this community are used as attachment places by mollusks, insect nymphs, rotifers, hydra, and midge larvae. These are all important fish foods. The submerged littoral zone is vital to the development of freshwater fish, as well as some marine and estuarine species, as these areas are the principal spawning sites and provide nursery and juvenile habitats.

2.9.3. Wildlife

Wildlife associated with forested wetlands is numerous and diverse. The furbearers are an important component of these wetlands and include beaver, muskrat, mink, otter, bobcat, gray fox, raccoon, and opossum. Deer, turkey, and even black bear in the more isolated areas, use the bottomlands. Palustrine emergent wetlands also provide excellent habitat for furbearers including the mink, beaver, and river otter. Terrestrial species from surrounding areas often utilize the fresh marsh edge for shelter, food, and water. These include raccoon, opossum, rabbit, and bobcat.

The study area is part of the Atlantic Flyway and forested wetlands provide important wintering habitat for many waterfowl species and nesting habitat for wood ducks. Many species of wodpeckers, hawks, and owls use the bottomlands and swamps. Neotropical migratory birds, many of which are decreasing in abundance, depend upon contiguous tracts of forested swamps for breeding and as corridors during migration. Robbins et al. (1989) found that the most area-sensitive bird species required at least 2,800 acres of contiguous forest to be present. The extensive forested wetlands of the Savannah River flood plain provide very valuable habitat for these birds. The American swallow-tailed kite, a state (South Carolina) listed endangered species, can be observed on the study area. Swallow-tailed kites nest in and are closely associated with palustrine wetlands.

Palustrine emergent wetlands also provide habitat for many bird species. Resident, transient, and migrating birds of both terrestrial and aquatic origin utilize food and shelter found in this community. Some species use freshwater marshes for nesting and breeding. Waterfowl feed upon fresh marsh vegetation, mollusks, insects, small crustaceans, and fish found in the fresh marsh community. Wading birds such as the wood stork, great blue heron, little blue heron, green heron, snowy egret, and great egret also heavily utilize the tidal freshwater marsh.

The study area provides excellent habitat for a large number of reptiles and amphibians. Wetland habitats support many kinds of frogs including the bullfrog, bronze frog, southern leopard frog, several species of tree frogs, cricket frogs, and chorus frogs. Turtles found in the wetlands include the river cooter, Florida cooter, pond slider, eastern chicken turtle, snapping turtle, mud turtle, and stinkpot. Snakes found in the wetlands include the red-bellied water snake, banded water snake, brown water snake, eastern mud snake, rainbow snake, and eastern cottonmouth. The American alligator can be observed on streams and ponds of the Coastal Plain study area.

In 2006, the Fish and Wildlife Service conducted a freshwater mussel survey in the Savannah River to determine species composition and distribution of mussels. This study encompassed the portion of the river from the Augusta Shoals region (river mile 203) near the Fall Line downstream to the tidewater region (river mile 22.8) near Savannah. This survey evaluated 39 sites using both shallow water (snorkeling and grubbing) and deep water (SCUBA) survey techniques. A total of 26 freshwater mussel species were identified during the survey efforts. With the exception of sites within the Augusta Shoals area, mussels were generally unevenly distributed in the surveyed areas, which is reflective of the distribution and quality of microhabitats within a particular river segment. In general mussels were most abundant in the

thalwag habitats at the base of the river bank, and rare to absent in the shifting sand dominated runs in the center of the channel.

Atlantic pigtoe (*Fusconaia masoni*) and Savannah liliput (*Toxolasma pullus*) were both observed in the 2006 mussel survey. Both of these species are experiencing range-wide declines. Atlantic pigtoe was found only in the Augusta shoals. This species has not been observed in any other Georgia or South Carolina Rivers in the many years. The population of Savannah liliput upstream of Little Hell boat landing (Allendale County) may be the largest remaining population of this species.

The 2006 discovery of four species not previously known to occur in South Carolina demonstrates the gross lack of knowledge regarding the mussel fauna of the Savannah River. The objective of the 2006 mussel survey was an attempt to estimate species composition and distribution in the Savannah River, but the surveyors only visited a small portion of the available habitat in the river.

Savannah liliput in the Savannah is found primarily in cutoff bends and sloughs. Preliminary observations indicate that much of this habitat is lost or degraded due to loss of connectivity with the main river at flows below 4,000 cfs at Augusta. Even when some water is present, low dissolved oxygen levels are probable during the warmer seasons because of lack of river flows and stagnant conditions in those specific sites.

2.9.4. Endangered Species

Federal Endangered, Threatened, and Candidate species that are likely to occur in the Savannah River Basin Study area are listed in Table 3 (Reconnaissance Planning Aid Report on the Savannah River Basin Study, US Fish and Wildlife Service, July 1999). State species are listed in Table 4.

Wetland Habitat

Table 3: Federal Endangered, Threatened and Candidate Species Likely to Occur in the Savannah River Basin Study Area

SPECIES	SCIENTIFIC NAME	FEDERAL STATUS
MAMMALS		
Indiana Bat	*Myotis sodalis*	E*
West Indian manatee	*Trichechus manatus*	E
BIRDS		
Red cockaded woodpecker	*Picoides borealis*	E
Piping plover	*Charadrius melodus*	T
Wood stork	*Mycteria americana*	E
Kirtland's warbler	*Dendroica kirtlandii*	E
REPTILES		
Eastern indigo snake	*Drymarchon corais couperi*	T
AMPHIBIANS		
Flatwoods salamander	*Ambystoma cingulatum*	T
Fish		
Shortnose sturgeon	*Acipenser brevirostrum*	E
PLANTS		
Canby's dropwort	*Oxypolis canbyi*	E
Chaff seed	*Schwalbea americana*	E
Schweinitz's sunflower	*Helianthus schweinitzii*	E
Small whorled pogonia	*Isotria medeoloides*	T
Pondberry	*Lindera melissifolia*	E
Rough leaved loosestrife	*Lysimachia asperulaefolia*	E
False Poison Sumac	*Rhus michauxii*	E
Bunched arrowhead	*Sagittaria fasciculata*	E
White irisette	*Sisyrinchium dichotomum*	E
Dwarf flowered heartleaf	*Hexastylis naniflora*	T
Mountain sweet pitcher plant	*Sarracenia rubra ssp. jonesii*	E
Harperella	*Ptilimnium nodosum*	E
Swamp pink	*Helonias bullata*	T
Smooth coneflower	*Echinacea laevigata*	E
Seabeach amaranth	*Amaranthus pumilus*	T
Persistent trillium	*Trillium persistens*	E
Relict trillium	*Trillium reliquum*	E
Little amphianthus	*Amphianthus pusillus*	T
Miccosukee gooseberry	*Ribes echinellum*	T
Bog asphodel	*Narthecium americanum*	C***

* Endangered
* Endangered
** Threatened
*** Candidate

Table 4: Georgia and South Carolina Rare, Threatened and Endangered Species Occurring in Counties Adjacent to the Savannah River

SCIENTIFIC NAME	COMMON NAME	GA STATE STATUS	SC STATE STATUS
Acipenser brevirostrum	Shortnose Sturgeon		FE[1]/SE[2]
Aimophila aestivalis	Bachman's Sparrow	R[3]	
Amblyscirtes reversa	Reversed Roadside Skipper		N3N4
Ambystoma cingulatum	Flatwoods Salamander		FT[4]/SE
Aneides aeneus	Green Salamander	R	
Autochton cellus	Golden-Banded Skipper		N4
Caretta caretta	Loggerhead		FT/ST[5]
Carex biltmoreana	Biltmore Sedge	T	
Carex manhartii	Manhart's Sedge	T	
Carex misera	Wretched Sedge	T	
Ceratiola ericoides	Rosemary	T	
Chamaecyparis thyoides	Atlantic White-Cedar	R	
Charadrius wilsonia	Wilson's Plover	R	
Clemmys guttata	Spotted Turtle	U	
Clemmys guttata	Spotted Turtle		ST
Corynorhinus rafinesquii	Rafinesque's Big-Eared Bat	R	SE
Cymophyllus fraserianus	Fraser's Sedge	T	
Cyprinella callitaenia	Bluestripe Shiner	T[6]	
Cypripedium acaule	Pink Ladyslipper	U[7]	
Cypripedium parviflorum var. Parviflorum	Small-Flowered Yellow Ladyslipper	U	
Cypripedium parviflorum var. Pubescens	Large-Flowered Yellow Ladyslipper	U	
Draba aprica	Open-Ground Whitlow-Grass	E[8]	
Echinacea laevigata	Smooth Coneflower		FE/SE
Elanoides forficatus	Swallow-Tailed Kite	R	
Elliottia racemosa	Georgia Plume	T	
Epidendrum conopseum	Green-Fly Orchid	U	
Fusconaia masoni	Atlantic Pigtoe Mussel	E	
Gopherus polyphemus	Gopher Tortoise		SE
Haematopus palliatus	American Oystercatcher	R	
Hydrastis canadensis	Goldenseal	E	
Hymenocallis coronaria	Shoals Spiderlily	E	
Isoetes tegetiformans	Mat-Forming Quillwort	E	
Isotria medeoloides	Small Whorled Pogonia		FT/ST
Lasmigona decorata	Carolina Heelsplitter		FE/SE
Lindera melissifolia	Pondberry		FE/SE
Lindernia saxicola	Rock False Pimpernel	E	
Litsea aestivalis	Pondspice	T	
Lysimachia fraseri	Fraser's Loosestrife	R	
Marshallia ramosa	Pineland Barbara Buttons	R	
Moxostoma robustum	Robust Redhorse	E	
Mycteria americana	Wood Stork		FE/SE
Myotis leibii	Eastern Small-Footed Myotis		ST
Myotis sodalis	Indiana Myotis		FE/SE
Nestronia umbellula	Indian Olive	T	
Notropis hypsilepis	Highscale Shiner	T	
Notropis photogenis	Silver Shiner	E	

SCIENTIFIC NAME	COMMON NAME	GA STATE STATUS	SC STATE STATUS
Notropis scepticus	Sandbar Shiner	R	
Oxypolis canbyi	Canby's Dropwort	E	
Oxypolis canbyi	Canby's Dropwort		FE/SE
Phenacobius crassilabrum	Fatlips Minnow	E	
Physostegia leptophylla	Tidal Marsh Obedient Plant	T	
Picoides borealis	Red-Cockaded Woodpecker		FE/SE
Plethodon websteri	Webster's Salamander		SE
Pseudobranchus striatus	Dwarf Siren		ST
Ptilimnium nodosum	Harperella		FE/SE
Quercus oglethorpensis	Oglethorpe Oak	T	
Rana capito	Gopher Frog		SE
Ribes echinellum	Miccosukee Gooseberry		FT/ST
Sanguisorba canadensis	Canada Burnet	T	
Sarracenia flava	Yellow Flytrap	U	
Sarracenia minor	Hooded Pitcherplant	U	
Sarracenia purpurea	Purple Pitcherplant	E	
Sarracenia rubra	Sweet Pitcherplant	E	
Schisandra glabra	Bay Starvine	T	
Schwalbea americana	Chaffseed		FE/SE
Scutellaria ocmulgee	Ocmulgee Skullcap	T	
Sedum pusillum	Granite Stonecrop	T	
Senecio millefolium	Blue Ridge Golden Ragwort	T	
Shortia galacifolia	Oconee Bells	E	
Speyeria diana	Diana		N3
Sterna antillarum	Least Tern		ST
Stewartia malacodendron	Silky Camellia	R	
Stylisma pickeringii var. Pickeringii	Pickering's Morning-Glory	T	
Trichechus manatus	Manatee		FE/SE
Trillium persistens	Persistent Trillium		FE/SE
Trillium reliquum	Relict Trillium		FE/SE
Waldsteinia lobata	Piedmont Barren Strawberry	T	
Xerophyllum asphodeloides	Eastern Turkeybeard	R	

Sources: Georgia EPD and South Carolina DNR

1 FE - Federal Endangered

2 SE - State Endangered (official state list-animals only)

3 R - Rare

4 FT - Federal Threatened

5 ST – State Threatened (official state list-animals only)

6 T - Threatened

7 U - Unusual (thus deserving of special consideration)

8 E - Endangered

2.9.5. Special Biological Areas

The tidal fresh marsh at the Savannah National Wildlife Refuge (NWR) supports an extremely diverse plant community providing food, cover and nesting habitat for a wide variety of wildlife species. Tidal freshwater marsh is relatively scarce in comparison to coastal brackish and salt marshes. Past harbor modifications, including harbor deepening, have greatly increased salinity levels throughout much of the Savannah NWR and reduced the quantity of tidal freshwater marsh. According to the USFWS, the Savannah NWR contained about 6,000 acres of tidal freshwater marsh when it was established in 1927. By 1997, due to the cumulative impacts of harbor deepening, tidal freshwater marsh had declined to 2,800 acres, a reduction of 53 percent (Reconnaissance Planning Aid Report on the Savannah River Basin Study, US Fish and Wildlife Service, July 1999). The freshwater marsh areas had historically been bottomland hardwoods, but were cleared in the 1800's for agricultural purposes, such as the rice culture. The leveled and diked areas were abandoned when the rice culture was no longer profitable after the Civil War. Those sites partially filled and now support a wide variety of plant and animal species.

Prior to 1977, the Savannah River supported the most important naturally reproducing striped bass population in the State of Georgia, but production of striped bass eggs in the Savannah River estuary declined by about 95 percent. Operation of the Tidegate, in conjunction with the cumulative impacts of harbor deepening, caused a number of impacts. These included increases in salinity and loss of suitable spawning habitat throughout most of Little Back River and the lower Savannah River (Reconnaissance Planning Aid Report on the Savannah River Basin Study, US Fish and Wildlife Service, July 1999). It was hoped that the Tidegate restoration project would improve most of these conditions. Annual stocking efforts by the GA DNR have been very successful in increasing the number of striped bass in the lower Savannah River, and current population levels approach historic levels. After a 17-year closure, the striped bass fishery was reopened in October 2005.

2.10. SOCIOECONOMIC ISSUES

2.10.1. Environmental Justice

The concept of environmental justice is based on the premise that no segment of the population should bear a disproportionate share of adverse human health or environmental effects. To address these concerns, Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low Income Populations* was issued. It requires each Federal agency to "make the achievement of environmental justice part of its mission by identifying and addressing disproportionately high and adverse human health and environmental effects on minority and low-income populations."

2.10.2. Protection of Children

The concept of protecting children arises out of a growing body of scientific knowledge, which demonstrates that children may suffer disproportionately from environmental health and safety risks. To address these concerns, Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* was issued. It requires each federal agency to

identify and assess environmental health and safety risks that may disproportionately affect children; and, ensures that policies, programs, activities, and standards address disproportionate risk to children that results from environmental health or safety risks

3.0 DESCRIPTION OF THE PROPOSED ACTION AND OTHER ALTERNATIVES

3.1. ALTERNATIVE FORMULATION

The Georgia Department of Natural Resources, Environmental Protection Division (GA DNR-EPD), South Carolina Department of Health and Environmental Control (SC DHEC) and the South Carolina Department of Natural Resources (SC DNR) developed and evaluated alternatives to address the diminishing conservation pools in the Corps' three-lake system on the Savannah River. Their proposal is included as Appendix B to this document. On October 1, 2008, GA DNR-EPD requested Savannah District consider reducing flows from its three-lake system this fall and winter (Appendix C). SC DNR submitted a similar request on October 9, 2008 (Appendix D). The states request follows much discussion between those agencies and various stakeholders over the course of the summer of 2008. The states considered several alternatives and proposed the Corps temporarily deviate from its Drought Contingency Plan to reduce discharges to 3,100 cfs during the cooler months of October 2008 through February 2009.

3.2. ALTERNATIVES ANALYSIS

Alternatives were developed for consideration as part of the planning process and are:

a. NAA (Continue with the SRBDCP, March 1989)
b. Alternative 1 (Selected Alternative)
c. Alternatives Considered But Eliminated From Detailed Consideration

3.2.1. No Action Alternative

This Alternative consists of the Corps taking no action to modify its existing Savannah River Basin Drought Contingency Plan (SBRDCP) with its 2006 modifications. This alternative incorporates the previously-approved deviation request for 3,600 cfs minimum daily flow from Thurmond and 3,600 cfs specified daily average flow once trigger Level 3 is reached. The operating procedures described in that 2006 SRBDCP Update would continue to be implemented and they form the basis upon which comparisons to the other alternatives can be made. Action thresholds were established in the 2006 SRBDCP Update and are based on pool elevations at Hartwell and Thurmond Lakes. Russell Lake has a relatively small conservation pool, therefore it does not have action thresholds delineated. Due to the nature of pumped storage operation, Russell Lake may vary throughout its five-foot conservation pool.

Table 5: Hartwell Action Levels for the NAA

LEVEL*	1 APR – 15 OCT (feet msl)	15 DEC – 1 JAN** (feet msl)	ACTION
1	656	654	Public safety information. Reduce Thurmond discharge to 4,200 cfs weekly average, reduce Hartwell discharge as appropriate to maintain balanced pools.
2	654	652	Reduce Thurmond discharge to 4,000 cfs weekly average, reduce Hartwell discharge as appropriate to maintain balanced pools.
3	646	646	Reduce Thurmond discharge to 3,800 cfs daily average, reduce Hartwell discharge as appropriate to maintain balanced pools.
4	625	625	Maintain 3,600 cfs as long as possible, therafter transition to daily average outflow = daily average inflow

Note. A temporary deviation was authorized on October 23, 2007, allowing a minimum daily average release of 3,600 cfs at Thurmond and a specified target of 3,600 cfs at drought Level 3.

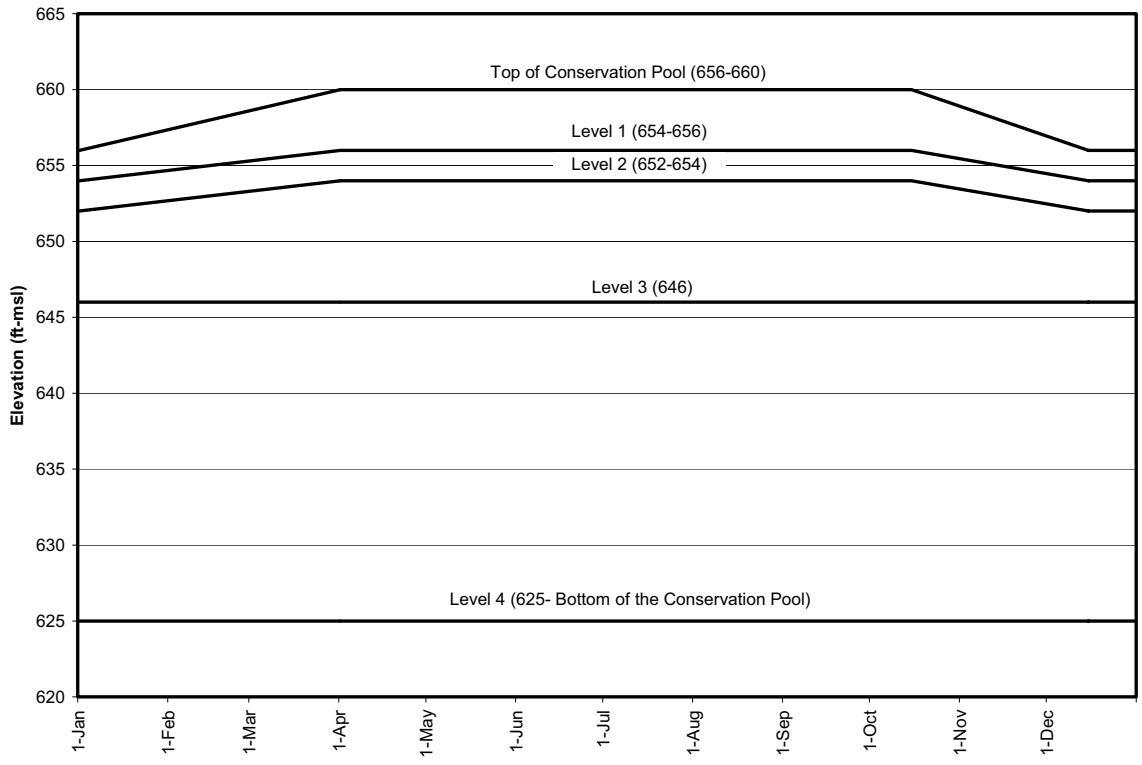


Figure 1: Hartwell Action Levels for the No Action Alternative

* Level as shown in Figure 1
** Lake elevations for the periods January 1 to April 18 and October 15 to December 1 are linearly interpolated from this data as shown in Figure 1

Table 6: J. Strom Thurmond Action Levels for the No Action Alternative

LEVEL*	1 APR – 15 OCT (FEET MSL)	15 DEC – 1 JAN** (FEET MSL)	ACTION
1	326	324	Public safety information. Reduce Thurmond discharge to 4200 cfs weekly average, reduce Hartwell discharge as appropriate to maintain balanced pools.
2	324	322	Reduce Thurmond discharge to 4000 cfs weekly average, reduce Hartwell discharge as appropriate to maintain balanced pools.
3	316	316	Reduce Thurmond discharge to 3800 cfs daily average, reduce Hartwell discharge as appropriate to maintain balanced pools.
4	312	312	Maintain 3600 cfs as long as possible, therafter transition to daily average outflow = daily average inflow

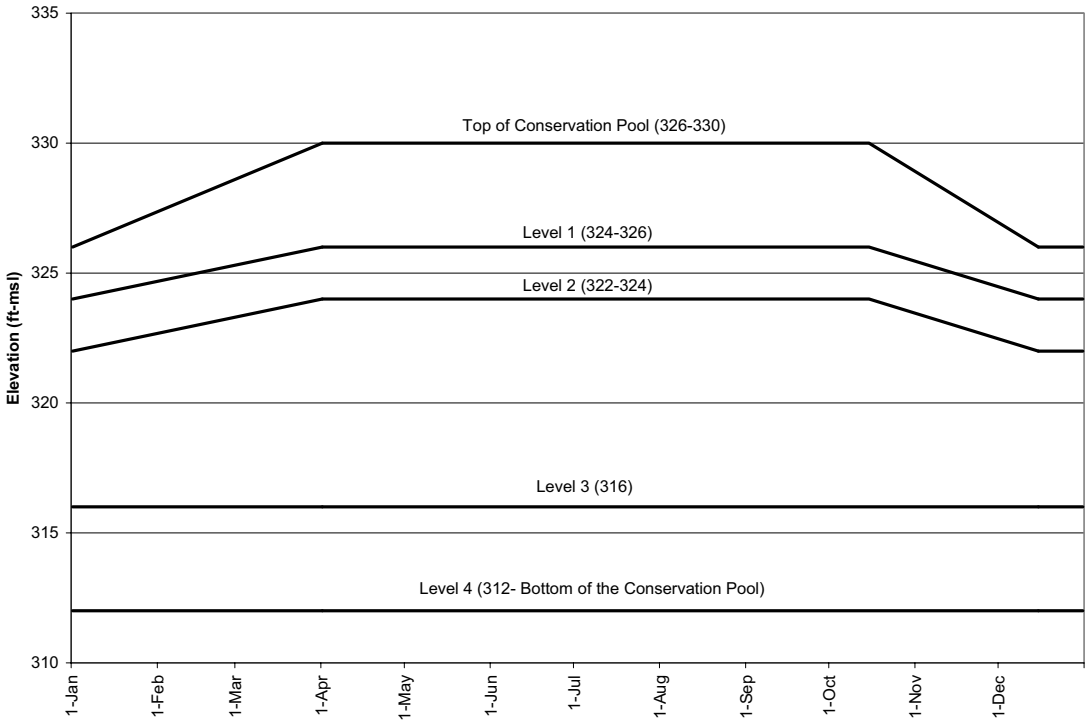


Figure 2: Thurmond Action Levels for the No Action Alternative

* Level as shown in Figure 1
** Lake elevations for the periods January 1 to April 1 and October 15 to December 1 are linearly interpolated from this data as shown in Figure 1

As described in the 1989 Drought Contingency Plan, the Corps would also monitor salinity levels in the estuary. During "critical water periods" Savannah District would perform roving salinity sampling at several locations in the estuary to determine and document the extent of salinity intrusion. The Savannah Basin projects have never reached Level 4 in the 16 years that the Plan has been operational.

As a result of mechanical difficulties, two pumped storage units are presently available at RBR for each alternative. Eighty unit hours of pumping per week is required to support the current hydropower contract. Pumping beyond 80 unit hours up to the maximum allowed by the Richard B. Russell Dam and Lake Project Pumped Storage Environmental Assessment of August 1999 can still occur when economically feasible.

This alternative is considered in detail and is evaluated in regard to all environmental concerns**.**

3.2.2. Alternative 1

Alternative 1 consists of temporarily modifying one feature of the approved Drought Contingency Plan. It is essentially the same as the NAA except the minimum daily average release at Thurmond Dam would be adjusted from 3,600 to 3,100 cubic feet per second (cfs) during the cooler months from November 1, 2008 through February 28, 2009.

The States of Georgia and South Carolina have indicated they intend to monitor the results of the proposed flow reduction, should it be implemented. With the cooperation of stakeholders, the States identified specific resources that they will be examining, as well as specific monitoring parameters and performance targets. The States are coordinating these monitoring efforts with various organizations which would perform the work. If parameters are found to exceed acceptable levels, the monitoring organization would notify the State, who would review the information, discuss the results with the other State (GA DNR, SC DHEC and SC DNR), and then recommend to Savannah District appropriate adjustments to Thurmond release levels. The Corps would restore the water flows up to the 3,600 cfs daily average if requested by either the State of Georgia or South Carolina.

Location	**Target**	**Responsible Party**
Shoals	Flow 1500 cfs	City Of Augusta
USGS 021989773	DO 5.0 mg/L daily average DO 4.0 mg/L instantaneous Temperature ≤ 90 ºF pH 6-8.5	GA DNR-EPD
USGS 02198840	Conductivity 10,000 µS/cm	GA DNR-EPD
Abercorn Creek	Chloride 16 ppm	City of Savannah
USGS 02198500	Flow < 4,500 cfs	SC DHEC
Various	Water level at the intakes	Intake operators

Various	Sturgeon migration	SC DNR

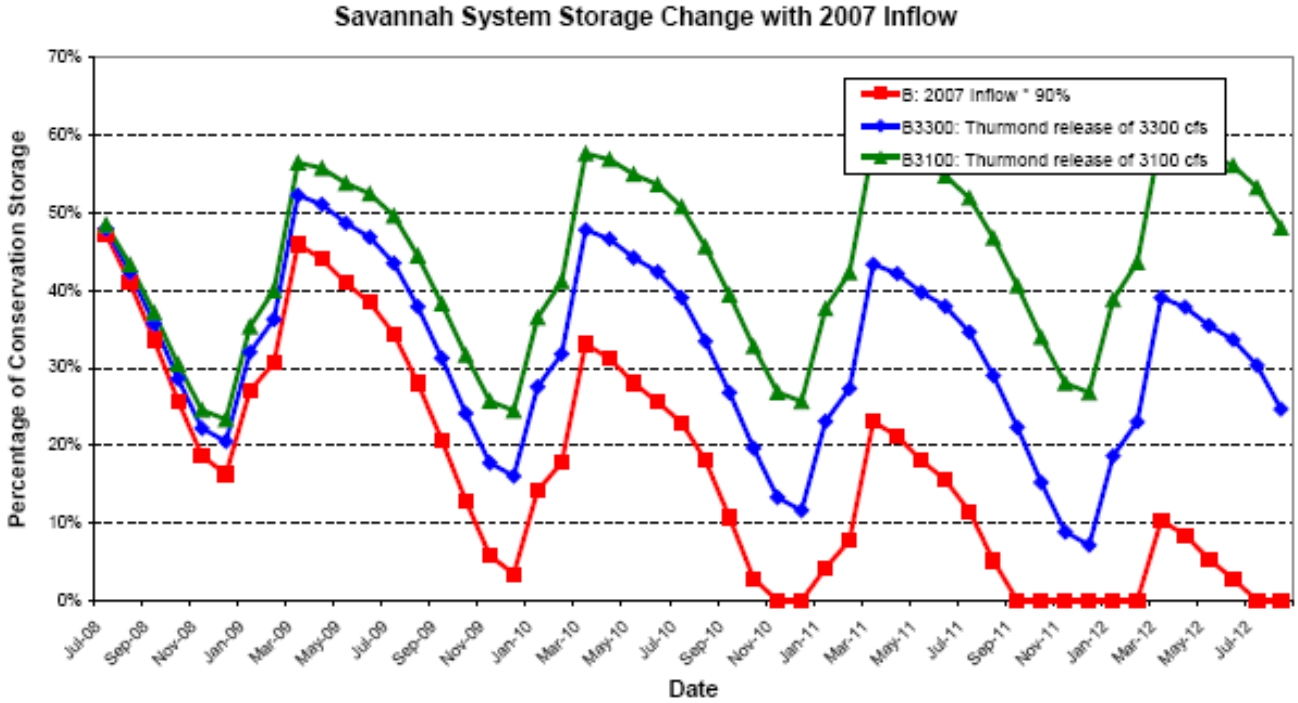
3.2.3. Alternatives Considered But Eliminated From Detailed Consideration

A preliminary alternative that was initially considered was similar to Alternative 1 with a daily average flow reduction to 3,300 cfs for the cooler months (October 1 through February 28). Under the recorded 2007 hydrology (with a 10% reduction in inflow), a release of 3,300 cfs from Thurmond Dam was found to not be enough to stabilize the reservoir system. There would still be a sharp decline of conservation storage within the 3-lake system, resulting in low system storage toward the end of 2009. Storage would recover somewhat during the winter and spring period of 2009, but would decline again and reach a new record low toward the end of 2010. Figure 3 below shows the percentage of conservation storage in the three-lake system that would remain over time with this alternative. This alternative was deemed to be unacceptable by the States and was dropped from further consideration.

3.2.4. Recommended Alternative

The Recommended Action is Alternative 1, the temporary modification of one feature of the approved Drought Contingency Plan. The minimum daily average release at Thurmond would be reduced from 3,600 cfs to 3,100 cfs in drought Level 3 for the cooler months from November 1, 2008 through February 28, 2009. The Corps would restore the water flows up to the 3,600 cfs daily average if requested by either the State of Georgia or South Carolina.

Figure 3 – Comparison of Alternatives



4.0 ENVIRONMENTAL AND SOCIO-ECONOMIC CONSEQUENCES

Savannah District does not anticipate any substantial effects to air quality, noise, non-renewable resources, mineral resources, farmland, wetlands, water quality in the lakes, or to fishery resources. We do not envision any irretrievable commitments of resources from either alternative. Savannah District believes the proposed project is consistent with both the Georgia and South Carolina Coastal Zone Management Program to the maximum extent practicable.

Flows up to 10,000-15,000 cfs, as discussed in Section 4.4, are expected to remain within the stream channel. Flows discussed in the drought alternatives range between 3,600 and 3,100 cfs, so they would be contained within the stream channels. Fluctuating these flows as discussed in Sections 4.3, 4.4 and 4.5 would produce no measurable impacts on adjacent floodplain wetlands along the river (upstream of the estuary).

4.1. WATER QUALITY

4.1.1 Overview

When discharges are reduced from Thurmond Dam, impacts could occur to downstream water quality. Lower discharges could increase water temperature and reduce the quality of the river downstream of point source discharges. The summer months are the most critical to aquatic resources, so reduced river flows during those months would cause greater adverse impacts.

The State of South Carolina uses the current drought plan Level 3 flow of 3,600 cfs (Andrew Wachob, South Carolina DNR) at the Savannah River Augusta gage for the permitting of point source discharges in the Augusta area and this flow is adjusted upward to account for tributary input as one moves down the river. The State of Georgia uses the 7Q10 flow values of 3,800 cfs at the Augusta gage, 4,160 cfs at the Millhaven gage, and 4,710 cfs at the Clyo gage in its point source discharge permit decisions. In the following analysis, the flows of the modeled alternatives were compared to the flows of the modeled No Action Alternative to determine the impacts of temporarily changing the SRBDCP.

The Georgia Department of Natural Resources, Environmental Protection Division (EPD) analyzed the potential effects on water quality from the proposed winter flow reduction. EPD evaluated the potential impacts in both the river and the estuary/harbor area. They concentrated on dissolved oxygen levels, since the States and EPA had previously identified that as a critical water quality parameter in this basin.

For the river portion (Thurmond dam to Clyo) of the basin, GA DNR-EPD used the RIV1 Model which they use to allocate point source discharges along the river to identify potential problems if the river flow was reduced. For the estuary/harbor portion of the basin (Clyo to ocean), they used the EFDC and WASP Models that had been developed by EPA and used for EPA's TMDL analysis. The States concluded that the modeling indicated that the proposed temporary seasonal reduction of Thurmond release would not cause water quality problems in the river or the harbor. The following paragraphs contain details of the water quality analyses:

4.1.2 Savannah River downstream of Thurmond Dam

The first model simulation was conducted with 2007 meteorological data, tributary inflows, and Thurmond release data; and 2006 wasteload discharges and water withdrawals. This simulation was developed to identify how well the model was calibrated to observed DO data. Figures 4 and 5 show the observed DO data (red squares) measured in 2007, which never went below 6.5 mg/L and 6.29 mg/L at River Mile (RM) 119 (US Highway 301) and RM 61 (Clyo Gage), respectively, versus the approximate calibration run. It is an approximate calibration run, since the model did not include 2007 discharge and withdrawal data, but rather that of 2006. Despite the approximation of this model run, the results indicate that the model was calibrated relatively well.

Figure 4 - Calibration of Savannah River water quality model at River Mile 119

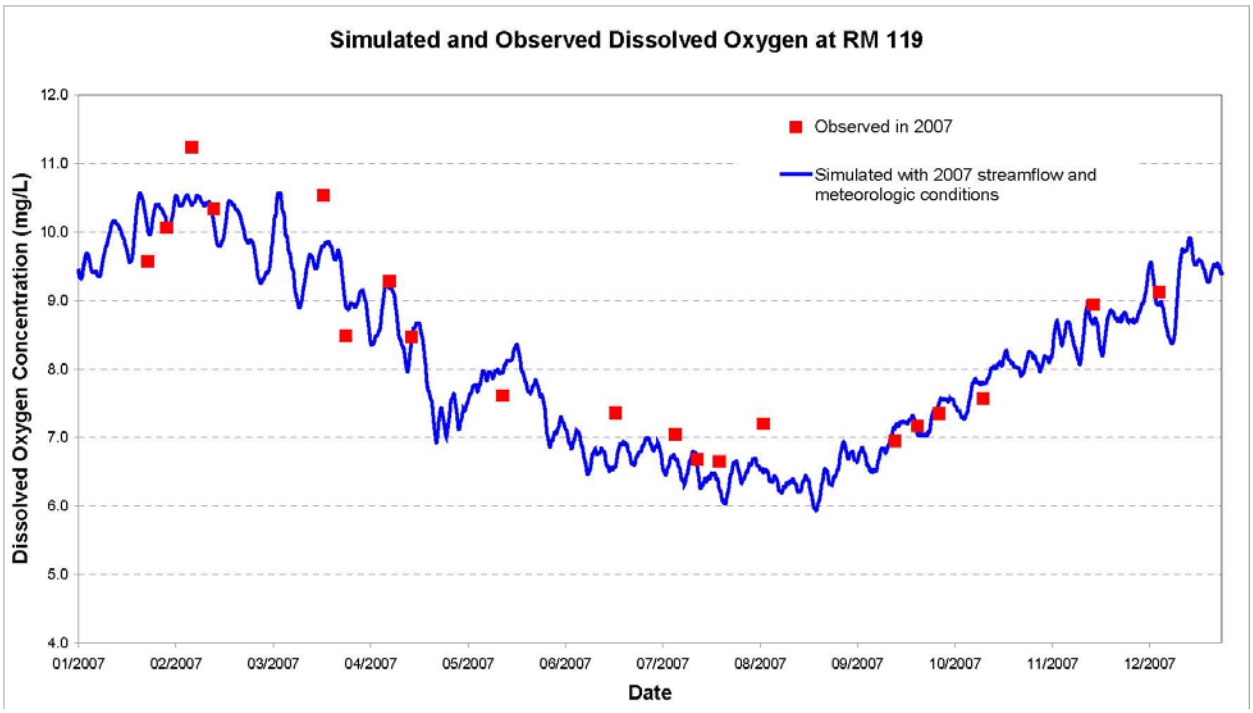
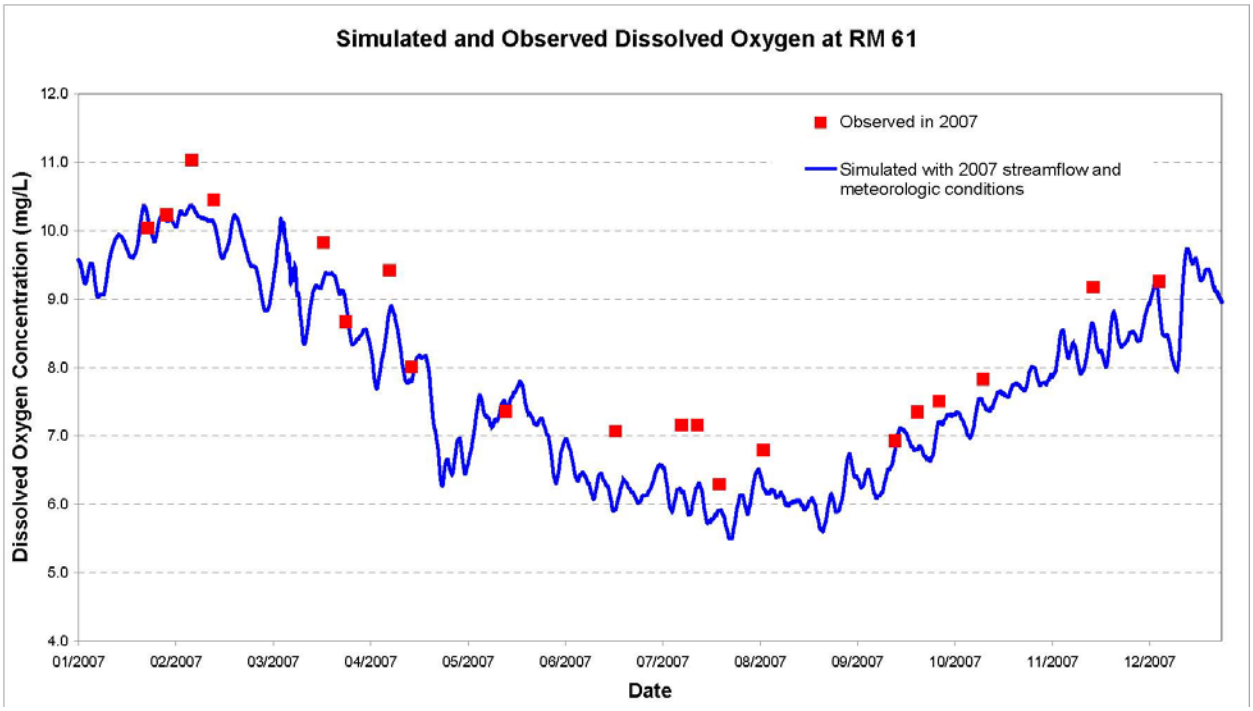


Figure 5 - Calibration of Savannah River water quality model at River Mile 61



GA DNR-EPD conducted additional model simulations using 2007 meteorological data and tributary inflows, and 2006 wasteload discharges and water withdrawals. These model simulations incorporated varying amounts of discharges from Thurmond Dam (3,600 and 3,100 cfs).

Figures 6 and 7 show the results of the 3,600 cfs simulation (No Action Alternative). Under a Thurmond release of 3,600 cfs, the simulated DO concentrations at RM 119 (US Highway 301) are predicted to be above 5 mg/L throughout the year (Fig. 6). Figure 7 shows simulated DO concentration at River Mile 61 (Clyo) under a Thurmond release of 3,600 cfs. Again, the simulated DO concentrations are predicted to be higher than 5 mg/L throughout the year. The riverine water quality model shows that the 5.0 mg/L DO standard would not be breached by a Thurmond release of 3,600 cfs.

Figure 6 – Dissolved Oxygen at RM 119

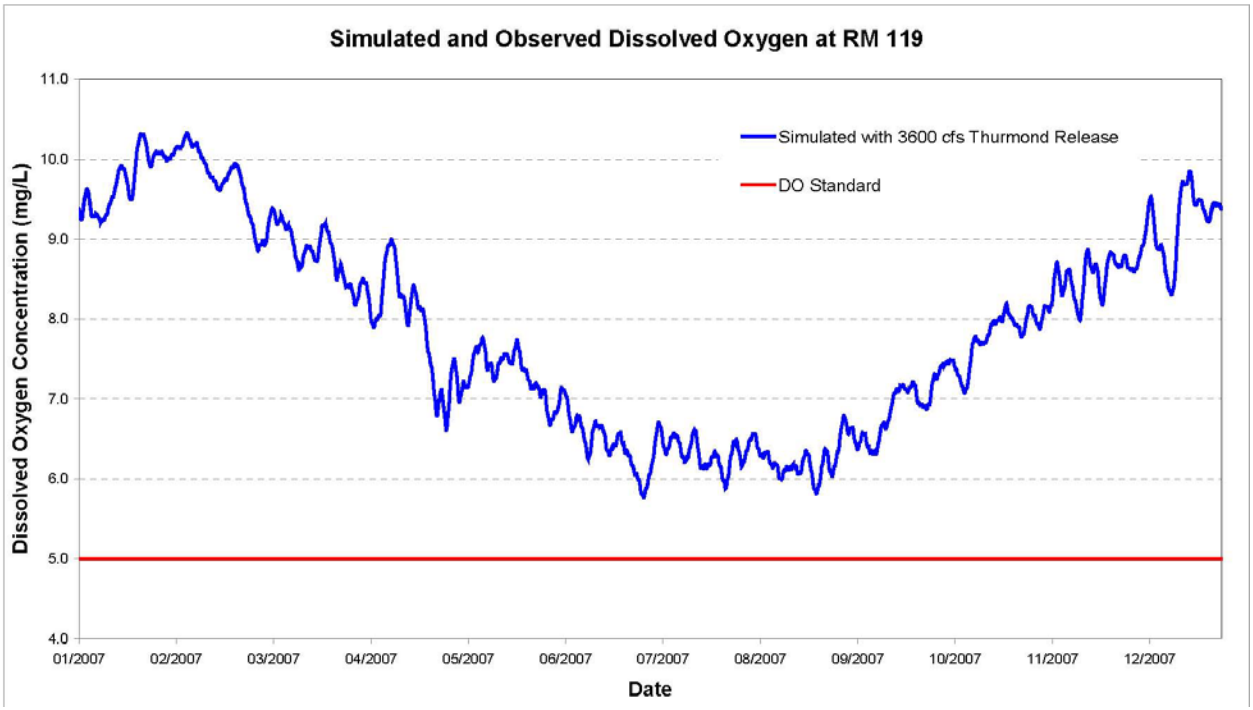
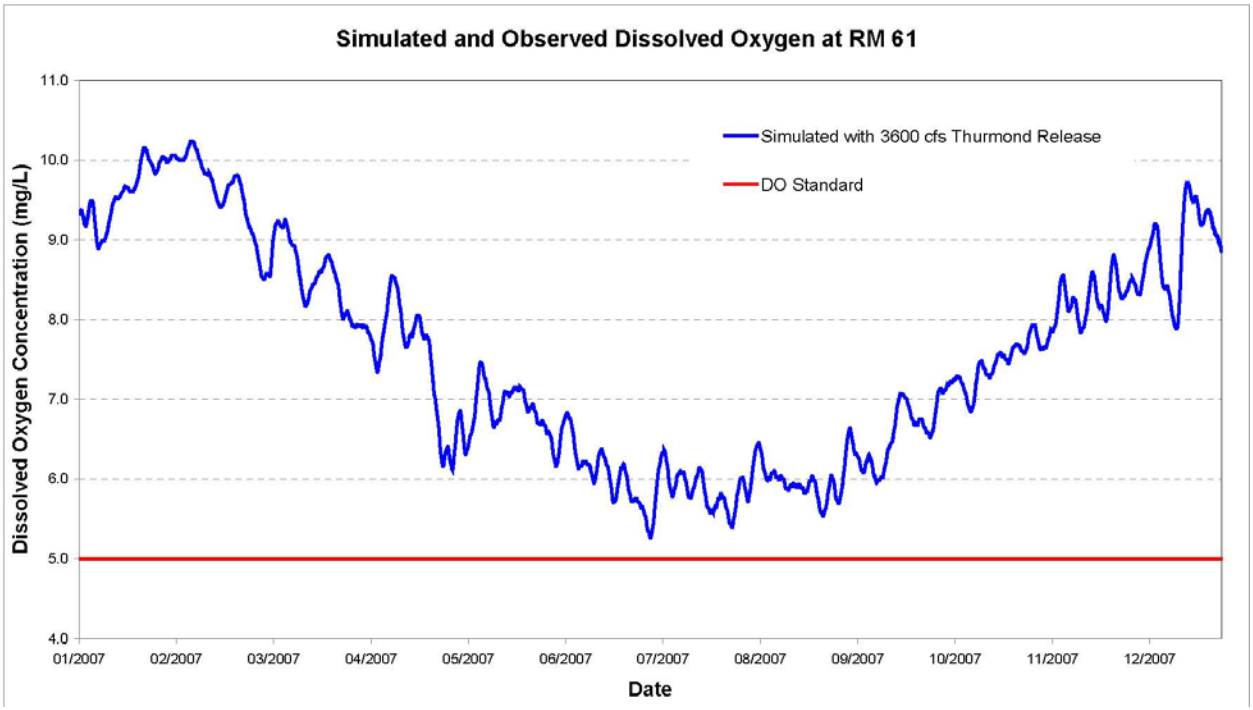


Figure 7 - Dissolved Oxygen at RM 61



Figures 8 and 9 show the simulated DO concentrations at River Mile 119 and River Mile 61 respectively, under a Thurmond release of 3,100 cfs. The model indicates that the DO would remain above the standard of 5 mg/L throughout the year. For the cooler months of October through February, DO concentration would remain higher than 6.0 mg/L and almost always be higher than 7.0 mg/L at both River Mile 119 and River Mile 61.

Figure 8 – Simulated Dissolved Oxygen at RM 119

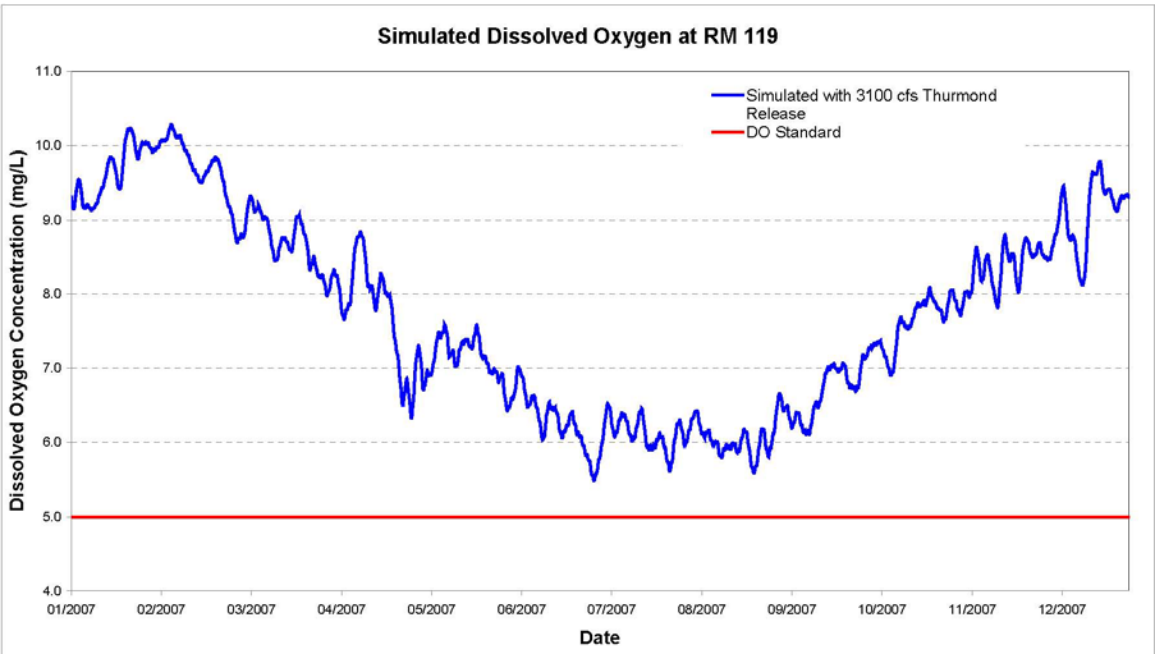
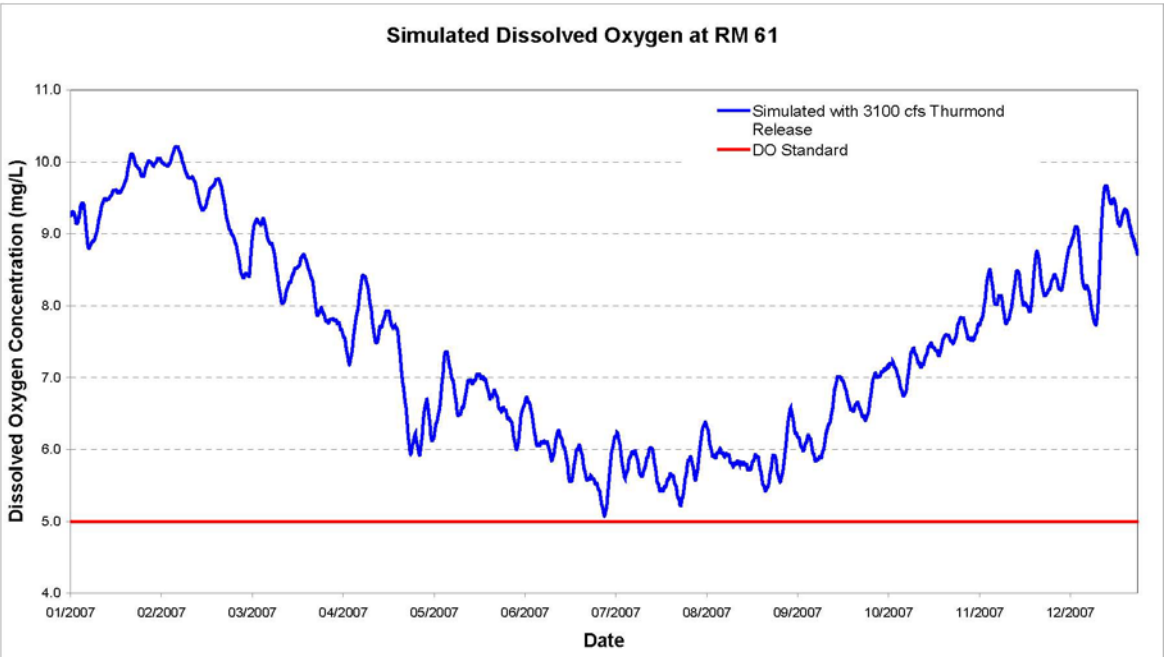


Figure 9 – Simulated Dissolved Oxygen at RM 61



One should note that the water quality model used in this analysis does not contain any modules simulating algal activity in the river. This lack of simulated algal activity means that the model tends to give overly pessimistic DO concentrations. It is likely that field data would document higher DO concentrations than the model predicts.

The proposed action includes a continuation of 3,600 cfs release from Thurmond Dam in the months of March through October and a reduced release from Thurmond Dam of 3,100 cfs in the cooler months (November 2008 through February 2009). This action would not result in any adverse change in DO concentration in the warmer months.

GA DNR-EPD indicates that monitoring stations would be set up at locations along the river to monitor changes in DO concentration along the lower reaches if the proposed operation is adopted. The Corps proposes to use adaptive management as part of the proposed action. If field observations indicate any problem with DO concentration, GA DNR-EPD or SC DHEC would notify the Corps and Savannah District would then increase flows up to a 3,600 cfs discharge to mitigate the adverse conditions.

Once the 3,100 cfs objective is reached, it would be maintained through February 28, 2009 or until such time that (1) a listed monitoring site fails to meet its environmental target, and (2) a decision is made by Savannah District, GA DNR-EPD, SC DHEC and SC DNR to modify the 3,100 cfs discharge. If such an event were to occur, the Corps would increase discharges from Thurmond incrementally by 100 cfs/week until the impact is alleviated or 3,600 cfs is reached.

4.1.2 Savannah Harbor

Two potential water quality related effects in the estuary were evaluated from reduced discharges from Thurmond Dam. These were elevated chloride concentrations at the City of Savannah municipal water intake on Abercorn Creek, and dissolved oxygen concentrations in the Harbor.

The City of Savannah's municipal and industrial water intake is located on Abercorn Creek, upstream of the harbor near river mile 29, approximately two miles from the Savannah River. The City of Savannah is concerned about distributing water to its industrial customers when chloride concentrations in Abercorn Creek are greater than roughly 12 milligrams per liter (mg/L). Such concentrations have been shown to cause scaling in boilers.

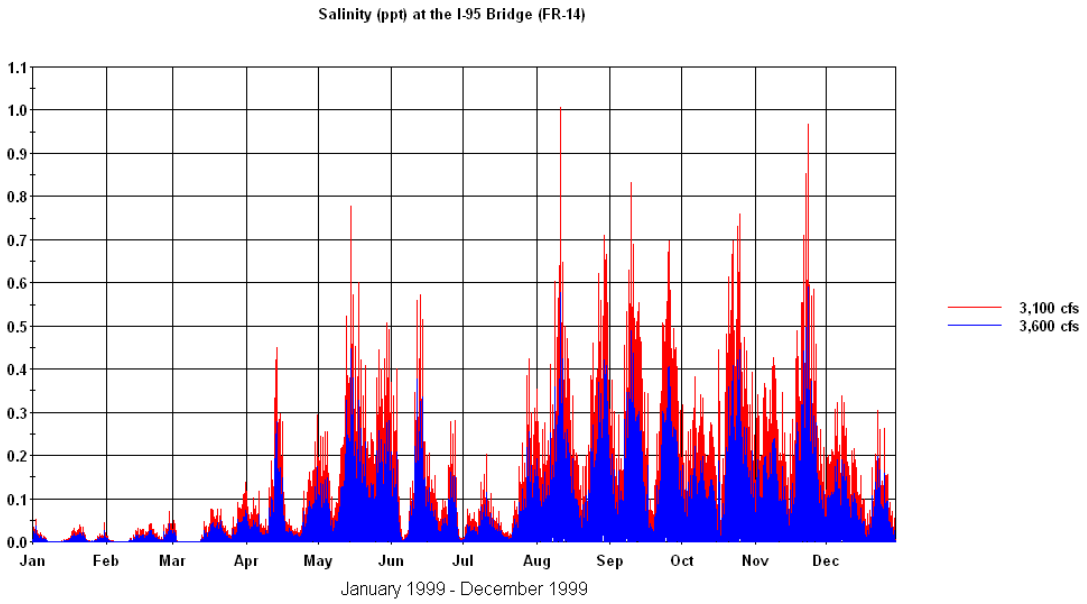
Sources of chloride in Abercorn Creek include upstream inflows from the Savannah River and salinity intrusion from the downstream Savannah Harbor. Studies have shown a good relationship between river flows at the U.S. Geological Survey's Clyo stream gage location and chloride concentrations. Results have shown that the Savannah River contains approximately 10 mg/L of chloride during low flows and 4 mg/L during high flows, when there is greater dilution. Therefore, it is during low flow periods where river chloride concentrations are as high as 10 mg/L when salinity intrusion from downstream can add additional chlorides in the vicinity of the intake and cause the water to exceed the 12 mg/L threshold. Analysis of the historical chloride

data collected at the City's intake shows that during drought years the number of samples with chlorides exceeding 12 mg/L ranges from 21 to 58 percent, and concentrations have approached 19 mg/L.

Reducing releases from Thurmond Reservoir, by itself, would not create higher chloride concentrations at the City of Savannah's water withdrawal. Rather, it is the combination of low releases from Thurmond Reservoir, low runoff from the downstream watershed, and high (spring) tides that create a condition for elevated chloride concentrations at the City's withdrawal. With sufficient downstream inflows and normal tidal conditions, chloride levels at the City's intakes should remain unchanged. However, given the sensitivity of the City's intake to chloride concentrations greater than 12 mg/L, the proposed reservoir operation (Alternative 1) combined with low downstream inflows could increase the number and magnitude of chloride concentrations greater than 12 mg/L at the City of Savannah's M&I water withdrawal. The City of Savannah monitors chloride concentrations each day of the water they are withdrawing from Abercorn Creek. If they identify unusual values after implementation of the proposed action, they would notify the Corps and GA DNR-EPD. If the observations by the City of Savannah indicate any problem with chloride concentrations, GA DNR-EPD would recommend an appropriate action to Savannah District, possibly including the resumption of the 3,600 cfs discharge.

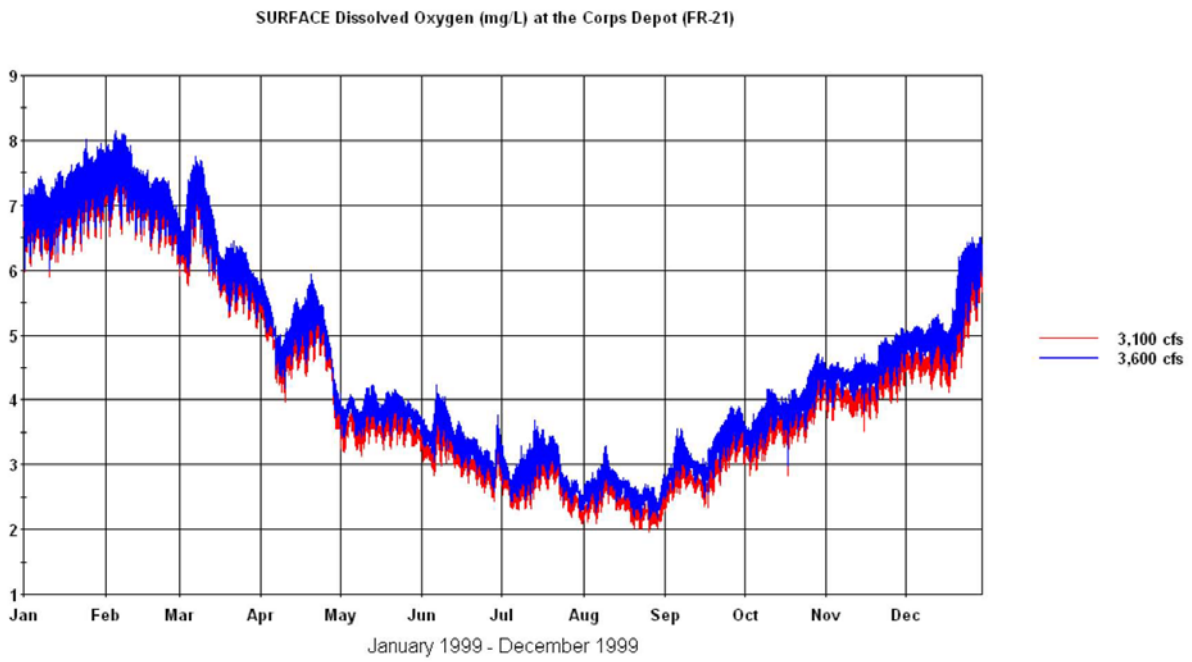
As part of the consideration of impacts to chloride levels at the City's intake, GA DNR-EPD used the Savannah Harbor EFDC Model to identify expected changes in salinity levels at the upper end of the harbor. Figure 11 shows the effects on salinity levels at the Interstate 95 Bridge, located at river mile 27.8. The results indicate that salinity should remain below 1 ppm at the I-95 Bridge during the winter months, even with the proposed reduction in discharge to 3,100 cfs.

Figure 10 – Salinity at I-95 Bridge



GA DNR-EPD evaluated the effect of the proposed Thurmond reservoir operation on dissolved oxygen concentrations in Savannah Harbor using the Savannah Harbor EFDC and WASP Models. The RIV1 Model streamflow and water quality results provided input for the upstream boundary of the harbor models. GA DNR-EPD evaluated model results and the effects on dissolved oxygen concentrations at the USGS monitoring station located at the U.S. Army Corps of Engineers' dock on Hutchinson Island in the harbor. EPD compared the results to the existing coastal fishing classification, whose dissolved oxygen criteria is no less than 3.0 mg/L during June through October, no less than 3.5 mg/L in May and November, and no less than 4.0 mg/L during December through April. The results are shown in Figure 10. GA DNR-EPD concluded that the modeling indicates that the proposed seasonal reduction of Thurmond releases would not result in substantial adverse impacts to dissolved oxygen levels in the harbor.

Figure 11 – Simulated Surface Dissolved Oxygen in Savannah Harbor



Once the 3,100 cfs objective is reached, it would be maintained until February 28, 2009, or until such time that 1) a listed monitoring site fails to meet its environmental target and 2) a decision is made by the Corps, GAEPD, SCDHEC and SCDNR to modify the 3,100 cfs. If such an event were to occur, discharges from Thurmond would be incrementally increased by 100 cfs/week until the impact is alleviated or 3,600 cfs is reached.

4.2. BIOTIC COMMUNITIES-LAKES

4.2.1. Largemouth Bass Spawning

Largemouth bass

State natural resource agencies have identified largemouth bass spawning at the three Corps Savannah River lakes as being a priority in water management decisions. The spawning period is defined as beginning when water temperatures reach 65 degrees Fahrenheit and lasts until three weeks after water temperatures reach 70 degrees. The water temperatures are taken each day throughout this period in a sunny cove between 1000 and 1630 hours by submersing a thermometer six inches where the water is approximately three to five feet deep. The spawning period usually starts around the first of April and lasts 4 to 6 weeks (Lake Regulation and Coordination for Fish Management Purposes, South Atlantic Division, US Army Corps of Engineers, March 30, 2001).

Past studies indicate that the 4-week period of April 1-28 is the peak spawning period. Stable lake levels should be provided during this peak spawning period to prevent the stranding of eggs and abandonment of nests. Throughout the spawning season, water levels should not be lowered more than six inches below the highest lake elevation recorded during the operational spawning window. If inflows during the spawning season cause lake levels to rise to flood levels, managers have the authority to lower lake levels more than 6 inches, since flood control takes precedence over fish spawn. Maintaining these stable lake levels may not be possible during drought.

In both the NAA and Alternative 1, stable lake levels would be provided during this peak spawning period as much as possible. The difference between the two alternatives is that the lakes would be somewhat higher if Alternative 1 is implemented, since they would have retained more water during the winter months. The NAA would result in less stable pool levels, thus having a higher potential to impact fish spawning. Alternative 1 would provide more flexibility to water managers, resulting in a greater potential to manage continued drought flows without adversely impacting the 2009 spawning season.

4.2.2. Aquatic Plants

Effects of the NAA

The NAA would have no adverse impacts on aquatic plants (including invasive species, such as hydrilla) as the existing SRBDCP of March 1989 with pumped storage operation would continue to be used.

Effects of Recommended Alternative

The prolonged drought from mid-1998 through the summer of 2002 significantly reduced the abundance of aquatic vegetation in JST Lake (including invasive species, such as hydrilla) (Aquatic Plant Management Plan, US Army Corps of Engineers, Savannah District, Calendar Year 2006 Update), which is the only lake of the three with an active aquatic vegetation

treatment program. Therefore, the proposed action and the associated small variations in lake levels when compared to the NAA are expected to have no adverse impact on aquatic plants in the lakes. No downstream effects are anticipated to occur within the main channel. Potential effects to aquatic plants in the shoals, estuary, and flood plain are discussed in the following sections.

4.3. BIOTIC COMMUNITIES-SHOALS

Shoals

Past studies and coordination have listed shad, robust redhorse, Atlantic sturgeon, the shoals spider lily (*Hymenocalis coronaria*) and juvenile out-migration as being high priorities for the Shoals during dry years. The Shoals are defined as the 7.2 kilometer stream segment that is upstream of Augusta and downstream of the Augusta Canal Diversion Dam. High priority fish species benefit from higher flows across the shoals from January to May, since such flows support seasonal spawning and passage. The state-listed endangered shoals spider lily benefit from higher flows from June to December, as such flows would provide protection from deer grazing. Undefined very high flows could be detrimental to the spider lily, but these are not expected during times of drought and are not considered here.

The flow regime in the Augusta Shoals is controlled by flow releases from Thurmond Dam, reregulation of flows at Stevens Creek Dam, and the diversion of water into the Augusta Canal by the City of Augusta at the Augusta Diversion Dam. At flows of 3,600 to 3,800 cfs, the City has stated that they will set the canal gates to provide flows of 1,000 to 1,500 cfs in the shoals.

Effects of the NAA

Selection of the NAA and continuing with the existing SRBDCP with coordinated additions would have acceptable effects on these biotic communities.

Effects of Recommended Alternative

This alternative would have minor effects on these biotic communities. As discussed earlier in the Water Quality section, this alternative provides flows that are slightly lower than the NAA. The flow reduction will occur between November 1, 2008 and February 28, 2009. The decrease in flows would occur during the cooler months, so no impacts to seasonal fish spawning or upstream fish passage are expected. Low flow conditions in the shoals could harm resident fishes by inhibiting movement, reducing cover, and foraging habitat. Fish are more susceptible to stranding and predation under these conditions. Anadromous species, including out-migrating juveniles, are unlikely to be within the shoals during the time of the proposed flow reduction. The decrease in flows could increase the susceptibility of shoals spider lily to grazing by deer. Atlantic pigtoe could also be impacted by insufficient water depth, exposure and increased predation. However, it is not anticipated that the reduction of flow from 3,600 cfs to 3,100 cfs

will result in significant long term adverse effects. The Corps anticipates that the City will fulfill its commitment and allow sufficient flow to pass over the Shoals so as not to extirpate species of concern from this area.

4.4. BIOTIC COMMUNITIES-FLOODPLAIN

Floodplain

The floodplain reach is defined as beginning downstream of the Augusta Shoals and extending to Ebenezer Landing (approximate river kilometer 65). Seedling establishment is a high priority for the floodplain reach during dry years. The establishment of seedlings is promoted by low flows (3,000 cfs or less was recommended in the 2003 workshop to occur every 10 to 20 years and not last longer than 3 years) between April and October for 3 consecutive years. However, flows up to an estimated 10,000 to 15,000 cfs remain within the stream channel at nearly all locations (15,000 cfs near the Millhaven Gage) and would not be expected to affect the floodplain.

Flows from both the No Action Alternative and Alternative 1 are expected to remain within the channel banks during the winter months. Neither plan would affect the establishment of seedlings in the floodplain. Therefore, there would be no difference between the two alternatives on potential impacts to this resource.

Modeling indicates that river levels will be reduced by approximately 6-inches downstream of Thurmond Dam. It is plausible to assume that this reduction will have a localized effect to mussel populations and other non-motile species that may be found in shallow sloughs and cutoff bends along the river. Many of these areas are already separated from the main river due to present low flow conditions, and will see no additional impact from the reduction. However, areas still connected by shallow cuts may be affected by the additional flow reduction. These areas comprise a small percentage of the overall river system. Therefore, impacts to these areas will not result in a significant impact to the river system.

No other effects were identified to flood plain communities.

4.5. BIOTIC COMMUNITIES-ESTUARY

Estuary

The report from the April 1-3, 2003 workshop listed freshwater marsh habitat and the salinity gradient as being the high priorities for the estuary reach during dry years. The estuary has been defined as extending from Ebenezer Landing (approximate river kilometer 65) down to the mouth of the river. Historically, river flows of 4,000 to 5,000 cfs and less at the USGS Clyo gage have resulted in a stressed freshwater marsh plant community and an associated upriver shift of the salinity gradient (higher salinity zones). Higher flows throughout the year would provide a healthier freshwater marsh plant community and allow more fish access. The estuary provides habitat for some species of fish for

which Management Plans have been prepared by the South Atlantic Fishery Management Council. The managed species

that could be affected by the proposed action include oyster, white shrimp, brown shrimp, and red drum. Other habitats that could be affected consist of saltmarsh, brackish marsh, oyster reefs, shell banks, tidal flats and freshwater wetlands.

The Atlantic States Marine Fisheries Commission (ASMFC) has Management Plans for river herrings and American shad, Atlantic sturgeon, and American eel. Shortnose sturgeon are managed under a recovery plan by the National Marine Fishery Service (NMFS). GA DNR-WRD and SC DNR have a Striped Bass Management Plan for the Lower Savannah River. Alewife and hickory shad are other managed species for which Management Plans have not been prepared that commonly occur in the Savannah River or its estuary.

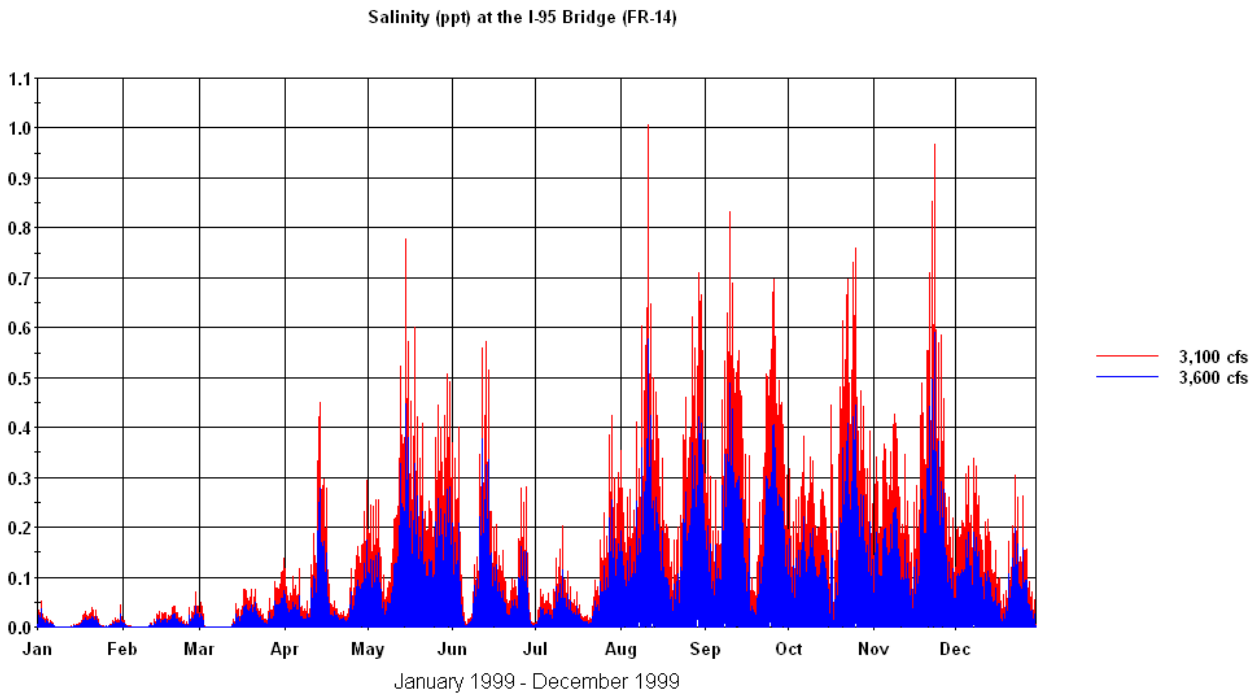
Effects of the NAA

Selection of the NAA and continuing with the existing SRBDCP would have acceptable impacts on these biotic communities for the near term. Long-term impacts are uncertain. Should the drought persist, Level 4 of the DCP could adversely affect the communities in this area.

Effects of Recommended Alternative

Modeling suggests that salinity differences of less than 1 ppt would occur at the I-95 bridge. This is below shown in Figure 12. This is within the natural variation seen in the estuary.

Figure 12 – Salinity Modeling at I-95 Bridge

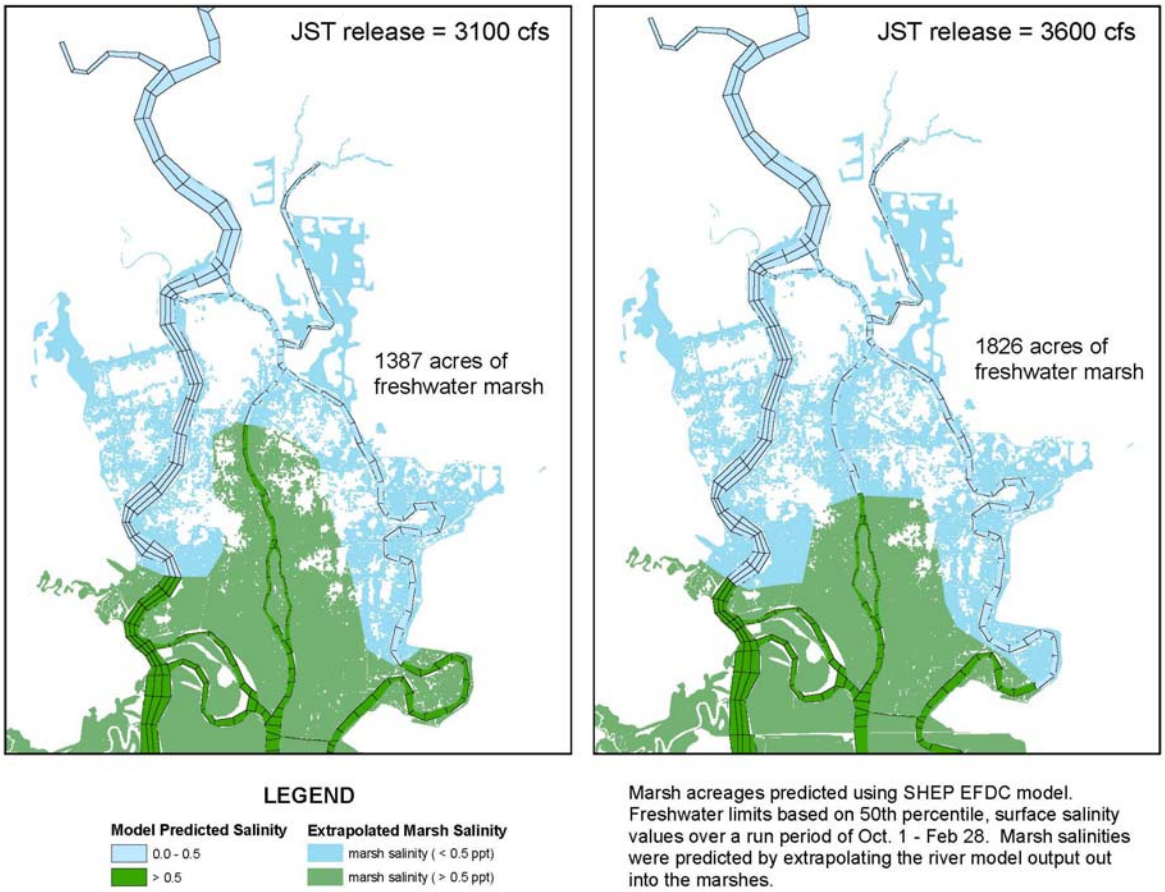


Savannah District used the Savannah Harbor EFDC model to evaluate the potential impact of salinity changes on freshwater wetlands in the estuary. The techniques followed by the District were similar to, but a slight variation from those used to evaluate potential impacts from the proposed Savanna Harbor Expansion Project. In the SH Expansion Project, the natural resource agencies had stated that the location of the 0.5 ppt surface contour across the marsh during the summer growing season was critical to determining the species composition in the estuary. In the present evaluation, the District used the surface salinity levels that would occur during the winter months, since those are the only ones that would change as a result of Alternative 1. With that difference in technique being understood, the analysis indicates that 439 acres of freshwater marsh could undergo temporary adverse effects due to higher salinity as a result of Alternative 1. This is shown in Figure 13 on the following page. The direct effect would be short-term, as salinity levels would be restored in the spring when flows are increased to 3,600 cfs or when normal rainfall and river flows are experienced.

To place the 439 acres in context, the same analysis technique predicts that 4,072 acres of freshwater marsh would exist under average river flows (1997 flows). The results would indicate that the existing drought has already caused the temporary conversion of 2,246 acres (4,072-1,826 acres) of freshwater marsh to brackish marsh. The Corps' previous analyses indicate that a typical, but severe drought (20-year recurrence interval) would have resulted in the existence of 2,208 acres of freshwater marsh. This drought-of-record has allowed salinity to move further into the estuary than a drought with a 20-year recurrence period, temporarily reducing the acreage of freshwater marsh.

The 439-acre impact likely overstates the changes in marsh vegetation, since the reduced flows and the resulting additional salinity would occur during the winter months, which is not the primary growth season for the plants. Under those conditions, the extent of the conversion of one marsh plant species to another at a site is uncertain. The District is continuing to evaluate this potential impact. It intends to apply the Marsh Succession Model developed by the USGS for this estuary to these alternatives. That tool adds the range of salinities that are acceptable to various vegetative communities to the surface salinity level to predict the types of community expected to occupy a given location in the estuary. Previous application of that tool revealed less of a biological effect for the same change in salinity than does just the use of the 0.5 ppt contour. Information from that analysis is expected to be available prior to a final decision on this propose action.

Figure 13 – Surface Salinity Modeling in the Estuary



An adaptive management plan is in place to mitigate impacts should any significant increases in salinity are observed.

4.6. Threatened and Endangered Species

The robust redhorse, shoals spider lily and the federally-listed shortnose sturgeon, manatee, and wood stork are the only Threatened or Endangered Species that may possibly be affected by small changes in flow.

Robust redhorse

Spider lily

Shortnose sturgeon

Effects of the NAA

Selection of the NAA and continuing with the existing Drought Contingency Plan would have no effects on threatened and endangered species above those that were previously approved. The NAA provides an average daily minimum flow of 3,600 cfs.

Effects of Recommended Alternative

As discussed earlier, this alternative provides an average daily minimum flow of 3,100 cfs. The decrease in predominant flows would occur during the cooler months, so potential impacts to seasonal fish spawning and fish passage, and impacts from deer grazing shoals spider lily should be minimal. The lower river levels could make shoals spider lily more susceptible to grazing from deer.

Spawning for the robust redhorse typically occurs from April through June. Flows of 3,600 cfs would be restored by that time under Alternative 1. Anadromous species are unlikely to be within the shoals or upper river areas during the time of the proposed flow reduction; therefore, no adverse effects are anticipated to these species. Staging and foraging areas for these species may see slight alterations in salinities, but modeling indicates those effects would be small, so these highly motile species should easily adapt to these fluctuations.

Changes in river flow, salinity levels, and dissolved oxygen levels that are experienced by shortnose sturgeon and manatee are expected to be minimal and within the variation produced by the tides on a regular basis. The lower river levels could make fish more susceptible to predation from wood stork.

The Corps has determined that the proposed action may affect, but is not likely to adversely affect shortnose sturgeon, manatee, and wood stork. No effects to any other federally listed species were identified.

4.7. Essential Fish Habitat

The proposed flow reduction would alter Essential Fish Habitats in the estuary. Although the reduced flow volume would change velocities, the extent of those changes would be too small to be measurable. The primary noticeable effect would be an increase in salinity at the freshwater/saltwater interface. Salinity would move further into the estuary with the proposed action. This change would be temporary and would disappear when flows are increased in March 2009 or when normal rainfalls occur, whichever comes first. Savannah District believes that these temporary changes to Essential Fish Habitats do not warrant mitigation.

4.8. RECREATION

As evident in past droughts, recreation experiences diminish on Hartwell and J. Strom Thurmond Lakes as the lake levels drop. Public boat ramps and private docks become unusable as the lakes recedes. In addition, tree stumps and sand bars are exposed in the lakes. For some boaters, continued use of the lakes poses a serious threat to damaging boats and injuring persons. Swimming outside the Corps of Engineers' designated areas increases the potential for swimming fatalities. The expected ½ foot decrease in water depth in the river with Alternative 1 could result in minor adverse impacts to boaters and fishermen using the river.

4.8.1. Boat-Launching Ramps and Private Docks

The NAA will result in further impacts to boat ramps and private docks on the Corps reservoirs as the water continues to recede from the normal pool shoreline. The relative stabilizing effect resulting from Alternative 1 would increase the duration of use for the currently functioning structures within the conservation pools. Boat ramps along the river could be impacted by the expected ½ foot decrease in water depth with Alternative 1. This impact is minimized by the winter timing of the proposal, a season when there are fewer users of those facilities.

4.8.2. Swimming

Swimming at beach areas usually occurs from May to September. Therefore, the recommended alternative is occurring outside the normal season for swimming activities. Further, Alternative 1 is designed to maintain the conservation pools where swimming occurs. The NAA would result in further long-term impacts to the conservation pools and, subsequently, swimming areas.

4.9. WATER SUPPLY

Water shortages during drought are the performance measure used to determine the impacts of the alternatives in comparison to the NAA.

Hartwell Lake

There are eight water supply users with intakes in Hartwell Lake. Two (Anderson County Joint Municipal Water System and the City of Lavonia) currently hold water storage contracts with the US Army Corps of Engineers, Savannah District. Although Hart County Water and Sewer Utility Authority does not have an intake, it does have a water storage contract. Hart County currently uses water from intakes owned by the Cities of Lavonia and Hartwell. The amount of water that they use from these two cities is charged against their water storage contract with the Corps of Engineers. The other six water supply users with intakes have riparian rights (City of Hartwell, Clemson University Musser Fruit Farm, Clemson University, Clemson Golf Course, J. P. Stevens, and Milliken Company). Clemson University's Musser Fruit Farm intake becomes inoperable at 653 feet msl. Irrigation occurs between the months of June and August. When the intake is inoperable, they use water from the City of Seneca, but only if it is absolutely necessary because of the increased cost. The recommended alternative will increase the amount of water remaining in the conservation pool, resulting in positive effects to the water users in Harwell

Lake by increasing the number of days they can withdraw water. The NAA would reduce the water supply available to users of this resource.

RBR Lake

There are 6 water supply intakes on RBR Lake. Two (City of Elberton and Santee Cooper) currently hold water storage contracts in RBR Lake with the US Army Corps of Engineers, Savannah District. Three have riparian rights (RBR State Park Golf Course, Mohawk Industries, and Calhoun Falls). One, the City of Abbeville, is in relation to mitigation for RBR construction. The highest intake elevation is 468.8 feet msl. The recommended alternative would increase the amount of water remaining in the conservation pool, resulting in positive effects to the water users in Harwell Lake by increasing the number of days they can withdraw water. The NAA would reduce the water supply available to users of this resource.

JST Lake

There are 8 water supply users with intakes on JST Lake. Seven (City of Lincolnton, City of Washington, City of McCormick, City of Thompson, Columbia County, Savannah Lakes POA Monticello Golf Course and Savannah Lakes POA Tara Golf Course) currently hold water storage contracts with the US Army Corps of Engineers, Savannah District. Hickory Knob State Park Golf Course has riparian rights. The City of Lincolnton has three intakes, one each at 321, 314 and 307 feet msl. If the highest intake at 321 feet msl is exposed, then the other two intakes can meet the water needs so that there are no shortages during a drought. This condition is the same for the City of Thompson and Columbia County that have three intakes one each at 320, 312 and 304. The golf courses have intake elevations at 324 feet msl. They experience water shortages with these intakes during drought periods. The recommended alternative will increase the amount of water remaining in the conservation pool, resulting in positive effects to the water users in Harwell Lake by increasing the number of days they can withdraw water. The NAA would reduce the water supply available to users of this resource.

Downstream of JST Lake

Water supply users downstream of the JST Lake include the Augusta/Richmond County (Canal and Shoals) and users with intakes in the NSBL&D pool including North Augusta, Mason's Sod, Kimberly Clark, Urquhart Station, PCS Nitrogen, DSM Chemical and General Chemical. Users below NSBL&D include the Beaufort-Jasper County Water Supply Authority, Plant Vogtle, the City of Savannah M&I Plant, the Savannah National Wildlife Refuge and many other cities and municipalities. The NAA would not result in any immediate changes for the current water users downstream of the JST Lake.

There may be concern from water users along the Augusta Canal from the recommended alternative. Diversions into the Augusta Canal are managed by the City of Augusta to maintain a minimum of 1,500 cfs (1,500 cfs May through January and 1,800 cfs otherwise) through the Shoals. Three electronically controllable gates, operated by the City of Augusta, allow for instantaneous changes of flow to the Canal, should a management target be approached.

Based on current permit information on the City of Augusta intake, the City is allowed to withdraw no more than 45 MGD (about 70 cfs). The City has four turbines to operate for water supply operations. These turbines are driven by water in the Canal. Then, in turn, they drive

pumps to lift water from the river for water supply purposes. The City usually uses two of its four turbines units (Units 1 and 4), requiring a flow of 1,364 cfs. This amount is passed through the turbines and returned entirely to the main stem Savannah River (about two thirds of the length of the shoals).

There are three mills on the Augusta Canal located downstream of the City's intake. They are Sibley, King, and Enterprise. All these mills have turbines that are driven by water in the Canal. All return the water used back to the main stem Savannah River downstream of the shoals. Sibley Mill needs a flow of 1,024 cfs; King needs approximately 880 cfs; and Enterprise needs a flow of approximately 560 cfs. The King mill is the only operating mill. One of the mills has closed and generates income from its use of the water to generate electrical power. The other "mill" has converted to residential use and uses its allocation of water to generate electrical power for its residents.

At the current level of Thurmond discharges (3,600 cfs) during Level 3 drought conditions, if there is no incremental flow between the dam and the Canal inlet, 3,600 cfs would flow to the Augusta Diversion Dam. Under those conditions, the City has agreed to pass 1,500 cfs to the Shoals. That leaves 2,100 cfs to go through the Canal. After the City's turbines (1,363 cfs), there would be less than 800 cfs remaining in the Canal for the mills.

Under the recommended alternative, Thurmond release would be reduced to 3,100 cfs from October through February. If the City operates the gates to pass 1,500 cfs to the Shoals, the amount of water going through the Canal would be 1,600 cfs, assuming little incremental flow. This would be enough to sustain the City's water supply pumping operations. However, after that, there would be less than 300 cfs left to go through the rest of the Canal, and the hydropower operations of the "mills" will be impacted.

The Corps understands that the mills are connected to the power grid and alternative power is available in case their generating capacity is limited. Failure to implement the Recommended Alternative (i.e. the NAA) has the potential to result in similar impacts to downstream users if the drought persists and the Corps is forced to go to Level 4 of the Drought Contingency Plan.

4.10. COASTAL ZONE CONSISTENCY

The proposed reduction of discharges from J. Strom Thurmond Lake would alter flows down the river to the estuary and the coastal zone. The flow reduction would affect salinity and dissolved oxygen levels in the estuary. It could also affect chloride levels at the City of Savannah's municipal and industrial water intake on Abercorn Creek. These potential changes were identified and discussed in Section 4.1 (Water Quality). The potential effects on freshwater vegetation in the estuary were identified and discussed in Section 4.5 (Biotic Communities - Estuary). The potential effects on endangered species were identified and discussed in Section 4.6 (Threatened and Endangered Species).

Recognizing the expected impacts identified and described in other sections of this document, Savannah District believes that the proposed temporary flow reduction is consistent to the maximum extent practicable with the enforceable provisions of both the Georgia and South Carolina Coastal Management Plans.

4.11. HYDROPOWER

A 500 cfs flow reduction from the three Corps dams would result in 13,000 MegaWatt Hours of additional shortage in meeting the contract hydropower generation energy requirement. That additional shortage is approximately 0.1% of the contractual energy requirement for the seasonal flow reduction period.

If sufficient water is available in the Mobile-managed basins, this power could possibly be generated by additional run time of hydropower units on those rivers. However, those basins are also presently experiencing a severe drought, so the likelihood that they could provide additional generating capability is small. SEPA could also purchase the additional power on the spot market to meet the additional contract requirements. That would increase SEPA's operating costs. The extent of that increase is not known. No immediate changes to hydropower are expected with the NAA.

4.12. CULTURAL RESOURCES

Consultation with the Georgia and South Carolina State Historic Preservation Officers and nineteen Native American Tribes would occur during the public comment period.

Effects of the No Action Alternative
The NAA would have no additional adverse impacts to historic properties, as the existing SRBDCP of March 1989 would continue to be followed.

Effects of Recommended Alternative
Since the maximum pool levels at all lakes will remain the same and the minimum pool levels would be higher (reducing erosion of submerged archaeological resources), this alternative would produce no additional adverse impacts to historic properties in the lakes. The lower river flows are not expected to expose additional cultural resources, so no adverse effects are expected to historic properties in the river or estuary.

4.13. ENVIRONMENTAL JUSTICE

Effects of the NAA
The NAA would have no adverse impacts on environmental justice as the existing SRBDCP of March 1989 would continue to be followed.

Effects of Recommended Alternative
This action would have effects along the entire length of the Savannah River Basin. The areas adjacent to the riverbanks and lakes do not support disproportionate concentrations of minority or low-income communities. Minority or low-income populations do not recreate on the river in disproportionate numbers. As a result, this alternative would not result in disproportionately high and adverse human health or environmental impacts on minority or low-income populations in the United States. It, therefore, complies with Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations".

4.14. PROTECTION OF CHILDREN

Effects of the NAA

The NAA would have no adverse impacts on the protection of children as the existing SRBDCP of March 1989 would continue to be followed.

Effects of Recommended Alternative

This action would have effects along the entire length of the Savannah River Basin. The areas adjacent to the riverbanks and lakes do not support disproportionate concentrations of children and children do not recreate on the river or lakes in disproportionate numbers. The proposed action would not result in a disproportionate risk or environmental impact to children that result from environmental health or safety risks within the meaning of Executive Order 13045. It therefore complies with Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks".

4.15. CUMULATIVE EFFECTS

Council on Environmental Quality regulations (40 CFR 150.7) require an analysis of the cumulative impacts resulting from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes these other actions. Cumulative impacts can result from individually minor, but collectively significant, actions. This cumulative impacts section of the EA addresses only the cumulative effects arising from considering the Proposed Action in combination with other ongoing or proposed actions in the Savannah River Basin.

The Savannah River does not function as it originally did, because of various changes. Several dams cross its flow, holding back high spring flows and raising low summer flows. Peaking operations at hydropower plants make the flows irregular during the course of day and week in some areas, rather than being primarily in response to rainfall events and seepage from adjacent wetlands. Numerous withdrawals of water occur, some for municipal use, some for industrial purposes, and others to aid adjacent recreation. The number of users of the river has increased dramatically. The ponded lakes that occur upstream of the dams provide sources for several types of recreation, and those sites are used heavily for those purposes. Fishermen use the free-flowing portions of the river, and their numbers have continued to increase with the overall growth in regional population.

If it were not for the multiple users of the river and lakes as they now exist, there would be little concern about the amount of water flowing in the river during a drought. But the goals and activities of many individuals, organizations, corporations, and government agencies are now affected by the amount of discharged from J. Strom Thurmond Lake to flow down to the ocean. Those users are expected to continue to conduct their activities on the lake and in the river in the future.

Although Savannah District is not aware of any specific plans to substantially increase the use of waters in the Savannah River Basin, we do expect some growth in both the number of users and the amount of water that is desired to be withdrawn from the lakes and river. The District is aware that Georgia Power would like additional water from the Savannah River for the proposed expansion of Plant Vogtle, near Waynesboro, Georgia. That proposed withdrawal may occur at some point in the future, but would not occur within the November – February time frame that is under consideration in this EA.

The Savannah River is viewed by some located in other river basins as a ready source of clean water for their needs. If the regulating government agencies agree that additional inter-basin transfers can occur, stresses on existing uses along the entire length of the Savannah River basin would increase to some degree.

The proposed flow reduction would come on top of reduction that is presently being experienced by biological communities along the river and in the estuary as a result of the present drought. Resources that are stressed by the present drought may be further stressed by the proposed additional reduction in flow volume over the winter months. These stresses would constitute a cumulative adverse impact of the proposed action. However, if no action is taken and the drought continues to the point that Level 4 conditions are reached where outflow from Thurmond Lake equals its net inflow, these biological resources would likely experience these same, or greater, stresses. If operations shift to outflow equals inflow during the summer months, the stresses on biological communities would be much greater than if they are experienced during the winter months.

In summary, flows in the Savannah River have been substantially modified over time, but the basin still presents a multitude of opportunities for the use and enjoyment of this valuable resource. The number of people desiring to use or benefit from this resource continues to increase. The uses vary seasonally, with lower demands placed on the aquatic ecosystem during the winter months. As a drought intensifies or continues in duration, the stress on both the natural ecosystem and human uses of the resources increase. Long term adverse cumulative impacts would result primarily from increases in water usage and an accompanying loss of water from the river basin.

5.0 CONCLUSIONS

This Environmental Assessment considers the potential environmental impacts of the proposed action. The impacts listed for most of the resources in the table below are similar for the NAA and Recommended Alternative. However, the NAA has adverse impacts on conservation pool levels, water usage, recreation, boat-launching ramps and docks at Hartwell and J. Strom Thurmond Lakes, while the Recommended Alternative has positive impacts on these resources. The Recommended Alternative would have minor effects on downstream biological resources. These minor impacts would primarily occur to mussels in cut-off bends and species in the Augusta Shoals area. Temporary adverse impacts would also occur to freshwater wetlands in the estuary. However, failure to implement the Recommended Alternative could result in earlier implementation of Level 4 of the drought contingency plan. Implementation of Level 4 would

likely result similar or greater impacts to these biological resources in 2009 – 2010 timeframe should the current drought continue. The Recommended Alternative would provide for a temporary deviation of the Savannah River Basin Drought Contingency Plan of March 1989, as updated in 2006. The conclusion of this Environmental Assessment is that the proposed action – reducing the minimum daily average release at J. Strom Thurmond Dam from 3,600 to 3,100 cubic feet per second while in drought Level 3 from November 1, 2008 through February 28, 2009 – would result in no significant environmental impact.

Based on a review of the information contained in this EA, the District determined that a temporary modification to the Savannah River Basin Drought Contingency Plan of March 1989, would not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of Section 102(2)(c) of NEPA. Accordingly, preparation of an Environmental Impact Statement is not required.

Table 7: Impact Summary

RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE 1
Water Quality	No immediate adverse impact	Modeling by EPD suggests no adverse impacts will occur, but an adaptive management plan has been developed to address any issues, should they occur.
Biotic Communities-Lakes, Largemouth Bass Spawning, by observing the Pool Elevation Tables	Acceptable impacts, because the existing Drought Contingency Plan would continue to be followed	The objective of this alternative is to maintain the current level of the conservation pool and improve refill capability. Therefore no significant adverse impacts were identified.
Biotic Communities-Lakes, Aquatic Plants	No adverse impact	No adverse impact
Biotic Communities-Shoals	Acceptable impacts for the short-term. Could have impacts if drought persists.	Will reduce flows in the Shoals area. This could affect fish movement and mussels. Impacts would be attenuated due to the flow reduction occurring in the cooler months outside of spawning season.
Biotic Communities-Floodplain (Lower flows recommended here)	Acceptable impacts for the short-term. Could have impacts if the drought persists.	No impact to wetlands identified. Some sloughs and cutoff bends could be impacted by reduced flows. Mussels and other organisms in these areas could see adverse effects. Given the overall project area, these localized occurrences would be minimal.
Biotic Communities-Estuary	Acceptable impacts for the short-term. Could have impacts if the drought persists.	Modeling suggests that salinity increases of less than 1ppt will occur at the I-95 bridge. This could adversely affect freshwater wetlands. An adaptive management plan is in place should any significant increases in salinity be observed.
Threatened and Endangered Species	Acceptable impacts	May affect, but not likely to adversely affect listed T&E species (shortnose sturgeon, manatee, and wood stork).
Recreation, Boat-Launching Ramps and Docks	No immediate adverse impacts	No Adverse Impacts
Recreation, Swimming	No immediate adverse impacts	No Adverse Impacts

RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE 1
Water Supply	Will impact water users on impoundments as this alternative will negatively impact the long-term stability of the conservation pools.	Some users in the Augusta Canal may experience a reduction in available water during the deviation period, but the effects are outweighed by the benefits to users within the impoundments and long-term low flow augmentation capability for downstream areas if the drought continues or worsens.
Hydropower	No effect immediately. Persistent drought may induce prolonged shortages.	Total of 13,000 MegaWatt Hours of additional shortage or 0.1 % of contract requirement..
Biological Resources	No immediate effect. Long-term impacts would occur if the drought persists.	No significant impacts identified. An adaptive management plan is in place should any significant impacts be observed.
Cultural Resources	No additional adverse impacts.	No additional adverse impacts.
Environmental Justice	No adverse impact.	No disproportionately high and adverse impacts.
Protection of Children	No adverse impact.	No disproportionately high and adverse impacts.

6.0 RELATIONSHIP OF PROJECT TO FEDERAL AND STATE AUTHORITIES

The following table summarizes the status of the compliance of the proposed action (Recommended Alternative) with applicable Federal and State environmental laws.

Table 8: Summary of Requirements

FEDERAL POLICIES	PROPOSED ACTION
Anadromous Fish Conservation Act, 16 U.S.C. 757, et. seq.	In compliance. Draft EA is being coordinated with NMFS.
Archaeological and Historic Preservation Act, as amended, 16 U.S.C. 469, et. seq.	In compliance. District's determination of no effect is being coordinated with the SHPO in both GA and SC.
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et. seq.	In compliance. Draft EA is being coordinated with EPA.
Clean Water Act, as amended (Federal Water Pollution Control Act) 33 U.S.C. 1251, et. seq.	In compliance. Draft EA is being coordinated with both GA and SC.
Coastal Zone Management Act, as amended, 16 U.S.C. 1451 et seq.	In compliance. CZM Consistency Determination is being coordinated with both GA and SC.
Endangered Species Act, as amended, 16 U.S.C. 1531, et. seq.	In compliance. District's determination of may affect, but not likely to adversely affect shortnose sturgeon, manatee, and wood stork is being coordinated with the USFWS and NMFS.
Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-12, et. seq.	In compliance.
Fish and Wildlife Coordination Act, as amended 16 U.S.C. 661, et. seq.,	In compliance. Draft EA is being coordinated with the GA DNR, SC DNR, USFWS, and NMFS.
Fishery Conservation and Management Act of 1976, Public Law 99-659.	In compliance.
Magnuson-Stevens Act, as amended, Public Law 104-297.	In compliance. District is being coordinated determination with NMFS.
National Historic Preservation Act of 1966, as amended, 16 U. S. C. 470f, et seq.	In compliance. District's determination of no effect is being coordinated with the SHPO in both GA and SC.
Protection of Wetlands, E.O. 11990	In compliance.
Environmental Justice, E.O. 12898	In compliance.
Protection of Children, E. O. 13045	In compliance.
Invasive Species, E. O. 13112	In compliance.

7.0 COORDINATION

Savannah District has coordinated with Federal and state officials during 2007 and 2008 as the drought continued in the Savannah River Basin. Some of the coordination has included the participation of other stakeholders. The meetings increased the understanding of the drought situation, monitoring which various stakeholders are presently performing, actions that could be taken to better manage the water resources at this time, and identified the resources which could be affected by various alternatives.

A Public Notice of Availability has been issued, notifying the public of the availability of the Draft EA. This Notice served as the formal advertisement of the proposed temporary deviation to the 1989 Savannah River Drought Contingency Plan, as amended. Agencies, individuals and organizations that have expressed an interest in the update will be furnished a copy of the EA.

8.0 LITERATURE CONSULTED

Applied Technology and Management, 1998. Savannah Harbor Expansion Environmental Impact Statement. Georgia Ports Authority. Savannah, Georgia. 244 pp.

Aquatic Plant Management Plan, US Army Corps of Engineers, Savannah District, Calendar Year 2006 Update.

Cooney, T. W., K. H. Jones, P. A. Drews, S. W. Ellisor and B. W. Church, 1998. Water Resources Data for South Carolina - Water Year 1998. US Geological Survey Report SC-98-1. Columbia, South Carolina. 546 pp.

Draft Fish and Wildlife Coordination Act Report on the Savannah River Basin Comprehensive Study, US Fish and Wildlife Service, October 2003.

Ecosystem Flow Recommendations for the Savannah River below Thurmond Dam, Final Report from April 1-3, 2003, Scientific Stakeholders Workshop, September 2003.

Ecosystem Functions Model Users Manual, US Army Corps of Engineers, Hydrologic Engineering Center, August 2002.

Environmental Assessement for Savannah River Basin Drought Contingency Plan Update, US Army Corps of Engineers, Savannah District, August 2006.

Lake Regulation and Coordination for Fish Management Purposes, South Atlantic Division, US Army Corps of Engineers, 30 March 2001.

Lamarre, Paul, Georgia EPD, e-mail of 11 Aug 2005.

McBay, L. G., 1968. Location of Sexually Mature Striped Bass. GA Game and Fish Comm. Coastal Region Fish Invest. Report. Job II-1:27-48.

Odum, W. E., T. J. Smith III, J. K. Hoover, and C. C. McIvor, 1984. The Ecology of Tidal Freshwater Marshes of the United States East Coast: a Community Profile. US Fish and Wildlife Service. FWS/OBS-83/17.

Pearlstine, L., W. Kitchens, P. Lathem, and R. Bartleston, 1990. Application of a Habitat Succession Model for the Wetlands Complex of the Savannah National Wildlife Refuge. Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville.

Reconnaissance Planning Aid Report on the Savannah River Basin Study, US Fish and Wildlife Service, July 1999.

Rees, R. A. 1974. Statewide Fish. Invest. GA. Game and Fish Div. Final Rept. Fed. Aid Proj. F-21-5 study 14 job 1. 11 pp.

Robbins, C. S., D. K. Dawson, and B. A. Dowell, 1989. Habitat Area Requirements of Breeding Forest Birds of the Middle Atlantic States. Wildlife Monograph No. 103. 34 pp.

Savannah River Basin Drought Contingency Plan, US Army Corps of Engineers, Savannah District, March 1989.

Schmitt, D. N. and J. H. Hornsby, 1985. A fisheries Survey of the Savannah River. Georgia Department of Natural Resources Final Report for Project Number F-30-12. Atlanta, Georgia. 91 pp.

Summary Report Supporting the Development of Ecosystem Flow Recommendations for the Savannah River below Thurmond Dam, June 2003. University of Georgia Team.

Teal, J. M. 1962. Energy Flow in the Salt Marsh Ecosystem of Georgia. Ecology, 43(4): 614-624.

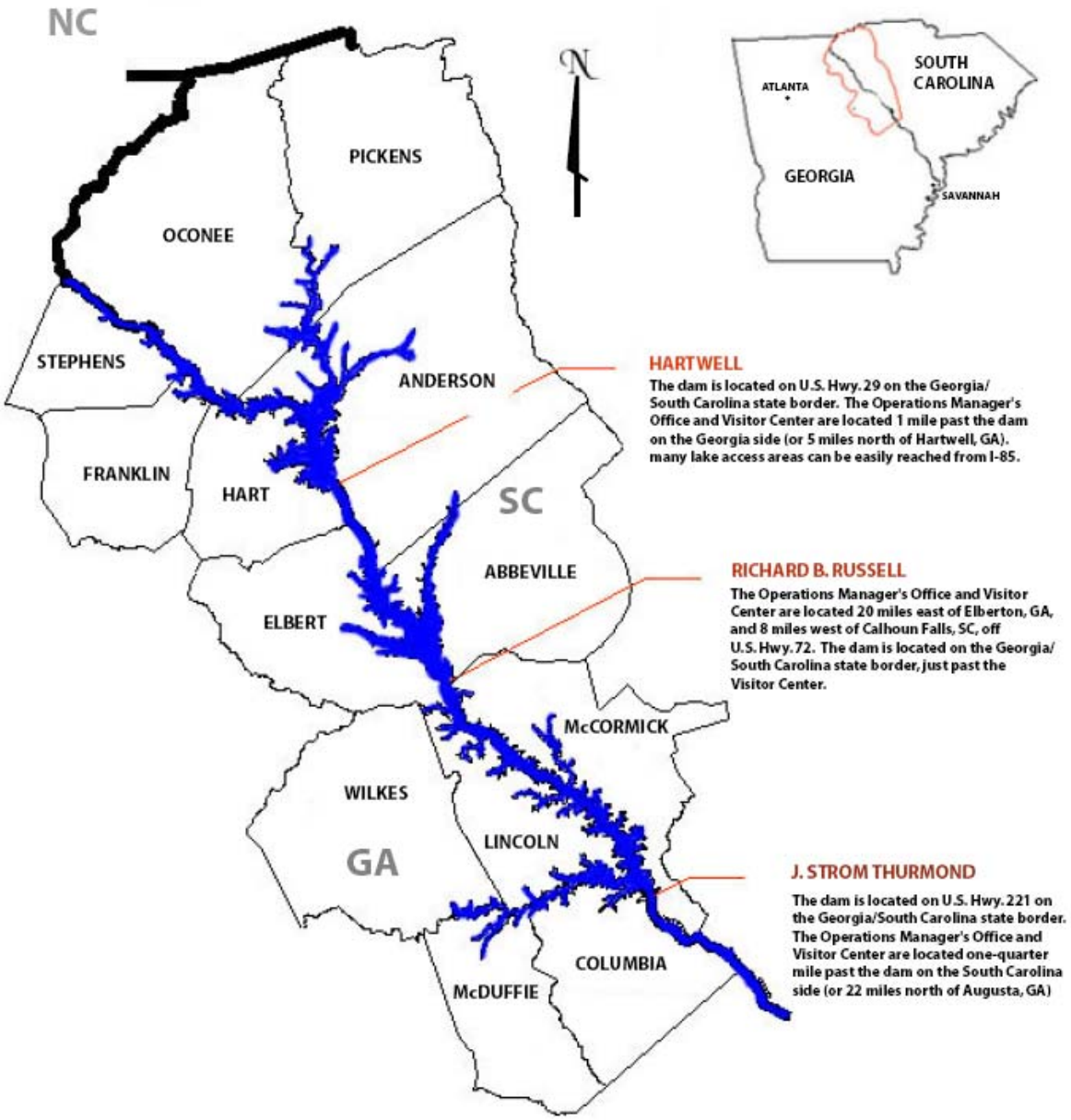
Van Den Avyle, M., M. Maynard, R. Klinger, and V. Blazer, 1990. Effects of Savannah Harbor Development on Fishery Resources Associated with the Savannah National Wildlife Refuge, Georgia Cooperative Fish and Wildlife Research Unit, University of Georgia, Athens.

Wachob, Andrew, South Carolina DNR, phone conversation of 4 Aug 2005.

Winger, P. V. and P. J. Lasier, 1990. Effects of Salinity on Striped Bass Eggs and Larvae. US Fish and Wildlife Service, National Fisheries Contaminant Research Center, University of Georgia, Athens. Report submitted to US Army Corps of Engineers, Savannah District.

APPENDIX A

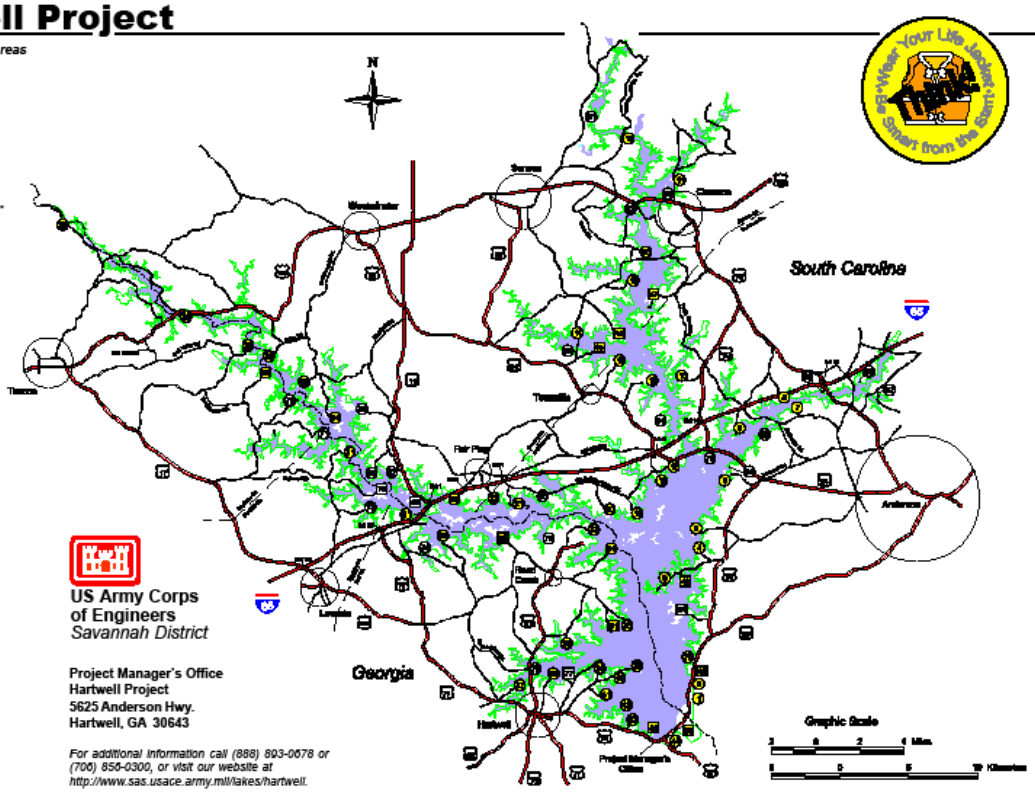
SAVANNAH RIVER BASIN MAPS


NC
N
PICKENS
OCONEE
STEPHENS
ANDERSON
FRANKLIN
HART
SC
ABBEVILLE
ELBERT
McCORMICK
WILKES
GA
LINCOLN
COLUMBIA
McDUFFIE
ATLANTA
SOUTH CAROLINA
GEORGIA
SAVANNAH
HARTWELL
The dam is located on U.S. Hwy. 29 on the Georgia/ South Carolina state border. The Operations Manager's Office and Visitor Center are located 1 mile past the dam on the Georgia side (or 5 miles north of Hartwell, GA). many lake access areas can be easily reached from I-85.
RICHARD B. RUSSELL
The Operations Manager's Office and Visitor Center are located 20 miles east of Elberton, GA, and 8 miles west of Calhoun Falls, SC, off U.S. Hwy. 72. The dam is located on the Georgia/ South Carolina state border, just past the Visitor Center.
J. STROM THURMOND
The dam is located on U.S. Hwy. 221 on the Georgia/South Carolina state border. The Operations Manager's Office and Visitor Center are located one-quarter mile past the dam on the South Carolina side (or 22 miles north of Augusta, GA)

Hartwell Project

Corps Recreation Areas

1 Hartwell Dam
2 Singing Pines
3 Jarrett*
4 Richland Creek
5 River Forks
6 Green Pond
7 Honea Path*
8 Denver
9 Asbury
10 Eighteen Mile Creek*
11 Twelve Mile
12 Lawrence Bridge
13 Martin Creek
14 Friendship
15 Townville
16 Camp Creek
17 Broyles
18 Apple Island*
19 Double Springs
20 Weldon Island
21 Glenn Ferry
22 Durham*
23 Fair Play
24 Choestoea
25 Mullins Ford
26 Tabor*
27 Walker Creek*
28 Stephens County
29 Spring Branch
30 Jenkins Ferry
31 Poplar Springs
32 Rock Springs
33 Mary Ann Branch
34 Crawfords Ferry
35 Carters Ferry*
36 New Prospect
37 Cleveland*
38 Gum Branch
39 Long Point
40 Duncan Branch*
41 Powderbag Creek*
42 Elrod Ferry
43 Hartwell Group
44 Big Oaks
47 Twin Lakes
53 Georgia River



US Army Corps
of Engineers
Savannah District

Project Manager's Office
Hartwell Project
5625 Anderson Hwy.
Hartwell, GA 30643

For additional information call (888) 893-0678 or (706) 856-0300, or visit our website at http://www.sas.usace.army.mil/lakes/hartwell.

Corps Campgrounds

45 Crescent Group Camp
46 Springfield
47 Twin Lakes
48 Oconee Point
49 Coneross
50 Paynes Creek
51 Militown
52 Watsadler
53 Georgia River

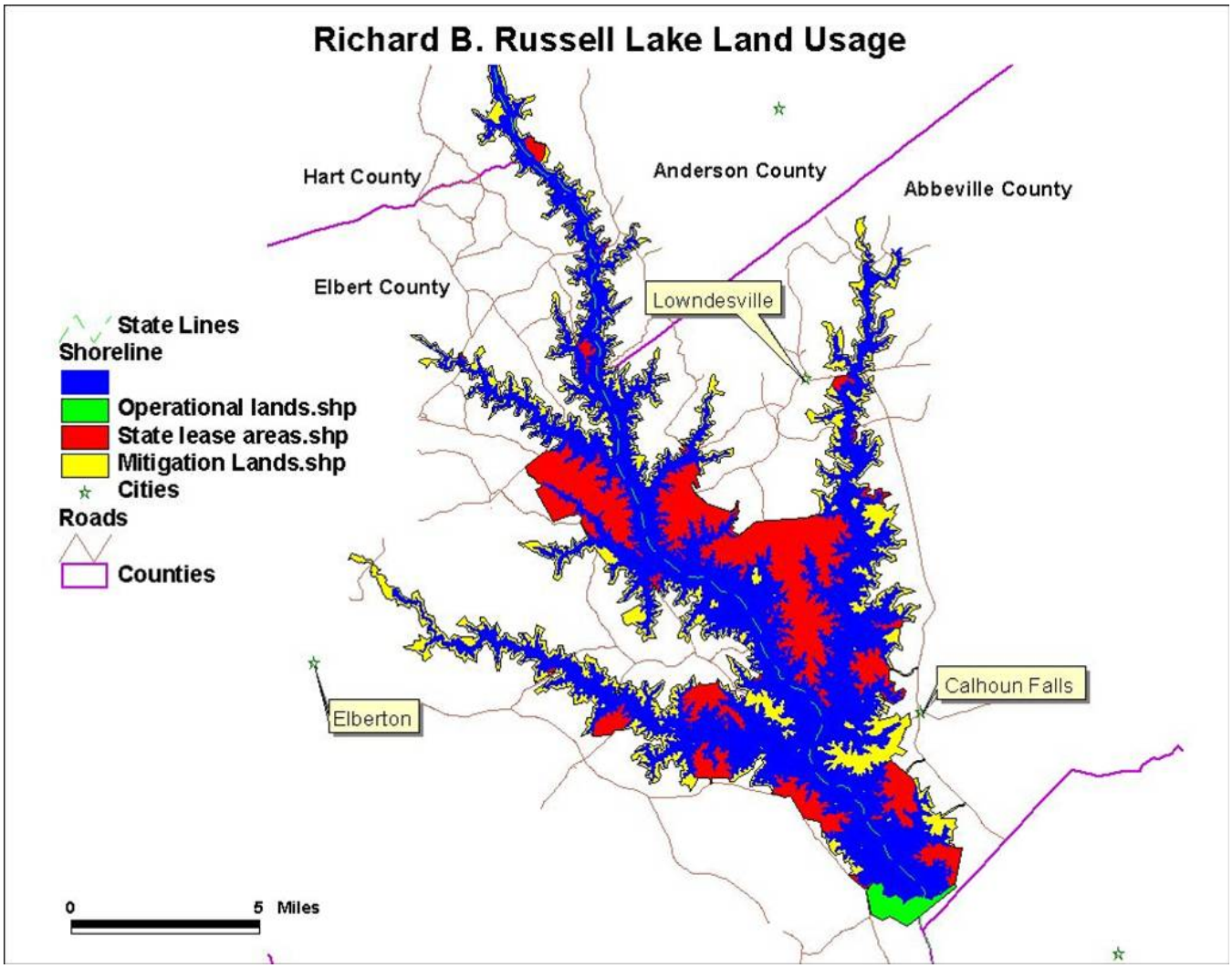
State & Municipal Recreation Areas

54 Sadlers Creek State Park
55 Jack's Landing*
56 White City*
57 Brown Road*
58 Darwin H. Wright
59 Hurricane Creek*
60 Clemson*
61 Holder's*
62 Seneca Creek*
63 Timberlake*
64 Hoyt-Tilley*
65 Cove Inlet*
66 Lake Hartwell State Park
67 Barton's Mill*
68 Port Bass*
69 South Union*
70 Bruce Creek*
71 Holcomb*
72 Tugaloo State Park
73 Franklin County*
74 Rocky Ford*
75 Reed Creek*
76 Bradberry*
77 Hart State Park

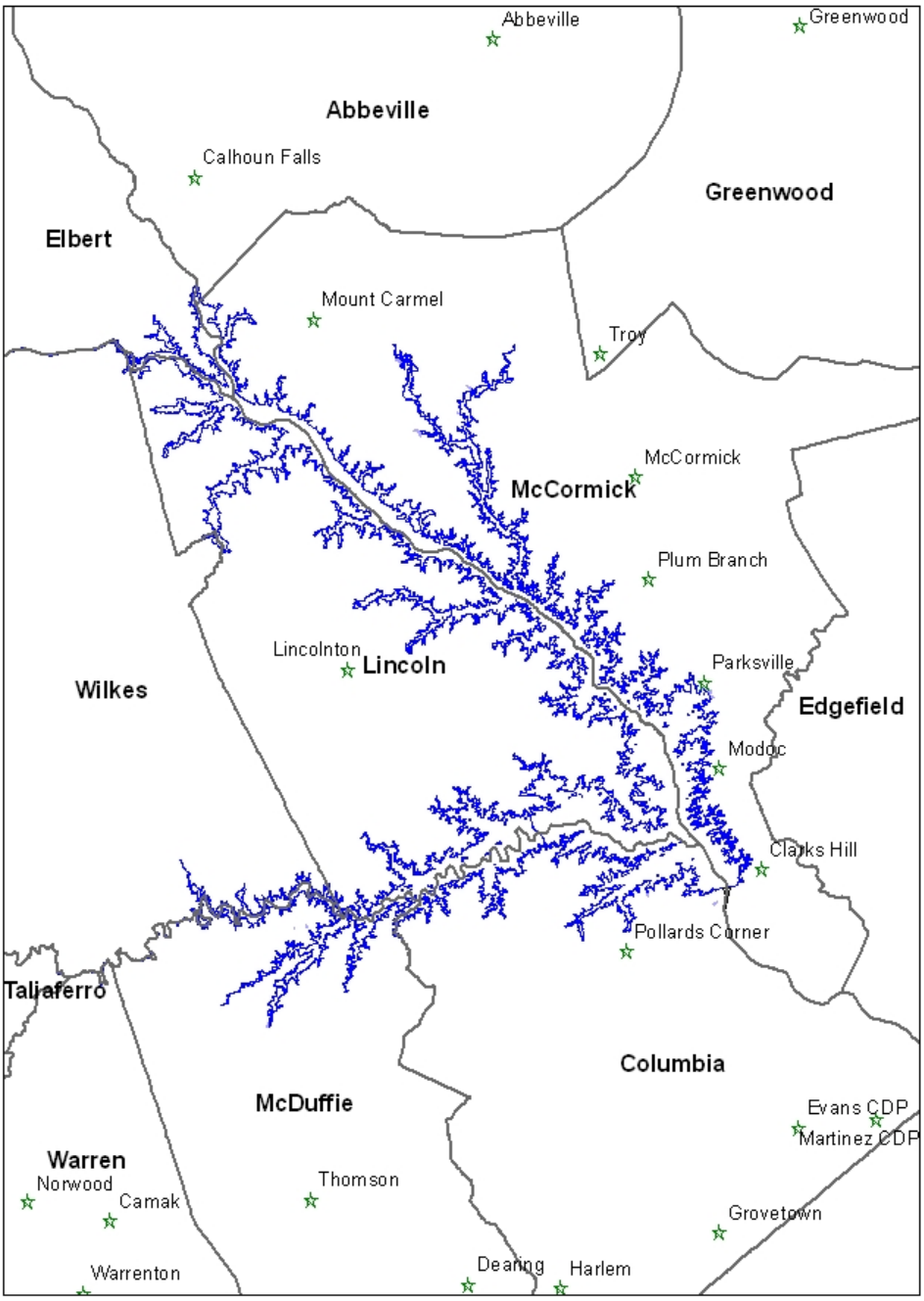
Commercial Marinas

78 Big Water
79 Portman
80 Seneca
81 Harbor Light
82 Hartwell

* Ramp access only


Richard B. Russell Lake Land Usage
Hart County
Anderson County
Abbeville County
Elbert County
Lowndesville
State Lines
Shoreline
Operational lands.shp
State lease areas.shp
Mitigation Lands.shp
Cities
Roads
Counties
Elberton
Calhoun Falls
0
5 Miles

J. STROM THURMOND RESERVOIR



APPENDIX B

AGENCY PROPOSAL

Proposed Changes to Lake Thurmond Releases to Mitigate Drought Impacts

Georgia Department of Natural Resources, Environmental Protection Division
(Georgia EPD)
South Carolina Department of Health and Environmental Control
(SCDHEC)
South Carolina Department of Natural Resources
(SCDNR)

July 2008

Executive Summary

As the ongoing drought in the southeastern U.S. approaches its third summer, the Savannah River reservoir system operated by the Army Corps of Engineers (hereafter referred to as the Savannah System) is experiencing extreme pressure and difficulties. As of July 23, 2008, the system has only 46% of its conservation storage remaining. Hartwell and Thurmond, the two large storage reservoirs, are approximately 12 feet below normal pool levels. Hartwell has less than 57% of its conservation storage left, and Thurmond has only 28% of its conservation storage remaining.

The recharge season of the year has long gone, and the status of the system is of particular concern to many parties in both Georgia and South Carolina depending on the resources provided by the storage in these reservoirs. Low inflows to the system last year and early this year raised the prospect that the system storage may be exhausted in the near future and a consequent transition to Level 4 operations (only releasing inflow) may be on the horizon.

Based on the Information Paper provided by the Army Corps of Engineers (Corps) and information compiled by other cooperating institutions, Georgia EPD, in coordination with SCDHEC and SCDNR, conducted a thorough analysis of potential operations of the system under a variety of hydrologic conditions. Georgia EPD, SCDHEC, and SCDNR propose that the current operation (i.e. a Thurmond release of 3,600 cfs) be revised to maintaining a 3,600 cfs release from Thurmond Dam in the warmer months of March through September and reducing the release to 3,100 cfs in the cooler months of October to February of next year.

The analysis conducted by Georgia EPD, in coordination with SCDHEC and SCDNR, indicated that such operations would be able to stabilize the system and substantially reduce the speed of decline in system storage. Even under a very pessimistic assumption of inflow (10% worse than the lowest historic inflow) for the next three consecutive years, the proposed operations would be able to prevent the system conservation storage from being depleted. System storage would only approach depletion toward the later part of 2011, with the assumption that worse-than-the-worst hydrology will persist through the years (a highly improbable event).

Our analyses indicate that water users along the river will not be impacted as a result of this revised operation. Also, modeling and field observations indicated that it is unlikely that water quality will be of a concern. Further modeling can be conducted if stakeholders raise additional concerns. In addition, water quality monitoring stations will need to be enhanced at strategic river locations to ensure that there is sufficient real time data available to evaluate and appropriately respond to during modified dam operations.

With respect to intake limiting factors, some of the intakes at the lower reaches may experience little margin in their access to water and thus their functionality. If the lowest incremental flow (recorded in 2007) were to take place again this year, some intakes may not function well in the short period of a few days. However, there are actions that can be taken to mitigate the impact, such as drought-proof engineering measures that will either deepen the bottom elevation at the intake or elevate the surface elevation, or adaptive management measures whereby the facility monitors the river elevation to make sure that sufficient flow takes place when incremental flow is not sufficient. Vulnerable facilities all across the basin will be part of a process that will ensure that proper emergency management measures are incorporated into local planning during this drought emergency.

Background Information

The Savannah River Basin has been experiencing a drought since early 2006. Rainfall and resulting stream flow have been particularly low, causing the reservoirs to drop faster than during previous droughts. If low inflows persist or deteriorate, the current drought could become the new drought-of-record for the basin.

The Corps manages its three impoundments on the Savannah River as a system and uses a Water Control Manual to describe how it will operate those projects. The Drought Contingency Plan is a component of that Manual and was developed (1) to address the effects of the Corps' operation on those impoundments and the downstream portion of the river, and (2) to assist the States of Georgia and South Carolina in drought contingency planning in their water management responsibilities for the Savannah River Basin.

The Corps' 1989 Drought Contingency Plan (DCP) and a 2006 Environmental Assessment (EA) describe activities that would be conducted during four stages of a continuing drought. Those four stages correspond to different lake levels. When the reservoirs reach the Level 1 trigger elevation, the Corps issues a public safety advisory concerning recreational use of the reservoirs. The Corps also reduces discharges from the reservoirs when Levels 1-3 are reached. When Level 4 is reached, the conservation pools are empty. If drought conditions persist after Level 4 is reached, discharges are further reduced to the point where the outflow from the lakes equals the net inflow.

The actions the Corps would take surrounding the Level 4 trigger were never evaluated in

detail when the plan was originally developed or during the 2006 Update. The Reservoir System Simulation modeling conducted to analyze the effects of the various operational scenarios during development of the 1989 DCP and its 2006 EA for the DCP Update always indicated that the lakes would not reach the bottom of conservation pool. This modeling was conducted using inflows that were the drought of record at that time. Sensitivity analyses revealed that the drought would need to extend three additional years to reach Level 4. Therefore, detailed consideration was never given for the best way to operate once that trigger was reached.

It should be noted that when a new drought of record takes place, the Corps' operational objective should always be to avoid ever reaching the bottom of the conservation pool. This requires a constant evaluation of the current operations and the update of the drought of record. If the current drought becomes the drought of record, then additional measures not included in the previous Manual or Drought Contingency Plan should be considered and evaluated to achieve this objective.

Status of System and Issue of Concern

As of 8:00 am July 23, 2008, the federal reservoirs on the Savannah River have 1.19 million acre-feet of conservation storage remaining. This is equivalent to 46% of the system conservation storage. Hartwell has 57% of its conservation storage remaining, while Thurmond has only 28% of its conservation storage available.

The recharge period in 2008 is over at this time, and both Hartwell and Thurmond are roughly 12 feet below their respective normal pool levels. Through the summer months, the evaportranspiration rate will increase, making it all but impossible for the reservoirs to meaningfully gain any storage during this time. This holds true regardless of the prospect of precipitation in the summer, even with the overly optimistic assumption that normal rainfall takes place.

Recent updates from climatologists and meteorologists suggest that it is likely that the current drought will extend into this summer and beyond. If this holds true, it is expected that inflow to the reservoir system will remain low or at least below normal, making it a likely scenario that the Corps will need to use storage to augment releases prescribed by the operation Manual and the Drought Contingency Plan.

If the drought persists or deteriorates, it is not inconceivable that the limited conservation storage will be exhausted, or at least be depleted to an intolerable extent. It is extremely important that all measures be evaluated to prevent the depletion of the Savannah System conservation storage. The following sections of this report document contemplated ways to achieve this.

Principles of Operations

We believe the principles of operating the Savannah System are the following: (1) To the extent possible, the Corps should try all it can to avoid depleting the conservation storage. (2) In order to achieve that, the Corps should take early measures to avoid ever reaching the bottom of the conservation pool. (3) The Corps should more explicitly identify the elevation and flow thresholds below which serious impacts take place at facilities across the basin. (4) If hydrologic conditions are such that an early intervention is unavoidable, then the Corps should identify the flow level below 3,600 cfs that bears the least impact and reduce its release from Thurmond Dam to that level. (5) The water users should identify ways (e.g. local engineering measures) of avoiding or mitigating impacts of such flow reduction and communicate such measures as well as the costs of such measures to the Corps and the States.

Proposed Hydrologic Conditions for Evaluation

On an annual basis, the total amount of inflow to the Savannah System (defined as the Savannah River reservoir system operated by the Army Corps of Engineers) was lowest in 1988, averaging only 3,286 cfs. The second lowest year was 2007, with an average inflow of 3,302 cfs. Based on a long-term average annual inflow of 7,852 cfs, the amounts of inflow in these two years are 42% of normal.

It is thus suggested that the hydrologic conditions of these two years be used to evaluate adverse conditions the system may experience in the rest of 2008 and the next two years. We believe it is a conservative assumption that the on-going drought (which is very close to the drought of record), after impacting for more than two years now, would repeat itself in the next three years. This basically means that after a year of 3,302 cfs inflow, inflow at this level would repeat again and again in each of the next three years.

We also suggest that variations of the 1988 and 2007 hydrology (e.g. 10% reduction in inflow) be used to evaluate potential operations of the Savannah System. We believe it is a very conservative assumption that another round of drought of record with a magnitude of 10% reduction in inflow will repeat itself in 2008, 2009, 2010, and 2011. This gives us the possible but very unlikely hydrologic scenario that after a year of 3,302 cfs inflow, we would have another two to three years in a row with inflow lower than 3,000 cfs (38% of normal).

Baseline Operations under Proposed Hydrologic Conditions

The Corps' current operation calls for a release of 3,600 cfs from Thurmond Dam. This operation's impact on the reservoirs can be assessed with the Corps' spreadsheet tool. Using this tool and the assumed hydrologic conditions, we were able to show how system conservation storage would change as a result of the baseline operation.

Fig. 1 shows the impact of the baseline operation on system conservation storage under recorded 2007 inflow and a variation of this inflow series. Under 2007 hydrology,

system storage will continue to decline to dangerously low levels toward the end of 2008, with only 18% of conservation storage remaining in Hartwell, Russell, and Thurmond. System conservation storage will recover somewhat in early 2009, but start declining again in April 2009 and reach 15% late 2009.

Under the hydrologic scenario with a 10% reduction in inflow, the system will fare even worse. There will be about 16% of system conservation storage left by the end of 2008, and only 3% remaining by the end of 2009. The conservation pool would be virtually empty at this point. The conservation pool will be completely exhausted by November 2010.

Fig. 2 shows the impact of the baseline operation on system conservation storage under another record dry year with a different precipitation pattern, year 1988. Under this hydrology, system conservation storage will see a less dramatic decline in the summer and fall seasons, but also with a less pronounced recovery in the following winter and spring. Overall, there will be a declining trend.

Under the reduced 1988 inflow scenario, system storage will reach 10% by the end of 2009, and be completely exhausted by October 2010.

In order to gauge the potential of devastating consequences, a probability of status analysis was performed for the Savannah River basin. It is assumed that 2007 hydrology is to repeat itself in 2008, and the resulting system storage by December 31, 2008 would be around 16% (see Fig. 1). With this as the starting condition for 2009, and hydrologic conditions from 1954 through 2007 applied to the Savannah system, there is a substantial probability (see Fig. 17) that the system will either be completely empty by the summer of 2009 (2% probability), or that the system will be further depleted toward the end of 2009 (6% probability). The probability of such catastrophe may be small, but it is substantial and its consequences severe.

It is apparent that if the current drought persists at its current intensity or if it intensifies, the baseline operation is not enough to stabilize conservation storage, let alone refilling the system. For the benefit of all stakeholders in the basin, more needs to be done to stop the loss of conservation storage in the middle of this drought.

Critical Flow Requirements

Prior work done by Georgia and South Carolina resource agencies and the federal government provided critical elevations for most withdrawing facilities along the main stem of the Savannah River downstream of Thurmond Dam. This information is provided in Table 1.

Based on rating curves provided by Georgia EPD's Savannah River water quality model, we were able to calculate flow rates that correspond to these minimum elevations. The flow rates are also provided in Table 1.

From this exercise, it is clear to us that the likely controlling flow rates are those at Savannah Electric-Plant McIntosh and Georgia Pacific. The minimum desired flow rate at the intake of Savannah Electric-Plant McIntosh is calculated to be 3,500 cfs. The minimum desired flow at the intake of Georgia Pacific is calculated to be 3,300 cfs. However, since surface elevation in the river at these two facilities is under tidal influence, which may nullify the effects of low stream flow in the river, this tidal influence may help ease the concern that potential reduction in Thurmond release would impact the facilities' intake.

Since flows desired at the locations of the other facilities are much lower than what is needed to sustain water access at these two facilities, we believe these flow rates should serve as the basis for the computation of any potential relief of flow requirement at Thurmond Dam. Another factor to consider is that there exists substantial amount of incremental flow between Thurmond Dam and the intakes of either Savannah Electric-Plant McIntosh or Georgia Pacific. A flow at the locations of these facilities is the result of Thurmond release supplemented by incremental flow between Thurmond and the concerned location.

Recorded Incremental Flow

If the Corps considers potential relief from the 3,600 cfs minimum release requirement from Thurmond, then it is critically important to determine the amount of incremental flow between Thurmond and the locations of the controlling facilities. Since the closest USGS gauge to the two controlling facilities, Savannah Electric-Plant McIntosh and Georgia Pacific, is Savannah River near Clyo, Georgia (02198500), we need to use the incremental flow between Thurmond and the Clyo gauge to estimate the amount of incremental flow. Also, since the Clyo gauge is upstream of these two facilities, the entire amount of incremental between Thurmond Dam and the Clyo gauge can be applied to both facilities.

Using release data from Thurmond (Corps) and gauged stream flow data at the Clyo gauge (USGS), we were able to derive incremental flow between these two locations. For the purpose of smoothing out the impact of routing and travel time, we applied a 7-day moving average for both variables.

As shown in Fig. 3, the magnitude of incremental flow between Thurmond and the Clyo gauge stayed above 500 cfs for most of 2007, with the exception of a few days in November 2007, when it dropped to around 300 cfs. For the previous drought of record, year 1988, the incremental flow between these two locations remained higher than 800 cfs (See Fig. 4). As the U.S. Drought Monitor (Figs. 5 and 6) indicate that the lower Savannah River Basin is in better shape compared to the worst time in last year, when the incremental flow was the lowest in November 2007, and the fact that the coastal area may benefit

from ocean-originated precipitation in the summer and fall, it is reasonable to assume that the incremental flow between Thurmond and Clyo this year will not be at a level worse than in 2007. In other words, it is not unreasonable for us to expect at least 300 cfs to 500 cfs of incremental flow between Thurmond and the Clyo gauge.

Proposed Relief from Thurmond Minimum Flow Requirement

We use the most severe hydrologic conditions suggested earlier in this document to evaluate the contemplated alternative operations of the Savannah System. These conditions are recorded 2007 inflow with a 10% reduction and recorded 1988 inflow with a 10% reduction. A repetition of such conditions, after two years of record-breaking drought, for the next three or four years, in our opinion, provides enough of a challenge to the entire system. Table 2 provides a summary of all the simulations.

Based on the estimated minimum incremental flow of 300 cfs to 500 cfs, we can use a Thurmond release of 3,300 cfs and 3,100 cfs to test the impact to the reservoir system and the downstream river. It is reasonable to assume that at these levels of Thurmond release, the needs of the other stakeholders are met (Table 1).

We first tested a flat release from Thurmond Dam of 3,300 cfs and 3,100 cfs with both hydrologic conditions. Table 2 provides a summary of the hydrologic conditions and alternative operations in the tested scenarios. The resulting reservoir conservation storage change is shown in Figs. 7 and 8.

Under the recorded 2007 hydrology (with a 10% reduction in inflow), a release of 3,300 cfs from Thurmond Dam will not be enough to stabilize the reservoir system. There will be a sharp decline of system conservation storage, resulting in a low system storage at 20% toward the end of 2008. Storage will recover somewhat during the winter and spring period of 2009, but will start to decline again and reach a new low (16%) toward the end of 2009. If hydrologic conditions do not improve dramatically, this downward trend will continue, and the low system storage will keep declining year after year (Fig. 7).

If release at Thurmond Dam is reduced to 3,100 cfs, however, the trend of decline will be stopped. The system storage will still go up and down seasonally, but the declining trend under the 3,300 cfs release will cease to exist.

Under the recorded 1988 hydrology (with a 10% reduction in inflow), the seasonal decline in the summer and fall will be less dramatic than under the 2007 inflow, however, there will be less of a recovery in the following rainy season (Fig. 8). Under a 3,300 cfs Thurmond release, system storage will reach 34% by the end of 2008 and around 24% toward the end of 2009. This moderate reduction in Thurmond release is far from enough to stop the sharp declining trend in system storage.

If release at Thurmond Dam is at 3,100 cfs level, the overall declining trend will still exist. However, the rate of decline of system conservation storage will be much more

moderate compared to the rate of decline under a release of 3,600 cfs (baseline) or 3,300 cfs (Fig. 8).

We understand that a full-scale deviation from the minimum release of 3,600 cfs may require the Corps to go through the NEPA process and to conduct an Environmental Impact Study, which may take years to complete and cause the loss of opportunity to slow the decline of system storage. We also understand that a seasonal deviation (e.g. a reduced release from Thurmond Dam in the cooler seasons) may be easier to achieve, since an Environmental Assessment may suffice in this case.

Thus, we tested an operation scenario where release from Thurmond will be kept at 3,600 cfs for the months of March through September and reduced to 3,100 cfs for the cooler seasons (October through February). The resulting conservation storage percentage (under both 2007 and 1988 inflow with a 10% reduction) is shown in Fig. 9. It can be seen that system conservation storage will remain available at least throughout the next three years. With such adverse hydrologic conditions, system storage will continue to decline, but at a comparatively slow rate.

Under this operation scheme, even if record-breaking drought conditions continue during the next three years, there will be enough conservation storage to support the revised Thurmond release, and the Corps will have enough time to make further revision of its operations in response to persistent or deteriorating conditions.

We make the recommendation that the Corps adopt this operation scheme.

Impacts to Lake and River Water Users

The suggested operation will not be any different from the current baseline operation in the months between March and September, and should not have any impact on water supply intakes throughout the basin during this time period.

In the cooler seasons when Thurmond release is reduced to 3,100 cfs, the most likely impact, based on information in Table 1 and earlier analysis, will be felt by facilities downstream of Thurmond Dam. These facilities include Savannah Electric-Plant McIntosh and Georgia Pacific. Because the proposed operation will not deplete system conservation storage, water users whose intakes are located in the pools of Hartwell, Russell, and Thurmond will not be affected.

Flow at the locations of Georgia Pacific can be determined by Thurmond release with the addition of incremental flow between Thurmond and the Georgia Pacific intake, which is estimated to be around 500 cfs at the driest times, except for a few days, when it may be as low as 300 cfs. This will result in the lower flow at the Georgia Pacific intake to be at 3,600 cfs generally, and at 3,400 cfs at the lowest level. Given that the facility intake will function at flows higher than 3,300 cfs, it is expected that the proposed revision in operation will not have any impact to this facility.

Flow at the intake of Savannah Electric-Plant McIntosh can also be determined similarly. The proposed operation may result in an at-site flow of 3,400 cfs to 3,600 cfs at the intake of Plant McIntosh. Table 1 shows that the intake at Plant McIntosh functions at the minimum flow of 3,500 cfs. So, if the lowest incremental flow (recorded in 2007) were to take place again this year, the intake at this facility may not function well in the short period of a few days when the at-site flow is as low as 3,400 cfs. However, since water surface elevation at this facility's intake is under tidal influence, any impact resulting from reduced Thurmond release may be nullified.

Also, there are measures that can be taken to mitigate the impact. First, drought-proof engineering measures can be taken to either deepen the bottom elevation at the intake or to elevate the water surface elevation. The Corps may be able to help such measures through federal emergency programs. In fact, we encourage all water users in the basin to consider local measures that can make water supply more secure.

Second, adaptive management can be put in place to monitor the elevation at this facility to make sure that sufficient flow takes place when incremental flow is not enough.

There may also be concern from water users along the Augusta Canal. Diversions into the Augusta Canal is managed by the City of Augusta to maintain a minimum of 1500 cfs (1500 cfs May through January and 1800 cfs otherwise) through the shoals. Three electronically controllable gates, operated by the City of Augusta, allow for instantaneous changes of flow to the canal should a management target be approached.

Based on current permit information on the City of Augusta intake, the City is allowed to withdraw no more than 45 MGD (about 70 cfs). The City has four turbines to operate for water supply operations. These turbines are driven by water in the Canal. Then in turn they drive pumps to pump water for water supply purpose. It usually uses two of its four turbines units (Units 1 and 4) with the need of a flow of 1364 cfs. This amount is passed through the turbines and returned entirely to the main stem Savannah River (about two thirds of the length of the shoals).

There are three mills downstream of the City's intake. They are Sibley, King, and Enterprise. All these mills have turbines that are driven by water in the Canal. All return the water used back to the main stem Savannah River downstream of the shoals. Sibley Mill needs a flow of 1024 cfs; King needs approximately 880 cfs; and Enterprise needs a flow of approximately 560 cfs.

At the current level of Thurmond release (3600 cfs), if there is no incremental flow between the dam and the Canal inlet, then 1500 cfs would have to be left to pass the shoals. That leaves only 2100 cfs to go through the Canal. After the City turbines and intake, there would be less than 800 cfs left in the Canal.

Under the proposed release strategy, Thurmond release would be reduced to 3100 cfs from October through February. If the City operates the gates to pass 1500 cfs to the shoals, the amount of water going through the Canal would be 1600 cfs, assuming little

incremental flow. This will be enough to sustain the City's water supply operations. However, after that, there would be less than 300 cfs left to go through the rest of the Canal, and the operations of the mills will be impacted.

We understand that the mills are connected to the power grid and alternative power is available in case their generating capacity is limited.

Impact to Water Quality

To assess the potential impact on water quality of the proposed operation, Georgia EPD, in coordination with SCDHEC and SCDNR, has performed water quality (dissolved oxygen - DO) modeling of both the Savannah River downstream of Thurmond Dam and the Savannah Harbor. The modeling results indicate that the seasonal reduction of Thurmond release would not cause water quality problems in the river or the harbor.

1. Savannah River downstream of Thurmond Dam

The first model simulation has been conducted with 2007 meteorological data, 2007 tributary inflows, 2007 Thurmond release data, and waste load discharges and water withdrawals as recorded in 2006. This run was performed to see how well the model is calibrated to observed DO data. Figs. 10 and 11 show the observed DO data (red squares) measured in 2007, which never went below 6.5 mg/L and 6.29 mg/L at River Mile (RM) 119 and RM 61, respectively, versus the approximate calibration run. It is an approximate calibration run since the model did not include 2007 discharge and withdrawal data, but rather that of 2006. Despite the approximation of this model run, the results indicate that the model has been calibrated relatively well.

Second and third model simulations were conducted with 2007 meteorological data, 2007 tributary inflows, and waste load discharges and water withdrawals as recorded in 2006. However, these model scenarios incorporated Thurmond releases of 3,600 and 3,100 cfs.

Figs. 12 and 13 show the results of the 3,600 cfs simulation. Under a Thurmond release of 3,600 cfs, the simulated DO concentrations at RM 119 were predicted to be above 5 mg/L throughout the year (Fig. 12). Fig. 13 shows simulated DO concentration at River Mile 61 under a Thurmond release of 3,600 cfs. Again, the simulated DO concentrations were predicted to be higher than 5 mg/L throughout the year. The water quality model shows that the 5.0 mg/L DO standard would not be breached by a Thurmond release of 3,600 cfs.

Figs. 14 and 15 show the simulated DO concentrations at River Mile 119 and River Mile 61 respectively, under a Thurmond release of 3,100 cfs. Even though we do not propose a reduction of Thurmond release in the summer time, our model indicated that there would not be a DO problem throughout the year. For the cooler months from October to February, DO concentration would always be higher than 6.0 mg/L and almost always higher than 7.0 mg/L at both River Mile 119 and River Mile 61.

We need to point out that the water quality model used in this analysis does not contain any modules simulating algal activity in the river. This lack of simulated algal activity means that our model tends to give overly pessimistic DO concentrations. It is highly likely that field data will provide higher DO concentrations than the model predicted.

The proposed action includes a continuation of 3,600 cfs release from Thurmond Dam in the months of March through September and a 3,100 cfs reduced release from Thurmond Dam in the cooler seasons (October through February). This action will not result in any adverse change in DO concentration in the warmer months. We suggest that monitoring stations be set up at locations along the river to monitor the change of DO concentration along the lower reaches, if the proposed operation is adopted. We also suggest that adaptive management be used as part of the Corps' operation. If field observation indicate any problem with DO concentration, then prompt actions can be taken to mitigate the adverse conditions.

2. Savannah Harbor

Two water quality related effects of lower Savannah River streamflows resulting from reduced Thurmond Reservoir releases were assessed. These were elevated chloride concentrations at the City of Savannah municipal water intake on Abercorn Creek, and dissolved oxygen concentrations in the Harbor.

The City of Savannah's municipal water intake is located on Abercorn Creek approximately two miles from the Savannah River. The City of Savannah is concerned about distributing water to its customers, particularly industries, when chloride concentrations in Abercorn Creek are greater than 12 milligrams per liter (mg/L). Such concentrations have been shown to cause scaling in boilers.

Sources of chloride in Abercorn Creek are upstream inflows from the Savannah River, and salinity intrusion from the downstream Savannah Harbor estuary. Studies have shown a good relationship between River flows at the U.S. Geological Survey's Clyo, Georgia stream gage location and chloride concentrations. Results have shown that the Savannah River contains approximately 10 mg/L of chloride during low flows, and 4 mg/L during high flows as a result of greater dilution. Therefore, it is during low flow periods where River chloride concentrations are as high as10 mg/L when salinity intrusion from downstream can cause an additional 2-4 mg/L in the vicinity of the intake and exceed the 12 mg/L threshold. Analysis of the historical chloride data collected at the City's intake shows that during drought years the number of samples with chlorides exceeding 12 mg/L ranges from 21 to 58 percent, and concentrations have approached 19 mg/L.

Lowering releases from Thurmond Reservoir, by itself, does not create higher chloride concentrations at the City of Savannah's water withdrawal. Rather, it is the combination of low releases from Thurmond Reservoir and low streamflows from the downstream watershed that create a condition for elevated chloride concentrations at the City's

withdrawal. Therefore, the proposed reservoir operation schedule will not improve conditions for chloride concentrations at the City's intake, and with sufficient downstream inflows these conditions should remain unchanged. However, given the existing sensitivity of the City's intake to chloride concentrations greater than 12 mg/L as shown by the historical exceedances of this threshold, proposed reservoir operation combined with low downstream inflows might increase the number and magnitude of chloride concentrations greater than 12 mg/L at the City of Savannah municipal water withdrawal. Therefore, it is recommended that Savannah River flows at Clyo and chloride concentrations at the City's water intake be monitored closely to assess the effects of reservoir operation.

The effect of the proposed Thurmond reservoir operation on dissolved oxygen concentrations in Savannah Harbor was evaluated using the Savannah Harbor Model. Savannah River Model streamflow and water quality results provided input for the upstream boundary of the Savannah Harbor Model. Model results and the effects on dissolved oxygen concentrations were evaluated at the U.S. Army Corps of Engineers' dock located in the Harbor. The results were compared to the existing coastal fishing classification whose dissolved oxygen criteria is no less than 3.0 mg/L during June through October, no less than 3.5 mg/L in May and November, and no less than 4.0 mg/L during December through April. The results are shown in Figure 16. With respect to Dissolved Oxygen Standards applicable to the Harbor, at the present time, the Savannah Harbor is under a Total Minimum Daily Load for Georgia which indicates 0 assimilative capacity available for the NPDES permitted wastewater treatment system dischargers. The TMDL is based on a 1989 Georgia seasonal Dissolved Oxygen standard which was never approved by the EPA. The GAEPD is in the process of revising the Harbor DO standard which will provide some assimilative capacity for the dischargers, and be similar and consistent with the South Carolina DO standard. Harbor dissolved oxygen monitoring will continue and impact to harbor dissolved oxygen attributable to seasonal dam releases will be evaluated and those operations modified as appropriate.

Other Potential Impacts

Since a seasonal deviation from the 3,600 cfs Thurmond release does not constitute a significant change in operations of the system, we do not foresee any impacts on other aspects and other water users of the Savannah River Basin.

We are willing to work with other resource agencies to address such concerns, if additional stakeholder groups raise concerns. We believe technical tools, such as WASP model and other models exist and are available for use to address salinity, temperature, and other issues.

Table 1. Major facilities along the main stem Savannah River and their tolerance of low elevations and flow rates

FACILITY NAME	INVERT ELEVATION (FT-MSL)	MINIMUM ELEVATION (FT-MSL)	NOTES	CORRESPONDING FLOW TO MIN ELEV. (CFS)
Columbia County			Their withdrawal is upstream from the Stevens Creek Dam.	
Augusta Canal			The necessary flow to support the municipal water withdrawal is 600-800 cfs. There is a deisel back-up pump but it is not capable of providing the full supply requirement. At some flow rate the downstream electric generation will be halted.	~1600 cfs in the Canal + 1000 cfs in shoal
Edgefield County	149.50	149.50	1989 Drought Plan. This value was confirmed by SCDHEC.	
City of Augusta		119.5		
City of North Augusta	106.00	109.00	Minimum elevation value came from the New Savannah Bluff Lock and Dam Project Disposition Report.	1000 cfs at elevation 109 ft
South Carolina Electric and Gas	106.00	105.50	Minimum elevation value came from the New Savannah Bluff Lock and Dam Project Disposition Report.	900 cfs at elevation 106 ft
PCS Nitrogen	97.75	103.90	PCS Nitrogen and DSM Chemical share the same intake structure. A minimum elevation value of 110 came from the New Savannah Bluff Lock and Dam Project Disposition Report. Actual numbers came from a contact with PCS Nitrogen.	1300 cfs at elevation 110 ft
DSM Chemicals	97.75	103.90	PCS Nitrogen and DSM Chemical share the same intake structure. A minimum elevation value of 110 came from the New Savannah Bluff Lock and Dam Project Disposition Report. Actual numbers came from a contact with PCS Nitrogen.	1300 cfs at elevation 110 ft
General Chemical	110.20	111.00	Minimum elevation value came from the New Savannah Bluff Lock and Dam Project Disposition Report.	1800 cfs at elevation 111 ft at DSM Chemical
Kimberly Clark		109.00	Minimum elevation value came from the New Savannah Bluff Lock and Dam Project Disposition Report.	1060 cfs at elevation 109 ft
International Paper	94.00	94.00		2800 cfs at elevation 94 ft
Savannah River Site	81.00	81.00	Latest information indicates that 79 ft is sufficient	3400 cfs at elevation 81 ft, 2300 cfs at elevation 79 ft
Plant Vogtle	70.00	70.00		always met
Savannah Electric-Plant McIntosh	7.50	7.50		3500 cfs at elevation 7.5 ft
Georgia Pacific	-1.00	5.16	Georgia Pacific stated that their minimum operational level is equivalent to a gage height of 2.0 feet at Clyo. Since the gage datum at Clyo is 13.39 feet-msl this results in a minimum elevation at Clyo of 15.39 feet-msl which is equivalent to a Savannah River flow of 3300 cfs. This corresponds to a water surface elevation of 5.16 ft-msl at the Georgia Pacific withdrawal.	3300 cfs per note
City of Savannah		-10.22		
Beaufort-Jasper		-3.0		

Table 2 Simulated hydrologic and operational scenarios

Scenario	A: Recorded 2007 Inflow	B: 2007 Inflow * 90%	C: Recorded 1988 Inflow	D: 1988 Inflow * 90%	B3300: Thurmond release of 3300 cfs	B3100: Thurmond release of 3100 cfs	D3300: Thurmond release of 3300 cfs	D3100: Thurmond release of 3100 cfs	B: 2007 Inflow 3100 Seasonal	D: 1988 Inflow 3100 Seasonal
Hydrology (Inflow to reservoir system)	Recorded 2007 inflow	Recorded 2007 inflow with a 10% reduction	Recorded 1988 inflow	Recorded 1988 inflow with a 10% reduction	Recorded 2007 inflow with a 10% reduction	Recorded 2007 inflow with a 10% reduction	Recorded 1988 inflow with a 10% reduction	Recorded 1988 inflow with a 10% reduction	Recorded 2007 inflow with a 10% reduction	Recorded 1988 inflow with a 10% reduction
Operation	Thurmond release of 3600 cfs	Thurmond release of 3600 cfs	Thurmond release of 3600 cfs	Thurmond release of 3600 cfs	Thurmond release of 3300 cfs	Thurmond release of 3100 cfs	Thurmond release of 3300 cfs	Thurmond release of 3100 cfs	Thurmond release of 3600 cfs in warmer months, and 3100 cfs in cooler months	Thurmond release of 3600 cfs in warmer months, and 3100 cfs in cooler months

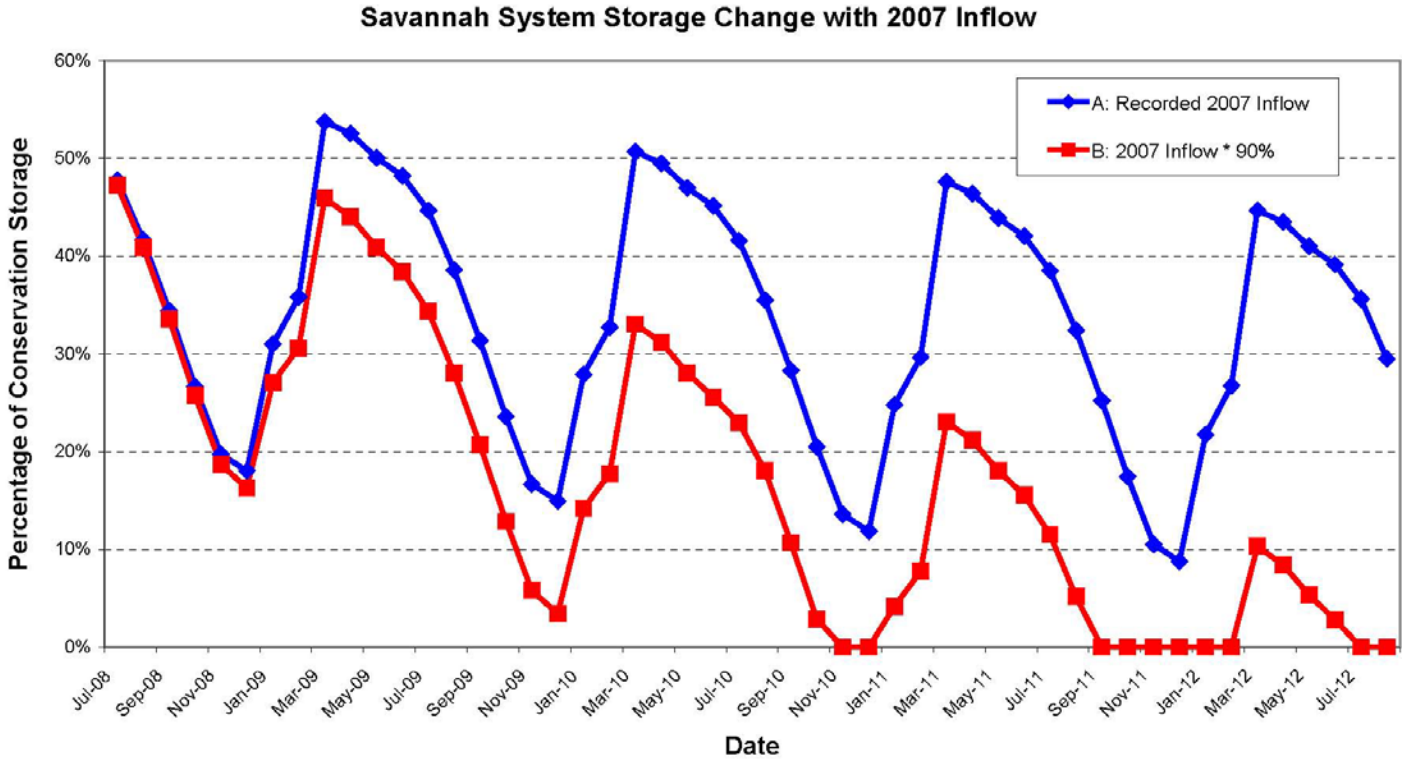


Fig. 1 Change of system conservation storage under 2007 hydrology and variation

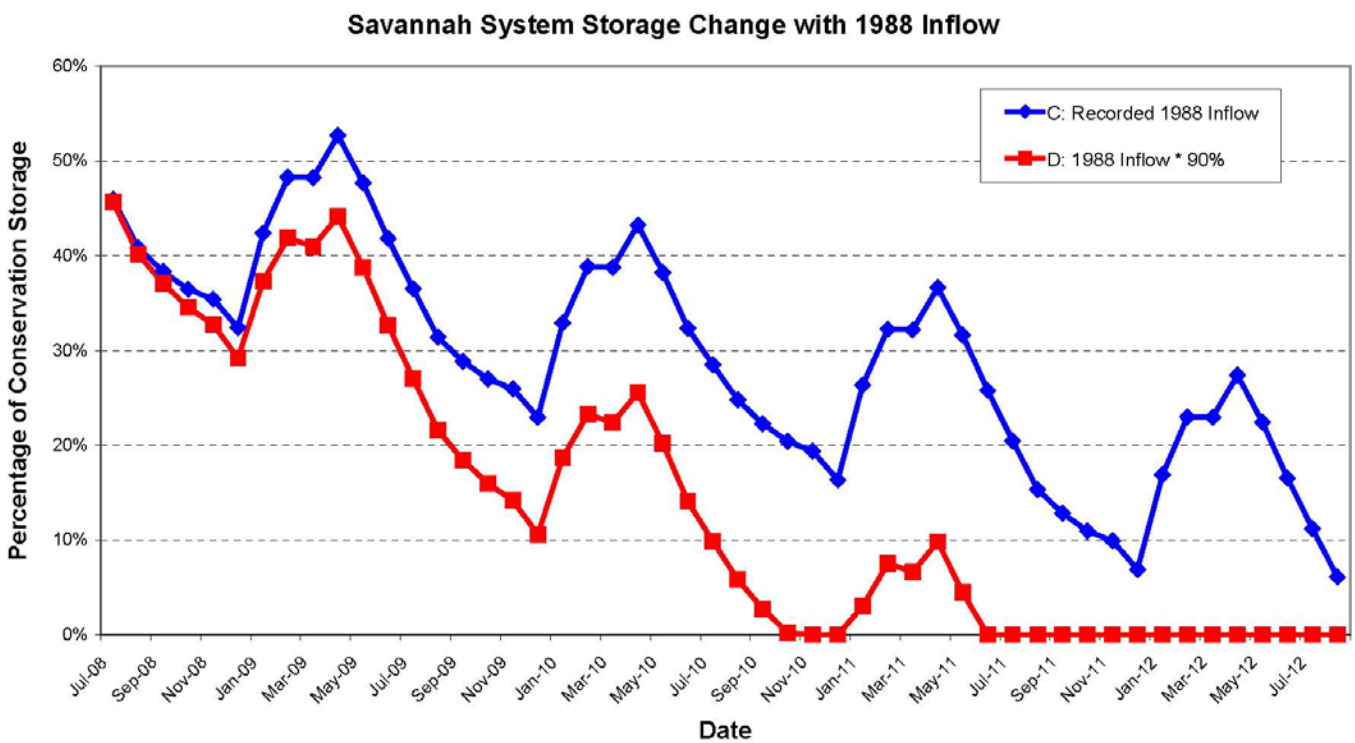
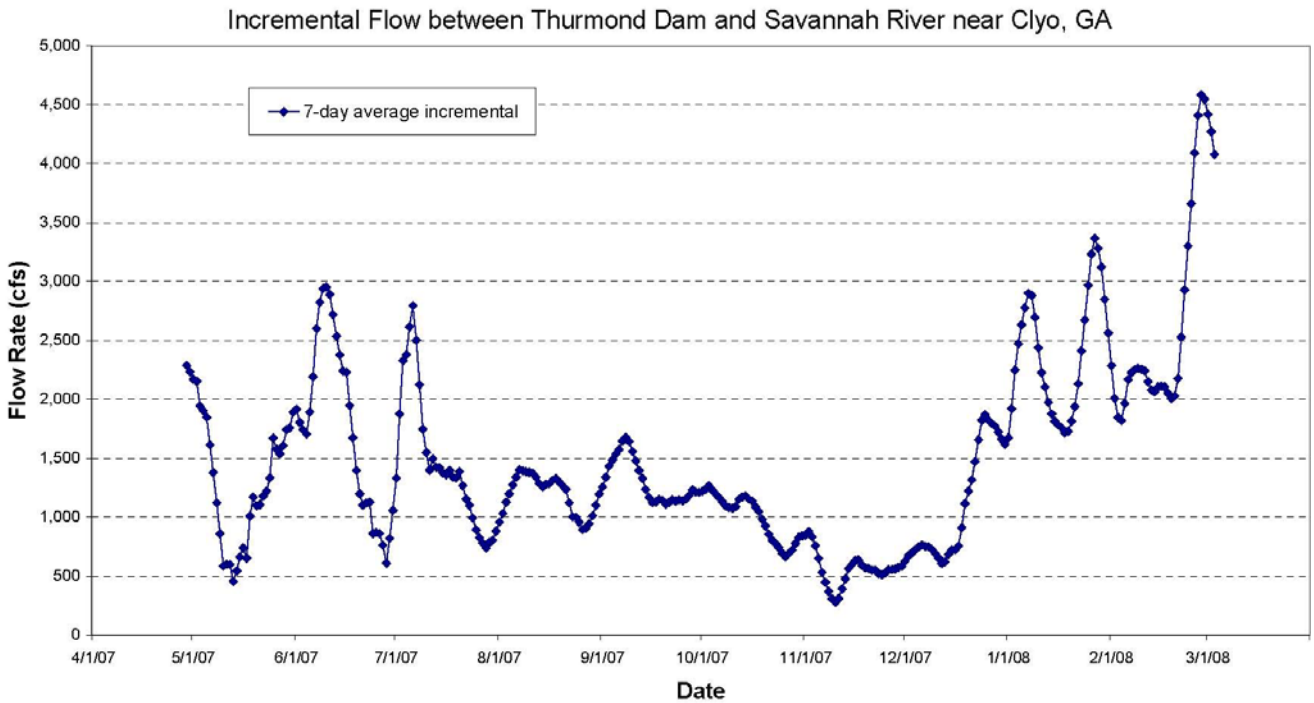


Fig. 2 Change of system conservation storage under 1988 hydrology and variation

Fig. 3 Incremental flow between Thurmond Dam and USGS Clyo gage in 2007-2008 period



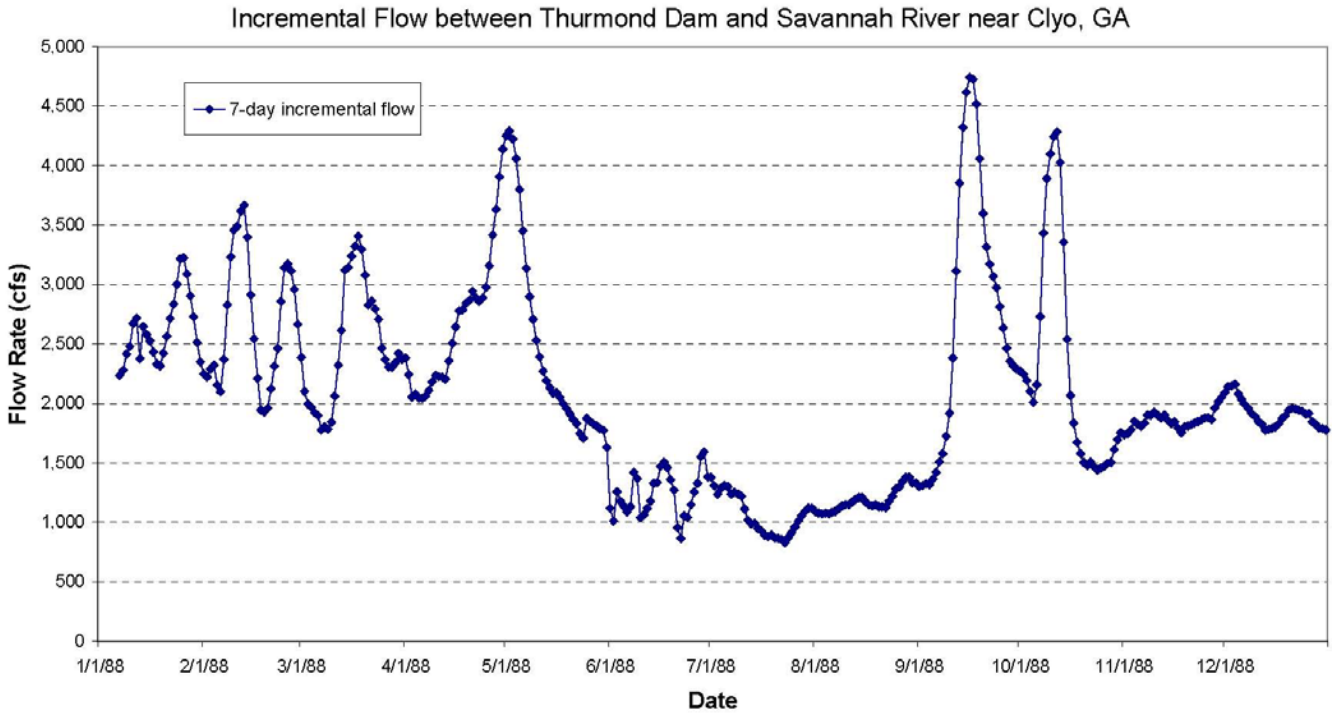


Fig. 4 Incremental flow between Thurmond Dam and the USGS Clyo gage in 1988

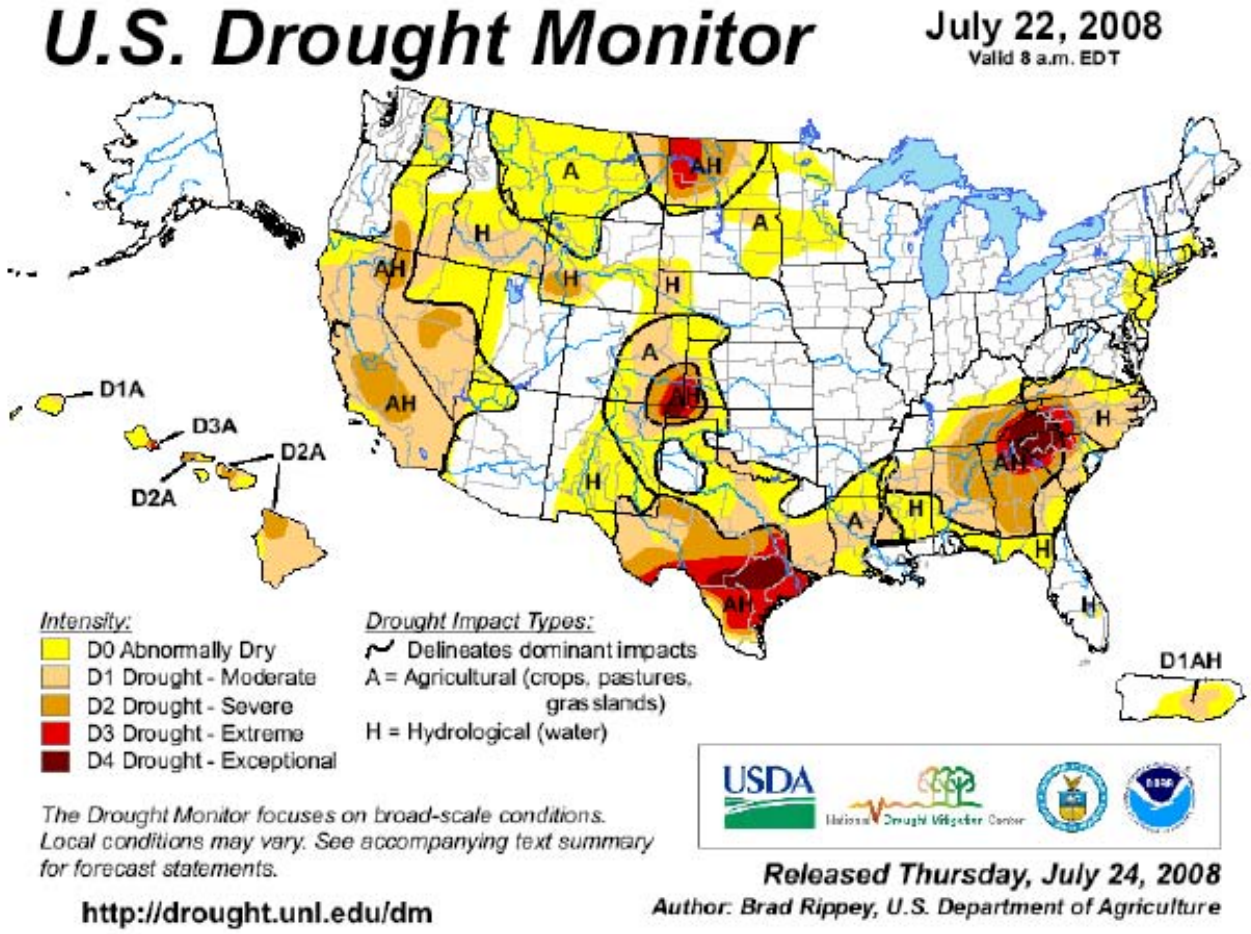


Fig. 5 U.S. Drought Monitor July 2008

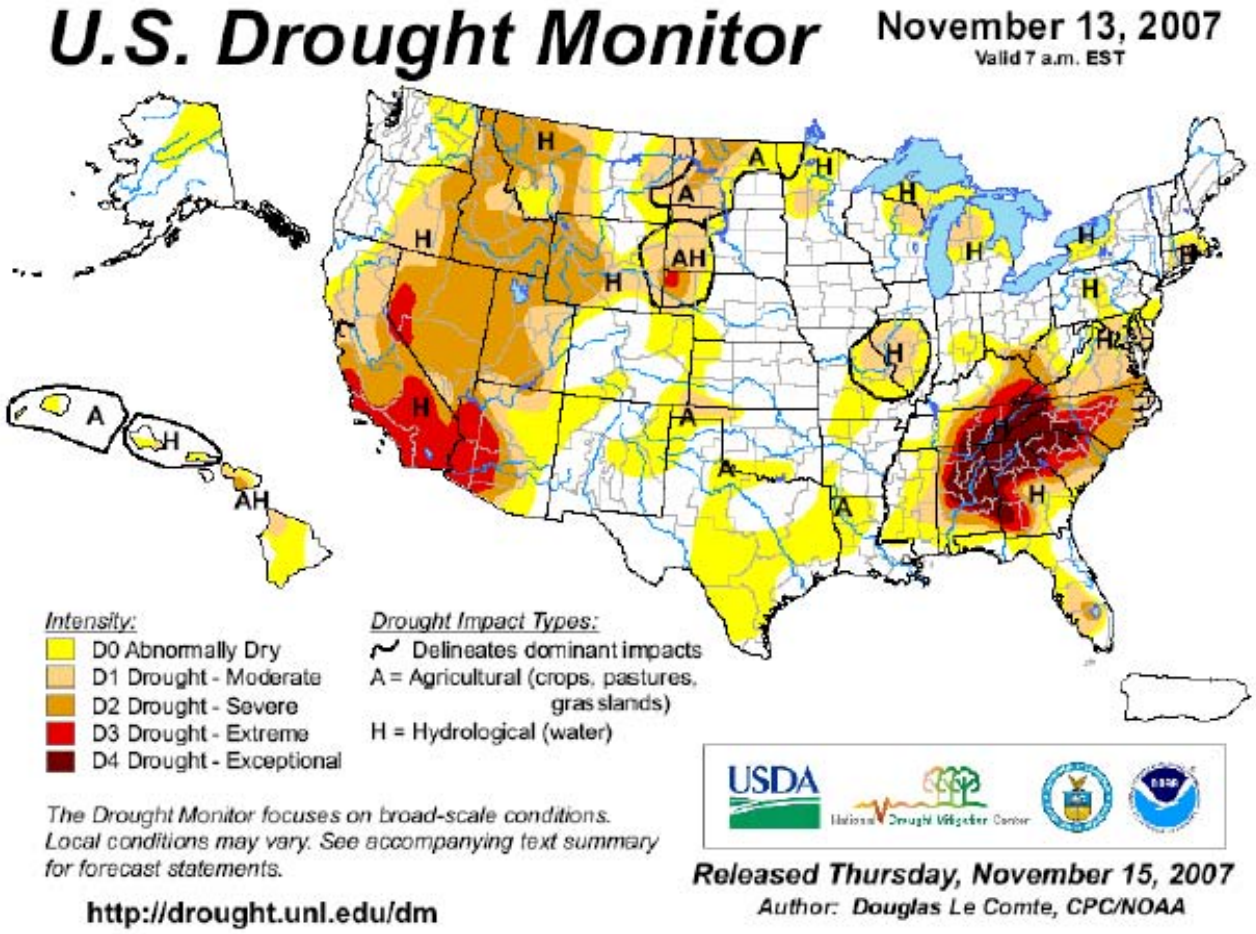
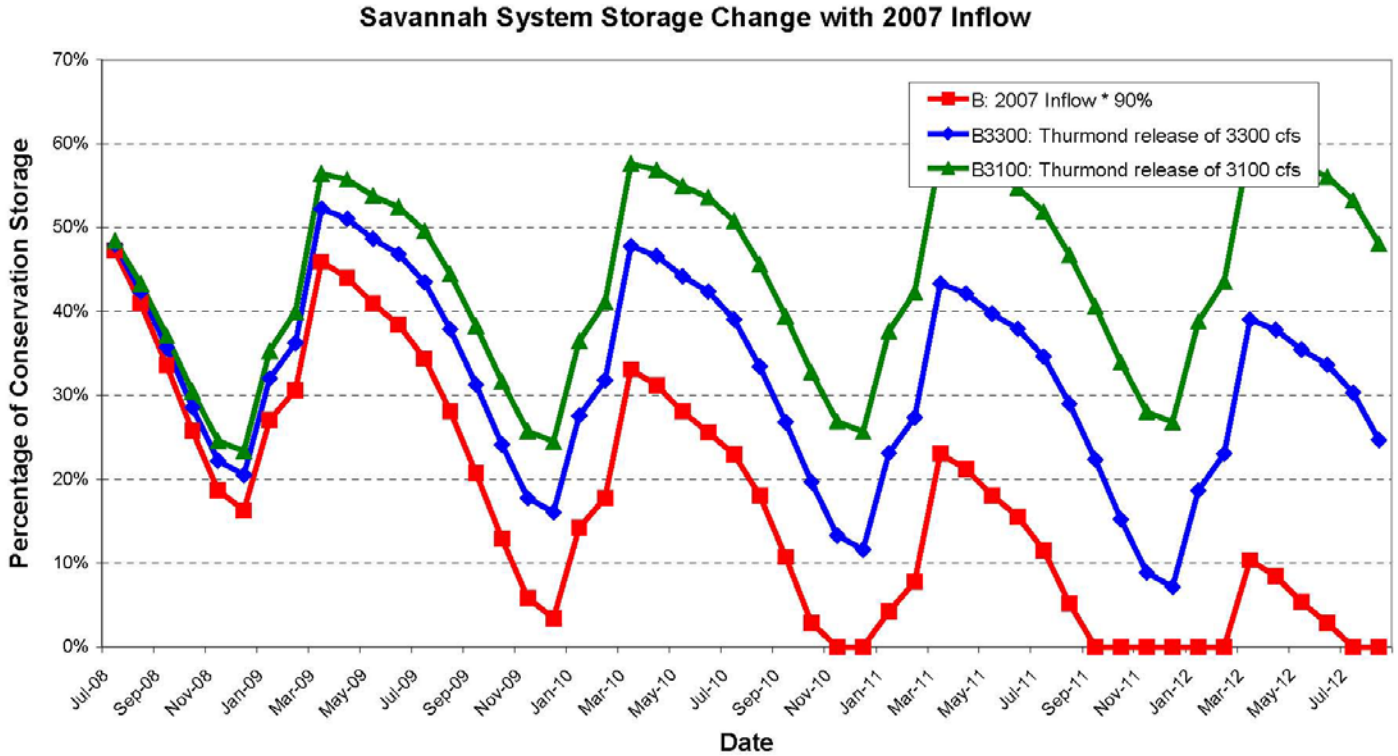


Fig. 6 U.S. Drought Monitor November 2007

Figure 7 Change of system conservation storage with 2007 hydrology and relief release at Thurmond



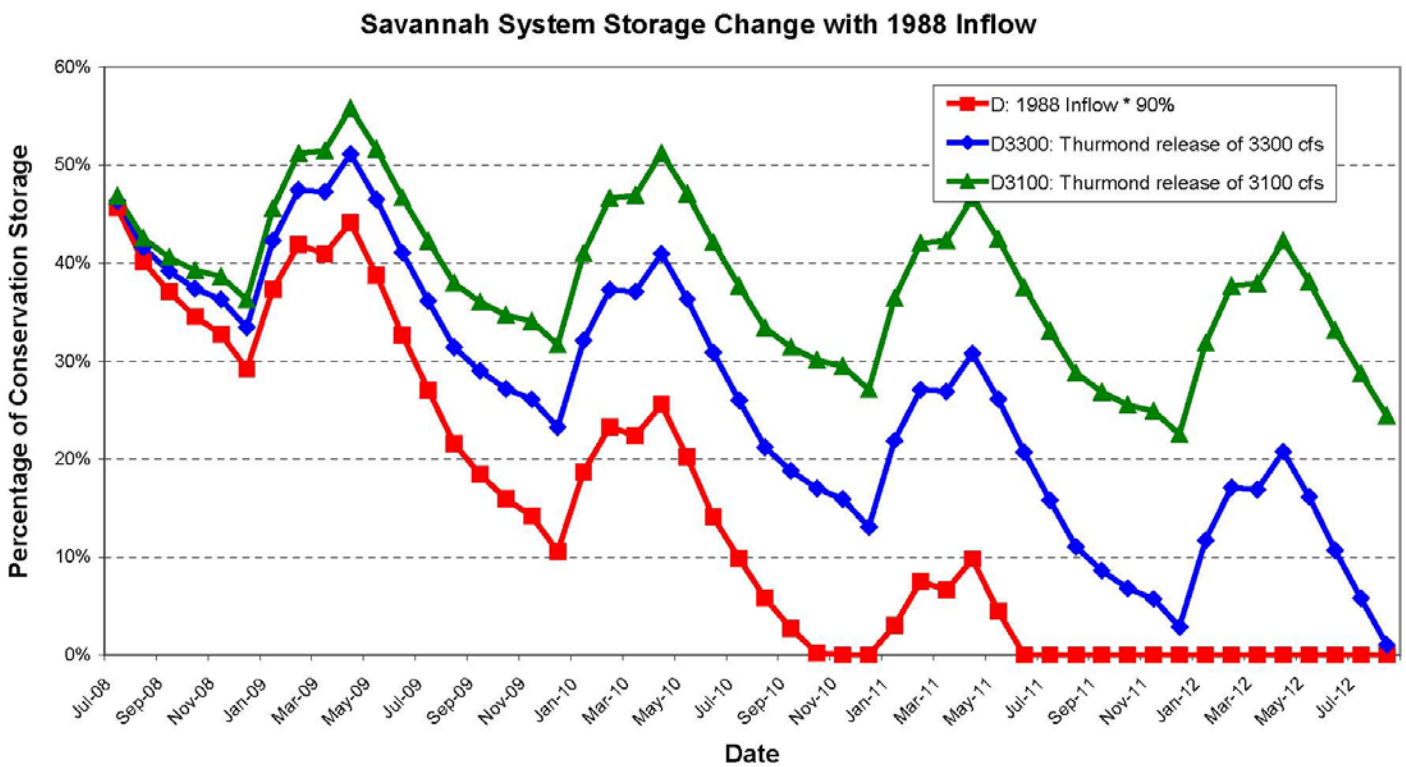


Fig. 8 Change of system conservation storage with 1988 hydrology and relief release at Thurmond

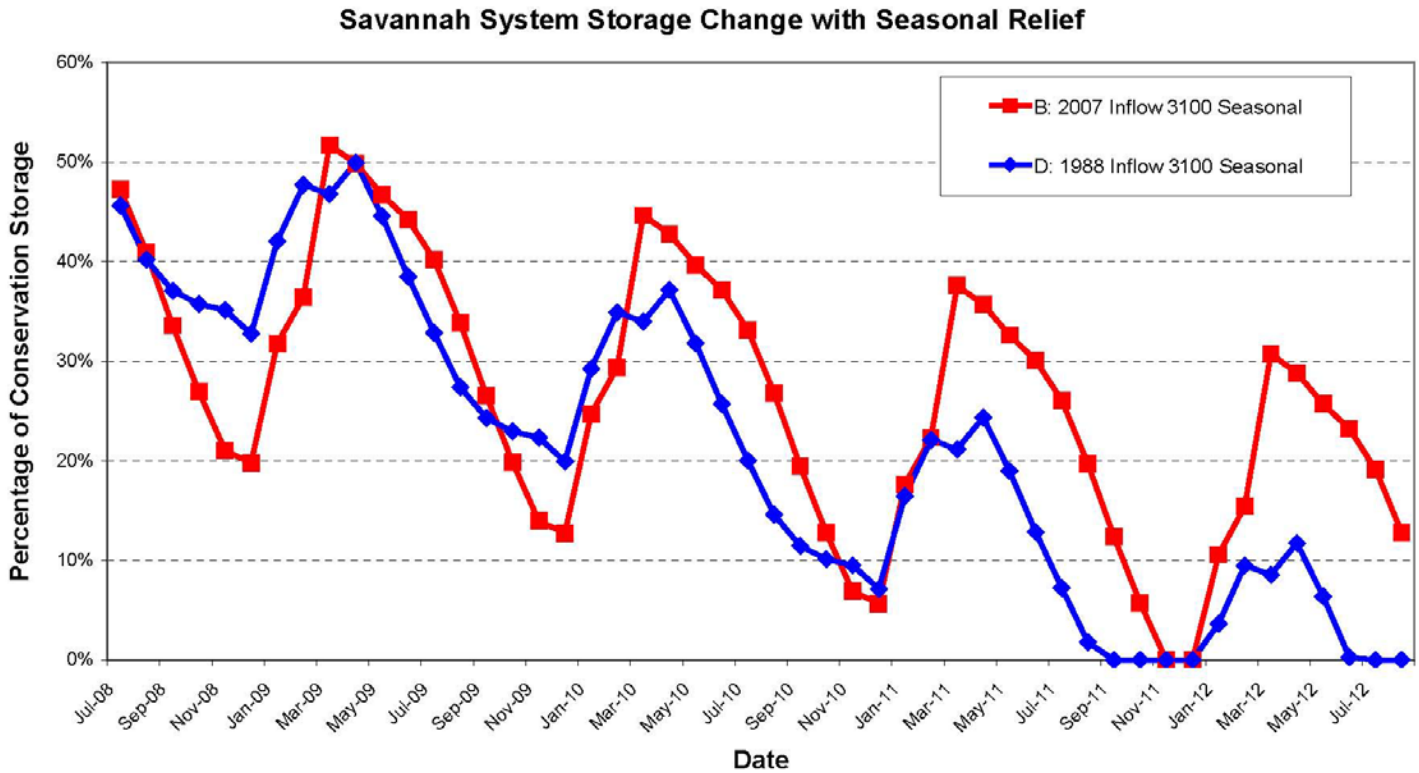


Fig. 9 Reducing Thurmond release to 3,100 cfs only in the cool season results in more stabilized system storage, even with worse-than-record inflow (90% of 2007 and 1998 recorded inflow)

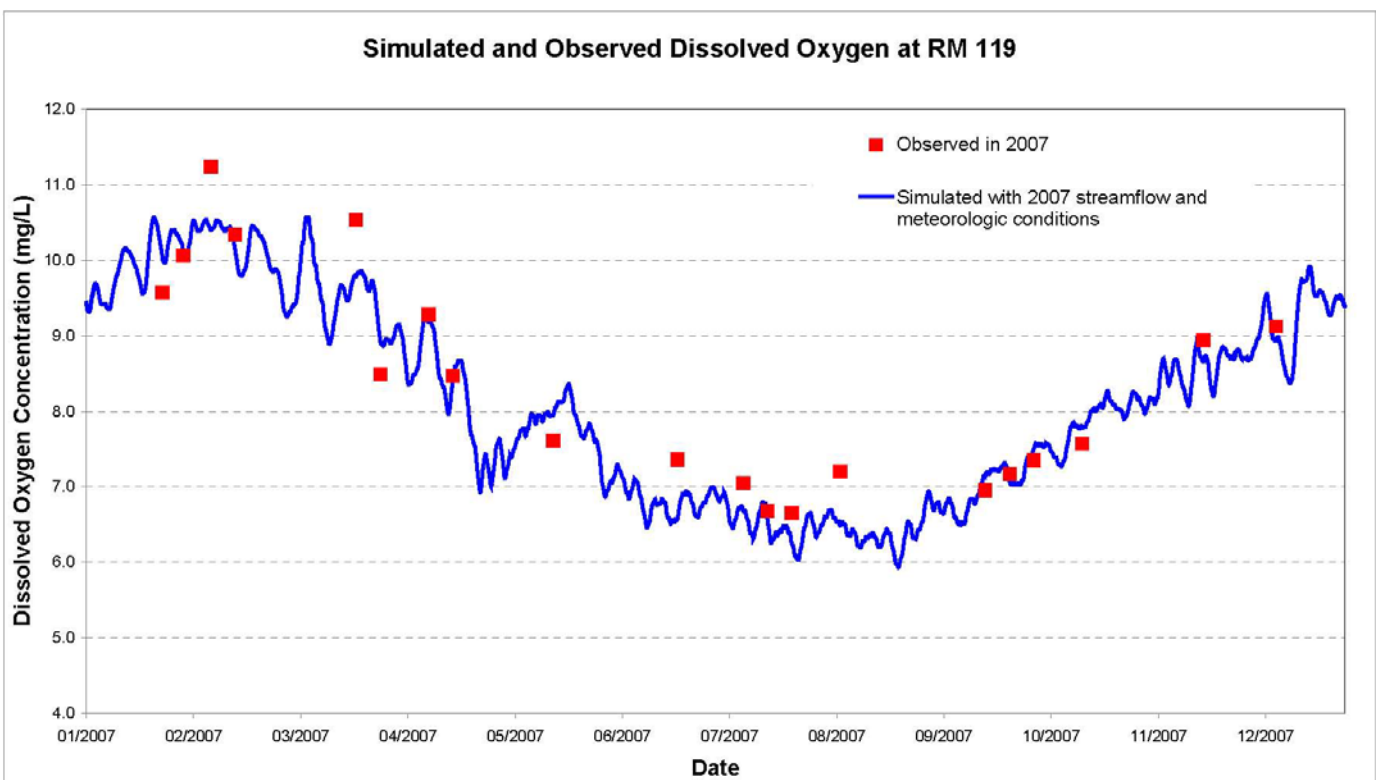
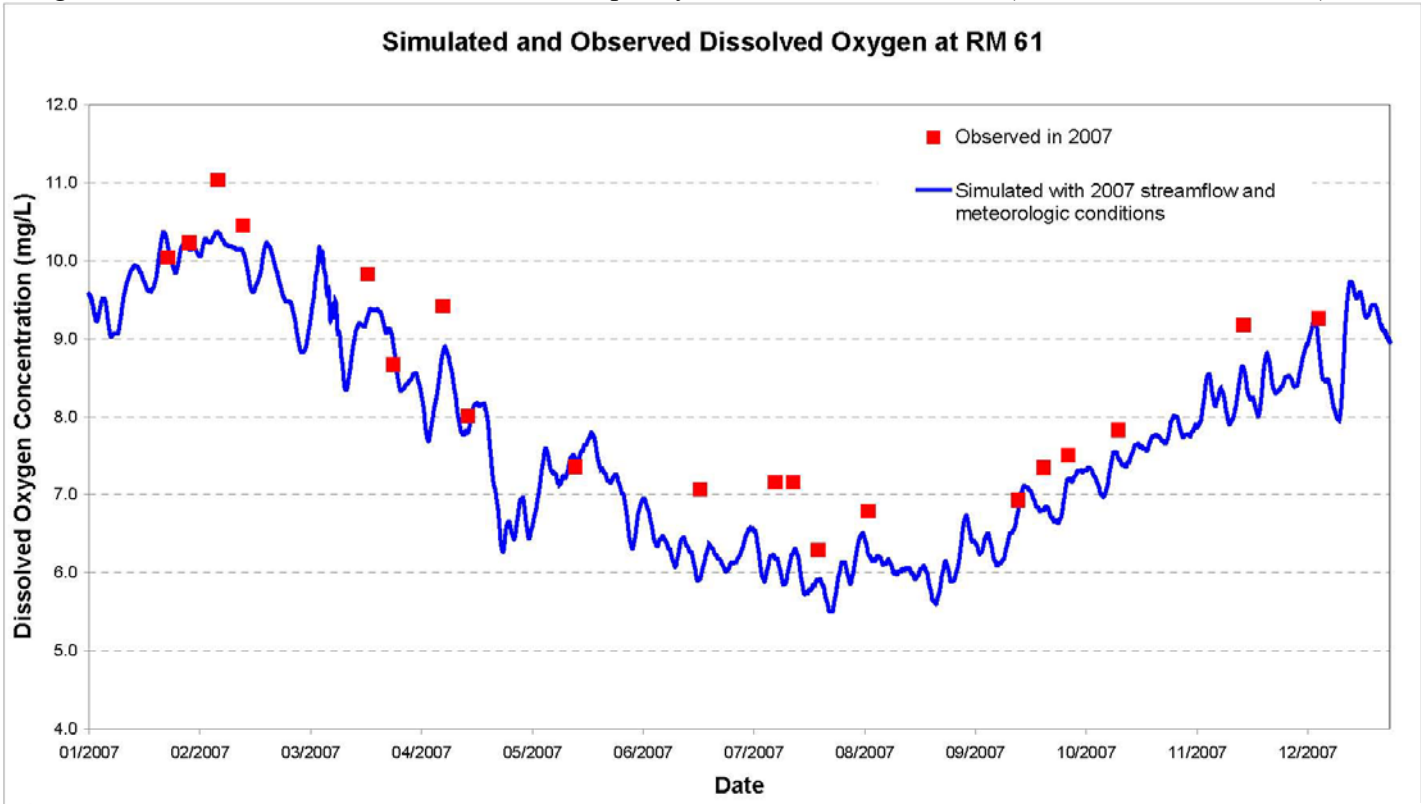


Fig. 10 Calibration of Savannah River water quality model at River Mile 119 (2007 Thurmond release)

Fig. 11 Calibration of Savannah River water quality model at River Mile 61 (2007 Thurmond release)



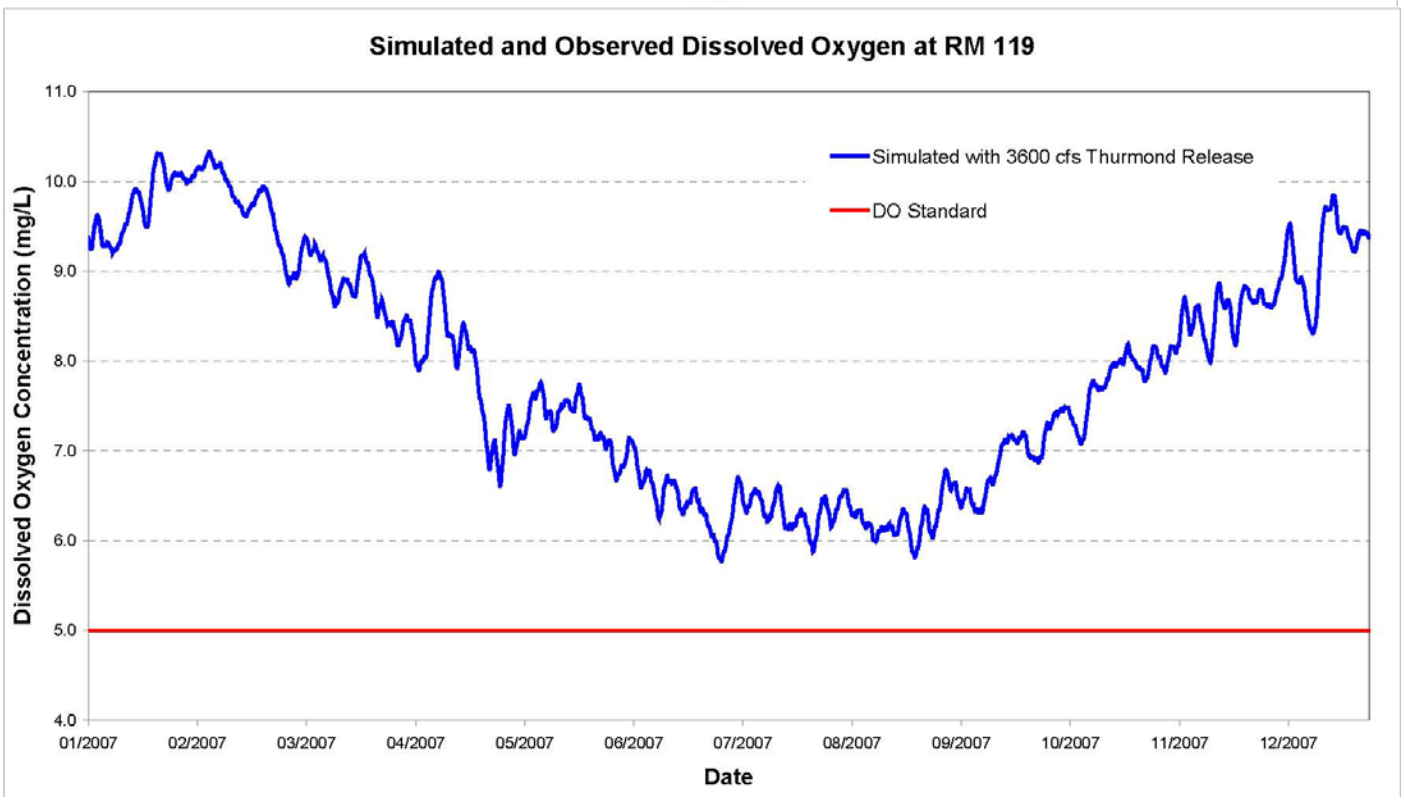


Fig. 12 Dissolved oxygen at RM 119 (with 2007 tributary inflow and meteorological data)

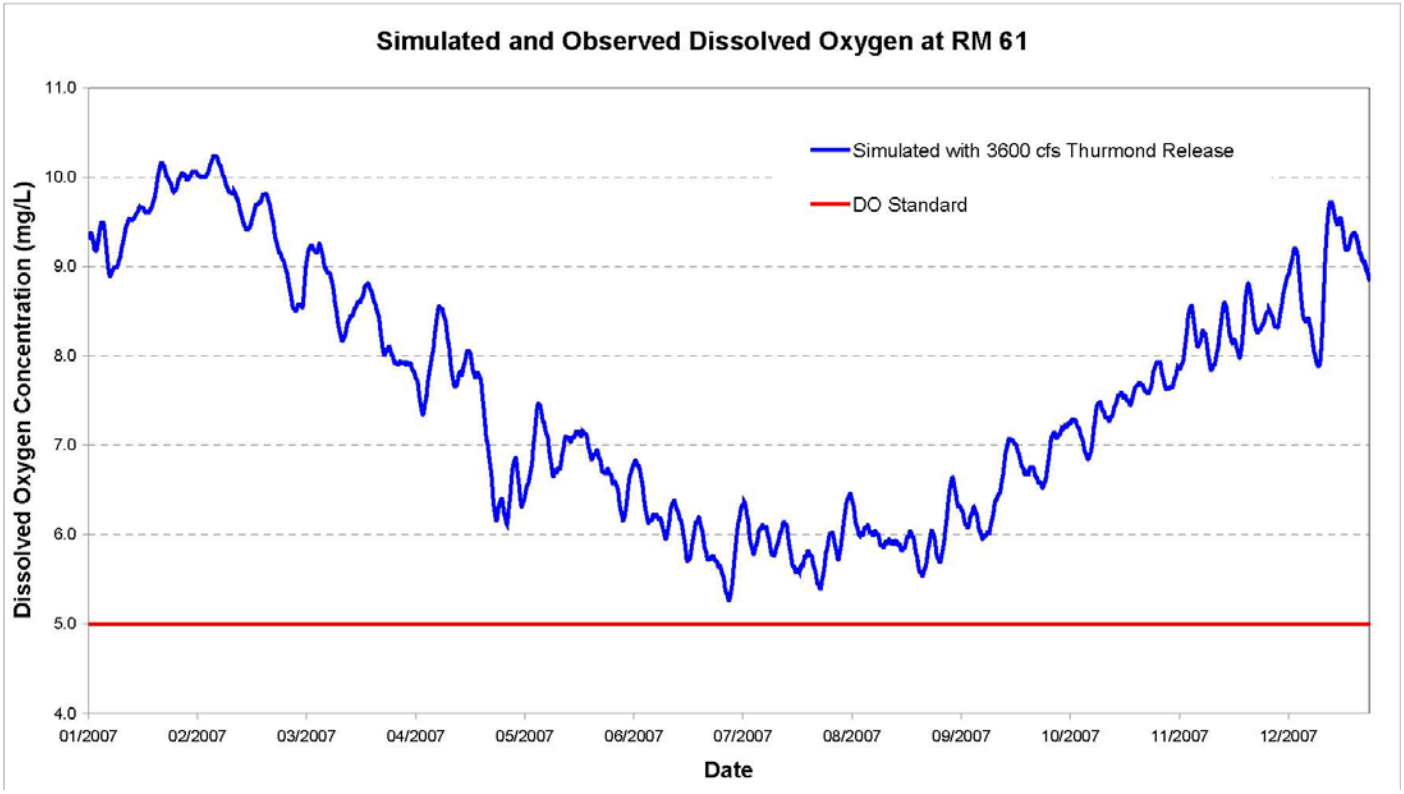


Fig. 13 Dissolved oxygen at RM 61 (with 2007 tributary inflow and meteorological data)

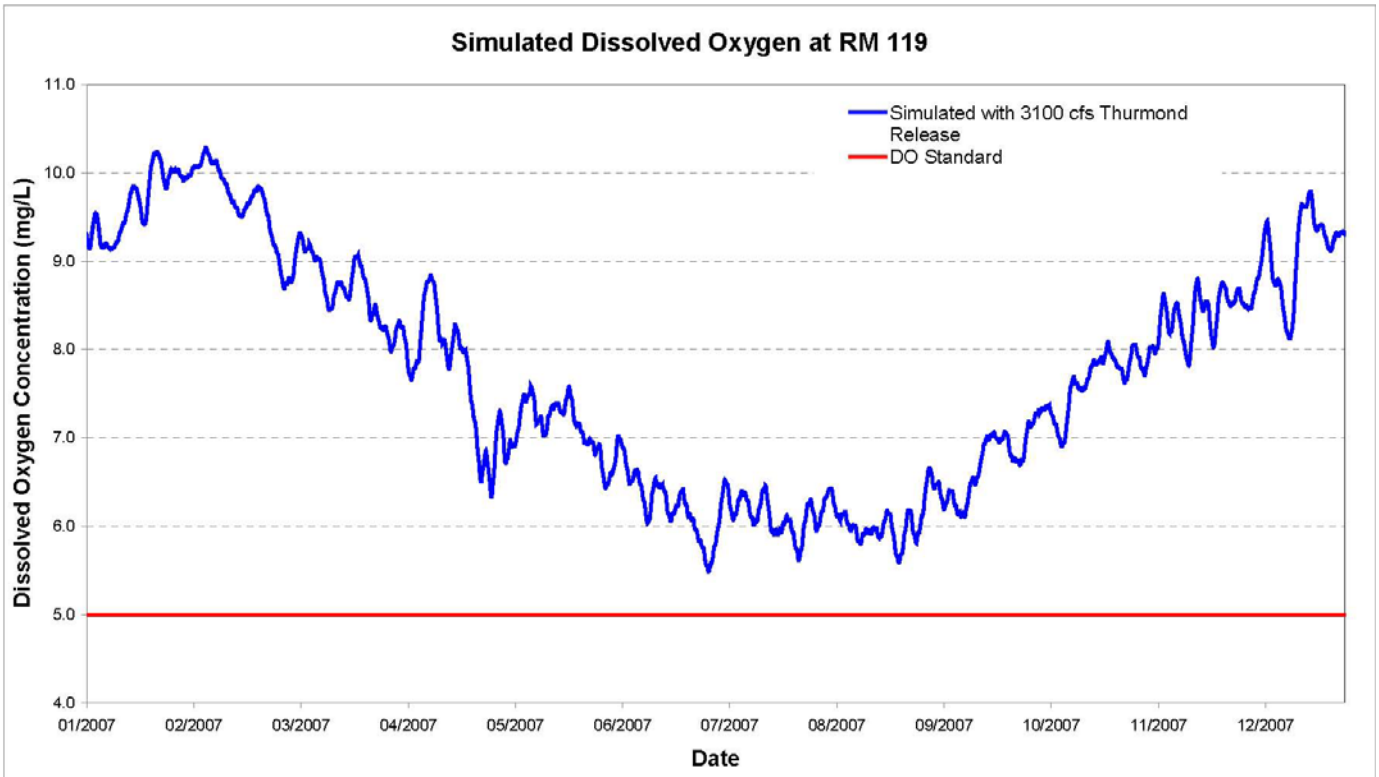


Fig. 14 Simulated dissolved oxygen at RM 119

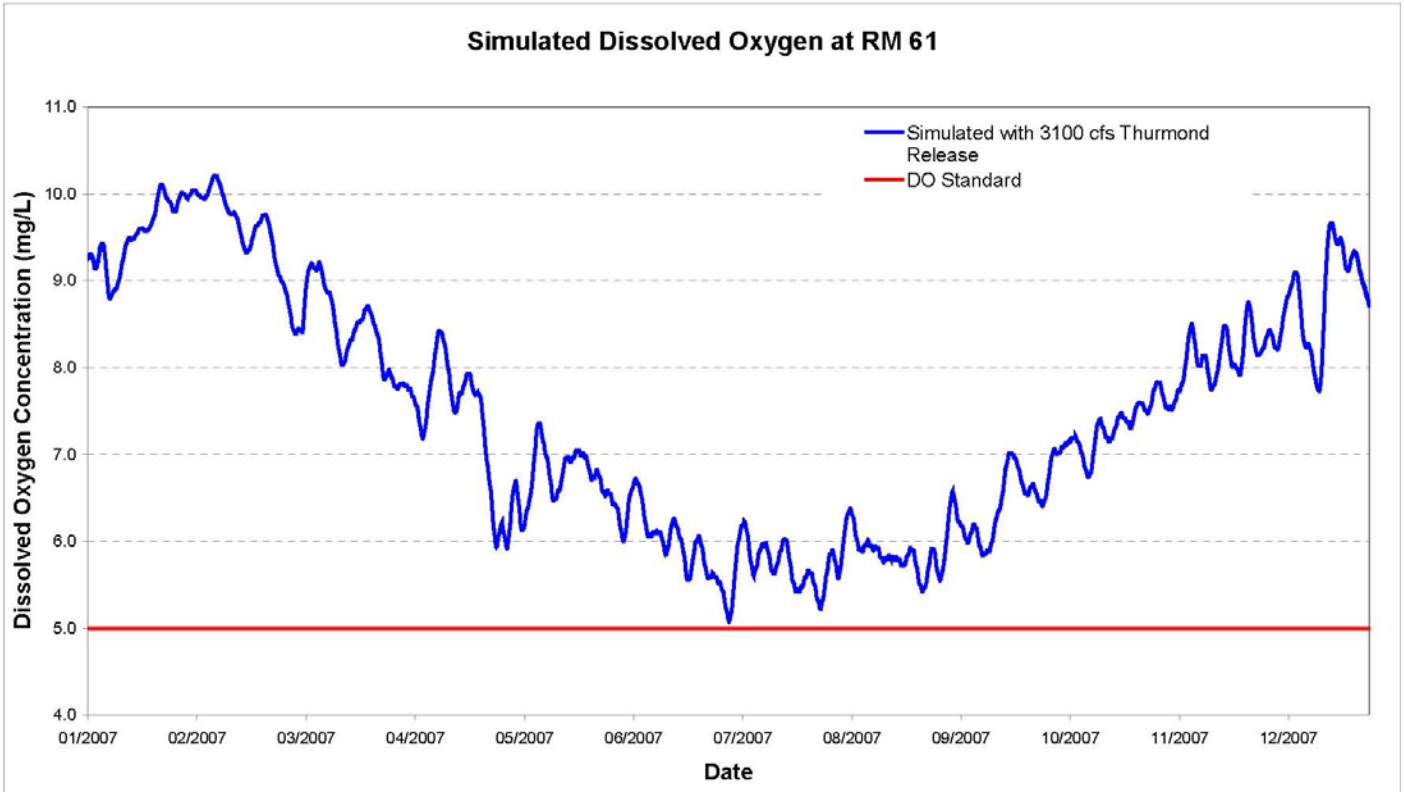


Fig. 15 Simulated dissolved oxygen at RM 61

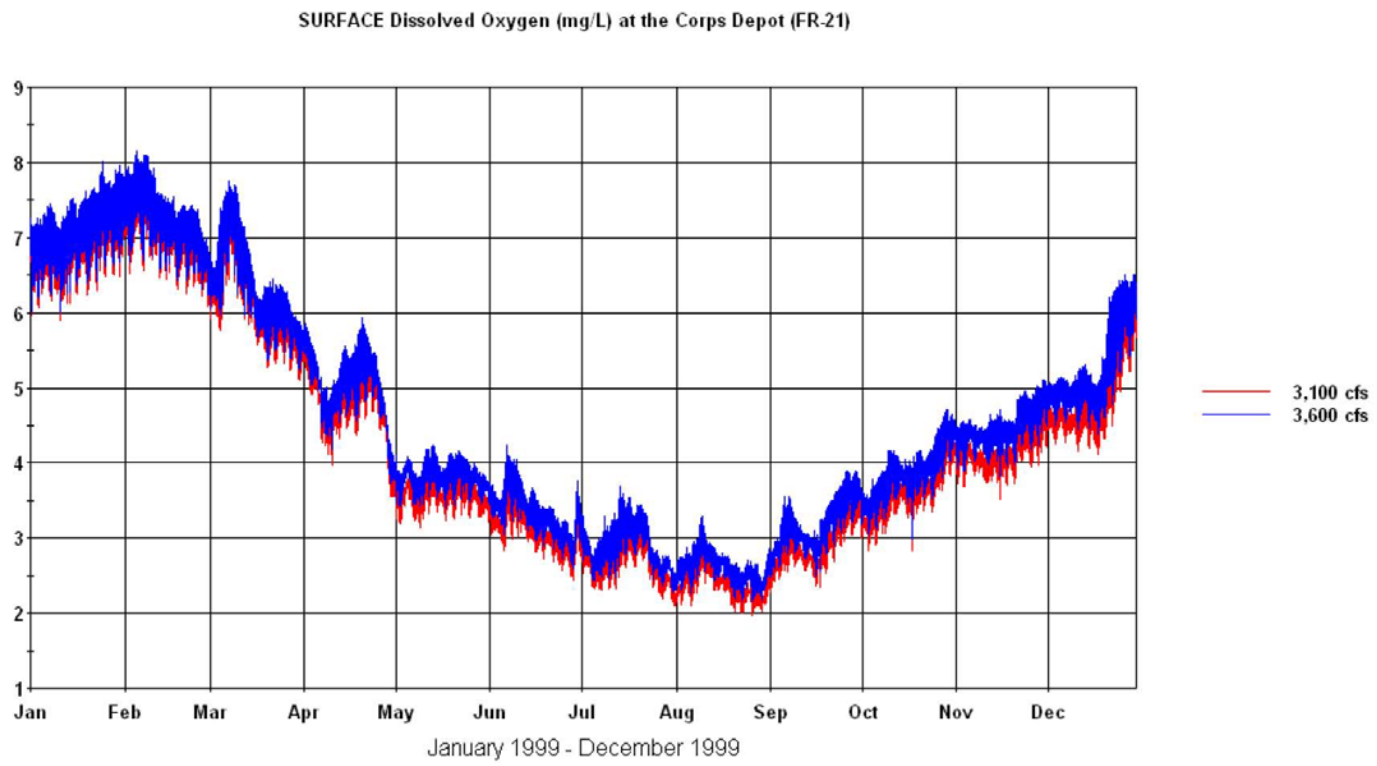
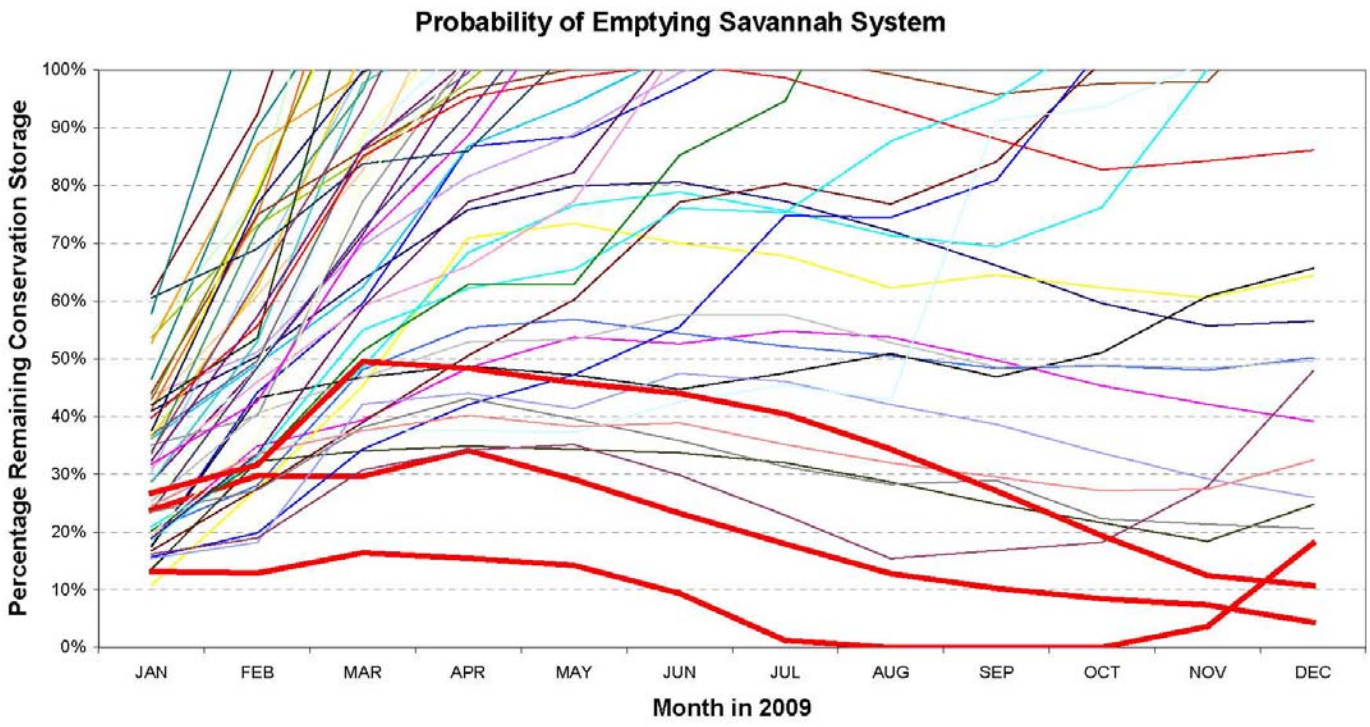


Fig. 16 Simulated surface dissolved oxygen in Savannah harbor

Fig. 17 Probability of refill (emptying) analysis reveals real danger of exhausting system conservation storage



Low Flow (Real Time) Management Plan
for Emergency Drought Response in the Savannah River Basin

A. Purpose/Background

As a result of extreme drought conditions in northeast Georgia, the Georgia Environmental Protection Division (GAEPD), South Carolina Department of Health and Environmental Control (SCDHEC), and South Carolina Department of Natural Resources (SCDNR) are proposing a temporary release reduction at Thurmond Dam from 3600 cfs to 3100 cfs beginning October 1st through the end of February. The Proposed Changes to Lake Thurmond Releases to Mitigate Drought Impact seeks to minimize the depletion of reservoir storage during extreme drought when less than 35% of system conservation remains. Minimizing the depletion of storage will affect both Lake Hartwell and Thurmond Lake. Implementation of the proposed changes should result, at current drought conditions, with the delay of lake level reductions to Level 4 (outflow=inflow) until sometime during the time period of September through November 2011.

This Low Flow (Real Time) Management Plan provides a method for implementing the Proposed Changes to Lake Thurmond Releases to Mitigate Drought Impacts, and for considering potential upward adjustments to the 3100 cfs (not to exceed 3600 cfs) should a decision be made that significant environmental impacts are occurring. The strategy and plan are not meant to replace the Army Corps of Engineers (ACE) current drought management plan, but instead are to be considered temporary modifications to the plan based on extreme drought conditions in the Savannah River Basin. Both documents were developed with input from multiple stakeholders.

B. Affected Environmental Elements/Low Flow Conditions

- Water quality standards (DO, pH, Temperature)
    - Important for maintaining aquatic biology
- Salt wedge location
    - Important for City of Savannah/BJWSA water supply intakes
    - Important for freshwater habitat maintenance
- Water levels at water intake structures
    - Important for all water users
- Habitat water levels/in-stream flow volumes
    - In shoal habitat within the Central Savannah River Area (CSRA)
        Important for fish spawning and the Rocky Shoals Spider Lily
    - In river bends that could be isolated
        Important for mussel habitat
    - At critical in-stream fish habitat
        Important for determining impact to known fish spawning habitat, especially those species that are endangered

C. Baseline Monitoring Parameters/Low Flow Conditions

- Water quality
  - Continuous sonde data
    - dissolved oxygen
    - pH
    - temperature
    - specific conductance
- Water quantity (Savannah River flow)
  - Continuous discharge measurements
  - Continuous water levels
    - At critical habitat locations
    - At water intake structures

All current monitoring locations within the basin are shown in the Appendix.

D. Management Plan Elements

1. Dams and Diversions (operational strategies for river impoundments and the Augusta Canal System)

a). Storage and Discharge from J. Strom Thurmond Dam

GAEPD, SCDHEC, and SCDNR are proposing a seasonal release from Thurmond Dam constituting 3600 cfs from March through September and 3100 cfs from October through February. Beginning October 1st, discharges from Thurmond Dam would be transitioned down to 3100 cfs over a one-week period. Once the 3100 cfs objective is reached, it would be maintained until 28 February or until such time that 1) a listed monitoring site fails to meet its environmental target and 2) a decision is made by GAEPD, SCDHEC and SCDNR to modify the 3100 cfs. If such an event were to occur, discharges from Thurmond would be incrementally increased by 100 cfs/week until the impact is alleviated or 3600 cfs is reached. It's important to note however that any increase in flow up to and including 3600 cfs during the winter months could result in Level 4 arriving sooner than the currently predicted time period of September through November 2011.

b). Storage and Discharge from Stevens Creek Dam

Stevens Creek Dam attenuates the large, hourly discharge peaks from Thurmond Dam. The Stevens Creek Reservoir will continue to be managed to release as flat a schedule as possible equaling the daily average release at Thurmond Dam plus any local inflows.

c) Discharge between Shoals and Augusta Canal at the Augusta Diversion Dam

Diversions into the Augusta Canal are managed by the City of Augusta to maintain a minimum of 1500 cfs through the Shoals (FERC) from May though January and 1800 cfs in the remaining months. Three electronically controllable gates, operated by the City of Augusta, allow for instantaneous changes of flow to the canal. Based on current permit information on the City of Augusta intake, the City is allowed to withdraw no more than 45 MGD (about 70 cfs). The City has four turbines in its water supply operation. These turbines are driven by canal water, which in turn operates raw water pumps. Usually the City operates Units 1 and 4 to supply water needs at 1364 cfs. This amount is passed through the turbines and returned entirely to the main stem of the Savannah River (discharged into the last third of the shoals).

There are three mills using canal water downstream of the Augusta intake: Sibley, King, and Enterprise. All three mills have turbines used for hydropower generation that are driven by canal water. All water is passed through to the main stem of the Savannah River; in this case downstream of the shoals. Sibley Mill reportedly needs a flow of 1024 cfs, King 880 cfs and Enterprise 560 cfs.

At 3600 cfs (current release from Thurmond), and without consideration of incremental flows (very low), 1500 cfs would have to be provided at the diversion for the shoals (FERC), leaving 2100 cfs for the canal. After the City's turbines and intake, there would be less than 800 cfs remaining for the canal and downstream use. Reportedly, at this time, the mills are still able to operate.

Under the proposed seasonal flow strategy, a 3100 cfs flow would be released from Thurmond Dam from October through February. If the City operates the gates to ensure 1500 cfs through the shoals, the remaining water through the canal would be 1600 cfs (again assuming low incremental flows). While this should be sufficient water for Augusta's water supply needs, the downstream mills would be receiving less than 300 cfs for their hydropower operations.

Reportedly, the mills are connected to the power grid. Discussions will need to occur with the mills to determine their abilities to operate at the 3100 cfs and to use, if necessary, power from the grid during the low flow periods.

d) CSRA pool elevation/discharge over NSBL&D

Discharge from the Lock and Dam would be adjusted to maintain the pool within its current operating limits.

2. Water Management Targets

a). Water quality standards (DO, pH, temperature) within the lower Savannah River Basin (Table 1)

At this time, most of the continuous monitors within the mainstem of the freshwater portion of the river are not Internet accessible. Flow correlations to continuous data can only be established after data has been downloaded and analyzed. However, USGS operates a continuous monitor in the Savannah River at the USACE Dock (021989773). This monitor is located near where the dissolved oxygen concentration is typically the lowest in the Savannah River Basin. If a violation of water quality standards occurs, specifically for DO, pH, and/or temperature, a decision will be made by GAEPD, SCDHEC and SCDNR as to the need to incrementally increase the release from Thurmond Dam by 100 cfs/week until the standard is met or until 3600 cfs is reached..

Table 1. Water quality standards

Waterbody	Dissolved Oxygen	Temperature	pH
Savannah River	5.0 mg/L daily average 4.0 mg/L instantaneous	≤ 90 ºF	6-8.5
[1] South Carolina Regulations 61-68 & 61-69, Water Classifications and Standards			
[2] Georgia DNR EPD Regulations 391-3-6-.03, Water Use Classifications and Water Quality Standards			

b). Saltwater Wedge

The USGS operates a water quality monitor at I-95 near Port Wentworth (02198840). A maximum specific conductivity level of 10,000 microseimens measured at I-95 will be considered a management target for unacceptable migration of the salt-water wedge. Conductivity of 8000 microseimens was measured at I-95 during the 1998-2002 drought, so 10,000 is considered a valid and conservative number. The City of Savannah's intake water quality could be adversely affected by expansion of this wedge. Currently the City collects chloride data in Abercorn Creek. If the City's intake chloride concentrations increase to 16 ppm , then the City of Savannah will be consulted prior to any decision by GAEPA, SCDHEC and SCDNR to release

additional water from Thurmond Dam. Typically the spring tide causes the largest intrusion of salt water upriver. If needed, benefit may come from releasing more water in time to meet the spring tide after which flows could be reduced back to the 3100 cfs.

c). Flows at Clyo/Savannah Harbor

There is a USGS gauge at Clyo (02198500), which also can be used as a management location. If the flows at Clyo are greater than 5000 cfs, there would be no need to increase flow above 3100 cfs from Thurmond Dam regardless of the water quality violations in the Harbor since the reduced flows from Thurmond Dam should not be the cause of the violations. However, if the flow at Clyo is less than 4500 cfs then closer evaluation of the water quality standards is warranted. Should water quality violations be occurring, then a decision will need to be made by GAEPD, SCDHEC and SCDNR regarding incrementally increasing flows from Thurmond Dam by 100 cfs/week until either the water quality standard is met or 3600 cfs is reached. Finally, if the flow at Clyo is between 4500 and 5000 cfs, then an evaluation of the situation to determine if there are unusual circumstances such as higher than normal tides, off shore storms, will be performed to assist in deciding if increase flows from Thurmond are warranted to help solve the problem.

d). Water levels at Permitted Surface Water Intakes

Initial minimum stage requirements have been established for each permitted intake (see Table 2 below). Each permit holder will monitor intake performance. If intakes become impacted and/or unusable due to insufficient river stage, releases from Thurmond Dam will be as required to ensure that the river stage is sufficient to return the intake to service. This is a high priority consideration for protection of public health. Should a problem with an intake arise, consultations with the affected intake operator will also occur to discuss the possibility of employing emergency measures that may be successful in adapting to the lower flows.

Table 2. Intake requirements for entities along the Savannah River.

Facility Name	Invert Elevation	Minimum Elevation Required	Corresponding Flow to Min. Elev (cfs)
Columbia Cty			
Augusta Canal			1600 cfs in canal + 1000 cfs in shoals
Edgefield Cty	149.5	149.5	
City of Augusta		119.5	
City of North Augusta	106	109	1000 cfs at elevation 109 ft
SCE&G	106	105.5	900 cfs at elevation 106 ft
PCS Nitrogen	97.75	103.9	1300 cfs at elevation 110 ft
DSM Chemical	97.75	103.9	1300 cfs at elevation 110 ft
General Chemical	110.2	111	1800 cfs at elevation 111 ft at DSM Chemical
Kimberly Clark		109	1060 cfs at elevation 109 ft
International Paper	94	94	2800 cfs at elevation 94 ft
Savannah River Site	81	81	3400 cfs at elevation 81 ft; 2300 cfs at elevation 79 ft
Plant Vogtle	70	70	always met
Savannah Electric- Plant McIntosh	7.5	7.5	3500 cfs at elevation 7.5 ft
Georgia Pacific	-1	5.16	3300 cfs at elevation 15.39 ft (at Clyo)
City of Savannah		-10.22	
Beaufort-Jasper		+3	

modified from GAEPD, SCDHEC, and SCDNR Draft, *Proposed Changes to Lake Thurmond Releases to Mitigate Drought Impacts*, July 2008

e). Sturgeon Protection

Sturgeon passage and spawning activity is monitored by SCDNR (fish are tagged and their movement closely observed). SCDNR can determine whether or not fish are successfully navigating toward their spawning habitat. Should problems result in sturgeon migration at lower flows, then a decision will need to be made by GAEPD, SCDHEC and SCDNR on releasing additional water up to the 3600 cfs for the required navigational period.

E. Habitat Water Levels/Instream Flow Volume Considerations

At this point, there is no correlation between discharge at the New Savannah Bluff Lock and Dam (NSBL&D) gauge and water elevation within the shoals. Water depths for fish spawning and habitat have not been established. There is no correlation between discharge and water elevation/depth within the cutoff bends which may affect mussel habitat. There is also no correlation between discharge and water elevation at critical in-stream fish habitat. Discharge measurements should be measured at the habitat site and correlated to a nearby USGS gauge.

The correlation between discharge and critical habitat will require measuring water depth and percent inundation at various discharges at the specific mussel and fish habitat sites. A mesohabitat study showing shoal habitat classifications/areas in response to a range of flows will need to be done. Fish passage monitoring for diadromous fish at the NSBL&D and sampling for juvenile diadromous fish, at least shad and striped bass in the Savannah River from the Augusta Dam downstream to appropriate sampling areas below the NSBL&D will need to be conducted. Juvenile/adult index could then be correlated with river basin flows from year to year. The Southeast National Sciences Academy (SNSA) is working with Augusta State, USFWS, TNC and others to determine these water level targets.

However, developing water level targets for the shoal habitat, the cutoff river bends, and at the critical instream fish habitat cannot be developed within the current time frame for this winter season. Information gathered this fall/winter could be used to develop water level targets that may be used if extreme drought conditions continue in the basin.

F. Monitoring Locations/Communication routes

The following table lists those parties that will be responsible for reporting to GAEPD on specific environmental targets. Upon review of that information, and discussion with SCDHEC and SCDNR, decisions will be made on notifying the ACE of appropriate adjustments to Thurmond release levels.

Table 3

Location	Target	Responsible Party
Shoals	Flow 1500 cfs	City Of Augusta
USGS 021989773	DO 5.0 mg/L daily average DO 4.0 mg/L instantaneous Temperature ≤ 90 ºF pH 6-8.5	GAEPD
USGS 02198840	Conductivity 10,000 µS/cm	GA EPD
Abercorn Creek	Chloride 16 ppm	City of Savannah
USGS 02198500	Flow < 4,500 cfs	SC DHEC
Various	Water level at the intakes	Intake operators
Various	Sturgeon migration	SC DNR

APPENDIX C

GEORGIA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

REQUEST LETTER

Georgia Department of Natural Resources
2 Martin Luther King Jr., Drive, Suite 1152 East Tower, Atlanta, Georgia 30334
Noel Holcomb, Commissioner
Carol A. Couch, Ph.D., Director
Environmental Protection Division
(404) 656-4713

October 1, 2008

Colonel Edward J. Kertis, Jr.
District Commander
U.S. Army Corps of Engineers
Savannah District
100 W. Oglethorpe Ave.
P.O. Box 889
Savannah, Georgia 31402-0889

RE: Savannah River Basin Drought
Request for Modification to the Drought
Contingency Plan Through
The Environmental Assessment Process (EA)

Dear Colonel Kertis:

As you are aware, since the US Army Corps of Engineers (USACE), Savannah District, first declared, in June of 2007, an Action Level 1 release from Thurmond Dam (4200 cfs), the State of Georgia Environmental Protection Division (GA EPD), along with the State of South Carolina, and other Federal, State and local stakeholders, have been routinely discussing and evaluating the drought crisis in the Upper Savannah River Basin via USACE bi-weekly conference calls. These calls have been very helpful and have allowed the participants to fully understand the status of drought in this region, predictions on persistence of the drought, how it might affect those users downstream of Thurmond dam, and how it is affecting the levels of Lakes Hartwell, Russell and Thurmond.

In response to continuing concerns regarding lake levels and predictions on when Action Level 4 (outflow =inflow) might be reached, in December of 2007, the GA EPD organized a Technical Coordination Group (TCG), comprised of Federal and State agencies (see attached list), whose charge was to analyze and evaluate possible alternatives to the existing releases as authorized under the USACE's Drought Contingency Plan. At that time, Thurmond Dam was being operated in accordance with a Modified Action Level 2 (3600 cfs minimum).

Through subsequent TCG meetings, and then just as critically, through breakout meetings involving the States of Georgia and South Carolina, a finalized proposal has been developed on how to extend storage in the lake system through a seasonal release strategy for Thurmond Dam. The attached document entitled Proposed Changes to Lake Thurmond Releases to Mitigate Drought Impacts (authored by the GA EPD, the South Carolina Department of Health and Environmental Control and the South Carolina Department of Natural Resources) provides the rationale for extending the life of each conservation pool via a seasonal release from Thurmond Dam (3100 cfs from October through February, with a return to a release of 3600 cfs (daily) from March

through September). The other attached document entitled Low Flow (Real Time) Management Plan for Emergency Drought Response in the Savannah River Basin (accomplished with an even broader stakeholder group) provides a program for monitoring appropriate environmental targets with the potential to adjust the 3100 cfs should unacceptable impacts occur to those targets during the October through February time period.

Throughout this process, the USACE has not only been vital in providing predictive information on lake storage levels, but with providing information on how best to expedite implementation of a seasonal strategy using the USACE's Environmental Assessment (EA) process. To that end, I am requesting that the USACE submit to public notice, via its EA process, a strategy for operating the Lake Thurmond project as detailed in the attached documents. Since I consider this an emergency situation and one worthy of reduced EA timelines, I request that the EA process be accomplished, if possible, through a 15 day public notice. The release from Thurmond Dam is now at Action Level 3 (3600 cfs daily), so time is of the essence in initiating the EA process so that the USACE can quickly implement these modifications.

Your continued cooperation in addressing this critical situation is appreciated.

Sincerely,

Carol A. Couch
Director

CC: Mr. Robert W. King, Jr.
Deputy Director
South Carolina Department of Health & Environmental Control-EQC

Mr. D. Breck Carmichael, Jr.
Deputy Director
Wildlife and Freshwater Fisheries Division
South Carolina Department of Natural Resources

ATTACHMENT

APPENDIX D

SOUTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES

REQUEST LETTER

South Carolina Department of
Natural Resources

John E. Frampton
Director

October 10, 2008

Col. Edward J. Kertis, Jr.
District Commander
U.S. Army Corps of Engineers
Savannah District
100 W. Oglethorpe Ave., PO Box 889
Savannah, GA 31402-0889

Dear Colonel Kertis:

As we all are aware, the upper Savannah River basin has experienced a severe drought for the past two and a half years that, despite conservation efforts by the Corps of Engineers, has lowered water levels in Hartwell, Russell, and Thurmond Reservoirs to near record-low levels.

These reservoirs are extremely important to both South Carolina's and Georgia's economies, natural resources, and the health of our citizens. Not only are the reservoirs themselves vital to South Carolina and Georgia, but during this severe drought, releases from the reservoirs are enhancing the flow of the Savannah River, thereby protecting downstream ecosystems, public water supplies, industries, and power plants.

The South Carolina Department of Natural Resources (SCDNR) has worked cooperatively with representatives from the Georgia Environmental Protection Division (GAEPD), the South Carolina Department of Health and Environmental Control (SCDHEC), the U.S. Army Corps of Engineers, and other agencies and stakeholders to develop a proposal to delay the complete depletion of the lakes' conservation pools. Together, the States of South Carolina and Georgia have finalized a proposal to reduce releases from Thurmond Reservoir during the winter months if this severe drought persists. The document entitled *Proposed Changes to Lake Thurmond Releases to Mitigate Drought Impacts*, coauthored by GAEPD, SCDHEC, and SCDNR, and which has already been presented to you by GAEPD, describes the seasonal flow reduction agreed upon by both States.

Due to the importance of this matter, I am recommending that you implement this flow reduction plan as soon as possible.

Rembert C. Dennis Building • 1000 Assembly St • P.O. Box 167 • Columbia, S.C. 29202 • Telephone: 803/734-4007
EQUAL OPPORTUNITY AGENCY • framptonj@dnr.sc.gov • www.dnr.sc.gov • PRINTED ON RECYCLED PAPER

Because the proposed release reduction from Thurmond Reservoir cannot be initiated until the Corps of Engineers complete an Environment Assessment, I am urging you to begin the Environment Assessment process immediately, and to make every effort to complete it as quickly as possible, including, if possible, the use of a 15-day public comment period. The opportunity for release reductions for October of this year has already been lost, but quick action by the Corps can allow these reductions to go into effect by November of this year.

Also, I would like to request that your staff work with representatives from both States in planning for the transition into Level 4 drought releases (outflow equals inflow) should this severe drought continue and our efforts to preserve the conservation pools prove unsuccessful.

I appreciate your serious consideration of this proposal.

Sincerely,

John E. Frampton
Director

cc: Michael G. McShane, Chairman, SCDNR Board
Robert W. King, Deputy Commissioner, SCDHEC
Noel Holcombe, Director, GADNR
Carol Couch, Director, GAEPD
Steve de Kozlowski, Interim Deputy Director, SCDNR-LWC
Bob Perry, Director, Office of Environmental Programs, SCDNR

APPENDIX E

LIST OF PREPARERS

LIST OF PREPARERS

Howard Ladner Biologist	USACE Planning - Environmental 7 years USACE
William Bailey Physical Scientist	USACE Planning - Environmental 27 years USACE
Stan Simpson Water Manager	USACE Engineering - Water Management 25 years USACE

APPENDIX F

PUBLIC NOTICE

Mobile/Savannah
Planning Center

JOINT PUBLIC NOTICE
US Army Corps of Engineers, Savannah District,
and the
Georgia Department of Natural Resources, Coastal Resources Division,
and the
South Carolina Department of Health and Environmental Control
Office of Ocean and Coastal Resource Management

TO WHOM IT MAY CONCERN:

SUBJECT: Notice of Availability of a Draft Environmental Assessment (EA) and Draft Finding of No Significant Impact (FONSI) for a temporary deviation to the US Army Corps of Engineers' Savannah River Basin Drought Contingency Plan on the Savannah River in Georgia and South Carolina, in response to continuing drought conditions.

Notice of the following is hereby given:

a. Pursuant to the National Environmental Policy Act of 1969, notice is hereby given that the US Army Corps of Engineers, Savannah District proposes a temporary deviation to the March 1989 Savannah River Basin Drought Contingency Plan, as revised.

b. The Savannah District announces the availability to the public of a Draft EA and Draft FONSI concerning the action. Copies of the Draft EA and unsigned FONSI can be obtained from the following website: www.sas.usace.army.mil, by emailing the following address: william.g.bailey@usace.army.mil, or by calling Mr. William Bailey at (912) 652-5781.

c. Written statements regarding the Draft EA and FONSI for the proposed action will be received at the Savannah District Office until

12 O'CLOCK NOON, OCTOBER 27, 2008

from those interested in the activity and whose interests may be affected by the proposed action.

PROJECT DESCRIPTION: The proposed action is a temporary revision to the US Army Corps of Engineers (Corps) 1989 Savannah River Basin Drought Contingency Plan. The revision would be a reduction in the minimum daily average discharge from the J. Strom Thurmond reservoir from 3,600 to 3,100 cubic feet per second (cfs) during the winter months from November 1, 2008 through February 28, 2009. This change would preserve water in the Corps reservoirs and delay the time at which those

reservoirs would reach the bottom of their conservation storage. The Corps would restore the discharges from the Thurmond reservoir up to the present 3,600 cfs per day daily average if requested by either the State of Georgia or South Carolina.

The US Army Corps of Engineers operates its three multi-purpose projects on the Savannah River (Hartwell, Richard B. Russell, and J. Strom Thurmond) as a three-lake system. The ongoing drought has reduced the volume of conservation storage remaining in those three lakes. As a result of declines in the conservation storage and concerns that Level 4 drought conditions will be reached if the drought continues, the Georgia Department of Natural Resources, Environmental Protection Division, and the South Carolina Department of Natural Resources requested Savannah District consider reducing discharges from the Thurmond reservoir during the winter months ending in February 2009. Alternatives considered included the following: (A) No Action, and (B) Reducing discharges during the winter months. The tentatively recommended plan is Alternative B, Reducing discharges from 3,600 to 3,100 cubic feet per second (cfs) during the winter months ending in February 2009.

AUTHORIZATION REQUIRED FROM THE STATE OF GEORGIA:

Coastal Zone Consistency: Savannah District has evaluated the proposed project and believes it is consistent with the Georgia Coastal Zone Management Program to the maximum extent practicable. The District will submit its evaluation to the Georgia Department of Natural Resources, Coastal Resources Division in Brunswick, Georgia, who administers that program. The State will review the proposed action and determine whether it concurs that the proposed project is consistent with the State's Coastal Zone Management Program to the maximum extent practicable. Any person who desires to comment or object to Georgia Coastal Zone Management Consistency Certification must do so in writing within 10 days of the date of this notice to the Federal Consistency Coordinator, Georgia Department of Natural Resources, Coastal Resources Division, Suite 300, One Conservation Way, Brunswick, Georgia 31520-8687 and state the reasons or basis for the objections.

AUTHORIZATION REQUIRED FROM THE STATE OF SOUTH CAROLINA:

Coastal Zone Consistency: Savannah District has evaluated the proposed project and believes it is consistent with the South Carolina Coastal Zone Management Program to the maximum extent practicable. The District will submit its evaluation to the South Carolina Department of Health and Environmental Control, Office of Ocean and Coastal Resource Management in Charleston, South Carolina, who administers that program. The State will review the proposed action and determine whether it concurs that the proposed project is consistent with the State's Coastal Zone Management Program to the maximum extent practicable. Any person who desires to comment or object to South Carolina Coastal Zone Management Consistency Certification must do so in writing within 10 days of the date of this notice to the South Carolina Department of Health and Environmental Control, Office of Ocean and Coastal Resource

Management; 1362 McMillan Avenue; Suite 400, Charleston, South Carolina 29405 and state the reasons or basis for the objections.

DEPARTMENT OF THE ARMY EVALUATION:

Environmental Assessment: Savannah District has prepared a Draft EA and found that an Environmental Impact Statement will not be required for this action. The Draft EA is being coordinated concurrently with this Notice to Federal and State natural resource agencies for review and comment. No wetlands would be filled, but riparian wetlands could be temporarily impacted by reduced river flows. No discharge of dredge or fill material into waters of the US is included in the proposed action, so no evaluation is required under Section 404 of the Clean Water Act.

Threatened and Endangered Species: The District reviewed the most recent information on Federally listed endangered or threatened species and determined that the proposed action may effect, but is not likely to affect shortnose sturgeon, manatee, and wood stork. This proposed action is being coordinated with the US Fish and Wildlife Service and the National Marine Fisheries Service under Section 7 of the Endangered Species Act.

Cultural Resources: In accordance with the National Historic Preservation Act (P.L. 89-655, as amended) and 36 CFR, Part 800, Savannah District has evaluated the proposed action's potential effect upon historic properties. The District has determined the proposed action will have no adverse effect upon historic properties and has initiated consultation with the Georgia and South Carolina State Historic Preservation Officers and nineteen Native American Tribes.

Essential Fish Habitat: Savannah District evaluated the proposal's potential effects on Essential Fish Habitat. The project's effects would be of relatively short duration. As a result, the District believes the proposed action would not produce long term effects on these valuable habitats that warrant mitigation. The District is coordinating the proposed action with the National Marine Fisheries Service under the Magnuson-Stevens Fishery Conservation and Management Act.

Coastal Zone Consistency: Savannah District evaluated compliance of the proposed action with both the Georgia and South Carolina Coastal Management Programs (CMP). The District believes that the proposed action is consistent with the CMPs to the maximum extent practicable. The District will submit the EA to the Georgia Department of Natural Resources, Coastal Resources Division in Brunswick, Georgia and to the South Carolina Department of Health and Environmental Control, Office of Ocean and Coastal Resource Management in Charleston, South Carolina.

Public Interest Review: The decision whether to proceed with the project as proposed will be based on an evaluation of the probable impact, including cumulative impacts, of the proposed activity on the public interest. That decision will reflect the national

concern for both the protection and use of important resources. The benefits which reasonably may be expected to accrue from the proposal will be balanced against its reasonably foreseeable detriments. All factors that may be relevant to the proposal will be considered, including the cumulative effects thereof. Among these are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife, flood hazards, flood plains, land use, navigation, shoreline erosion/accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, consideration of property ownership, environmental justice, and, in general, the needs and welfare of the people.

Consideration of Public Comments: The US Army Corps of Engineers is soliciting comments from the public; Federal, State, and local agencies and officials; Native American Tribes; and other interested parties in order to consider and evaluate the impacts of the proposed activity. Any comments received will be considered by the US Army Corps of Engineers in its deliberations on this action. To make this decision, comments are used to assess impacts to endangered species, wetlands, historic properties, water quality, general environmental effects, socioeconomic effects, and the other public interest factors listed above. Comments are used in the preparation of the Environmental Assessment pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

Comment Period: Anyone wishing to comment to the Corps on this proposed action should submit comments no later than the end of the comment period shown in this notice, in writing, to the US Army Corps of Engineers, Savannah District, Mobile/Savannah Planning Center, ATTN: Mr. William Bailey, Post Office Box 889, Savannah, Georgia 31402-0889, by FAX to 912-652-5787, or by emailing the comments to the following address: william.g.bailey@usace.army.mil.

Any person who desires to comment or object to Georgia Coastal Zone Management Consistency Certification must do so in writing to the Georgia Department of Natural Resources, Coastal Resources Division, Federal Consistency Coordinator, Suite 300, One Conservation Way, Brunswick, Georgia 31520-8687.

Any person who desires to comment or object to South Carolina Coastal Zone Management Consistency Certification must do so in writing to the South Carolina Department of Health and Environmental Control, Office of Ocean and Coastal Resource Management, 1362 McMillan Avenue; Suite 400, Charleston, South Carolina 29405.

Point of Contact: If there are any questions concerning this Public Notice, please contact Mr. William Bailey, US Army Corps of Engineers, Mobile/Savannah Planning Center, at (912)652-5781.

William Bailey
Acting Savannah Unit Chief
Mobile/Savannah Planning Center

APPENDIX G

COMMENTS RECEIVED DURING PUBLIC REVIEW

This section will contain the comments that Savannah District receives from coordination of the Draft EA and Joint Public Notice with the natural resource agencies and the public.