Final
Environmental Assessment
and Finding of No Significant Impact

Drought Plan Revision
Savannah River Basin

US Army Corps of Engineers
Savannah District

July 2012

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ACRONYMS

CFR---------------Code of Federal Regulations
cfs-----------------cubic feet per second
DCP----------------Drought Contingency Plan
DHEC ------------Department of Health and Environmental Control
DNR--------------Department of Natural Resources
DO----------------Dissolved Oxygen
EA ----------------Environmental Assessment
EFDC-------------Environmental Fluid Dynamics Code Model
EFM --------------Ecosystems Function Model
EPA---------------Environmental Protection Agency
EPD---------------Environmental Protection Division
FNSI---------------Finding of No Significant Impact
GA------------------Georgia
HEC --------------US Army Corps of Engineers Hydrologic Engineering Center
HTRW -----------Hazardous, Toxic and Radioactive Waste
JST----------------J. Strom Thurmond
msl----------------mean sea level
NAA--------------No Action Alternative
NEPA ------------National Environmental Policy Act of 1969
NMFS ------------National Marine Fisheries Service
NOAA------------National Oceanic and Atmospheric Administration
NSBL&D--------New Savannah Bluff Lock and Dam
NWR -------------National Wildlife Refuge
PA ----------------Programmatic Agreement
PDT---------------Project Delivery Team
PCB---------------polychlorinated biphenyl
ppt ----------------parts per thousand
ResSim ----------Reservoir Simulation Model
RIV-1-------------One dimensional Dynamic Hydraulic and Water Quality Model
RM----------------River Mile
RBR --------------Richard B. Russell
SC-----------------SouthCarolina
SEPA-------------Southeastern Power Administration
SHPO-------------State Historic Preservation Officer
SOP---------------Standard Operating Procedure
SRB---------------Savannah River Basin
SRBDCP---------Savannah River Basin Drought Contingency Plan
TMDL------------Total Maximum Daily Load
USACE ----------United States Army Corps of Engineers
USFWS ----------United States Fish and Wildlife Service
USGS-------------United States Geologic Survey
WASP------------Water Quality Analysis Simulation Program Model
WY ---------------Water Year

FINDING OF NO SIGNIFICANT IMPACT

Name of Action: Drought Plan Revision for the Savannah River Basin

1. Description of the Proposed Action

The Proposed Action (Alternative 2) consists of retaining the major components of Alternative 1 and modifying the discharge of Levels 2 and 3. For Level 2 of this Alternative, if the current 28-day Broad River percentile inflow is greater than the 10^{th} percentile flow, then the prescribed J. Strom Thurmond (JST) Dam release would be 4000 cfs from February through October. For Level 2, if the current 28-day Broad River percentile inflow is less than or equal to the 10^{th} percentile flow, then the prescribed JST release would be 3800 cfs from February through October. The November to January discharge for Level 2 would be 3600 cfs (February extension of 3600 cfs could be implemented with NOAA Fisheries pre-approval). The Level 3 JST release for February through October would be 3800 cfs and the target for November through January discharge would also be reduced to 3100 cfs (February extension of 3100 cfs could be implemented with NOAA Fisheries pre-approval). If requested by either the State of Georgia or South Carolina, the Corps would restore the Thurmond discharge up to 3800 cfs daily average for the 3100 cfs release in Level 3. For Levels 1-3, the Hartwell discharge would be reduced as appropriate to maintain balanced pools.

2. Other Alternatives Considered

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

a) No Action Alternative: Consists of the Corps taking no action to modify its existing 1989 Savannah River Basin Drought Contingency Plan, as amended in 2006 and 2011. This alternative is considered in detail and is evaluated in regard to environmental concerns**.**

Action levels were established in the 1989 SRBDCP and are based on pool elevations at Hartwell and Thurmond Lakes. Russell Lake has a relatively small conservation pool; therefore, it does not have delineated action thresholds. Due to the nature of pumped storage water control management activities, Russell Lake may vary throughout its five-foot conservation pool through Action Level 3.

As described in the 1989 SRBDCP, the Corps would monitor salinity levels in the estuary. During Level 3 operations, Savannah District would perform roving salinity sampling at several locations in the estuary to determine and document the extent of salinity intrusion. The Savannah River Basin projects have never reached Level 4 in the 21 years that the plan has been operational.

In Level 4 during November through January, once a 3,100 cfs discharge is implemented at Thurmond in a given year, monitoring efforts associated with an adaptive management strategy would be coordinated through the Savannah River Basin Drought Coordination Committee (SRBDCC). This Committee consists of representatives from each of the following organizations: Savannah District Engineering Division, South Atlantic Division Engineering Division, Georgia DNR, South Carolina DNR, USFWS and NOAA Fisheries. The flow reduction would be maintained through the end of February or until such time that a monitoring parameter is outside of acceptable levels. If concerns arise, the monitoring organization would notify the State, who would review the information and discuss the results with the SRBDCC. If appropriate, the State would recommend to the Savannah District adjustments to Thurmond release levels. If requested by either the State of Georgia or South Carolina, the Corps will make a decision about restoring the Thurmond discharge to as much as the 3,600 cfs daily average. NOAA Fisheries will also be involved in monitoring and will initiate discussions with the SRBDCC concerning the potential impact to spawning shortnose sturgeon or other aquatic resources. Savannah District will accept a request from the Department of Energy's Savannah River Site to increase flows during a 3,100 cfs flow window. If the District receives such a request, it would coordinate with the States as part of its evaluation of whether to increase flows at that time.

b) Alternative 1: Consists of retaining the major components of the NAA with one modification. The modification is intended to improve drought response to include a representative of basin inflow as an operational trigger. This allows varying discharge within Levels 1 and 2 by referring to the 10th percentile flow at the USGS Broad River near Bell, GA streamgage. Streamflow at this location is a good representation of inflow into the basin as a whole because the Broad River is a large unregulated basin with a long period of record (currently at 79 years). The 10th percentile flow is defined as the 28 consecutive day average of streamflow data compared to the same 28-day average for the historic flow at the gage. Weekly reservoir release calculations will be conducted each Wednesday and the current 28 day average percentile will be compared to the 10th percentile to determine the following week's release target from Thurmond Dam. For example, when in Level 1 of this Alternative, if the current percentile inflow is greater than the 10th percentile flow, then the prescribed JST release is 4200 cfs. Alternatively, if the current percentile inflow is less than or equal to the 10th percentile flow, then the prescribed JST release is 4000 cfs. For Level 2 of this Alternative, if the current percentile inflow is greater than the 10th percentile flow, then the prescribed JST release is 4000 cfs. Alternatively, if the current percentile inflow is less than or equal to the 10th percentile flow, then the prescribed JST release is 3800 cfs. For Levels 1-3, the Hartwell discharge would be reduced as appropriate to maintain balanced pools.

c) Alternative 3: Consists of retaining the major components of Alternative 1 and modifying the discharge of Levels 2 and 3. For Level 2 of this Alternative, the Thurmond discharge for November through January would be reduced to 3600 cfs (February extension of 3600 cfs could be implemented with NOAA Fisheries pre-approval). The Level 3 Thurmond release for February through October would be 3600 cfs and the target for November through January discharge would also be reduced to 3100 cfs (February extension of 3100 cfs could be implemented with NOAA Fisheries pre-approval). If requested by either the State of Georgia or South Carolina, the Corps would restore the Thurmond discharge up to 3600 cfs daily average for the 3100 cfs release in Level 3. For Levels 1-3, the Hartwell discharge would be reduced as appropriate to maintain balanced pools.

d) Alternative 4: Consists of retaining the major components of Alternative 1 and modifying the discharge of Levels 2 and 3. For Level 2 of this Alternative, if the percentile inflow is less than or equal to the 10^{th} percentile flow, then the prescribed JST release is 3600 cfs. The Level 3 Thurmond release target would be 3600 cfs. The Level 3 Thurmond release target for November through January would also be reduced to 3100 cfs (February extension of 3100 cfs could be implemented with NOAA Fisheries pre-approval). If requested by either the State of Georgia or South Carolina, the Corps would restore the Thurmond discharge up to 3600 cfs daily average for the 3100 cfs release in Level 3. For Levels 1-3, the Hartwell discharge would be reduced as appropriate to maintain balanced pools.

e) Alternatives Considered but Eliminated from Detailed Consideration: the eliminated Alternatives include one similar to Alternative 1 that contains a prescribed flow of 3600 cfs for Level 3, one similar to Alternative 2 that does not include the Level 2 3600 cfs release for November to January and one similar to Alternative 3 that has the Level 2 3600 cfs flow for November to January tied to the less than or equal for 10^{th} percentile flow.

3. Coordination

Savannah District has coordinated this action with Federal, State and local agencies, including public review of a Draft Environmental Assessment.

4. Conclusions

Based on a review of the information contained in this Environmental Assessment (EA), I have determined that the proposed action, Alternative 2, is the best course of action. I have also determined that this Drought Contingency Plan Revision for the Savannah River Basin is not a major Federal action significantly affecting the quality of the human environment 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 have significant adverse effects on any Federal threatened or endangered species

b. The proposed changes would have no additional effect on historic properties beyond those that may occur from the presently-approved reservoir water control management activities.

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 modify 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.

30 July 2012
Date

Jeffrey M. Hall
Colonel, US Army
Commanding

FINAL
ENVIRONMENTAL ASSESSMENT

1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1. INTRODUCTION

1.1.1. History

The US Army Corps of Engineers, Savannah District (hereinafter "the Savannah District") operates and manages three Federal impoundments on the Savannah River, Hartwell Dam, Russell Dam and Thurmond Dam, as a system in accordance with a Water Control Manual (Manual).

In 1986, the Savannah District developed a Short-Range Drought Water Management Strategy to address the water shortage conditions in the Savannah River Basin. That document served as a guide for using the remaining storage in the Savannah River impoundments for the duration of the 1981 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. The 1989 SRBDCP is a component of that Manual and was developed (1) to address the effects of the Savannah District water control management activities 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.

That SRBDCP was modified in 2006 by revising the management actions that would be taken at various lake levels. The Environmental Assessment for the Savannah River Basin Drought Contingency Plan Update dated August 2006 modified the 1989 plan was written with the intent to respond earlier in a drought to preserve additional water in the lakes, thereby delaying the time when the conservation pools would be depleted. The EA implemented a flow reduction at Trigger level 1, and adjusted the Trigger level 3 flow. With these modifications, the Savannah District issues a public safety advisory concerning recreational use as the reservoirs reach the Level 1 trigger. A flow reduction to 4200 cfs for Level 1 was introduced, Level 2 was decreased from 4500 to 4000 cfs, and Level 3 was increased to 3800 cfs as a tradeoff for the earlier response. The actions the Savannah District would take surrounding the Level 4 trigger were not evaluated in detail when the plan was originally developed or during the 2006 EA. In every case, the modeling for the Savannah River Basin Drought Contingency Plan Update indicated that the lakes would not reach the bottom of conservation pool.

The Savannah River Basin Level 4 Drought Operations EA and FONSI, signed in October 2011, clarified Level 4 operations as adjusting the minimum daily average release at Thurmond Dam from 3,600 to 3,100 cubic feet per second during the cooler months from November 1 through the end of February (February only after receiving separate approval from NOAA Fisheries due to concerns about potential impacts to shortnose sturgeon) while in Action Level 4. Level 4 3600 or 3100 cfs releases would continue until all available storage is depleted. At that point, outflow would match inflow due to the physical constraints of the project outlets.

Subsequently, the Savannah River Basin experienced a severe drought that began in early 2007 and ended in 2009. Rainfall and resulting stream flow were particularly low, causing the reservoirs to drop faster than any previous drought on record. Hartwell and Russell Lakes experienced their lowest pool elevations since they were initially filled. In October 2007, the Federal and State natural resource agencies agreed with Savannah District's request to temporarily reduce the minimum daily average discharge from Thurmond Dam from the 3,800 cfs level specified in the 2006 Environmental Assessment for the Savannah River Basin Drought Contingency Plan Update back to the 3,600 cfs level as provided in the 1989 SRBDCP. The USACE South Atlantic Division office approved that temporary deviation to the SRBDCP that same month. This action was taken in response to the continued drought as a means of preserving water in the lakes and delaying the time when the conservation pools would be depleted. By December 2008, the Savannah River Reservoir System had less than 25% of its conservation storage remaining. Hartwell Lake had about 33% of its conservation storage left, while Thurmond had only 10% of its conservation storage remaining. As the 2007-2009 drought completed its third year, the Savannah River reservoir system experienced extreme pressures and difficulties. Concerns and conflicts over competing water issues intensified as drought conditions became more severe and lake levels continued to fall. This drought had become the new drought-of-record for the basin. Heavy rainfall during September 2009 brought relief to the drought conditions. Reservoir levels and conservation storage began to return to near normal levels and by November 2009 they were completely restored. The severity of this latest drought created conditions that stressed the traditional management concepts which the Savannah District followed to regulate their individual impoundments and the integrated water management of the three lakes. See below for a chronological list of events and actions.

Drought Timeline

Event	Action	Description
1986-1989 Drought (New Drought of Record)	Short Range Drought Management Strategy	To address water shortage conditions in the SRB
	1989 Drought Contingency Plan	Introduced flow restrictions Level 1 – Safety Advisory for boaters Level 2- Max weekly average 4500 cfs Level 3- Specified 3600 cfs daily average at Thurmond
1998-2002 Drought (New Drought of Record)	December 2002, Draft EA-Wintertime Flow Reductions from Thurmond Dam	3600 reduction to 3000 in wintertime, not implemented, lack of natural resource agency approval
	2006 Drought Plan Update Environmental Assessment	Level 1 – Max weekly average 4200 cfs Level 2- Max weekly average 4000 cfs Level 3- Specified 3800 cfs daily average at Thurmond
2007-2009 Drought (New Drought of Record)	Temporary Deviation to 3600 cfs at Thurmond Oct 2007-May 2009	Reduction occurred at Drought Level 2 (Hartwell @ 649.85 /Thurmond@319.76)
	Temporary Deviation to 3100 cfs Dec 2008-Jan 2009	3100 cfs implemented with monitoring for adverse effects
	Drought Level 4 Study – Oct 2011	Developed standard operating procedure for inactive storage (Level 4)
2011-until present Drought	November 2011, Temporary Deviation Request	3100 Nov-Jan, not implemented, lack of natural resource agency approval
	2012 Drought Plan Revision Environmental Assessment	Evaluating the 2006 EA operating plan in the 2007-2009 drought and temporary deviations

1.1.2. Requirement for Environmental Documentation

An 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 federal 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. NEPA requires the consideration of the environmental impacts associated with a "Proposed

Action" and its alternatives prior to implementing the action. This EA addresses proposed revisions to the SRBDCP.

1.1.3. General Objectives

The objectives of the Proposed Action are to:

- ⇨ determine a balanced approach to operate the Savannah District reservoirs on the Savannah River when in drought conditions.
- ⇨ comply with all applicable environmental laws, regulations, and policies.
- ⇨ Evaluate the value of discharge reductions during the winter months when in severe droughts.

1.2. PURPOSE AND NEED

This Drought Contingency Plan revision is required by section 6d of the USACE Engineering Manual 1110-2-240 Water Control Management. The Drought Contingency Plan is an appendix of the Savannah District Water Control Plan. The regulation says:

> "The objectives of efficient water control management are to produce beneficial water savings and improvements in the availability and quality of water resulting from project regulation. Balanced resource use through improved regulation should be developed to conserve as much water as possible and maximize all project functions consistent with project/system management. Continuous examination should be made of regulation schedules, possible need for storage reallocation (within existing authority and constraints) and to identify needed changes in normal regulation. Emphasis should be placed on evaluating conditions that could require deviation from normal release schedules as part of drought contingency plans (ER 1110-2-1941)."

The Savannah River Basin experienced a severe drought from 2007 to 2009. Rainfall and resulting stream flow were particularly low, causing the reservoirs to drop faster than during previous droughts. The pools in the reservoirs approached the bottom of their conservation pools to new record low levels. The SRBDCP was intended to be a dynamic document which could be changed as new drought periods occur. Items that were mentioned in the SRBDCP that may be cause for future changes include: additional experience, further studies of salinity intrusion in Savannah Harbor, changing water supply needs, improvements to water intakes and the uncertain future operational plan at the Savannah River Site. The new drought of record from 2007 to 2009 has been a source of additional experience.

This EA evaluates the effectiveness of the existing drought plan from 2006 and examines the utility of temporary deviations used during the new drought of record as permanent features. The purpose of the analysis is to improve reservoir system operations that reflect the hydrology of the basin and incorporate more resiliency to the effects of severe drought. The alternatives include a broader range of available releases than the present Drought Contingency Plan, while still attempting to balance impacts on project purposes.

1.3. Scope

The scope of this EA is limited to assessing the potential environmental and socio-economic effects resulting from implementing an Action Alternative or the No Action Alternative (NAA). After eliminating alternatives that are not considered feasible or effective, the potential environmental impacts associated with four Alternatives are compared to the NAA. The proposed action is limited to water control management activities at the Savannah District's Savannah River Basin projects while operating in drought conditions.

1.4. Study Methodology

HEC-ResSim is a numerical reservoir simulation model developed by the USACE Hydrologic Engineering Center in Davis, California. An application of HEC-ResSim was developed to model each alternative for the Drought Plan Revision study and model results and output were used to evaluate effects of the alternatives on authorized project purposes. All simulations ran from 23 February 2007 to 26 November 2009 to cover the new drought of record for the SRB. The District used reservoir storage derived inflow data for the drought period as input to ResSim since other inflow datasets available did not include the drought recover period of 2009. The base condition for the study, or NAA, was modeled to provide a baseline from which to evaluate proposed management changes. The base condition follows the existing water release procedures described in the current SRBDCP. Pumped storage was important to include in the NAA because this feature was not available during the original implementation of the SRBDCP in 1989. Alternatives to the NAA were then modeled to analyze their effect during the period of record drought simulation.

Previous GA-DNR dissolved oxygen and salinity modeling was used to evaluate water quality (See Section 4.1), pool elevation tables were used to evaluate biotic communities in the lakes (See Section 4.2), and hydrologic output was used with the HEC-Ecosystems Functions Model (HEC-EFM) to evaluate the effects of each alternative on biotic communities downstream of the reservoirs (See Sections 4.3 to 4.7). Pool elevation tables were used to determine impacts on recreational swimming and boating (Section 4.8). Swimming impacts were determined by counting the number of days in between May 1 and September 30 that the designated Corps swim areas had 3 or more feet of water. Recreational boating impacts were compared by assessing the number of public boat ramps available for use at the most extreme point in the drought of record. Water supply (section 4.9) in the lakes was determined by counting the number of users whose intakes would no longer be functional at the most extreme point in the drought. Downstream water supply was determined by the flows at the Augusta Canal and Shoals on the Savannah River. Energy output from ResSim was used to evaluate hydropower effects of the alternatives. Cumulative hydropower energy shortages were computed for the NAA and each alternative during the drought of record using weekly reservoir system energy output from ResSim. A monthly valuation of on peak energy from Southeastern Power Administration was applied to the energy shortages due to each set of drought plan rules to compare cumulative energy shortages values in each alternative. Minimum cumulative system conservation storage was used to compare each alternative to the NAA in terms of its resiliency during the new drought of record.

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 USACE 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.

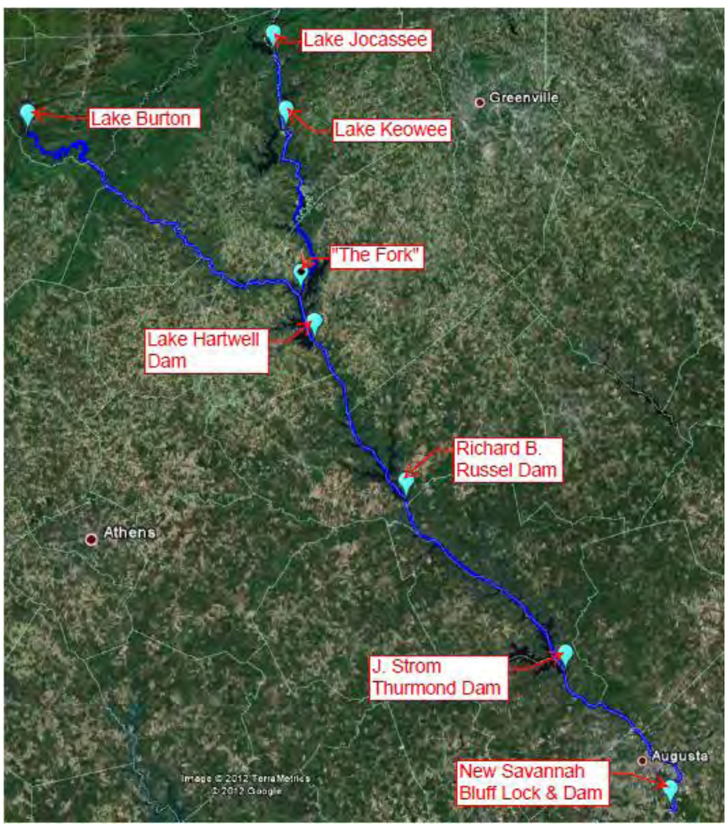


Figure 1: Location of Dams on the Savannah River

The Tugaloo River and the Seneca River meet at what is known as "The Forks" and form the Savannah River at River Mile (RM) 312. Lakes Keowee and Jocassee are upstream on the Seneca River System and Burton Powerhouse, Nacoochee Powerhouse, the Mathis-Terrora development and Tallulah Falls Powerhouse are upstream on the Tugaloo River System.

Water discharge in the Savannah River varies considerably both seasonally and annually, even though it is largely controlled by releases from the 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. Average discharge at Clyo (Effingham County, Georgia) is 12,040 cfs. Tidal effects extend upstream to approximately RM 45 (Reconnaissance Planning Aid Report on the Savannah River Basin Study, US Fish and Wildlife Service, July 1999).

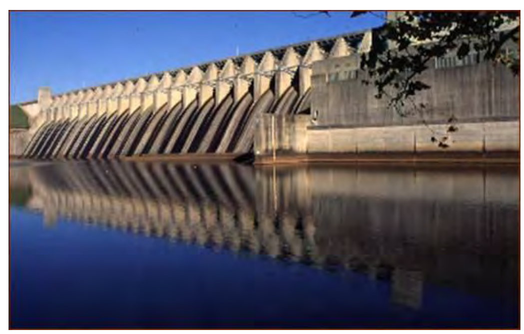
2.2. Description of Savannah District Projects Within the Savannah River Basin


Hartwell Lake and Dam

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


R. B. Russell Lake and Dam

The storage at each of the three multipurpose projects on the Savannah River is Congressionally authorized to be used for specific purposes including Flood Control, Recreation, Fish and Wildlife Management, Hydropower, Water Supply, Water Quality, and Navigation. The storage at each multipurpose project is divided into three zones: Flood Control, Conservation, and Inactive Storage. Figure 2 shows the Flood Control Storage, Conservation Storage and Inactive Storage in acre feet for each of the lakes in the Savannah River System. Figures 3 and 4 introduce what are referred to as Action Levels. The Inactive Storage shown in Figure 2 corresponds to Level 4 shown in Figures 3 and 4. These will be referred to throughout this document. See Figures 5-7 for pertinent information for each dam.


J. S. Thurmond Lake and Dam

The upper zone of each pool, the area above the guide curve is specifically designated as Flood Storage. This portion of the pool has been reserved for managing high inflows due to storm events. The flood management objective is to store the inflow from these events while making releases during and after these storms at non damaging rates. The amount of flood storage required at each project was determined in the initial design. Whenever storm events cause pool elevations to rise into this zone, flood management takes priority, and all other project purposes become secondary or incidental.


New Savannah Bluff Lock and Dam

The Water Control Manual and SRBDCP prescribe a regulation guide curve to facilitate the water control regulation for the Corps storage reservoirs. The guide curve for each federal project defines the top of conservation storage water surface elevation. Water management regulation decisions strive to maintain the pool elevation at the top of the conservation guide curve elevation or at the highest elevation possible while meeting project purposes. The middle zone of each pool, the storage residing between the guide curve and the top of the inactive storage, is designated conservation storage. The water stored in the conservation zone is used to meet all of the authorized project purposes other than Flood Control.

The authorized navigation 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 downstream of the Houlihan Bridge (US Highway 17). The terminus of the deep-draft channel in Savannah Harbor is at approximately RM 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). Savannah District, U.S. Army Corps of Engineers is evaluating deepening Savannah Harbor.

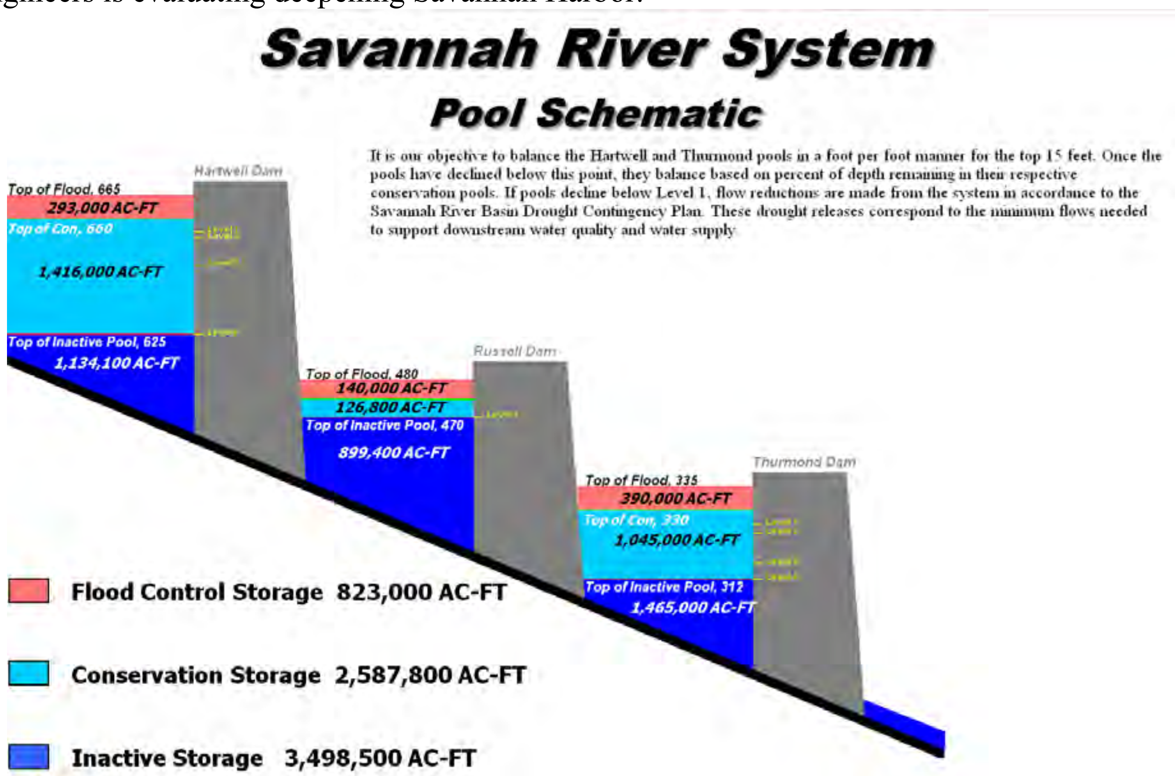


Figure 2: Savannah River System Pool Schematic

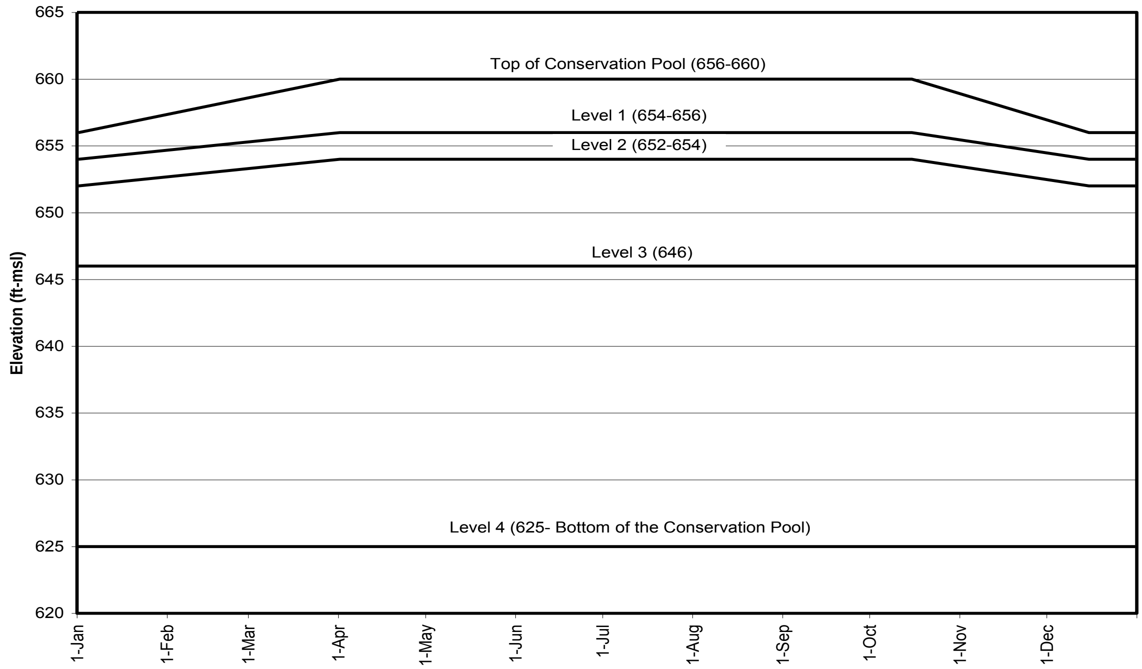


Figure 3: Hartwell Action Levels for the No Action Alternative

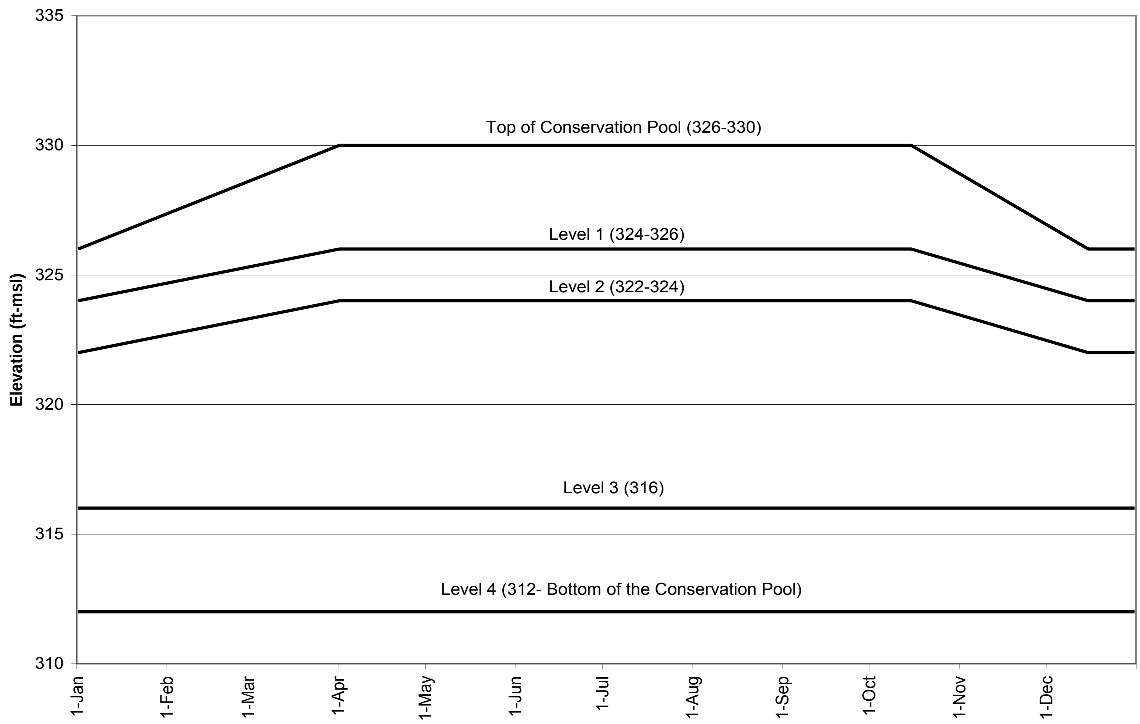


Figure 4: Thurmond Action Levels for the No Action Alternative

Hartwell Pertinent Elevations

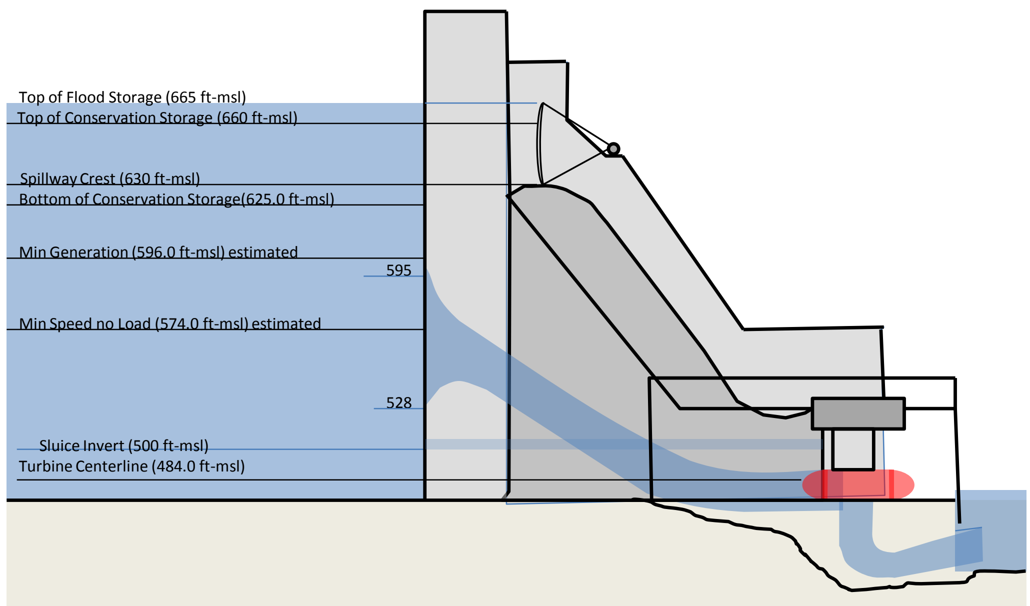


Figure 5: Hartwell Pertinent Elevations

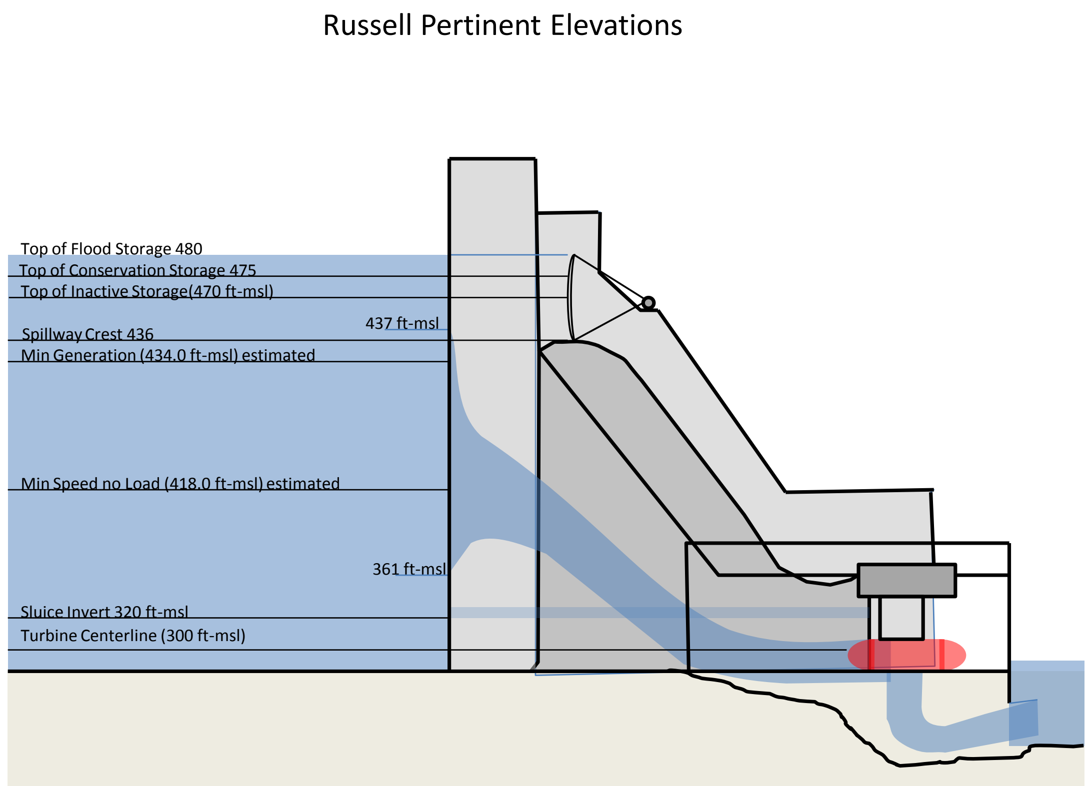


Figure 6: Russell Pertinent Elevations

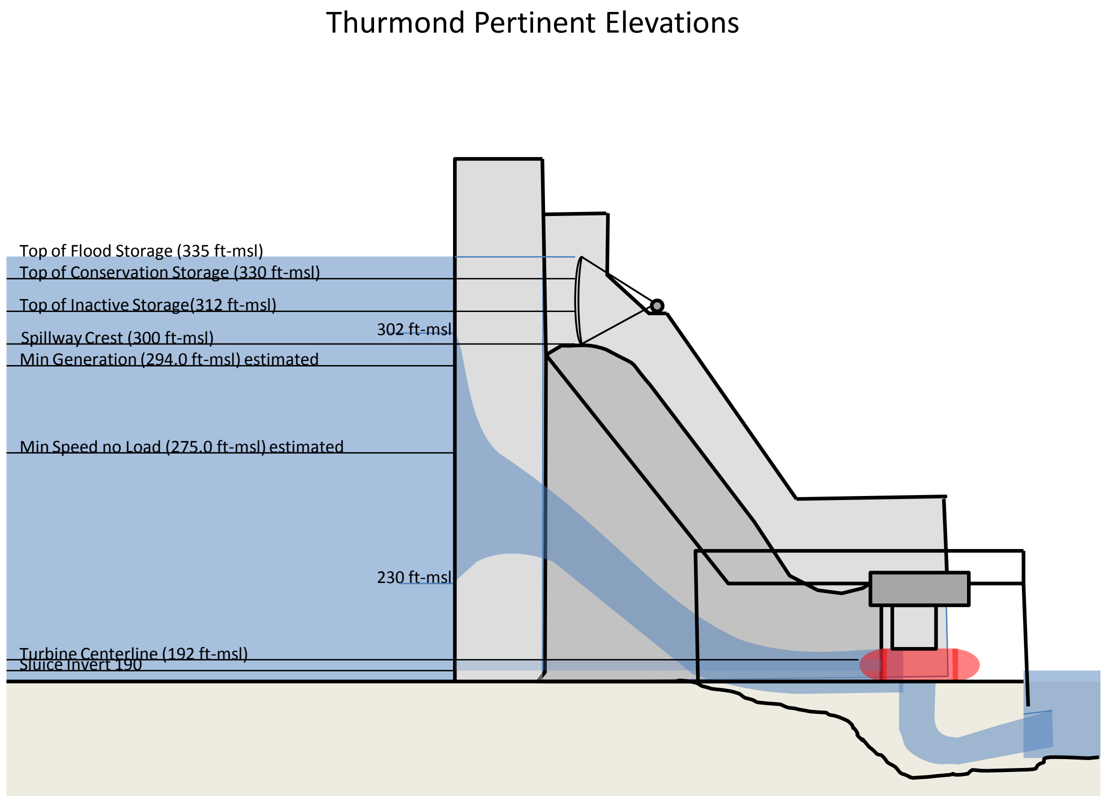


Figure 7: Thurmond Pertinent Elevations

2.3. RECREATION

The lakes of the Savannah River Basin provide excellent opportunities for water resource-based recreation. In times of drought, when the lake levels of Hartwell and JST Lake drop 4 feet below summer Guide Curve elevations, drought and low water information is disseminated to the public. In addition, at 6 feet below summer Guide Curve elevations, designated swimming areas become dry. However, adverse impacts become noticeable at designated swimming areas when lake levels drop 3 feet below summer Guide Curve elevations.

According to the Savannah River Basin Water Use Data Collection Presentation of Findings, June 2004, conducted 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 recreational users 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 reservoirs.

Hartwell Lake
There are 94 public boat-launching ramps with a total of 109 lanes located on Hartwell Lake. From lake elevation 660 to 658.01 feet mean sea level (msl) all boat 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, 1 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 percent) ramps become unusable, but 71 (76 percent) remain usable. When lake levels drop to 646 feet msl, 23 more ramps or a total of 46 (49 percent) boat-launching ramps become unusable. If lake levels were to ever drop to 638 feet msl, all boat launching ramps would be unusable. Table 1 shows which ramps go out of service at approximate lake levels.

Table 1: Hartwell Lake - Unusable Ramps by Lake Level 658 to 638 feet msl

Name of Boat Ramp	No. of Lanes	Approx. Lake Elevation When Ramp Becomes Unusable (feet msl)
Holders Access, SC	1	658
Jacks landing, SC	1	658
Lakeshore	1	658
Mountain Bay	1	658
Sadlers Creek State Pk.	1	658
Tugaloo State Park	2	658
Reed Creek, GA	1	657.5
Rocky Ford, GA	1	657.5
Walker Creek	1	657
Brown Road, SC	1	657
Hurricane Creek, SC	1	657
Seneca Creek, SC	1	657
Cove Inlet, SC	1	656.5
Durham	1	655.7
South Union, SC	1	655.5
Bradberry, GA	1	655
Timberland, SC	1	654
Barton Mill, SC	1	653
Darwin Wright City Pk.	1	653
Port Bass, SC	1	653
Seymour, GA	1	653
Tillies, SC	1	653
White City, SC	1	653
Paynes Creek (inner) Left	1	652.6
Paynes Creek (inner) rt.	1	652.6
Big Oaks (Left Lane)	1	652.5
Tabor	1	652.5
Townville	1	652.3
Apple Island, SC	1	651.5
Poplar Spring (left rp)	1	651.5
Stephens Co.	1	651.5
Broyles (East rp)	1	651.3
Friendship (Left Lane)	1	651
Lawrence Bridge	1	651
River Fork (right rp)	1	651
Broyles (West rp)	1	650.5

Jarrett	1	650
Holcomb	1	650
Cleveland	1	649.5
Spring Branch	1	649
Honea Path	1	648.5
Twin Lakes (right rp)	1	648
Twin Lakes(left rp)	1	648
Fairplay (Left Lane)	1	647
Twelve Mile (Left Lane)	1	647
Twelve Mile (Rt. Lane)	1	647
Clemson	1	645.5
Milltown	1	645.36
Carters Ferry	1	645
Watsadler	1	645
Big Oaks (Rt. Lane)	1	644
Camp Creek	1	644
Choestoea	1	644
Coneross	1	644
Double Spring	1	644
Duncan Branch	1	644
Fairplay (Rt. Lane)	1	644
Friendship (Rt. Lane)	1	644
Glenn Ferry	1	644
Green Pond	1	644
Hatton's Ford	1	644
Long Point	1	644
New Prospect	1	644
Rock Spring	1	644
Gum Branch	6	644
Poplar Spring (right rp)	1	643.6
Springfield	1	643.6
Crawford Ferry	1	643.3
Asbury (camping)	1	643
Denver	1	643
Eighteen Mile Creek	1	643
Elrod Ferry	1	643
Jenkins Ferry	1	643
Martin Creek	1	643
Mary Ann Branch	1	643

Oconee Point	1	643
Paynes Creek (outer)	1	643
Powder Bag Creek N	1	643
Richland Creek	1	643
River Forks (left rmp)	1	643
Singing Pines	1	643
Weldon Island	1	643
Harbor Light Marina	2	643
Hartwell Marina	1	643
Hart State Park	2	643
Portman Shoals	1	643
Broyles (middle rp)	1	642
Tugaloo State (Mega)	6	642
Mullins Ford	1	638
Big Water	1	638
Bruce Creek	1	638
Lake Hartwell State Pk.	2	638
Lightwood Log Creek	1	638
Sadlers Creek State Pk. #1	2	638

There are approximately 10,700 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.

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 79 public boat-launching ramps with a total of 95 lanes 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 ramps become unusable. At and below lake level 324 feet msl, 5 more or a total of 10 boat-launching ramps become unusable. At and below lake level 323 feet msl, 2 more or a total of 12 (15 percent) boat-launching ramps become unusable while 67 ramps (85 percent) remain useable. At and below lake level 317 feet msl, 24 more or a total of 36 (46 percent) boat-launching ramps become unusable. At and below lake level 315 feet msl, 10 more or a total of 46 (58 percent) boat-launching ramps become unusable. All boat-launching ramps are unusable at 306 feet msl. Table 2 shows which ramps go out of service at approximate lake levels.

Table 2: J.Strom Thurmond - Unusable Ramps by Lake Level 326 to 306 feet msl

Name of Boat Ramp	Lane No..	Approx. Lake Elevation When Ramp Becomes Unusable (feet msl)
Hwy 28 Access Ramp	1	326
Long Cane Creek Ramp	1	325.7
Catfish Ramp	1	325.5
Calhoun Falls Ramp	1	325
Broad River Campground	1	325
Cherokee Recreation Area	5	324.7
Mistletoe State Park	1, 2	324.2
Soap Creek Park	1	324
Little River Quarry Ramp	1	324
Lakeside Subdivision Ramp	1	324
Scotts Ferry (New Ramp)	1, 2	323.8
Clay Hill Campground	1	323.5
Mt Pleasant Ramp	1	322.4
Wildwood Park	5, 6	322
Morrahs Ramp	1	321.5
Bussey Point	1	321
Modoc Campground	1	321
Murray Creek Ramp	1	321
Parkway Ramp	1	321
Cherokee Recreation Area	4	321
Fishing Creek/Hwy 79 Ramp	1	320.7
Wildwood Park	5, 6	320
Maxim Subdivision Ramp	1	320
Wells Creek Subdivision	1	320
Leroys Ferry Campground	1	319.5
Ridge Road Campground	1	319
Cherokee Recreation Area	3	318.71
Chamberlain Ferry Ramp	1	318.33
Double Branches Ramp	1	318.1
Soap Creek Marina	1	318
Cherokee Recreation Area	2	318
Amity Recreation Area	1	317.9
Raysville Marina	1	317.6
Elbert County Subdivision Ramp	1	317.6
Modoc Ramp	2	317.2
Soap Creek/Hwy 220 Ramp	1	317
Landam Creek Ramp	1	316.2
Dordon Creek Ramp	1	316.2
Hickory Knob State Park	1	316.2

Elijah Clark State Park	1, 2, 3	316
Holiday Park	1	315.6
Ft. Gordon Recreation Area	1, 2	315
Plum Branch Yacht Club	1	315
Wildwood Park	3, 4	315
Bobby Brown State Park	1, 2	315
New Bourdeaux Subdivision Ramp	1	315
Gill Point Ramp	1	314.8
Cherokee Recreation Area	1	314.6
Little River/Hwy 378	1	314.5
Parksville Recreation Area	1	314.5
Buffalo Creek Subdivision Ramp	1	314.5
Dorn	1,2,5,6	314.4
Amity Recreation Area	2	314.3
Hamilton Branch State Park (Day Use)	1	314
Hamilton Branch State Park	1, 2	314
Little River Marina	1	314
Baker Creek State Park	1	314
Tradewinds Marina	1	314
Morrahs Ramp	2	314
Amity Recreation Area	3	313.8
Big Hart Recreation Area	1	313.8
Petersburg Campground	1	313.7
Mt. Carmel Picnic	1	313.7
Modoc Ramp	1	313.5
Clarks Hill Park	1	313.5
Hawe Creek Campground	1	313.5
Little River Subdivison Ramp	1	313.5
Mistletoe State Park Low Water Ramp	1	313.5
Hesters Ferry Campground	1	312.9
Raysville Campground	1	312.2
Winfield Campground	1	311.7
Little River Marina	2	311.3
Mt. Carmel Campground	1	311
Scotts Ferry Ramp	1	310.7
Modoc Shores Subdivision Ramp	1	310.4
Keg Creek Ramp	1	309
Lake Springs Park	1, 2, 3	308.7
Dorn	3,4	308.4
Leathersville Ramp	1	306.3

There are approximately 1,962 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 are mainly utilized from May through September.

Hartwell Lake
At Hartwell Lake, there are 20 USACE operated swimming beach areas located in 12 recreation areas. When lake levels reach 654 feet msl, all designated swimming areas are dry. 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 and possibly increases the risk of fatalities. During the 1986 drought, when swimming beaches were unusable, recreation fatalities for swimming activities increased from three to fifteen. They fell to six when the beaches were back in service in 1987. During the 3 March 2007 to 26 November 2009 drought of record, there were 7 swimming fatalities while in fiscal year 2010, 2005, and 2006 there were a total of 4 swimming fatalities.

RBR Lake
At RBR, there are no USACE operated designated swimming areas.

JST Lake
At JST Lake, there are 39 USACE operated swimming beaches located in 13 recreation areas. When lake levels reach 324 feet msl, the designated swimming areas are dry. When the lake level drops below 327 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 and possibly increases the risk of fatalities. During the 3 March 2007 to 26 November 2009 drought of record, there were 5 swimming fatalities while in fiscal year 2010, 2005, and 2006 there were a total of 3 swimming fatalities.

2.4. WATER SUPPLY

Hartwell Lake
There are 8 water supply users on Hartwell Lake. The highest intake elevation is 650 feet msl. The lowest intake elevation is 611 feet msl.

RBR Lake
There are 6 water supply users on RBR. The highest intake elevation is 468.8 feet msl. The lowest intake elevation is 454.75 feet msl.

JST Lake
There are 7 water supply users on JST Lake. The highest intake elevation is 321 feet msl. The lowest intake elevation is 300 feet msl.

Downstream of JST Lake

Major water supply users downstream are the Augusta Canal and Shoals. Users with intakes in the New Savannah Bluff Lock and Dam (NSBL&D) pool include Augusta-Richmond County Water Treatment Facility, 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. These water supply users currently require a minimum normal flow from JST of 3,600 cfs to maintain adequate stage for their intakes.

2.5. Hydropower and Pumped Storage

The Southeastern Power Administration (SEPA) markets hydropower generated at Hartwell, RBR and JST dams. SEPA markets the energy through contracts negotiated between SEPA and certain preference customers. Ten hydropower facilities provide the energy and capacity requirements of the contract. These projects are located in the Savannah, Alabama-Coosa-Tallapoosa, and Apalachicola-Chattahoochee-Flint Basins. Under normal conditions, if some reservoir projects are unable to meet hydropower needs, SEPA can sometimes utilize other projects in the system when available through coordination with USACE-Mobile District and USACE-Savannah District water management. 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 USACE does not generate enough power to meet the requirements of SEPA's contract. SEPA 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. Pumped Storage consists of pumping water from below the RBR dam into the RBR reservoir during times of low demand for electricity and using this water to generate electricity during times of high demand. Pumped Storage is not possible when JST lake levels fall to approximately 312 feet msl. 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 Action 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 the SRBDCP, during which time a maximum of two pumped storage units may be used. From May 16 to May 31, USACE 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.
- There shall be no pumped storage operational restrictions from March – May when a Level II drought is declared in accordance with this plan.

- From June 1 to September 30, the Corps 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

Hartwell, RBR and JST water quality is monitored and permitted by both Georgia and South Carolina. 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 (where sufficient light penetrates to permit growth of green plants) and, lacking free circulation with surface waters, has no potential to renew dissolved oxygen (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.

As the DO of the bottom layer decreases, the DO of the top layer remains relatively constant, at approximately 7 mg/l. The level of the maximum DO concentration gradient is established at a depth of about 30 feet in July, about 40 feet in August, and about 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 in the lower portion of RBR Lake at or above 5 mg/l throughout the year. This system also maintains DO concentrations in the RBR Tailwater (upper portion of JST Lake) at or above 5 mg/l through the release of generation water from RBR into JST Lake.

Water released through Hartwell Dam for hydropower comes from the low DO layer, and adverse effects on the aquatic environment in the Hartwell tailwater area can occur. To improve the DO in the Hartwell tailwater, the Corps 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 DO 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 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 completion of the rehabilitation in 2007, discharges from Thurmond Dam possess at least 3 mg/l of DO throughout the year. A hypolimnetic oxygen injection system was also implemented at Thurmond Lake in 2011. Operation of this system increased the DO of waters within the lake, as well as those which pass through the dam to flow downstream. The system maintains DO in the lower portion of JST Lake from 3 mg/l to 5 mg/l of DO throughout the year and also improves the DO concentration of water entering the turbines at JST Dam to 3 mg/l. This DO injection system was designed primarily to replace lost coolwater habitat for Striped bass in the upper portion of JST Lake caused by four unit pumped storage operations at RBR Dam.

2.7. Water Quality in the Savannah River

The Savannah River below JST Dam is classified as “Freshwater” by SC DHEC (Watershed Water Quality Assessment-Savannah River Basin, August 2010, Technical Report No. 02F-10). 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 EPD of the GA DNR has classified the designated use of the main river as "Fishing" waters. The water quality standards for DO, 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 not fully supported along the main length of the Savannah River. Both South Carolina (2010 Section 303d list) and Georgia (2008 Section 303d list) have at least portions of the Savannah River (Thurmond Dam to Interstate 95) on their List of Impaired Waters.

SC states that aquatic life is impaired at two sites due to levels of zinc and at one site for turbidity while recreation is impaired at two sites due to fecal coliform. 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. The advisory also states that some fish also contain cesium-137 and strontium-90. The levels of these radioisotopes in fish are low and have decreased over time.

The GA Section 303(d) list states that drinking water is impaired from J. Strom Thurmond Dam to the Stevens Creek Dam due to low levels of DO, most likely as a result of releases from the dam. Savannah District has completed installation of a DO injection system within Thurmond Lake. Discharges from Thurmond Dam contain at least 5 ppm of DO throughout the year. That level meets both the Georgia and South Carolina standard for DO levels for those waters. The DO system is not designed to function in Level 4 drought.

The GA Section 303(d) list includes numerous tributaries as not meeting the designated use of Fishing for a variety of reasons, including primarily low DO or high levels of fecal coliform. GA lists the main river (Stevens Creek Dam to Tidegate) as meeting its designated uses of Drinking Water, Fishing, or Coastal Fishing. It states that Coastal Fishing is impaired from GA Highway 25 (Houlihan Bridge) to Elba Island Cut (roughly RM 4) due to low levels of DO.

The Environmental Protection Agency (EPA) has prepared the following Total Maximum Daily Loads (TMDLs) for portions of the Savannah River:

- Fecal coliform – Savannah River in Richmond County
- Lead – Savannah River between Butler & McBean Creeks
- DO – Savannah River from the Seaboard Coastline Railroad Bridge (RM 27.4 to the coast). The existing zero discharge TMDL is currently being revised by EPA's 2010 draft TMDL based on Georgia's recently revised DO standard.

Seasonal DO sags occur in the summer months in the estuarine portion of the river. EPA's TMDL for DO calls for substantial reductions in the discharge of oxygen-depleting substances from Augusta to the coast.

South Carolina DHEC classifies the estuarine portion of the river as "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 DNR-EPD has classified the designated use of the estuarine portion of the river as "Coastal Fishing."

The DO requirement for South Carolina is a daily average of 5.0 mg/L and a daily minimum of 4.0 mg/L for all of the year. The DO requirement for Georgia recently changed to effectively match that of South Carolina.

The State of South Carolina uses the current drought plan Level 3 flow of 3,600 cfs (Larry Turner, South Carolina DHEC) at the Savannah River Augusta gage for the permitting of point source discharges in the Augusta area. 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 for the permitting of point source discharges (Paul Lamarre, Georgia DNR-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 species such as white and striped bass, hybrid bass, largemouth bass, spotted bass, bluegill, pumpkinseed, redear sunfish, yellow perch, walleye, and catfish. Nongame species found within the lake include blueback herring, carp, longnose gar, redhorse and spotted sucker. The Georgia DNR and South Carolina DNR both actively stock, on average, 500,000 to 1,000,000 striped bass and hybrid bass annually in Hartwell Lake.

The Hartwell tailrace supports a coldwater put-and-take trout fishery that is supported by stocking from both States. Georgia DNR-EPD classifies the Savannah River in Hart County (which includes the Hartwell tailrace) as Secondary Trout Waters. Secondary Trout Waters are described as waters capable of supporting trout throughout the year despite no evidence of natural trout reproduction. Striped bass 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). Water control management procedures are followed by the 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 are stocked annually in JST Lake. Robust redhorse can also be found in the JST reservoir.

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 fishermen net blueback herring in the RBR tailrace and in JST and RBR Lakes.

2.8.4. Aquatic Plants at Hartwell Lake

Aquatic plants are not abundant in Hartwell Lake. There is a small stand of water primrose in Eighteen Mile Creek that does not appear to change in distribution or abundance from year to year. There is concern that hydrilla will be introduced from J. Strom Thurmond Lake or Keowee

Lake into Hartwell Lake. In an effort to identify the spread of hydrilla as early as possible, boat surveys are conducted periodically throughout the summer and fall of each year.[1]

2.8.5. Aquatic Plants at RBR Lake

Boat surveys are conducted periodically throughout the summer and fall to determine plant distribution and abundance. Approximately one acre of hydrilla was present in RBR Lake in the Bond Creek area during the 2009 growing season. No hydrilla was detected in RBR Lake in 2010 or 2011. Approximately 5-10 acres of Brazilian Elodea is present on the Savannah River one to five miles below Hartwell Dam. Brazilian elodea has consistently been detected in these same areas of RBR Lake for the past 5 years and the abundance and distribution appears to be very stable. Aquatic plant growth has not reached nuisance levels requiring treatment.

2.8.6. Aquatic Plants at JST Lake

An extensive survey of Hydrilla distribution and abundance was conducted on Thurmond Lake in 2010. Hydrilla was found along 641 miles of shoreline with an estimated abundance of 4,959 acres. The majority of plant growth occurs in water depths less than 15 feet. The Thurmond Project staff monitors the abundance and migration of hydrilla in the reservoir annually. If treatment is required, an appropriate herbicide is selected and used for control based upon site location, desired level of control, and cost per acre. Annual changes in the proposed treatment program are coordinated with the GA DNR, SC DNR, and affected outgrantees prior to implementation.

Approximately 200 water hyacinth plants were found in the Clarks Hill Park area of JST Lake during September 2008 and were removed by hand. No water hyacinth plants have been found since 2008.

In 2010, approximately 32 acres of water primrose and 10 acres of alligatorweed were discovered growing in the Little River, SC and Dry Fork Creek portions of the lake. In 2011, an additional 62.2 acres of alligator weed was found in Little River, SC and 5.1 acres in Big Creek, GA. This plant growth is also monitored annually.

A large population (approximately 600 acres) of slender pondweed was present in the Savannah River headwaters of JST Lake (RBR tailwater) in 2008. In 2009, 81.2 acres of slender pondweed were treated. In 2011, the plant was detected throughout most of the area immediately below RBR dam and affected RBR pumpback operations during the last drought. The plant abundance did not warrant herbicide treatments in 2011.

[1] Exec. Order No. 13,112, 64 F. R. 6183 (1999) (Executive Order 13112 directs federal agencies to take actions to prevent the introduction of invasive species and control populations of invasive species in a cost-effective and environmentally sound manner. Executive Order 13112 is applicable to actions taken at Hartwell Lake, RBR Lake and JST Lake).

2.8.7. Aquatic Plants at New Savannah Bluff Lock and Dam

Aquatic plant populations in the upstream embayment were monitored periodically throughout the 2011 growing season. The following aquatic plants were identified: water hyacinth, elodea, fanwart, pickerelweed, and cattail.

2.8.8. Largemouth Bass Spawning

State natural resource agencies have identified largemouth bass spawning at the three 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 submerging 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).

In most years, 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 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 spawning. Maintaining these stable lake levels may not always be possible during drought.

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 River 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. Sturgeons are known to have migrated well into the Piedmont. A portion of the river was diverted in 1846 at the site of the Augusta Diversion Dam. In 1875, that structure was extended to the entire channel width to create the present Augusta Diversion Dam. That structure restricted inland migration of diadromous species except during high flow periods when the Dam was overtopped. When those conditions occurred, some fish species could continue their upstream migrations. A fish ladder was installed in 1886, but it is presently not considered to be effective in passing fish upstream. Completion of the New Savannah Bluff Lock and Dam (NSBLD) in 1937 further restricted spawning migrations in many years to below RM 265, with the exception of high flow periods that occurred during the spawning season. During the late 1950's through the early 1960's, the USACE Savannah River navigation project constructed 38 cuts across meander bends that shortened the river by 78 miles. As a result of these cutoffs, the NSBLD is now located at RM 187.3. The Stevens Creek Dam, a South Carolina Electric and Gas hydroelectric facility, was constructed 0.9 miles 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. Some species pass upstream by swimming through fully-opened dam gates at flows of 24,000 cfs or higher, and by swimming through the navigation lock when it is operated in a manner suitable for fish passage. The NSBLD restricts passage of sturgeon to periods when high flows overtop the riverbanks during the spawning season. In 2006, The Nature Conservancy monitored the movement of tagged shortnose sturgeon fish when flows exceeded the height of the dam but stayed within the river banks. TNC could not identify any passage of shortnose sturgeon upstream of the NSBLD under those flow conditions. Without access to the upstream shoal spawning habitat, gravel bars downstream of the NSBLD likely represent the only remaining spawning habitat for shortnose sturgeon in the Savannah River. The proposed Savannah Harbor Expansion Project includes a fish bypass with all flows up to 8,000 cfs going through the bypass. Shortnose sturgeon and other important species have been identified at gravel bars downstream of the NSBLD (river miles 179-190, 275-278, and 286) during spawning months of February and March (Hall and Lamprecht, 1991, Grabowski and Isely, 2006, and Wrona, unpublished data). Research conducted in 1999-2000 (Collins et al 2002) indicate there has been no increase in recruitment of shortnose sturgeon into the population over the previous 8 years, but that an observed increased number of shortnose in the river was due to the stock enhancement program conducted by SC DNR from 1990-1992.

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 have opened the fishery for that species in the estuary.

Essential Fish Habitat in the Savannah River estuary includes saltmarsh. The structure and function of a saltmarsh are influenced by tide, salinity, nutrients and temperature. Saltmarsh can be a stressful environment to plants and animals, with rapid changes occurring in these abiotic variables (Gosselink 1980; Gosselink et al. 1974). Although species diversity may be lower than in other systems, saltmarsh is one of the most biologically productive ecosystems in the world (Teal 1962; Teal and Teal, 1969). The high primary productivity that occurs in the marsh, and the transfer of detritus into the estuary from the marsh, provides the base of the food chain supporting many marine organisms. The Estuarine Water Column is also considered to be Essential Fish Habitat and is highly influenced by the maintenance of Tidal Freshwater Marsh. Oyster beds, in more saline waters, are also considered to be Essential Fish Habitat.

USACE, Georgia DNR, South Carolina DNR, USFWS, and NOAA Fisheries 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. Forested wetlands provide important wintering habitat for many waterfowl species and nesting habitat for wood ducks. Many species of woodpeckers, 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 in 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 community.

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 in streams and ponds of the Coastal Plain study area.

Wetland Habitat

In 2006, the Fish and Wildlife Service conducted a freshwater mussel survey in the Savannah River to determine species composition and distribution of mussels. The objective of the 2006 mussel survey was to estimate species composition and distribution in the Savannah River; however, the surveyors only visited a small portion of the available habitat in the river. Specifically, the study encompassed the portion of the river from the Augusta Shoals region (RM 203) near the Fall Line downstream to the tidewater region (RM 22.8) near Savannah. The 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. 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. 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 many years. The population of Savannah liliput upstream of Little Hell boat landing (Allendale County) may be the largest remaining population of this species. Savannah liliput in the Savannah River 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 DO 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. The robust redhorse, shoals spider lily, Altamaha arcmussel, brother spike and the federally-listed Atlantic sturgeon, shortnose sturgeon, manatee, and wood stork are the only

Threatened or Endangered Species that may possibly be affected by small changes in flow. Low flows can restrict spawning of the Atlantic Sturgeon, shortnose sturgeon and robust redhorse on gravel bars in the areas downstream of NSBLD. Low flows could also expose the shoals spider lily to deer grazing at the Augusta Shoals. The Altamaha arcmussel can be exposed in oxbows.

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 development, harbor deepening, and sea level rise, 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. This was at least partially the result of 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. The cessation of operation of the Tidegate (leaving the Tidegate open beginning in 1990) restored salinity levels in Back River to those experienced in the 1980's. 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 partially reopened in October 2005.

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
Atlantic sturgeon	*Acipenser oxyrinchus*	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

** 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]	
Alasmidonta arcula	Altamaha Arcmussel	T	
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	
Elliptio fraterna	Brother Spike		SE
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	

SCIENTIFIC NAME	COMMON NAME	GA STATE STATUS	SC STATE STATUS
Notropis hypsilepis	Highscale Shiner	T	
Notropis photogenis	Silver Shiner	E	
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	
Toxolasma pullus	Savannah Lilliput	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

2.10. 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.

2.10.3. General Economic Activity

In a study conducted by the Strom Thurmond Institute of Government and Public Affairs at Clemson University titled "An Economic Analysis of Low Water Levels In Hartwell Lake" dated November 8, 2010, the regional economic impacts of low lake levels on the six county region bordering Hartwell Lake were examined. The estimated economic impacts of low water levels in Hartwell Lake, while measurable, are small when compared to the overall level of economic activity in these six counties. In the six county region as a whole, the estimated decrease in output resulting from low water levels was about one-tenth of one percent of the value of total regional output. This study demonstrated that Hartwell Lake is not a primary economic driver in the region and provides evidence that the six counties surrounding Hartwell Lake have sufficient breadth and depth to weather prolonged low lake levels without realizing substantial declines in their economic well-being. This analysis also showed that the impact of low lake levels on real estate sales is measurable, but not the primary factor driving the large decline in transactions. The study acknowledged that economic fluctuations tend to be felt by the people most vulnerable to changes in specific areas of economic activity. In the case of lower lake levels, USACE recognizes that those who feel the economic effects the most are those business, property owners, and communities located closest to a lake who rely heavily on it as the sole resource for their livelihood and well-being.

2.11. Soils and Sediment

Like other basins of large rivers in the Southeast which flow into the Atlantic Ocean, the Savannah River Basin embraces three distinct areas: the mountain section, the Piedmont Province and the Coastal Plain. The rocks of the mountain section and the Piedmont Plateau are indurated and largely crystalline. They are of igneous or metamorphic origin and include granites, gneisses, schists, basic eruptives, and highly metamorphosed shales, sandstones and limestones. These rocks constitute the oldest within these states and are probably, in the main, of pre-Cambrian age. They have been subjected to great organic movement and have been folded and faulted to considerable degree. On most level or gently sloping areas, the rocks have disintegrated to a depth of many feet and the surface is largely formed of residual material. This section includes some mountainous areas and deep valleys, but no lowlands or general highlands. The Coastal Plain differs from the Piedmont Plateau chiefly in the character of the terrain and in the kind of rocks that underlie it. It is built on much younger water-lain deposits of sand, clay, and limestone, and rests on a foundation which is the buried continuation of the crystalline rocks of the Piedmont belt. It is difficult to determine from the ground surface where the Piedmont belt ends and the Coastal Plain begins. However, in the river beds, the distinction is noticeable, as the hard crystalline rocks give rise to falls or rapids.

The problem of sediment in the Savannah River Basin has been greatly reduced since the early 1900's by the conversion of much former cropland to silviculture and pasture. Cotton farming, considered a highly erosive land use, greatly declined in central Georgia and western South Carolina during the last century. This and widespread implementation of soil conservation practices have resulted in lessened stream sediment loads. Deposits of silt in the reservoirs and channel retrogression below the dams are not major problems.

2.12. HAZARDOUS, TOXIC AND RADIOACTIVE WASTE (HTRW)

The documented accounts of HTRW in the Savannah River Basin at and below drought river and lake levels are limited. The presence of polychlorinated biphenyls (PCBs) in Twelvemile Creek/Lake Hartwell was discovered when surface water, sediment, and fish from the area were sampled in the mid-1970s. The source of this contamination was determined to be the Sangamo-Weston, Inc. capacitor manufacturing plant in Pickens, South Carolina. Sangamo-Weston, Inc. operated the plant from 1955 to 1987. The liabilities associated with that operation were subsequently assumed by Schlumberger Technology Corporation (STC). Dielectric fluids, used in the manufacture of capacitors until 1977, contained PCBs, and materials containing these fluids were disposed via land burial. In addition, PCBs were present in discharges from the plant to Town Creek (a tributary of Twelvemile Creek). Surface water and sediment contaminated by the discharged PCBs eventually migrated downstream to Twelvemile Creek and Lake Hartwell.

In 1994, the United States Environmental Protection Agency (EPA) issued a Record of Decision (ROD) for the Twelvemile Creek/Lake Hartwell area that included natural recovery of PCB-contaminated sediments. This alternative was supported by studies showing that PCB-contaminated sediments are expected to be continually buried by sediment entering Twelvemile Creek and Lake Hartwell. In addition, the ROD called for ongoing monitoring of biota, adoption of risk-based guidelines for human consumption of Lake Hartwell fish, and a public education program designed to increase public awareness of the fish consumption advisory.

2.13. CULTURAL RESOURCES

The Savannah River Basin has a long history of human occupation with earliest evidence of settlement dating as far back as the Paleoindian Period, ca. 9,500 B. C. The basin has long been an area of archaeological interest for researchers. Prior to the impoundment and subsequent inundation of JST Lake (aka Clark Hill), Hartwell Lake and RBR Lake cultural resources investigations of varying degrees of comprehensiveness were conducted. The surveys also included some portions of the Savannah River bank that are included in USACE management from the headwaters of Hartwell Lake to below JST dam. Recent archaeological investigations at JST and Hartwell have focused primarily on the upland areas (i.e., above 335 ft amsl), although smaller shoreline surveys have been conducted at JST.

Archaeological fieldwork conducted in the late 1940s and early 1950s through the Smithsonian Institution's River Basin Survey identified more than 200 sites at JST, with limited excavation conducted at a minimum of 21 of the sites by former Smithsonian Institution and University of Georgia personnel (Elliott 1995). The survey focused on site visits to locales reported by local collectors, previously recorded sites and visits to likely village sites as determined through archival research and previous experience of working in similar environmental settings. Some of the recorded sites were discovered during excavation of the reservoir. Nearly 100 of the sites were determined to be flooded by the inundation of JST (i.e., at or below 335 above msl) and almost the same number was situated outside of the flood pool.

More recently shoreline surveys of JST have been conducted that resulted in the recordation of numerous previously unrecorded archaeological sites. In 1983-84, the US Forest Service identified 54 sites, 38 of which had been previously unrecorded. Sites ranged from the Early Archaic period (8,000 B.C. – 6,000 B.C.) to the early 20th century (Elliott 1995). Anderson et al. (1994) conducted a terrestrial and underwater survey of a two mile section of lake shore and a 440 acre upland tract that identified 14 upland sites, 32 sites along the shoreline as well as one underwater site. Only the underwater site had been previously located by the River Basin Survey in the 1940s-1950s.

Archaeological surveys conducted in the mid-late 1990s at JST by cultural resources firms contracted by Savannah District focused exclusively on upland areas. These large-scale surveys were conducted to comply with Section 110 of the National Historic Preservation Act, as amended (NHPA) in areas that were managed for timber. As a result of the surveys, over 1600 archaeological sites, isolated finds and rockpiles were recorded. A wide array of site types are represented at JST, ranging from prehistoric camp sites to 19th-20th century mills and cemeteries.

Hartwell Lake lies in the Upper Savannah River basin, an area which has also received considerable archaeological research attention. Construction of the proposed Hartwell dam prompted the first archaeological investigations of the area by Joseph Caldwell in 1952. The reconnaissance-level survey examined the uppermost 8 miles of the Savannah River, approximately 40 miles of the Tugaloo River, and 32 miles of the Seneca-Keowee Rivers (Caldwell 1953). Caldwell recorded 54 archaeological sites and provided management recommendations based on a full pool level of 665 ft above msl for the proposed lake (full pool level was later changed to 660 ft above msl). Six of the sites were recommended for additional excavations and one site was recommended for additional testing. Among the sites excavated were 3 mound sites, Chauga, Estatoe, and Tugalo. A recent review of the Caldwell survey indicated that several of the sites had been incorrectly plotted and steps have been taken to provide suggestions on the true locations of the sites (Sweeney and Whitely 2011). Rectification of the data suggests that at least four of the sites noted as inundated are actually outside of the flood pool (i.e., above 665 ft amsl).

Cultural resources investigations of upland areas at Hartwell Lake were conducted in the late 1970s and early 1980s to comply with Section 106 of the NHPA, resulting in the identification of 92 archaeological sites. A large-scale, approximately 3,727-acre Section 110 of the NHPA survey was conducted in 2010 (Sweeney and Whitely 2011). Water levels during the field survey ranged from 660.58-661.19 ft amsl, which prohibited investigation of shoreline areas. The survey resulted in identifying 47 previously unrecorded archaeological sites. None of the sites were recommended eligible for the National Register of Historic Places.

Of the three multi-purpose projects, RBR has been subjected to the most archaeological investigations. Surveys were conducted in 1970 (Hutto) and 1978 (Taylor and Smith) in areas that would be impacted by construction or impoundment; 48 and 400 site locations were recorded, respectively. More than 35 of the sites recorded by Taylor and Smith were excavated as part of the Richard B. Russell Cultural Resource Mitigation Program, which was sponsored by Savannah District and the National Park Service. The program included testing and data recovery at a variety of prehistoric and historic sites.

Until recently, surveys have been conducted of the upland areas to comply with Section 106 of the NHPA. A recent large-scale, 2465-acre Section 110 of the NHPA survey was conducted by Brockington and Associates that identified 31 previously undocumented archaeological sites (Sweeney and Whitely 2011). Additional investigation was recommended at 6 sites to definitively determine NRHP-status. Fieldwork was limited to the upland areas surrounding the lake.

Archaeological sites have been recorded along the bank of the Savannah River below JST on lands that are not managed by the Corps. Like the sites recorded upstream of JST, the archaeological sites reflect occupations dating from the early prehistoric period through the 20th century.

2.14. FLOOD CONTROL

Hartwell, RBR and JST Lakes each have 5 feet of flood control storage with the top of the flood control pools at elevation 665.0, 480.0 and 335.0 respectively. The combined storage is 823,000 acre-feet. The action proposed in this document deals with water management during drought conditions, so flood control is outside the scope of this document.

2.15. CLIMATE CHANGE

For this analysis, the potential effects of climate change, including changes in storm frequency, intensity, and duration, are uncertain at present and the effects on a particular area are even more unknown. Estimated global land precipitation increased by approximately 2% over the course of the 20th century, though the calculated trend varies if different time endpoints are chosen, complicated by the El-Nino Southern Oscillation (ENSO), other oscillations, including greater global land precipitation in the 1950s and 1970s than the later 1980s and 1990s despite the positive trend over the century overall. Similar slight overall increases in global river runoff and in average soil moisture has been observed.

According to NOAA, the historic sea level change trend at the Fort Pulaski gage based on 70 plus years of data collection is a rise of 2.98 mm/year. Scientific opinions vary on how this trend will continue in the coming years with the effect of greenhouse gases, changing climate, and other variables influencing sea level change. Sea level change estimates for 50 years are 0.5 ft, 0.9 ft and 2.3 ft, for some low, intermediate and high scenarios, respectively. Assuming that there will be some sea level rise over 50 years, the saltwater interface can be expected to move inland, unless the previously discussed river runoff returns to an increase as in the 1970's.

3.0 DESCRIPTION OF THE PROPOSED ACTION AND OTHER ALTERNATIVES

3.1. ALTERNATIVE FORMULATION

The objective of the alternative formulation process was to assess changes to the existing SRBDCP that focus on conservation of water resources during droughts. A District- level Project Delivery Team (PDT) was formed to develop a basic set of alternatives for consideration. Subsequent meetings were held to review model output, allowing comparison between the proposed alternatives and the No Action Alternative. The alternatives include a broader range of available releases than the SRBDCP, while still attempting to balance impacts on project purposes.

A minimum downstream flow of 3,600 cfs plus local inflow in the Savannah River below Thurmond Dam at Augusta has become the standard upon which both Georgia and South Carolina base their various water quality permitting and upon which downstream public and private infrastructure has built their intakes. Through extensive collaboration, it has been determined that it is possible to deviate below 3,600 cfs at Thurmond Dam for severe drought management purposes during times of year that are likely to have less of an impact on water quality, water supply, and habitat. A wintertime flow reduction strategy, whereby the minimum daily average release at Thurmond Dam was adjusted from 3,600 cfs to 3,100 cfs during the cooler months while in Action Level 4, was incorporated into the SRBDCP in the 2011 Level 4 Drought Operations EA and following Standard Operating Procedure (SOP) produced by the Corps. The District considered the comments that the natural resource agencies and the public provided on the last EA that the District prepared concerning the way it manages discharges from its three reservoirs on the Savannah River.

3.2. ALTERNATIVES

Alternatives (see Table 5) were developed for consideration as part of the planning process and include:

a. NAA (Continue with the SRBDCP, 1989 as amended in 2006 and 2011)
b. Alternative 1
c. Alternative 2 (Selected)
d. Alternative 3
e. Alternative 4
f. Other Alternatives Considered But Eliminated From Detailed Consideration

Table 5: Thurmond Release Targets for Drought Plan Revision Alternatives
(cubic feet per second)

Level	NAA	Alt 1	Alt 2	Alt 3	Alt 4
1	Max 4200 Min 4000	4200; BI > 10% Qin 4000; BI ≤ 10% Qin	4200; BI > 10% Qin 4000; BI ≤ 10% Qin	4200; BI > 10% Qin 4000; BI ≤ 10% Qin	4200; BI > 10% Qin 4000; BI ≤ 10% Qin
2	Max 4000 Min 3800	4000; BI > 10% Qin 3800; BI ≤ 10% Qin	4000; BI > 10% Qin 3800; BI ≤ 10% Qin 3600 Nov-Jan	4000; BI > 10% Qin 3800; BI ≤ 10% Qin 3600 Nov-Jan	4000; BI > 10% Qin 3600; BI ≤ 10% Qin
3	3800	3800	3800 3100 Nov-Jan	3600 3100 Nov-Jan	3600 3100 Nov-Jan
4	3600 3100 Nov-Jan*	3600 3100 Nov-Jan*	3600 3100 Nov-Jan*	3600 3100 Nov-Jan*	3600 3100 Nov-Jan*

BI = (Basin Inflow) Current 28 day average streamflow at Broad River near Bell gage
10% Qin is defined as the 10^{th} percentile 28-day average flow at the Broad River near Bell
*Continue level 4 releases as indicated for as long as possible, thereafter Outflow=Inflow.

3.2.1. No Action Alternative

This alternative consists of the Corps taking no action to modify its existing 1989 SRBDCP, as amended in 2006 and 2011. This alternative is considered in detail and is evaluated in regard to all environmental concerns**.**

Action levels were established in the 1989 SRBDCP and are based on pool elevations at Hartwell and Thurmond Lakes. See Figures 8 and 9 and Tables 6 and 7 for more presentation of the Action Levels and the associated Action. Russell Lake has a relatively small conservation pool; therefore, it does not have delineated action thresholds. Due to the nature of pumped storage operation, Russell Lake may vary throughout its five-foot conservation pool through Action Level 3.

As a drought ends and conditions begin to improve, the reservoirs would be refilled in the opposite order that they were drafted. As both Hartwell and JST pools rise 2 feet above the top of the drought zone for which they are currently operating, the target flow will reset to the next higher zone.

Table 6: 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 is issued. Reduce Thurmond discharge to 4,200 cfs weekly average (the point at which flows transitioned from the max to the min within each zone was based on engineering judgement), reduce Hartwell discharge as appropriate to maintain balanced pools.
2	654	652	Reduce Thurmond discharge to 4,000 cfs weekly average (the point at which flows transitioned from the max to the min within each zone was based on engineering judgement), 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	Reduce Thurmond discharge to 3,600 cfs daily average. Further reduce Thurmond discharge to 3100 cfs for November through January (February reduction from 3,600 to 3,100 cfs requires NOAA Fisheries pre-approval).

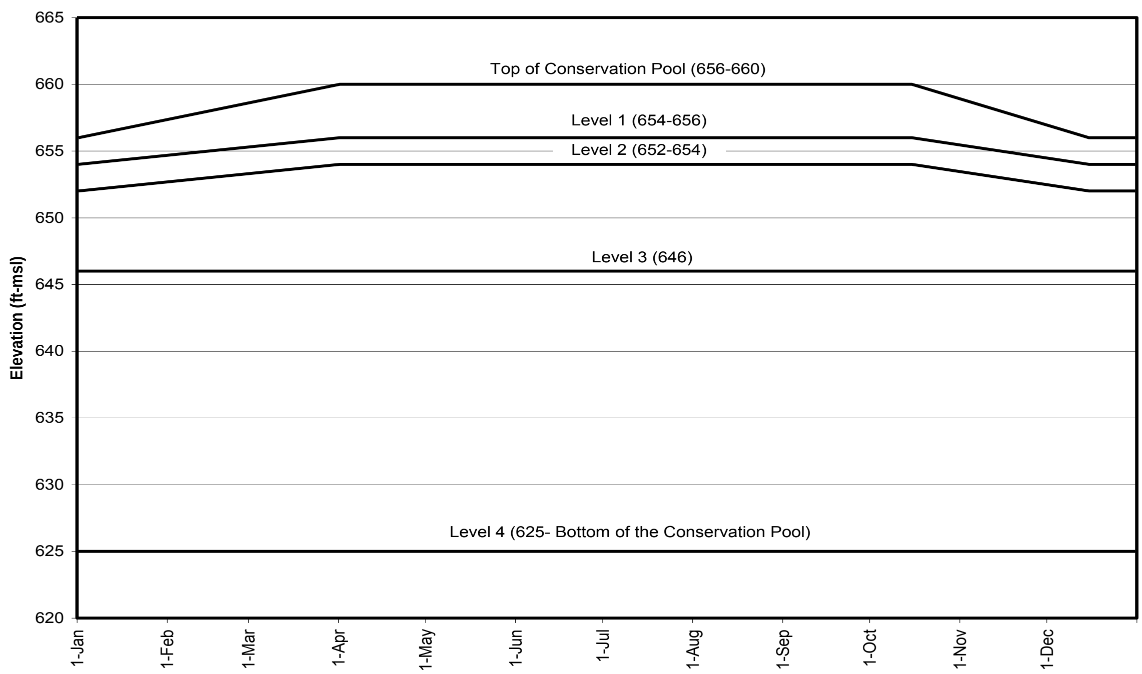


Figure 8: Hartwell Action Levels for the No Action Alternative

* Level as shown in Figure 8
** 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 7: 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 is issued. Reduce Thurmond discharge to 4200 cfs weekly average (the point at which flows transitioned from the max to the min within each zone was based on engineering judgement), reduce Hartwell discharge as appropriate to maintain balanced pools.
2	324	322	Reduce Thurmond discharge to 4000 cfs weekly average (the point at which flows transitioned from the max to the min within each zone was based on engineering judgement), 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	Reduce Thurmond discharge to 3,600 cfs daily average. Further reduce Thurmond discharge to 3100 cfs for November through January (February reduction from 3,600 to 3,100 cfs requires NOAA Fisheries pre-approval).

* Level as shown in Figure 9
** 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

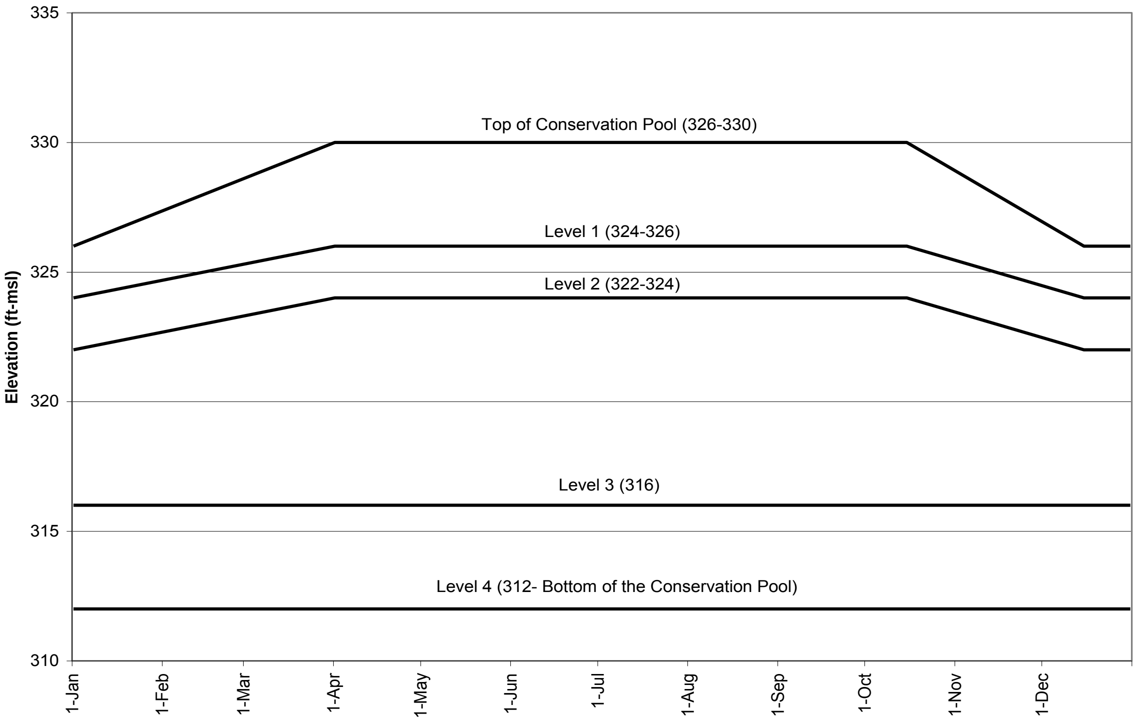


Figure 9: Thurmond Action Levels for the No Action Alternative

As described in the 1989 SRBDCP, the Savannah District would 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 River Basin projects have never reached Level 4 in the 21 years that the plan has been in place.

In Level 4 during November through January, once a 3,100 cfs discharge is targeted at Thurmond in a given year, monitoring efforts associated with an adaptive management strategy would be coordinated through the Savannah River Basin Drought Coordination Committee (SRBDCC). This Committee consists of representatives from each of the following organizations: Savannah District, South Atlantic Division, Georgia DNR, South Carolina DNR, USFWS and NOAA Fisheries. The flow reduction would be maintained through the end of February or until such time that a monitoring parameter, as defined in Table 8, is outside of acceptable levels. If concerns arise, the monitoring organization would notify the State, who would review the information and discuss the results with the SRBDCC. If appropriate, the State would recommend to the Savannah District adjustments to Thurmond release levels. If requested by either the State of Georgia or South Carolina, the Corps will make a decision about restoring the Thurmond discharge to as much as the 3,600 cfs daily average. NOAA Fisheries will also be involved in monitoring and will initiate discussions with the SRBDCC concerning the potential impact to spawning shortnose sturgeon or other aquatic resources. Savannah District will accept a request from the Department of Energy's Savannah River Site to increase flows during a 3,100 cfs flow window. If the District receives such a request, it would coordinate with the States as part of its evaluation of whether to increase flows at that time. The critical monitoring objectives and monitoring organizations are described in Table 8 below.

Table 8: Critical Monitoring Objectives and Responsible Parties

Location	Target	Monitoring Organization
Augusta Shoals	Flow > 1,500 cfs	City of Augusta and USFWS
USGS 021989773 (USACE Dock)	DO > 5.0 mg/L daily average DO > 4.0 mg/L instantaneous Temperature ≤ 90 ºF pH 6.5-8.5	GA DNR-EPD
USGS 02198840 (I-95 Bridge)	Conductivity < 10,000 µS/cm	GA DNR-EPD
Abercorn Creek	Chloride < 16 ppm	City of Savannah
USGS 02198500 (Clyo)	Flow > 4,500 cfs	SC DHEC
Various	Water level at the intakes	Intake operators
Various	Sturgeon migration	SC DNR and NOAA Fisheries

The values shown above in Table 8 are general performance targets and are not intended to be mandatory requirements. Failure to achieve the desired targets would initiate an evaluation of impacts, which could lead to a request by the State of Georgia, the State of South Carolina, or NOAA Fisheries to the Corps to restore the discharges from Thurmond Dam to 3,600 cfs. The District expects the following offices in Table 9 to represent their agencies.

Table 9: Offices Representing Agencies

Agency	Office	Individual
GA DNR-EPD	Watershed Protection Branch	Jeff Larson, Assistant Branch Chief
SC DNR	Office of Environmental Programs	Bob Perry, Director
SC DHEC	Bureau of Water	David Baize, Assistant Bureau Chief
NOAA Fisheries, Southeast Regional Office	Protected Resources Division	Stephania Bolden, Fishery Biologist
USFWS	National Wildlife Refuge	Chuck Hayes
DOE	Savannah River Site	Bill Payne

3.2.2. Alternative 1

Alternative 1 consists of retaining the major components of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) with one modification. The modification is intended to improve drought response to include a representative of basin inflow as a water control

management trigger. This allows varying discharge within Levels 1 and 2 by referring to the 10th percentile flow at the USGS Broad River near Bell, GA streamgage. Streamflow at this location is a good representation of inflow into the basin as a whole because the Broad River is a large unregulated basin with a long period of record (currently at 79 years). The 10th percentile flow is defined as the 28 consecutive day average of streamflow data compared to the same 28-day average for the historic flow at the gage. The 10 Percentile flow is being computed by the USGS and is explained on their web page at
http://waterwatch.usgs.gov/new/index.php?m=pa28d&r=ga&w=map.
Weekly reservoir release calculations will be conducted each Wednesday and the current 28 day average percentile will be compared to the 10th percentile to determine the following week's release target from JST. For example, when in Level 1 of this Alternative, if the current percentile inflow is greater than the 10th percentile flow, then the prescribed JST release is 4200 cfs. Alternatively, if the current percentile inflow is less than or equal to the 10th percentile flow, then the prescribed JST release is 4000 cfs. For Level 2 of this Alternative, if the current percentile inflow is greater than the 10th percentile flow, then the prescribed JST release is 4000 cfs. Alternatively, if the current percentile inflow is less than or equal to the 10th percentile flow, then the prescribed JST release is 3800 cfs. For Levels 1-3, the Hartwell discharge would be reduced as appropriate to maintain balanced pools. See the below Table 10 for more presentation of the Alternative 1 Action Levels. See Figure 10 below, where the blue shaded area represents the time when the Broad River gage indicates flow was lower than the 10th percentile 28 day average during the drought of record. 56 % of the time the indicator was below the 10th percentile flow and 44% of the time it was above the 10th percentile during the drought of record. See the below Table 10 for more presentation of the Alternative 1 Action Levels.

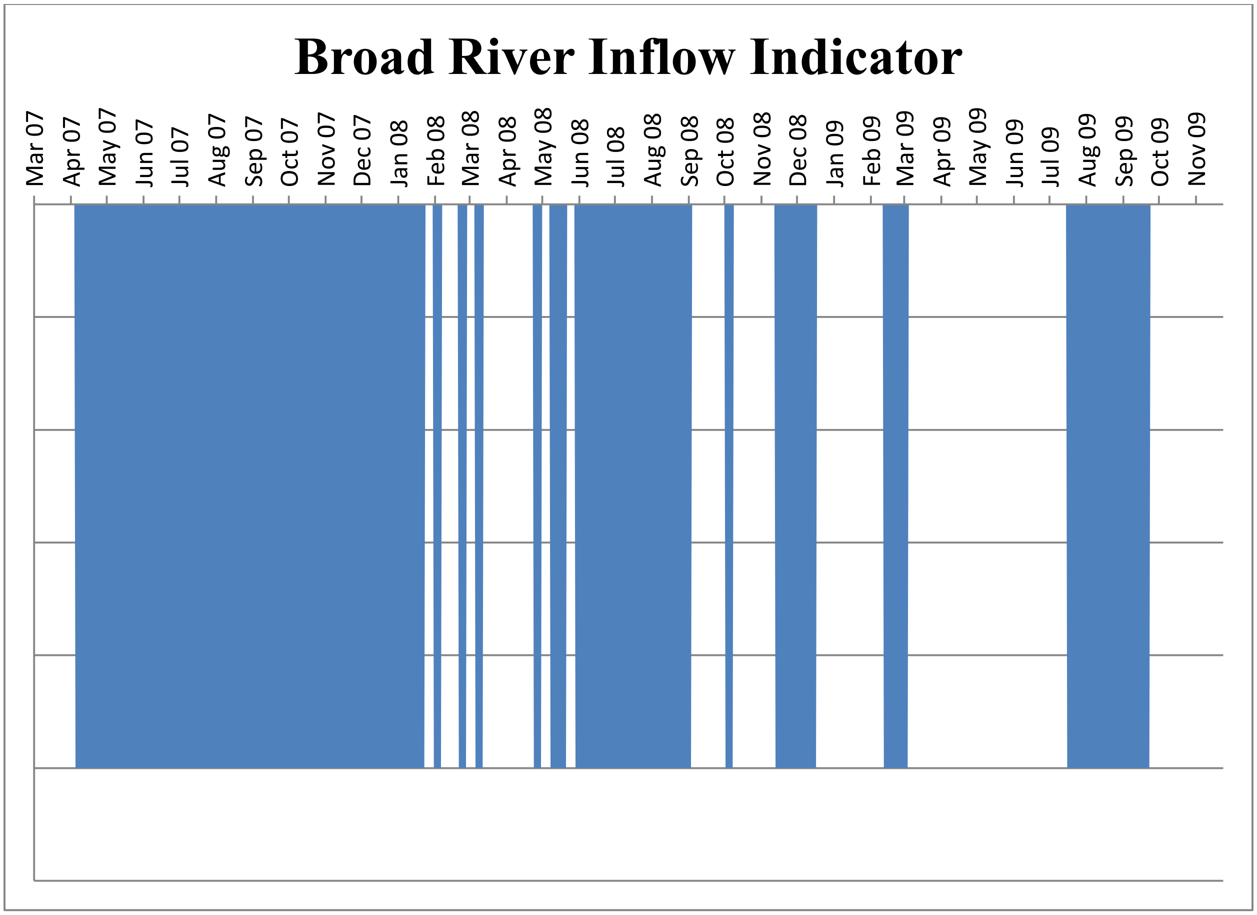


Figure 10. Broad River Inflow Indicator

Table 10: Hartwell and Thurmond Action Levels for Alternative 1

LEVEL*	1 APR – 15 OCT (FEET MSL)	15 DEC – 1 JAN** (FEET MSL)	ACTION
1	656, 326	654, 324	Public safety information is issued. 4200 cfs, >10% Q in (column is JST, typ.) 4000 cfs, ≤10% Q in Reduce Hartwell discharge as appropriate to maintain balanced pools.
2	654, 324	652, 322	4000 cfs, >10% Q in 3800 cfs, ≤10% Q in Reduce Hartwell discharge as appropriate to maintain balanced pools.
3	646, 316	646, 316	3800 cfs Reduce Hartwell discharge as appropriate to maintain balanced pools.
4	625, 312	625, 312	Same as No Action Alternative.

* Level as shown in Figure 8, 9
** 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

3.2.3. Alternative 2

Alternative 2 (Selected) consists of retaining the major components of Alternative 1 and modifying the discharge of Levels 2 and 3. For Level 2 of this Alternative, if the current 28-day Broad River percentile inflow is greater than the 10th percentile flow, then the prescribed JST release would be 4000 cfs from February through October. For Level 2 of this Alternative, if the current percentile inflow is less than or equal to the 10th percentile flow, then the prescribed JST release would be 3800 cfs from February through October. The November to January discharge for Level 2 would be 3600 cfs (February extension of 3600 cfs could be implemented with NOAA Fisheries pre-approval). The Level 3 JST release for February through October would be 3800 cfs and the target for November through January discharge would also be reduced to 3100 cfs (February extension of 3100 cfs could be implemented with NOAA Fisheries pre-approval). If requested by either the State of Georgia or South Carolina, the Corps would restore the Thurmond discharge up to 3800 cfs daily average for the 3100 cfs release in Level 3. For Levels 1-3, the Hartwell discharge would be reduced as appropriate to maintain balanced pools. See the below Table 11 for more presentation of the Alternative 2 Action Levels.

Table 11: Hartwell and Thurmond Action Levels for Alternative 2

LEVEL*	1 APR – 15 OCT (FEET MSL)	15 DEC – 1 JAN** (FEET MSL)	ACTION
1	656, 326	654, 324	Public safety information is issued. 4200 cfs, >10% Q in 4000 cfs, ≤10% Q in Reduce Hartwell discharge as appropriate to maintain balanced pools.
2	654, 324	652, 322	4000 cfs, >10% Q in 3800 cfs, ≤10% Q in 3600 cfs, November to January (February reduction to 3,600 cfs requires NOAA Fisheries pre-approval). Reduce Hartwell discharge as appropriate to maintain balanced pools.
3	646, 316	646, 316	3800 cfs 3100 cfs, November to January (February reduction from 3,800 to 3,100 cfs requires NOAA Fisheries pre-approval). Reduce Hartwell discharge as appropriate to maintain balanced pools.
4	625, 312	625, 312	Same as No Action Alternative.

* Level as shown in Figure 8, 9
** 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

3.2.4. Alternative 3

Alternative 3 consists of retaining the major components of Alternative 1 and modifying the discharge of Levels 2 and 3. For Level 2 of this Alternative, the JST discharge for November through January would be reduced to 3600 cfs (February extension of 3600 cfs could be implemented with NOAA Fisheries pre-approval).. The Level 3 JST release for February through October would be 3600 cfs and the target for November through January discharge would also be reduced to 3100 cfs (February extension of 3100 cfs could be implemented with NOAA Fisheries pre-approval). If requested by either the State of Georgia or South Carolina, the Corps would restore the Thurmond discharge up to 3600 cfs daily average for the 3100 cfs release in Level 3. For Levels 1-3, the Hartwell discharge would be reduced as appropriate to maintain balanced pools. See the below Table 12 for more presentation of the Alternative 3 Action Levels.

Table 12: Hartwell and Thurmond Action Levels for Alternative 3

LEVEL*	1 APR – 15 OCT (FEET MSL)	15 DEC – 1 JAN** (FEET MSL)	ACTION
1	656, 326	654, 324	Public safety information is issued. 4200 cfs, >10% Q in 4000 cfs, ≤10% Q in Reduce Hartwell discharge as appropriate to maintain balanced pools.
2	654, 324	652, 322	4000 cfs, >10% Q in 3800 cfs, ≤10% Q in 3600 cfs, November to January (February reduction to 3,600 cfs requires NOAA Fisheries pre-approval). Reduce Hartwell discharge as appropriate to maintain balanced pools.
3	646, 316	646, 316	3600 cfs 3100 cfs, November to January (February reduction from 3,600 to 3,100 cfs requires NOAA Fisheries pre-approval). Reduce Hartwell discharge as appropriate to maintain balanced pools.
4	625, 312	625, 312	Same as No Action Alternative.

3.2.5. Alternative 4

Alternative 4 consists of retaining the major components of Alternative 1 and modifying the discharge of Levels 2 and 3. For Level 2 of this Alternative, if the percentile inflow is less than or equal to the 10th percentile flow, then the prescribed JST release is 3600 cfs. The Level 3 Thurmond release target would be 3600 cfs. The Level 3 Thurmond release target for November through January would also be reduced to 3100 cfs (February extension of 3100 cfs could be implemented with NOAA Fisheries pre-approval). If requested by either the State of Georgia or

* Level as shown in Figure 8, 9
** 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

South Carolina, the Corps would restore the Thurmond discharge up to 3600 cfs daily average for the 3100 cfs release in Level 3. For Levels 1-3, the Hartwell discharge would be reduced as appropriate to maintain balanced pools. See Table 13 for more presentation of the Alternative 4 Action Levels.

Table 13: Hartwell and Thurmond Action Levels for Alternative 4

LEVEL*	1 APR – 15 OCT (FEET MSL)	15 DEC – 1 JAN** (FEET MSL)	ACTION
1	656, 326	654, 324	Public safety information is issued. 4200 cfs, >10% Q in 4000 cfs, ≤10% Q in Reduce Hartwell discharge as appropriate to maintain balanced pools.
2	654, 324	652, 322	4000 cfs, >10% Q in 3600 cfs, ≤10% Q in Reduce Hartwell discharge as appropriate to maintain balanced pools.
3	646, 316	646, 316	3600 cfs 3100 cfs, November to January Reduce Hartwell discharge as appropriate to maintain balanced pools.
4	625, 312	625, 312	Same as No Action Alternative.

3.2.6. Alternatives Considered But Eliminated From Detailed Consideration

The eliminated Alternatives include one similar to Alternative 1 that contains a prescribed flow of 3600 cfs for Level 3, one similar to Alternative 2 that does not include the Level 2 3600 cfs release for November to January an one similar to Alternative 3 that has the Level 2 3600 cfs flow for November to January tied to the less than or equal to the 10th percentile flow.

3.2.7. Selected Alternative

The Proposed Action is Alternative 2 that consists of retaining the major components of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) with modification to three Action Levels (1, 2 and 3) as described in Section 3.2.3.

4.0 ENVIRONMENTAL AND SOCIO-ECONOMIC CONSEQUENCES

The Savannah District does not anticipate any effects to air quality, climate change (precipitation changes uncertain), noise, non-renewable resources, mineral resources, HTRW (including past PCB issues at Hartwell Lake), farmland, wetlands, water quality in the lakes, flood control, hydrology, soils, sediment or to fishery resources from either the No Action Alternative or the selected alternative. Nor does the Savannah District envision any irretrievable commitments of resources from any alternative. The Savannah District believes the proposed project is consistent

* Level as shown in Figure 8, 9
** 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

with both the Georgia and South Carolina Coastal Zone Management Programs to the maximum extent practicable (See Section 4.10).

As discussed in Section 4.4, flows up to 10,000-15,000 cfs, are expected to remain within the stream channel. Flows discussed in the drought alternatives range between 3,100 and 4,200 cfs, so they would be contained within the stream channels. Fluctuating these flows within these low ranges would produce no measurable impacts on adjacent floodplain wetlands along the river (upstream of the estuary).

Alternatives 1, 2, 3 and 4 were each compared to the NAA in this Section and summarized in the Table included in Section 5.0. Effects are classified as negligible, minor, moderate or significant in this Section. For Sections 4.2 thru 4.6, this was conducted primarily by comparing Downstream Hydrographs (an example can be found in Appendix B), comparing Pool Elevation Tables (an example can be found on Page 67, Table 14) and by employing the Ecosystems Function Model (EFM), in conjunction with information from the 1-3 April, 2003, Scientific Stakeholders Workshop. The Workshop included approximately 48 attendees and the organizations represented included the University of Georgia, GA DNR, SC DNR, USACE, USGS, USFWS, EPA, The Nature Conservancy, the Southeastern Natural Sciences Academy, NMFS, and the South Carolina Coastal Conservation League. An example of the EFM can be found on pages 71-72.

There was a revision of the Selected Alternative 2 as a result of Public Review comments by GA DNR-CRD where the portion of Level 3 flows previously designated as “3600; BI ≤ 10% Qin” was revised to 3800 cfs. This is expected to result in a slight lessening of adverse impacts in Section 4 to water quality, biotic communities in the shoals, floodplain and estuary, threatened and endangered species, essential fish habitat and coastal zone consistency.

4.1. WATER QUALITY

4.1.1 Overview

When discharges are reduced from JST, impacts could occur to downstream water quality. Lower discharges could increase water temperature and reduce the water quality downstream of point source discharges. The summer months are the most critical to aquatic resources; therefore, reduced river flows during the summer months are likely to cause greater adverse impacts than reduced river flows during the winter months.

The State of South Carolina uses the flow of 3,600 cfs (Larry Turner, South Carolina DHEC) 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.

The State of Georgia's Dissolved Oxygen (DO) standards are: A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times. If it is determined that the 'natural condition' in the waterbody is less than the values stated above, then the criteria will revert to the 'natural condition' and the water quality standard will allow for a 0.1 mg/L deficit from the 'natural' dissolved oxygen value.

Up to a 10% deficit will be allowed if it is demonstrated that resident aquatic species shall not be adversely affected.

The Georgia DNR-EPD analyzed the potential effects on water quality for a proposed winter flow reduction to 3100 cfs in 2008. EPD evaluated the potential impacts in both the river and the estuary/harbor area. They concentrated on DO levels, since the States and Georgia DNR-EPD had previously identified DO as a critical water quality parameter in this basin.

For the river portion (JST to Clyo) of the basin, Georgia DNR-EPD used the RIV1 (One dimensional Dynamic Hydraulic and Water Quality) Model to identify potential point source discharge problems along the river if the river flow was reduced. For the estuary/harbor portion of the basin (Clyo to ocean), Georgia DNR-EPD used the EFDC (Environmental Fluid Dynamics Code) and WASP (Water Quality Analysis Simulation Program) Models which were developed by EPA and used for EPA's TMDL analysis.

4.1.2 Savannah River downstream of JST to Clyo

Georgia DNR-EPD conducted model simulations using the RIVI Model, 2007 meteorological data and tributary inflows, and 2006 wasteload discharges and water withdrawals. These model simulations incorporated varying amounts of discharges from JST (3,600 and 3,100 cfs).

Figures 11 and 12 show the results of the 3,600 cfs simulation. Under a JST release of 3,600 cfs, the simulated DO concentrations at river RM 119 (US Highway 301) are predicted to be above 5 mg/L throughout the year (Fig. 11). Figure 12 shows simulated DO concentration at RM 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 violated by a JST release of 3,600 cfs.

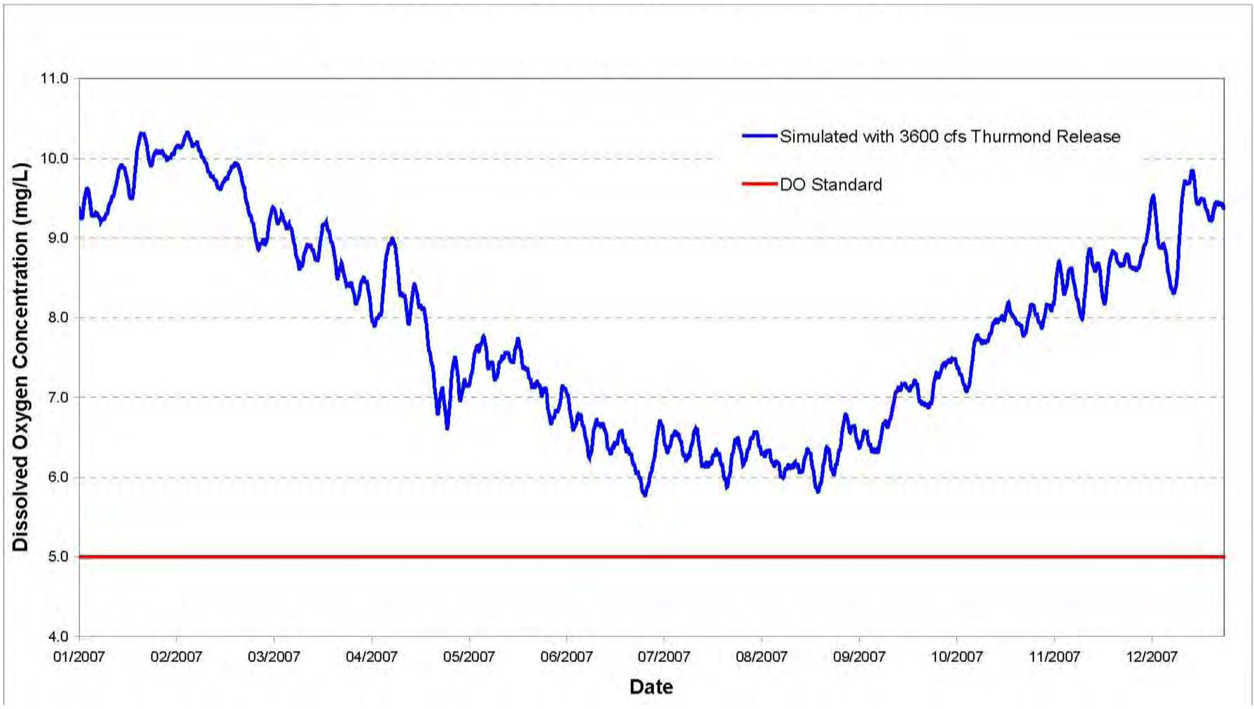


Figure 11 – Dissolved Oxygen at RM 119

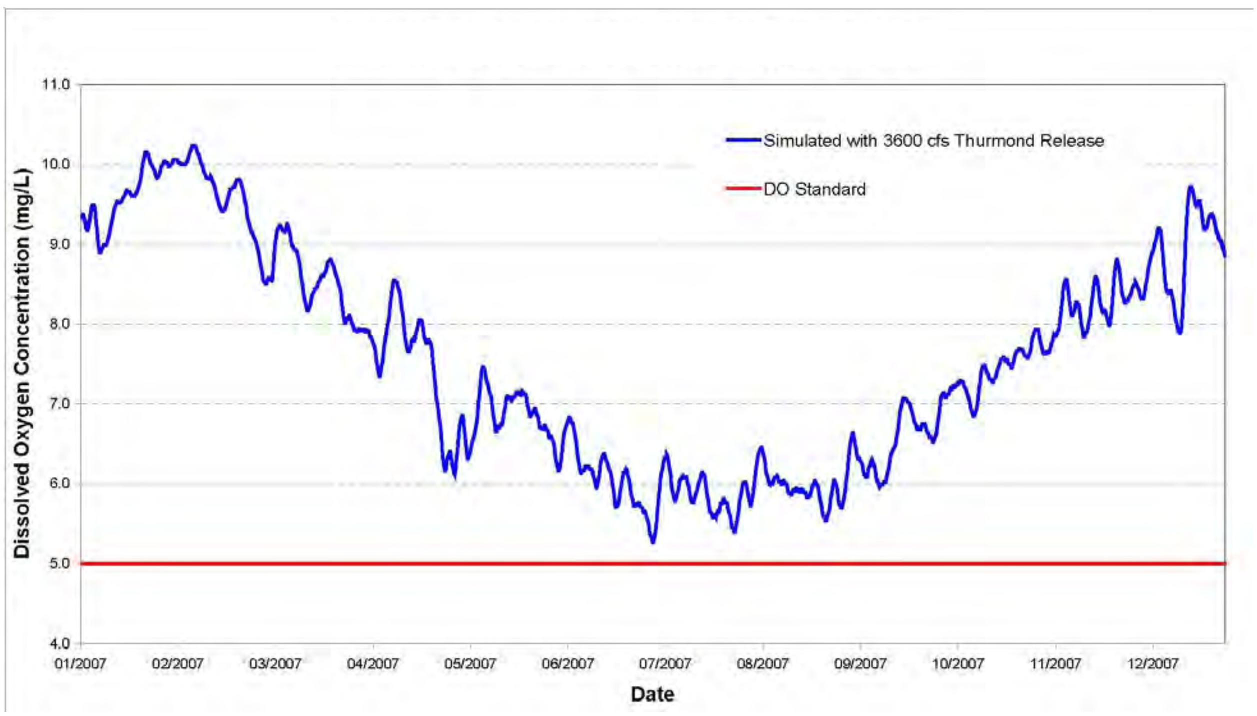


Figure 12 - Dissolved Oxygen at RM 61

Figures 13 and 14 show the simulated DO concentrations at RM 119 and RM 61 respectively, under a JST 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 concentrations would remain higher than 6.0 mg/L and almost always be higher than 7.0 mg/L at both RM 119 and RM 61. The riverine water quality model shows that the 5.0 mg/L DO standard would not be violated by a JST release of 3,100 cfs.

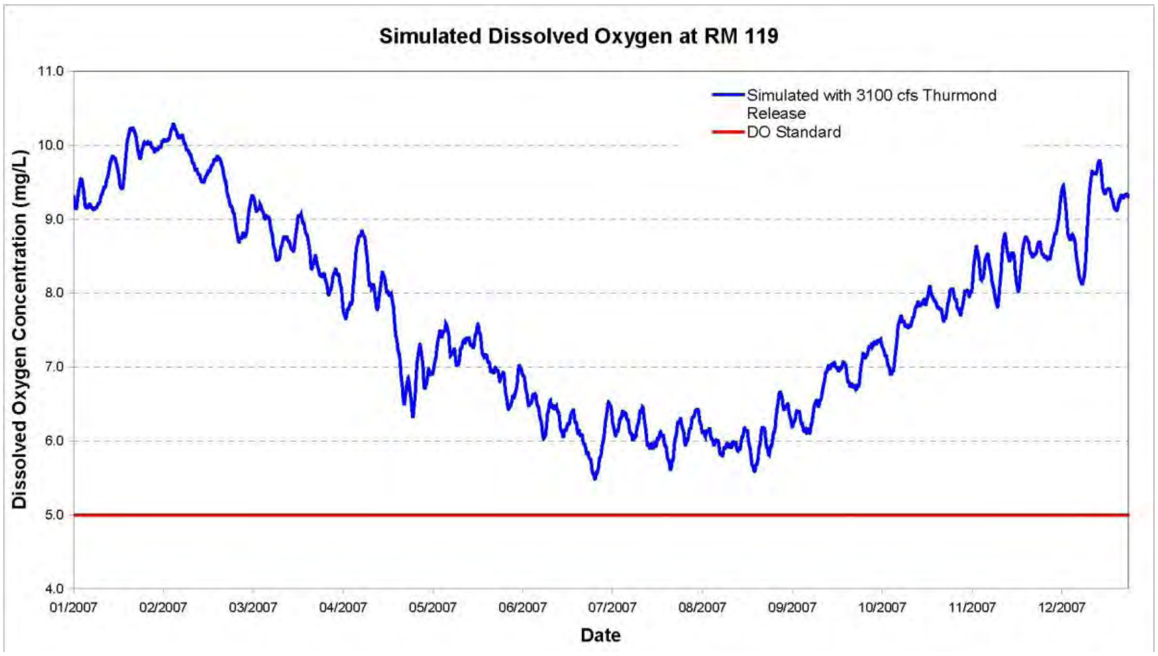


Figure 13 – Simulated Dissolved Oxygen at RM 119

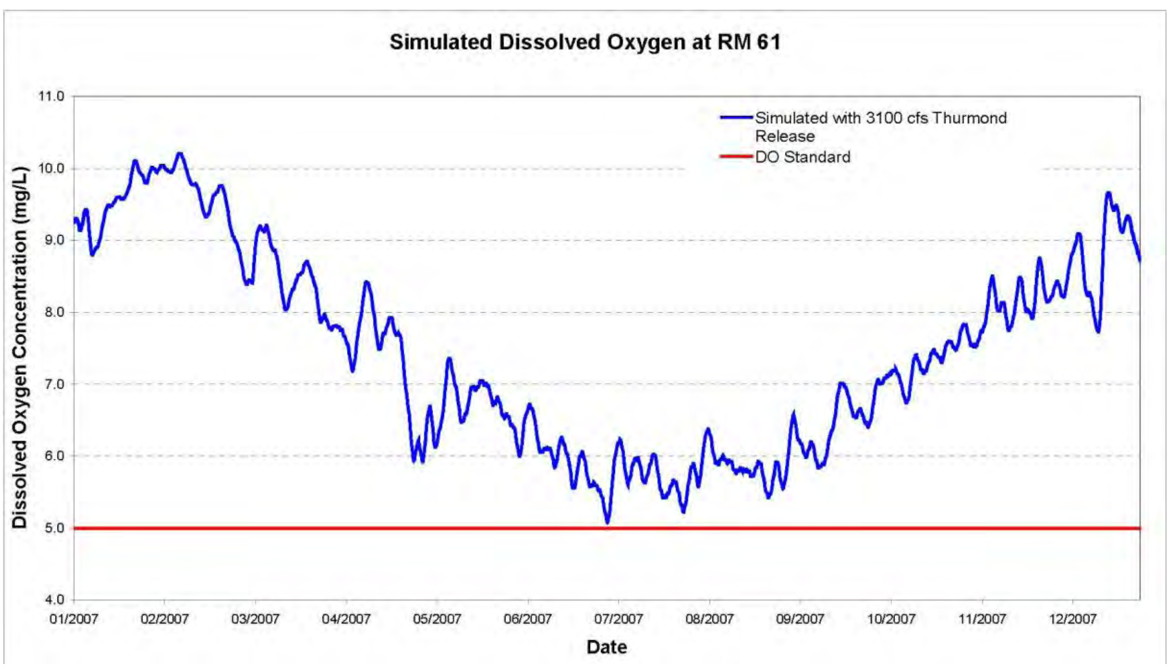


Figure 14 – Simulated Dissolved Oxygen at RM 61

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 may give overly pessimistic DO concentrations. Algal activity typically increase DO concentrations during the day, while algal respiration and decay of the algal biomass tend to decrease DO at night. It is likely that field data would document higher DO concentrations than the model predicts.

Georgia DNR-EPD has indicated in the past that monitoring would occur at locations along the river to identify changes in DO concentration along the lower reaches if similar proposed operations were adopted. The Corps proposes to use adaptive management as part of the proposed action. If field observations indicate a substantial problem with DO concentrations at any time while releasing between 3100 and 3800, or 3100 and 3600 cfs, depending on drought level, GA DNR-EPD or SC DHEC would notify the Savannah District. The Savannah District would then increase flows upward to as much as 3600 or 3800 cfs, depending on drought level, to mitigate the adverse conditions.

Once initiated in a given year, a 3100 cfs targeted release would be maintained through February (November through February, with February only after receiving separate approval from NOAA Fisheries due to concerns about potential impacts to shortnose sturgeon). If during this period, a listed monitoring site fails to meet its general environmental target as defined in Table 8, or sturgeon spawning appears to be adversely impacted, an evaluation of the impacts would be initiated. This could lead to a request by the State of Georgia, the State of South Carolina, or NOAA Fisheries to the Savannah District to increase the targeted release at JST from 3100 cfs to as much as 3600 or 3800 cfs, depending on drought level. A decision would be made by Savannah District to modify the release target consistent with the adaptive management strategy as defined in Alternative 2, the selected alternative.

4.1.3 Savannah Harbor

The two water quality related effects in Savannah Harbor include elevated chloride concentrations at the City of Savannah municipal water intake on Abercorn Creek, and DO concentrations in the Savannah Harbor.

The City of Savannah's municipal and industrial water intake is located on Abercorn Creek, upstream of the harbor near RM 29, approximately two miles from the Savannah River. The City of Savannah is concerned with 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. The chloride standard is 250 mg/L for drinking water.

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 correlation between river flows at the US Geological Survey's Clyo stream gage location and chloride concentrations in Abercorn Creek. 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 JST, 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 JST, 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 water control management activities (Alternative 2) 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 for the water they withdraw from Abercorn Creek. If they identify unusual values after implementation of the proposed action, they would notify USACE and GA DNR-EPD. If the observations by the City of Savannah indicate a substantial problem with chloride concentrations, GA DNR-EPD would recommend an appropriate action to Savannah District, possibly including the resumption of the 3,600 or 3,800 cfs discharge, depending on drought level.

The Beaufort-Jasper Water and Sewer Authority water intake is located at RM 39.2, so it would experience less effects than the City of Savannah's intake, because of its location further upstream than Savannah's water intake.

As part of the chloride level impacts review concerning the City of Savannah'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 for the 2008 Temporary Deviation EA. Figure 15 shows the effects on salinity levels at the Interstate 95 Bridge, located at RM 27.8. The results indicate that salinity should remain below 1 ppt at the I-95 Bridge, even with the proposed reductions in discharge to 3,100 cfs.

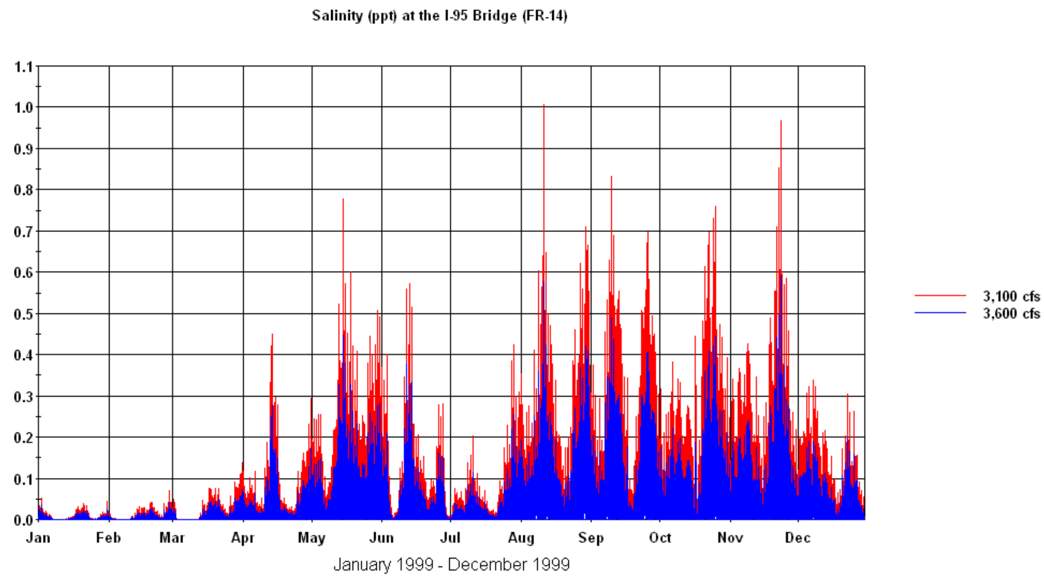


Figure 15 – Salinity at I-95 Bridge

As mentioned earlier, GA DNR-EPD evaluated the effect of the proposed JST water control management activities on DO concentrations in Savannah Harbor using the Savannah Harbor EFDC and WASP Models for the 2008 Temporary Deviation EA and Figure 16 resulted. 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 DO concentrations at the USGS monitoring station located at the U.S. Army Corps of Engineers' dock on Hutchinson Island in the harbor.

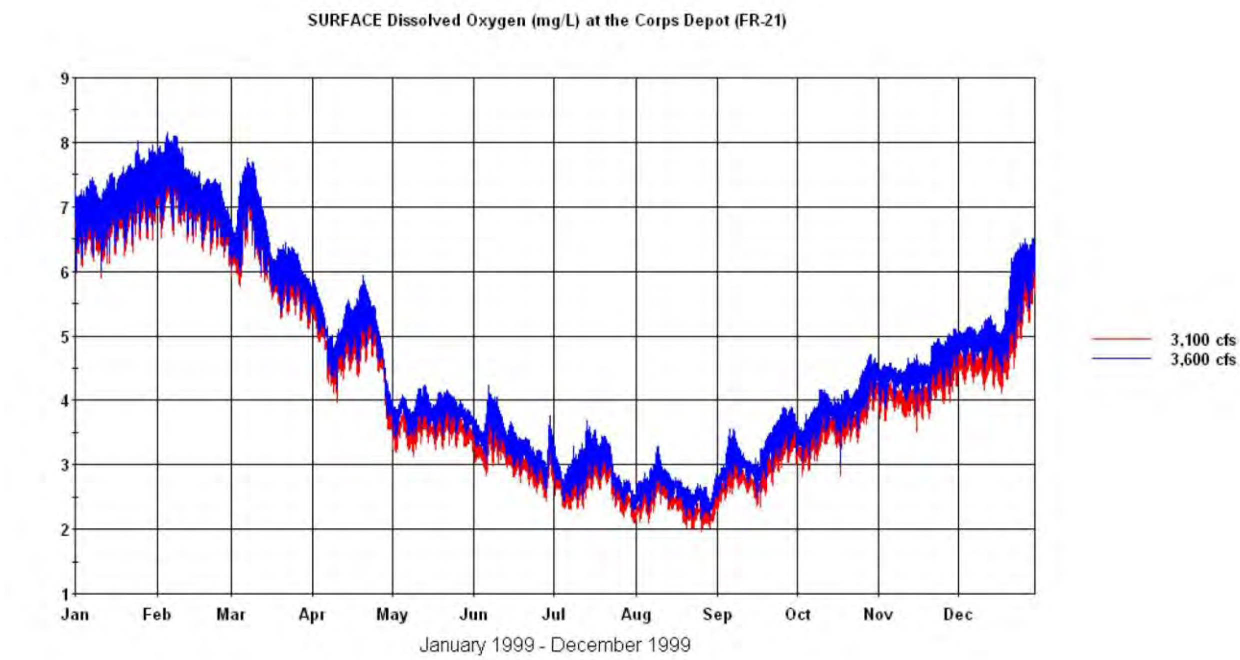


Figure 16 – Simulated Surface Dissolved Oxygen in Savannah Harbor

4.1.4 Effects on EPA TMDLs

At EPA's request for the 2008 Temporary Deviation EA, the Corps reviewed the below TMDL's that EPA previously issued for DO, Fecal Coliform and Lead for the Savannah River.

Please see the previous section on impacts in the estuary for the discussion of potential effects of the reduced discharge on DO.

The 2000 TMDL for Fecal Coliform indicates that the 23-mile river segment that is impaired is located directly downstream of the City of Augusta's wastewater treatment plant, between the Butler Creek and McBean Creek. The City of Augusta improved their stormwater conveyance system and separated their stormwater and sanitary sewer systems. The improvements led to dramatic decreases in fecal coliform loading into the Savannah River. The TMDL evaluated three different river flow conditions. However, the TMDL of 1.37 x 1013 Counts/day was established using the minimum daily average flow of 2,810 cfs. That flow would be exceeded under the No Action Alternative and Alternatives; therefore, the TMDL for Fecal Coliform would not be affected by either alternative that is under consideration.

The 1999 TMDL for Lead indicates that the impaired 53-mile river segment is located between Brier Creek and Ebenezer Creek. The TMDL could not identify any sources of lead within the watershed. It stated that the latest sampling did not identify any lead in that segment of the river. The lower river flows associated with Alternative 1 could increase the concentration of lead in the water, if any is still present. Since there is uncertainty as to whether lead is still present, the Savannah District believes that the reductions in flow would not significantly affect the long term ability of the segment to meet the water quality standard of 0.54 ug/l of lead.

EPA issued a TMDL for Lead in 2000 for the 23-mile segment directly downstream of the City of Augusta's wastewater treatment plant, between the confluence of Butler and McBean Creek. Again, the TMDL could not identify any sources of lead within the watershed. The TMDL assumed that there was a legacy load of lead either in contaminated sediments or nonpoint source runoff. For this river segment, the TMDL used the critical low flow of 2,810 cfs. That flow would be exceeded under the No Action Alternative and Alternatives; therefore, the TMDL for Lead in this river segment would not be affected by either alternative that is under consideration.

Effects of the NAA

Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no effects on Water Quality.

Effects of Alternative 1

This action includes 3,100 cfs releases or greater from JST, so Figures 13, 14, and 15 show that there would be no adverse effects on RM 119 DO, RM 61 DO and salinity at the I-95 bridge. Adaptive management is in place if needed for chloride concentrations at the City of Savannah water intake. There would be no adverse effects to the TMDL's for fecal coliform or lead.

In applying the Georgia DO standard to Figure 15, the proposed reduction of JST releases to 3600 (Level 4 only, as in the NAA) results in no adverse impacts from May through November to the DO levels in the harbor without adequate inflows downstream of Thurmond. Impacts to DO would be avoided by implementing the previously-discussed adaptive management (restoring discharges to 3,600 cfs if requested by Georgia or South Carolina).

Effects of Alternative 2

This alternative would have very similar effects to Alternative 1 for RM 119 DO, RM 61 DO, salinity at the I-95 bridge, chloride concentrations, fecal coliform and lead.

In applying the Georgia DO standard to Figure 16, the proposed reduction of JST releases to 3600 (Level 4 and a portion of Level 2) could result in minor adverse impacts from May through November to the DO levels in the harbor without adequate inflows downstream of JST. Impacts to DO would be avoided by implementing the previously-discussed adaptive management (restoring discharges to 3,600 or 3,800 cfs, depending on drought level, if requested by Georgia or South Carolina).

Effects of Alternative 3

This alternative would have very similar effects to Alternative 1 for RM 119 DO, RM 61 DO, salinity at the I-95 bridge, chloride concentrations, fecal coliform and lead.

In applying the Georgia DO standard to Figure 16, the proposed reduction of JST releases to 3600 (Level 4 and a portion of Level 2) could result in moderate adverse impacts from May through November to the DO levels in the harbor without adequate inflows downstream of Thurmond. Impacts to DO would be avoided by implementing the previously-discussed adaptive management (restoring discharges to 3,600 cfs if requested by Georgia or South Carolina).

Effects of Alternative 4

This alternative would have very similar effects to Alternative 1 for RM 119 DO, RM 61 DO, salinity at the I-95 bridge, chloride concentrations, fecal coliform and lead.

In applying the Georgia DO standard to Figure 16, the proposed reduction of JST releases to 3600 (Level 4 and a portion of Level 2) could result in moderate adverse impacts from May through November to the DO levels in the harbor without adequate inflows downstream of Thurmond. Impacts to DO would be avoided by implementing the previously-discussed adaptive management (restoring discharges to 3,600 cfs if requested by Georgia or South Carolina).

4.2. BIOTIC COMMUNITIES-LAKES

4.2.1. Largemouth Bass Spawning


Largemouth bass

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 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 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.

Pool Elevation Tables that were generated by HEC-ResSim (US Army Corps of Engineers Hydrologic Engineering Center Reservoir Simulation Model) modeling were used in this Section to compare Alternatives 1, 2, 3 or 4 to the NAA. As an example, Table 14 below reveals that the modeled pool elevations show a 0.63-foot maximum drop that would occur from 1 April to 10 April 2007 for Hartwell Lake. The first paragraph below contains this occurrence of 0.63 feet that exceeds six inches. There are forty-five tabular months that were used similarly in this Biotic Communities-Lakes section (see Appendix L). The Hec-ResSim planning model used in this study is not used to operate the reservoir system on a real-time basis. Actual water control regulation activities are more adaptive in maintaining stable lake levels for spawning.

Table 14: Hartwell Pool Elevations

Date	Hartwell Pool Elevation (ft)
4/1/2007 Sun	659.49
4/2/2007 Mon	659.43
4/3/2007 Tue	659.35
4/4/2007 Wed	659.30
4/5/2007 Thu	659.23
4/6/2007 Fri	659.11
4/7/2007 Sat	659.14
4/8/2007 Sun	659.17
4/9/2007 Mon	659.09
4/10/2007 Tue	658.86
4/11/2007 Wed	658.86
4/12/2007 Thu	658.86
4/13/2007 Fri	658.86
4/14/2007 Sat	658.86
4/15/2007 Sun	658.86
4/16/2007 Mon	658.86
4/17/2007 Tue	658.86
4/18/2007 Wed	658.86
4/19/2007 Thu	658.86
4/20/2007 Fri	658.86
4/21/2007 Sat	658.86
4/22/2007 Sun	658.86
4/23/2007 Mon	658.86
4/24/2007 Tue	658.86
4/25/2007 Wed	658.86
4/26/2007 Thu	658.86
4/27/2007 Fri	658.86
4/28/2007 Sat	658.86

Effects of the NAA (By observing the Pool Elevation tables)

Hartwell Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.63, 0.24 and 0.17 foot.

RBR Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.67, 0.95 and 1.00 foot.

JST Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.63, 0.61 and 0.48 foot.

Review of the above model-generated pool elevation reductions show that the 6-inch maximum lowering for April 1-28 would be exceeded 1 year at Hartwell Lake, 3 years at RBR Lake and 2 years at JST Lake during the 3-year period of analysis. The approved SRBDCP has been found to be an acceptable plan based on its impacts on biotic communities in the lakes. Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no effects on bass spawning.

Effects of Alternative 1 (By observing the Pool Elevation tables)

Hartwell Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.63, 0.46 and 0.72 foot.

RBR Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.67, 0.96 and 1.28 foot.

JST Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.63, 0.37, and 0.51 foot.

Review of the above model-generated pool elevation reductions shows that the 6-inch maximum lowering for April 1-28 would be exceeded 2 years at Hartwell Lake, 3 years at RBR Lake and 2 years at JST Lake during the 3-year period of analysis. This alternative would have a minor adverse impact, as 7 total exceedances were observed and 6 were observed previously for the NAA. The exceedances do not primarily occur at one lake, but 3 do occur at RBR Lake.

Effects of Alternative 2 (By observing the Pool Elevation tables)

Hartwell Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.54, 0.61 and 0.42 foot.

RBR Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.54, 0.54 and 1.32 foot.

JST Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.95, 0.18 and 0.62 foot.

Review of the above model-generated pool elevation reductions shows that the 6-inch maximum lowering for April 1-28 would be exceeded 2 years at Hartwell Lake, 3 years at RBR Lake and 2 years at JST Lake during the 3-year period of analysis. This alternative would have a minor adverse impact, as 7 total exceedances were observed and 6 were observed for the NAA. The exceedances do not primarily occur at one lake, but 3 do occur at RBR Lake.

Effects of Alternative 3 (By observing the Pool Elevation tables)

Hartwell Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.54, 0.61 and 0.78 foot.

RBR Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.54, 1.51 and 1.29 foot.

JST Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.97, 0.18 and 0.67 foot.

Review of the above model-generated pool elevation reductions shows that the 6-inch maximum lowering for April 1-28 would be exceeded 3 years at Hartwell Lake, 3 years at RBR Lake and 2 year at JST Lake during the 3-year period of analysis. This alternative would have a moderate adverse impact, as 8 total exceedances were observed and 6 were observed for the NAA. The exceedances do not primarily occur at one lake, but 3 do occur at both Hartwell and RBR Lake.

Effects of Alternative 4 (By observing the Pool Elevation tables)

Hartwell Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.54, 0.34 and 0.49 foot.

RBR Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.54, 1.29 and 1.03 foot.

JST Lake
The maximum lowering of the pool elevations between April 1-28 for the drought of record years 2007 to 2009 would respectively be 0.97, 0.45 and 0.47 foot.

Review of the above model-generated pool elevation reductions shows that the 6-inch maximum lowering for April 1-28 would be exceeded 1 year at Hartwell Lake, 3 years at RBR Lake and 1 year at JST Lake during the 3-year period of analysis. This alternative would have no adverse impact, as 5 total exceedances were observed and 6 were observed for the NAA. The exceedances do not primarily occur at one lake, but 3 do occur at RBR Lake.

4.2.2. Aquatic Plants

Effects of the NAA

Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no adverse effects on Biotic Communities in the lakes (including invasive species, such as hydrilla).

Effects Alternative 1

The persistent drought from March 2007 through November 2009 significantly reduced the abundance of aquatic vegetation in JST Lake (including invasive species, such as hydrilla) (Aquatic Plant Treatment Plan, US Army Corps of Engineers, Savannah District, Calendar Year 2010 Update), which is the only lake of the three with an active aquatic vegetation treatment program. Due to this reduced abundance and the proposed action's small variations in lake levels, there would be no adverse impact on aquatic plants in the lakes.

Effects Alternative 2

This alternative would have a very similar effect to Biotic Communities in the lakes as Alternative 1, so no adverse impacts are expected.

Effects Alternative 3

This alternative would have a very similar effect to Biotic Communities in the lakes as Alternative 1, so no adverse impacts are expected.

Effects Alternative 4

This alternative would have a very similar effect to Biotic Communities in the lakes as Alternative 1, so no adverse impacts are expected.

4.3. BIOTIC COMMUNITIES-SHOALS


Shoals

Past studies and coordination have listed American 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 brother spike can also be found at the Shoals. 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 benefits from higher flows from June to December, as such flows provide protection from grazing deer. Undefined very high flows could be detrimental to the Shoals spider lily; however, such flows are not expected during times of drought. Therefore, the impacts associated with very high and undefined flows are not considered in depth here.

The flow regime in the Augusta Shoals is controlled by flow releases from JST, 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. USGS data indicates that in 2008 when discharges from JST were at 3,600 cfs, the City maintained the canal gates at levels that resulted in an average of 3,150 cfs passing down the Canal and 450 cfs passing over the Shoals.

The City of Augusta has a pending hydropower license application with the Federal Energy Regulatory Commission (FERC) which has not been formally approved by the Augusta-Richmond County Commission, pending resolution of appeals with regard to the Georgia Section 401 water quality certification. A Settlement Agreement concerning the split of water between the Augusta Canal and the Shoals was negotiated as part of the processing of the FERC license. That Agreement has not yet been finalized.

In a letter dated October 22, 2008, the City of Augusta notified the Corps that they commit "to the methodology set forth in the proposed Settlement Agreement for determining the Aquatic Base Flow and reserving for the Shoals those amounts set forth in Section 4.3 of the Settlement Agreement for the respective periods and tiers set forth therein." The tier flows refer to the Thurmond release plus twice the Stevens Creek release. That section contains the following information:

Table 15: Agreed Aquatic Base Flows

	FEB/MAR	APR	MAY 1-15	MAY 16-31	JUNE- JAN
Tier 1 ≥5400	3300	3300	2500	1900	1900
Tier 2 4500-5399	2300	2200	1800	1800	1500
Tier 3 3600-4499	2000	2000	1500	1500	1500
Tier 4 <3600	1800	1800	1500	1500	1500

Although the City is not required to implement the provisions of the yet-to-be finalized Settlement Agreement, it states that it will "use its best efforts to meet the terms for flows as set forth therein, including the higher flows during the month of February as set forth in the respective tiers." If the City of Augusta fulfills this commitment, the impacts of the proposed flow reduction on the previously mentioned biota within the Shoals would be minimal. If the City does not fulfill its commitment, impacts to the Shoal communities would be greater. The Corps believes that a 50/50 split in the 500 cfs flow reduction is probably a good assumption for prediction of future impacts. Under that scenario, the Shoals would experience a 250 cfs reduction in flow from what they presently receive with the 3,600 cfs average daily discharge from JST. This amount of flow reduction is expected to result in minor effects to the previously mentioned Shoals biotic communities.

Effects of the NAA

Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no effect on these biotic communities.

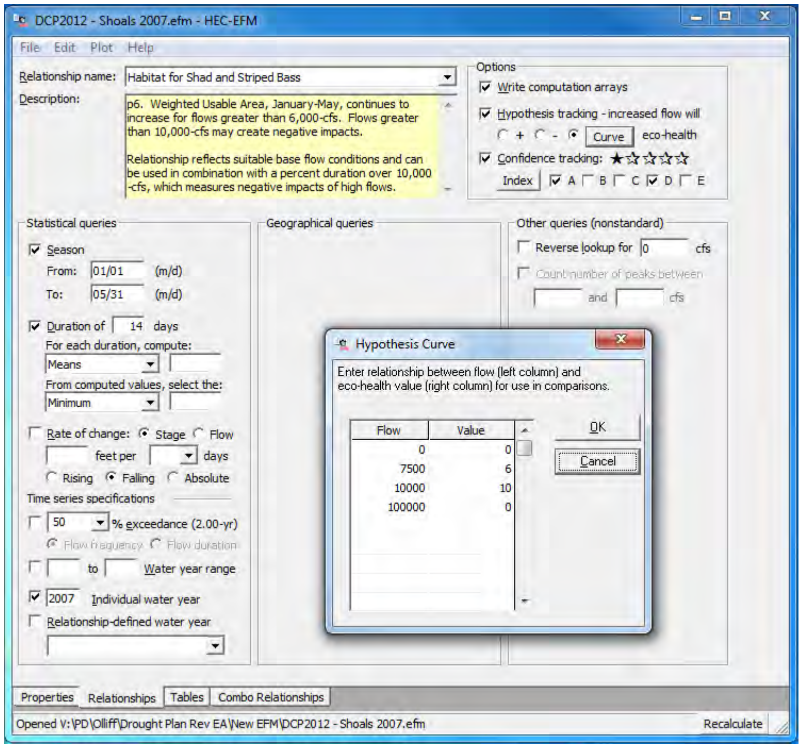
Effects of Alternative 1 (By comparing the alternatives Augusta gage Downstream Hydrograph to that of the NAA)

The median flow for March 2007 to November 2009 was reduced by 61 cfs (-1.3% change) for Augusta when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 4000 cfs from 23 February 2007 to 26 November 2009. From mid-July 2007 to mid-December of 2007, June to early August of 2008 and mid-July to mid-September of 2009 this alternatives flows are 200 cfs less than those of the NAA, so seasonal fish spawning, fish passage, shoals spider lily protection from deer grazing and juvenile out-migration would be impacted.

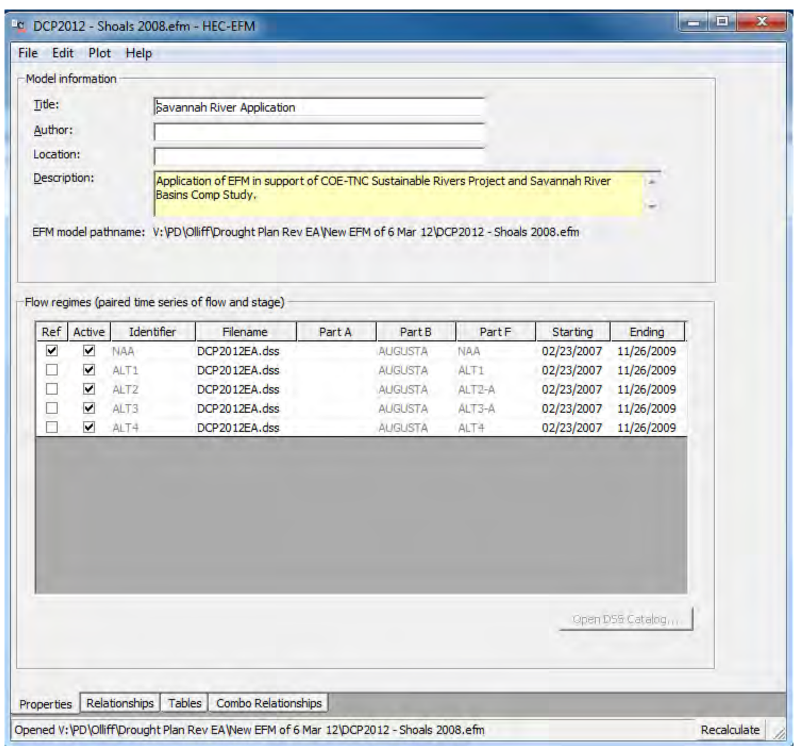
Effects of Alternative 1 (By employing the Ecosystems Function Model (EFM) in conjunction with Augusta Shoals information from the 1-3 April 2003 Scientific Stakeholders Workshop)

The Ecosystems Function Model (EFM) that was developed by the US Army Corps of Engineers Hydrologic Engineering Center (HEC) was used to compare Alternatives 1, 2, 3 and 4 to the NAA. Recommendations from the 2003 Scientific Stakeholders Workshop, including seasonal and eco-health curve data, were used to establish flow/habitat relationships (see Example 1) for several resources in the EFM. HEC-ResSim files were loaded into the model and are shown listed in Example 2. Output from the EFM-model consists of the average flow for each alternative in the specified water year and whether a positive or adverse impact would result for the particular resource when the flow in the alternatives is compared to the flow in the NAA (see Example 3). The flow outputs, as seen in Example 3, were used to calculate Water Year percent changes.

Example 1



Example 2



Example 3

Summary

		NAA		Alt1			Alt2			Alt3			Alt4		
Relationship	Conf.	Stage, ft	Flow, cfs	Chg.	Stage, ft	Flow, cfs	Chg.	Stage, ft	Flow, cfs	Chg.	Stage, ft	Flow, cfs	Chg.	Stage, ft	Flow, cfs
Base - Habitat for Shad and Striped Bass	*	4454.7	4,455	Neg	4275.2	4,275	Neg	4275.2	4,275	Neg	4275.2	4,275	Neg	4075.2	4,075

Four flow/habitat relationships were analyzed for the shoals area.

Habitat for Shad and Striped Bass (7500 cfs recommended in the workshop):
The 2008 Water Year output for this model run was 4275 cfs (-4.0% change). This is less than the output of 4455 cfs for the NAA 2008 Water Year model run. The 2009 Water Year output for this model run was 4472 cfs (0.0% change). This is equal to the output of 4472 cfs for the NAA 2009 Water Year model run.

Shoals Spider Lily in June and July (6200 cfs recommended in the workshop):
The 2007 Water Year output for this model run was 4236 cfs (-0.9% change). This is less than the output of 4275 cfs for the NAA 2007 Water Year model run. The 2008 Water Year output for this model run was 3991 cfs (-4.8% change). This is less than the output of 4191 cfs for the NAA 2008 Water Year model run. The 2009 Water Year output for this model run was 4133 cfs (-3.6% change). This is less than the output of 4286 cfs for the NAA 2009 Water Year model run.

Shoals Spider Lily from August to October (5500 cfs recommended in the workshop):
The 2007 Water Year output for this model run was 4063 cfs (-4.7% change). This is less than the output of 4263 cfs for the NAA 2007 Water Year model run. The 2008 Water Year output for this model run was 3977 cfs (0.0% change). This is equal to the output of 3977 cfs for the NAA 2008 Water Year model run. The 2009 Water Year output for this model run was 4120 cfs (-3.6% change). This is less than the output of 4275 cfs for the NAA 2009 Water Year model run.

Shoals Spider Lily in November and December (6200 cfs recommended in the workshop):
The 2008 Water Year output for this model run was 3984 cfs (-4.8% change). This is less than the output of 4184 cfs for the NAA 2008 Water Year model run. The 2009 Water Year output for this model run was 4125 cfs (0.0% change). This is equal to the output of 4125 cfs for the NAA 2009 Water Year model run.

Therefore, based on the 61 cfs reduction in median flows from the NAA and the above percent changes that are below 10%, Alternative 1 would produce a minor adverse impact on the resources.

Effects of Alternative 2 (By comparing the alternatives Augusta gage Downstream Hydrograph to that of the NAA)

The median flow for March 2007 to November 2009 was reduced by 130 cfs (-2.8% change) for Augusta when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 3600 cfs from 23 February 2007 to 26 November 2009. From mid-July 2007 to January of 2008, June to July of 2008 and mid-July to mid-September of 2009 this alternatives flows are 200 cfs less than those of the NAA. Also, from November 2008 to January 2009 the flows are 600 cfs less than those of the NAA, so seasonal fish spawning, fish passage, shoals spider lily protection from deer grazing and juvenile out-migration would be impacted.

Effects of Alternative 2 (By employing the EFM in conjunction with Augusta Shoals information from the 1-3 April 2003 Scientific Stakeholders Workshop)

Four flow/habitat relationships were analyzed for the shoals area.

Habitat for Shad and Striped Bass (7500 cfs recommended in the workshop):
The 2008 output for this model run was 4275 cfs (-4.0% change). This is less than the output of 4455 cfs for the NAA 2008 model run. The 2009 output for this model run was 3933 cfs (-12.1% change) . This is less than the output of 4472 cfs for the NAA 2009 model run.

Shoals Spider Lily in June and July (6200 cfs recommended in the workshop):
The 2007 output for this model run was 4179 cfs (-2.2% change). This is less than the output of 4275 cfs for the NAA 2007 model run. The 2008 output for this model run was 3991 cfs (-4.8% change). This is less than the output of 4191 cfs for the NAA 2008 model run. The 2009 output for this model run was 4133 cfs (-3.6% change). This is less than the output of 4286 cfs for the NAA 2009 model run.

Shoals Spider Lily from August to October (5500 cfs recommended in the workshop):
The 2007 output for this model run was 4053 cfs (-4.9% change). This is less than the output of 4263 cfs for the NAA 2007 model run. The 2008 output for this model run was 3793 cfs (-4.6% change). This is less than the output of 3977 cfs for the NAA 2008 model run. The 2009 output for this model run was 4120 cfs (-3.6% change). This is less than the output of 4275 cfs for the NAA 2009 model run.

Shoals Spider Lily in November and December (6200 cfs recommended in the workshop):
The 2008 output for this model run was 3784 cfs (-9.6% change). This is less than the output of 4184 cfs for the NAA 2008 model run. The 2009 output for this model run was 3600 cfs (-12.7% change). This is less than the output of 4125 cfs for the NAA 2009 model run.

Therefore, based on the 130 cfs reduction in median flows from the NAA and the above percent changes that are between 10% and 20%, Alternative 2 would produce a moderate adverse impact on the resources.

Effects of Alternative 3 (By comparing the alternatives Augusta gage Downstream Hydrograph to that of the NAA)

The median flow for March 2007 to November 2009 was reduced by 180 cfs (-3.9% change) for Augusta when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 3600 cfs from 23 February 2007 to 26 November 2009. From mid-July 2007 to January of 2008, mid-May to July of 2008, late August to October of 2008 and mid-July to mid-September of 2009 this alternatives flows are 200 cfs less than those of the NAA. Also, from November 2007 to mid-December 2007 the flows are 400 cfs less than those of the NAA and from November 2008 to January 2009 the flows are 600 cfs less than the NAA, so seasonal fish spawning, fish passage, shoals spider lily protection from deer grazing and juvenile out-migration would be impacted.

Effects of Alternative 3 (By employing the EFM in conjunction with Augusta Shoals information from the 1-3 April 2003 Scientific Stakeholders Workshop)

Four flow/habitat relationships were analyzed for the shoals area.

Habitat for Shad and Striped Bass (7500 cfs recommended in the workshop):
The 2008 output for this model run was 4275 cfs (-4.0% change). This is less than the output of 4455 cfs for the NAA 2008 model run. The 2009 output for this model run was 3933 cfs (-12.1% change). This is less than the output of 4472 cfs for the NAA 2009 model run.

Shoals Spider Lily in June and July (6200 cfs recommended in the workshop):
The 2007 output for this model run was 4179 cfs (-2.2% change). This is less than the output of 4275 cfs for the NAA 2007 model run. The 2008 output for this model run was 3991 cfs (-4.8% change). This is less than the output of 4191 cfs for the NAA 2008 model run. The 2009 output for this model run was 4133 cfs (-3.6% change). This is less than the output of 4286 cfs for the NAA 2009 model run.

Shoals Spider Lily from August to October (5500 cfs recommended in the workshop):
The 2007 output for this model run was 4053 cfs (-4.9% change). This is less than the output of 4263 cfs for the NAA 2007 model run. The 2008 output for this model run was 3776 cfs (-5.1% change). This is less than the output of 3977 cfs for the NAA 2008 model run. The 2009 output for this model run was 4120 cfs (-3.6% change). This is less than the output of 4275 cfs for the NAA 2009 model run.

Shoals Spider Lily in November and December (6200 cfs recommended in the workshop):
The 2008 output for this model run was 3784 cfs (-9.6% change). This is less than the output of 4184 cfs for the NAA 2008 model run. The 2009 output for this model run was 3600 cfs (-12.7% change). This is less than the output of 4125 cfs for the NAA 2009 model run.

Therefore, based on the 180 cfs reduction in median flows from the NAA and the above percent changes that are between 10% and 20%, Alternative 3 would produce a moderate adverse impact on the resources.

Effects of Alternative 4 (By comparing the alternatives Augusta gage Downstream Hydrograph to that of the NAA)

The median flow for March 2007 to November 2009 was reduced by 228 cfs (-4.9% change) for Augusta when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 3600 cfs from 23 February 2007 to 26 November 2009. From August 2007 to mid-December of 2007, June to July of 2008, late July to late September of 2009 this alternatives flows are 400 cfs less than those of the NAA. Also, from November 2008 to January 2009 the flows are 600 cfs less than the NAA, so seasonal fish spawning, fish passage, shoals spider lily protection from deer grazing and juvenile out-migration would be impacted.

Effects of Alternative 4 (By employing the EFM in conjunction with Augusta Shoals information from the 1-3 April 2003 Scientific Stakeholders Workshop)

Four flow/habitat relationships were analyzed for the shoals area.

Habitat for Shad and Striped Bass (7500 cfs recommended in the workshop):
The 2008 output for this model run was 4075 cfs (-8.5% change). This is less than the output of 4455 cfs for the NAA 2008 model run. The 2009 output for this model run was 3933 cfs (-12.1% change). This is less than the output of 4472 cfs for the NAA 2009 model run.

Shoals Spider Lily in June and July (6200 cfs recommended in the workshop):
The 2007 output for this model run was 4179 cfs (-2.2% change). This is less than the output of 4275 cfs for the NAA 2007 model run. The 2008 output for this model run was 3791 cfs (-9.5% change). This is less than the output of 4191 cfs for the NAA 2008 model run. The 2009 output for this model run was 3933 cfs (-8.2% change). This is less than the output of 4286 cfs for the NAA 2009 model run.

Shoals Spider Lily from August to October (5500 cfs recommended in the workshop):
The 2007 output for this model run was 3863 cfs (-9.4% change). This is less than the output of 4263 cfs for the NAA 2007 model run. The 2008 output for this model run was 3776 cfs (-5.1% change). This is less than the output of 3977 cfs for the NAA 2008 model run. The 2009 output for this model run was 3920 cfs (-8.3% change). This is less than the output of 4275 cfs for the NAA 2009 model run.

Shoals Spider Lily in November and December (6200 cfs recommended in the workshop):
The 2008 output for this model run was 3784 cfs (-9.6% change). This is less than the output of 4184 cfs for the NAA 2008 model run. The 2009 output for this model run was 3600 cfs (-12.7% change). This is less than the output of 4125 cfs for the NAA 2009 model run.

Therefore, based on the 228 cfs reduction in median flows from the NAA and the above percent changes that are between 10% and 20%, Alternative 4 would produce a moderate adverse impact on the resources.

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). The report from the April 1-3, 2003 workshop listed seedling establishment as being the high priority for the floodplain reach during dry years. The establishment of seedlings is promoted by low flows (3000 cfs or less was recommended in the 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 (15,000 cfs near the Millhaven Gage is discussed in this Section) are expected to remain within the stream channel at nearly all locations and are not expected to affect the floodplain. The 2003 workshop recommendations and the estimated 15,000 cfs stream channel capacity at Millhaven are considered below. Graphical and tabular information is available for 23 February 2007 to 26 November 2009. The proposed Savannah Harbor Expansion Project includes a fish bypass with all flows up to 8,000 cfs going through the bypass.

It is possible that the flow reduction will have a localized effect on mussel populations and other non-motile species that may be found in shallow sloughs and cutoff bends along the river. Many of these areas would have already separated from the main river due to 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.

Effects of the NAA

Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no effect on the floodplain.

Effects of Alternative 1 (By comparing the alternatives Millhaven gage Downstream Hydrograph to that of the NAA)

Considering the 2003 Workshop recommendations listed above for the floodplain:
Reducing flows to the levels recommended above would produce adverse impacts for other Savannah River resources. Action Level 4 would be required to produce flows as low as 3000 cfs in the floodplain. The median flow for March 2007 to November 2009 was reduced by 37 cfs (-0.7% change) for Millhaven when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 4000 cfs from 23 February 2007 to 26 November 2009. From mid-July 2007 to mid-December of 2007, May to July of 2008 and mid-July to mid-September of 2009 this alternative's flows are 200 cfs less than those of the NAA. The lower flows produced by this alternative are expected to produce a minor positive impact on floodplain seedling establishment, because they represent smaller increases above the recommended 3000 cfs. It should be noted that achieving flows of 3000 cfs for the desired three

separate seasons would likely result in a violation of state water quality standards. A minor adverse impact would be expected on non-motile species including mussels as small areas of sloughs and cutoff bends are isolated.

Considering stream channel capacity: The physical characteristics of the Savannah River stream channel limit the floodplain overbank benefit to flows exceeding 15,000 cfs near the Millhaven Gage. The modeled flows produced by this alternative rarely exceed bankfull capacity for the period of 23 February 2007 to 26 November 2009, so no adverse impact would result. Additional flood control storage in the reservoir system may be required to eliminate periods when flows exceed channel capacity between April and October during a three year period for seedling establishment during normal to wet years.

Effects of Alternative 2 (By comparing the alternatives Millhaven gage Downstream Hydrograph to that of the NAA)

Considering the 2003 Workshop recommendations listed above for the floodplain:
Reducing flows to the levels recommended above would produce adverse impacts for other Savannah River resources. Action Level 4 would be required to produce flows as low as 3000 cfs in the floodplain. The median flow for March 2007 to November 2009 was reduced by 142 (-2.7% change) cfs for Millhaven when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 4000 cfs from 23 February 2007 to 26 November 2009. From mid-July 2007 to mid-October of 2007, mid-December 2007 through January of 2008, June to July of 2008 and mid-July to mid-September of 2009 this alternatives flows are 200 cfs less than those of the NAA. The flows from November 2007 through Mid-December 2007 are 400 cfs less than the NAA. Also, from November 2008 to January 2009 the flows are 700 cfs less than those of the NAA. The lower flows produced by this alternative are expected to produce a minor positive impact on floodplain seedling establishment, because they represent smaller increases above the recommended 3000 cfs. It should be noted that achieving flows of 3000 cfs for the desired three separate seasons would likely result in a violation of state water quality standards. A minor adverse impact would be expected on non-motile species including mussels as small areas of sloughs and cutoff bends are isolated.

Considering Stream Channel Capacity: The physical characteristics of the Savannah River stream channel limit the floodplain overbank benefit to flows exceeding 15,000 cfs near the Millhaven Gage. The modeled flows produced by this alternative rarely exceed bank-full capacity for the period of 23 February 2007 to 26 November 2009, so no adverse impact would result. Additional flood control storage in the reservoir system may be required to eliminate periods when flows exceed channel capacity between April and October during a three year period for seedling establishment during normal to wet years.

Effects of Alternative 3 (By comparing the alternatives Millhaven gage Downstream Hydrograph to that of the NAA)

Considering the 2003 Workshop recommendations listed above for the floodplain: Reducing flows to the levels recommended above would produce adverse impacts for other Savannah River resources. Action Level 4 would be required to produce flows as low as 3000 cfs in the floodplain. The median flow for March 2007 to November 2009 was reduced by 185 cfs (-3.6% change) for Millhaven when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 4000 cfs from 23 February 2007 to 26 November 2009. From mid-July 2007 to October of 2007, June to mid-October of 2008 and mid-July to mid-September of 2009 this alternatives flows are 200 cfs less than those of the NAA. From November 2007 to mid-December 2007 the flows are 400 cfs less than those of the NAA. Also, from November 2008 to January 2009 the flows are 600 cfs less than those of the NAA. The lower flows produced by this alternative are expected to produce a minor positive impact on floodplain seedling establishment, because they represent smaller increases above the recommended 3000 cfs. It should be noted that achieving flows of 3000 cfs for the desired three separate seasons would likely result in a violation of state water quality standards. A minor adverse impact would be expected on non-motile species including mussels as small areas of sloughs and cutoff bends are isolated.

Considering Stream Channel Capacity: The physical characteristics of the Savannah River stream channel limit the floodplain overbank benefit to flows exceeding 15,000 cfs near the Millhaven Gage. The modeled flows produced by this alternative rarely exceed bank-full capacity for the period of 23 February 2007 to 26 November 2009, so no adverse impact would result. Additional flood control storage in the reservoir system may be required to eliminate periods when flows exceed channel capacity between April and October during a three year period for seedling establishment during normal to wet years.

Effects of Alternative 4 (By comparing the alternatives Millhaven gage Downstream Hydrograph to that of the NAA)

Considering the 2003 Workshop recommendations listed above for the floodplain: Reducing flows to the levels recommended above would produce adverse impacts for other Savannah River resources. Action Level 4 would be required to produce flows as low as 3000 cfs in the floodplain. The median flow for March 2007 to November 2009 was reduced by 205 cfs (-4.0% change) for Millhaven when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 4000 cfs from 23 February 2007 to 26 November 2009. From mid-July 2007 to mid-December of 2007, June to late August of 2008 and late July to mid-September of 2009 this alternatives flows are 400 cfs less than those of the NAA. Also, from November 2008 to January 2009 the flows are 600 cfs less than those of the NAA. The lower flows produced by this alternative are expected to produce a minor positive impact on floodplain seedling establishment, because they represent smaller increases above the recommended 3000 cfs. It should be noted that achieving flows of 3000 cfs for the desired three separate seasons would likely result in a violation of state water quality standards. A minor adverse impact would be expected on non-motile species including mussels as small areas of sloughs and cutoff bends are isolated.

Considering Stream Channel Capacity: The physical characteristics of the Savannah River stream channel limit the floodplain overbank benefit to flows exceeding 15,000 cfs near the Millhaven Gage. The modeled flows produced by this alternative rarely exceed bank-full capacity for the period of 23 February 2007 to 26 November 2009, so no adverse impact would result. Additional flood control storage in the reservoir system may be required to eliminate periods when flows exceed channel capacity between April and October during a three year period for seedling establishment during normal to wet years.

4.5. Biotic Communities-Estuary


Estuary

The report from the April 2003 workshop listed freshwater marsh habitat and the salinity gradient as being 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 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, snapper/grouper, bluefish, summer flounder 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 NOAA Fisheries. 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.

The Savannah National Wildlife Refuge contains both tidal wetlands and managed wetland impoundments. The Refuge was established in 1927 to provide waterfowl habitat. Since then, it has broadened its mission to the following:

- To provide habitat and sanctuary for migratory birds consistent with the objectives of the Atlantic Flyway.
- To provide habitat and protection for plants and animals whose survival is threatened or endangered.
- To use Refuge property as "a refuge and breeding ground for native birds and wild animals".
- To maintain and enhance the habitats of all other species of indigenous wildlife and fishery resources.

The Refuge manages its impoundments as “managed wetlands”. These lands are diked and the habitats within the diked areas are managed for migratory birds, including wintering waterfowl. The USFWS uses prescribed burning and water level control to increase vegetation that provides food for migrating ducks, as well as suppress vegetation that is of less value to waterfowl. According to the USFWS, the moist soil management practices that are used in most of the management units on the Refuge produce the most productive waterfowl habitat. Fresh water is provided to the managed wetlands through a supply canal located off of Little Back River (about RM 24). In the Savannah NWR, the managed wetlands provide the most heavily used habitat for wintering waterfowl and wading birds. Based on mid-winter waterfowl surveys from 1990-2002, the Refuge provided habitat for 23 percent of the waterfowl in South Carolina.

Lower flows are projected by the model runs of the alternatives.

Effects of the NAA

Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no effect on these biotic communities.

Effects of Alternative 1 (By comparing the alternatives Clyo gage Downstream Hydrograph to that of the NAA)

The median flow for March 2007 to November 2009 was reduced by 18 cfs (-0.3% change) for Clyo when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 4300 cfs from 23 February 2007 to 26 November 2009. From mid-July 2007 to mid-December of 2007, June to early August of 2008 and mid-July to mid-September of 2009 this alternative’s flows are 200 cfs less than those of the NAA, so tidal freshwater marsh would be impacted.

Effects of Alternative 1 (By employing the EFM in conjunction with estuary information from the 1-3 April 2003 Scientific Stakeholders Workshop)

Three flow/habitat relationships were analyzed for the estuary area.

Instantaneous maintenance of tidal freshwater marsh (5000 cfs recommended in the workshop): The 2008 output for this model run was 4413 cfs (-0.9% change). This is less than the output of 4453 cfs for the NAA 2008 model run.

Spring seasonal maintenance of tidal freshwater marsh (8000 cfs recommended in the workshop): The 2008 output for this model run was 5021 cfs (-3.8% change). This is less than the output of 5221 cfs for the NAA 2008 model run. The 2009 output for this model run was 5837 cfs (0.0% change). This is equal to the output of 5837 cfs for the NAA 2009 model run.

Summer and fall seasonal maintenance of tidal freshwater marsh (6000 cfs recommended in the workshop): The 2007 output for this model run was 4590 cfs (-4.2% change). This is less than the output of 4790 cfs for the NAA 2007 model run. The 2008 output for this model run was 4468 cfs (0.0% change). This is equal to the output of 4468 cfs for the NAA 2008 model run.

Therefore, based on the 18 cfs reduction in median flows from the NAA and the above percent changes that are below 10%, Alternative 1 would produce a minor adverse impact on the resources.

Effects of Alternative 2 (By comparing the alternatives Clyo gage Downstream Hydrograph to that of the NAA)

The median flow for March 2007 to November 2009 was reduced by 132 cfs (-2.3% change) for Clyo when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 4100 cfs from 23 February 2007 to 26 November 2009. From mid-July 2007 to mid-October of 2007, mid-May 2008 to July of 2008 and mid-July 2009 to mid-September of 2009 this alternatives flows are 200 cfs less than those of the NAA. From November 2007 to mid-December 2007 the flows are 400 cfs less than those of the NAA. Also, from November 2008 to January 2009 the flows are 600 cfs less than those of the NAA, so tidal freshwater marsh would be impacted.

Effects of Alternative 2 (By employing the EFM in conjunction with estuary information from the 1-3 April 2003 Scientific Stakeholders Workshop)

Three flow/habitat relationships were analyzed for the estuary area.

Instantaneous maintenance of tidal freshwater marsh (5000 cfs recommended in the workshop): The 2008 output for this model run was 4304 cfs (-3.3% change). This is less than the output of 4453 cfs for the NAA 2008 model run.

Spring seasonal maintenance of tidal freshwater marsh (8000 cfs recommended in the workshop): The 2008 output for this model run was 5021 cfs (-3.8% change). This is less than the output of 5221 cfs for the NAA 2008 model run. The 2009 output for this model run was 5529 cfs (-5.3% change). This is less than the output of 5837 cfs for the NAA 2009 model run.

Summer and Fall seasonal maintenance of tidal freshwater marsh (6000 cfs recommended in the workshop): The 2007 output for this model run was 4459 cfs (-6.9% change). This is less than the output of 4790 cfs for the NAA 2007 model run. The 2008 output for this model run was 4422 cfs (-1.0% change). This is less than the output of 4468 cfs for the NAA 2008 model run.

Therefore, based on the 132 cfs reduction in median flows from the NAA and the above percent changes that are below 10%, Alternative 2 would produce a minor adverse impact on the resources.

Effects of Alternative 3 (By comparing the alternatives Clyo gage Downstream Hydrograph to that of the NAA)

The median flow for March 2007 to November 2009 was reduced by 162 cfs (-2.8% change) for Clyo when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 4100 cfs from 23 February 2007 to 26 November 2009. From mid-July to October 2007, mid-December 2007 to January 2008, June to July 2008, September to October 2008, February 2009, and mid-July to mid-September 2009, this alternative's flows are 200 cfs less than those of the NAA. From November to mid-December 2007, the flows are 400 cfs less than those of the NAA. From November 2008 to January 2009, the flows are 600 cfs less than those of the NAA, so tidal freshwater marsh would be impacted.

Effects of Alternative 3 (By employing the EFM in conjunction with estuary information from the 1-3 April 2003 Scientific Stakeholders Workshop)

Three flow/habitat relationships were analyzed for the estuary area.

Instantaneous maintenance of tidal freshwater marsh (5000 cfs recommended in the workshop): The 2008 output for this model run was 4210 cfs (-5.5% change). This is less than the output of 4453 cfs for the NAA 2008 model run.

Spring seasonal maintenance of tidal freshwater marsh (8000 cfs recommended in the workshop): The 2008 output for this model run was 5021 cfs (-3.8% change). This is less than the output of 5221 cfs for the NAA 2008 model run. The 2009 output for this model run was 5490 cfs (-5.9% change). This is less than the output of 5837 cfs for the NAA 2009 model run.

Summer and Fall seasonal maintenance of tidal freshwater marsh (6000 cfs recommended in the workshop): The 2007 output for this model run was 4459 cfs (-6.9% change). This is less than the output of 4790 cfs for the NAA 2007 model run. The 2008 output for this model run was 4268 cfs (-4.5% change). This is less than the output of 4468 cfs for the NAA 2008 model run.

Therefore, based on the 162 cfs reduction in median flows from the NAA and the above percent changes that are below 10%, Alternative 3 would produce a minor adverse impact on the resources.

Effects of Alternative 4 (By comparing the alternatives Clyo gage Downstream Hydrograph to that of the NAA)

The median flow for March 2007 to November 2009 was reduced by 208 cfs (-3.6% change) for Clyo when compared to the NAA. The downstream hydrograph of this alternative and the NAA provides flows that greatly exceed 4200 cfs from 23 February 2007 to 26 November 2009. From August to late December 2007, June to early August 2008, and mid-July to mid-September 2009, this alternative's flows are 400 cfs less than those of the NAA. From November 2008 to January 2009, the flows are 600 cfs less than those of the NAA, so tidal freshwater marsh would be impacted.

Effects of Alternative 4 (By employing the EFM in conjunction with estuary information from the 1-3 April 2003 Scientific Stakeholders Workshop)

Three flow/habitat relationships were analyzed for the estuary area.

Instantaneous maintenance of tidal freshwater marsh (5000 cfs recommended in the workshop): The 2008 output for this model run was 4176 cfs (-6.2% change). This is less than the output of 4453 cfs for the NAA 2008 model run.

Spring seasonal maintenance of tidal freshwater marsh (8000 cfs recommended in the workshop): The 2008 output for this model run was 4821 cfs (-7.7% change). This is less than the output of 5221 cfs for the NAA 2008 model run. The 2009 output for this model run was 5490 cfs (-5.9% change). This is less than the output of 5837 cfs for the NAA 2009 model run.

Summer and Fall seasonal maintenance of tidal freshwater marsh (6000 cfs recommended in the workshop): The 2007 output for this model run was 4390 cfs (-8.4% change). This is less than the output of 4790 cfs for the NAA 2007 model run. The 2008 output for this model run was 4279 cfs (-4.2% change). This is less than the output of 4468 cfs for the NAA 2008 model run.

Therefore, based on the 208 cfs reduction in median flows from the NAA and the above percent changes that are below 10%, Alternative 4 would produce a minor adverse impact on the resources.

4.6. THREATENED AND ENDANGERED SPECIES

The State listed robust redhorse, shoals spider lily, Altamaha arcmussel, brother spike (mussel), Savannah lilliput (mussel) and the federally-listed Atlantic sturgeon, shortnose sturgeon, manatee, and wood stork are the only Threatened or Endangered Species that may possibly be affected by small changes in flow. Among the conclusions of the scientific stakeholders workshop in April of 2003 was that higher flows throughout the year would provide a healthier freshwater marsh plant community and allow more fish access.

Robust redhorse

Spider lily

Shortnose sturgeon

Effects of the NAA

Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no effect on any threatened and endangered species.

Effects of Alternative 1 (By comparing the alternatives Augusta and Millhaven gage medians to that of the NAA and by employing the EFM in conjunction with Augusta Shoals information from the 1-3 April 2003 Scientific Stakeholders Workshop)

As discussed earlier in Section 4.3, the Augusta gage median flow is 61 cfs (-1.3% change) less than the NAA. For EFM the 10 Water Year percent changes would be -4.0, 0.0, -0.9, -4.8, -3.6, -4.7, 0.0, -3.6, -4.8, and 0.0, so a minor adverse impact would result for the shoals spider lily and fish species.

As discussed earlier in Section 4.4, the Millhaven gage median flow is 37 cfs (-0.7% change) less than the NAA, so a minor adverse impact would result on mussels as small areas of sloughs and cutoff bends are isolated.

Effects of Alternative 2 (By comparing the alternatives Augusta and Millhaven gage medians to that of the NAA and by employing the EFM in conjunction with Augusta Shoals information from the 1-3 April 2003 Scientific Stakeholders Workshop)

As discussed earlier in Section 4.3, the Augusta gage median flow is 130 cfs (-2.8% change) less than the NAA. For EFM the 10 Water Year percent changes would be -4.0, -12.1, -2.2, -4.8, -3.6, -4.9, -4.6, -3.6, -9.6, and -12.7, so a moderate adverse impact would result for the shoals spider lily and fish species. This proposed action may affect, but is not likely to adversely affect Atlantic sturgeon, shortnose sturgeon, manatee or the wood stork, because the Atlantic sturgeon and shortnose sturgeon are primarily found in the lower water column, the manatee has a limited inland range and the nesting/feeding of the wood stork is not expected to be affected.

As discussed earlier in Section 4.4, the Millhaven gage median flow is 142 cfs (-2.7% change) less than the NAA, so a minor adverse impact would result on mussels as small areas of sloughs and cutoff bends are isolated.

Effects of Alternative 3 (By comparing the alternatives Augusta and Millhaven gage medians to that of the NAA and by employing the EFM in conjunction with Augusta Shoals information from the 1-3 April 2003 Scientific Stakeholders Workshop)

As discussed earlier in Section 4.3, the Augusta gage median flow is 180 cfs (-3.9% change) less than the NAA. For EFM the 10 Water Year percent changes would be -4.0, -12.1, -2.2, -4.8, -3.6, -4.9, -5.1, -3.6, -9.6, and -12.7, so a moderate adverse impact would result for the shoals spider lily and fish species.

As discussed earlier in Section 4.4, the Millhaven gage median flow is 185 cfs (-3.6% change) less than the NAA for the Millhaven gage, so a minor adverse impact would result on mussels as small areas of sloughs and cutoff bends are isolated.

Effects of Alternative 4 (By comparing the alternatives Augusta and Millhaven gage medians to that of the NAA and by employing the EFM in conjunction with Augusta Shoals information from the 1-3 April 2003 Scientific Stakeholders Workshop)

As discussed earlier in Section 4.3, the Augusta gage median flow is 228 cfs (-4.9% change) less than the NAA. For EFM the 10 Water Year percent changes would be -8.5, -12.1, -2.2, -9.5, -8.2, -9.4, -5.1, -8.3, -9.6, and -12.7, so a moderate adverse impact would result for the shoals spider lily and fish species.

As discussed earlier in Section 4.4, the Millhaven gage median flow is 205 cfs (-4.0% change) less than the NAA, so a minor adverse impact would result on mussels as small areas of sloughs and cutoff bends are isolated.

4.7. Essential Fish Habitat

Among the conclusions of the scientific stakeholders workshop in April of 2003 was that higher flows throughout the year would provide a healthier freshwater marsh plant community and allow more fish access.

Effects of the NAA

Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no effects on Essential Fish Habitat.

Effects of Alternative 1

As discussed earlier in Section 4.5, the median flow is 18 cfs (-0.2% change) less than the NAA for the Clyo gage. For EFM the 5 Water Year percent changes would be -0.9, -3.8, 0.0, -4.2, and 0.0. Therefore, based on the previous percent changes that are below 10%, Alternative 1 would produce a minor adverse impact on the resources and salinity would be expected to move slightly further into the estuary.

Effects of Alternative 2

As discussed earlier in Section 4.5, the median flow is132 cfs (-2.3% change) less than the NAA for the Clyo gage. For EFM the 5 Water Year percent changes would be -3.7, -3.8, -5.3, -4.2, and -1.0. Therefore, based on the previous percent changes that are below 10%, Alternative 2 would produce a minor adverse impact on the resources and salinity would be expected to move slightly further into the estuary.

Effects of Alternative 3

As discussed earlier in Section 4.5, the median flow is162 cfs (-2.8% change) less than the NAA for the Clyo gage. For EFM the 5 Water Year percent changes would be -5.5, -3.8, -5.9, -6.9, and -4.5. Therefore, based on the previous percent changes that are below 10%, Alternative 3 would produce a minor adverse impact on the resources and salinity would be expected to move slightly further into the estuary.

Effects of Alternative 4

As discussed earlier in Section 4.5, the median flow is 208 cfs (-3.6% change) less than the NAA for the Clyo gage. For EFM the 5 Water Year percent changes would be -6.2, -7.7, -5.9, -8.4, and -4.2. Therefore, based on the previous percent changes that are below 10%, Alternative 4 would produce a minor adverse impact on the resources and salinity would be expected to move slightly further into the estuary.

4.8. RECREATION

As evident in past droughts, recreation opportunities diminish on Hartwell and JST. Some public boat ramps and private docks are out of the water as the lake level recedes. In addition, tree stumps and sand bars are exposed in the lakes. For some boaters, there is the perception that use of the lakes poses a serious threat to damaging boats and injuring persons. For swimmers, swimming outside the USACE operated designated areas increases the potential for swimming fatalities.

4.8.1. Boat-Launching Ramps and Private Docks Hartwell Lake

An examination of the number of days water surface elevations are at and below each lake level over the period of record of drought from 3 March 2007 to 26 November 2009 for each alternative provides the number of times at which lake levels are at and below a lake level relative to the No Action Alternative (Table 16). All lake levels use the National Geodetic Vertical Datum of 1929 (NGVD 29) sea level to determine the feet above msl (ft msl).

Table 16: Hartwell Lake: Days At and Below Lake Level by Alternative

Lake Level (ft msl)	660	659	658	657	656	655	654	653	652	651	650	649	648	647
NAA	1000	968	913	869	847	837	797	692	628	547	446	406	364	309
Alternative 1	1000	968	913	863	845	818	740	641	573	465	414	375	312	236
Alternative 2	1000	967	910	861	836	765	693	589	543	448	401	349	287	216
Alternative 3	1000	967	907	860	830	755	697	585	542	448	400	348	285	216
Alternative 4	1000	967	902	846	769	713	677	574	488	425	378	328	258	178

Lake Level (ft msl)	646	645	644	643	642	641	640	639	638	637	636	635	634	Lowest Lake Level
NAA	238	202	174	161	132	90	78	70	54	40	23	5	0	634.59
Alternative 1	184	159	138	84	74	60	46	29	16	0	0	0	0	637.29
Alternative 2	167	104	88	75	59	43	24	1	0	0	0	0	0	638.96
Alternative 3	165	100	84	68	53	36	17	0	0	0	0	0	0	639.37
Alternative 4	108	82	63	47	31	6	0	0	0	0	0	0	0	640.81

At and below lake level 658 feet msl, some boat-launching ramps at Hartwell Lake become unusable. Table 16 shows that there is little change between Alternatives 1, 2, 3, and 4 and the NAA in the number of days at and below each lake level from 658 through 654 feet msl. Starting at and below lake level 656, there is a consistently measurable change in the number of days at and below each lake level between Alternative 2 and 3 and the NAA.

The following table shows the number of unusable and useable public boat-launching ramps by lake level in one-foot increments.

Table 17: Hartwell Lake: Number of Unusable and Usable Ramps by Lake Level

At And Below Lake Level (feet msl)	Additional Ramps Unusable By 1-Foot Drop In Lake	Total Ramps Unusable By 1-Foot Drop In Lake Level	Useable Ramps By 1-Foot Drop In Lake Level
659	0	0	94
658	6	6	88
657	6	12	82
656	1	13	81
655	3	16	78
654	1	17	77
653	6	23	71
652	5	28	66
651	7	35	59
650	3	38	56
649	2	40	54
648	3	43	51
647	3	46	48
646	0	46	48

645	4	50	44
644	15	65	29
643	21	86	8
642	2	88	6
641	0	88	6
640	0	88	6
639	0	88	6
638	6	94	0

Tables 18 through 21 are a comparison of the NAA and each Alternative including the difference in the number of days at and below each lake level and the number of public boat-launching ramps adversely impacted.

Effects of the NAA
The NAA's minimum lake level elevation during the modeled drought of record is estimated at 634.59 feet msl (Table 16). Therefore, none of the boat-launching ramps would be useable at the worst period of drought under the NAA.

According to a survey conducted by the Lake Hartwell Association in 2003, most of the people surveyed (80 percent) considered boating and water sports safe when lake levels are above 652 feet msl. In 2002, when lake levels were below 652 feet msl all year, the survey reveals an estimated 63 percent drop in the number of boating trips taken from non-drought years. This number corresponds to the estimated 61 percent drop in visits according to the Zapata report. Therefore, one may conclude, based on these reports, that once lake levels drop at and below 652 feet msl approximately 37 to 39 percent of all boating trips conducted in non-drought years would be impacted.

Currently, there are an estimated 10,700 private boat docks in Hartwell Lake. The SRBDCP, March 1989 estimated that there were approximately 5,400 private docks. It was roughly estimated that about 50 percent of these private docks were unusable at 652 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 newer developments are located in shallow coves. Hence, at and below 652 feet msl more than 50 percent of these private docks would likely be unusable for 628 days.

Effects of Alternative 1
Alternative 1's minimum lake level elevation is estimated at 637.29 feet msl (Table 16). Therefore, none of the boat-launching ramps would be useable at the worst period of drought under Alternative 1. As shown in Table 18, above 654 feet msl, there are measureable differences in the number of days between the NAA and Alternative 1 at and below each lake level. At and below 654 feet msl there are more measurable negative differences between the NAA and Alternative 1 in the number of days at and below each lake level. At each lake level there are more days available to use the boat-launching ramps than the NAA. Hence, Alternative 1 has a minor positive impact on boat-launching ramps at Hartwell Lake.

Table 18: Hartwell Lake: Days At and Below Lake Level - Comparison of NAA and Alternative 1 Including Number of Boat-Launching Ramps Impacted by 1 Foot Increment

Lake Level (ft msl)	660	659	658	657	656	655	654	653	652	651	650	649	648	647
NAA	1000	968	913	869	847	837	797	692	628	547	446	406	364	309
Alternative 1	1000	968	913	863	845	818	740	641	573	465	414	375	312	236
Difference	0	0	0	-6	-2	-19	-57	-51	-55	-82	-32	-31	-52	-73
# of Ramps Out	0	0	6	12	13	16	17	23	28	35	38	40	43	46

Lake Level (ft msl)	646	645	644	643	642	641	640	639	638	637	636	635	634
NAA	238	202	174	161	132	90	78	70	54	40	23	5	0
Alternative 1	184	159	138	84	74	60	46	29	16	0	0	0	0
Difference	-54	-43	-36	-77	-58	-30	-32	-41	-38	-40	-23	-5	0
# of Ramps Out	46	50	65	86	88	88	88	88	94	94	94	94	94

At every lake level there are more days available to use private docks. Therefore, Alternative 1 has a similar positive impact on private docks as it had on public ramps at Hartwell Lake relative to the NAA.

Effects of Alternative 2

The minimum lake level for Alternative 2 is 638.96 feet msl (Table 16). Therefore, 6 public boat-launching ramps (6 percent) would be useable at the worst period of the drought. At each lake level there are more days available to use the boat-launching ramps than the NAA. Hence, Alternative 2 has a minor positive impact on boat-launching ramps at Hartwell Lake.

Table 19: Hartwell Lake: Days At and Below Lake Level – Comparison of NAA and Alternative 2 Including Number of Boat-Launching Ramps Impacted by 1 Foot Increment

Lake Level (ft msl)	660	659	658	657	656	655	654	653	652	651	650	649	648	647
NAA	1000	968	913	869	847	837	797	692	628	547	446	406	364	309
Alternative 2	1000	967	910	861	836	765	693	589	543	448	401	349	287	216
Difference	0	-1	-3	-8	-11	-72	-104	-103	-85	-99	-45	-57	-77	-93
# of Ramps Out	0	0	6	12	13	16	17	23	28	35	38	40	43	46

Lake Level (ft msl)	646	645	644	643	642	641	640	639	638	637	636	635	634
NAA	238	202	174	161	132	90	78	70	54	40	23	5	0
Alternative 2	167	104	88	75	59	43	24	1	0	0	0	0	0
Difference	-71	-98	-86	-86	-73	-47	-54	-69	-54	-40	-23	-5	0
# of Ramps Out	46	50	65	86	88	88	88	88	94	94	94	94	94

At every lake level there are more days available to use private docks. Therefore, Alternative 2 has a similar positive impact on private docks as it had on public ramps s at Hartwell Lake relative to the NAA.

Effects of Alternative 3

The minimum lake level for Alternative 3 is 639.37 feet msl (Table 16). Therefore, 6 public boat-launching ramps (6 percent) would be useable at the worst period of the drought. At each lake level there are more days available to use the boat-launching ramps than the NAA. Hence, Alternative 3 has a minor positive impact on boat-launching ramps at Hartwell Lake.

Table 20: Hartwell Lake: Days At and Below Lake Level – Comparison of NAA and Alternative 3 Including Number of Boat-Launching Ramps Impacted by 1 Foot Increment

Lake Level (ft msl)	660	659	658	657	656	655	654	653	652	651	650	649	648	647
NAA	1000	968	913	869	847	837	797	692	628	547	446	406	364	309
Alternative 3	1000	967	907	860	830	755	697	585	542	448	400	348	285	216
Difference	0	-1	-6	-9	-17	-82	-100	-107	-86	-99	-46	-58	-79	-93
# of Ramps Out	0	0	6	12	13	16	17	23	28	35	38	40	43	46

Lake Level (ft msl)	646	645	644	643	642	641	640	639	638	637	636	635	634
NAA	238	202	174	161	132	90	78	70	54	40	23	5	0
Alternative 3	165	100	84	68	53	36	17	0	0	0	0	0	0
Difference	-73	-102	-90	-93	-79	-54	-61	-70	-54	-40	-23	-5	0
# of Ramps Out	46	50	65	86	88	88	88	88	94	94	94	94	94

At every lake level there are more days available to use private docks than the NAA. Therefore, Alternative 3 has a similar positive impact on private docks as it had on public ramps at Hartwell Lake relative to the NAA.

Effects of Alternative 4

The minimum lake level for Alternative 4 is 640.81 feet msl (Table 16). Therefore, 6 public boat-launching ramps (6 percent) would be useable at the worst period of the drought. At each lake level there are more days available to use the boat-launching ramps than the NAA. Hence, Alternative 4 has a minor positive impact on boat-launching ramps at Hartwell Lake.

Table 21: Hartwell Lake: Days At and Below Lake Level – Comparison of NAA and Alternative 4 Including Number of Boat-Launching Ramps Impacted by 1 Foot Increment

Lake Level (ft msl)	660	659	658	657	656	655	654	653	652	651	650	649	648	647
NAA	1000	968	913	869	847	837	797	692	628	547	446	406	364	309
Alternative 4	1000	967	902	846	769	713	677	574	488	425	378	328	258	178
Difference	0	-1	-11	-23	-78	-124	-120	-118	-140	-122	-68	-78	-106	-131
# of Ramps Out	0	0	6	12	13	16	17	23	28	35	38	40	43	46

Lake Level (ft msl)	646	645	644	643	642	641	640	639	638	637	636	635	634
NAA	238	202	174	161	132	90	78	70	54	40	23	5	0
Alternative 4	108	82	63	47	31	6	0	0	0	0	0	0	0
Difference	-130	-120	-111	-114	-101	-84	-78	-70	-54	-40	-23	-5	0
# of Ramps Out	46	50	65	86	88	88	88	88	94	94	94	94	94

At every lake level there are more days available to use private docks than the NAA. Therefore, Alternative 4 has a similar positive impact on private docks as it had on public ramps at Hartwell Lake relative to the NAA.

RBR Lake

The minimum lake level for the NAA is 471.25 feet msl. The minimum lake levels for Alternatives 1, 2, 3, and 4, are 471.63 feet msl; 471.77 feet msl, 471.39 feet msl, and 471.41 feet msl, respectively. Lake level would have to be at 466 feet msl and lower to have adverse impacts on the boat-launching ramps in the RBR Lake. Therefore, for all the alternatives, there are no adverse impacts on public boat-launching ramps in RBR Lake.

There are no private docks on the RBR Lake.

JST Lake

An examination of the numbers of days at and below each lake level from 3 March 2007 to 26 November 2009 for each alternative provides the number of times at which lake levels are at and below a lake level for each alternative relative to the NAA (Table 22).

Table 22: JST Lake: Days At and Below Lake Level by Alternative

Lake Level (ft msl)	331	330	329	328	327	326	325	324	323	322	321	320
NAA	1000	998	984	914	853	810	774	720	656	599	535	434
Alternative 1	1000	997	984	899	840	801	692	660	608	549	460	408
Alternative 2	1000	996	968	896	839	703	656	612	577	513	451	377
Alternative 3	1000	995	966	894	813	692	640	599	573	513	446	376
Alternative 4	1000	994	957	897	730	666	599	576	559	491	408	356

Lake Level (ft msl)	319	318	317	316	315	314	313	312	Lowest Lake Level
NAA	392	315	228	206	188	67	2	0	312.72
Alternative 1	346	254	205	180	127	37	0	0	313.07
Alternative 2	324	237	202	126	80	23	0	0	313.35
Alternative 3	323	236	201	119	75	19	0	0	313.40
Alternative 4	292	209	143	97	56	6	0	0	313.58

Table 22 shows that starting at and below lake level 328 feet msl, there is a measurable change in the number of days at and below each specific lake level between all the Alternatives and the

NAA. As shown in Table 23, at and below lake level 326 feet msl, boat-launching ramps start to become unusable. For example, when the lake level is at and below 326 feet msl, Alternative 2 (Table 22) provides an additional 107 days of recreation for 1 boat ramp while Alternative 1 (Table 22) provides only 9 more days of recreation than the NAA.

There are 79 public boat-launching ramps and marinas located on JST Lake. Above lake elevation 326 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 (21 percent) boat-launching ramps become unusable while 62 (78 percent) remain useable. At and below lake level 317 feet msl, 36 (46 percent) boat-launching ramps become unusable. At and below lake level 315 feet msl, 46 (58 percent) boat-launching ramps become unusable. All boat-launching ramps would become unusable at 306 feet msl.

Table 23: JST Lake: Number of Unusable and Useable Ramps by Lake Level

At and Below Lake Level (feet msl)	Additional Ramps Unusable by 1-Foot Drop in Lake	Total Ramps Unusable By 1-Foot Drop in Lake	Useable Ramps by 1-Foot Drop in Lake
327	0	0	79
326	1	1	78
325	4	5	74
324	5	10	69
323	2	12	67
322	2	14	65
321	6	20	59
320	4	24	55
319	2	26	53
318	5	31	48
317	5	36	43
316	5	41	38
315	5	46	33
314	13	59	20
313	9	68	11
312	2	70	9
311	3	73	6
310	2	75	4
309	1	76	3
308	2	78	1
307	0	78	1
306	1	79	0

Effects of the NAA

The NAA's minimum lake level during the modeled drought of record is estimated at 312.72 feet msl (Table 22). Therefore, 9 public boat-launching ramps (11 percent) would be useable at the worst period of drought under the NAA. At and below lake level 326 feet msl, boat-launching ramps start to become unusable. At and below lake level 326 feet msl, 1 boat-launching ramp is unusable for 810 days. At and below lake level 325 feet msl, 4 additional boat-launching ramps become unusable for 774 days. At and below lake level 324 feet msl, 7 additional boat launching ramps become unusable for 720 days. The total number of unusable boat-launching ramps continues to increase to 68 at and below 313 feet msl.

Currently, there are approximately 1,962 private boat docks on the JST Lake. This is a 25 percent increase from the March 1989 SRBDCP. In the SRBDCP, 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. However, by the time lake levels are at and below 322 feet msl, it is estimated that 61 to 63 percent of the visits have been displaced.

Effects of Alternative 1

The minimum lake level for Alternative 1 is 313.07 feet msl (Table 22). Therefore, 20 boat-launching ramps would be useable (25 percent) at the worst period of drought for Alternative 1. Alternative 1 is considered to have a minor positive impact on boat-launching ramps at JST Lake since there is a measurably consistent increase in the number of days that boat-launching ramps are available especially above lake level 322 feet msl from the NAA.

Table 24: JST Lake: Days At and Below Lake Level – Comparison of NAA and Alternative 1 Including Number of Boat-Launching Ramps Impacted by 1-Foot Increment

Lake Level (ft msl)	331	330	329	328	327	326	325	324	323	322
NAA	1000	998	984	914	853	810	774	720	656	599
Alternative 1	1000	997	984	899	840	801	692	660	608	549
Difference	0	-1	0	-15	-13	-9	-82	-60	-48	-50
# of Ramps Out	0	0	0	0	0	1	5	10	12	14

Lake Level (ft msl)	321	320	319	318	317	316	315	314	313	312
NAA	535	434	392	315	228	206	188	67	2	0
Alternative 1	460	408	346	254	205	180	127	37	0	0
Difference	-75	-26	-46	-61	-23	-26	-61	-30	-2	0
# of Ramps Out	20	24	26	31	36	41	46	59	68	70

Above lake level 322 feet msl, there is a measurable increase in the number of days that private docks are available compared to the NAA. Therefore, Alternative 1 has a similar positive impact on private docks as it had on public ramps at JST Lake relative to the NAA.

Effects of Alternative 2

The minimum lake level for Alternative 2 is 313.35 feet msl (Table 22). Therefore, 20 boat-launching ramps would be useable (25 percent) at the worst period of drought for Alternative 2.

Alternative 2 is considered to have a minor positive impact on boat-launching ramps at JST Lake since there is a measurably consistent increase in the number of days that boat-launching ramps are available especially above lake level 322 feet msl from the NAA.

Table 25: JST Lake: Days At and Below Lake Level – Comparison of NAA and Alternative 2 Including Number of Boat-Launching Ramps Impacted by 1-Foot Increment

Lake Level (ft msl)	331	330	329	328	327	326	325	324	323	322
NAA	1000	998	984	914	853	810	774	720	656	599
Alternative 2	1000	996	968	896	839	703	656	612	577	513
Difference	0	-2	-16	-18	-14	-107	-118	-108	-79	-86
# of Ramps Out	0	0	0	0	0	1	5	10	12	14

Lake Level (ft msl)	321	320	319	318	317	316	315	314	313	312
NAA	535	434	392	315	228	206	188	67	2	0
Alternative 2	451	377	324	237	202	126	80	23	0	0
Difference	-84	-57	-68	-78	-26	-80	-108	-44	-2	0
# of Ramps Out	20	24	26	31	36	41	46	59	68	70

Above lake level 322 feet msl, there is a measurable increase in the number of days that private docks are available compared to the NAA. Therefore, Alternative 2 has a similar positive impact on private docks as it had on public ramps at JST Lake relative to the NAA.

Effects of Alternative 3

The minimum lake level for Alternative 3 is 313.40 feet msl (Table 22). Therefore, 20 boat-launching ramps would be useable (25 percent) at the worst period of drought for Alternative 3. Alternative 3 is considered to have a minor positive impact on boat-launching ramps at JST Lake since there is a measurably consistent increase in the number of days that boat-launching ramps are available especially above lake level 322 feet msl from the NAA.

Table 26: JST Lake: Days At and Below Lake Level – Comparison of NAA and Alternative 3 Including Number of Boat-Launching Ramps Impacted by 1-Foot Increment

Lake Level (ft msl)	331	330	329	328	327	326	325	324	323	322
NAA	1000	998	984	914	853	810	774	720	656	599
Alternative 3	1000	995	966	894	813	692	640	599	573	513
Difference	0	-3	-18	-20	-40	-118	-134	-121	-83	-86
# of Ramps Out	0	0	0	0	0	1	5	10	12	14

Lake Level (ft msl)	321	320	319	318	317	316	315	314	313	312
NAA	535	434	392	315	228	206	188	67	2	0
Alternative 3	446	376	323	236	201	119	75	19	0	0
Difference	-89	-58	-69	-79	-27	-87	-113	-48	-2	0
# of Ramps Out	20	24	26	31	36	41	46	59	68	70

Above lake level 322 feet msl, there is a measurable increase in the number of days that private docks are available compared to the NAA. Therefore, Alternative 3 has a similar positive impact on private docks as it had on public ramps at JST Lake relative to the NAA.

Effects of Alternative 4

The minimum lake level for Alternative 4 is 313.58 feet msl (Table 22). Therefore, 20 boat-launching ramps would be useable (25 percent) at the worst period of drought for Alternative 4. Alternative 4 is considered to have a minor positive impact on boat-launching ramps at JST Lake since there is a measurably consistent increase in the number of days that boat-launching ramps are available especially above lake level 322 feet msl from the NAA.

Table 27: JST Lake: Days At and Below Lake Level – Comparison of NAA and Alternative 4 Including Number of Boat-Launching Ramps Impacted by 1-Foot Increment

Lake Level (ft msl)	331	330	329	328	327	326	325	324	323	322
NAA	1000	998	984	914	853	810	774	720	656	599
Alternative 4	1000	994	957	897	730	666	599	576	559	491
Difference	0	-4	-27	-17	-123	-144	-175	-144	-97	-108
# of Ramps Out	0	0	0	0	0	1	5	10	12	14

Lake Level (ft msl)	321	320	319	318	317	316	315	314	313	312
NAA	535	434	392	315	228	206	188	67	2	0
Alternative 4	408	356	292	209	143	97	56	6	0	0
Difference	-127	-78	-100	-106	-85	-109	-132	-61	-2	0
# of Ramps Out	20	24	26	31	36	41	46	59	68	70

Above lake level 322 feet msl, there is a measurable increase in the number of days that private docks are available compared to the NAA. Therefore, Alternative 4 has a similar positive impact on private docks as it had on public ramps at JST Lake relative to the NAA.

4.8.2. Marinas

Based on recent information from marina operators, it is suggested that they are adversely impacted once lake levels reach Level 2 drought condition (654' at Hartwell or 324' at JST) for any part of the boating season. There is little difference in the initial number of days to reach this drought condition between all the alternatives including the NAA.

4.8.3. Swimming

Swimming at beach areas usually occurs from May-September. Therefore, it is important to identify the differences between the NAA and Alternatives 1, 2 and 3 during this period of time. Designated swimming areas are considered useable by lake managers with greater than 3 feet of water. Hence, only a change in the number of swimming days available could occur when lake levels are greater than 657 feet msl at Hartwell and 327 feet msl at JST.

Hartwell Lake
At Hartwell Lake, there are 20 USACE operated swimming beach areas located within 12 recreation areas. At and below lake level 654 feet msl, all designated swimming areas are completely dry. Designated swimming areas are useable with greater than 3 feet of water. Hence, a change in the number of swimming days available from what would occur when the lake level is at 657 (in the NAA) would constitute an impact on swimming.

Effects of the NAA
Designated swimming areas are completely dry 797 days at and below 654 feet msl during the modeled drought of record, 332 of those days occurred between the months of May and September. Designated swimming areas are above 3 feet of water for 64 days between the months of May and September with a drought of record like the one from 23 February 2007 to 26 November 2009.

Effects of Alternative 1
Designated swimming areas are above 3 feet of water for 64 days between the months of May and September with a drought of record like the one from 23 February to 26 November 2009. Therefore, Alternative 1 provides no adverse impact on swimming days available.

Effects of Alternative 2
Designated swimming areas are above 3 feet of water for 64 days between the months of May and September with a drought of record like the one from 23 February 2007 to 26 November 2009. Therefore, Alternative 2 provides a no adverse impact on swimming days available.

Effects of Alternative 3
Designated swimming areas are above 3 feet of water for 64 days between the months of May and September with a drought of record like the one from 23 February 2007 to 26 November 2009. Therefore, Alternative 3 provides a no adverse impact on swimming days available.

Effects of Alternative 4
Designated swimming areas are above 3 feet of water for 64 days between the months of May and September with a drought of record like the one from 23 February 2007 to 26 November 2009. Therefore, Alternative 4 provides a no adverse impact on swimming days available.

RBR Lake
At RBR, there are no USACE operated designated swimming beach areas.

JST Lake
At JST Lake, there are 39 swimming beach areas located in 13 recreation areas. At and below lake level 324 feet msl, the designated swimming beaches become completely dry. Designated swimming areas are useable with greater than 3 feet of water. Hence, only a change in the number of swimming days available above lake level 327 from the NAA would constitute an impact on swimming.

Effects of the NAA
Designated swimming areas are completely dry 720 days at and below lake level 324 feet msl during the modeled drought of record, of which 304 occurred between the months of May and September. There are 58 total days usable for swimming above lake level 327 or above 3 feet of water in the designated swimming area between the months of May and September with a drought of record like the one from 23 February 2007 to 26 November 2009.

Effects of Alternative 1
Designated swimming areas are above 3 feet of water for 58 total days between the months of May and September with a drought of record. This is a 9 percent increase in the number of swimming days available from the NAA to Alternative 1. Therefore, Alternative 1 provides minor positive impact on swimming days available.

Effects of Alternative 2
Designated swimming areas are above 3 feet of water for 58 total days between the months of May and September with a drought of record like the one from 23 February 2007 to 26 November 2009. This is a 9 percent increase in the number of swimming days available from the NAA to Alternative 2. Therefore, Alternative 2 provides minor positive impacts on swimming days available.

Effects of Alternative 3
Designated swimming areas are above 3 feet of water for 74 total days between the months of May and September with a drought of record like the one from 23 February 2007 to 26 November 2009. This is a 12 percent increase in the number of swimming days available from the NAA to Alternative 3. Therefore, Alternative 3 provides moderate positive impact on swimming days available.

Effects of Alternative 4
Designated swimming areas are above 3 feet of water for 148 total days between the months of May and September with a drought of record like the one from 23 February 2007 to 26 November 2009. This is a 28 percent increase in the number of swimming days available from the NAA to Alternative 4. Therefore, Alternative 4 provides a significant positive impact on swimming days available.

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 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 Savannah District. 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 645 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. All the Action Alternatives provides an additional 8 days of lake level above 645 feet msl during the modeled drought of record from June through August in comparison to the NAA. The Clemson University's Musser Fruit Farm intake would experience a minor positive impact with any of the alternatives when compared to the NAA. The next highest intake at elevation 638 feet msl is used by Clemson University for heating and cooling. This intake is above the lowest water level modeled for the NAA for 54 days and Alternative 1 for 16 days, but stays below Alternatives 2, 3, and 4. This represents a minor positive impact of almost a 4 percent increase over the period of record. The City of Lavonia's intake is above the lowest lake level of the NAA for 23 days, but below it for all the other alternatives for a minor positive impact. Table 28 below summarizes the intakes in Hartwell Lake, the elevation the intake becomes inoperable, and whether the intake is above or below the lowest lake level.

Table 28: Hartwell Lake Water Supply Intake Elevations Compared to Lowest Lake Elevation During Modeled Drought of Record from 3 March 2007 to 26 November 2009

Hartwell Lake Intakes	Intake Inoperable (feet msl)	NAA Lowest Lake Level (634.59' msl)	Alt 1 Lowest Lake Level (637.29' msl)	Alt 2 Lowest Lake Level (638.96' msl)	Alt 3 Lowest Lake Level (639.37' msl)	Alt4 Lowest Lake Level (640.81'msl)
Clemson University Agriculture	645	Above	Above	Above	Above	Above
Clemson University	638	Above	Above	Below	Below	Below
City of Lavonia	636	Above	Below	Below	Below	Below
Clemson Golf Course	633	Below	Below	Below	Below	Below
City of Hartwell	612	Below	Below	Below	Below	Below
Anderson County Joint Municipal Water System	615	Below	Below	Below	Below	Below
Milliken Company	611	Below	Below	Below	Below	Below
J.P. Stevens	610	Below	Below	Below	Below	Below

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 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. None of the alternatives have lowest lake levels below 471.25. Therefore, there would be no adverse impacts to water supply users in RBR Lake for all the alternatives in comparison to the NAA.

Table 29: RBR Water Supply Intake Summary

RBR Lake Intakes	Intake Inoperable (feet msl)	NAA Lowest Lake Level (471.25' msl)	Alt 1 Lowest Lake Level (471.63' msl)	Alt 2 Lowest Lake Level (471.84' msl)	Alt 3 Lowest Lake Level (471.39' msl)	Alt 4 Lowest Lake Level (471.41' msl)
RBR State Park Golf Course	468.8	Below	Below	Below	Below	Below
City of Elberton	465	Below	Below	Below	Below	Below
Santee Cooper (John S. Rainey)	460.5	Below	Below	Below	Below	Below
City of Abbeville	457.5	Below	Below	Below	Below	Below
Calhoun Falls	457	Below	Below	Below	Below	Below
Mohawk Industries	464.75 459.75 454.75	Below Below Below	Below Below Below	Below Below Below	Below Below Below	Below Below Below

JST Lake
There are 7 water supply users with intakes on JST Lake. The 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 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 like the one from 3 March 2007 to 26 November 2009. 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 would experience water shortages with these intakes. There is minimal change in the lowest lake level between the NAA and the other alternatives. As a result, the state of whether an intake is above or below the lowest lake level does not change amongst all the alternatives and between the NAA and the other alternatives. There would be no adverse impacts on water supply intakes in the JST Lake between the NAA and the other alternatives.

Table 30: JST Lake Water Supply Intake Summary

JST Lake Intakes	Intake Inoperable (feet msl)	NAA Lowest Lake Level 312.72' msl	Alt 1 Lowest Lake Level 313.07' msl	Alt 2 Lowest Lake Level 313.35' msl	Alt 3 Lowest Lake Level 313.40' msl	Alt 4 Lowest Lake Level 313.58' msl
Savannah Lakes POA Monticello Golf Course	324	Above	Above	Above	Above	Above
Savannah Lakes POA Tara Golf Course	324	Above	Above	Above	Above	Above
Hickory Knob State Park Golf Course	324	Above	Above	Above	Above	Above
City of Lincolnton	321 314 307	Above Above Below	Above Above Below	Above Above Below	Above Above Below	Above Above Below
City of Thompson McDuffie County	320 312 304	Above Below Below	Above Below Below	Above Below Below	Above Below Below	Above Below Below
Columbia County	320 312 3	Above Below Below	Above Below Below	Above Below Below	Above Below Below	Above Below Below
City of Washington	307	Below	Below	Below	Below	Below
City of McCormick	3	Below	Below	Below	Below	Below

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.

Users downstream of JST Lake request a minimum normal flow from JST of 3,600 cfs to maintain adequate stage for their intakes. Alternative 1 and the NAA provide this minimum flow year round. Additional conservation measures are implemented beyond the NAA for Alternative 2, Alternative 3, and Alternative 4 by reducing outflows at JST Dam from 3,600 cfs to 3,100 cfs from the beginning of November through January. February may be considered only after receiving separate approval from NOAA Fisheries due to concerns about potential impacts to shortnose sturgeon. Additional monitoring and coordination associated with the wintertime flow reduction to 3,100 cfs will occur. The District and other potentially affected parties will provide support to the State of Georgia and South Carolina, who will monitor a prescribed set of locations, parameters and general performance targets. The States would coordinate these monitoring efforts with the Savannah River Basin Drought Coordination Committee (SRBDCC).

The SRBDCC members consist of the Savannah District and South Atlantic Division Corps of Engineers, the Georgia and South Carolina Water Resource agencies, USFWS and NOAA-NMFS. If measured parameters are found to exceed acceptable levels, the monitoring organization would notify the District, who would coordinate a meeting with the SRBDCC members which would recommend appropriate adjustments to Thurmond release levels. If requested by either the State of Georgia or South Carolina, the Savannah District will restore the JST discharge up to the 3,600 cfs daily average. NOAA-Fisheries will be involved in discussions concerning the potential impact to spawning sturgeon. Therefore, there would be no adverse impacts on water supply intakes downstream of JST Dam. The critical monitoring objectives and responsible parties are described in Table 31 below.

Table 31: Critical Monitoring Objectives for 3,100 cfs JST Releases

Location	Target	Responsible Party
Augusta Shoals	Flow < 1,500 cfs	City of Augusta/USFWS
USGS 021989773 (USACE Dock)	DO > 5.0 mg/L daily average DO > 4.0 mg/L instantaneous Temperature ≤ 90 ºF pH 6.5-8.5	GA DNR-EPD
USGS 02198840 (I-95 Bridge)	Conductivity < 10,000 µS/cm	GA DNR-EPD
Abercorn Creek	Chloride < 16 ppm	City of Savannah
USGS 02198500 (Clyo)	Flow > 4,500 cfs	SC DHEC
Various	Water level at the intakes	Intake operators
Various	Sturgeon migration	SC DNR and NOAA Fisheries

However, flow requirements for the Augusta Canal and shoals shows that many of the water years of the modeled drought do not provide sufficient flows to meet Augusta Canal and shoals demands. The Augusta, Georgia, Utilities Department projected average water needs (in cfs) from 2015 through 2035 in ten-year increments for the Augusta Canal for the summer, winter and spring periods. Minimum water needs during periods of drought for the Augusta shoals were estimated at 1500 cfs in the summer and winter and 2000 cfs in the spring. In the following table, the Augusta Canal and shoals water needs are combined.

Table 32: Projected Average Flows Required for Augusta Canal and Shoals by Season

YEAR	SUMMER 1 Jun - 30 Nov	WINTER 1 Dec - 29 Feb	SPRING 1 Mar – 31 May
2015	5,503 cfs	5,268 cfs	5,912 cfs
2025	5,796 cfs	5,512 cfs	6,186 cfs
2035	5,853 cfs	5,807 cfs	6,346 cfs

Effects of the NAA

Table 33: NAA JST Average Annual Modeled Flows by Water Year and Season

NAA	Summer **(cfs)**	Winter **(cfs)**	Spring **(cfs)**
Water Year 1	4,797	4,794	6,427
Water Year 2	4,236	4,957	5,184
Water Year 3	5,575	NA	5,825

The difference between the projected Augusta Canal and shoals projected water demands (Table 32) and the NAA JST average annual modeled flows (cfs) by water year (Table 33) determines the impact on projected water demands for the Augusta Canal and shoals in the NAA. In Table 34, analyzing the NAA JST average annual modeled flows by water year for the summer period in comparison to the Augusta Canal and shoals water demands indicates that 2015 projected water demands of 5,503 are unmet in the first two water years of the drought of record and met in water year 3. Measuring the modeled drought of record average annual flows against the Augusta Canal and shoals projected water demands of 5,796 cfs in 2025 and 5,853 cfs in 2035 indicates unmet demands in the NAA during all water years of the modeled drought of record.

Table 34: NAA JST Summer Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (4,797 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 2 (4,236 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 3 (5,575 cfs)	Met (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)

In Table 35, analyzing the NAA JST average annual modeled flows by water year for the winter period in comparison to the Augusta Canal and shoals projected water demands indicates that the Augusta Canal and shoals projected water demands are unmet in 2015, 2025, and 2035 for all water years of the modeled drought of record.

Table 35: NAA JST Winter Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (4,794 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 2 (4,257 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 3 Not Available	NA	NA	NA

In Table 36, analyzing the average annual modeled flows for the spring period in comparison to the Augusta Canal and shoals projected water demands indicates that Augusta Canal and shoals water demands are met in 2015, 2025, and 2035 during water year 1, but unmet for the water year 2 and 3.

Table 36: NAA JST Spring Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (6,427 cfs)	Met (5,912 cfs)	Met (6,186 cfs)	Met (6,346 cfs)
Water Year 2 (5,184 cfs)	Unmet (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)
Water Year 3 (5,825 cfs)	Unmet (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)

Effects of Alternative 1

Table 37: Alternative 1 JST Average Annual Modeled Flows by Water Year and Season

	Summer **(cfs)**	Winter **(cfs)**	Spring **(cfs)**
Water Year 1	4,652	4,783	6,427
Water Year 2	4,166	4,957	4,964
Water Year 3	5,903	NA	5,851

The difference between the projected Augusta Canal and shoals projected water demands (Table 32) and the Alternative 1 JST average annual modeled flows (cfs) by water year (Table 37) determines the impact on projected water demands for the Augusta Canal and shoals in Alternative 1. In Table 38, analyzing Alternative 1 JST average annual modeled flows by water year for the summer period in comparison to the Augusta Canal and shoals water demands indicates that 2015, 2025, and 2035 projected water demands are unmet in the first two water years and met in water year 3.

Table 38: Alternative 1 JST Summer Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (4,652 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 2 (4,166 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 3 (5,903 cfs)	Met (5,503 cfs)	Met (5,796 cfs)	Met (5,853 cfs)

In Table 39, analyzing Alternative 1 JST average annual modeled flows by water year for the winter period in comparison to the Augusta Canal and shoals projected water demands indicates that the Augusta Canal and shoals projected water demands are unmet in 2015, 2025, and 2035 for all water years of the modeled drought of record.

Table 39: Alternative 1 JST Winter Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (4,783 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 2 (4,957 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 3 Not Available	NA	NA	NA

In Table 40, analyzing the average annual modeled flows for the spring period in comparison to the Augusta Canal and shoals projected water demands indicates that Augusta Canal and shoals water demands are met in 2015, 2025, and 2035 during water year 1, but unmet for the water years 2 and 3.

Table 40: Alternative 1 JST Spring Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (6,427 cfs)	Met (5,912 cfs)	Met (6,186 cfs)	Met (6,346 cfs)
Water Year 2 (4,964 cfs)	Unmet (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)
Water Year 3 (5,851 cfs)	Unmet (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)

Effects of Alternative 2

Table 41: Alternative 2 JST Average Annual Modeled Flows by Water Year and Season

	Summer **(cfs)**	Winter **(cfs)**	Spring **(cfs)**
Water Year 1	4,621	4,638	6,434
Water Year 2	4,037	4,442	5,055
Water Year 3	6,269	NA	6,007

The difference between the projected Augusta Canal and shoals projected water demands (Table 32) and the Alternative 2 JST average annual modeled flows (cfs) by water year (Table 41) determines the impact on projected water demands for the Augusta Canal and shoals in Alternative 2. In Table 42, analyzing the Alternative 2 JST average annual modeled flows by water year for the summer period in comparison to the Augusta Canal and shoals water demands indicates that 2015, 2025, and 2035 projected water demands are unmet in the first two water years and met in water year 3.

Table 42: Alternative 2 JST Summer Projected Water Demands Met and Unmet

	2015	2025	2035
Water Year 1 (4,621 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 2 (4,037 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 3 (5,903 cfs)	Met (5,503 cfs)	Met (5,796 cfs)	Met (5,853 cfs)

In Table 43, analyzing the Alternative 2 JST average annual modeled flows by water year for the winter period in comparison to the Augusta Canal and shoals projected water demands indicates that the Augusta Canal and shoals projected water demands are unmet in 2015, 2025, and 2035 for all water years of the modeled drought of record.

Table 43: Alternative 2 JST Winter Projected Water Demands Met and Unmet

	2015	2025	2035
Water Year 1 (4,638 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 2 (4,442 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 3 Not Available	NA	NA	NA

In Table 44, analyzing the average annual modeled flows for the spring period in comparison to the Augusta Canal and shoals projected water demands indicates that Augusta Canal and shoals water demands are met in 2015, 2025, and 2035 during water year 1, but unmet for the water year 2. Water Year 3 met 2015 projected water demands, but in 2025 and 2035 they were unmet.

Table 44: Alternative 2 JST Spring Projected Water Demands Met and Unmet

	2015	2025	2035
Water Year 1 (6,434 cfs)	Met (5,912 cfs)	Met (6,186 cfs)	Met (6,346 cfs)
Water Year 2 (5,055 cfs)	Unmet (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)
Water Year 3 (5,996 cfs)	Met (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)

Effects of Alternative 3

Table 45: Alternative 3 JST Average Annual Modeled Flows by Water Year and Season

	Summer **(cfs)**	Winter **(cfs)**	Spring **(cfs)**
Water Year 1	4,621	4,634	6,434
Water Year 2	3,985	4,413	5,055
Water Year 3	6,355	NA	6,013

The difference between the projected Augusta Canal and shoals projected water demands (Table 32) and the Alternative 3 JST average annual modeled flows (cfs) by water year (Table 45) determines the impact on projected water demands for the Augusta Canal and shoals in Alternative 3. In Table 46, analyzing the Alternative 3 JST average annual modeled flows by water year for the summer period in comparison to the Augusta Canal and shoals water demands indicates that 2015, 2025, and 2035 projected water demands are unmet in the first two water years and met in water year 3.

Table 46: Alternative 3 JST Summer Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (4,621 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 2 (3,985 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 3 (6,355 cfs)	Met (5,503 cfs)	Met (5,796 cfs)	Met (5,853 cfs)

In Table 47, analyzing the Alternative 3 JST average annual modeled flows by water year for the winter period in comparison to the Augusta Canal and shoals projected water demands indicates that the Augusta Canal and shoals projected water demands are unmet in 2015, 2025, and 2035 for all water years of the modeled drought of record.

Table 47: Alternative 3 JST Winter Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (4,634 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 2 (4,413 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 3 Not Available	NA	NA	NA

In Table 48, analyzing the average annual modeled flows for the spring period in comparison to the Augusta Canal and shoals projected water demands indicates that Augusta Canal and shoals water demands are met in 2015, 2025, and 2035 during water year 1, but unmet for water years 2. In water year 3 the demands of 2015 were met with the demands of 2025 and 2015 going unmet.

Table 48: Alternative 3 JST Spring Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (6,434 cfs)	Met (5,912 cfs)	Met (6,186 cfs)	Met (6,346 cfs)
Water Year 2 (5,055 cfs)	Unmet (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)
Water Year 3 (6,013 cfs)	Met (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)

Effects of Alternative 4

Table 49: Alternative 4 JST Average Annual Modeled Flows by Water Year and Season

	Summer **(cfs)**	Winter **(cfs)**	Spring **(cfs)**
Water Year 1	4,525	4,630	6,434
Water Year 2	3,928	4,413	4,992
Water Year 3	6,537	NA	5,899

The difference between the projected Augusta Canal and shoals projected water demands (Table 32) and the Alternative 4 JST average annual modeled flows (cfs) by water year (Table 49) determines the impact on projected water demands for the Augusta Canal and shoals in Alternative 4. In Table 50, analyzing the Alternative 4 JST average annual modeled flows by water year for the summer period in comparison to the Augusta Canal and shoals water demands indicates that 2015, 2025, and 2035 projected water demands are unmet in the first two water years and met in water year 3.

Table 50: Alternative 4 JST Summer Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (4,525 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 2 (3,928 cfs)	Unmet (5,503 cfs)	Unmet (5,796 cfs)	Unmet (5,853 cfs)
Water Year 3 (6,537 cfs)	Met (5,503 cfs)	Met (5,796 cfs)	Met (5,853 cfs)

In Table 51, analyzing the Alternative 4 JST average annual modeled flows by water year for the winter period in comparison to the Augusta Canal and shoals projected water demands indicates that the Augusta Canal and shoals projected water demands are unmet in 2015, 2025, and 2035 for all water years of the modeled drought of record.

Table 51: Alternative 4 JST Winter Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (4,630 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 2 (4,413 cfs)	Unmet (5,268 cfs)	Unmet (5,512 cfs)	Unmet (5,807 cfs)
Water Year 3 Not Available	NA	NA	NA

In Table 52, analyzing the average annual modeled flows for the spring period in comparison to the Augusta Canal and shoals projected water demands indicates that Augusta Canal and shoals water demands are met in 2015, 2025, and 2035 during water year 1, but unmet for water years 2 and 3.

Table 52: Alternative 4 JST Spring Projected Water Demands Met and Unmet

	2015	**2025**	**2035**
Water Year 1 (6,434 cfs)	Met (5,912 cfs)	Met (6,186 cfs)	Met (6,346 cfs)
Water Year 2 (4,992 cfs)	Unmet (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)
Water Year 3 (5,899 cfs)	Unmet (5,912 cfs)	Unmet (6,186 cfs)	Unmet (6,346 cfs)

In conclusion, for the summer period, all the average annual modeled flows for the alternatives met the projected water demands for the Augusta Canal and shoals in water year 3 in 2025 and 2035 whereas the NAA average annual modeled flows were unmet. This was the only change and is considered to be a minor positive change in the summer period from the NAA to the alternatives, but it does not distinguish the other alternatives from each other.

For the winter period, there were no adverse impacts since there were no changes between the NAA and the other alternatives.

For the spring period, there were no changes between the NAA and the other alternatives for water year 1 and 2. In water year 3, Alternatives 1 and 2 met projected water demands in 2015 whereas the NAA does not. This was the only change from the NAA to the alternatives and it is considered to be a minor positive change. It also distinguishes Alternatives 1 and 2 as being able to meet projected water demand in 2015 from Alternatives 3 and 4 that do not.

Table 53: Augusta Canal and Shoals Met and Unmet Projected Water Demands

SUMMER PERIOD															
	No Action Alternative			Alternative 1			Alternative 2			Alternative 3			Alternative 4		
Water Year	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
1	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet
2	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet
3	Met	Unmet	Unmet	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met
WINTER PERIOD															
	No Action Alternative			Alternative 1			Alternative 2			Alternative 3			Alternative 4		
Water Year	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
1	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet
2	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet
3	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
SPRING PERIOD															
	No Action Alternative			Alternative 1			Alternative 2			Alternative 3			Alternative 4		
Water Year	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
1	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met
2	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet
3	Unmet	Unmet	Unmet	Unmet	Unmet	Unmet	Met	Unmet	Unmet	Met	Unmet	Unmet	Unmet	Unmet	Unmet

4.10. COASTAL ZONE CONSISTENCY

The proposed reduction of discharges from JST would alter flows down the river to the estuary and the coastal zone. The flow reduction would affect salinity and DO 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 flow reduction is consistent to the maximum extent practicable with the enforceable provisions (such as those related to saltwater intrusion, other water quality and fisheries resources) of both the Georgia and South Carolina Coastal Management Plans.

4.11. HYDROPOWER CONTRACT

This Section discusses shortages of hydropower generation. If sufficient water is available in the Mobile District-managed reservoirs, power could possibly be generated by additional run time of hydropower units on those rivers. SEPA could also purchase additional power on the spot market to meet additional contract requirements. That would increase SEPA's operating costs. The extent of that increase is unknown.

Reservoir modeling with HEC-ResSim allows tracking of the system hydropower energy on a weekly basis relative to the hydropower contract in each alternative considered in this study. Weekly energy shortages were summed and a valuation for the current month per megawatt hour of on peak energy was used to calculate cumulative energy shortages during the drought simulations. Average monthly on-peak and off-peak energy values from FY 2006-2010 were used for the valuation (SEPA, per comm.). For additional Energy Shortage information, see Figure 17.

Effects of NAA
The NAA output indicates that during the drought of record there is a total shortage of 553,686 MWh at a cost of $42,862,216.

Effects of Alternative 1
Alternative 1 output indicates that during the drought of record there is a total shortage of 571,378 MWh at a cost of $44,454,840. This is an increase in shortages of 17,701 MWh and an increase of $1,592,624 (3.7%) in cost. Therefore, Alternative 1 provides a minor adverse impact in terms of shortages for hydropower.

Effects of Alternative 2
Alternative 2 output indicates that during the drought of record there is a total shortage of 584,977 MWh at a cost of $47,046,740. This is an increase in shortages of 31,291 MWh and an increase of $4,184,524 (9.8%) in cost. Therefore, Alternative 2 provides a minor adverse impact in terms of shortages for hydropower.

Effects of Alternative 3
Alternative 3 output indicates that during the drought of record there is a total shortage of 581,344 MWh at a cost of $47,674,129. This is an increase in shortages of 27,658 MWh and an increase of $4,811,914 (11.2%) in cost. Therefore, Alternative 3 provides a moderate adverse impact in terms of shortages for hydropower.

Effects of Alternative 4
Alternative 4 output indicates that during the drought of record there is a total shortage of 589,955 MWh at a cost of $49,124,634. This is an increase in shortages of 36,269 MWh and an increase of $6,262,418 (14.6%) in cost. Therefore, Alternative 4 provides a moderate adverse impact in terms of shortages for hydropower.

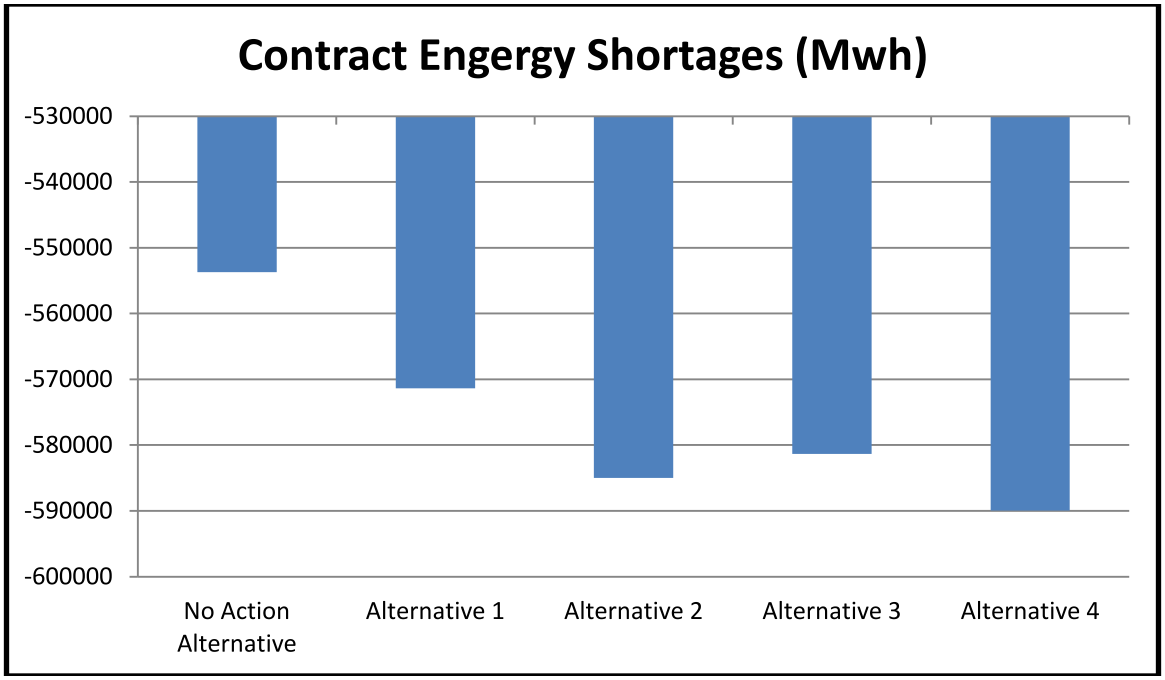


Figure 17: Energy Shortages by Alternative

4.12. Cultural Resources

Effects of the NAA

Resources on Corps-Managed Lands

Comprehensive archaeological surveys were not conducted within the flood pools of the lake projects prior to inundation. As stated in Chapter 2, surveys of the areas that would be inundated were conducted at JST and Hartwell, but fieldwork mostly consisted of visits to reported or previously recorded sites rather than large-scale intensive surveys. Excavations were carried out on a handful of sites within the flood pool. No archaeological surveys have been conducted of the fluctuation zones or the river bank or channel since inundation. Surveys have been conducted of the upland areas at JST and of the upland areas of Hartwell Lake.

While intensive surveys have not been conducted of the submerged zones or river bank or channel, sites are known to exist within these areas. Elliott (1995) identifies 11 site locations at JST that, at the time of the 1940s River Basin Survey (RBS) were listed as partially submerged. Many of these sites were surface finds and considered to have limited, if any, intact buried deposits. Additionally nearly 100 sites located during the RBS were considered to be flooded by the project. More recently a two-mile shoreline and underwater survey conducted at JST in the early 1990s identified 32 previously unrecorded shoreline sites and one known submerged site. To date, no attempts have been made to determine to what degree any of these sites are exposed during episodes of fluctuating water levels.

Other recorded sites include two Native American villages, each with a mound, that were tested in the 1950s, as well as a previously unrecorded mill site. All three sites were exposed during the most recent drought and were adversely affected by changes in pool elevation. These adverse affects include erosion and the destruction of artifact resulting from the continually wetting and drying of the sites.

The number of other potentially significant prehistoric and historic resources that are located within the fluctuation zone, river bank or channel, and are adversely affected by changing pool elevations is unknown. The completeeffect of fluctuations in water surface elevations upon these resources located at JST and Hartwell as the pools decline is unknown. A study conducted by the US Army Corps of Engineers Waterways Experiment Station of historic properties in drawdown zones of Corps of Engineers reservoirs discussed two types of impacts that may occur to sites within drawdown zones. Generally historic properties sustain impacts from the geomorphic processes of erosion or deposition and/or human impacts such as looting and vandalizing (Dunn et al. 1996). While management of JST and Hartwell is based on a guide curve and rain level, not a drawdown cycle, similar effects to historic properties at JST and Hartwell would be expected to occur.

Continuation of the NAA has the potential to adversely impact significant cultural resources due to changes in water depths and durations. However, there are multiple factors or unknowns that, once known, may alter this statement. Currently, very little work has been conducted to understand how changes in water levels affect cultural resources in this area. At this time, it is not completely understood what effect this fluctuation has already had on cultural resources that exist within the project area and the extent to which further fluctuations of the water may further impact resources.
To document the effects of hydrologic changes on cultural resources, Savannah District is implementing field surveys to document the effects on significant cultural resources. This effort will take considerable time to complete and, as such, Savannah District is implementing a Programmatic Agreement (PA) as specified under 36CFR800.14b(1)(ii). The PA allows Savannah District to complete needed studies and postpone its determination while sufficient studies are taking place.

The PA contains a strategy for identifying shoreline and submerged archaeological sites and assessing the impacts that may be caused by hydrologic changes. The PA has been coordinated with the Georgia and South Carolina State Historic Preservation Officers and interested tribes. The surveys and assessments will document the impacts to archaeological sites.

Resources located Below JST on non-USACE lands

Archaeological sites that are located on lands not managed by the USACE could potentially be affected as water levels and discharge rates change upstream. It is anticipated that archaeological sites would be affected similarly to those sites located on USACE-managed property. As stated previously studies have been conducted that have shown historic properties sustain impacts from erosion or deposition and/or human impacts such as looting due to fluctuating water levels and flow.

Effects of Alternative 1

No additional adverse impacts would result to historic properties due to changes in water depths and durations. At this time it is not understood what effect fluctuating water levels have already had on cultural resources that exist within the project area and if water control management activities as proposed under this alternative will further impact resources. If such impacts associated with changes to the hydrologic pattern have already impacted resources in the project area, then current proposed changes would have no effect on historic properties. Savannah District is in the process of coordinating and implementing a PA to understand the effects of fluctuating water levels on archaeological sites within the proposed project area. Once the surveys and assessments have been completed a determination of effect can be made.

Effects of Alternative 2

This alternative would have a very similar effect on Cultural Resources as Alternative 1.

Effects of Alternative 3

This alternative would have a very similar effect on Cultural Resources as Alternative 1.

Effects of Alternative 4

This alternative would have a very similar effect on Cultural Resources as Alternative 1.

4.13. ENVIRONMENTAL JUSTICE

Effects of the NAA

Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no effects on Environmental Justice.

Effects of Alternative 1

Implementation of Alternative 1 would affect the entire length of the Savannah River Basin. The adverse effects would be minimal in scope and relatively evenly distributed along the 238 miles of river downstream of JST. The high ground adjacent to the river does 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. No adverse impacts to humans would occur on or adjacent to the Savannah District’s three reservoirs. Therefore, this alternative complies with Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations”.

Effects of Alternative 2

This alternative would have a very similar effect on Environmental Justice as Alternative 1.

Effects of Alternative 3

This alternative would have a very similar effect on Environmental Justice as Alternative 1.

Effects of Alternative 4

This alternative would have a very similar effect on Environmental Justice as Alternative 1.

4.14. Protection of Children

Effects of the NAA

Selection of the NAA (continuing with the 1989 SRBDCP, as amended in 2006 and 2011) would have no impacts on children.

Effects of Alternative 1

Implementation of Alternative 1 would affect the entire length of the Savannah River Basin. The adverse effects would be minimal in scope and relatively evenly distributed along the 238 miles of river downstream of Thurmond Dam. The high ground adjacent to the river does not support disproportionate concentrations of children and children do not recreate on the river in disproportionate numbers. No adverse impacts to children would occur on or adjacent to the Corps' three reservoirs. The 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; therefore, this alternative complies with Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks".

Effects of Alternative 2

This alternative would have a very similar effect on children as Alternative 1.

Effects of Alternative 3

This alternative would have a very similar effect on children as Alternative 1.

Effects of Alternative 4

This alternative would have a very similar effect on children as Alternative 1.

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 past, ongoing and proposed actions in the Savannah River Basin.

The Savannah River does not function as it originally did due to various changes. Several dams cross its flow, holding back high spring flows and raising low summer and fall 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 over the past several decades. 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; however the amount discharged from JST Lake effects the competing users of the river and lakes. 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 Savannah District is aware that Georgia Power will likely withdraw additional water from the Savannah River for expansion of Plant Vogtle, near Waynesboro, Georgia. Savannah District is aware of 4 water reallocation requests at Hartwell by Anderson Joint Regional, Pioneer Water, the City of Lavonia and Landology-Stephens County.

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.

Savannah District is evaluating deepening Savannah Harbor. The Savannah River Basin Drought Plan Revision FONSI will likely be signed before the Savannah Harbor Expansion Project Record of Decision. The Savannah Harbor Expansion Project would result in environmental conditions comparable to the conditions before its implementation. The Savannah Harbor Expansion Project would mitigate for its effects on the environment. No significant permanent long-term effects would result if both projects were implemented. The reductions proposed as part of this drought plan revision would cause salinity to move slightly further upstream in some portions of the estuary on a temporary basis, possibly resulting in the temporary conversion of marshes to more saline communities. However, the proposed flow reductions would be implemented only during droughts. No permanent significant adverse cumulative impacts are expected.

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. Long term adverse cumulative impacts would result primarily from increases in water usage and an accompanying loss of water from the river basin.

4.16. Percent of System Storage

As shown in Table 54, the Percent of System Storage Remaining varies between the alternatives. With the No Action Alternative, 17% of the conservation storage would remain at the most severe point of the drought of record. That number would increase with the various alternatives to 22, 25, 26, and 29% of the conservation storage remaining. The authorized project purposes are affected as changes are made to the water control management rules and targets. The intent of the SRBDCP is to analyze action alternatives which conserve additional storage, while equitably balancing the impacts on the project purposes and not defeating any single project purpose. Higher storage volumes in the reservoirs indicate that less water would be discharged from the reservoirs. The proposed action is not a significant change from the SRBDCP.

4.17. Additional Storage Modeling Results

The modeled Days to Refill, as shown in Table 54, for the NAA and Alternatives 1, 2, 3, and 4 are respectively 997, 993, 988, 986 and 985. The Hartwell and JST modeled Minimum Pool Elevations and Days in Level for each Alternative are also listed in Table 54. These additional modeling results indicate that there are more beneficial days in each zone and in refill time for all action alternatives with more benefits for Alternative 2 than Alternative 1. For further information on Hartwell and JST pool elevations for the various alternatives, see Figures 18 and 19 below.

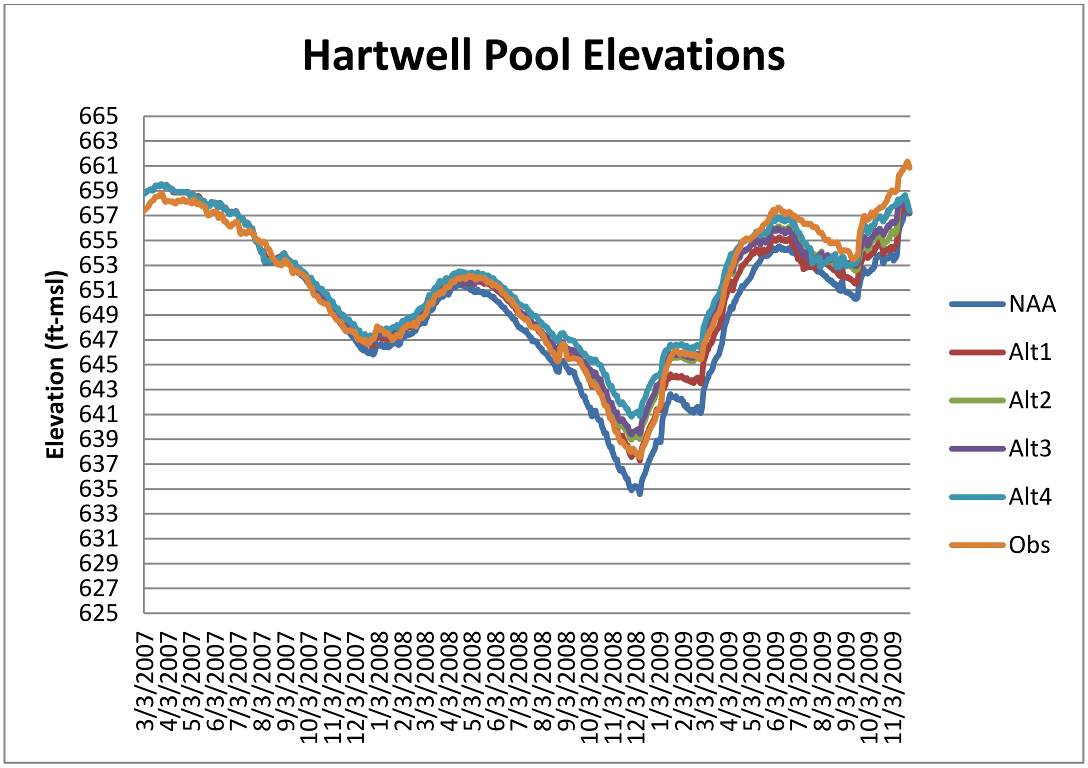


Figure 18

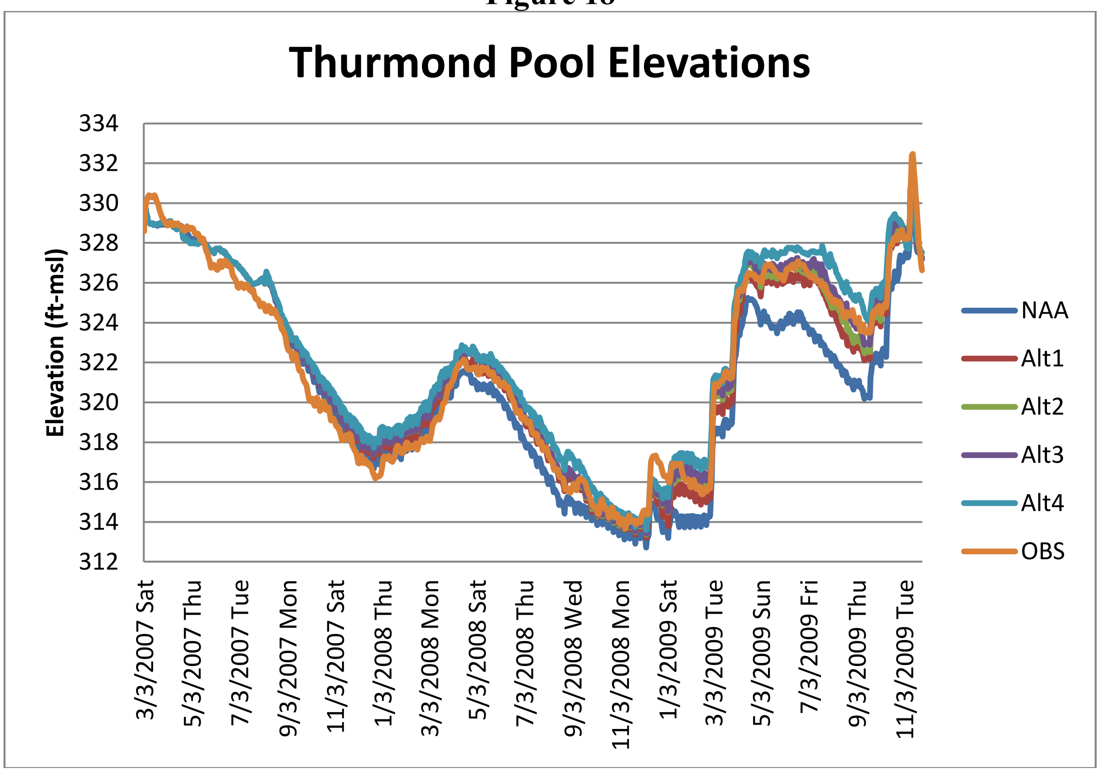


Figure 19

4.18. PLAN SELECTION RATIONALE

When comparing the alternatives to the NAA the following rationale for selection was used. The criteria were based on the severity of impacts in various resource areas, such as system storage, environmental impacts, hydropower, recreation, water supply, and time in drought zones.

An increase in system storage incorporates more resiliency in response to severe drought. All the Alternatives increase the system storage above the 17% that would remain in the NAA. The storage volume would increase to 22, 25, 26, and 29% of the conservation storage remaining with the various alternatives. The proposed action is not a significant change in the remaining system storage from the NAA.

The impacts on environmental resources occur both upstream and downstream. The modeled downstream hydrographs have long periods of 200 to 600 cfs reductions in flow for Alternatives 2, 3 and 4, while the long periods are only 200 cfs reductions for Alternative 1. The EFM Modeling regularly produced percent changes from -5% to above -12% for Alternatives 2, 3 and 4 with the percentages getting larger for each of the three Alternatives. These percent changes are below 5% for Alternative 1. This leads to a conclusion that there will be moderate adverse impacts with Alternative 2 for biotic communities at the shoals (may affect, but not likely to adversely affect Federal threatened and endangered species as discussed in Section 4.6) and minor adverse impacts for Alternative 1.

Hydropower impacts would occur through a reduction in the amount of energy produced by the Savannah District's Savannah River reservoirs, which would require SEPA to purchase energy from other sources to meet there customer contracts. In all of the Action Alternatives, less energy would be produced. Alternatives 1, 2, 3 and 4 would produce shortages worth $1.59 million, $4.18 million, $4.81 million and $6.26 million, respectively more than the NAA.

Some positive impacts of the Action Alternatives center around Recreation Boat Launching Ramps at Hartwell and JST, Swimming Areas at JST and Water Supply in Hartwell Lake. Alternative 1 for Hartwell Recreation-Boat Launching Ramps would provide an additional 32 days above the 650' lake level while Alternative 2 would provide an additional 45 days; Alternative 3 would provide an additional 46 days; and Alternative 4 would provide an additional 68 days in comparison to the NAA. Alternative 1 for Thurmond Recreation Boat Launching Ramps would provide an additional 26 days above the 320' lake level while Alternative 2 would provide an additional 57 days; Alternative 3 would provide an additional 58 days; and Alternative 4 would provide an additional 78 days in comparison to the NAA. Swimming areas at JST for Alternatives 1 and 2 would provide an additional 39 days; Alternative 3 would provide an additional 55 days; and Alternative 4 would provide an additional 129 days above lake level 327' in comparison to the NAA from May through September. For water supply, Alternative 1 allows an additional water intake to be used for the duration of the drought in comparison to the NAA. Alternatives 2, 3 and 4 allow an additional 2 intakes to be used for the same period when compared with the NAA.

The days in each drought zone were also included in the selection rationale. Alternative 1, when compared with the NAA, spends 3 less days not in a drought, 5 less days in Level 1, 92 more days in Level 2, 92 less days in Level 3, and 4 less days recovering to full pool. Alternative 2, when compared to the NAA, spends 3 less days not in a drought, 41 more days in Level 1, 59 more days in Level 2, 107 less in Level 3, and 9 less days recovering to full pool.

Therefore, Alternative 2 is the selected alternative. See Table 54 for a Resource Impact Summary.

5.0 CONCLUSIONS

This Environmental Assessment considers the potential environmental impacts of the Alternatives developed as part of the planning process. The Proposed Action (Alternative 2) would have moderate adverse impacts on shoals biotic communities and threatened and endangered species (may affect, but not likely to adversely affect Federal threatened and endangered species as discussed in Section 4.6). There would be minor adverse impacts on harbor D.O., lake largemouth bass spawning, invasive plant species control, floodplain reach mussels, estuary biotic communities, Essential Fish Habitat and hydropower. No adverse impacts are expected to water quality upstream of the estuary, marinas, recreational swimming at Hartwell, water supply users in RBR and JST, environmental justice and protection of children. There would be minor positive impacts on recreational boat-launching ramps/docks, recreational swimming at JST, Hartwell water supply users and water supply downstream of JST at Augusta Canal and Shoals. The Proposed Action would have no additional adverse impacts on cultural resources. The Action would modify the existing Savannah River Basin Drought Contingency Plan. The conclusion of this Environmental Assessment is that the action would result in no significant environmental impacts.

Based on a review of the information contained in this EA, the District determined that the proposed modification to the Savannah River Basin Drought Contingency Plan would not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of Section 102(2) of NEPA. Accordingly, preparation of an Environmental Impact Statement is not required. Table 54 contains a Resource Impact Summary.

Table 54. Resource Impact Summary

Resource	NAA	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Biotic Communities-Lakes, Largemouth Bass Spawning, by observing the Pool Elevation Tables	No change to the Standard Operating Procedure.	Minor adverse impact.	Minor adverse impact.	Moderate adverse impact.	No adverse impact.
Biotic Communities-Lakes, Aquatic Plants	No change to the Standard Operating Procedure.	Minor adverse impact.	Minor adverse impact.	Minor adverse impact.	Minor adverse impact.
Hydropower	No change to the Standard Operating Procedure.	Minor adverse impacts.	Minor adverse impacts.	Moderate adverse impacts.	Moderate adverse impacts
Recreation, Boat-Launching Ramps and Docks	No change to the Standard Operating Procedure	Minor positive impact.	Minor positive impact.	Minor positive impact.	Minor positive impact.
Recreation, Swimming	No change to the Standard Operating Procedure.	Minor positive impact at Thurmond.	Minor positive impact at Thurmond.	Moderate positive impact at Thurmond.	Significant positive impact at Thurmond.
Marinas-at Level 2 Drought are adversely impacted	No change to the Standard Operating Procedure.	No adverse impact.	No adverse impact.	No adverse impact.	No adverse impact.
System Storage % Remaining	17	22	25	26	29
Days to Refill	997	993 (4 less than NAA)	988 (9 less than NAA)	986 (11 less than NAA)	985 (12 less than NAA)
Days in Zone	Level 0, 135 Level 1, 26 Level 2, 523 Level 3, 304	Level 0, 132 Level 1, 21 Level 2, 615 Level 3, 212	Level 0, 132 Level 1, 67 Level 2, 582 Level 3, 197	Level 0, 132 Level 1, 39 Level 2, 611 Level 3, 195	Level 0, 142 Level 1, 93 Level 2, 580 Level 3, 162
Minimum Pool Elevations	H: 634.59 T: 312.72	H: 637.29 T: 313.07	H: 638.96 T: 313.35	H: 639.37 T: 313.40	H: 640.81 T: 313.58
Cultural Resources	Potential adverse impact.	No additional adverse impacts beyond those identified under the NAA.	No additional adverse impacts beyond those identified under the NAA.	No additional adverse impacts beyond those identified under the NAA.	No additional adverse impacts beyond those identified under the NAA.
Water Quality	No change to the Standard	No adverse impacts.	Minor adverse impacts for	Moderate adverse impacts	Moderate adverse impacts

	Operating Procedure.		harbor DO.	for harbor DO.	for harbor DO.
Water Supply at lakes	No change to the Standard Operating Procedure.	Hartwell has minor positive impacts.	Hartwell has minor positive impacts.	Hartwell has minor positive impacts.	Hartwell has minor positive impacts.
Water Supply Below JST Dam at Augusta Shoals and Canal	No change to the Standard Operating Procedure	No adverse Impact	Minor Positive Impact	Minor Positive Impact	No Adverse Impact
Environmental Justice	No change to the Standard Operating Procedure.	No adverse impact.	No adverse impact.	No adverse impact.	No adverse impact.
Protection of Children	No change to the Standard Operating Procedure.	No adverse impact.	No adverse impact.	No adverse impact.	No adverse impact.
Biotic Communities-Shoals	No change to the Standard Operating Procedure.	Minor adverse impact.	Moderate adverse impact.	Moderate adverse impact.	Moderate adverse impact.
Biotic Communities-Floodplain	No change to the Standard Operating Procedure.	Minor positive impact would result on floodplain reach seedling establishment and a minor adverse impact would result on mussels.	Minor positive impact would result on floodplain reach seedling establishment and a minor adverse impact would result on mussels.	Minor positive impact would result on floodplain reach seedling establishment and a minor adverse impact would result on mussels.	Minor positive impact would result on floodplain reach seedling establishment and a minor adverse impact would result on mussels.
Biotic Communities-Estuary	No change to the Standard Operating Procedure.	Minor adverse impact.	Minor adverse impact.	Minor adverse impact.	Minor adverse impact.
Threatened and Endangered Species	No change to the Standard Operating Procedure.	Minor adverse impact due to EFM at Shoals, minor adverse impact would result on mussels in the floodplain reach.	Moderate adverse impact due to EFM at Shoals, minor adverse impact would result on mussels in the floodplain reach.	Moderate adverse impact due to EFM at Shoals, minor adverse impact would result on mussels in the floodplain reach.	Moderate adverse impact due to EFM at Shoals, minor adverse impact would result on mussels in the floodplain reach.
Essential Fish Habitat	No change to the Standard Operating Procedure.	Minor adverse impact.	Minor adverse impact.	Minor adverse impact.	Minor adverse impact.

6.0 RELATIONSHIP OF PROJECT TO FEDERAL AND STATE AUTHORITIES

The following table summarizes the status of the compliance of the selected action with applicable Federal and State environmental laws.

Table 55: Summary of Requirements

FEDERAL POLICIES	PROPOSED ACTION
Anadromous Fish Conservation Act, 16 U.S.C. 757, et. seq.	In compliance.
Archaeological and Historic Preservation Act, as amended, 16 U.S.C. 469, et. seq.	District is implementing a Programmatic Agreement with the States of South Carolina and Georgia and interested Native American Tribes to comply with the Act and with 36 CFR, Part 800.
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et. seq.	In compliance. Draft EA reviewed by EPA.
Clean Water Act, as amended (Federal Water Pollution Control Act) 33 U.S.C. 1251, et. seq.	In compliance. Draft EA reviewed by GA, SC, and EPA.
Coastal Zone Management Act, as amended, 16 U.S.C. 1451 et seq.	In compliance. GA DNR-CRD concurred with a condition to return to 3800 cfs at times to satisfy DO concerns. Planned 3600 cfs releases have been removed from Level 3 and replaced with 3800 cfs.
Endangered Species Act, as amended, 16 U.S.C. 1531, et. seq.	In compliance. The District determined the project may affect, but is not likely to adversely affect Atlantic sturgeon, shortnose sturgeon, manatee, and wood stork. USFWS concurred for manatee and wood stork. NOAA-Fisheries states that sturgeon wil have some access to spawning habitat.
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 was coordinated with the GA DNR, SC DNR, USFWS, and NOAA Fisheries.
Fishery Conservation and Management Act of 1976, Public Law 99-659.	In compliance.
Magnuson-Stevens Act, as amended, Public Law 104-297.	Draft EA with its EFH assessment was coordinated with NOAA Fisheries.
National Historic Preservation Act of 1966, as amended, 16 U. S. C. 470f, et seq.	District is implementing a Programmatic Agreement with the States of South Carolina and Georgia and interested Native American Tribes to comply with the Act and with 36 CFR, Part 800.
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

A Public Notice of Availability was issued on 13 Apr 2012 notifying the public of the availability of the Draft EA. This Notice served as the formal advertisement of the proposed modification to the 1989 Savannah River Drought Contingency Plan, as amended.

A Notice of Availability was published in the following local newspapers to inform the public of the availability of the Draft EA and invite their comments:

- Savannah Morning News
- Augusta Chronicle
- Elberton Star
- Anderson Independent Mail
- Aiken Standard
- The Island Packet

The following natural resource agencies were provided a copy of the Draft EA:

- Georgia DNR, EPD
- Georgia DNR, Wildlife Resources Division
- Georgia DNR, Coastal Resources Division
- Georgia DNR, Historic Preservation Division
- Georgia State Clearinghouse

- South Carolina DNR
- South Carolina DHEC
- South Carolina DHEC, Office of Ocean and Coastal Resource Management
- South Carolina State Budget and Control Board
- South Carolina Department of Archives and History

- US Environmental Protection Agency, Region 4
- US Fish and Wildlife Service, Field Supervisor
- US Department of Interior, Regional Environmental Officer
- National Marine Fisheries Service, Habitat Protection Division
- National Marine Fisheries Service, Assistant Regional Administrator

A copy of the Draft EA was sent to representatives of federally-recognized tribes that are culturally affiliated with the project area to inform them of the proposed action and invite their comments.

The District accepted comments on the proposal by mail, email, FAX and over the telephone through 14 May 2012. The comment letters are included in the Final EA in Appendix F.

EPA, USFWS, SC DNR, SC DHEC and GA DNR expressed concern about the proposed action. The concerns included reduced spawning habitat for fish, SNWR requirements for fresh water from November to January, impacts to Atlantic sturgeon and any flow reduction that would further impair water quality in the Savannah Harbor.

The GA DNR-CRD letter states Coastal Zone Management "concurs with your federal consistency determination with condition that Level 2 and 3 discharges are returned to 3800 cfs at any time dissolved oxygen in the Savannah Harbor is below a 5 mg/l daily average or 4 mg/l instantaneous minimum. If the proposed project is not modified to include the above condition, all parties shall treat this conditional concurrence letter as an objection letter". Planned 3600 cfs releases have been removed from Level 3 and replaced with 3800 cfs.

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